Microfoundations of Industrial Competitiveness in a Small Developing Economy: The Case of Jordan's Manufacturing Industries

Thesis submitted for the degree of

Doctor of Philosophy

at the University of Leicester

By

Jamal Hasan Al-Homsi

Department of Economics

University of Leicester

March 2002

Dedicated to.....

My Parents, Wife, and Children

Acknowledgements

All praises are due to Allah; without the aid of Allah, this Thesis could not have been initiated nor completed.

I am deeply indebted to Prof Steve Thompson, my supervisor, for his sincere encouragement, guidance and comments on earlier drafts of this work.

The generous financial support from the Central Bank of Jordan (CBJ) is gratefully acknowledged[1]. I am also grateful to the Department of Statistics for data access and support.

Finally, I would like to express my sincerest gratitude to my wife, Amal, for her emotional support and patience throughout my research, as well as to my kids, Waseem and Yasmeen. Due appreciation is also extended to our families.

[1] The views and interpretations expressed in this Thesis are those of the Researcher and should not be attributed to the CBJ.

ABSTRACT

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By: Jamal Hasan Al-Homsi

The primary objective of the thesis is to contribute towards the understanding of certain empirical and conceptual issues underlying the global competitiveness of the Jordanian manufacturing industries (JMIs). It aims also to function as an input in informing debate over the future direction of Jordanian industrial competitiveness policy. Having explored the theoretical aspects of industrial competitiveness, the thesis presents a survey on the measurement and interpretation of industrial performance. It then presents three substantive empirical chapters on the *microfoundations* of competitiveness in JMIs.

The empirical part of the thesis uses a unique, large microdata set, extracted from the 1994 Industrial Census. Each substantive chapter adopts a distinct research design. The first uses an inter-industry design (following Caves and Barton, 1990) to explore **technical efficiency (TE)**. The second utilises an inter-firm design to investigate **scale efficiency**, another potentially significant *cost driver* in JMIs. Finally the third substantive chapter offers a case study on the Jordanian pharmaceutical industry (JPI), examining **high-technology** as a *benefit deriver*.

Some of the more important empirical findings may be summarised briefly: (i) producer concentration (unadjusted for foreign trade) is found negatively related to TE in a linear and robust link; (ii) the pro-competition effect of imports on TE appears to be insignificant; (iii) increasing returns to scale exists in 44 out of 51 JMIs, and significantly so in 29 industries; (iv) firm size is positively and robustly associated with firm-level export intensity; (v) no systematic pattern between firm size and unit labour costs has been detected; (vi) despite superior average performance in terms of exports, profitability and wage competitiveness, JPI can be considered as a vulnerable industry in face of the current technological and marketing challenges. The thesis then draws out some of the implications of these findings for the formulation of competition, industrial and technology policies in Jordan.

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List of Abbreviations

CA	Comparative Advantage
CATs	Competitiveness Analytical Tools
CBJ	Central Bank of Jordan
CD	Cobb-Douglas
CR4	Four-Firm Concentration Ratio
DEA	Data Envelopment Analysis
DOS	Department of Statistics (Jordan)
EC	European Commission
EU	European Union
FDI	Foreign Direct Investment
FTA	Free Trade Area
GC	Global Competitiveness
GDP	Gross Domestic Product
HHI	Herfindahl-Hirschman Index
HTIs	High-Technology Industries
HTMIs	High-Technology Manufacturing Industries
IPRs	Intellectual Property Rights
ISIC	International Standard Industrial Classification
JD	Jordanian Dinar
JE	Jordanian Economy
JMIs	Jordanian Manufacturing Industries
JPI	Jordanian Pharmaceutical Industry
LCs	Labour Costs
LDCs	Less Developed Countries
LP	Labour Productivity
MGI	McKinsey Global Institute
ML	Maximum Likelihood
NA	Not Available
NICs	Newly Industrialising Countries
PCM	Price-Cost Margin
R&D	Research and Development
RIAs	Regional Integration Agreements
RTS	Returns to Scale
SCP	Structure-Conduct-Performance
SDRs	Studentised Deleted Residuals
SFA	Stochastic Frontier Analysis
SITC	Standard International Trade Classification
SMEs	Small and Medium-sized Enterprises
TE	Technical Efficiency
TFP	Total Factor Productivity
TRIPs	Agreement on Trade-Related Aspects of Intellectual Property Rights
ULCs	Unit Labour Costs
UNCTAD	United Nations Conference on Trade and Development
UNIDO	United Nations Industrial Development Organization
VA	Value Added
WTO	World Trade Organization

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CHAPTER ONE

Introduction

1.1 Background and Research Problem

Issues of global industrial competitiveness have climbed the political and economic agenda very rapidly in recent years, fuelled by the end of the Cold War and the rapid advancement into economic liberalisation and globalisation. Surprisingly, both the South and the North widely share similar *concerns* regarding the possible repercussions of a more liberalised world economic order. While industrial countries basically worry about their relative competitiveness position vis-à-vis other leading industrial competitors and low-wage newly industrialising countries (NICs), less developed countries (LDCs) are concerned about their ability to pass the test of international competition vis-à-vis industrial countries in general and high-technology gigantic multinationals in particular. Furthermore, certain stakeholders in industrial countries, namely industrialists and workers, press for protection from the threat of low-wage countries in the South. The developing world, still trying to close the historical 'development gap', is now challenged by a more difficult global test; to close the 'competitiveness gap' under more restrictive economic rules taken from the Uruguay Round. The recent intensification of economic globalisation and regionalism is the main force behind the concerns over international competitiveness. For example, of the 194 regional integration agreements (RIAs) notified to the GATT/WTO at the beginning of 1999, 87 were notified since 1990 (World Bank, 2000b).

The liberalisation of goods, services, direct investment and capital flows (but, surprisingly, *not* technology and labour) seems to generate asymmetric *responses* among nations with different underlying competitiveness bases. Industrial countries have established councils for competitiveness, formulated master strategies and plans, issued competitiveness policy statements, and consistently seek to upgrade and monitor the competitive performance of their national economies, industries and enterprises. The majority of LDCs, on the other hand, seem less obsessed with the competitiveness challenge, as if the developing world is satisfied with its competitive position.

At the analytical level, competitiveness policy analysis is just beginning to flourish in LDCs. At the policy level, one crucial issue is whether the stabilisation and structural adjustment programmes, undertaken by many LDCs, including Jordan, under the surveillance of Bretton Woods Institutions to deal with debt and growth problems, are sufficient response to the competitiveness challenge. Many economists believe that macroeconomic stabilisation and structural reform programmes, although necessary, are *not sufficient* to deal with the competitiveness and development challenges (Lall, 1990; Pack, 1993; Kirkpatrick, 1995; Porter, 1999). According to Lall (1990: 11), "[i]t is certainly better to get prices right than wrong, but this is a necessary condition for industrial success and not a sufficient one".

In Jordan, the profound alterations in the operating parameters of the business sector in the 1990s (see Chapter 2) presented a hard challenge to industry to adjust and improve its competitive performance. This turbulent era has changed the intensity of international and domestic competition as well as industrial input and output prices, raising concerns over the global competitiveness of the Jordanian manufacturing sector.

Against the above background, this Thesis aims at exploring *microeconomic* foundations of industrial competitiveness in a small developing economy, taking **Jordanian manufacturing industries (JMIs)** as a case study. It is also the intention of the Thesis to function as an input in informing debate over the future direction of Jordanian competitiveness strategy in manufacturing. Because microfoundations of competitiveness include many *competitiveness drivers*, the empirical part of the Thesis focuses on certain important drivers, namely *technical efficiency* (TE), *scale efficiency* and *high-technology*.

1.2 Research Subjects, Objectives and Hypotheses

This Thesis emphasises applied research potentially capable of guiding policy, aided with a unique and large microdata set, extracted from the latest 1994 Industrial Census. However, it is essential to clarify what is meant by the term 'industrial competitiveness' at the outset. The concept actually defies incontestable definition, but in this Thesis industrial competitiveness is defined as:

> *The sustained ability of domestic industrial firms to compete successfully and fairly with foreign products (in import competition and export rivalry) and foreign firms (hosted multinationals),* ***utilising price, differentiation and focus competitive strategies****. To ensure sustainability, the process should be within an enabling environment for upgrading technological capabilities, processes and products, and ultimately aims at improving the society's economic welfare.*

The above definition emphasises *competitiveness drivers*. Indeed, the strategic management literature offers three *generic* competitive strategies that JMIs can adopt to upgrade their global competitiveness: (i) cost leadership; (ii) product differentiation; and (iii) focus (or market niches) in terms of geographical area, product lines or customer type. The United Nations Industrial Development Organization (UNIDO) in its report *Jordan: Stimulating Manufacturing Employment and Exports* (1987) advocated a focus strategy instead of wage competitiveness strategy for JMIs. Suggesting that low-wage strategy would have a contractionary expenditure-reducing effect, the report concluded that:

> *"It is...not by increased price [or cost] competitiveness but by the development of an effective "niche" strategy that Jordan can significantly enhance manufactured export earnings...Export growth should not be pursued at the expense of the domestic economy by suppressing real wages. This would have a significant negative impact on the growth of both manufacturing production and employment"* (p.35).

While the main recommendation seems plausible for a small economy, it should be emphasised that *cost drivers*, or basic factors which determine a firm's unit costs, are much more diverse than labour costs or even input costs; enhancing TE, scale efficiency, capacity utilisation as well as learning and external economies are among other important drivers for improving cost advantage (see Grant, 1998; Besanko et al., 2000). Chapters (5) and (6) of this Thesis are an endeavour to investigate empirically both technical and scale efficiency in JMIs, using 1994 firm-level data. Another possible competitive strategy for JMIs is to make use of *benefit drivers*, i.e. factors leading to a superior quality or variety of a product. The ultimate aim here is enhancing the differentiation advantage of Jordanian products, both regionally and globally. This strategy requires upgrading the technological capabilities of Jordanian firms and their innovation clusters (technological external economies), and will incur additional costs in terms of technology transfer and development. A case study of high-technology manufacturing industry in Jordan -the pharmaceutical industry- is undertaken in Chapter (7).

Accordingly, the study's main objectives are concerned with:

1. Investigating empirically inter-industry patterns of TE in JMIs via: (i) *measuring* inter-firm variation in TE in each well-defined industry using a robust method that performs well, even in the presence of random measurement errors in the response variable- the Stochastic Frontier Analysis (SFA); and (ii) *explaining* inter-industry variation in TE utilising the structure-conduct-performance (SCP) paradigm. The work typically

follows that of Caves and Barton's study on the USA manufacturing industries (CB, 1990).

2. Examining quantitatively the expected impact of firm size on the competitive performance of Jordan's manufacturing sector via exploring the competitiveness position of small firms vis-à-vis large firms. More specifically, this work explores the impact of firm size on its: (i) survival-ability; (ii) labour productivity; (iii) unit labour costs; and (iv) export performance. Moreover, scale elasticity is estimated for each manufacturing industry, at a fine level of disaggregation, to examine the existence and significance of technical economies of scale, as well as its policy implications.
3. Assessing, in a case study approach, the ability of Jordanian pharmaceutical firms to compete globally in a challenging environment characterised by: (i) rapid technological innovations and enforcement of intellectual property rights; and (ii) a progressive regional and global competition.

More specifically, this research seeks to determine:

1. Whether TE investigation using SFA can be usefully applied in a mechanical way to large number of industries in a small developing manufacturing sector, similar to the case of industrial countries.
2. Whether JMIs suffer from a long 'tail' of less productive firms unfavourably affecting *average* industrial productivity. These (technically inefficient) firms are thought to be particularly vulnerable to foreign competition, and capable of increasing output without investing in more capital or employing more manpower.
3. Whether market structure affects TE performance in JMIs; whether domestic and import competition as well as firm entry have a positive and significant effect on TE performance.
4. Whether JMIs enjoy significant economies of scale in production, raising issues such as the anti-trust dilemma and 'efficiency defences' in Jordan's competition policy.
5. Whether or not micro and small enterprises in JMIs are less efficient than larger enterprises in terms of survival-ability, labour productivity and unit labour costs. If true, this could make small manufacturing sector, under existing policy framework, more vulnerable to import liberalisation and RIAs.
6. Whether there is a positive and significant relationship between firm size and export performance in JMIs, making larger manufacturing firms more capable of exploiting new exports opportunities of globalisation.

7. Whether the Jordanian pharmaceutical industry needs an amended strategy or assistance policy if the aim is facing the 'new competition'.

1.3 Research Scope

Competitiveness research is diverse in terms of aim, unit of analysis (macro, meso or industrial perspective), and methodology. First, work on competitiveness can be classified into three main paradigms: (i) the efficiency and productivity (price competitiveness) paradigm; (ii) the quality (non-price competitiveness) paradigm; and (iii) the trade performance paradigm. While the first two approaches focus on *foundations* of competitiveness, the last paradigm emphasises competitiveness *outcome*.

From another angle, competitiveness research can be divided based on addressing domestic performance vis-à-vis international benchmarking. The first research type examines whether performance in the domestic economy is *below its own potential*. Examples of such an approach: inter-firm comparison of manufacturing performance in a domestic context and tracking an industry's performance over a period of time. International benchmarking, on the other hand, focuses not on a country's absolute or domestic performance, but how well it performs *relative to other reference economies*. In both approaches, the unit of analysis can be a firm, industry, sector or economy.

Finally, applied competitiveness work can further be classified whether it emphasises competitive *position* (e.g. cross-country comparison of labour productivity *levels*), or *changes* in competitive position (e.g. evolution of unit labour costs over time, either in a domestic or global setting).

Using the last two criteria for classifying competitiveness research, one can construct a simple two-dimensional matrix detecting four types of competitiveness research. Examples of each type are shown below in what the researcher called *'The Grand Matrix of Competitiveness Research'*. It is noteworthy that the case study approach (e.g. cluster analysis), due to its flexibility, can occupy more than one cell.

Table 1.1
The Grand Matrix of Competitiveness Research

	Position Indicators	Change Indicators
Domestic Benchmarking	**[1]** Examples: stochastic and deterministic frontier analysis; research on firm size and performance; exploratory survey-based competitiveness studies	**[2]** Examples: total factor productivity growth, unit labour cost changes, exports growth, all in a specific domestic setting
International Benchmarking	**[3]** Examples: productivity gap research (Davies and Caves, 1987; the International Comparisons of Output and Productivity ICOP project); benchmarking (small) business environment in a global context	**[4]** An example: comparative trends in competitiveness performance, such as the U.S. Bureau of Labor Statistics (BLS) approach to international productivity comparisons

SOURCE: Researcher.

After scanning the competitiveness research area, one can easily locate the scope of this research. This study: (i) adopts an industry and sectoral perspective. It examines the competitiveness of JMIs, the largest single tradable and technology-intensive sector, not Jordanian economy as a whole; (ii) focuses on the efficiency and productivity paradigm, but certain aspects of export performance are explored as well; and (iii) follows largely a domestic benchmarking approach. Overall, the principal emphasis of the Thesis is on type [1] research design, in recognition of the availability of microdata as well as because of the various pitfalls of international benchmarking approach (see Chapter 3). More specifically, Chapters (5) and (6) basically embrace type [1], while Chapter (7) combines more than one type or research design in a case study.

The detailed advantages and drawbacks of each research type are examined later in the Thesis (Chapters 3 and 4). Suffice it to say at this point that because of its research scope, this study is generally not susceptible to Krugman's influential criticisms on the concept of *national* competitiveness and its potentially hostile protectionist policy implications (1994a, 1998)[1]. Moreover, unlike the export performance approach, the efficiency and productivity paradigm is able to cover the performance of all manufacturing enterprises, not just a limited

[1] According to Krugman, competitiveness is a "meaningless word when applied to *national* economies" (1994a: 17, emphasis added). Thus, it seems that 'industrial competitiveness', as a concept, is more defendable than 'national competitiveness'. Furthermore, not all competitiveness policies are 'beggar-my-neighbour policies' or are part of a zero-sum game (Boltho, 1996). An example of neutral policies is domestic horizontal programmes and policies to get the 'fundamentals' or business environment right, including those for productivity and innovation (see Chapter 3 for more details on the issues raised by Krugman's criticism).

sample of export-oriented firms (constitute in Jordan less than 3 % of total number of manufacturing firms in 1994).

1.4 The Data Sets, Research Methodology and Caveats

The investigation of industrial competitiveness is typically a data-intensive research, particularly if it is based on large-scale microdata or adopts a global perspective. This Thesis is enriched with the following manufacturing data sets:

- The 1994 firm-level census data for 8400 enterprises, constituting 68 % of the total number of manufacturing firms and 73 % of total manufacturing employment in 1994[2]. The data set, extracted from the *latest* Industrial Census, is classified into 51 (4-digit) narrowly defined industries, using the United Nations (ISIC2) international classification. This unique cross-section data set is utilised to investigate static (technical and scale) efficiency in JMIs. The raw database covers *all* manufacturing enterprises in Jordan, including single-person businesses, a unique opportunity for small business research. The choice of time frame is dictated by the availability of census data[3]. Since data quality is crucial in census microdata, 'prudent' editing rules were adopted to avoid potential measurement errors (Chapter 5).

- Industry-level, time-series data over the period 1986-98, taken from industrial surveys and censuses carried out by Department of Statistics (DOS) in Jordan. The data are classified according to ISIC2 at a fine level of disaggregation (4-digit).

- To augment international benchmarking in the case study chapter, the Thesis utilised many international databases on trade and industry, namely: the ECLAC and World Bank (2000) Trade**CAN** (**C**ompetitiveness **A**nalysis of **N**ations) database on analytical foreign trade; UNIDO (1998) IDSB (Industrial Demand-Supply Balance) database on output and trade; OECD (1999) STAN (STructural ANalysis) database; and UNIDO (2000) International Yearbook of Industrial Statistics.

As for research methodology, both formal modelling and exploratory qualitative research will be utilised. Table (2) outlines various types of econometric modelling adopted in the Thesis. As shown, both linear and censored regression models are used. Moreover, both maximum likelihood (ML) and OLS estimators are adopted.

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[2] The Census data were accessed under strict conditions of confidentiality. See **Appendix (1)** for an overview on the data set.

[3] Selecting a more recent year with somewhat more 'typical' growth in value added (Figure 2.1, Chapter 2), using industrial *survey* data, would cost much in terms of sample size. The sampling design in industrial surveys is currently based on: a complete enumeration of all Jordanian firms with 20 workers or more; a sample of 21% of all firms with 5-19 workers; and a sample of 7.4% of all firms with 4 workers or less. Given the highly skewed firm-size distribution in JMIs, the resulting impact of using survey data on the average number of firms (observations) per industry is remarkable. Furthermore, census data, covering all manufacturing firms of different sizes, are probably more suitable for small business research (Chapter 6).

Table 1.2
Typology of Quantitative Modelling Adopted in the Thesis

Chapter/ Section	Model/ Research Design	Aim	Estimation Method	Type of Data / Sample Size
5/ Section 5.4	Stochastic frontier production function (single-equation)	Measuring intra-industry technical efficiency scores for 51 industries	Maximum likelihood (ML)	Firm-level cross-section data/ between 10 and 1308 firms per industry
5/ Section 5.5	Inter-industry econometric model (single-equation)	Explaining inter-industry variation in TE	Ordinary least squares (OLS)	Industry-level cross-section data/ 35 industry
6/ Sub-section 6.3.2	Cobb-Douglas production function (single-equation model)	Measuring technical scale economies in 51 industries	OLS	Firm-level cross-section data/ between 10 and 1308 firms per industry
6/ Sub-section 6.3.3	Inter-firm regression model (single-equation)	Examining whether firm size is associated with labour productivity and unit labour costs	OLS	Firm-level cross-section data/ 6872 firms
6/ Sub-section 6.3.4	Inter-firm censored regression model (Tobit analysis)	Investigating whether firm size is associated with export intensity	ML	Firm-level, cross-section data/ 6872 firms

SOURCE: Researcher.

Turning to main research caveats, since no study on productivity or efficiency can adequately proceed without capital data, this fact raises the problem of capital valuation and vintage. Cross-section microdata, unlike longitudinal microdata, can claim the advantages of large sample and better variability without the need for micro-level (output and inputs) prices as well as matching businesses across time. Furthermore, cross-sectional estimators appear to be much less sensitive to measurement errors and missing data compared with panel estimators. On the other hand, questions of sequential causality and dynamic performance are difficult to address in a cross-section research design and certain findings might be time-specific (i.e. cannot be generalised to all stages of business cycle). See Chapter (3) for more details.

1.5 The Significance and Contribution of the Study

As a small country in quest of market access, growth and national security, Jordan has been seeking to be a working regional and global partner. Recently, many significant events embodied this quest:

- Jordan has signed a Partnership Agreement with the European Union in 1997, which results in gradually establishing a free trade area (FTA) in 2010. Furthermore, it has concluded another FTA with USA very recently.
- Jordan joined the WTO in 2000.
- Jordan is a member of Arab FTA to be completed by 2007.
- Jordan is implementing a Structural Adjustment Programme since 1989.

These significant steps carry with them wide-ranging opportunities and challenges. Thus, there is an urgent need for policy studies to help clarify visions and objectives, formulate competitiveness strategy and policies, and implement specific programmes and actions.

While public policy in Jordan tends to focus on promoting new manufacturing investment and removing barriers to *de novo entry*, sustainable manufacturing growth requires further emphasis on the efficiency of *existing* investments and resources. Actually, in any year, the stock of existing manufacturing enterprises will always be larger in importance than new firms. Thus, taking care of, *inert alia*, productive efficiency, scale efficiency and dynamic efficiency, is of great importance in terms of wealth creation. In other words, competitiveness of *existing* firms and industries is at least as important as the creation of new firms and industries.

As an applied competitiveness research, the single most significant contribution of this study is empirical in nature. The study fills an important gap in existing JMIs' competitiveness research. While Muhtaseb (1995) has covered certain important aspects of the trade paradigm, Al-Hajji et al. (1997a, 1997b) have assessed *qualitatively* the competitiveness of JMIs using primary survey data (N=800). Moreover, the Ministry of Planning (MOP) in Jordan has undertaken an extended research project examining the competitiveness of main manufacturing clusters in Jordan. This study examines the neglected area of Jordan's industrial competitiveness. It investigates empirically selected important microfoundations of Jordan's manufacturing competitiveness using a large-scale secondary data set (N=8400).

The principal value added expected from this research can be classified as follows:

A NEW CONTEXT: In general, there is lack of sufficient empirical research specifically about microfoundations of industrial competitiveness in small developing economies. For example, Berry (1992: 54) acknowledged that "[m]ost of the empirical work on economies of scale [based on survey or engineering evidence] has been undertaken in industrialized countries". Indeed, this research, as far as we are aware, is the first to examine technical and scale efficiency in a large sample of JMIs.

A NEW DATA SET: To the best of the researcher's knowledge, this is the first quantitative study to utilise large-scale firm-level data on JMIs. Indeed, a minority of industrial studies have used such data sets in LDCs. This type of data has many advantages over aggregate industry-level data, including larger sample size and higher variation. According to Lall and Latsch (1998), "empirically oriented micro-level approaches are the most promising in guiding policy decisions" (p. 437).

AT THE EMPIRICAL LEVEL:

This study contributes towards assessing the expected *competition* and *scale effects* of trade liberalisation and RIAs[4] in JMIs. Furthermore, the study examines the effectiveness of structural policies, such as competition policy towards market structure and industrial policy towards firm size, in improving the performance of JMIs.

In Chapter (5), the flexible but more complex form of inefficiency distribution, the truncated-normal, is applied successfully in measuring and explaining TE, using appropriate software. In the TE explanation stage, a data reduction technique, the principal component analysis, is utilised to construct a 'principal' TE measure.

In Chapter (6), when testing the link between firm size and its performance, a more comprehensive measure of cost competitiveness at the firm level, namely unit labour costs (ULCs), is constructed and utilised. It proved to offer new insights vis-à-vis the often-used indicator, namely labour productivity.

1.6 The Structure of the Study

The study consists of eight chapters. A brief summary of the content and sequence of these chapters is as follows:

[4] The mechanisms for tracing the impact of RIAs on product market can be grouped into two main types; competition and scale effects, and trade and location effects (World Bank, 2000b). Scale and technical efficiency are likely to be much more important than the traditional trade (creation and diversion) effects (Pelkmans, 1997), but often overlooked partially because of lack of microdata, and partially because of the complexity of such an exercise (EC, 1996c: 122).

Chapter (2), the macro and sectoral setting, is intended to provide background information that outlines the research setting, covering the salient features, policy framework and recent performance of both the Jordanian economy and the Jordanian manufacturing sector. Chapter (3) provides a critical literature survey of the economics of global competitiveness, covering both conceptual issues and empirical paradigms. Chapter (4), the measurement and evaluation of industrial competitive performance, is meant to present a concise survey of various competitiveness measures, or what are here termed: *Competitiveness Analytical Tools (CATs)*. Chapter (5) investigates inter-industry variation in TE in JMIs, with the aim of enhancing the sector's resource utilisation. Chapter (6) empirically explores the link between firm size and performance in JMIs, and its implications on the competitiveness of small manufacturing sector.

Since industrial competitiveness recently became synonymous with technological superiority, Chapter (7) aims at assessing global competitiveness of Jordan's high-technology manufacturing industries taking the pharmaceutical industry as a case study. Many strategic issues are discussed, including the global enforcement of intellectual property rights (through the TRIPs Agreement) and options for foreign technology transfer to the industry.

Finally, Chapter (8) ends with the main findings and conclusions, as well as policy recommendations and future research directions.

CHAPTER TWO

The Macroeconomic and Sectoral Setting: The Manufacturing Sector within the Jordanian Economy

2.1 Introduction

This Chapter presents exploratory analysis on both the **Jordanian manufacturing industries (JMIs)** and the **Jordanian economy (JE)** as a whole. The main aim is to delineate the economic environment of Jordanian manufacturing firms, and to make accessible to the English-language reader background information that outlines the research setting, covering the salient features, policy framework and recent performance of both the JE and JMIs.

The Chapter is structured as follows. In the *macroeconomic setting part*, an overview of salient features of JE is presented, followed by an outline on the structure of JE. The next section reviews various sectoral indicators relating to: (i) contribution of the small business sector; (ii) government participation and foreign equity investment in main sectors; and (iii) geographical concentration of economic activity. In all cases, a comparative presentation of manufacturing profile vis-à-vis other sectors in the JE is undertaken. Finally, growth performance and the policy framework in JE are addressed. The *sectoral context part* introduces selected microfoundations of competitiveness related to coming substantive chapters. After presenting an overview of JMIs, and a chronology of Jordanian industrial policy towards manufacturing, the reminder of this part addresses the following core issues in JMIs: (i) market structure (concentration and entry); (ii) the profile and potential impact of firm-size distribution; and (iii) the current situation and policy framework towards technological capabilities in JMIs.

PART ONE: THE MACROECONOMIC RESEARCH SETTING

2.2 The Jordanian Economy: An Overview

The Jordanian economy (JE) can best be described as a small, open, and service-oriented developing economy with limited natural resources (mainly phosphate and potash) and relatively well-educated human resources. It is a small economy in the Middle East in terms of income, geographical area and population. The size of the JE as measured by nominal gross domestic product (GDP) reached approximately $8.3 billions in 2000. With an area of 89.3 thousands sq. km., Jordan is about the size of Portugal. Classified by the World Bank as a lower middle-income economy, the nominal per capita income is currently at $1650. Due to a modest population base (5.0 millions) and limited export competitiveness, the resulting small market size has contributed to a relatively narrow manufacturing base (16 % of GDP in 2000) that is insufficient to cover a large and rising import requirements of the economy.

Imports of goods constitute about 54 % of GDP compared with 26 % for the UK[1] (Table 2.1), fuelled by high population growth (about 3.5 % annual average) and the input requirements of a strong economic growth (an average of 5.0 % per annum during the period 1976-2000). Merchandise imports are more than two times larger than exports of goods. Openness in goods markets is accompanied by openness in labour market; Jordan is both an exporter of skilled manpower and an importer of unskilled labour. Actually, the leading factor in financing the large and chronic trade deficit in JE is services exports, particularly exports of skilled labour to oil-producing Gulf countries.

The structure of merchandise exports is biased towards chemicals, mining, and certain agricultural exports. Geographically, the exports are highly concentrated in the Arab countries. The dominance of services income in the balance of payments is accompanied by a similar bias in the structure of the JE; services sectors account for more than two-thirds of real GDP, with the real estate, government services and communications services being the largest sectors.

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[1] As emphasised by Healey (1995), openness varies inversely with country size; larger countries tend to be relatively more self-sufficient. The structure of merchandise imports in the JE is dominated by raw materials and intermediate goods (including crude oil) with a share of 50 % in 2000, followed by consumer goods (30 %) and then by capital and other goods (20 %).

Table 2.1
The Economies of Jordan and the EU (1999):
Size, Openness and Living Standards

	Population (In Millions)	GNP (Billion US $)		Share of Manufacturing (1997)[2]	Openness[3]	GNP per Capita[1] (US $)
		Atlas Method[1]	PPPs			
Ireland	4	71.4	71.5	..	56.0	19160
Jordan	**5**	**7.0**	**16.6**	**14**	**53.7**	**1500**
Denmark	5	170.3	129.1	18	29.4	32030
Portugal	10	105.9	151.3	25	39.0	10600
Belgium	10	250.6	247.4	21	67.5	24510
Greece	11	124.0	153.8	14	34.4	11770
Netherlands	16	384.3	364.3	20	47.4	24320
Spain	39	551.6	659.3	21	22.0	14000
Italy	58	1136.0	1196.3	23	20.0	19710
UK	59	1338.1	1234.4	20	26.2	22640
France	59	1427.2	1293.8	22	20.4	23480
Germany	82	2079.2	1837.8	28	24.5	25350

NOTES:
[1] GNP is calculated here at current prices using the World Bank Atlas method.
[2] Share of manufacturing value added in GDP (at constant prices).
[3] Defined as percentage share of imports in GDP, 1994 figures.

SOURCES: (i) World Bank (2001) for size and living standards; (ii) UNIDO (2000) and Central Bank of Jordan (CBJ), Monthly Statistical Bulletin, for manufacturing shares; and (iii) Healey (1995) and CBJ, Monthly Statistical Bulletin, for openness data.

All of the above features of the JE (size, openness and structure) have implications on the state of industrial competition and competitiveness, and on the design and implementation of a viable competitiveness strategy.

The initial conditions of the JE (demographic size and movements, geopolitical position, and natural endowments) are among the leading explanatory factors behind both its structure and performance. Of particular importance are the forced population emigration towards Jordan (in 1948, 1967, and 1990) as a result of regional conflicts and the voluntary emigration of skilled Jordanian workers towards oil-producing Gulf countries. The inward population movements enlarged the role and size of the public sector and stimulated residential demand and investment. The outward movement led to an exceptionally high level of services income from abroad, even probably crowding out the commodity-producing sectors as a result of availability of funds and shortage of skilled labour.

Although Jordan is seeking to implement policy reforms that enhance its self-reliance, consumption, savings and employment in the JE remain highly dependent on foreign economic activity, like many small economies, leaving the economy subject in its performance to external shocks (both favourably and unfavourably). After years of strong growth in the 1970s and early 1980s, the subsequent decline in oil prices caused a decrease in regional demand, workers' remittances and foreign aids from oil-producing Gulf countries. This regional slowdown had an accumulative negative effect on Jordan's internal and external balances, growth and employment. Eventually, and after a balance of payment crisis, Jordan adopted in 1989 a programme for macroeconomic stabilisation and structural reform with the co-operation of the IMF and the World Bank aiming at achieving macroeconomic stability and a sustainable course of growth.

Overall, the programme has clearly contributed to a better performance at the macroeconomic level, especially price and financial stability, but certainly more can be done at the structural and sectoral level, particularly in tradable sectors, as indicated by the growth slowdown in 1996 and thereafter[2]. This Thesis seeks to contribute towards a viable competitiveness strategy in the JE that goes beyond "getting prices right". The strategy *complements* the structural adjustment programme in laying down the basis for a more robust growth in the face of progressive global competition.

The main strengths of JE are: its geographical position at the centre of three continents[3], competitive labour costs (compared with industrial countries) and a well-educated Jordanian labour force, though the majority of these assets are shared also by some regional competitors, particularly Egypt[4]. In addition, JE is characterised by diverse touristic sites and off-season agriculture. The major weaknesses consist of interrelated factors: limited natural resources (including oil, fresh water, sea outlets and arable land), smallness of domestic market, in addition to dependency on foreign markets and savings. The long-term challenges the JE should face are: (i) progressive international competition; (ii) supply-side constraints on secular growth (water and energy); (iii) structural uncertainty due to unfavourable external environment; and (iv) unemployment and poverty.

Coping with the challenges of economic globalisation, JE is seeking to enlarge its global market access in order to tackle the limitations of a small domestic market. Regionally, it has initiated a Partnership Agreement with the European Union (EU), which results in establishing a free trade area in 2010. Globally, Jordan has recently joined WTO in 2000.

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[2] See below for possible explanations for recent growth slowdown.
[3] Location for small economies has two-fold significant impact: on foreign trade, location can be an advantage in terms of transport costs (to be near the principal shipping and airline routes); on FDI, foreign investment is affected by proximity to large markets.
[4] In the jargon of strategic analysis, most of these strength points do not constitute *distinctive* capabilities.

2.3 The Structure of the Jordanian Economy

Due partially to sustained urbanisation and limited global competitiveness in manufacturing, the sectoral distribution of Jordan's GDP is biased against agriculture and manufacturing activities and in favour of services sectors. Dependency on high income from abroad[5], coupled with weak access to international markets necessary to gain scale economies, have contributed to the current economic structure. The trade and regulatory regimes probably played a reinforcing role.

Commodity-producing sectors constitute 30 % of real GDP in 2000, about its level in 1988, while services sectors, including government services, account for the rest (Table 2.2). Manufacturing is the largest sector among the commodity producing sectors with a share of some 16 % of real GDP in 2000, followed by construction and agriculture with shares of 4.5 % and 3.8 %, respectively. Within the manufacturing sector, the major industries are: food, chemicals (including pharmaceuticals and manufactured fertilisers) and cement.

Table 2.2
Jordan: Sectoral Shares in Value Added at Constant Prices (%)

Economic Activity	1988	1994	2000[(1)]
Agriculture, Hunting, Forestry and Fishing	8.8	5.2	3.8
Mining & Quarrying	3.7	2.7	2.9
Manufacturing	**8.8**	**15.7**	**15.8**
Electricity & Water	3.4	2.3	2.6
Construction	5.8	8.1	4.5
Commodity Producing Sectors	**30.4**	**34.0**	**29.6**
Wholesale & Retail Trade, Restaurants & Hotels	12.1	11.4	12.9
Transport, Storage & Communication	15.4	14.3	17.8
Finance, Insurance, Real Estate and Business Services	19.6	20.1	20.6
Community, Social and Personal Services	2.1	3.0	3.5
Producers of Government Services	21.6	17.9	17.6
Producers of Private non-profit Services To Household	1.1	1.2	1.0
Domestic Services of Households	0.3	0.1	0.2
Imputed Bank Service Charge	-2.5	-2.0	-3.2
Services Sectors	**69.6**	**66.0**	**70.4**

(1) Preliminary.

SOURCES: CBJ, Monthly Statistical Bulletin Vol. 37, No. 2 & 4 (for 1994 & 2000), revised data; Department of Statistics (DOS), http://www.dos.gov.jo (for 1988).

[5] Jordan relies heavily on services income and private transfers to generate export earnings. The high amounts of income from abroad, including workers' remittances and foreign grants, have contributed substantially in financing previous imports, weakening the urgency to industrialise- a sort of 'Dutch Disease'.

The sector of 'finance, insurance, real estate, and business services' is the largest sector among the services sectors with a share of 20.6 % of GDP in 2000. The sub-sector of real estate services contributes by more than two-thirds of the sector's overall value added. The sector of 'transport, storage and communications' is the second largest among services sectors, followed by 'producers of government services', both are related to population growth and public investment programme.

2.4 Sectoral Indicators in the Jordanian Economy

This section provides background information on: (i) the contribution of small business, government investment and foreign investment in the JE; and (ii) business geographical concentration in Jordan.

A size analysis of Jordanian enterprises is shown in Table (2.3). Small enterprises, defined as firms with less than five persons, constitute the lion's share in terms of number in major sectors, except mining and construction. About 75% of the manufacturing firms, 94 % of the trading firms, and 90 % of the services firms, are small enterprises. In contrast, small firms' contribution to employment and value added is modest compared with their numbers, a pattern broadly consistent with international experience[6]. In particular, the contribution of small miners, contractors and manufacturers in their corresponding sectoral value added is severely limited.

Table 2.3

Jordan: Main Indicators of Small Enterprises[1] (1998)
(Absolute level and as a percentage of total sectoral enterprises)

	No. of Enterprises		No. of Employees		Gross Value Added	
	Absolute (in 000)	%	Absolute (in 000)	%	Absolute (million JD)	%
Manufacturing	**11.2**	**75**	**27.6**	**26**	**58.3**	**7**
Mining	0.03	22	0.1	1.4	Neg.	0.3
Wholesale and Retail Trade[2]	43.3	94	82.0	75	272.9	57
Other Services[3]	18.6	90	36.7	36	83.5	21
Construction	0.4	36	0.8	4	0.5	0.6

[1] Defined as firms engaging less than 5 persons.
[2] For 1997.
[3] As defined by the services annual surveys carried out by DOS.
SOURCE: DOS, http://www.dos.gov.jo.

[6] For example in the EU 93 % of total enterprises are very small enterprises (i.e. with less than 10 persons). This size group provide a third of EU15 jobs and a quarter of turnover (EC, 1996a: 26).

The ownership structure in the JE is mixed. The government is not directly engaged in agriculture, manufacturing or construction activities although it owns a minority and declining equity investment in certain public-shareholding firms (Table 2.4). The Government's direct production is basically concentrated in mining (phosphate and potash), basic services (health and education), and economic infrastructure sectors (water, electricity, transportation and communications). Due to the privatisation policy, private sector participation is currently encouraged. Hence, the ownership structure is moving towards the private sector, especially in manufacturing and certain utilities (Table 2.4).

Table 2.4

Government Equity Participation in Selected Sectors

	Government share in capital paid (In %)		
Economic activity	**1992**	**1995**	**1998**
Manufacturing	**17.1**	**9.7**	**5.7**
Mining	55.7	56.3	52.8
Wholesale and Retail Trade	9.6	6.2	7.2*
Other Services	15.2	13.6	12.5
Construction	0.4	0.3	0.5

* For 1997.
SOURCE: DOS. http://www.dos.gov.jo

Because of its potential technology spillovers, foreign direct investment (FDI) is a potential competitiveness driver. In JMIs, most foreign investments can be classified as portfolio investments with severely limited technology spillovers[7]. Based on annual sectoral surveys, the share of foreign participation (both Arab and non-Arab) in capital in manufacturing recorded an increase from 6.5 % in 1992 to 11.4 % in 1998 (Table 2.5), but still remains low by international standards. Compared with other sectors, construction has registered a surge in foreign investment in 1998.

[7] Economies differ in their threshold level for foreign equity ownership taken as evidence of FDI, but usually the threshold level ranges between 10 and 50 %. The IMF in its revised edition of the Balance of Payment Manual (1993) suggests a minimum of 10 % (see UNCTAD, 2000b).

Table 2.5
Stock of Foreign Investment in Selected Sectors

	Foreign share in capital paid (In %)		
Economic activity	**1992**	**1995**	**1998**
Manufacturing	6.5	6.9	11.4
Mining	20.2	19.7	17.5
Wholesale and Retail Trade	0	0	1.0*
Other Services	4.7	0.9	1.6
Construction	5.7	1.5	25.3

* For 1997.
SOURCE: Sectoral Surveys, DOS. http://www.dos.gov.jo

Business enterprises in the JE are geographically concentrated. The core of Jordanian economy is located in the adjacent Amman and Zarka governorates in the north west of the country (Table 2.6). The spatial concentration of enterprises is clearly biased towards the Capital of Amman. Apart from mining (a natural resource-based industry), some 50 % of total number of enterprises in 1998 is located in Amman, accounting for some 60-80 % of total employment according to the sector. In terms of number of enterprises, the share of the largest two governorates reached more than 60 %, while their share of total employment and gross value added is substantially larger in most sectors.

Table 2.6
Geographical Concentration of Economic Activity (1998)
(Share of Amman and Zarqa as a Percentage of Total)

	No. of enterprises		No. of employees		Gross Value Added (000 JD)	
	Absolute	**%**	**Absolute**	**%**	**Absolute**	**%**
Manufacturing	14,918	**63.9**	98,497	**70.9**	618,643	**62.6**
Mining	49	**32.2**	541	**5.8**	3,565	**1.8**
Wholesale and Retail Trade	29,617	**64.5**	80,513	**73.7**	396,251	**82.8**
Other Services	13,935	**67.2**	78,988	**78.0**	319,904	**81.9**
Construction	617	**59.5**	18,608	**85.8**	76,539	**89.5**

SOURCE: DOS. http://www.dos.gov.jo

2.5 Growth Performance of the Jordanian Economy

Introduction and Overview

The growth performance of the JE is an outcome of combined effect of three main factors: initial conditions, external shocks and policy stance and reform[8]. Due to smallness and openness of the economy, the factor of external shocks seems to explain a large part of its growth dynamics and fluctuations (IMF, 1998a). Variations in external factors such as income and transfers from abroad, population movement, and regional outlook have substantially affected, favourably and adversely, the growth performance of the economy. This macro vulnerability to external shocks constitutes a feature shared generally by all 'small' economies[9] (Helleiner, 1982; Armstrong and Read, 1998; Easterly and Kraay, 2000).

As for long-term performance, notwithstanding the data limitations, available research on productivity performance indicates the poor profile of total factor productivity (TFP) growth in the JE (Maciejewski et al., 1996), confirming that Jordanian growth is factor using rather than efficiency improving.

The Jordanian economy enjoyed strong growth during the 1970s and early 1980s supported by favourable external stimuli. The supporting growth drivers were high levels of workers' remittances that boosted private investment and foreign aid that expanded government investment, especially in social overhead capital. Due to negative regional developments in the aftermath of declining oil prices, reinforced by unsustainable inward and state-led development strategy, the economy started in 1983 its slowdown cycle that accumulated to a severe economic depression and a balance of payment crisis in 1988/89.

During the last twelve years or so, the Government of Jordan pursed an ambitious reform programme to restore macroeconomic stability and strengthen the supply side of the economy[10]. The reforms contributed to economic recovery during 1992-95. But due to weak

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[8] According to Hughes (1992: 16), the voluminous development literature suggests that "natural resource endowment, country size, geography, location and capital inflows (notably of aid) are not the *principal* causes of differentials in national growth rates" (emphasis added). This conclusion seems to confirm Porter's (1996b) basic proposal that national prosperity is created, not inherited. On the same issue, the World Bank (1987) pointed out that "[i]nitial conditions of size, population, and natural resources may influence the timing and pattern of early industrialization, but further progress along the path is greatly influenced by government policy" (p.57).

[9] This vulnerability is due to other 'stylised facts' of small economies; openness, smallness, and narrowness of output and exports (Armstrong and Read, 1998). Chapter (3) highlights *micro*economic size disadvantages of small economies.

[10] See Zaghlool and Hazaima (1999) for a review on reform measures.

initial conditions and unfavourable regional developments, growth performance fell below original targets in the second half of the last decade.

Stages of Growth Performance in the Jordanian Economy

Growth performance in Jordan during the period 1976-2000 can be classified into five distinct phases (see Maciejewski et al., 1996):

The Boom of the 1970s and Early 1980s

Jordan's economy achieved high growth rates during the period 1976-82 with an average of 10 % (Table 2.7). This outstanding performance was supported by: (i) expansionary fiscal policy and ambitious public investment programmes, with special emphasis on infrastructure and mining projects, financed largely by foreign grants and loans; and (ii) autonomous private expenditures, especially residential investment, financed largely by workers' remittances. A new element of growth strategy in this phase was the exporting of skilled Jordanian manpower (to the Gulf region).

The First Slowdown During the Period 1983-87

Compared with former years, the JE witnessed a slowdown in its average growth during the period 1983-87 accompanied by a deceleration in consumer price inflation. The growth rate averaged 3.1 % during that period (Table 2.7). This slowdown reflected, at least in part, regional slackening as a result of falling oil prices and its negative implications on workers' remittances, external aid and exports to Gulf countries. No substantial policy shift occurred during this period, but the government pursued an industrial protection policy in late 1985 to stimulate industrial growth and improve the Kingdom's trade balance.

Table 2.7

Jordan: Real Growth Rates (1976-2000)

Period	Average Real GDP Growth
1976-1982	10.0
1983-1987	3.1
1988-1991	-3.1
1992-1995	8.3
1996-2000	3.0

SOURCE: CBJ, Monthly Statistical Bulletin Vol. 37, No. 2 & 4 (for 1994-2000), revised data; DOS, http://www.dos.gov.jo (for 1986-1993); researcher estimates for (1976-85) based on DOS data for nominal GDP and consumer price index.

Economic Crisis in Late 1980s

The prevailing external conditions of declining workers' remittances, foreign grants and loans in the mid-1980s had led to a growing and persistent macroeconomic imbalances in the form of external imbalance and budget deficit. In 1987-88, the government sought to supplement falling foreign resources with increased commercial borrowing from abroad. This policy was unsustainable and eventually the situation ended with a balance of payment crisis in 1988/89, which was accompanied by a severe decline in the exchange rate of the Jordanian Dinar.

Economic Recovery During 1992-95

After years of stagnation or absolute decline during 1988-91, the JE recovered its strong growth in 1992. Average growth rate in 1992-95 amounted to 8.3 % compared with a decline of 3.1 % during 1988-91. The main factors behind this inflexion in economic activity were:

- The return of about 300,000 Jordanians (some 10 % of total population) with their savings and high skills from the Gulf countries in the aftermath of Gulf crisis. This led to an increase in residential and productive investment in the JE.
- The implementation of a macroeconomic stabilisation and structural adjustment programme with the support of international institutions. This policy restored macroeconomic stability and retrieved confidence to domestic and foreign investors.

As a result of these two factors, the supply side of the economy responded positively to a sudden rise in effective demand for consumer goods and residential buildings; manufacturing and construction sectors showed high growth during this period (Table 2.8).

Table 2.8

Growth Rates of Economic Sectors at Constant Prices

(Percentage Change)

Economic Activity	**1988**	**1994**	**2000 (1)**
Commodity Producing Sectors			
Agriculture, Hunting, Forestry and Fishing	32.6	-13.9	7.1
Mining & Quarrying	-7.3	3.1	-1.3
Manufacturing	**-19.1**	**17.3**	**5.6**
Electricity & Water	-2.5	6.7	3.6
Construction	-18.4	7.3	1.3
Services Sectors, of which:			
Wholesale & Retail Trade, Restaurants & Hotels	-14.2	-0.5	8.5
Transport, Storage & Communication	-0.6	3.4	4.0
Finance, Insurance, Real Estate and Business Services	11.0	5.8	5.2
Producers of Government Services	6.3	3.7	6.9
Gross Domestic Product at Producers' Prices	**-1.9**	**5.0**	**3.9**

(1) Preliminary.
SOURCE: CBJ, Monthly Statistical Bulletin (for 1994 & 2000), revised data; DOS, http://www.dos.gov.jo (for 1988).

The Second Slowdown During 1996-2000

After years of high growth, Jordan's economy faced in 1996 upwards a slowdown in economic expansion. According to available data, average growth decline from 8.3 % during the period 1992-95 to 3.0 % during 1996-2000 (Table 2.7). This deceleration is due to cyclical adjustment in construction activity, a slowdown in industrial growth as a result of weak domestic and regional demand (from Iraq and Gulf countries), and deterioration in the regional political environment. Indeed, the setback of the Peace Process in 1996 had its negative impact on Jordan's investment and tourism levels. As a result, new firm entry declined in this period (Table 2.13) and incumbent enterprises suffered from large excess capacity, particularly in manufacturing and real estate sectors.

2.6 The Current Policy Framework in the Jordanian Economy

As emphasised above, Jordan's public policy framework during the 1970s and most of the 1980s was characterised by a widespread government regulation and intervention, aided by the availability of government resources from abroad.

As of 1989, after an economic crisis, Jordan adopted a structural adjustment programme to strengthen the supply side of the economy and improve the functioning of the markets. The new policy framework emphasised the following directions:

- *External trade liberalisation.* Imports were gradually but substantially liberalised; while exchange controls, quantitative restrictions and licensing requirements were abolished, tariff barriers have been eased. In addition, state trading monopolies have been eliminated. As a result, import entry barriers were substantially eased on tradable goods. Finally, Jordan has recently issued the Law for the Protection of Domestic Production consistent with WTO rules with the aim of protecting domestic producers against dumping. According to the Law, the protection will be selective, temporary and conditional, using either tariff or non-tariff instruments with the first instrument being preferred.

- *Market and investment liberalisation.* Both domestic and foreign investment regimes were deregulated. The Investment Promotion Law of 1995 and its regulations stipulated Jordan's policy for facilitating (direct and portfolio) foreign investment. The negative list on foreign ownership is short; only in mining, construction and trade, foreign investors are not permitted to own more than 50 % of any project. Many foreign-specific constraints such as prior entry approvals and high minimum capital requirement were removed from the former regulation. Administrative price controls were generally eliminated including interest rate, and consumer subsidies were phased out allowing partial cost recovery in public services.

- *Privatisation and sectoral regulatory reform.* The aim of this element of structural reform is to decrease the role of the public sector in production decisions and to enhance the efficiency of the financial sector in allocating resources. Decreasing the size of state-owned sector would be done through: (i) core privatisation; and (ii) selling government's shares in public shareholding companies. In this field, implementation is behind planning, but good progress has been achieved in selling shares owned by the state.

PART TWO: THE SECTORAL RESEARCH SETTING

2.7 The Jordanian Manufacturing Industries (JMIs): An Overview[11]

As a latecomer to industrialisation, Jordan has started its noticeable industrial development in late 1950s (Mazur, 1979) with the establishment of several large industrial projects in mining and manufacturing, aided with state equity participation, industrial concessions and improved infrastructure. At constant prices, the manufacturing sector contributed 14 % of GDP in 1997 compared with 7 % in 1952[12]. Despite this temporal improvement, Jordan's manufacturing share in real GDP is comparatively low by international standards (Table 2.1); 23 % for the world and 24 % for NICs in 1997 (UNIDO, 2000).

According to the latest industrial survey, JMIs employed 105,000 persons in 1998, working in some 15,000 manufacturing enterprises, of which 11,200 are small enterprises (engaging less than 5 persons). Furthermore, the sector comprises 92 (comparatively large) public shareholding companies (AFM, 1997). The manufacturing sector accounted for 61 % of merchandise exports in 2000 compared with 44 % in 1985[13]. Due partially to geographic export concentration towards Arab economies, regional political conflicts and inter-Arab relations have significantly affected the robustness of the sector's performance[14], leading to high variation in annual growth rates (Figure 2.1). Notwithstanding this variation, long-term average growth is favourable; about 5 % during the period 1986-2000.

The private sector is dominant in JMIs; the government currently owns just a minority share in the sector (Table 2.4). Government's equity participation in manufacturing is concentrated in non-metallic mineral products, including cement (18 % in 1998); food industries (11 %); printing and publishing (4 %), and chemicals (3 %).

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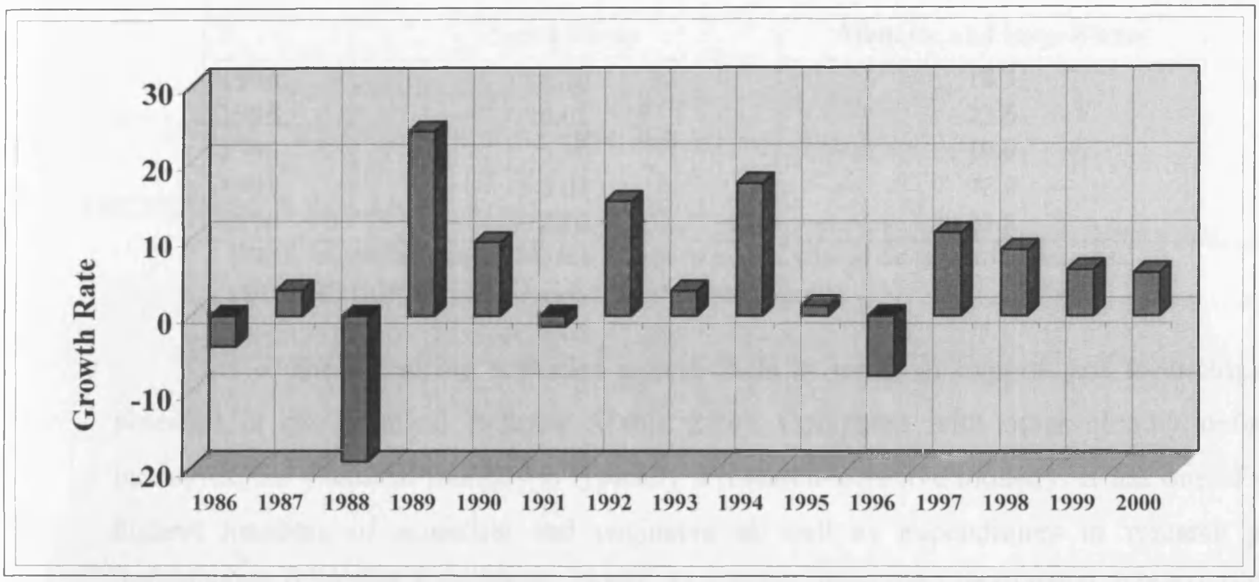
[11] Manufacturing industries can be broadly defined as industries involved in physical or chemical transformation of materials or components into new product (Mayes et al., 1994). Manufacturing industries are listed under major division 300 in the United Nations International Standard Industrial Classification (ISIC). Thus, it excludes crude petroleum & natural gas, mining & quarrying, electricity, and industrial services.

[12] 1952 figure is at current prices.

[13] Source: CBJ. Manufacturing export is defined here as total merchandise exports minus SITC sections 0-4 or agricultural products and raw materials. If section 4 is included (consists mainly of vegetable fats, a semi-processed product), then the share of manufactured exports rise to 65 % in 2000.

[14] ESCWA (1995) cited many examples of external shocks to JMIs resulting from regional political conflicts: the Iraq-Iran War; the Lebanon Civil War; the Arab-Israeli Wars; and the recent Gulf crisis (in 1990-91).

Figure 2.1
Jordan: Real Growth in Manufacturing Value Added



SOURCE: CBJ, Monthly Statistical Bulletin Vol. 37, No. 2 & 4 (for 1994-2000), revised data; DOS, http://www.dos.gov.jo (for 1986-93).

Jordanian manufacturing enterprises are typically engaged in assembly-type operations. The vertical integration of JMIs is weak; neither the supply of capital equipment nor down stream processing being highly developed. The ratio of value added to gross output in 1998 ranges from 21% for chemical products to 46 % for non-metallic mineral products.

The capital goods sector is modest in size[15]; consumer and intermediate industries are dominant. Most manufacturing industries produce mainly for the local market but a number of well-defined industries export more than 50 % of their output during 1996-98. Most notable export-oriented industries in manufacturing, as defined above, are: fertilisers & pesticides, drugs, and basic industrial chemicals in addition to spare parts for motor vehicles, vegetable oils and jewellery. With the exception of 1996, export performance of small manufacturing firms is exceptionally weak in JMIs (Table 2.9), with export intensity less than 1%.

[15] The aggregate classification of Table (2.10) below gives an opposing conclusion, but in reality, the sector of 'fabricated metal products, machinery and equipment' is dominated by small, low-technology, enterprises manufacturing structural metal products (ISIC 3813) such as light tanks, metal doors and screens and windows frames.

Table 2.9
Jordan: Export Intensity of Small And Larger Manufacturing Firms (1994-98)

	Small Firms	Medium and large Firms
1994	0.10	18.5
1995	0.02	23.5
1996	5.30	19.6
1997	0.01	22.2
1998	0.12	23.8

NOTE: export intensity is the ratio of exports to total sales in the respective size class.
SOURCE: DOS, industrial surveys, http://www.dos.gov.jo.

One of the promising activities among JMIs in terms of exports and technological potential is the chemical industry (Table 2.10). Compared with other broadly defined industries, the chemical industry is typically a research-intensive industry. It has one of the highest numbers of scientists and engineers as well as expenditures in research and development (Cox and Kriegbaum, 1989). As a result, protecting intellectual property rights (IPRs) could play a significant role in the development of this sector in the long term (see EC, 1996b). Indeed, Mansfield (1992) found that, unlike other industries, patents are very important for pharmaceutical and chemical sectors in encouraging R&D and technological dissemination (cited in UNCTAD, 1996b: 51).

Table 2.10
Jordan: Structure and Performance of the Manufacturing Sector
(1998 unless otherwise indicated)

Industry	No. of Firms	Share[1] (%)	Mean Firm Size[1]	Mean 3-firm CR[2] (1997)	Export Intensity (1994-98) %	Average Growth[3] (1990-98)
Food, beverages and tobacco	2,226	27.6	10	54	15.0	8.5
Textile and leather	2,316	6.3	5	43	24.5	8.2
Wood and wood products	3,772	4.3	3	8	2.6	10.7
Paper, printing & publishing	312	5.5	22	56	13.2	7.7
Manufacture of chemicals	431	31.1	43	55	29.5	6.8
Manufacture of non-metallic mineral products	2,183	13.0	6	55	13.0	6.5
Basic metal industries	38	3.4	53	64	3.0	8.7
Fabricated metal products, machinery and equipment	3,564	8.4	5	44	20.5	10.9
Other manufacturing	94	0.4	7	N. A.	48.0	25.1
Total Manufacturing	**14,936**	**100**	**7**	**47**	**20.5**	**8.5**

[1] In terms of employment.
[2] CR is concentration ratios based on employment; the mean is calculated as simple average.
[3] Based on employment changes and using least square method.
SOURCE: DOS, industrial surveys, http://www.dos.gov.jo. For concentration ratios, data provided by DOS.

2.8 Business Strategy and Industrial Policy in JMIs

Firm Business Strategy in JMIs and its Pitfalls

Jordanian manufacturing firms, explicitly or implicitly, tend to emphasise a strategy of cost leadership[16] coupled with regional focus and imitation rather than adopt a differentiation strategy. This is revealed by the apparent geographical concentration in exports and limited investment in R&D and foreign technology licensing[17]. A recent survey evidence suggests two main reasons for Jordanian firms ignoring improved foreign technology, despite their knowledge about its existence: (i) lack of financial resources; and (ii) demand deficiency (Al-Hajji et al., 1997a). According to the survey, 58 % and 48 % of Jordanian industrialists confirm that lack of money and market, respectively, are important reasons for avoiding better technology (Table 2.11). This is equivalent to reasons for giving less emphasis on differentiation strategy. As expected, lack of funding is more pronounced by small entrepreneurs. Pursuit of differentiation is often not costless[18] (Besanko et al., 2000) but, quite naturally, the recent introduction of patent protection in JE will aggravate the financial barriers for new technology (see below).

Table 2.11
Jordanian Industrial Firms:
Main Constraints on Foreign Technology Transfer

	Percentage of firms expressing opinion that the relevant factor is discouraging		
	Financial Obstacles	**Technical Incompetence**	**Demand Deficiency**
Small Firms	68	13	49
Medium Firms	43	12	42
Large Firms	36	14	47
All Firms	58	13	48

SOURCE: Al-Hajji et al., 1997a (p. 109) and 1997b (Table 26).

In general, a low-cost competitive strategy is traditionally linked with two elements: (i) high-volume production and product standardisation; and (ii) low labour costs. The main potential weakness of a low-cost strategy in JMI is two-fold: high volume production is

[16] The use of cheap foreign labour is one element of such a strategy, especially for smaller firms.
[17] For more details, see the coming section on 'technology development and transfer in JMIs'.
[18] According to Dale (2000), quality-related costs commonly range from 5-25 % of company's annual sales.

typically absent, and low-wage advantage is not sustainable. A discussion of both points is in turn. **First**, due to their small size, many Jordanian manufacturing firms are probably below 'minimum efficient scale' to benefit from scale economies[19]. Furthermore, JMIs suffer from limited domestic demand and unstable regional markets leading to a chronic excess capacity problem. One recent study (Al-Hajji et al., 1997a) found that the 1994 average capacity utilisation in the industrial sector did not exceed 53 %. This signals the vulnerability of capital-intensive and large firms in a small and fluctuating market, and weakens the benefits of scale economies in the relevant industries (Speight, 1970). **Second**, although low-wage advantage is a powerful competitive weapon in the early stages of industrial development, many arguments affirm that it lacks sustainability. It is well known that industrial growth derives up labour demand and wage and eventually diminishes cost advantage (see Segal-Horn and Faulkner, 1999). Furthermore, foreign firms might surpass Jordanian counterparts in terms of *other significant cost drivers*; technical efficiency and learning economies, non-labour costs and higher dynamic efficiency arising from process innovation. Finally, many multinationals seeking efficiency can easily target low-wage economies in their locational decisions to achieve wage competitiveness.

The Jordanian Industrial Policy Towards Manufacturing

For better or worse, Jordan did not yet develop an explicit and coherent 'industrial policy' for the manufacturing sector. Instead, Jordan used to adopt some sort of disjointed incrementalism (see Lindblom, 1959) in formulating its industrial policy. Uncertainty regarding the 'optimal' policy as well as changing policy environment partially explain the lack of such an explicit master plan. The muddling through process took diverse policy directions, ranging from industrial targeting to horizontal polices, emphasising different policy instruments, and focusing on large projects in specific stages and SMEs in others (Figure 2.2). The policy shift is driven by perceived failure of past policies, global policy reversal, as well as policy commitment with Bretton Woods institutions.

In the 1950s and 1960s[20], after the independence, the policy stance focused on establishing 'national champions' or large industrial firms supported by government

[19] Chapter (6) explores technical scale economies in JMIs.
[20] See Mazur (1979) for a historical perspective on Jordanian 'industrial policy'.

partnership and support[21]. The granted industrial concessions (or monopoly rights) to the majority of these companies reflected the policy bias towards big enterprises in that phase. Small domestic market is thought to require entry regulation, including that of imports.

In the 1970s, a period of noticeable economic growth, a policy reversal occurred in the Jordanian industrial policy. The emphasis switched to encouraging competition and free entry of enterprises and imports, affected by economic prosperity, global mood towards SMEs and the intention to minimise the monopoly power created by the former stage of strong government intervention.

Jordan's trade regime in late 1980s was highly restrictive. The economic slowdown in early 1980s has contributed to the adoption of an industrial protectionist policy in 1985 with a view to stimulate industrial growth and maintain the Kingdom's foreign exchange. In general, the 1980s period witnessed a 'soft' type of industrial paternalism in many other spheres, including firm entry. Finally, the need for outward-oriented industrialisation felt strongly during the 1980s, leading to progressive measures to promote exports.

Since 1989 and within the World Bank's structural adjustment programme, industrial policy reform has focused on market reform embodied in the 'Washington Consensus'. The main elements of such a standard reform are[22]:

- Market deregulation: removal of price (including interest rate) and other controls on enterprises (including entry).
- Trade liberalisation: removal of quantitative barriers on trade and the gradual reduction of tariff barriers.
- FDI promotion: reducing restrictions on foreign direct and portfolio investment.
- Privatisation of state-owned enterprises.
- Exchange rate devaluation.

During the 1990s, Jordan achieved a noticeable progress in the first three components, but was sluggish in implementing the fourth component in non-manufacturing sectors, and refrain from using exchange rate as an industrial policy instrument.

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[21] Examples are: Jordan Cement Factories (1951), Jordan Phosphate Mines Company (1953), Arab Potash Company (1956), Jordan Petroleum Refinery (1956), Arab Pharmaceutical Manufacturing (1964).

[22] See, for example, Kirkpatrick and Weiss (1992). These elements are, of course, *not* manufacturing-specific. Many of these elements are initiated in Jordan under the World Bank's **I**ndustry and **T**rade **P**olicy **A**djustment **L**oan (ITPAL).

Figure 2.2
Jordan: A Typology & Chronology of Industrial Policy Towards Manufacturing

Policy Area	Type of Policy[1]	1950s	1960s	1970s	1980s	1990s	2000+
Enterprise policy towards firm size							
Government's participation, industrial concessions and loan guarantees	T						
Tax incentives for small firms (in Investment Law)	H						
Investment policy: policy towards domestic and foreign investment							
Tax incentives for domestic investment	H						
FDI promotion	H						
Privatisation	H						
Trade policy: policy towards import substitution and export promotion							
Industrial protection[2]	T						
Export promotion	T						
Financial policy towards availability, channels and cost of credit							
Directed credit allocation	T						
Loan guarantee for SMEs	T						
Soft loans for SMEs[2]	T						
Technology policy to promote technological progress (new products and processes)							
R&D aids	H						
Protecting IPRs	H						
Industrial modernisation	H						
Tax concessions for R&D	H						
Competition policy towards market structure and firm entry							
Competition law (expected)	H						
Firm entry regulation[2]	T						

[1] H: horizontal policy (symmetric treatment of all activities, regions and enterprises); T: targeting policy (favouring certain activities and enterprises).
[2] The intensity of colour denotes the intensity of policy.
SOURCES: Researcher, based on Mazur (1979); Abu Hammour (1988); Muhtaseb (1995); Mustafa (1999); Zaghlool and Hazaima (1999).

Recently, Jordan has enforced IPRs, a step that could benefit the long-term prospect for the chemical and IT industries, two main high-technology industries in the JE (see Chapter 7). Furthermore, aided with foreign support, the government has launched several industrial programmes with a view to enhance industrial competitiveness. Noticeable initiatives are: the EU industry modernisation programme and Jordan-Japan cooperation programme on industrial development.

2.9 Market Structure in JMIs

Market structure, as measured by competition intensity[23], has traditionally been thought to be a major predictor of market performance. Actually, increased competition is often cited as one of the principal intended consequences of many policies, ranging from trade liberalisation (Levinsohn, 1993) to regional integration agreements RIAs (Pelkmans, 1997: 12) as well as competition policy (CA, 1992). Endorsing competition can enhance both allocative and technical efficiency and can reduce rent-seeking behaviour among firms, but it is capable also of harming scale and dynamic efficiency[24].

Measures of Market Structure in JMIs

In JMIs, producer concentration, a proxy for domestic competition, seems comparatively high. According to 1997 figures, simple average of 3-firm concentration ratios, based on employment, was 47 %, compared with 30 % and 33 % for the USA and Japan, respectively (Van Ark and Monnikhof, 1996)[25]. Taking a closer view, without adjusting for foreign trade, about half of JMIs are characterised by levels of concentration associated with tight oligopoly or monopoly power (see Table 2.12).

Table 2.12
Jordan: Frequency Distribution of Producer Concentration in Manufacturing (1997)

Industry Classification	CR3 Group	Number of Industries	Share in Numbers (%)
Effective competition	30 or Less	16	28.6
Monopolistic competition	45 or Less	12	21.4
Tight oligopoly	99.9 or Less	27	48.2
Pure Monopoly	100	1	1.8
Total		**56**	**100.0**

SOURCE: Researcher's tabulation based on data provided by DOS.

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[23] Market structure is a broad based concept with multiple elements (Geroski, 1994). In this section, the focus will be on market concentration and entry.
[24] See Chapter (4) for a clear statement regarding the nature and relationship among various efficiency concepts.
[25] Data for Jordan are based on 56 industries classified according to *ISIC2*. The Jordanian simple average is calculated after omitting consolidated (heterogeneous) industries. All countries use establishment-level data for the calculation of concentration ratios, which are *not* adjusted for international trade.

Several factors can explain the high combined employment share of the leading three manufacturing enterprises in JMIs: (i) the small domestic size of JE relative to minimum efficient scale; (ii) the historically strong government regulation in the form of industrial concessions (e.g. oil refinery), licences and red tape that affect entry; (iii) imperfections in Jordan's capital market that limit long-term financing for potential competitors. But market dominance in JMIs is actually not as severe as one might think from *producer* concentration ratios. This is due to the high level of import competition in JMIs. Nevertheless, in LDCs in general, several potential factors dampen the pro-competition effect of trade liberalisation, such as product differentiation and diversity[26], the domestic manufacturer's use of strategic behaviour to prevent import competition (Pickford, 1991), and the presence of noticeable monopoly power in the wholesale trade sector.

Market entry is an important element of market structure that ranks high in Jordan's industry policy agenda. Free entry facilitates "adjustment to changes in demand, technology, and factor prices, increase competition, and induces incumbent firms to operate as efficiently as possible" (Siegfried and Evans, 1994: 122). The pattern of firm entry in JE reflects both economy-wide and sector-specific effects. Though asymmetric, overall market entry was at its maximum in 1992 and 1993 (Table 2.13). This is due to market growth resulting from forced return of Jordanian workers from Kuwait and other Gulf countries in the aftermath of the Gulf crisis. Entry is weak in all sectors in 1996, affected by general economic slowdown. Net entry peaked in manufacturing in 1992. Within manufacturing, chemical industry by far witnessed the largest increase in net entry during the 1990s- an average annual growth of 18 %.

Table 2.13

Net Firm Entry in the Jordanian Economy (Growth Rates)

	1992	1993	1994	1995	1996	1997	1998
Manufacturing	**23.2**	**2.4**	**4.2**	**10.4**	**2.4**	**3.5**	**3.2**
Mining	5.0	0.0	3.2	1.6	9.2	0.7	5.6
Trade	NA	1.2	7.5	5.9	5.0	5.6	NA
Services	2.3	22.9	2.9	2.6	2.7	2.7	1.6
Construction	13.0	15.8	12.7	8.3	2.1	1.5	18.0

SOURCE: Researcher's calculation based on DOS survey data, http://www.dos.gov.jo.

[26] Indeed, imported goods and home goods tend to have asymmetric variety and quality, due partially to asymmetric technological capabilities.

To prevent anti-competitive practices and protect the competition process, Jordan is in the process of enacting a competition law. The draft law appears to take a balance stance between the *per se* approach (e.g. in horizontal restraints) and *rule of reason* approach (e.g. in merger policy); it takes into account the existence of cases where certain *restrictions* on competition can have an overall efficiency gains, broadly defined.

2.10 Size Structure in JMIs

Variation in efficiency arising from differences in firm size is considered as one of the most crucial structural feature of production (Moroney, 1972). Scale factor is potentially a significant cost and benefit driver in many manufacturing industries (see Emerson et al., 1988; Symeonidis, 1996; Sutton, 1999), particularly in small economies. Although small firms possess their own comparative advantages and capabilities, it is often argued that micro- and small-enterprises, in a non-cooperative game, have less opportunity to reap potential scale economies in production and innovation.

Firm-size distribution in JMIs

In Jordan, manufacturing sector suffers from extreme fractioning:

- In 1994, 72 % of manufacturing enterprises are engaging 4 persons or less (Table 2.14).
- On the other side of firm-size distribution, there are just 11 manufacturing enterprises employing more than 500 workers in 1994 out of 12,358 firms, or 0.09 % of total number of enterprises[27].

Table 2.14
Jordan: Firm-Size Distribution in Manufacturing (1994)

Enterprise Classification	Employment Size Class	Number of Enterprises	Share in Total (%)	Cumulative Share (%)
Small Enterprises	1-4	8935	72.3	72.3
Medium Enterprises	5-9	2357	19.1	91.4
	10-14	320	2.6	94.0
	15-19	163	1.3	95.3
Large Enterprises	20-29	180	1.5	96.7
	30-49	165	1.3	98.1
	50-99	105	0.8	98.9
	100-199	81	0.7	99.6
	200 and more	52	0.4	100.0
	Total	12,358	100.0	

Note: In Jordan, SMEs are informally defined as firms with less than 20 workers, compared with 10-250 workers in the EU.

SOURCE: DOS, unpublished 1994 census data covering all JMIs and firms.

[27] Source: DOS, unpublished data.

The skewness of firm-size distribution in favour of small enterprises is one of the stylised facts of all economies (Agarwal and Audretsch, 1999), irrespective of size of the economy and stage of industrialisation. But in the case of JMIs, the smaller size of domestic economy, weak export performance and tariff protection policy have contributed to an extremely skewed size distribution in manufacturing compared with selected economies (Table 2.15). In addition, the Table shows clearly the shortage of 'medium-sized' firms in JMIs compared with other countries, a phenomenon called the 'missing middle' in the literature of small business economics (UNCTAD, 1998).

Table 2.15
Establishment-Size Distribution in Manufacturing Industry:
An International Comparison (1994)

Employment Group	**0-19**	**20-99**	**100-499**	**500+**
	(Percentages)			
Jordan	**95.3**	**3.6**	**1.0**	**0.1**
Australia	82.0	14.1	3.4	0.4
Iceland (1992)	90.8	6.7	2.5	0.0
Netherlands (1993)	78.0	17.2	4.3	0.6
United Kingdom	82.7	12.9	3.7	0.8

SOURCES: for Jordan, Table (2.14); for industrial countries, OECD (1997a). The first size class in Australia, Netherlands and the UK omits sole proprietorships or establishments with zero paid employees. All distributions are based on establishment data.

This structural feature of JMIs has potentially significant impact on the sectoral long-term performance in terms of export capability, product quality and productivity. As a result of a remarkably large share of SMEs, the average size of Jordanian firms is well below the European average. If scale economies in production, marketing and innovation are significant in many manufacturing industries, this smaller typical plant size could, *ceteris paribus*, imply higher costs and weaker technological capabilities, leading to inferior price and non-price competitiveness compared with both large domestic firms and its European counterpart[28].

In Jordan, there is no coherent and explicit industrial policy towards firm size, but the policy stance is recently oriented towards the promotion of small business sector (Figure 2.2). It is well known that small enterprise sector suffers from high failure rate in general (Geroski, 1995) and cost disadvantage in industries enjoying significant scale economies, suggesting

[28] According to a recent survey-based study (Al-Hajji et al., 1997a), quality commitment in JMIs is related inversely to firm-size class; SMEs are less able or keen to get quality certification or produce according to specific product standards vis-à-vis large firms. The same applies to employment of R&D personnel and foreign technology licensing.

certain weaknesses in the sector. On the other hand, if industrial policy in a small economy seeks to encourage large-scale enterprises to reap internal scale economies, this can cause unintended consequences in terms of creating monopoly power. Thus, an interesting policy issue is whether the government should *focus* one side of the firm-size distribution and the efficiency implications of such a choice, a question to be dealt in detail in Chapters (5) and (6).

2.11 Technological Capabilities in JMIs: An Overview of the Current Situation and Policy Framework

Introduction

The role of technological capability in enhancing the competitive advantage of industry is recently attracting more attention in competitiveness research (UNCTAD, 1996b). According to available estimate, expenditures on R&D in the JE as a whole did not exceed 0.4 % of GDP compared with 1.0 % targeted for LDCs (Zaghlool and Hazaima, 1999). Table (2.16) shows the educational attributes of workers employed in manufacturing compared with other selected sectors in 1994. It reveals the relatively high share of low-education workers in JMIs, at least compared with other knowledge-based sectors[29].

Table 2.16
Jordan: Educational Levels of Manufacturing Manpower
(Share in Sectoral Total, 1994)

	Illiterate and Others	Secondary Level or Less	Intermediate Diploma & B. Sc.	Higher Diploma & M. A.	Ph.D.	Total
Manufacturing	**6.5**	**74.9**	**17.9**	**0.6**	**0.1**	**100.0**
Mining	12.9	64.7	21.0	1.1	0.2	100.0
Financial Intermediation	0.6	35.5	59.2	4.4	0.4	100.0
Education	2.4	16.1	72.5	6.5	2.5	100.0

SOURCE: DOS, Population and Housing Census Accompanying Survey 1994 (1996).

[29] One explanation for this fact is the high participation rate of foreign unskilled labour in many JMIs. Jomard (1996), in a survey-based study on investment constraints in Jordan, cites that 89 % of investors think that lack of skills is an investment obstacle in Jordan, and 77% believe that it is "greatly an important obstacle".

The technology profile of JMIs is investigated next using: (i) statistics on R&D expenditures; (ii) indicators on foreign technology transfer; and (iii) recent empirical research on productivity growth in manufacturing.

Technology Development and Transfer in JMIs

Compared with industrial countries, quality competitiveness generally ranks low in JMIs (World Bank, 1988). Although certain Jordanian manufactures (such as pharmaceuticals) are considered of superior quality by *regional* standards, these products still need to establish a worldwide reputation. A recent survey-based study on the competitiveness of Jordan's industrial sector (manufacturing and mining) has showed that the sector as a whole spent just JD 1.0 million (or $1.4 million) on R&D in 1994 (Al-Hajji et al., 1997b), mainly in the chemical and mining industries, or just 0.14 % of nominal value added[30]. Moreover, the number of employees in R&D activities did not exceed 0.7, 0.3 and 0.1 % of total manpower in large, medium and small industrial firms, respectively (Al-Hajji et al., 1997a: 110). Nevertheless, many large Jordanian companies are questing to improve non-price competitiveness and publicly signal their quality commitment through quality certification (such as ISO9000)[31]. Naturally, acquiring technology from abroad is an alternative for developing technology within the firm. Modes of foreign technology transfer vary: FDI (wholly or majority ownership), joint ventures, technology licensing, foreign alliances, franchising, turnkey projects, management contracts, marketing & technical service contracts and imports of high-technology capital goods. The following will cover some of the main modes in JMIs, starting with licensing.

Due to limited resources of SMEs in JMIs and, until very recently, the absence of patent protection, technology licensing is relatively limited, but showing an upward trend (Figure 2.3). This trend is hiding a noticeable fluctuation depending on economic outlook.

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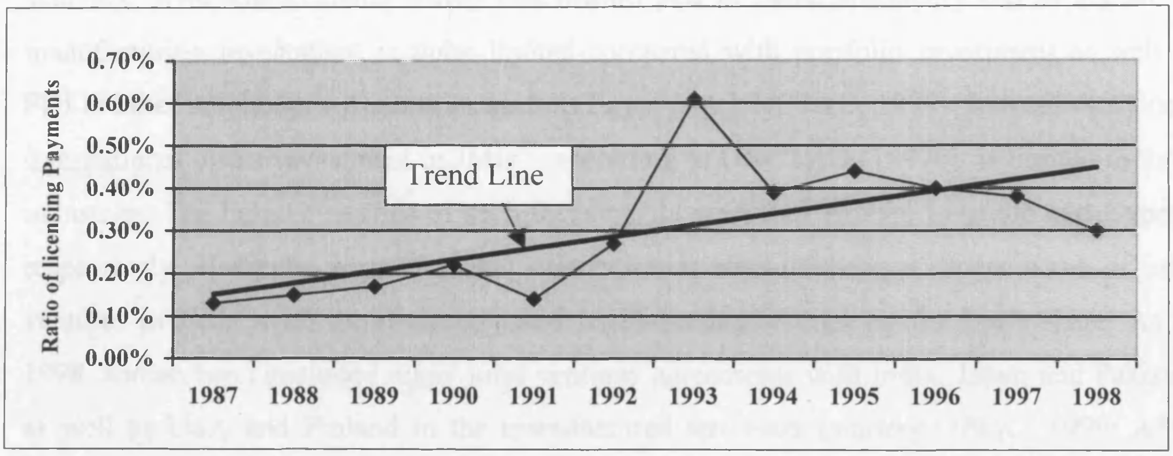
[30] Volume 2, Annex (10-1), after taking adjustment factor into account. An upper bound for *manufacturing* R&D intensity, provided by another (economy-wide) study, indicates a level of 0.6 % (HCST, 1998: 256) but with the same qualitative conclusion.

[31] Generally speaking, the evidence regarding the impact of quality management programmes on firm's competitive performance is inconclusive *in industrial countries*, suggesting that quality certification can improve performance but "not necessary for success" (Coulter, 1998: 51), see also Powell (1995) and Reed et al. (1996). On the other hand, the World Bank (1997) reports association between quality certification and export success *to industrial economies* in the case of Malaysia.

Figure 2.3

Jordan: Evolution of Licensing Payments in Manufacturing Sector

(As a percentage of manufacturing nominal value added)



SOURCE: Based on data of Jordanian industrial surveys, DOS, http://www.dos.gov.jo.

More specifically, during the period 1987-98, royalty payments by Jordanian manufacturing firms, a potential measure of technological capability[32], reached an average annual of JD 1.8 million, or about 0.3 % of manufacturing nominal value added. Licensing payments, as expected, are highly correlated with manufacturing's value added[33]. It registered -as a percentage of value added- an average annual growth rate of some 11 % during the above period. Table (2.17) appears to indicate that Jordanian manufacturing firms invest less in technology licensing compared with Asian NICs, but certainly more than some Latin American countries.

Table 2.17

International Comparison of Licensing Payments (1986-90)

(As a percentage of manufacturing value added)

Country	Licensing Payments
Jordan	**0.16***
Korea	0.44
Hong Kong	0.17
Singapore	1.61
Argentina	2.87
Brazil	0.02
Chile	0.00

* For the period (1987-91).

SOURCE: Dahlman et al., cited in Pack (2000), and DOS, industrial surveys.

[32] See Chapter (4) on the limitations of this measure.

[33] Correlation coefficient equals 0.87.

Another possible mode of technology transfer is inward FDI[34]. In Jordan, the accurate profile of *manufacturing* FDI is obscured by the lack of a detailed sectoral distribution of FDI statistics. Available evidence shows that inward FDI in JMIs, absolutely and as a share of manufacturing investment, is quite limited compared with portfolio investment as well as FDI in other neighbouring countries such as Egypt (see UNCTAD, 1999). Indeed, significant transnational direct investment in JMIs[35], according to UNCTAD (1997b), is limited to three industries. The home countries of such investments are Saudi Arabia, Lebanon and Cyprus, respectively. However, a more global orientation is characterising a recent wave of joint ventures in JMIs, with the resource-based fertilisers industry taking the lion's share. As of 1998, Jordan has concluded many joint ventures agreements with India, Japan and Pakistan as well as USA and Finland in the manufactured fertilisers industry (JPMC, 1999; APC, 2000).

Possible reasons for the poor FDI profile are: (i) smallness (and thus volatility) of the domestic market compared with neighbouring countries, including the Gulf countries; (ii) higher labour costs (e.g. compared with Egypt); and (iii) other combined factors such as foreign ownership restrictions (lifted only in 1995), comparatively low tariff protection (see Caves, 1996) and regional uncertainty and instability.

The overall conclusion of this section is that Jordanian manufacturing firms currently possess a limited innovative capacity, and depend on technology imitation. This weakness can result in an extensive industrial growth rather than intensive sustainable growth; growth would be a primary outcome of factor using rather than efficiency improving. Indeed, the results of most econometric work undertaken on Jordan's industrial sector are consistent with the above conclusion in revealing an insignificant or, at best, meagre positive effect of technological change (as proxied by TFP growth) on Jordan's overall industrial growth (Al-Badri, 1995; el-Khatib et al., 1996; Al-Hammori and Al-Badri, 1996 and studies cited therein)[36].

[34] Empirical research seems to show mixed support for the idea that FDI generates positive spillovers for domestic industry, see Hanson (2001).
[35] The term 'significant' denotes minimum sales of five millions JDs.
[36] Most undertaken research combine manufacturing and mining. The above generalisation is not confirmed by Bani-Hani and Shamia (1989); they found a negative contribution for technical change in the industrial sector.

Technology Policy Framework in Jordan

Although Jordan ranks high among LDCs in terms of technological capabilities, it is actually a latecomer to the 'world technology club'. While science and technology (S&T) sector has attracted more attention from the Jordanian government since the 1970s, many significant steps have been undertaken during the last fifteen years. At the institutional level, the Higher Council for Science and Technology (HCST) was established in 1987. At the policy level, Jordan has recently started implementing its coherent National Policy for Science & Technology, launched in 1995. Moreover, Jordan joined the WTO in 2000 and thus has just enforced the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs) to effectively protect the production of knowledge. Along with much legislation affecting industrial innovation such as tax, investment and companies laws, Jordan has recently upgraded its IPRs laws to become TRIPs-consistent. The previous patent laws (No. 22 of 1953 and No. 8 of 1986) were not particularly effective in solving the appropriability problem inherent in innovation. Like other 'traditional' patent systems in LDCs, previous patent laws in Jordan protected the process but *not* the product, and the protection period was for 16 years from application date (compared with the international norm of 20 years)[37].

The policy change embodied in enforcement of TRIPs can effectively foster technology transfer and inward FDI to Jordan *if other favourable factors are present* (Maskus, 1998 and 2000; Mansfield, 2000). This is more likely to occur in *high-technology industries (HTIs)* such as the chemical industries (EC, 1996b; Mansfield, 2000) and information technology (IT) industry (Torrisi, 1998). Overall, the enforcement can have some beneficial impact on domestic innovation programmes, at least in the long run (UNCTAD, 1996a), again most likely if the overall environment is favourable (including satisfactory market size, firm size and firm capabilities)[38]. On the other hand, the Agreement has the likely negative implications of restricting technology diffusion, lowering consumer welfare and disrupting domestic industrial activity in HTIs in the short- to medium-term (see UNCTAD, 1996a; Correa, 2000). A further possible impact scenario of tighter IPRs is raising quality and reducing costs of *authorised* technology transfer as well as facilitating technology diffusion through FDI rather than via uncompensated imitation (see Maskus, 2000).

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[37] Facilitating technology diffusion was one of the main goals of the Patent Law No. 22.

[38] For example, Sequeira (1998), taking the case of Spanish pharmaceutical industry, concludes that strong patent system had *no* overall positive or negative influence on the rate of technological development of the industry; other factors were more important influences on building innovative capabilities.

The existing regulatory framework in Jordan does offer multiple inducements for expanding R&D investment by firms. The Income Tax Law provides tax advantages as it considers R&D expenditures in all firms as deductible expenses; the Investment Promotion Law promotes FDI and provides tax incentives for 'substantial' modernisation of production techniques leading to increased capacity (Article 6-C); the Companies Law obliges public shareholding companies to allocate at least one percent of their annual net profits to be spent on supporting R&D (and vocational training) within the company (Article 188). The overall impact, however, is still weak, due probably to weaknesses in research's infrastructure and rate of return.

2.12 Conclusions

After five decades of industrial development, Jordan has certainly achieved a better level of industrialisation, as measured by the contribution of manufacturing to GDP and to merchandise exports, as well as a more diverse manufacturing base. Nevertheless, Jordan still suffers from geographical concentration of manufacturing exports that reinforces its external vulnerability. Furthermore, the share of manufacturing still represents a comparatively small manufacturing base by international standards. Thus, enhancing exports rivalry and the competitiveness of import-competing firms in JMIs is of great importance, particularly in view of: (i) the high degree of openness in the JE; (ii) the rigidity of exchange rate in the JE; and (iii) the intensification of global competition.

In view of the limited natural endowments in the JE, Jordan's industrial policy should give more emphasis on high value, knowledge intensive industries (both in commodity and services sectors) that would make use of abundant labour and knowledge assets, and reduce dependence on material-intensive and energy-intensive activities. Indeed, both the production and export structures in the JE do confirm the fact that Jordan's revealed comparative advantage lies in the services economy, whether this is biased through policy or imposed by destiny. Examples of such high value growth industries are: information technology (IT) and pharmaceuticals. These sectors are *not* overly sensitive to weak initial conditions such as domestic market size or limited natural resources[39]. Strategic positioning is crucial to be able to compete in such global industries.

[39] Both the Japanese and EU experts seem to share a variant of this view, see HCST (1996) and EC (1999).

The background information of this Chapter raises an abundant research agenda. An interesting policy issue is whether small open economies -such as Jordan- should have a competition law, in view of the need to reap scale economies. According to Warner (2000: 51), "[t]here is no *a priori* reason to believe that competition law and policy is only relevant to relatively large open or closed economies", indicating the importance of empirical research in deciding:

- Whether strengthening domestic competition is a significant cost driver for enhancing technical efficiency in an open economy (the topic of Chapter 5). After all, minimising organisational slack might be as important as reaping potential internal scale economies.
- Whether the pro-competition effect of imports is equivalent to domestic competition, taking into account that international trade patterns are less stable than domestic trade pattern (Pickford, 1991).

A related and equally important policy issue is investigating empirically the existence and significance of technical scale economies in JMIs (Chapter 6). Finally, even if scale economies in production are insignificant in most JMIs, one might argue that relatively large enterprises are still needed in JMIs in order to promote exports, reap scale economies in innovation and enhance quality and dynamic efficiency, an issue to be discussed in Chapters (6) and (7).

CHAPTER THREE

The Economics of Global Competitiveness: Conceptual Issues and Empirical Paradigms

3.1 Introduction and Background

The competitiveness literature, wrote Richard Nelson (1992), is "not consolidated, rather it is divided up into relatively disjointed intellectual clusters that have little contact with each other" (p.127). After a decade, this statement seems true, spurring the need for a recent survey of the main conceptual and practical issues of 'the economics of global competitiveness'[1]. This Chapter reviews and seeks to synthesise the wide spectrum of research done by economists on the economic performance of nations. More specifically, it examines the nature, unit of analysis, indicators as well as potential determinants of international or **global competitiveness (GC)**. Furthermore, major empirical paradigms or research directions were identified and assessed with special emphasis on the efficiency & productivity paradigm[2].

Fuelled by progressive trade liberalisation and, paradoxically, stringent technology protection, issues of global competitiveness have climbed the top of the policy agenda and public debate in recent years, both in industrial countries and LDCs. Despite the growing attention, there seems to be diverse perspectives and little consensus on the exact nature and determinants of GC. Furthermore, economists do not agree on how economies and industries will exactly respond to progressive global competition. Two broad *competitiveness scenarios* or *conjectures* dominate recent literature:

[1] The literature on GC is large, diverse and expanding. To the best of the researcher's knowledge, a recent and comprehensive survey on GC is lacking. Available surveys are either dated (McGeehan, 1968) or selective (e.g. Nelson, 1992). Nelson (1981), Matthews (1988), Islam (1999) and Bartelsman and Doms (2000) provide a survey of a sub-set of the literature (the productivity paradigm) from different perspectives. The works of Muhatseb (1995) and Boltho (1996) are the closet to the researcher's ambition.

[2] This Chapter deals with broad issues of global competitiveness, whether it is related to *national* competitiveness or *industrial* competitiveness.

- ✓ **The pessimistic scenario,** believed by many developing and small economies[3], argues that *adjustment costs* to progressive trade liberalisation and protective patent regimes are huge, and entail substantial industrial contraction and disruption. According to this view, global trade competition and technology protection are real *threats* for economies suffering from technological and size disadvantages, particularly in less-favoured regions, vulnerable sectors and less productive enterprises. Although many of these countries enjoy low-wage advantage, it is argued that this is a low-order and unsustainable advantage. This scenario is based on some type of absolute advantage theory. Shaikh (1996), for example, has argued that world trade is increasingly dominated by absolute rather than comparative advantage. Moreover, according to Dosi et al. (1990), average competitiveness of nations is crucially affected by absolute (dis)advantages in technological capabilities across countries.

- ✓ **The optimistic scenario,** held by many international economists and defenders of various forms of regional and global economic integration, suggests that removal of tariff and non-tariff barriers is expected to have many favourable static and dynamic gains that exceed short-term adjustment costs. According to this view, global trade competition is an *opportunity*. Trade exposure, including total exposure by weak players, poses *no special problems* for economies. International trade is not a zero-sum game and there are no absolute losers from trade liberalisation. According to Krugman, GC is a "meaningless word when applied to national economies" (1994a: 17). The optimistic conjecture is based on the theory of comparative advantage (CA), which excludes the case of finding a country without a CA. Furthermore, adherents of the optimistic scenario believe that LDCs, although being net importers of technological products and processes, will benefit from stronger global protection of IPRs in the long-term.

Ideally, a robust paradigm of GC is expected to:

- Define the nature and boundaries of GC concept and whether it constitutes a zero-sum game or not. Furthermore, the paradigm should clarify the link between competitive advantage and the core concept of international trade theory, namely CA. Finally, the paradigm ought to reveal the relationship between GC and general economic policy targets such as economic development, sustained economic growth, external balance, productivity and living standards.

[3] This view is shared by certain pressure groups in industrial countries, mainly industrialists and labour unions, although their argument is based on high-wage disadvantage.

- Decide which of the above *scenarios* are more 'realistic', and which are the most vulnerable regions, countries, sectors, industries and firm-size classes.
- Measure GC in a valid empirical way with the aim of: (i) tracing *changes* or *trends* in GC, i.e. deciding whether there is a *temporal* improvement or deterioration in GC in a given setting; (ii) making valid ranking in competitiveness *positions* or *levels* for a group of countries or industries in *spatial* comparisons.
- Offer robust explanations about determinants of GC within a specific setting.
- Ethical issues about the normative basis of the GC paradigm (i.e., why GC is *desirable*, how GC *should* be defined and achieved, and its link to society's economic welfare) are also valuable.

As will be shown later, current competitiveness research is far from the ideal. The current state is embodied in vague definitions leading to distinctive empirical approaches with typically different policy conclusions. Even measurement is still in its infancy (e.g. comparability across space) and data requirements of some approaches are outside the current statistical capabilities of many LDCs. Furthermore, the research coverage is biased; most research is undertaken for industrial economies.

This Chapter is structured as follows. Section 2 provides an outline of various competitiveness definitions including a proposed one, followed by other conceptual issues, namely the nature and objectives of competitiveness policy and the distinction between *comparative* advantage and *competitive* advantage. Section 3 is designated to highlights various units of analysis and indicators in GC research. Section 4 examines potential determinants of GC, concluding with a comprehensive framework outlining determinants of GC. Here, some remarks are made on the expected impact of special conditions of small LDCs on their relative competitiveness position. In section 5, diverse empirical 'paradigms' of GC are outlined and linked. While, section 6 discusses selected issues in efficiency & productivity paradigm, related to the Thesis's later empirical work, section 7 is devoted to conclusions.

3.2 The Nature of Global Competitiveness

Due to its multidimensionality and normative connotation, economists do not agree on what GC means, or how to quantify it properly[4]. As a result, some empirical studies on 'competitiveness' proceed on investigating the topic without addressing the terminology issue, and even an early survey did not offer an explicit definition (McGeehan, 1968).

Available conceptual definitions and empirical measures of GC are based on clearly different 'paradigms'. Taking the economy as the unit of analysis, some definitions are *instrumental* and pragmatic with emphasis on certain competitiveness policy instruments. Examples of this category are definitions based on real exchange rate (Manzur et al., 1999) or relative unit labour costs (Hooper and Larin, 1989; O'Mahony, 1995). At the other extreme, some definitions are substantial with emphasis on *ultimate* competitiveness *targets*. An obvious example is the definition that stresses the nation's ability to sustain high and rising standards of living (Fagerberg, 1996: 48; DTI, 1999: 6). Still a third group emphasises *intermediate* competitiveness *targets* (e.g. achieving high average productivity or sustained economic growth). Finally, some economists see competitiveness as a *policy framework* that combines a *set* of policy instruments (Oughton, 1997).

The following is a sample of popular definitions for GC at the aggregate level:

> *"[T]he degree to which [a nation] can, under free and fair market conditions, produce goods and services which meet the test of international markets, while simultaneously maintaining and expanding the real incomes of its people over the longer term"* (OECD, 1992: 237).

This widely quoted definition considers sustainable economic growth as one of the two main targets of competitiveness. Furthermore, it identifies the allocational mechanism for competitiveness strategy (the market mechanism), thus seems to exclude major government activism as a possible complementary element in the strategy.

> *"[T]he sustained ability of a nation's industries or firms to compete with foreign counterparts in foreign markets as well as in domestic markets under conditions of free trade"* (Kim and Marion, 1997: 337).

This definition shares the first one its free trade orientation and absence of operational criterion for 'ability to compete', but focuses on two types of foreign competition.

> *"The only meaningful concept of competitiveness at the national level is productivity"* (Porter, 1996b: 160).
>
> *"[T]he ability of a country to expand its shares in domestic and world markets"* (WIFO et al., 1998: 7).
>
> *"[T]he ability of a country to realise central economic policy goals, especially growth in income and employment, without running into balance-of-payments difficulties"* (Fagerberg, 1988: 355).

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[4] See Muhtaseb, 1995; and Aiginger, 1998 for a good review.

While the latter two definitions take an outcome-oriented conception (external trade and growth performance), the first definition emphasises foundation of competitiveness.

Finally, OECD has recently provide another definition:

> *"[S]upporting the ability of companies, industries, regions, nations or supra-national regions to generate, while being and remaining exposed to international competition, relatively high factor income and factor employment levels"* (cited in OECD, 1996: 13).

This definition is a good reminder of the importance of employment in assessing competitiveness, and emphasises the fact that low-wage strategies (in LDCs) can contradict with the ultimate aim of competitiveness.

To sum up, most definitions share the notion of ability of firms, industries, sectors and countries to meet, in a sustainable way, the challenge of increasing contestability of international markets. Little attention is allocated to the question of *how* to achieve competitiveness.

A Proposed Definition for Global Competitiveness

This Thesis defines GC at the national or industrial level as:

> *The sustained ability of domestic firms (individually or on average) to compete successfully and fairly with foreign products and services (in import competition and export rivalry) and foreign firms (hosted multinationals or service operators),* ***utilising price, differentiation and focus competitive strategies****. To ensure sustainability, the process should be within an enabling environment for upgrading technological capabilities, processes and products, and ultimately aims at improving the society's economic welfare.*

This definition has many features. **First**, it covers different types of global competition, both positive (export rivalry) and negative (import competition and multinational corporations). **Second**, unlike the first OECD definition, it is politically neutral and open-ended. Thus, it does not superficially impose market ideology or government activism, and does not exclude the potential role of government in competitiveness strategy. **Third**, the definition places special emphasis on main strategies for acquiring competitive advantage (cost leadership, product differentiation and niches), excluding dumping and other unfair business practices. **Fourth**, it emphasises a favourable environment for achieving technological change via technology development and transfer as a necessary condition for sustainable competitiveness (see Chapters 4 and 7). This element of the definition raises the issue of intellectual property rights (IPRs) in the global economy, particularly in LDCs. **Finally**, in view of the global spread of privatisation and deregulation of foreign direct and portfolio investment, the definition signals the possible vulnerability of domestic economies and industries to capital flows, both short-term and long-term, as revealed by the last two financial crises in Mexico and East Asian countries.

The operationalisation of the proposed definition for the purpose of policymaking is not an easy job. It seems that any single indicator would miss something; there is no clearly superior measure. For example, using relative labour productivity (LP) levels as "one of the most useful summary indicators of...national competitiveness" (Birnie and Hitchens, 1999: 23), would ignore labour compensation and non-labour costs, exchange rate and non-price competitiveness. Available empirical evidence seems to support this conclusion. Even for concepts of GC emphasising trade competitiveness, the use of one indicator is 'sub-optimal' (Marsh and Tokarick, 1996) and the superior indicator appears not identified (Anderton and Dunnett, 1987). Thus, GC must be assessed and monitored using a variety of measures (Hughes, 1993). Entitled indicators include LP, total factor productivity (TFP), unit labour costs (ULCs), and efficiency (technical and scale), in addition to quality, profitability and trade performance (see Chapter 4). Of course, constructing a composite index would open the complication of assigning an adequate weight for individual indicators.

The objective of GC at the national level is not clear in the literature. While many definitions stress the aim of enhancing living standards through improving growth, employment and productivity, others limit the aim to improving the external position. It is worth saying that the link between achieving competitiveness and improving 'living standards', mentioned in widely accepted definitions of GC, is far from clear. First of all there is the weak link between per capita income and 'living standards'. On this point, one cannot do better than Scitovsky (1976) in pointing out that:

> "*Economic quantification is attractive and useful, but we must not let it seduce us into attaching more significance to the measure of quantity and to what is quantified than they deserve. The national income is, at the very best, an index of economic welfare, and economic welfare is a very small part and often a very poor indicator of human welfare [living standards]*" (p.145).

Secondly, if productivity growth (or growth in per capita income) is achieved via reducing labour input, instead of increasing output for a given labour input, then productivity competitiveness can hurt some people and affect the goal of job creation (Oughton, 1997). Thus, productivity growth unaccompanied by employment growth does not constitute a pure

Pareto improvement, at least in the short run. This point is stated clearly by Griliches (1994: 17):

> *"[P]roductivity growth contributes to the potential for welfare, but it is not the same thing. Welfare can move in the opposite direction if the resources released by productivity growth do not find adequate employment in other, economically valuable, activities (including leisure)".*

Turning to more action-oriented concepts, the term competitiveness policy can be defined as "the promotion of conditions which are conducive to the achievement of competitive advantage by particular firms and industries" (Pratten and Deakin, 1999: 5) or measures for "enhancing the strength of national industries relative to their foreign competitors" (El-Agraa, 1997: 1505). Too little thought in the literature is given to the conceptual link between competitiveness policy and loosely defined terms such as supply side policies, industrial policy and structural adjustment policies.

Finally, any coherent conceptual framework for GC should clarify the link between *competitive advantage*, the core of competitive and strategy analysis, and *comparative advantage (CA)*, a well-known theory in international economics[5]. A review of literature on both strategic analysis and international trade shows that until now the interface between business economists and international economists is minimal.

According to Porter (1998a), CA rests on factor endowments such as labour, natural resources and financial capital, while competitive advantage is a *broader* concept that depends on "creating a business environment, along with supporting institutions, that enable the nation to productively *use* and *upgrade* its inputs" (p. xii).

On the other hand, Broadberry (1997), representing the typical opinion of international economists, claims that "economists have been reluctant to use the term 'competitive advantage', preferring to stick with the older term 'comparative advantage' " (p.82). Finally, Jeannet and Hennessey (1998) seek to reconcile the two concepts by suggesting that "[a]lthough the concept of comparative advantage provides a powerful tool for explaining the rationale for mutually advantageous trade, it gives little insight into the source of the relative productivity differences" (p. 46). Thus, competitive advantage "does not refute the theory of comparative advantage; rather it helps explain why industries have a comparative advantage" (p.47).

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[5] For a recent and applied coverage of the theory of CA, see Greenaway and Milner (1993).

To sum up, one can argue that the concept of competitive advantage is increasingly attracting much acceptance by applied economic research and business economics[6]. One reason for such popularity is its action-oriented nature; performance of firms, industries and thus national economies *can* be enhanced. CA, on the other hand, has an inaction bias via emphasising the positive-sum nature of international trade as well as the traditional, natural, and tangibles resources of the economy. Within the competitiveness paradigm, comparative advantage *can* be created or upgraded via innovation, not just inherited.

3.3 Unit of Analysis and Indicators in Competitiveness Research

3.3.1 *Unit of Analysis in Competitiveness Research*

In assessing GC, the unit of analysis is a crucial dimension, and can vary from a plant or firm, to larger units like countries or even supra-national organisations (e.g. the EU). Economic analysis, in contrast to business and strategic analysis, tends traditionally to focus on aggregate entities such as industries (in industrial economics), sectors (in development economics) or even countries (in growth theory). This tendency is due to theoretical and practical considerations explained below:

a. The traditional neoclassical bias against analysing individual firms in favour of more aggregated data. As pointed out by Nelson (1981):

> *"[F]rom the neoclassical perspective, there are few interesting empirical questions that can be explored or resolved by studying particular firms or by considering differences among individual firms in similar market conditions"* (p.1037).

b. Until recently, lack of microdata in sectors other than regulated industries, due to confidentiality considerations.

c. The inherent difficulties in implementing firm-specific industrial competitiveness policy (such as R&D subsidies or picking 'winners' measures). This is due to firm heterogeneity and asymmetric information between the private firm and public institution implementing the selective incentives, with the resulting high agency costs (EC, 1998; Barros and Nilssen, 1999).

[6] See, for example, Perman and Scouller (1999).

The following is a discussion regarding the possible levels of aggregation in GC research:

I. **The economy-wide approach.** The national competitiveness (or competitiveness of nations) approach is characterised by taking a broad national scope. Competitiveness at the country level has recently attracted influential attack from some prominent economists. Two lines of argument appeared: one which considers competitiveness as a "meaningless word when applied to national economies" (Krugman, 1994a: 17) and embodying a 'dangerous obsession', thus suspecting both the validity of the concept and its policy implications. The other argument suggests that GC at the national level is not clear because "no nation or state is, or can be, competitive in every thing" (Porter and Linde, 1995: 98). The first argument has much influence and thus will be discussed in detail.

Krugman suggests, first, that national competitiveness has an elusive character because, unlike companies, nations do not compete with each other and "have no well-defined bottom line" (1994a: 4). Secondly, the argument views GC culture as an enabling environment for protectionism, distortions in resources allocation, inappropriate policy priorities and, ultimately, international economic conflict.

While one can easily agree that national competitiveness is less amenable to concise definition vis-à-vis firm competitiveness, to claim that the former is meaningless because nations do not have a unique objective is subject to the following counter-arguments:

a. Nations do have a general objective, namely enhancing the living standards of their citizens. Hence, one can argue that "[e]conomies only compete in the sense that some do better than others at delivering rising living standards (and employment) to their citizens, whilst exposed to an open trading environment" (EC, 1997d: 71).

b. To argue that national competitiveness is meaningless because states have no single objective is to argue against many similar concepts, such as 'development'.

c. Furthermore, the situation of multiple objectives is a possible and legitimate state of affair for most decision units. Even corporate firms, as managerial and behavioural theories of the firm inform us, could have multiple objectives.

Furthermore, concerning the hazards of national competitiveness, not all competitiveness policies are 'beggar-my-neighbour policies' or are part of a zero-sum game (Boltho, 1996). An example of neutral competitiveness policies is domestic horizontal programmes and policies to get the 'fundamentals' or business environment right (including those for education, productivity and innovation). Fagerberg (1996) summarises the context of Krugman's criticism by stating:

> *"[W]hat Krugman is aiming his criticism at is the common American attitude of blaming shortcomings in its economic performance on foreigners (and acting accordingly). If American producers do not meet the standards of international competition, then this failure is more or less automatically explained by unfair practices by foreign competitors and/or governments, and Congress is lobbied for protection. Although the tendency to blame others for one's own failures may be universal, it has never been a real option in smaller economies".*

As for the argument of Porter and Linde, to assess national competitiveness is not to confirm competitive superiority of all domestic firms and industries; the concern is on *average* performance of tradable sectors compared with other countries as well as on the policy framework and business clusters affecting the performance of *all* enterprises.

II. The sector-level approach. The sectoral competitiveness perspective, both the aggregate and inter-industry approaches, usually deals with GC in some tradable sector, basically manufacturing, but other sectors including agriculture or tradable services are also investigated. In this approach, the emphasis is on the competitive performance of a particular sector as a whole without *explicit* focus to industry or firm-specific effects. The main advantage of this approach vis-à-vis industry case study approach is its potential ability to generate generalised conclusions or broad recommendations for industrial competitiveness policy. This is hard to reach in the case study approach due to data limitations and the presumably heterogeneous results of industry case studies.

Davies and Caves (1987: xi) carefully assessed the cross-section inter-industry model as follows:

> *"[Cross-section econometric modelling] has much to offer: the capacity to evaluate a wide range of, sometimes conflicting, hypotheses within a consistent framework....Equally however, it has its limitations: the focus tends to be an* ***average*** *relationship across industries; sometimes statistical results are open to alternative interpretations; and the research is only as good as the data upon which it is based".*

An important variant of sectoral analysis is the small business sector. Due to its vulnerability to global competition, the SMEs sector is recently receiving more attention in competitiveness research (see Chapter 6).

III. The industry case study approach. This approach, favoured by 'new' industrial organisation, accommodates the fact that manufacturing is inherently heterogeneous with different industries. Thus, each industry requires a special and separate analysis. As clarified by Davies and Lyons (1991: 21):

> *"There is an increasing tendency in more recent research towards examination of data on intra-industry differences...This switch in empirical emphasis underlines ...[the] remark that cross-industry econometrics can be a blunt tool, especially in a world where conduct is not uniform, and in which competition is seen more as a process".*

Taking industry as the unit of competitiveness investigation seems to be less susceptible to criticism than the economy-wide perspective[7].

IV. The industrial cluster approach. This approach is recently attracting much attention by both economists and business analysts. A cluster is "a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities" (Porter, 1996c: 199). The cluster approach has been popularised by M. Porter who suggested that: (i) the cluster, not the individual industry or the firm, is the appropriate unit of observation; and (ii) the cluster perspective to competitiveness captures one of the major influences on competitive advantage; the interdependence and the joint activity among related fields and the expanding opportunities of agglomeration economies (Porter, 1996a, 1996c).

This approach combines the unit of analysis favoured by new industrial economics with the logic of systems theory. An industry is not defined exclusively as an isolated group of firms producing similar or identical product, but as a system "involving a mix of institutions- some private, and some public" (Nelson, 1992: 135). The private institutions include firms, industry and consumer associations, private export intermediaries, academic and professional societies as well as infrastructure and input providers. Public institutions include government regulatory agencies pertaining to firm entry, export promotion and product quality as well as capital financing and manpower education and training. This approach provides a "systematic way of understanding the *interaction* of private and public policies and institutions" (ibid: 136, emphasis added)[8].

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[7] See Porter and Linde (1995: 98). According to Brenton et al. (1997), "competitiveness [at the industry level] is an issue only if all firms in the industry become less efficient relative to foreign rivals" (p.277).

[8] The cluster analysis shares the industry case study approach many of its strengths and weaknesses, including its heuristic nature, see Roelandt and Hertog (1998).

3.3.2 *Indicators of Competitiveness*

Measuring trends and positions in competitive performance is an important dimension in the economics of competitiveness. This part will scan, very briefly, those indicators used to monitor competitiveness levels, trends and gaps at various levels of aggregation[9].

I. Indicators of National Competitiveness

Applied work on national competitiveness is based on diverse types of indicators and methods for combining them. These can be classified into single versus framework indicators:

- Single indicators, such as:
  - GDP per capita (levels and growth rates).
  - Employment rate.
  - National (labour or total factor) productivity.
  - Economy-wide ULCs.
  - Real exchange rate (based on consumer prices, export unit values or ULCs). An overvalued real exchange rate indicates a fall in competitiveness.
  - Exports performance (commodity and services exports).

- Framework indicators: One way to classify such indicators is the single index vis-à-vis multiple indicators:

  - Single composite index in a cross-country setting. This methodology constructs a complex composite index summarising various structural and performance indicators for various countries to assess their relative competitiveness positions. Examples are the World Competitiveness Yearbook of International Institute for Management Development (IMD) and the Global Competitiveness Report of World Economic Forum (WEF)[10].

  - Multiple indicators in a country-specific setting. This methodology uses various indicators without aggregating them into a single composite index. An example is the 'UK Competitiveness Indicators' of the Department of Trade and Industry (DTI, 1999). This kind of work is justified by the view that a "single-valued index cannot capture all the dimensions of economic performance, nor can it do justice to the complexity of the economy" (ibid). In addition, this approach avoids the weight problem inherent in combining indicators.

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[9] The measurement of competitive industrial performance is covered in Chapter (4).
[10] For an assessment of the approach adopted by the Global Competitiveness Report with particular emphasis on LDCs, see Lall (2001).

II. Indicators of Industrial Competitiveness

Competitiveness indicators at the industry level can be classified as follows:

1. Efficiency & productivity indicators:

   - LP (trends and relative levels).
   - TFP (mainly trends).
   - ULCs (trends and relative levels).
   - Technical efficiency (TE).
   - Allocative efficiency.
   - Scale efficiency.
   - Domestic resource cost analysis.

2. Trade performance indicators:

   - Exports shares.
   - Coverage ratios.
   - Import penetration ratios.
   - Net export share (exports-imports in percentage of total world exports in the industry).

3. Quality-based competitiveness indicators (e.g. R&D expenditures and royalty payments).
4. Price indicators:

   - Relative output (producers) prices.
   - Relative exports prices.
   - Relative ULCs.

3.4 Potential Determinants of Superior Competitive Position: An Overview

Competitive performance at the macro or industry level, however defined or measured, is influenced by many interrelated and complex factors, many of which are qualitative and hard to quantify accurately. Competitiveness policy, to be effective, must be directed towards exogenous factors affecting competitive performance. Consequently, it is important in competitiveness policy design to be aware of the crucial difference between *proximate* sources of, for example, growth or productivity and *ultimate* sources (Olsen, 1982; Abramovitz, 1993; Maddison, 1995). For example, physical capital is commonly regarded as one important source of economic growth (in growth accounting approach), but investigating ultimate sources implies explaining investment itself, including the effect of behavioural influences. Overall, there is no unified theoretical paradigm that explains sources of GC, and, indeed, there are only possible and partial explanations.

As a model stressing the crucial impact of *competitive market structure* and competition policy, the *Structure-Conduct-Performance* (SCP) paradigm in industrial organisation targets the structural elements of the market with the aim of improving market performance (Geroski, 1991).

The work of Porter (1990, 1996b) is considered an elaboration on the SCP paradigm through offering the *diamond model* as a unified framework explaining industrial performance. The diamond model aims at mapping factors that generate the industry's competitive advantage. These are: (i) firm strategy, structure and rivalry; (ii) factor conditions; (iii) demand conditions; (iv) related and supporting industries (a narrow conception of a cluster); and (v) the government. Within this framework, intensity of domestic competition (within industrial clusters) is the most important determinant of international success. Porter's conception of domestic competition is broad and include *five forces*; potential entrants, buyer bargaining power, supplier bargaining power, the threat of substitute products or services and finally the forces of other stakeholders such as unions and governments.

'New' industrial economics stresses the importance of firm's basic economic conditions (cost and demand) and strategic decisions (including R&D and advertising expenditures) in shaping its relative performance (Norman and La Manna, 1993), thus sharing certain elements of the diamond model. Unlike the SCP paradigm, this research paradigm considers market structure as endogenous, and thus not a proper policy instrument for government intervention.

Within the field of strategic management, the resource-based theory stresses firm resources (capabilities and assets) instead of industry structure in acquiring and maintaining competitive advantage[11]. More specifically, the theory suggests that firms are inherently heterogeneous in terms of resources (tangible and intangible), especially those that are valuable and unique, and this explains their relative competitive performance. Applying the theory to the national or sectoral level, either in explaining sustainable competitive performance or recommending specific competitiveness policies, one should search for distinct human and natural resources that: (i) add value to national economy; (ii) are rare in world economy; (iii) hard to imitate by other economies; and (iv) can be exploited.

[11] See Coulter, 1998; Perman and Scouller, 1999 for an overview of this theory.

Privatisation theory and the literature on corporate governance stress the importance of *ownership structure* (free markets and profit motive) and efficient capital markets in enhancing economic efficiency (Cook and Kirkpatrick, 1995). Neoclassical growth theory tends to emphasis the role of savings and investment efficiency in achieving GC. More recently, human capital and innovation have received more attention. In addition, international economics highlights the role of CA (e.g. natural factor endowments) and scale economies in enhancing export performance.

The traditional economic approach to GC, by emphasising technological advances, investment and market competition, tends to ignore non-economic factors, including individual motivation, moral values and social institutions. These factors are potentially crucial and could be part of the 'ultimate' sources of growth and competitiveness. Outside the neoclassical paradigm, an increasing number of scholars have recently investigated and stressed the important role of cultural influences, social norms and political institutions in their quest for explaining the 'missing' sources of superior economic performance[12], whether this hard-to-quantify factor is called achievement motivation (McClelland, 1961); social capability (Abramovitz, 1986); institutions (North, 1990, 1993); idea gap (Romer, 1993); social capital (Fukuyama, 1995); or social infrastructure (Hall and Jones, 1999). These scholars were writing from the perspective of the economics of institutions and from other fields inside and outside economics[13].

3.4.1 *Competitiveness of Small Developing Economies*

Apart from the research done on firm size and performance (see Chapter 6), there is lack of literature specifically on the competitiveness of small economies, or the impact of country size on its competitiveness position (Walsh, 1987). This is particularly true for the case of small *and* developing countries. The following is a brief discussion on this important research direction.

[12] See, *inter alia*, Baumol, 1990; Maddison, 1995; Eichengreen, 1996; Granato et al., 1996; Keefer and Knack, 1997.

[13] Certain writers from similar line of thought have highlighted the positive role of ethics, trust, and consensus in minimising rent seeking and transaction costs and, thus, improving market performance. Hirsch (1977) suggests that the principle of *individual* self-interest is incomplete as a social organising device, and thus should be complemented by a moral framework. Within the same broad lines, Olsen (1982) emphasises the negative role of special-interests *groups* in reducing efficiency through rent-seeking activities. More recently, Fukuyama (1995) highlights the role of *human trust* and *social capital* in improving the efficiency of the economic system.

In addition to *macro*economic vulnerability to external shocks (Chapter 2) and a limited resource base (Armstrong and Read, 1998), small economies, *a priori*, tend to suffer from several *micro*economic size disadvantages: (i) the private and social rates of return on innovation tend to be lower, due to lack of scale economies in innovation; (ii) higher per capita costs of providing public goods in general (Burki, 2000), such as defence and technology institutions for upgrading national innovation systems (see OECD, 1998a); (iii) a lower ability to exploit scale economies in production *within* the domestic economy (Scherer, 1973; Burki, 2000); (iv) higher levels of monopoly power and industrial concentration (see Weiss, 1989c), leading to a more severe trade-off between reaping potential scale economies and promoting domestic competition (World Bank, 2000b)[14]; and (v) a less attractive environment for inward FDI (UNCTC, 1992)[15].

Vanhoudt (1999) clarified the negative influence of small country size on level of innovation (point i above) in the context of new growth theory. The scale-effect argument has related components that suggest the efficiency of the research sector is higher in larger economies due to: (i) larger rent and spillovers arising from new innovations; and (ii) more efficient mechanism for spreading risk; small size implies higher per capita (sunk) costs of a new innovation. While the empirical link between firm size and innovation is inconclusive *in industrial economies* (EC, 1997c; Torrisi, 1998; CEA, 1999), market size is seen as an important stimulus (Pelkmans and Winters, 1988; Lyons and Matraves, 1996), probably because of the combined effects of competition and scale of a country's size.

Despite all the above theoretical arguments against 'smallness', Easterly and Kraay (2000) in a recent empirical study, suggest that small economies "have, if anything, significantly *higher* per capita income than others in their region. There is no significant difference in growth performance between large and small states" (p.2024). Of course, small countries can be industrialised or developing countries. An interesting policy issue outside the scope of this survey is investigating how *small* industrial countries and NICs managed to offset their size disadvantages. Trade openness and good governance could be important factors.

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[14] As emphasised by the World Bank (2000b), enlarging the market, via RIAs or export promotion, "shifts this trade-off, as it becomes possible to have both larger firms and more competition" (p.31). On the other hand, Sutton (1991, 1998) has argued that the relationship between market size and concentration needs not to be negative; larger market size gives rise to larger firms in an important class of industries. Lyons et al. (2001) found empirical support for Sutton's theory; in industries competing using endogenous fixed costs of advertising and R&D, concentration is significantly less sensitive to market size.

[15] For possible advantages of small economies, which seem contingent, see Streeten (1993).

As for the impact of *level of economic development* on competitiveness position, the available literature refers to the following possible explanations for the weak competitiveness (slow economic growth) of LDCs[16]: (i) quality of policymaking; (ii) weak institutions and property rights; and (iii) inferior human capital and technological capabilities. Due to lack of specialised skills in LDCs, almost 98 % of all world R&D expenditures originate in the industrial countries (Todaro, 1994: 115).

3.4.2 Towards a Synthesis of Competitiveness Determinants

One way to integrate the above possible determinants of GC is to utilise the 'systemic competitiveness' framework (Esser et al., 1996) that identify four analytical levels of GC sources: the meta, macro, meso, and micro levels (Figure 3.1). Recently, the research and policy focus has shifted from macro to micro determinants. As a comprehensive model for *both industrialised and LDCs*, the systemic competitiveness framework can claim the virtue of avoiding reductionism in explaining a complex phenomenon, a criticism that faces even Porter's diamond framework. The systemic competitiveness framework might give the impression of trying to explain everything thus explaining nothing, but this is not its objective. The ultimate aim is to provide a *frame of reference* for potential sources of national and industrial competitiveness. Empirical evidence can assess the size and significance of any particular factor in a specific setting.

The meta level consists of initial conditions such as natural resources including geographical area, location and population size[17] and 'ultimate' sources such as cultural values, technological capabilities and political and social institutions as well as ethical norms and individual (including entrepreneur) motivations. The meta level includes also the competitiveness strategy that is supposed to be a meta-policy co-ordinating all public policies affecting GC and potential growth. At the macro level, there exist factors such as stabilisation (fiscal and monetary) policies, exchange rate policy, investment and export promotion strategy and commercial policy.

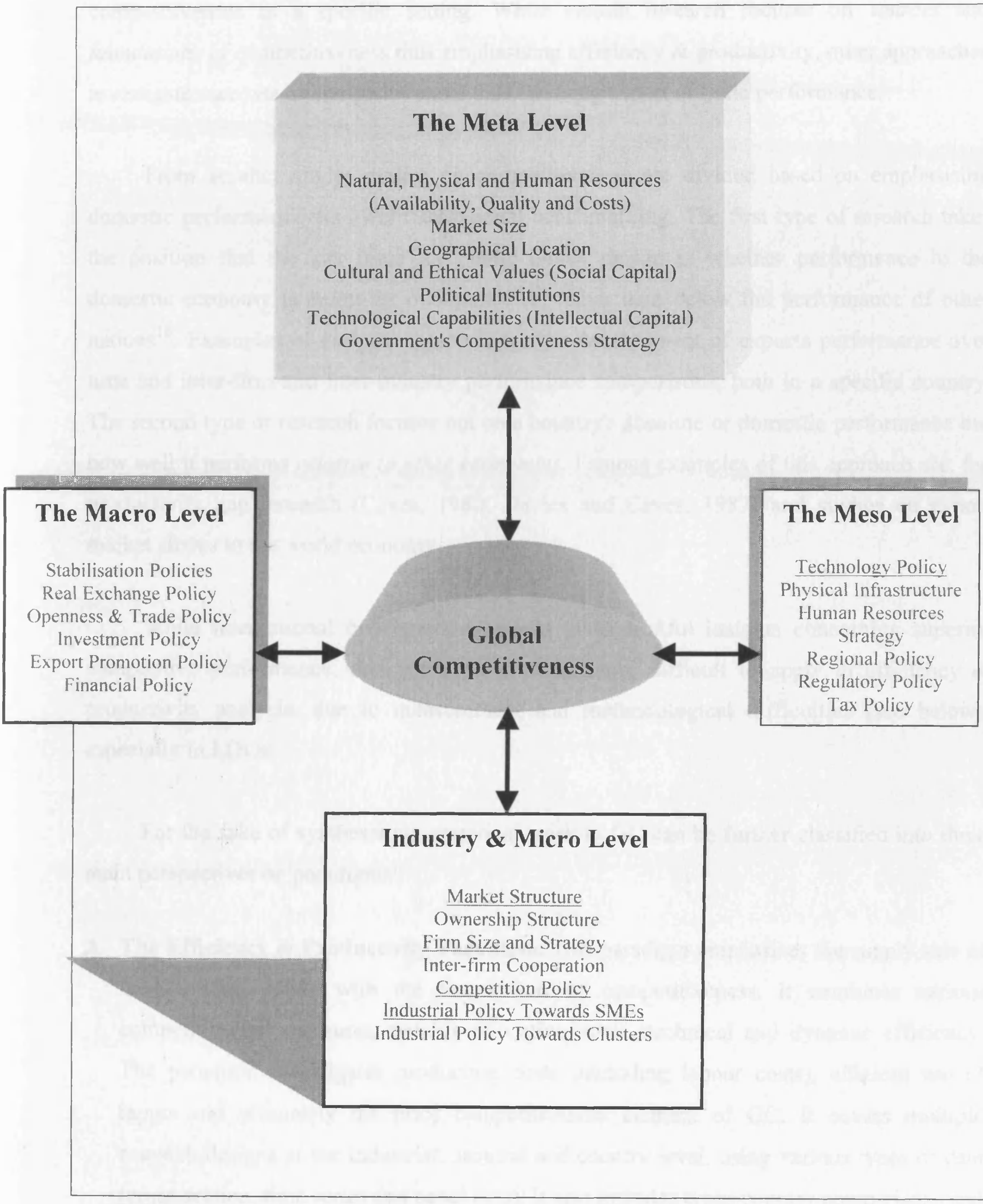
The meso level covers the physical infrastructure that affects the availability, quality and cost of business services. It also includes sectoral and regional policies affecting inter-sectoral resource allocation such as sector-specific regulatory framework and human resources strategy affecting cost, quantity and quality of skilled manpower. Finally, the micro

[16] See, for example, Lall (1990) and Colombatto (1998).
[17] See Chapter (2) on the potential impact of initial conditions on national competitive performance.

component of the 'competitiveness elephant' (to borrow from Nelson, 1992) consists of all micro cost and benefit drivers affecting industrial performance. The most important micro factors are: market structure, ownership structure and industrial policy towards competition, SMEs and industrial clusters.

While the meta level tends to determine the stock of basic *capabilities*, whether inherited (e.g. natural resources and proximity to large markets) or acquired (technological capabilities), the micro level shapes *incentives*. Incentives are affected by both economic and non-economic influences. The neoclassical paradigm emphasises economic motives, while many paradigms in social sciences stresses the important role of culture, political and social institutions, values and motivation in shaping human behaviour and thus performance. Incentives "guide the use of the capabilities and, indeed, stimulate their expansion, renewal or disappearance" (OECD, 1987: 18). Macro and meso levels constitute the economic environment in which capabilities and incentives interact and determine competitiveness performance. In this Thesis, the focus will be on certain microfoundations of industrial competitiveness, underlined in Figure 3.1.

Figure 3.1
A Framework for Determinants of Global Competitiveness



SOURCE: A revised version of Esser et al.'s (1996) framework.

3.5 Main Empirical Paradigms in Competitiveness Research

As with theoretical aspects, there are diverse empirical directions to investigate competitiveness in a specific setting. While certain research focuses on *sources* and *foundations* of competitiveness thus emphasising efficiency & productivity, other approaches investigate *outcome* of competitiveness thus stressing export or trade performance.

From another angle, studies on competitiveness are divided based on emphasising domestic performance vis-à-vis international benchmarking. The first type of research takes the position that the key issue for public policy design is whether performance in the domestic economy is *below its own potential*, rather than below the performance of other nations[18]. Examples of such an approach are the development of exports performance over time and inter-firm and inter-industry performance comparisons, both in a specific country. The second type of research focuses not on a country's absolute or domestic performance but how well it performs *relative to other economies*. Famous examples of this approach are: the productivity gap research (Caves, 1980; Davies and Caves, 1987) and studies on export market shares in the world economy.

While international benchmarking might gives fruitful insights concerning superior competitive performance, this approach is much more difficult to apply in efficiency & productivity analysis, due to measurement and methodological difficulties (see below), especially in LDCs.

For the sake of synthesising, empirical work in GC can be further classified into three main perspectives or 'paradigms':

A. **The Efficiency & Productivity Paradigm.** This paradigm emphasises the supply side of the economy along with the *foundations* of competitiveness. It combines various competitiveness measures, notably allocative, scale, technical and dynamic efficiency. The paradigm investigates production costs (including labour costs), efficient use of inputs and ultimately the price competitiveness element of GC. It covers multiple research designs at the industrial, sectoral and country level, using various types of data (cross-section, time series and panel data). It also includes cross-country comparisons and

[18] Examples of studies focusing on domestic performance are Erzan and Filiztekin (1997) and Buxton and Mananyi (1998).

intra-country studies. Since this Thesis emphasises efficiency & productivity perspective, a detailed exposition of this paradigm will follow later.

B. The Quality Paradigm. This non-price competitiveness approach focuses on quality (or product differentiation) as a major source of competitive advantage[19], and embodies various methodologies to measure quality competitiveness in a specific sector. Quality here covers all non-price factors that affect ability to compete such as reliability, durability, location, brand and reputation, packaging, delivery, guarantee and post-sale services. The rationale for this paradigm is embodied in the fact that 'the product' is not homogenous and aspects of product differentiation are prevalent and important to consumer choice, particularly in price-inelastic products. Research on productivity has emphasised price competitiveness on the assumption that either quality is similar or the product is relatively standard. While this might be a sensible assumption in certain intermediate goods industries, such as cement, it is not generally applicable in modern consumer goods and high-technology industries.

C. The Trade Performance Paradigm: This approach addresses *competitiveness outcome* in terms of external position of the economy. Examples of this paradigm are: assessing export performance and import penetration. Other policy instruments related to this paradigm are real exchange rate and relative export prices (both affecting price competitiveness). The paradigm's rationale is that the ultimate test for the competitive performance of the firm, industry, or economy is its ability to penetrate foreign markets.

In this Thesis, the emphasis is on the efficiency & productivity paradigm (Chapters 5 and 6), but certain aspects of trade performance are also addressed (in Chapters 6 and 7). In Chapter (6), an exploration between firm size and export performance is undertaken in the context of JMIs. Furthermore, Chapter (7) briefly evaluates the trade performance of Jordan's pharmaceutical industry using different measures. Depending on the unit of analysis and type of data, one can outline various approaches for investigating GC using *The Detailed Matrix of Competitiveness Research* (Table 3.1). Highlighted areas are the topics examined later in the Thesis.

[19] For recent studies, see Stout and Swann, 1993; Swann et al. 1996; Swann, 1998; Anderton, 1999a and 1999b.

Table 3.1
The Detailed Matrix of Competitiveness Research

Type of Data / Unit of Analysis	*Activity-based Data*			*Product-level Data (Time Series)*
	Cross-section	*Time-series*	*Panel & Longitudinal*	
Micro (Plant Firm, consumer)	Stochastic frontier analysis (SFA); Data Envelopment Analysis (DEA); scale economies research; firm size and export performance; buyers quality surveys; survey-based competitiveness studies	Business strategy studies	SFA; DEA; firm entry and exit studies	
Industry	'Traditional' SCP paradigm in industrial organisation; productivity gap research	Technical progress (TFP growth); industry case study	Some Recent SCP research	
'Related' Industries	Cluster's competitive analysis			
Sector		Technical progress research		
Domestic Economy	Cross-country research on *levels* of economic performance (Hall and Jones, 1999) and growth rates	Single country growth accounting	Panel studies on growth (Islam, 1995)	
Product Group (Values, Volumes, Prices and Unit Values)				Export performance; quality research

Source: Researcher

Assessment and Link of Competitiveness Empirical Paradigms

The evaluation and link among competitiveness paradigms is not an easy task. Assessment criteria varies from conceptual and measurement problems to policy coverage and feasibility. Moreover, the causal relationships among the paradigms are uncertain and complex. Actually, from the policy perspective, these paradigms need not be mutually exclusive.

The Assessment

Every competitiveness paradigm has its strengths and weaknesses. The recent accessibility to government's microdata is surely a recent advantage for the efficiency & productivity paradigm[20]. On the other hand, the current availability of comparable and computerised international trade databases is an asset for the trade paradigm. The following is a detailed assessment of the advantages of the productivity paradigm vis-à-vis the trade paradigm:

i. The policy instruments of productivity and quality paradigms, including horizontal policies (i.e. business environment policies), are *more acceptable* to the international community, since they entail less retaliation and trade wars (Boltho, 1996).
ii. The policy instruments of this approach tend to be *more ample,* because of the analytical richness of the paradigm (see Table 3.1).
iii. The *scope* of productivity policy can be much wider. In particular, *export* performance gauges competitiveness of export-oriented firms and industries, thus ignoring the large majority of import-substitution firms. Moreover, the trade paradigm typically ignores trade in tradable services (Harrison, 1995).
iv. Trade performance is probably the outcome of superior productivity, not its causes (see below). Furthermore, productivity has a direct link to the economic welfare of a nation, as "living standards are determined by productivity growth and not by trade performance" (Eltis and Higham, 1995: 71).

On the other side, the productivity and quality paradigms are not without criticisms:

i. In international benchmarking, data comparability and availability are most likely against the productivity and quality paradigms. For example, international comparison of output and productivity *levels*, unlike trade data, requires price conversion to convert production data of different economies into common currency.
ii. Enhancing productivity and quality is a medium- and long-term competitive strategy. Thus, benefits from productivity programmes cannot usually be acquired in the short run, and the lag period depends on initial conditions and speed and credibility of the reform. In contrast, exchange rate policy, for example, does have a short-term impact.
iii. Running counter to competitiveness conventional wisdom, Krugman (1994b) suggests that competitiveness as measured by productivity is irrelevant to a country's ability to compete in international markets. In the words of Broadberry, (1997: 82):

> *"[T]rade can still occur if one country has an 'absolute advantage' in all products, with the low productivity country specialising in the products in which its productivity inferiority is relatively small"*.

Because the last point is crucial to the core concept of GC, it requires some discussion. Based on the logic of Ricardo's exposition of CA, Krugman demonstrates -with two countries two-goods world- that being less productive than your trading partners "poses no special problems" (1994b: 269), although it will affect negatively domestic living standards. Moreover, "success of a country in exporting depends not on absolute but on comparative productivity advantage" (p. 272).

The rationale behind Krugman's conclusion is based on: (i) the theory of comparative advantage, despite the latter's well-known verification problems[21]; and (ii) the fact that low wages serve to offset inferior LP. Whether low labour costs alone in LDCs are sufficient to compensate for their inferior performance in TFP and output quality, or indeed sufficient to access markets with technical standards and other non-tariff barriers is questionable.

The Link

The exact relationship between export performance and productivity is not definite in the literature. Theoretical considerations appear to offer two possible directions for causality; one from export expansion to productivity growth, and the other from productivity growth to rising export intensity[22]. It is often argued that export expansion, particularly in small economies, represents an opportunity to reap scale economies. Furthermore, export rivalry can lead to improvement in technical or X-efficiency through the 'challenge-response mechanism'. On the other hand, the ability to penetrate foreign markets requires achieving high productivity (or quality) performance. The underlying theoretical basis here is that "there are fixed costs of exporting which deter those firms that are below a threshold level of efficiency" (Bleaney and Wakelin, 1999: 1).

Empirical research on the causality direction follows different research directions and uses various types of data. At the aggregate level, the positive relationship between efficiency improvements (as proxied by *changes* in ULCs) on one hand, and export growth on the other, has been questioned by the so-called 'Kaldor paradox'. This paradox asserts that, at least for some countries, the link between changes in ULCs and changes in export market shares, contrary to what is commonly assumed, seems to be positive (Fagerberg, 1988; Agenor, 1997). It appears that there are intervening variables that distort the assumed positive link between efficiency and exports; ULCs competitiveness is just one factor in determining export performance and other factors such as quality and non-labour costs can have a great

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[20] See Bartelsman and Doms (2000) for a recent survey.

[21] It is worth-mentioning that the theory of CA is hard to test empirically in a direct way using *ex ante* information (see Gowland, 1985). For a balanced assessment of empirical evidence on the Ricardian hypothesis using indirect proxies, see Bowen et al., 1998, pp.104-109.

[22] On export-productivity nexus, see Bonelli (1992) and Aw and Hwang (1995).

influence. Empirical studies on Kaldor paradox offer somewhat mixed results, and some recent research, using industry-level panel data, has reasserted the significant role of labour costs (Carlin et al., 1999).

Very recently, the direction of causality has been examined thoroughly utilising panel microdata. This research direction, focussing on *levels* not *changes*, revealed that export success to be primarily the consequence, rather than the cause, of exceptional firm performance[23]. Thus, superior firms -in terms of efficiency and quality- seem capable of penetrating foreign markets, while exporting *per se* does not lead to significant improvements in firm performance (i.e., there is weak learning-by-exporting effect).

3.6 The Efficiency & Productivity Paradigm: Selected Issues

The efficiency & productivity paradigm has recently attracted more attention from economists[24]. This can be explained by the richness of the paradigm for both analytical and policy purposes and because of microdata availability. The aim of this section is to outline some important issues related to: (i) potential determinants of productivity change; (ii) main research directions in the paradigm; and (iii) weaknesses (and possible solutions) shared by these research directions.

3.6.1 *Main Potential Determinants of Productivity Growth*

A complete model of productivity levels is difficult to specify and test empirically (Caves, 1980; Pilate, 1996). Economic theory and empirical findings have failed to reach to a robust set of productivity determinants. Nevertheless, the literature outlines possible causes of productivity *growth* as follows[25]:

A. Changes in factor intensity (including physical and human capital).
B. Shift in activity from lower to higher productivity industries.
C. Catching up with best-practice firms; an improvement in technical efficiency.
D. Exit of the least efficient firms.
E. Entry of new more efficient businesses.
F. Technology innovation and diffusion (technical progress or dynamic efficiency).
G. Shift in plant-size distribution towards larger plants (if scale economies are significant).
H. Market growth and improvements in capacity utilisation.
I. Better product quality.
J. Intensification of domestic and foreign competition.

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[23] See Bernard and Jensen, 1995 and 1999; Clerides et al., 1998; and Aw et al., 2000.

[24] For recent studies adopting this paradigm, see for example, Dollar and Wolf, 1993; Hitchens et al., 1994; O'Mahony; 1995; Coelli et al. (1998); Porter, 1999; Mamgain, 2000.

[25] See Lansbury and Mayes, 1996; Mayes, 1996; Pilate, 1996; Roberts and Tybout, 1996.

These determinants highlight the role of the following potential factors in enhancing productivity growth: (i) the sector's structural composition in the sense of being more specialised in high productivity activities; (ii) firm entry and exit; (iii) capital stock and innovation; (iv) technical efficiency; (v) scale efficiency; and (vi) allocative efficiency.

3.6.2 *Types of Efficiency & Productivity Studies*

Work on efficiency & productivity is one of the research-intensive areas in applied economics. Measures examined in this area include LP, TFP, ULCs, allocative, scale and technical efficiency. Empirical research in this paradigm includes the following approaches (see also *The Detailed Matrix of Competitiveness Research*)[26]:

A. Cross-country comparison of (labour or total) productivity *level* for *total* manufacturing using industry-specific conversion factors (Van Ark and Pilat, 1993). An extended version of this approach is measuring *and* explaining inter-industry variation in LP in a bilateral context[27]. The last approach is based on measuring how much the productivity *levels* of particular industries in one country differ from those in another major (reference) country and seek to explain why the productivity shortfall in the first economy varies from industry to another (Caves, 1980).
B. A case study approach to diagnose cross-country productivity differences in a *'selected' sample of industries* using carefully matched firms and products (e.g. MGI, 1993). Although carefully designed to distinguish between apples and oranges, the results of such a study is not always easy to generalise (Pilat, 1996).
C. Economy-wide, sector-level or industry-level investigation of TFP growth within a single country to investigate whether the growth process in a specific nation is input using or efficiency enhancing.
D. Measuring and explaining inter-industry variation in technical efficiency (TE) levels in manufacturing (see Chapter 5, and CB, 1990; CA, 1992; Mayes et al., 1994), or inter-firm variation in TE in a specific industry.
E. Inter-industry variation in allocative (in)efficiency in a domestic setting, common in the SCP paradigm.
F. Scale efficiency studies using microdata with the aim of measuring returns to scale, and investigating the link between firm size and various performance measures (see Chapter 6).

[26] See Matthews (1988) and Pilat (1996).
[27] See Caves, 1980; Davies and Caves; 1987; Hitchens et al. (1990).

3.6.3 *Methodological Issues in Efficiency & Productivity Analysis*

As with other competitiveness empirical paradigms, the efficiency & productivity paradigm suffers from certain methodological defects and data limitations that need to be taken into consideration in empirical research and policy recommendations[28]:

1. Capital Stock Data

Most research on efficiency & productivity cannot adequately proceed without capital data or some proxy for it. Even studies focusing on *partial* measures of productivity (i.e. LP) or on non-productivity measures (e.g. inter-industry variation in profitability) have to control for heterogeneity in capital intensity.

Of the statistical data sets required to investigate efficiency & productivity, capital (stock or cost) is typically the weakest in terms of quality and availability. Ideally, capital stock should be measured at replacement cost, but the data required are hard to obtain, particularly at the firm level. There are at least four responses to this crucial data limitation in empirical work:

a. Estimating capital stock. With sufficient data, one can apply the Perpetual Inventory Method (PIM)[29] to estimate capital stock from data on *real* capital formation and depreciation. This can be a feasible option at the level of industry, but quite difficult to undertake at the level of the firm, particularly in LDCs, due to data availability.
b. Using proxies for capital stock, such as book value (or historical cost) of capital stock, fuel or electricity consumption, and depreciation.
c. Utilising an assets survey or capital census, if available.
d. Recent treatments of capital data imperfections suggest using some kind of errors-in-variables modelling (Tybout, 1992a), or an outlier detection methodology.

In this Thesis, the researcher will utilise (b) and (d) approaches. More specifically, when analysing microdata (Chapters 5 and 6), capital stock at book value will be used as a proxy for capital stock at replacement cost, coupled with an outlier detection approach.

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[28] Trade data, although more internationally comparable than output data, suffer from problems in coverage (smuggling), classification (usually not research friendly in comparison with output, industry-based, data), accuracy (under-reporting) and internal inconsistency. See Rozanski and Yeats (1994) for an assessment of the reliability of world trade data.

[29] Ideally, the length of the series should be over a time period "long enough to include the assumed average age of the oldest surviving assets" (Ward, 1976: 32). The cited reference contains a good exposition on the mechanics of PIM.

2. Heterogeneity in Units of Analysis

When heterogeneous units are compared, unit-specific influences on performance (such as technological opportunity, history or size) should be controlled for. This is essential to avoid the bad habit of "comparing apples to oranges" in productivity analysis (see Ijiri and Simon 1977; Bernard and Jones, 1996) or "confusing product heterogeneity with inefficiency" in TE research (Mayes et al., 1994). Cross-section data are known to have a weakness in identifying and controlling for unit-specific effects (Hausman and Taylor, 1981).

There are at least four options to deal with this complexity in efficiency & productivity analysis:

- To restrict the study to a specific industry (e.g. pharmaceutical industry) or to relatively homogenous or closely related industries (e.g. chemical industries). This is the logic behind the case study approach in competitiveness policy analysis.
- To use dummy variables to represent various possible groups of industries (e.g. splitting industries into high-technology and low-technology industries).
- To control for the problem of structural heterogeneity using panel data or control variables (in cross-section studies). While many industrial economists might prefer to use panel microdata (Martin, 1993), after unsatisfactory experience with control variables, it is worth mentioning that some prominent economists in growth theory still prefer to use cross-section data in explaining cross-country growth rates (Barro, 1996), or suggest that the best way to control for unobserved fixed effect (heterogeneity) might be to use some proxy instead of panel data (Griliches and Mairesse, 1995).
- One alternative way to deal with heterogeneity in technological opportunity is to use the space dimension, i.e., industry-specific performance in other economies (Davies, 1991b) instead of time dimension (in panel data). This research strategy (adopted by Davies and Caves, 1987) has the advantage of making like being compared with like through matching *similar* industries in different economies.

Firm heterogeneity can take so many aspects to be controlled for. Firms can be different in terms of product characteristics, product mix, capacity utilisation, vertical integration, labour skills and incentives, managerial capabilities, factor prices, transport cost and, finally, marketing strategy (Gold, 1981). Furthermore, enterprises differ in their size, age, location, capital vintage, technology opportunity (including input mix), and financial structure (debt-equity ratio). Given present answers, this problem still needs both a better and practical solution. While panel data at the industry level are accessible, this is not necessary true at the firm or plant level, particularly in LDCs. Furthermore, even if longitudinal microdata are available, panel estimators are much more sensitive to measurement errors (Tybout and Westbrook, 1996; Temple [Jonathan], 1998), a serious problem in LDCs' data.

In this Thesis, the heterogeneity problem is alleviated through using microdata coupled with some sort of the first three approaches (see also Chapter 4, section 4.3.3).

3. Causality and Simultaneity Bias

One of the most complex problems in efficiency & productivity studies is the complexity of economic reality; the relationship between productivity and its potential determinants "is most sensibly seen as only part of a larger simultaneous system" (Davies, 1991b: 233). In economics, as in other social sciences, the researcher lacks the existence of deterministic relationships and, in most cases, experimentation. Instead of adopting controlled experimental designs, the economist's most ambition is to get 'true' empirical regularities and non-spurious robust relationships. Furthermore, it is difficult to establish sequential causality in a cross-section research (i.e., no time order) in non-experimental research designs (Bryman and Cramer, 1999)[30].

Econometric theory offers certain tools for detecting and correcting for the simultaneity bias. While the Hausman-Wu test can be used to detect the presence of a simultaneity problem (Martin, 1993), many possible solutions for the problem are available (Hay and Morris, 1996), belonging to the simultaneous-equation approach. Ideally, simultaneous-equation models that take into account feedback effects of 'endogenous' variables seem preferable to the OLS single-equation models. While structural models can reduce estimation bias, even macroeconomists who accumulate special experience in building structural macroeconomic models still disagree on the issue. The reason for the disagreement is that economists are yet to possess sound theoretical basis to construct tight structural models. Furthermore, simultaneous equation systems typically have insufficient exogenous variables to identify the endogenous ones (Schmalensee, 1989) and can suffer from small sample bias. In this Thesis, no attempt has been made to construct simultaneous-equation models.

4. Pitfalls in International Benchmarking

Research on GC faces many obstacles in making reliable comparison of international industrial performance in productivity and quality paradigms[31]. This is due to factors related to idiosyncrasies of various economies, including different accounting convictions, diverse

[30] See Mebane (1991) on the special assumptions needed to justify causal inference in cross-sectional contexts: homogeneity among units of analysis and temporal stationarity.

[31] Many prominent economists in productivity paradigm have documented this conclusion. In TE, see Caves (1992a: 8); in scale economies, see Emerson et al. (1988: 127); in international price comparison, see Heston and Summers (1996: 24); in international productivity *level* comparisons, see EC (2000a: 28).

data collection methods and asymmetric price structures, as well as heterogeneity in economic size, structure and development. Sources of discrepancies include:

- Character of the production units covered by the sectoral government surveys and censuses (establishments, enterprises, and alike).
- Coverage of smaller units in government surveys (Caves, 1998).
- The relative size of the informal sector (ILO, 1999); underground activities in production data and smuggling in international trade data
- Methods of surveys and compilation convictions, such as sampling procedures and adjustment for the firm or unit secondary activity.
- Valuation of transactions (treatment of taxes and subsidies in output data; CIF versus FOB valuation in import data).
- Differences in output quality and input characteristics (e.g. capital vintage, age and education characteristics of labour force) across countries.
- Different disaggregation levels of data are available in different countries.
- Different industrial structures or composition.
- Differences in price structure and levels (see below).

While some sources are capable of remedy (such as divergent data classifications), others are very hard to solve. Failure to account for such salient differences could easily lead to 'statistical artefacts' instead of real differences in performance.

5. Spatial Price Differences

In international comparison of industrial productivity, capital is not the only measurement pitfall; the reliability of *real* output data is another obstacle. When comparing productivity *levels* across space (productivity gap), either at the meso or industry level, differences in price *levels* should be taken into consideration. Using nominal exchange rates to account for price differences is unreliable either because of their variability (Emerson et al., 1988) or because they do not adequately manifest actual price differences among countries. Thus, actual or official exchange rate for a particular year might be atypical, and does not usually correspond to purchasing power parities. This implies that some adjustment for price differentials between nations is essential in international comparisons.

One effective way that avoids the pitfalls of exchange rates, but still makes illuminating international benchmarking, is the use of *change* indicators (measuring changes in competitiveness performance over time) instead of *level* indicators (comparing levels of competitiveness performance across countries in a specific point of time). This approach will be utilised in Chapter (7). In *temporal* comparisons, there is no need for a common currency, and the comparison covers larger period (i.e. probably not affected by cyclical factors that can distort *spatial* one-year comparisons).

3.7 Conclusions

National competitiveness is a fuzzy concept, and has both emotive and objective content. Its emotive content arises from the fact that international trade is generally not a zero-sum game and because the concept is indistinguishable from other economic goals such as economic development, growth and external balance. The objective content of the concept arises from the facts that: (i) performance of firms, industries and even economies cannot be fully explained without recourse to industry- and country-specific factors, including business environment and generalised agglomeration economies. In other words, there are enough significant differences in national business environments to influence the performance of firms in different countries (OECD, 1997b); (ii) while it is true that international trade is a positive-sum game and thus the *fact* of exchange benefit all players, there is typically conflict of interests in *terms* of trade, particularly in imperfect international markets[32], affecting weak LDCs; and (iii) given the severity of market failure and imperfections in LDCs, competitiveness is a valid policy issue (Lall, 2001). *That is said, this Thesis takes manufacturing industry, not the economy, as its unit of analysis.*

It seems that national competitiveness is not a 'dangerous obsession' *per se* (Fagerberg, 1996). This depends on types of competitiveness policies adopted (protective trade policies versus horizontal productivity-enhancing policies). This Thesis emphasises domestic performance that is likely to affect global competitiveness instead of focusing on trade policy options.

Although there are important empirical research directions, the current state of the economics of GC is still primitive and unframed. At the level of measurement (see Chapter 4), international comparisons of competitive performance *levels* (with the possible exception of trade and profitability) are difficult to undertake compared with intertemporal comparisons. The UNIDO, the major international organisation responsible for collecting and disseminating international manufacturing data, is still using exchange rates to compare *levels* of manufacturing output and productivity across countries; we still need Penn World

[32] See Boulding (1973) for a general argument regarding exchange in general. Imperfect market conditions are not restricted to monopoly power; other imperfections such as asymmetric information (e.g. in high-technology products and technologies) and externalities are also important.

Tables for narrowly defined industries. Thus, international comparisons of productivity levels are "difficult to make with precision and are affected by the timing of the economic cycle" (Eltis and Higham, 1995: 72). The case is probably more severe in measuring and comparing non-price competitiveness.

A probably higher level of ignorance applies at the level of explanation. The theoretical foundations of competitiveness paradigms are generally weak. As emphasised above, a complete model of productivity levels is difficult to specify and test empirically. Offering robust cross-country explanations of comparative growth performance is also a difficult ambition as modern growth theory might conclude (Temple, 1999). From a pragmatic point of view, GC concept raises the level of urgency needed to face the international challenge, and emphasises international benchmarking (Eltis and Higham, 1995).

Whether the pessimistic or the optimistic competitiveness scenarios will dominate, regionally or globally, as a result of progressive international competition and protective IPRs global system is an open question that is difficult to answer conclusively (see Emerson and Portes, 1990; Kirkpatrick and Weiss, 1992; Maskus, 2000). The degree of *indeterminacy* can be minimised through resorting to case-by-case empirical analysis (Clarke and Kirkpatrick, 1992), but predictions, as well as opportunities and threats of global competition, tend to be *conditional*. In general, this Chapter seems to confirm that there are objective reasons to worry and others to ease our concerns.

In the pessimistic side, as revealed by robust microdata evidence of export performance and other anecdotal evidence, it appears that global market access in many and increasing number of industries requires ***strong players***, with special skills and intellectual capital. Furthermore, scale economies and technical efficiency gains (Chapters 6 and 7), two of the often-mentioned benefits of trade liberalisation, are best described as *potential* gains; they are ***not automatic*** outcome of openness, and require careful policy design (World Bank, 2000b). In the optimistic side, the logic of comparative advantage indicates that *absolute* performance differences among countries are not the *only* determinant of exports performance, and the logic of *competitive* advantage refers to the possibility of creating potential comparative advantages. Furthermore, small and vulnerable economies can 'use the international market' to mitigate rather than exacerbate the consequences of inferior domestic performance (Krugman, 1994b: 270). But in an increasingly knowledge economy, the *fair* use of international markets entails local technological capabilities and global competition policy.

Based on various empirical paradigms of GC, *competitiveness drivers* can be classifies into two main categories:

- Cost drivers: these drivers create a *price* or *cost* advantage based on the cost side of the enterprise. Although typically related to scale economies (mass production) or low-wage, cost drivers are much more numerous, and include productive efficiency, learning economies, process innovation, as well as non-wage costs and capacity utilisation (Grant, 1998).
- Benefit drivers: these drivers create a *differentiation* advantage based on superior technological capabilities of the enterprises, leading to premium price and revenues. Industrial countries tend to focus on these drivers in upgrading their competitive advantage (EC, 2000b).

The two types of drivers are not wholly independent; benefit drivers can lead to higher sales and thus scale economies, and low costs resulting in higher profits could offer an opportunity to increase R&D expenditures.

As for future research, more work is needed to investigate competitiveness of LDCs, individually and collectively. Along this research line, more methodological work is required to accommodate data constraints in these countries. An equally important research direction is the impact of economy size on its GC.

Outlining coming work, the Thesis's focus will be on the efficiency & productivity paradigm with a microeconomic perspective to GC. The first empirical chapter investigates one of the main determinants of low average productivity in manufacturing; the existence of a long tail of under-performing firms. The second empirical chapter deals with scale efficiency. The key policy issue in both chapters is whether performance in JMIs is below its *own potential* rather than compared with international leader(s). This research design, not basically susceptible to Krugman's (1994a, 1998) influential criticisms on *national* competitiveness, represents a necessary step towards upgrading the global performance of JMIs. Indeed, the existence of a long tail of low productivity firms diagnoses the existence of a large number of manufacturing firms that are vulnerable to GC. Furthermore, the existence of substantial scale economies in JMIs can signal the vulnerability of small firms.

CHAPTER FOUR

The Measurement and Evaluation of Industrial Competitive Performance: A Survey of Competitiveness Analytical Tools (CATs)

4.1 Introduction

Measuring competitiveness, according to Gambardella et al. (2001), "is always a difficult exercise, given the ambiguity with which the concept is sometimes used and the different possible interpretation that can be found in the literature" (p.3). This Chapter aims at critically mapping various measures of industrial competitiveness with special emphasis on cost drivers. The survey covers static and dynamic, price and non-price, as well as process and outcome competitiveness measures. The relevance of different measures and methods to LDCs is also examined.

It is widely believed that sound assessment of manufacturing performance helps industrial competitiveness policy, broadly defined, in monitoring and upgrading manufacturing competitiveness. The ultimate aim is utilising scarce and distinct resources more efficiently and effectively. Indeed, the strategic management of a dynamic manufacturing sector requires accurate knowledge on points of strength and weakness in the industrial sector, as well as external threats and opportunities, and this can be facilitated through consistently tracking the sector's performance.

In exposing the measurement dimension in the economics of GC, the concepts and techniques presented here will heavily draw on applied industrial economics. Technical and scale efficiency, inter alia, are emphasised because they are investigated empirically later in the Thesis. As suggested by Davies (1991b: 235), "[i]t seems likely that productivity and efficiency will play an increasing part in the development of the literature on industry structure and performance". Given the deficiency of macroeconomic demand-side policies and intensification of GC in the world economy, the emphasis on microfoundations of market performance constitutes a healthy research direction for both LDCs and industrial economies.

4.2 The Concept of Performance

Performance can best be defined as "the overall status of an organisation in relation to its competitors, or against its own or external standards" (Holloway et al., 1995: 1). Within these lines, performance measurement and comparison can be done for the economy, sector, industry, or firm utilising two dimensions:

- Horizontal or space-based evaluations (also called benchmarking): comparing the current performance of the economy, sector, industry or firm with the current performance of the relevant (domestic or foreign) competitor(s). An example is inter-firm differential in TFP within an industry.
- Vertical or time-based evaluations: comparing the current performance with past achievements. Examples of such an approach are: exports growth and after-before comparison of the effects of competitiveness policy changes.

It is well known that economic performance is a multi-dimensional concept and the ultimate judgement on what is considered as 'good' performance can differ among individuals. According to Devine et al. (1993: 301), performance is "an elusive and often ambiguous concept that is open to a variety of different interpretations and measurements". Thus, it is recommended in competitiveness policy analysis to undertake robustness checks to research findings in order to avoid reductionism in measuring and assessing competitive performance.

4.3 Performance Criteria and Measurement[1]

In assessing competitive performance of firms and industries, the analysts can utilise different performance measures, or what this Thesis called *Competitiveness Analytical Tools (CATs)*. The list of measures examined in this Chapter covers:

1. Allocative inefficiency: excess profitability.
2. Productive or technical efficiency (TE).
3. Scale efficiency.
4. Dynamic efficiency: process innovation, TFP growth or technical progress.
5. Product quality and product innovation.
6. Labour productivity (LP).
7. Unit labour costs (ULCs).
8. Trade-based indicators: comparative advantage (CA) family of measures.

The above list is actually not exhaustive; other measures, not discussed here, include capacity utilisation, learning economies, and employment generation and cost. Industrial economics, until recently, has been traditionally preoccupied by allocative efficiency and

[1] For a good overview, see Devine et al. (1993) and Jacobson and Andreosso (1996).

scale efficiency, though other measures, such as TE and product quality, have recently attracted more attention.

The reminder of this Chapter presents a survey of the main conceptual and empirical issues underling the measurement of the above performance criteria, discussing their uses, interpretation and limitations. Also emphasised is the link among different performance criteria and their relevance to global industrial competitiveness of LDCs.

4.3.1 Allocative Inefficiency: Excess Profitability

The concept of allocative efficiency

Allocative efficiency is defined as "the production of the 'best' or optimal combination of outputs by means of the most efficient combination of inputs" (Pearce, 1992: 13). An example of 'wrong' output mix is the one resulted from market power. One of the traditional arguments against monopolistic market structures is that they tend to cause allocative inefficiency or misallocation of resources; output is reduced and price is increased above marginal cost compared with perfect competition. The more the divergence between price and marginal cost the larger the monopoly power and hence allocative distortions and static welfare loss.

Another example of 'distorted' output mix is due to trade barriers that prevent domestic producers from responding to signals of international prices and thereby specialising according to their CA. Allocative efficiency can also be affected through ignoring factor price signals. When a firm choose the wrong input mix, this results in allocative inefficiency leading to higher production costs, and thus a loss in GC (UNICTAD and the World Bank, 1994).

Allocative inefficiency is typically measured in industrial economics in terms of 'abnormal' or excess profitability. This explains the long-standing interest of industrial economists in studying the relationship between profitability and market structure (Weiss, 1974; Cowling and Waterson, 1976). As clarified by Shaw and Sutton (1976: 191):

> *"[P]ersistently high profits provide a basis for a **prima facie** case of misallocation. Empirical studies of performance therefore look for an association between some index of price-cost margins or profitability and a measure or measures of market structure".*

On the other hand, Porter (1998b) argues against overemphasising targeting concentrated market structures with the aim of reducing profits. He suggests that:

> "*Economists were concerned mainly with the societal and public policy consequences of alternative industry structures and patterns of competition. The aim was to push "excess" profits down. Few economists had ever even considered the question of ... how to push profits up*" (p. xi).

It seems that profit *per se* is not a bad thing, especially if it is re-channelled in a further investment in later periods. Indeed, profitability is seen as a key determinant of investment expenditure on machines, ideas and people, and thus a major source of competitiveness (Oughton, 1993; Bigsten et al., 1999). Though persistent abnormal profits could be a sign of a stagnant market structure and enduring market power, and thus should be monitored by competition authorities, it might be equally important to emphasise the incentive role of profits in stimulating new entry and dynamic efficiency in LDCs.

Another difficulty in using profit as a *social* performance criterion is the problem of interpretation of high profits emphasised by the Chicago school in industrial organisation (Demsetz, 1973; Peltzman, 1977). This school interprets high profits as an evidence of efficiency (lower costs) rather than monopoly power (higher price); high profitable firms should not be punished for their more efficient scale and organisational effectiveness. This explanation has stimulated some research in productivity (Davies, 1991b).

The measurement of allocative efficiency

Profitability can be measured either by price-cost margins (PCMs)[2] using government industrial censuses and surveys, or by accounting rate of return on capital using company-level data and reports. In 'traditional' industrial organisation, empirical research is typically based on industry-level census data, suggesting a bias towards the adoption of the first criterion. To conveniently measure PCMs ((Price-Marginal Cost)/Price), one can assume a constant long run marginal cost (i.e. constant returns to scale). According to Shaw and Sutton (1976: 192), empirical evidence is "normally consistent" with such an assumption. This allows for the equality of marginal cost (MC) and average cost (AC), thereby eliminating the need for measuring MC. Consequently, PCMs could be measured as (P-AC)/P. More conveniently, multiplying through by sales volume (Q) yields (TR-TC)/TR, were TR is total revenue (total sales or gross output) and TC is total cost.

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[2] Also known as price mark-ups, or rate of return on sales.

This measure has several advantages in terms of empirical convenience (Stead et al., 1996) and strong theoretical foundation through its link to allocative efficiency (Scherer and Ross, 1990), but it suffers from a coverage defect. The estimates for TC are rarely complete (Shaw and Sutton, 1976); it usually excludes fixed and capital costs, with the effect of enlarging PCMs superficially[3]. To control for this upward bias in PCMs, empirical work often includes some kind of proxy for capital-labour ratio as an explanatory variable, but often the capital estimates are of bad quality. In empirical work, PCM is proxied using two alternative definitions (EC, 1997b):

PCM1 = (value added (VA) - labour costs (LCs))/ sales
PCM2 = (VA - labour costs)/ VA

From the above formulas, it seems that the question of whether net revenue (VA) or gross revenue (sales or gross output) should be used in PCM calculation is not yet resolved, suggesting that profitability studies should present robustness checks[4].

A relatively recent development in the methodology for assessing impact of industrial concentration on market allocative performance is the use of *price* instead of *profitability* as a proxy for allocative efficiency. The most comprehensive evidence on the link between concentration and price levels is provided by Weiss (1989a).

The relevance of allocative efficiency assessment to LDCs' competitiveness

The role of allocative efficiency in enhancing industrial competitiveness is generally governed by the still debated trade-off between static efficiency and dynamic efficiency as well as by the potential conflict between different types of static efficiency, most notably allocative efficiency and scale efficiency. Definite conclusions can only be properly established in a case-by-case basis. But it is worth noting that *even if* large firms and concentrated industries are more efficient in the technical sense, they can refrain from transferring efficiency gains to consumers and export performance (through lowering prices) or to the benefit of innovation (through reinvestment of retained earnings); dominant firms can just enjoy their monopoly rent without being more competitive locally or globally (see UNCTAD, 2000d).

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[3] The same could apply to the accounting measure of profitability in case of measuring capital at historical value, thus undervaluing capital stock in periods of inflation. Further, the most serious weakness of the accounting measure, according to Amato and Wilder, is its sensitivity to inter-industry variations in accounting practices (1995). But census data are themselves *derived* from raw accounting data (Martin, 1993), and thus are not necessary immune from this particular pitfall.
[4] See Conyon (1995) for more discussion on this practical issue.

In general, although some economists suggest that allocative inefficiency does not pose a high welfare cost on society (Harberger, 1954; Leibenstein, 1966), this suggestion does not necessarily apply to most small LDCs, for the following reasons:

1. Although many empirical studies on the welfare loss of monopoly pricing do confirm the relatively low cost of allocative distortions, it is important to remember that these studies were done for large, developed and liberal economies (mostly USA and the UK). It is likely that the magnitude of allocative inefficiency depends on size of the economy and strength of antitrust actions (Weiss, 1989c), in addition to market contestability and openness to international trade, all are clearly asymmetric among countries.
2. Almost all empirical studies were done on manufacturing industries (Stead et al., 1996), ignoring other, more concentrated, sectors in LDCs, such as public utilities.

In summary, the cost of allocative inefficiency arising from monopoly power can be higher in small LDCs. Thus, investigating allocative implications of market structure, including disciplinary role of imports[5], in the case of small and developing countries is quite a relevant issue in competitiveness debate. Taking into account that industrial competitiveness depends partially on offering lower price *and* minimising costs, analysing factors that affects PCMs is an important topic in the agenda of both competition policy and competitiveness strategy.

As for operational issues, the measurement of PCMs in small LDCs poses the following particular points, related to the severe skewness of firm-size distribution:

1. The assumption of constant returns to scale in manufacturing might not hold in some industries.
2. Labour costs or compensation for non-paid employees should be imputed in single-person and family businesses; otherwise PCMs would be distorted upwards.

4.3.2 Productive or Technical Efficiency (TE)

Introduction

Unlike allocative efficiency, TE until recently has received little attention in microeconomic or industrial research as an important performance criterion (Caves, 1992a). Welfare economics, the main paradigm for microeconomic policy analysis, is still preoccupied by the notion of allocative efficiency. Furthermore, well-known surveys on SCP

[5] For a recent empirical investigation of the "imports-as-market-discipline hypothesis" in a developing country, see Katircioglu et al. (1995). For a conceptual analysis of the link between import liberalisation and industrial performance, see Lall, and Latsch (1998).

paradigm in industrial economics (Cubbin, 1988; Schmalensee, 1989) have not emphasised TE as a legitimate performance criterion for testing the superiority of alternative market structures. Caves (1992a) has clarified the main reason behind this:

> "*[T]he hypothesis of profit maximisation has mutated into an axiom ever ready to deny any allegation of productive inefficiency: If it paid to do something more efficiently, someone would already have seized the opportunity*" (p.1).

According to Caves, two developments have made TE an important research inquiry. First, microeconomic theoretical advances in the causes of market failures (such as bounded rationality and information asymmetries) have raised doubt on the ability of decision makers to maximise utility and profits. Second the attractive new technique for measuring TE using stochastic frontier analysis (SFA). One can add to these two reasons, access to microdata necessary to investigate TE, and the greater attention countries recently assign to the challenge of GC.

The concept of TE and related policy objectives

TE can be simply defined as cost-effective *use* of given inputs or resources (Pratten and Deakin, 1999: 5). Technical inefficiency exists when firms can produce more with given inputs, or need less inputs to produce a given output (Sharpe, 1995). Indeed, TE can be defined as a measure of distance from the production frontier (Torii, 1996)[6].

While allocative or price efficiency is concerned with input *choice or proportions*, TE addresses the problem of input *utilisation*. As clarified by CB [Caves and Barton] (1990: 3):

> "*[A firm] can be technically inefficient by obtaining less than the maximum output available from whatever bundle of inputs it has chosen to employ. It can be allocatively inefficient by purchasing what is not the best bundle of inputs, given the prices of the various inputs and their marginal productivities in its production process*".

The relative importance of improving allocative versus technical aspects of efficiency is not conclusive in the literature, but many economists would agree that TE is at least as important as allocative efficiency, and it is potentially more crucial in terms of welfare gains (CB, 1990; Torii, 1992).

6 The exact relationship between TE and so-called X-efficiency is not clear in the literature. While some economists do not distinguish between them (CB, 1990; Green and Mayes, 1991), others consider X-efficiency a version of TE (Deakin and Hughes, 1999) or explain the existence of technical inefficiency in terms of X-inefficiency theory (Lee, 1986). Still a further party suggests a real difference in concept (Leibenstein, 1977; Button and Weyman-Jones, 1994; Torii, 1996).

The Measurement of technical efficiency

There are several criteria to classify approaches for TE measurement. As summarised by Forsund et al. (1980: 7-8), research on frontier paradigm can be classified according to the way the frontier is specified and estimated:

> *"First, the frontier may be specified as a parametric function of inputs, or it may not. Second, an explicit statistical model of the relationship between observed output and the frontier may be specified, or it may not. Finally, the frontier itself may be specified to be either deterministic or random".*

Among eight possible permutations for frontier research design, the two main competing paradigms for TE measurement are: the econometric paradigm (also known as the stochastic frontier analysis (SFA) or the 'composed error' model) and the mathematical programming paradigm (so-called data envelopment analysis (DEA))[7]. The SFA approach is parametric, statistical and stochastic. The DEA approach is basically non-parametric and non-stochastic. It is by far the most commonly used model of deterministic frontiers. While economists tend to favour the econometric paradigm in their empirical work, management scholars tend to prefer the DEA approach. These two paradigms seem to embody a difficult choice between imposing an *ad hoc* parametric structure (in SFA) and adopting a data driven methodology with no structure at all (in DEA). But in conducting DEA, we actually impose a restricted assumption that all variation in performance is due to inefficiency (see Table 4.1 for a comparison between the two methods). This choice is a crucial issue yet to be resolved since a large spectrum of empirical studies concludes that, as a rule, the findings of the two methods vary substantially[8]. Consistent with the above statement, Button and Weyman-Jones (1994: 98), in a selected survey of TE studies, conclude that "[i]n all instances, the degree of measured inefficiency is very sensitive to the researcher's assumptions about the appropriate method to analysis". It appears that the two techniques are in conflict instead of being substitutes. One economist responded to this dilemma by suggesting, "either we know the correct structure to impose *a priori* or we estimate a sufficiently flexible model so that possible restrictions can be tested" (Bauer, 1990: 40)[9].

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[7] See Coelli et al. (1998) for an up-to-date introductory review of SFA and DEA methods. The term 'data envelopment analysis' arises because DEA can be thought of as fitting a frontier that envelops the data (Cubbin and Tzanidakis, 1998).

[8] See, for example, Corbo and de Melo (1986) on manufacturing industries; Neff et al., (1993) on agriculture; Drake and Weyman-Jones (1996) on building societies; Hjalmarsson et al., (1996) on cement industry; Cubbin and Tzanidakis (1998) on water utilities.

[9] Another possible solution to this dilemma is developing a third technique combining both stochastic and non-parametric features of SFA and DEA. Indeed, research on *stochastic DEA* is starting to appear in the literature.

Table 4.1

Strengths and Weaknesses of Main Techniques for TE Measurement

	Stochastic Frontier Analysis (SFA)	**Data Envelopment Analysis (DEA)**
Handling Data Imperfections	Accommodates outliers and statistical noise (in the dependent variable). It is generally risky to use maximum likelihood (ML) with small samples (Long, 1997). SFA estimators tend to be biased in finite samples when inefficiency contribution in the composed error is small (Coelli, 1995).	Highly sensitive to outliers resulting from measurement errors and random disturbances, commonly known in survey data. DEA is even less likely to be efficient in small samples (Cubbin and Tzanidakis, 1998).
Modelling Assumptions	Imposes strong assumptions on the model (Schmidt, 1986; Coelli et al., 1998); an explicit functional form (technology) as well as an inefficiency distribution term (in cross-section data).	Function-free and data-driven. Does not impose an inefficiency distribution. Assumes "an extremely tight structure on the symmetric error: it is always zero" (Koop et al., 1999: 461).
Testing Hypothesis	Well-developed statistical testing (Cubbin and Tzanidakis, 1998).	Non-parametric tests tend to be weaker than the well-established parametric tests (Cubbin and Tzanidakis, 1998).
Overall Ease of Use	Complicated research agenda with high budget in inter-industry design (CA, 1992). Requires non-linear optimisation algorithm for ML estimator when employing the truncated distribution. High level of data mining in the measurement stage.	Easier to use because of relatively limited modelling options. Based on linear mathematical optimisation algorithm.
Computational Complexity	Subject to certain estimation failures, which generate nothing or implausible results (Olsen et al., 1980; Mayes et al., 1994; Drake and Weyman-Jones, 1996). Failure rate can reach 50 % of cases (Corbo and de Melo, 1986; Caves, 1992a).	Smoother estimation procedure.

Source: Researcher.

To conclude, since the two methods have both advantages and disadvantages, it is difficult to provide an absolute preference applicable to all cases, and the choice should be based on a case-by-case basis. In Chapter (5), the research design is based on SFA because of the necessity to accommodate data imperfections in a small developing economy in terms of data quality and, to some extent, sample size. Errors in measuring output and limited number of firms in some industries constrain DEA and other deterministic approaches from providing reliable estimates for efficiency scores.

In SFA, the choice of inefficiency distribution is not easy to justify on *a priori* basis. The literature is yet to generate a conclusive convergence concerning the sensitivity of efficiency estimates to distributional assumptions of the inefficiency term. Schmidt (1986:

308) suggests a pessimistic view. He summarises his opinion stating that "the only serious intrinsic problem with the stochastic frontiers is that the separation of the noise and inefficiency ultimately hinges on strong (and arbitrary) distributional assumptions". On a less pessimistic side, Lovell pointed out that "he is yet to see a comparative empirical analysis in which distributional assumptions have a significant influence upon predicted technical efficiency" (cited in Coelli et al., 1998: 187). Green (1993: 79), in a recent survey, argues that "[i]t is ...unclear how the restriction of μ to zero [i.e. adopting a half-normal distribution], as is usually done, would affect efficiency estimates". However, available limited empirical evidence suggests that various distributions "has a very small impact on the measurement of inefficiency" (Corbo and de Melo, 1986: 27), and that the "difference in estimates...[is] relatively small" (Green et al., 1991: 1640). A third study affirms that "[t]he distributional assumption... makes little difference" (Cummins and Zi, 1998: 148). Thus, one might take the conservative side and conclude that, although there is insufficient evidence on the issue, it seems that findings of frontiers research are less sensitive to type of inefficiency distribution vis-à-vis nature of frontier itself.

The standard specification of SFA can be presented as follows[10]:

$$\mathbf{ln\ (Y) = ln\ \ f(X; B) + e}$$
$$\mathbf{e = u - \mathit{v}}$$

Y is firm's output (VA or gross output), X is inputs vector (L, K, and other inputs), B is unknown parameter vector, **f** is the functional form. The 'combined residual' or 'composed error' component, **e**, comprises two elements: a symmetric random component common in statistical modelling (**u**), representing random disturbances (beyond the firm's control), measurement errors, and minor omitted variables, as well as a non-symmetric component (***v***) representing technical inefficiency, ***v*** >= 0. Technical inefficiency represents factors that can be controlled by the firm (Hjalmarsson et al., 1996: 308).

Unlike the standard econometric production function, (**e**) is the centre of interest in SFA instead of the by-product B (Green, 1993). More specifically, the aim of SFA is to

[10] While the production function approach, assumed here, is most common in manufacturing SFA studies, the cost function approach has many applications in utilities sector. The advantage of the cost approach is the ability to estimate both technical and allocative efficiency but at the cost of demanding more scarce data, namely input prices.

obtain estimates of technical inefficiency measure, ***v***, assuming to have a specific distribution, through decomposing the combined residual into a stochastic component and an inefficiency component.

The inefficiency term (***v***) is one-sided (truncated below zero) to ensure that all firms' output (observations) lie on or beneath the stochastic frontier production function, defined as the maximum output that can be obtained given inputs (Meyes et al., 1994): I.e., being non-negative, the inefficiency component captures the shortfall of actual output (Y) from potential output (F(X,B)+u). It should be emphasised that the level of maximum output (the *stochastic* frontier) is represented in this model by a *random* distribution (typically normal) rather than an exact point (Forsund et al., 1980). The existence of the composed error "enables efficient firms to be randomly distributed round the frontier and inefficient firms to be spread out inside the frontier but also subject to the same random influences" (Green and Mayes, 1991: 526).

Thus, the logic of SFA is to distinguish firm inefficiency (operation below the stochastic frontier) from exogenous environmental conditions and measurement errors (random variation around the frontier). This decomposition can be generated by maximum likelihood or, alternatively, by corrected ordinary least square (see Coelli et al., 1998). The Cobb-Douglas (CD) or translog production functions usually represent the functional form. Finally, the distribution of the inefficiency component is typically assumed to be half-normal.

Interpretation of technical efficiency scores

Though SFA provides competitiveness analysis with a powerful tool for benchmarking firm performance, one should be aware of certain problems in interpreting TE scores at the industry level. Despite ample empirical evidence revealing observed inter-firm disparities in TE, some critics are still unconvinced due to their adherence to the axiom of economic man (see Stigler, 1976). As Comanor (1994: 1233) puts it: "if it is found [i.e. inefficiency], there must be an omitted explanatory variable. Whatever empirical results are obtained are then merely statistical artifacts and not a true reflection of inefficiency at all". Consistent with the above view, Page (1984: 133) suggests that:

> *"Economic data, no matter how carefully collected and specified, inevitably omit some relevant inputs into production [such as capital stock vintage, hours worked and skills]...If inputs were more fully specified and variables more completely defined, much of the apparent variation in efficiency levels would presumably disappear".*

Apparently, measurement and classification imperfections are probably relevant here, but it is difficult, as it is interesting, to prove empirically that these imperfections account for most or all of inter-firm variation in TE[11]. Indeed, accounting for omitted variables and data imperfections might strengthen the observed variation in performance. Another possible outcome is cancelling out missing factors, leading to a small final difference. For example, better skills resulting from 'learning by doing' in established firms can compensate for their older capital vintages.

The relevance of technical efficiency assessment to LDCs' competitiveness

Due to imperfect competition and lack of developed markets, technical inefficiency is expected to be a serious problem in LDCs. In measuring TE in those countries, the following complexities should be taken into consideration:

1. Technical efficiency is measured in relative terms, thus it is greatly influenced by whether national or international standards are used (Sharpe, 1995).
2. The method assumes heterogeneity in *performance* among similar production units. As clarified by (CB, 1990: 27), "[T]he methodology requires that the collection of units compromising the 'industry' embrace at least some that are efficient enough meaningfully to identify the efficient frontier". But it might be the case that in a traditional industry in a developing country, "all firms ... are operating old vintage technology, perhaps failing to take up new technologies available elsewhere" (Davies, 1991b: 230). In such a case, the introduction of new technology by leading firms can *favourably* increase disparities in inter-firm variation in TFP and *decrease* industry-level TE.
3. Firms in an industry are inherently heterogeneous in nature. This heterogeneity poses some problems as "efficiency measures may be rather more indicators of heterogeneity in an industry than of strict technical inefficiency" (Mayes, 1996: 12). Ijiri and Simon (1977) go even further, suggesting that:

[11] If one accepts labour productivity as a proxy for TFP that can claim the virtue of being not subject to capital measurement errors, then empirical evidence *do* clearly support the hypothesis of TE variation among firms in the same industry.

"[T]he theorists point out that 'industry' is such a vague and arbitrary term that comparing the sizes of different firms is like comparing oranges and apples" (p.139)

4.3.3 Scale Efficiency

The concept of scale efficiency and related terms

A firm can be called scale inefficient if it chooses the 'wrong' output level or scale of operation (Atkinson and Cornwell, 1998) in terms of costs, survival-ability or achieving maximum 'performance'. Both scale efficiency and TE can be seen as "two different sources of cost reductions" (EC, 1997c: 19), and thus distinct possible sources of price competitiveness at both the domestic and global levels[12]. Elaborating on this point:

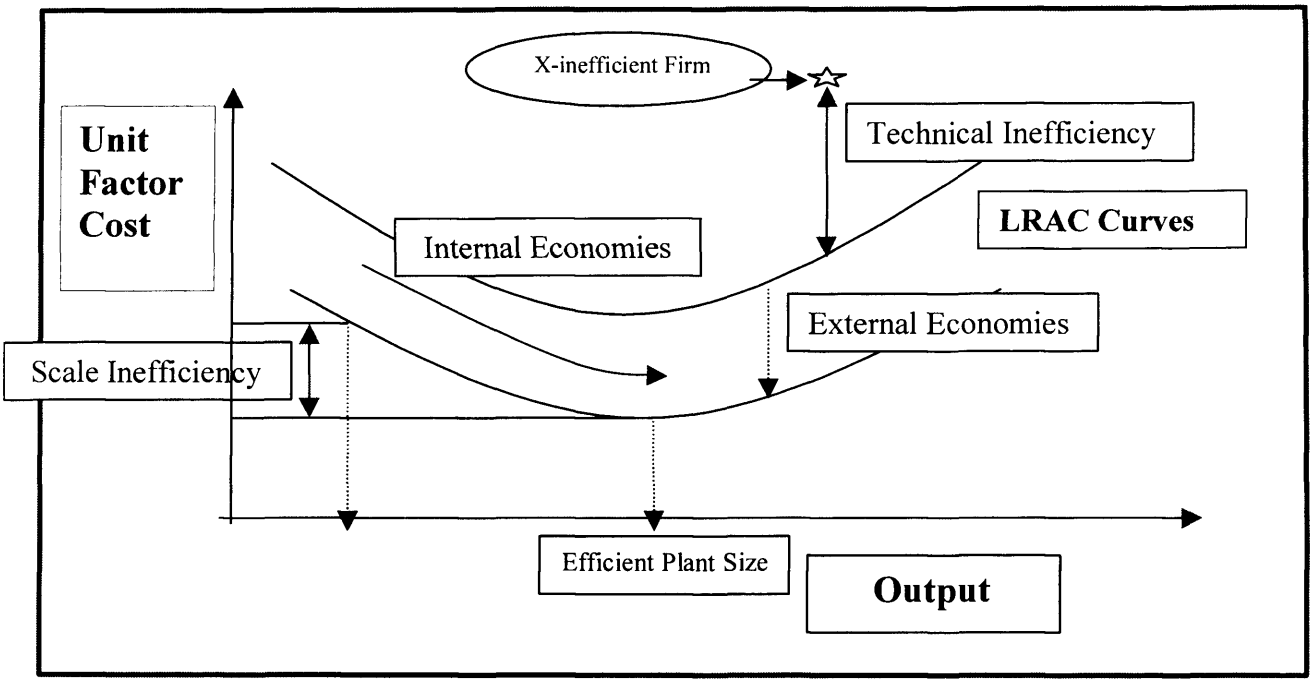
> *"[D]epartures above the [cost] curve involve X-inefficiency...On the other hand, scale inefficiency is represented by departures away from the optimum scale of production on the curve where costs are minimized"* (EC, 1997c: 18). Emphasis added

While TE results from catching up with best-practice establishment(s) *on* an industry's long run average cost (LRAC) irrespective of firm size, scale efficiency results from catching up with the 'efficient plant scale' or, less restrictively, the minimum efficient plant (see Figure 4.1). It is worth emphasising that the 'right' output level is actually not an absolute threshold independent of time and space; instead it can easily vary not only among various industries, but also among different firms. As clarified by Gold (1981: 31):

> *"[S]cale effects may differ widely, not only as among industries, but even among the plants and firms within many industry categories that actually produce different products by more or less differing technologies under different market conditions"*.

[12] On the distinction between TE and scale economies, see Mayes et al., 1994: 166; EC, 1997c: 18-19.

Figure 4.1
The Relationship between Firm Size and Selected Cost Drivers



NOTE: Long run average cost (LRAC) curve can, and actually do, take other shapes such as **L**. The shape presented here is just for illustrative purposes.
SOURCE: Researcher, based partially on Oughton and Whittam (1997, Figure 1).

An important distinction in scale economies is that between internal economies of scale and external economies of scale. Whereas internal economies is related to *firm size* and growth, external economies is associated with *industry size*. Both result in falling unit factor costs, and thus both enhance *firm* competitiveness. Unlike external economies, internal economies are usually thought to be incompatible with competitive industrial structures, at least for a given small market. In view of declining significance of internal economies in some industries due to flexible technology (see Oughton and Whittam, 1997), external economies is expected to attract more attention by policy-makers, mainly because it is more consistent with both competition policy and competitiveness strategy[13].

General approaches for investigating scale efficiency

One can classify approaches for examining the presence and importance of scale effect into two main methods:

[13] This is actually a type of horizontal industrial policy aiming at making the business environment 'right'. See Oughton and Whittam, (1997) for more information on the potential role that external economies of scale can play in upgrading performance of SMEs in the context of industrial districts.

1. The Production Function (or Cost Function) Approach:

This approach takes many variants, but the most common in manufacturing are the 'frontier' production function and 'average' production function. The first variant tests the hypothesis regarding the impact of 'firm size' on firm-specific TE (Taymaz and Saatci, 1997; Ahuja and Majumdar, 1998; Lundvall and Battese, 2000)[14], while the second variant examines the presence and significance of scale economies in production. The second variant takes many approaches (production versus cost approach) using either cross-section data (GR [Griliches and Ringstad], 1971; Baldwin and Gorecki, 1986; Szpiro and Cette, 1994) or, more recently, panel data (Westbrook and Tybout, 1993). Both variants entail microdata[15], but the first technique additionally requires firm-level TE predictors, both environmental and organisational, in addition to the variable of concern (size predictor).

2. The Ad Hoc Approach:

Many variants of such an approach are common in applied industrial organisation; empirical models examining the impact of firm size on LP (Majumdar, 1997); growth performance (Evans, 1987; Hall, 1987); profitability (Hall and Weiss, 1967; Marcus, 1969; Ravenscraft, 1983); export performance (Auquier, 1980; Caves, 1986; Bleaney and Wakelin, 1999); and, finally, innovation activity (see, Symeonidis, 1996), all measured at the firm level. Furthermore, more descriptive techniques for measuring scale efficiency such as the survivor and engineering approaches could be classified within this category. Table (4.2) presents the profile for selected important approaches utilised to measure potential scale economies.

[14] CB (1990: Chapter 7) proposed another approach for assessing the link between firm size and TE through "dividing each industry with data available on sixty or more plants into halves and estimating technical efficiency separately for the larger and smaller halves of its plants". This approach is ignorant to the fact that estimates of TE are frontier-specific. I.e., TE estimates for different size-classes in the same industry or for different industries generated by *separate* frontiers are difficult to compare (Bhavani, 1991; Lundvall and Battese, 2000).

[15] McGee (1974) criticises the use of industry-level data to measure internal scale economies. In his own words, "if anything, these studies show how input and output relationships vary with the size of industries, not firms. They shed no light on economies of scale of a firm" (p. 68). Indeed, the results of such a research design are expected to assess *external* economies of scale instead of internal economies (Walters, 1968).

Table 4.2
Comparison among Selected Techniques for Exploring Scale-Performance Relationship

	The Average Production Function Approach	***The Survivor Technique***	***Engineering Cost Studies***
Rationale	Assessing how physical output changes as all inputs change, *ceteris paribus,* within each homogenous industry using econometric analysis	Testing the relative ability of firms in different size classes of an industry to compete, survive and grow (increase their markets share) *over time.* The market place is the ultimate test for determining the most efficient size class(es)	Only a case study and primary data taken from experts can reveal the exact link between scale and cost in the context of a well-defined industry and satisfied assumptions
Data Input	Microdata, cross-section or panel, taken primarily from industrial surveys and censuses	Secondary time series data of firm-size distribution at two or more points of time	Primary cross-section data taken from interviews with design engineers and other experts
Primary Output	Scale elasticity	The most efficient firm-size class(es)	Minimum efficient plant size
Main Assumptions	Parameter homogeneity among firms/ plants; technical efficiency; homogenous product; given input prices	Presence of competitive market structures so that intra-industry competition removes the relatively inefficient plants. Absence of firm mobility between different size classes over time (see Hart and Clark, 1980); given technology	Given technology; fixed input prices
Main Strengths	Capable of covering large number of firms and industries; relatively robust to measurement errors (in cross-section design)	Simplicity; the impact of all forces affecting business success is tested	Probably the most reliable technique as a result of assuring constant input prices and technology
Main Weaknesses	Requires firm-level data; possible simultaneity bias in cross-section estimators (Tybout and Westbrook, 1996); potential specification error for the production function	Strong a priori assumptions; potentially sensitive to the measure of market share; heterogeneities among firms grouped into size classes, thus weakening the link between scale and cost competitiveness	Data availability especially in LDCs; paucity of industries that can be covered because of high cost; non-production costs are usually not included; rely on *ex ante* information

SOURCES: Based on Silberston, 1972; Rees, 1973; Gorecki, 1976; Hart and Clark, 1980; Fuss and Gupta, 1981; Shone, 1981; Pratten, 1988; Salvatore, 1993; Hay and Morris, 1996; Tybout and Westbrook, 1996.

An assessment of techniques for scale efficiency measurement

In his critical assessment of applications done with the aim of measuring scale-returns relationship, Gold (1981: 21) suggests that:

"The single most important reason for the pervasive inadequacies of such empirical research is the overwhelming tendency for the analyses to be carried out at levels of aggregation that prevent [theoretical validity and practical usefulness]".

The criticism of Gold is focused on the general problem of extensive heterogeneities that exist among different industries, firm-size classes, firms, or even establishments (see Chapter 3, sub-section 3.6.3). This complexity feature of modern economic life, if ignored in empirical research, could weaken or invalidate research findings. This is due to the intervening effect of many salient idiosyncrasies of the units analysed. In this Thesis, the problem of heterogeneity among units is acknowledged, and the intensity of this research problem is thought to be at its minimum, in view of the following reasons:

1. The use of microdata and the most available disaggregation level to classify firms within the industry boundary (4-digit ISIC2 classification).
2. The truncation of single-person enterprises to account for producer heterogeneity.
3. Unlike the case in industrial economies, most manufacturing enterprises in Jordan (as in most LDCs) are single-establishment firms with limited product variety; problems of multi-products firms and intra-industry variation in product characteristics and mix are not severe in JMIs.
4. In the case of pooling data of various industries to establish widely applicable generalisations, industry dummies are introduced in the model to control for industrial idiosyncrasies.

The relevance of scale efficiency assessment to LDCs' competitiveness

Scale is potentially a crucial quality ladder and cost driver in manufacturing in small LDCs, particularly in high-technology industries. Flexible technology, external resources and inter-firm cooperation can effectively mitigate or possibly eliminate the need for large scale in some industries, but these factors are significantly less common in LDCs.

Most empirical work on scale efficiency has been undertaken in industrial large nations, spurring the need for research in small LDCs. While the engineering method appears too expensive in LDCs, caution should be observed in interpreting the results of the survivor technique, as this approach assumes open competition and contestable markets.

4.3.4 Dynamic Efficiency: Process Innovation, TFP Growth and Technical Progress

The nature of dynamic efficiency and related concepts

While both allocative efficiency and TE are static performance notions, dynamic efficiency, in contrast, embodies a time dimension. To further appreciate the difference among the three efficiency concepts, one can say that achieving allocative efficiency (in factor mix) can be represented by moving *along* the production frontier in a way that reflect the relative scarcity (and thus cost) of various inputs. Change in TE, on the other hand, entails moving *towards* the production frontier (Sharpe, 1995). Finally, improvement in dynamic efficiency can be characterised by a *shifting out* in the production frontier over time resulting from advances in knowledge and organisational effectiveness (Oulton and O'Mahony, 1994), an important process in improving future economic growth and GC in LDCs.

Economists disagree on the exact relationship between static and dynamic efficiency, but it is widely believed that the two goals can be inconsistent. For example routines or old technologies that improve static efficiency can result in inertia that prevents dynamic efficiency (Jacobson and Andreosso, 1996). Other potential areas of conflict are patent regimes (Deakin and Hughes, 1999), policy towards high profitability in concentrated markets (Oughton, 1993) and industrial targeting policy.

Dynamic efficiency (or technical progress) is the outcome of *process* and *product* innovation and diffusion. It can be defined as *the rise* in the ratio of total output compared with total inputs (Shepherd, 1990). Technical change, a crucial dimension of market performance, is derived from innovation, learning and technology transfer. Innovation is a heterogeneous activity that is difficult to measure (Shaw and Sutton, 1976; Ferguson and Ferguson, 1994). Empirical research has employed three main measures (Davies, 1991b: 212) [16]:

- Head-counts of number of patents issued.
- Expenditure or employment of personnel on R&D.
- Head-counts of the number of innovations, sometimes confined to 'significant' innovations.

[16] Furthermore, examining the 'technology content' of exports (Lall, 1998) is another approach for assessing economy-wide innovative capability. For practical manuals used in measuring scientific and technological activities, see OECD (1981, 1993) and OECD and Eurostat (1997).

While the first two measures are input-based, the third is an output-based measure of innovativeness. All of the above measures suffer from certain pitfalls (Ferguson and Ferguson, 1994). For example, the first and third measures lack homogeneity, while the second measure may not be well correlated with innovation. Furthermore, patent counts may distort innovative activity because many patents are never exploited.

The nature and advantage of TFP growth (vis-à-vis LP growth)

Empirically, technical progress is usually measured by *growth* in TFP, which is responsible for a substantial proportion of real GDP *growth* in Western economies over the long run. TFP *growth* can be defined as that part of output growth that cannot be explained by input growth[17]. Because a portion of TFP growth is potentially due to many factors; changes in labour quality, capital vintage, omitted inputs, capacity utilisation and scale effect as well as mismeasurement of inputs and output, it is also called a 'measure of our ignorance'. Variations in TFP growth among industries are crucial determinants of evolving CA and have a major impact on both growth potential and structural change in the medium- to long-term (Nishimizu and Robinson, 1986).

The following is a summary of main advantages of TFP growth (vis-à-vis LP growth) as a competitiveness indicator:

1. TFP growth analysis has been used to address the important question of *sources of long-run growth*; whether industrial growth has been a primary outcome of employing more factor inputs (so-called extensive growth) or due to improvements in 'technical knowledge' (intensive growth). This can help in formulating an industrial policy that is conducive to higher and sustainable industrial growth and productivity (Ray, 1998), though caution should be observed concerning the *direction of causality* (see below). On the other hand, TFP *growth*, in principle, is one of the best performance criteria in evaluating *improvements* in competitive position, and whether the industrial sector in a specific economy is *catching up, forging ahead or falling behind* the world productivity leaders (see Abramovitz, 1986).

2. LP measure fails to *explain* sources of changes or variations in productivity. LP, in other words, fails to distinguish between increases in LP that arise from capital deepening and increases resulting from technical progress (Krueger and Tuncer, 1980).

[17] TFP *level* can be defined as output per unit of total factor input. Though Ray (1998: 118) suggests that TFP *level* "carries no information at all, because it can be chosen arbitrarily" depending on the chosen base year of estimation, TFP levels are indeed crucial in international benchmarking, albeit quite difficult to compare.

Against these advantages of more complexity, one can summarise the following disadvantages:

1. Growth decomposition or identity, though informative, yields no clear conclusions regarding the *direction of causality* between output growth and productivity growth. Indeed, higher capital accumulation and better utilisation of idle capacity associated with fast output growth can lead to an increase in TFP (Cameron et al., 1997; Devine et al., 1993). Thus, this important **CAT** still lacks a strong theoretical foundation (Lall, 2000a).

2. Since TFP growth is determined simply as a residual, it encompasses, in addition to technical progress, the effect of all influences on efficiency of production (Cameron et al., 1997: 18). In addition, being a residual, TFP growth estimates are sensitive to errors of measurement (Krueger and Tuncer, 1980) and omitted variables.

3. TFP growth analysis typically assumes constant returns to scale and TE (Coelli, et al., 1998: 133). Clearly these assumptions can be unrealistic.

The Measurement of TFP Growth:

Using the production function approach, and to simplify the analysis, let us assume a two-input Cobb-Douglas (CD) production function with constant returns to scale - a typical start in TFP analysis:

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}$$

Where Y is VA, A is TFP level or the 'residual', K and L refer to capital and labour services respectively, and t is time. The parameter (α) stands for the share of capital in total compensation of factor inputs (VA), while (**1-**α) represents wage share. Actually, the two parameters represent elasticities of output with respect to capital and labour, respectively. Differentiating the last equation, assuming (α) to be a constant.

$$\therefore \frac{\Delta Y_t}{Y_{t-1}} = \frac{\Delta A_t}{A_{t-1}} + \alpha \frac{\Delta K_t}{K_{t-1}} + (1-\alpha)\frac{\Delta L_t}{L_{t-1}}$$

TFP growth in the above equation can be defined as the difference between rate of output growth and rate of growth of inputs, appropriately weighted (Krueger and Tuncer, 1980). TFP growth is positive when output is increasing faster than inputs. Using time series data, and assuming a constant trend in productivity growth, TFP change can be estimated using OLS for the first equation to get the long run TFP growth trend (least square growth rate of productivity). More explicitly, TFP growth rates can be estimated based upon regression estimates of (logarithmic) time trends for outputs and inputs, and on average shares of factors of production (Krueger and Tuncer, 1980). The use of time trend smoothes a great deal of year-to-year variation in data, and average shares decrease fluctuation in input shares as well. For example, the CD production function:

$$y_t = A X_1^{b1} X_2^{b2}$$

can become

$$\ln y_t = \ln A + b_1 \ln X_1 + b_2 \ln X_2$$

The rate of exogenous technical change in an industry can be estimated by including a time-trend variable to the last equation. The production function then becomes:

$$\ln y_t = b_o + b_1 \ln X_1 + b_2 \ln X_2 + b_t t$$

Where **t** is a time trend (t=1,2,..,T). The coefficient $\mathbf{b_t}$ provides an estimate of the annual percentage change in output thought to be resulting from technical change (Coelli et al., 1998: 34-35)[18].

As with TE, TFP growth can be measured using either parametric (econometric) or non-parametric (index number) approaches[19]. The most widely used productivity index is the Tornqvist index, which has the desirable property of a flexible functional form, namely the translog function (Suer, 1995). The non-parametric approach can claim the advantage of minimum data requirements in terms of number of observations; just two data points are sufficient to estimate TFP growth in an industry. The Tornqvist TFP index measures TFP growth as the rate of growth in output not accounted for by the weighted growth of inputs (see Suer, 1995):

[18] It should be emphasised that although the mathematical formula for estimating TFP change is quite simple, empirical research is complicated by many practical choices (e.g. appropriate functional form and estimating factor shares) and data availability constraint (e.g. capital stock and input deflators).
[19] See, for example, Coelli et al., 1998; Suer, 1995; Oum et al., 1992.

$\ln TFP_1 - \ln TFP_0$

$$= \ln(Q_1 / Q_0) - \sum_{i}^{N} \{(W_{io} + W_{i1})/2)\} \ln(X_{i1} / X_{i0})$$

Where 1 and 0 are adjacent time periods, Q is (*real* gross or net) output, Xi is the *quantity* index for input *i,* and Wi is the cost share of input *i* (shares of capital and labour in VA). This method still assumes constant returns to scale (RTS), which can be tested econometrically.

The relevance of dynamic efficiency assessment to LDCs' competitiveness

TFP growth offers a potentially useful indicator of manufacturing competitiveness at the sector or industry level in LDCs. As clarified by Dogramaci and Adam (1981: 26):

> " *[TFP analysis] should be helpful in (1) identifying the portions of output growth that cannot be explained by changes in tangible inputs; (2) facilitating the formulation of working hypotheses with regard to major factors affecting the size of TFP and its growth pattern, thereby promoting a better understanding of the production process; (3) assessing the welfare implications of variations of TFP in terms of changes in the "total pie" available for distribution at the economy, industry, and company levels; (4) monitoring potential for changes in relative performance levels of companies and industries (e.g., profitability, growth, competitiveness) and the economy (e.g., inflation, employment, living standards, international trade); and (5) managing government enterprises and regulated industries on the basis of production efficiencies*".

The technique's principal strength point is its long-term view of industrial performance and technological capabilities. Moreover, while allocative efficiency is open to different interpretations concerning its feasibility and social desirability, TFP according to Norsworthy and Jang, (1992: 9) is the "only measure whose increase is unambiguously beneficial, in the sense that is corresponds to a decline in the total unit cost of production"[20]. The main weaknesses of TFP analysis are: (i) strong *a priori* assumptions; and (ii) its nature as a residual[21]. Applications typically proceed without testing the hypotheses regarding the presence of constant RTS and absence of technical inefficiency, both tend to be unrealistic in many industries. Furthermore, being a residual, this summary measure is affected by measurement errors (e.g. in capital stock), omitted inputs (both observable and unobservable)

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[20] This assertion assumes that TFP growth will contribute positively to job creation in the long run.
[21] See also the criticisms of Lall (1990; 2000a).

and overall specification errors (see Oum et al., 1992). Most applications in LDCs, due to limited statistical capabilities, are plagued by data imperfections, thus affecting the reliability of estimates. Finally, due to late industrialisation of LDCs, disaggregate time-series data are typically available in LDCs for a relatively short time period. This constraint can be eased through using non-parametric techniques, such as the Tornqvist TFP index.

4.3.5 Product Quality and Product Innovation

The concept of quality and related measures

Quality differential arising from asymmetric technological capabilities across countries is considered today a crucial determinant of industrial competitiveness in modern global markets[22]. In a world characterised by the dominance of product differentiation and innovation as well as enforcement of product standards and technical regulation, a minimum level of product quality is essential for a viable and outward-oriented manufacturing sector. According to Swann (1998: 137), "in a majority of competitive settings, quality (defined broadly) is a more important source of competitive advantage than price, and sometimes much more important".

Despite the recent consensus on the crucial impact of quality in establishing firm's competitive advantage, the concept defies easy definition. Quality is sometimes defined as "everything that influences consumers' preferences apart from the price variable" (Stout and Swann, 1993: 28). This definition is a good reminder of the two main sources of competitive advantage; cost (or price) advantage and differentiation advantage. Others define quality as "the totality of the attributes of a good or service which meet the requirements of buyers or customers" (Pass et al., 1993: 455). As the latter definition shows, quality has both a subjective dimension and an objective element (Swann, 1998). Unlike price, quality is a multi-dimensional concept, covering many aspects of the product, including performance, design, delivery, after-sales services, 'image' or marketing and other non-price factors (Swann, 1998).

[22] Empirical evidence has showed that changes in price competitiveness (approximated by changes in ULCs) do not account for the whole changes in export shares in industrial countries or, in a much stronger version, is indeed associated with it inversely (so-called the 'Kaldor paradox'), thus fuelling the research on non-price competitiveness.

The link between quality performance and other measures of industrial performance such as profitability and TE is a complex issue. Early strategy literature maintained that organisations (firms, economies, etc) could not simultaneously pursue a low-cost and a differentiation strategy; otherwise they will "stuck in the middle" (Porter, 1980). Producing a novel product in performance, design, location, or image, it is argued, is costly, and thus differentiation option can easily contradict with the cost leadership strategy. The implications of such an argument to LDCs are important, since it indicates that LDCs, lacking the innovative capabilities of industrial countries, cannot enhance their competitive advantage and stuck in their low-order positioning strategy. However this may not be the case.

Zairi (1994) distinguishes between negative and positive quality. Negative quality is the minimum level of quality that firms need to sustain to avoid contraction or closure. It is basically a quality *control*, not necessarily a quality *improvement*, concept. Negative quality is reactive to incidents and complaints and it is mainly a *cost*-driven concept. Positive quality, on the other hand, deals with innovativeness and product development. It is essentially a *benefit*-driven concept aiming at customers' maximum satisfaction (Table 4.3).

Table 4.3
Main Types of Quality

	Negative Quality	**Positive Quality**
Ultimate Aim	Avoiding waste (technical efficiency)	Achieving value (dynamic efficiency)
Emphasis	Costs	Revenues
Main instrument	Quality control	R&D and imitation

NOTE: While embracing quality standards can enhance the competitive advantage of firms, it is hardly covered by the exact definition of R&D activities. According to Frascati Manual (OECD, 1981), quality control and standardisation is part of scientific and technological services, which is distinguishable from R&D.

SOURCE: based on Zairi (1994).

Recent research on business strategy highlights the possibility and reality of integrating low-cost and differentiation strategies[23]. Indeed, one of the central themes of Total Quality Management (TQM) is that minimising product defects results in net cost savings and thus superior profitability (Grant, 1998). Thus, improving negative quality enhances TE through minimising defective output; it maximises output using the same amount of input. To

[23] See, for example, Coulter (1998) and Grant (1998).

conclude, pursuing negative quality does not entail excessive additional expenditures, and can allow a partnership between quality strategy and low-cost strategy.

Measuring quality performance

Among various dimensions of industrial performance, quality is probably the most difficult to measure. The measurement of quality competitiveness is blurred by problems of definition and measurement, which exacerbated at the international level. Evidence about non-price competitiveness can be established through various research designs:

- Cross-section subjective approach (surveys of buyers).
- Hedonic price regression approach. This 'objective' approach for the measurement of quality *changes* uses either cross-section or time series data[24]. One clear disadvantage of the method is its data requirements, even for one product, one country case (Buxton and Mananyi, 1998).
- Time series external trade techniques. Many variants exist for this aggregate approach such as unit values (Aiginger, 1997) and income elasticity of exports and imports (Donek, 1998).
- Ad hoc proxies: three measures of technology measured at the industry level are often used; R&D expenditure, patenting activity and investment in fixed capital[25]. More relevant measures in LDCs are indicators of technology transfer (e.g. technology licensing and technical agreements). Similar to the ratio of R&D to industrial output, royalty payments indicator: (i) is an input measure; (ii) is ignorant to other inputs to technical change such as 'learning-by-doing'; (iii) higher ratio could be the result of declining value added; and (iv) the measure ignores unauthorised technology imitation.

The relevance of product quality assessment to LDCs' competitiveness

Increasingly, LDCs aiming at improving export performance and facing import penetration should upgrade their quality reputation. They need not reach world-class level of quality, but seek to achieve negative quality as well as 'cheap' elements of positive quality. Choosing to compete just on the basis of labour costs advantage is "a very poor strategic choice" (Fairbanks and Lindsay, 1997: 31) as this advantage has "become less important" (World Bank, 2000a: 212). The huge implications of ignoring quality can be judged by the beef crisis in the UK (Hirst and Thompson, 1999).

[24] See Berndt (1991) for a survey.
[25] See, for example, Carlin et al. (1999).

In view of the above, one might wonder why most entrepreneurs in LDCs are still ignorant regarding the 'quality imperative'. There are certain conjectures regarding the reasons for this ignorance. Some explanations rest on incentive structure, others on limited capabilities and resources of entrepreneurs. It is sometimes suggested that LDCs producers were less keen to invest in improving quality because consumers in such low-income countries are not willing to pay for it (see, Stout and Swann, 1993 for a general argument). According to this argument, quality is valuable to producers only if customers are prepared to pay for it (Perman and Scouller, 1999: 195). This argument, however, fails to explain the high import penetration of Western, high quality, products in LDCs, at least in certain industries. Moreover, within the new global rules, internationalisation of economic activity requires taking into account preferences of foreign as well as domestic customers.

The other argument suggests that most firms in LDCs lack the technological capabilities (see Lall, 1992) and resources necessary to upgrade the quality of their products, particularly in the dominant sector of SMEs. According to the document laying down the guidelines for the European industrial policy (EC, 1990), pursuing a strategy that combines both high positive quality and acceptable price requires special organisational skills in addition to technical expertise and capital.

4.3.6 Labour Productivity (LP)

Introduction

Measures of productivity can be classified into single factor productivity and TFP. The simplest and most commonly used index of single factor productivity in manufacturing is LP, commonly defined as output per employee. LP, both its level and growth rate, is one of the crucial measures of comparative economic performance for both intertemporal and international comparisons. Though TFP is a more comprehensive measure of productivity, high share of labour compensation in value added (VA) implies that LP tends to be a reasonable approximation for TFP (Pilat, 1996).

The level of LP in manufacturing industry can be measured by different methods: VA per employee; VA per hour worked; gross output per employee; gross output per hour worked. While comparison among different industries in the same country faces the problem of heterogeneity in capital intensity and technology opportunity, cross-country comparison is further constrained by price differences and the availability of internationally comparable data (see Chapter 3).

Productivity gaps (differences in productivity *levels*) among economies are typically measured in terms of LP rather than TFP due to serious difficulties in comparing real capital stocks across countries (Kravis, 1976; Pilat, 1996). Furthermore, most international LP comparisons are based on VA *per worker* rather than VA *per hour* because of availability of employment data (Sharpe, 1995). While some economists prefer to use VA *per hour* in cross-country comparisons because average weekly hours actually worked differ across countries for various reasons, others argue that estimating annual hours are difficult to be made accurately since it involves making allowances for sickness, maternity leave and holidays (Oulton, 1994). Finally, although *gross output* might be a superior concept for estimating productivity gap than *net output* (or VA), gross output is typically not available for international comparisons.

Price conversion in international comparison of manufacturing LP

It is well known that intertemporal comparisons of industrial LP levels within a specific country require price deflators (producer price indices) to transform nominal values into real levels adjusted for price changes *over time*. Similarly, international comparisons of LP levels entail converting nominal values in national currencies into a common currency adjusted for price differences *across space*. Cross-country differences in value of output per worker could be due to differences in quantity or price. Because price structures do differ across countries, this fact should be taken into account in making international comparison of output and productivity. Thus, the measurement of manufacturing LP gap between economies requires accounting for the *relative* producer prices of manufactured products (O'Mahony, 1992). As emphasised in Chapter (3), exchange rates do not necessarily reflect disparities in price structures. Thus, there is a need to construct industry-specific inter-spatial price indices in any serious attempt to make international comparison of manufacturing VA or industrial productivity[26].

There are at least four methods for currency conversion or for dealing with relative price structures at the industry level[27]:

[26] Industrial publications of international organisations, such as the UNIDO, still use US dollars as a conversion factor. See UNIDO (2000).
[27] See, for example, O'Mahony, 1992; MGI, 1993; Pilat, 1996.

1. Industry of origin approach (unit value ratios UVRs). The main features of this approach are as follows:

   - It takes a sectoral perspective to estimate industry-specific PPPs through comparing producer price levels of 'representative' products among countries (Pilat and Prasada Rao, 1996).
   - It computes UVRs through getting information, mainly from census data, about sales values and quantity produced, at the product level, for a 'representative' *sample* of goods.
   - It uses census data to ensure that figures for VA and employment refer to the same reporting unit (O'Mahony, 1992).
   - It faces difficulties in matching *products* and *industries* in aspects of *quality* variations and *mix* differences (MGI, 1993). If countries are producing a wide range of varieties and qualities of a particular good, the derived UVR is a rather crude measure for comparative purposes. This limitation is at its minimum in homogenous goods (Pilat, 1996). In general, the production structure of economies tends to be far less comparable than the expenditure structure.

2. Using physical measures approach: this method tries to avoid the problem of comparing nominal or monetary values among economies through using physical productivity measures, e.g., thousands tons of cement per worker (Rostas, 1948). But in the modern manufacturing sector, there are few industries producing a single homogenous output to fit properly this approach (Kravis, 1976).

3. Utilising final expenditure purchasing power parities (EPPPs) information. The main features of this approach are as follows:

   - It takes a macro perspective and compares prices of detailed final expenditure categories (consumer goods and capital goods, but *not* intermediate goods) across countries (Oulton, 1994).
   - It uses International Comparison Program (ICP) PPPs for currency conversion (MGI, 1993). United Nations, EC (Eurostat) and OECD implement ICP with the aim of comparing living standards among economies.
   - It corrects *consumer* prices of final expenditures taken from ICP to construct industry-specific prices (*producer* price ratios). Thus, adjustments should be made to EPPPs to transform them into industry-specific PPPs.
   - EPPPs are based on expenditures within a country not output, so it includes imports and exclude exports (Oulton, 1994).

4. Using total GDP PPPs: for cross-country comparisons of economy-wide LP, it is appropriate to use total GDP PPPs, such as those published by Summers and Heston (1991). Some studies do utilise such data for comparing industry-level LP across countries (Havlik, 1998). This practice, imposed by lack of data, commits "a very strong simplification" (Ibid: 174), with errors that are "unknown, but obviously depend on the

relative sizes of the manufacturing sectors across countries and their representativeness" (Buxton and Lintner, 1998: 449).

Among the four methods, the first one is currently the most common and operational technique for comparing sectoral productivity gap. Indeed, a leading project adopting such method is the International Comparisons of Output and Productivity (ICOP) at the University of Groningen. This project has been lunched in 1983 to compare output and productivity in a selected number of countries, taking a sectoral perspective (Pilat and Prasada Rao, 1996).

Advantages of LP measure (versus TFP):

1. LP is easier to estimate and compare over time and across firms. Furthermore, its data requirements are more accessible. This is due mainly to the fact that labour input is more easily and accurately measured than capital input.

2. LP is an important performance criterion for both society's economic welfare and GC. As illustrated by Smith et al. (1982: 13):

> "*At the national level, output per man, and by extension, output per head of the population, is the basic determinant of living standards. At the sectoral level, since labour costs bulk large in many economic activities, differences in labour productivity levels are a major determinant of inter-industry costs and international competitiveness*"

3. LP imposes very few (if any) theoretical restrictions on data compared with TFP (Cameron et al., 1997), and it is free from any functional form. The key assumption in *output per worker* measure is that the worker in various industries and countries operates the same number of *hours per year*. TFP analysis, on the other hand, assumes perfect competition in output and input markets and constant returns to scale, a common benchmark throughout the empirical literature (Cameron et al., 1997), but may prove to be unrealistic.

The relevance of labour productivity assessment to LDCs' competitiveness

LP is an important CAT in terms of cost competitiveness and living standards. Moreover, when utilised as a *change* indicator, the tool can be easily and fruitfully used in international comparisons.

While LP *level* is certainly a useful indicator for international benchmarking, it is fair to say that comparability of data and of industrial structures among countries makes productivity gap research plagued by measurement errors. This is particularly true if the gap is estimated between a developing economy and an industrial country. Although detailed and appropriate cross-country price information -preferably at the product level- is an essential requirement for investigating productivity gap, this is by no means the only obstacle. Products chosen in the sample should be representative of the entire production structure as well as comparable in terms of variety and quality (see also Chapter 3 on pitfalls of international benchmarking). Thus, probably only in the context of an industry case study research design one can hope to get reasonable estimates for productivity gap between a developing country and an industrial counterpart.

Productivity gap research in general presupposes implicitly that labour and capital are homogeneous factors of production, i.e., no qualitative differences among factor inputs (Jacobson and Andreosso, 1996). For example, quality of employees can vary markedly over time and across space, not so much because of innate ability but because of asymmetric levels of education and training (Lansbury and Mayes, 1996). In addition, employees may work different number of hours per day or work part-time. In summary, it seems that there is no perfect homogeneity in either people or hours (Mayes, 1996), and this can affect estimation accuracy of productivity gap.

4.3.7 Unit Labour Costs (ULCs)

Introduction

The unit labour costs (ULCs) measure is an elaboration of the LP performance measure for the purpose of measuring cost competitiveness. ULC is defined as the ratio of *total* nominal labour compensation divided by *quantity* produced or *real* VA (O'Mahony, 1995). Total labour compensation or cost includes both wage and non-wage costs, i.e., various additional costs accruing as a result of the employment relationship such as social security payments, pension contributions and alike should be included. However, since ULC is a measure designed to assess the combined role of labour costs (LCs) and LP (Oulton, 1994), it is convenient to divide through by labour input to get the formula:

$$\textbf{ULCs} = \textbf{ALCs} / \textbf{LP}$$

where **ALCs** is average LCs per employee at nominal prices, and **LP** is VA (or gross output) per employee at *constant* prices. It is also common to adjust ULCs for exchange rate changes, another important determinant of competitiveness:

$$\mathbf{ULC\ \$_t = E_t.\ ULC_t}$$

where E_t is the exchange rate in period t. The last index serves for comparing *changes,* not levels, of ULCs across countries. The ULC summary statistic can be estimated for the whole economy (GDP), manufacturing sector, or for a specific industry. The rationale for ULCs measure is that LP, both levels and changes, cannot be adequately assessed apart from LCs per worker (and vice versa). This is due to the fact that high LP is frequently accompanied by high labour compensation (Hooper and Larin, 1989; Oulton, 1994; Havlik, 1998). LCs level in manufacturing industries is one of the fundamental cost drivers. It is a crucial indicator of price competitiveness in price-elastic labour-intensive sectors (Havlik, 1998). LCs compared with capital costs can claim the virtues of being: (i) more readily available; (ii) more variable (Buxton and Mananyi, 1998) both across countries and over time; and (iii) constitute a high proportion of VA.

It is worth noting that comparisons of ULCs *levels* among countries require internationally comparable estimates for VA or LP levels. At the macro level, one can utilise GDP PPPs, but the same cannot be true at the manufacturing sector level, unless one adopts a quite strong assumption that "the relative price levels in the manufacturing industry (and its individual branches) are the same as over the whole GDP" (Havlik, 1998: 165-166).

ULCs performance measure, despite its superiority to LP, has been criticised on the basis that it does not take into consideration total production costs, in addition to its shortcoming in measuring non-price (quality) performance (Muhtaseb, 1995).

The relevance of ULCs' assessment to LDCs' competitiveness

As for competitiveness analysis in LDCs, industrial ULCs measure is relatively easy to track over time, assuming the availability of producers' price indices at the desired level of disaggregation. In view of the difficulties encountered in comparing production and price structures as well as labour quality between a developing country and an industrial economy, one possible solution is to use the method adopted by the US Bureau of Labor Statistics

(BLS) for international productivity comparisons. This method is based on comparing *trends* (instead of *levels*) of ULCs for the countries concerned. Moreover, the method can be applied based on national currency or US Dollars.

Through comparing indices of ULCs among global competitors relative to their *own* performance in a *unified* base year, one can monitor *changes* in competitiveness position compared with other competitors.

4.3.8 Trade-based Indicators

Overview

Unlike previous measures, trade-based performance indicators are result-based measures of competitiveness, designed to measure industrial performance in open economies. Trade-related measures, particularly export performance measures, have received more attention by competitiveness analysis in recent years. The availability of internationally comparable trade data at a fine level of disaggregation coupled with advances in data management capabilities of modern computers are among the factors for growing use of trade statistics in international benchmarking and global market positioning (see ECLAC and World Bank, 2000).

Acknowledging the link between industrial organisation and industrial trade in modern open economies, trade performance is preferably measured at the industry-level, although sometimes the analysis is done at the level of the commodity or commodity groups due to data limitation. In the literature, the following trade-based indicators are cited[28]:

- **Revealed comparative advantage (RCA) or the degree of specialisation**: this criterion shows the relative importance of a country's export of a particular product relative to its overall export performance (UNCTAD, 2001). It is measured by the ratio of a country's world market share in a particular product to the world market share of its total manufactured exports. Thus, it is calculated in a specific year as follows:

  (Country's exports of a specific manufacturing industry / World exports of the industry) /
  (Country's manufacturing exports / World manufacturing exports)

[28] See, for example, Jacobson and Andreosso, 1996; Brenton et al., 1997; Kim and Marion, 1997.

This criterion requires global as well as domestic data. The 'world' can be defined as all countries reporting to the United Nations, or confined to strongest competitors or trade partners. If RCAi > 1, the country has a CA in relation to industry i[29].

- **OECD measure of RCA**: measured as:

  (Domestic exports of a specific manufacturing industry / Total domestic manufacturing exports) / (Domestic output of a specific manufacturing industry / Total domestic manufacturing output)

  This measure requires data on output as well as trade, but does not require global data.

- **A third measure of RCA**: compares the share of exports and imports in a particular industry with the relation of total exports to imports:

  (Exports of a specific manufacturing industry / Imports of the same manufacturing industry) / (Total domestic manufacturing exports / Total domestic manufacturing imports)

- **Intra-industry trade (IIT) index**: intra-industry trade is the simultaneous import and export of products belonging to the same industry (i.e. products differentiated by quality or attributes but which are close substitute)[30]. This index can be interpreted as a measure of product variety enjoyed by the consumer in a specific industry (Greenaway and Milner, 1987), an indicator for potential competitiveness (Havrylyshyn and Kunzel, 1997), or an indicator for vulnerability to trade liberalisation (EC, 1997e). Most empirical work uses Grubel and Lloyd (G-L) index, which can be written as:

  $$\mathbf{IIT = 100 * [\,1 - |\,Xi - Mi\,|\,/\,(Xi + Mi)]}$$

  For a specific industry, if IIT index has the minimum value of zero, there is no intra-industry trade. If the index has the maximum value of 100, this indicates complete intra-industry trade (Xi equals Mi).

- **Net export share**: measured as exports minus imports as a percentage of total world exports in the industry.

- **Relative trade performance index**: a measure of trade performance of an industry relative to performance of other industries *in a country*. It is measured as:

  (Domestic exports of a specific manufacturing industry / Total domestic manufacturing exports) - (Imports of the same manufacturing industry / Total manufacturing imports).

- **Net Trade index**: measured for an industry in a given country as (exports - imports) / (exports + imports).
- **Net exports**: measured for an industry as its trade balance (exports - imports).
- **Exports intensity**: defined for a specific industry as the ratio of exports to gross output or production (total sales).

[29] For a critical assessment to the theoretical basis of this family of measures, see Bowen (1983). These measures implicitly assume that a country exports every commodity. Moreover, as Temple [Paul] (1998) has emphasised, RCA says nothing about whether the denominator (world exports) is either rising or falling.
[30] On the empirical measurement of IIT, see Bowen et al. (1998). For an up-to-date survey on the theory, measurement and policy issues of IIT, see Greenaway and Torstensson (1997).

- **Imports penetration ratio**: defined for a specific manufacturing industry as imports to gross output or, more accurately, to apparent consumption[31] (gross output + imports - exports). This measure is hard to compare across countries, as this requires internationally comparable *output* data.
- **Coverage ratio**: defined as exports/ imports.

The relevance of trade performance assessment to LDCs' competitiveness

Although Harrison (1995) suggests that TFP rather than trade is the preferable criterion for competitiveness since commodity trade statistics precludes trade in services, it is fair to say that TFP is not also a perfect measure, particularly in LDCs, due to difficulties of international comparability and measurability (e.g. capital stock).

On the other hand, while trade data are more internationally comparable than output data, it typically suffers from problems in coverage (smuggling; only exporting firms are covered), classification (not research-friendly in industry analysis) and internal inconsistency (Rozanski and Yeats, 1994), particularly in LDCs. Furthermore, adopting a trade-based approach to competitiveness ignores other important modes of foreign entry, over and above exports, such as licensing and FDI (Traill and da Silva, 1996). This fact could distort international comparison of competitiveness using commodity export data.

4.4 Conclusions

This Chapter emphasises the variety and complexity of the measurement dimension within the economics of GC. It shows that *industrial competitive performance* is a fuzzy concept that embodies multiple dimensions. To ensure robustness in conclusions, multiple measures of competitive performance, or what the Researcher called *Competitiveness Analytical Tools* (CATs), can be utilised in assessing overall industrial competitiveness and in designing industrial policies. Another clear conclusion is the crucial role of interpretation in industrial assessment; competitiveness measures do not speak for themselves.

A complex issue might arise if competitiveness tools happen to signal conflicting conclusions. For example, SMEs, using labour-intensive and 'appropriate' technology, are often believed to be cost-effective job creators with potentially significant positive implications for welfare distribution. On the other hand, the small business sector might be

[31] Also named domestic disappearance or consumption, home demand and market size.

'inefficient' vis-à-vis large firms sector. The question arises on how to rank the relative importance of the above outcomes, assuming that empirical analysis has confirmed the above relationships in a certain economic context.

If economic performance is a term "used to measure how well industries accomplish their economic tasks *in society's interests*" (Viscusi et al., 1997: 73 emphasis added), then objective assessment of industrial performance and arrangements, *in cases of policy conflicts*, should be based on the society's social welfare function. More clearly, to properly assess policy changes, market structures and firm size in a given context, economists need a social ranking of economic objectives upon which they can evaluate the ability of various economic arrangements to achieve 'society's interests'. In practical terms, industrial assessment must take into account national objectives and social premisses.

In addition to issues of robustness, interpretation and policy conflict, another constraint on objective assessment of industrial performance is embodied in the fact that CATs are typically based on certain a priori assumptions. Table (4.4) exhibits restrictions imposed on data (or interpretation) for various industrial performance measures. The Table clearly shows the interdependence among various CATs.

Table 4.4
Main Assumptions of CATs

Industrial Measure	Main Assumption(s)
LP & ULCs	Constant capital intensity (for LP); identical hours worked per year
Trade-based indicators (RCA *family* of measures)	The country exports every commodity (Bowen, 1983)
Technical efficiency (TE) (parametric method)	Parameter homogeneity; negative skewness of OLS residuals
Scale efficiency (parametric regression method)	Parameter homogeneity and TE
Allocative inefficiency (excess profit)	Constant returns to scale; symmetric TE between small and large firms
Dynamic efficiency or TFP growth (parametric method)	Parameter homogeneity; constant returns to scale; TE; absence of measurement errors or omitted variables

SOURCE: Researcher.

An overall conclusion is the analytical difficulty in detecting potential comparative advantage in JMIs, particularly in picking 'winners', or designing selective industrial policy where *future* growth is targeted. Thus, in crafting and executing industrial competitiveness policy, accurate information relevant to judging competitiveness and potential comparative advantage must be sought continuously from every possible source (Westphal, 1990).

As for coming Chapters, the above Table shows clearly that testing the constant returns to scale (RTS) hypothesis is essential for many further assessment of CATs, notably allocative and dynamic efficiency. Thus, Chapter (6) is intended to cover scale efficiency in JMIs. Furthermore, TE did not receive the sufficient attention of the SCP paradigm. In contrast, "literally hundreds of...studies have examined the relation between concentration and profitability in cross-section data" (Schmalensee, 1988: 666), inviting the effect of diminishing research returns in examining allocative efficiency (at least in industrial countries). At any rate, TE might represent a more useful concept than allocative efficiency in view of the sensitivity of allocative efficiency recommendations to both the ethical premisses of Paretian welfare economics and the factual implications of the theorem of the second-best. Consequently, the present Thesis will focus on technical and scale efficiency, acknowledging that dynamic efficiency in JMIs has been covered by previous research.

CHAPTER FIVE

Inter-Industry Investigation of Technical Efficiency in a Small and Developing Economy: The Case of Jordan's Manufacturing Industries

5.1 Introduction

In parallel with increasing interests in upgrading industrial competitiveness, a widespread and rapid increase in volume of published research is devoted to empirical assessment of technical efficiency (TE) in various industries of the economy. In the literature, TE in manufacturing has been subject to investigation at both firm level (Taymaz and Saatci, 1997; Ahuja and Majumdar, 1998 and Lundvall and Battese, 2000) and industry level (CB [Caves and Barton], 1990; CA [Caves and Associates], 1992; Mayes et al., 1994). As the largest tradable sector in the JE, improving TE in Jordan's manufacturing industries is crucial for any Jordanian competitiveness programme[1].

Technical efficiency investigation represents a modern empirical application of production theory, and has been applied in many policy spheres such as industrial policy and regulatory policy. This research direction in productivity and efficiency analysis aims at examining the nature, magnitude and influences on TE in wide varieties of industries (Fare et al., 1994: XVI).

The influential work of Farrell (1957) has led to multiple approaches for the empirical measurement of TE with different levels of sophistication (see Chapter 4). These techniques share the idea of 'best-practice' firms, where the observed performance of homogenous firms in an industry is compared with the 'best' reported performance, as measured by the frontier.

[1] Based on 1994 Census microdata, size distributions of manufacturing firms by labour productivity (LP) in 51 JMIs have revealed high variations in LP within JMIs, signalling potentially high levels of technical inefficiency and large gains from alleviating the problem.

In this context, technical inefficiency is defined as the distance by which a firm lies below its industry frontier. Among various research designs for investigating TE, this Chapter adopts the *Stochastic Frontier Analysis* (SFA) to accommodate noisy data in the context of a small developing economy.

Traditional industrial economics found in SFA an opportunity to revive its research on cross-section variation in industrial performance. Although SFA was originally applied to a single industry or sector adopting inter-firm research design, some industrial economists extend this methodology to explain inter-industry TE, using the structure-conduct-performance (SCP) paradigm.

Utilising cross-section census microdata, this study attempts, for the first time, to examine TE in JMIs in two stages. While the first stage aims at measuring industry-level TE, the second stage addresses the question of explaining inter-industry variation in TE. The study helps to extend the literature in three ways. First, in the measurement stage, the more flexible form of inefficiency distribution, the truncated-normal, is applied successfully. Second, an explicit research strategy is adopted to accommodate noisy data and small enterprises in measuring TE within a small developing economy. Third, in stage of TE explanation, the principal component analysis is utilised to pick up common patterns in various TE measures. Furthermore, a brief survey of TE research in manufacturing sector is presented.

The Chapter is structured as follows. Section 2 examines main conceptual and practical issues in TE investigation, covering both the measurement and explanation stages[2]. Questions of measurement errors and heterogeneity in firm size, two main idiosyncrasies of TE research in small LDCs, are explored in this section. Section 3 presents an overview of previous findings in manufacturing. While section 4 examines the estimation stage of SFA in JMIs, section 5 investigates inter-industry differences in TE. Finally section 6 ends with preliminary conclusions.

[2] Chapter (4) outlines selected main issues in TE measurement.

5.2 Theoretical and Practical Considerations in Technical Efficiency Investigation Using the Stochastic Frontier Analysis (SFA)

5.2.1 Issues in the Measurement Stage of SFA

5.2.1.1 Rationale and Assumptions of SFA

SFA has many hidden assumptions that competitiveness analysts should be aware of before making definite conclusions. The logic behind SFA can be simplified as follows: in any relatively homogenous industry, and given the same (quantity and quality) observed inputs used, firms still do not produce identical reported output. The inter-firm variation in observed performance can be explained by three main factors. These are: organisational effectiveness, heterogeneity in firm-specific characteristics, as well as random disturbances and measurement errors. The method's logic is to try to isolate the first factor (which can be controlled by the firm and reflects TE) from other non-controllable and non-relevant variables. To separate organisational and managerial effectiveness from other intervening variables that affect TE, the research methodology assumes the following:

1. Parameter homogeneity: there is a *reasonably similar* set of establishments (or single-plant firms) in a given industry (Mayes et al., 1994). This assumption enables the method to employ a single and common technology or production function (**Y=F(L,K)**) that fits properly all establishments in the industry. Moreover, it ensures that like is being compared with like. Heterogeneity of firms mixes TE with firm-specific influences. Consequently, the present technique requires microdata coupled with a reliable industrial classification. The use of more aggregate data (e.g. industry or country) is infrequent and, one can argue, highly suspect in a cross-section research design.
2. The *random* nature of the frontier: unlike *Data Envelopment Analysis* (DEA), the frontier representing maximum output in SFA is stochastic (that is, a randomly distributed, typically normal, error term) rather than deterministic. Random disturbances include both external shocks outside the control of the firm and measurement errors common in survey data. This assumption ensures that random disturbances affecting observed performance of firms are accounted for in the model and are not incorporated incorrectly in TE estimates. Unlike DEA, SFA does not blend technical inefficiency with statistical noise, but suffers from the risk of imposing a rigid error distribution in the model.
3. Variation in performance and negative skewness of OLS residuals: within an industry, and after taking into account random disturbances, measurement errors, firm heterogeneity and non-controllable factors influencing firm performance, technical inefficiency of production units is non-negative. This is due to *variability* of performance among establishments. Being positive, the inefficiency component captures the shortfall of actual output (**Y**) of average production function from potential output (**F(L,K)+u**) or best practice production level. The inefficiency component cannot be negative since this

means that firm performance can exceed the frontier. This representation ensures that all firms (observations) lie on or beneath the stochastic frontier production function, defined as maximum output that can be obtained given inputs.

Moreover, inference concerning TE can be obtained based on the skewness of the production function residuals. Industries with negative skewness are interpreted to reflect inefficiency; industries with symmetrically distributed residuals are interpreted to have no inefficiency; and industries with positive skewness are usually excluded from the efficiency analysis since these industries do not fit the structure of the model (Tybout, 1992b). The performance variation assumption restricts the type of questions that SFA can address; factors causing all firms to be uniformly inefficient, such as unfavourable business environment, will *not* be qualified in this research design (CB, 1990: 67).

5.2.1.2 The Statistical Model of SFA

This study aims at estimating the gap between average and best-practice output within each Jordanian manufacturing industry at a fine level of disaggregation (four-digit ISIC2). More specifically, technical inefficiency is modelled and estimated through augmenting the traditional average production function specification by a one-sided, non-negative, stochastic error term (ν). This novel, asymmetric distribution is intended to capture the impact of inefficiency on firm's reported output. A stochastic frontier for any form of production function can be generally specified as:

$$\mathbf{Yi = F(X_i) \,.\, exp\,(u_i - \nu_i), \quad \nu_i > 0 \;\; and \;\; i=1,\ldots, N}$$

or $$\mathbf{Ln\,(Y_i) = Ln\,F(X_i) + u_i - \nu_i}$$

Where Yi is actual output for firm i, Xi is observed inputs for firm i, **F** is the production function with a form determined by the researcher. (u_i-ν_i) is the composed error term for SFA model, one to account for random disturbances and another to account for technical inefficiency in production. u_i are the usual symmetric random error terms, independently and identically distributed as standard normal distribution with zero mean and a standard deviation equals to σ^2_u; N (0, σ^2_u). ν_i are non-negative errors, independently and identically distributed random variables with a mean μ and standard deviation σ^2_ν; N+ (μ, σ^2_ν). It represents technical inefficiency or the gap between potential output and actual output for firm i. Thus, the stochastic frontier model is a classical linear regression model with a nonnormal, asymmetric disturbance (Green, 1997).

In the two-factor Cobb-Douglas (CD) production function, for example, SFA model would be:

$$LnY_i = A + B1\ Ln\ L_i + B2\ Ln\ K_i + (u_i - \nu_i)$$

As emphasised in Chapter (4), one of the disadvantages of SFA, compared with DEA, is that there is no *a priori* strong argument to choose a specific form for the production function **F**, and for the inefficiency distribution ν. For simplicity, previous applications typically assumed ν to be a half-normal distribution with zero mean and standard deviation σ^2_v; $|N(0, \sigma^2_v|$. Other possible asymmetric distributions are exponential, truncated-normal or gamma. Instead of imposing the assumption that $\mu = 0$ in the half-normal case, the truncated-normal endogenised the truncation point for the inefficiency distribution.

5.2.1.3 Measures of Technical (In)efficiency in SFA

Using the maximum likelihood (ML) estimator[3], estimates for production parameters (A, B1 and B2 in the CD function) and variance parameters (σ^2_u, σ^2_v) can be obtained[4]. More specifically, the aim of the estimation procedures is to separate technical inefficiency from statistical noise; using data on inputs and output, a decomposition of the composed error structure (u_i-ν_i) is undertaken to obtain estimates for variance parameters, which are subsequently used to construct various TE measures. Indeed, most TE measures are based on estimates of variance parameter associated with the asymmetric (one-sided) component of the composed error. The following is the list of industry-specific measures of technical efficiency and inefficiency used in this study[5]:

First: Measures of Technical Efficiency

1. The skewness of the overall OLS residuals **(SKEW)**. This measure is positively related to TE. It is not affected by the form of inefficiency distribution, but suffers from inferior theoretical standing (Caves, 1992c: 259) compared with measures that utilise information on variance parameters, *particularly in its positive range.*

[3] Due to non-normality of the composed disturbance in SFA, the OLS estimates are inefficient in this context, and the estimate of the constant term is inconsistent (Green, 1993).

[4] A further parameter, μ, is estimated in the case of adopting the truncated-normal distribution. It should be emphasised that SFA, unlike DEA, is subject to common types of estimation failure, named by Olson et al. (1980) as case (1) failure and case (2) failure. The first type occurs when the skewness of the OLS residuals (composed error) is positive (i.e. the skewness is in the wrong direction suggested by the model). The second type of failure occurs when the variance of the inefficiency term is greater than the variance of the composed error, implying that the variance of the noise term is negative. For more information, see Mayes et al., 1994.

[5] See CB (1990) and Mayes et al. (1994) for more information.

2. The expected value of the ratio of actual to potential (frontier) output adopting the half-normal inefficiency distribution (Lee and Tyler, 1978):

   Expected TE **(ETEH)** = $E[\exp(-v)] = 2 \cdot \exp(\sigma^2_v / 2) \cdot [1 - \Phi(\sigma_v)]$.
   Where Φ is the standard normal distribution function.

   This widely used measure, and indeed the measure favoured by Caves and Barton (CB, 1990: 108), depends only on the variance of the inefficiency component.

3. The expected value of the ratio of actual to potential (frontier) output adopting the truncated-normal inefficiency distribution (Mayes et al., 1994):

   Expected TE **(ETET)** = $E[\exp(-v)] = [\exp((\sigma^2_v/ 2) - \mu) \cdot \Phi((\mu/\sigma_v) - \sigma_v)] / \Phi(\mu/\sigma_v)$.

4. Mean technical efficiency for half-normal and truncated-normal **(MTEH and MTET)**: the arithmetic (unweighted) average of firm-specific TE in the industry using both distributions (see Coelli et al., 1998: 189).

Second: Measures of Technical Inefficiency

5. The ratio of standard deviations of the asymmetric and symmetric components of the composed error using the half-normal **(LAMBDAH or λ)**.

   $\lambda = \sigma_v / \sigma_u$

This measure utilises information on both the noise component and the inefficiency component, but unlike other measures (with the exception of SKEW) can take a value that exceeds one.

6. The expected technical inefficiency **(ETIH)** assuming half-normal inefficiency distribution:

   ETIH = $\sigma_v \cdot \sqrt{(2 / \pi)}$.

7. The ratio (or percentage contribution) of the variance of technical inefficiency to total variance (or error) term **(GAMMAH)** using the half-normal distribution (see Coelli, 1995).

   GAMMAH = $\gamma / [\gamma + (1 - \gamma) \cdot (\pi / (\pi - 2))]$

Where gamma (γ) equals σ^2_v / σ^2_s, and $\sigma^2_s = \sigma^2_v + \sigma^2_u$

5.2.1.4 TE Measurement in Small LDCs: Measurement Errors and Size Heterogeneity

Introduction

Microdata-based empirical research, including TE studies, typically adopts some method for dealing with potential measurement errors. The method adopted can range from simple editing rules that 'clean' raw data irregularities, to sophisticated econometric methods.

Many factors show the important step of embracing an explicit strategy to detect and manage data errors, particularly in the context of small LDCs:

1. The existence of data errors in any data set, estimated to be 1 to 10 % (Hampel et al., 1986).
2. Measurement errors are especially common in large data sets (Neter et al., 1989) including microdata. This is particularly true in LDCs due to relative weakness of the social and legal infrastructure necessary for efficient information gathering and processing.
3. The severe skewness of firm-size distribution in small economies towards small enterprises (Staley and Morse, 1965), which are thought to have inferior data quality.
4. Census data typically suffer from noticeable non-sampling errors due to the huge effort of implementing a complete enumeration.
5. In the case of TE research, the high sensitivity of TE estimates to extreme outliers. Robust estimates of TE require, thus, special emphasis on the outlier problem.

An important and related issue in TE measurement, particularly in small LDCs, is the proper approach in dealing with micro- and small-enterprises. In the case of small developing economy, the exceptionally large share of small enterprises (in terms of numbers) and the data quality of such enterprises constitute two of the main idiosyncrasies as far as census firm-level research is concerned. Vital questions such as the proper truncation point for firm-size distribution and 'prudent' outlier management were not given the deserved attention in the TE research agenda in particular and industrial economics in general. This part of the chapter is an attempt to tackle these issues.

Theoretical Approaches Dealing with Measurement Errors

Having emphasised the importance of tackling the problem of measurement errors in firm-level research, particularly but not exclusively in LDCs, one can outline possible approaches to address this problem in empirical research as follows:

1. Errors-in-Variables Model

One possible approach to deal with measurement errors in SFA is to use the errors-in-variables model known in econometrics[6]. This model relaxes the unrealistic assumption, held by the classical regression theory, that the independent variables are actually measured without errors. The problem with this approach is finding a 'good' instrumental variable (Haddad, 1993), particularly in a cross-section research design (Schmalensee, 1989).

[6] See Wallace and Silver (1988) for a good introduction and Tybout (1992a) for an application on TE.

2. Robust Estimator Approach

SFA can be considered as a more robust estimator compared with DEA because it does not consider all variation in performance (including chance variations and data errors) is due to technical inefficiency. Thus, SFA is less sensitive to any particular observation that is affected by measurement error or temporary external shock. Although SFA accommodates random errors in output, it does not deal with data errors in independent variables, most notably capital (Tybout, 1992a).

3. Outliers Diagnostics Approach[7]

Outliers play a crucial impact in SFA. Outliers are "observations that do not conform to the pattern (model) suggested by the majority of the observations in the data set" (Hadi and Son, 1998: 441). Outliers have two main causes; either they are data errors arising from, for example, reporting or recording error, or simply the subject is different from the rest (Stevens, 1996). In the last case, the outlier is not a data error; it is just different or has different circumstances (because of firm heterogeneity).

In the case of SFA, a firm with a relatively large positive residual is an interesting outlier since it has a high (i.e. above average) level of TE and thus contributes to the formulation of the frontier. It arises either because of exceptionally high performance (the firm is a star), or because of a reporting/recording error (measurement error), or simply the firm belongs to a different industry or activity (classification error). The last type of error reveals the importance of appropriate industrial classification that ensures a 'plausible' level of homogeneity among firms in an industry. On the other hand, firms with a relatively large negative residual reflect relatively low TE.

Thus, residual analysis and frontier analysis are closely related. Frontier analysis attempts to benchmark the performance of firms in a homogenous sector with the 'best performers' firms. Furthermore, the skewness of OLS residuals provides a leading indicator for the applicability of SFA to a set of firms and, indeed, a possible indicator for TE itself. More specifically, while regression analysis (average production function) assumes symmetry of the error distribution (i.e. assumes the absence of technical inefficiency), frontier analysis presumes the negative skewness of the error term (i.e. presupposes the

[7] For up-to-date surveys on the outlier problem with different levels of sophistication, see Hadi and Son (1998); Donald and Maddala (1993) and Bollen and Jackman (1990). For a criticism of this approach in favour of robust estimation, in the context of growth performance, see Temple [Jonathan] (1998). In TE research, Harris (1992) and Hay and Liu (1997) have used outlier diagnostics approach in an industrial economy context.

existence of inefficiency). A negative value for skewness indicates that relatively more values are below the mean than above it, while a positive skewness indicates the opposite (Kleinbaum et al., 1998). CB (1990: 34) summarise the effect of outliers in output or input variables as follows:

> *"A large positive data error in the measurement of a single plant's output ... can either increase the extent of estimated technical inefficiency (by raising its industry's estimated frontier) or make inefficiency appear nonexistent (by reversing the skewness of the residuals). A large understatement of an important input will have the same effect".*

Although not all outliers are necessarily 'bad' observations and should not in principle be deleted automatically, a 'prudent' deletion policy (of limited points) after checking for data plausibility might be inevitable in this research (see below). 'Prudent' rejection is a feasible and probably a desirable option. Other alternatives to prudent rejection are: acceptance, accommodation, correction, replacement, and weighting. The rejection (of relatively limited data points) option can be defended by the following arguments:

1. Accepting outliers, an alternative to discarding them, is clearly not a good response, as outliers can "distort parameter estimation, invalidate test statistics, and lead to incorrect statistical inference" (Hadi and Son, 1998: 441).
2. Correcting outliers is not a feasible option. Outliers in industrial census are very hard to correct. Correcting via replacing data errors through revisiting the respondent or checking the questionnaire is clearly unfeasible in this research, as this step should typically follow the fieldwork done by the census team.
3. Producing sensitivity analysis using 'with and without outliers' approach. One option to deal with outliers is to "report two analyses (one including the outliers and the other excluding it)" (Stevens, 1996: 18). Due to possible estimation failure in the 'with scenario' or 'without scenario', this option is hard to apply across many industries in SFA.
4. Deleting statistical outliers (after examining their logical plausibility) can be defended in industrial census analysis by resorting to maximin criterion in decision theory; deletion can be a kind of insurance against the risk of 'bad' estimation (Anscombe, 1960).

Small Enterprises in TE Research: Does it Make a Difference?

Since small firms constitute a larger fraction of total number of enterprises in small economies, TE research in small LDCs ought to face this idiosyncrasy that can possibly violate assumption (1) of SFA (see above). There are two common arguments in the literature in favour of isolating small- or micro-enterprises[8] in firm-level empirical research for separate analysis: (i) technological heterogeneity; and (ii) lower data quality. Small

[8] The exact definition of small enterprises and microenterprises vary by country, sector and industry (Storey, 1994). In Jordan, enterprises engaging less than 5 persons are informally considered as small. In a larger economy such a threshold might hold for microenterprises.

enterprises, it is argued, can be 'different' from larger firms in technology used, thus might have a distinct production function. Furthermore, the data of small enterprises, the argument goes, are expected to be less reliable (or, sometimes, less comparable) than medium and large-scale firms. In their famous establishment-level study of 1963 Norwegian manufacturing sector, GR [Griliches and Ringstad] (1971: 126) suggest that:

> "*In general, there is much more "noise" in the smaller units. After some experimentation we excluded all units with less than three production workers. In other contexts one might wish to raise this limit to perhaps ten (or even more) production workers. In any case, in studies of this type, the very small units should be either excluded or subject to some other special treatment*".

More recently, Caves and Barton in their study of U.S. manufacturing industries (CB, 1990) have excluded plants employing fewer than four workers:

> "*[O]n the **conjecture** that such small operations are unlikely to be carrying on activities comparable to the larger establishments classified to their industries. Also any errors in the data reported by such plants might well be large proportionally*" (p. 36). Emphasis added.

While these arguments are useful as a starting point, the adopted truncation point of small enterprises in practice cannot be determined on *a priori* basis and requires a case-by-case examination. In many cases, mostly in large countries, the coverage of industrial census 'solves' the problem, but in many small economies where all enterprises are enumerated in industrial censuses, including single-person enterprises, the truncation point is usually determined by the researcher and not imposed by the data.

5.2.2 Issues in the Explanation Stage of SFA

5.2.2.1 Factors Underlying Technical Inefficiency

In Chapter (4), a sceptical view on the genuineness of technical inefficiency is stated and partially refuted. Actually, one can infer the existence of inefficiency through providing possible causes for non-maximising production behaviour by firms. In general, lack of (developed) markets, weak property rights and deficient organisational effectiveness (e.g., management skills and information systems) that deliver the required incentive and capability, represent main sources of technical inefficiency relative to both the domestic frontier and international standards. More specifically, many studies have emphasised the role of market power in the product market in generating technical inefficiency (CB, 1990;

CA, 1992; Hay and Liu, 1997) as well as low TFP growth (Nickell, 1996; Nickell et al., 1997).

In the corporate sector, the manager's incentive in public shareholding companies might be below its potential due to deficiency of the market to generate appropriate corporate control (see Mayer, 1996; Nickell, 1996). State-owned enterprises share the corporate sector in the absence of "clearly defined property rights in the returns to cost saving" (Weyman-Jones, 2000: 65) and lack of sufficient accountability to owners. Furthermore, inward oriented development strategies designed to protect the industrial sector might weaken the incentive structure, leading to resources waste through rent-seeking activities (Lee, 1986).

Indeed, many recent theoretical advances that sought to explain firm behaviour can provide possible explanation for inter-firm variation in TE in the same industry[9]:

- Firms are not identical in their technological capabilities (Lall, 1992) or other distinct capabilities. Technological diffusion and imitation are typically not a rapid or easy process (Karshenas and Stoneman, 1995). In general, organisational differences in atomistic markets are expected to be much smaller in comparison with monopolistic market structures (Carlsson, 1972).
- Firms differ in their ownership structure, and thus tend to suffer asymmetrically from the principal-agent problem (i.e., controlling managers in corporations).
- Firms differ in their managerial ability to detect opportunistic behaviour in general and shirking behaviour of members of production team in particular (Alchian and Demsetz, 1972), depending on effectiveness of their controlling and incentive schemes (including quality control rules). Contracts are not complete to motivate maximum contribution as reminded by the Economics of Law.
- Entrepreneurs surely differ in their informational and intellectual capabilities in dealing with uncertainty and complexity of business world and thus in alleviating the constraint imposed by bounded rationality. Both evolutionary economics and transaction costs economics are based on the premise of bounded rationality instead of maximal rationality (Williamson, 1991). In general, informational asymmetry among firms are less in atomistic market structures due to the existence of more experiments with resources deployment and faster diffusion of investment outcome and best practices (Carlsson, 1972; CB, 1990). Related to this issue is heterogeneity in firm age. New firms have less

[9] Modern firm theorists tend to highlight the heterogeneity of firms in terms of conduct, capabilities and performance. See Roller and Desgagne (1996) and Perman and Scouller (1999) for a recent overview of this literature. See also Besanko et al. (2000) on *cost drivers* or basic sources of cost differences among firms.

experience and 'learning by doing' than incumbents, giving established enterprises a possible absolute cost advantage (Geroski, 1994).

- Firms are not uniform in their rent seeking capabilities and resources deployed in strategic behaviour and non-price competition. For example, the use of excess capacity to deter new entry leads to under utilisation of capital, a type of technical inefficiency.
- Inter-firm differences in size, resources and capacity utilisation.

As for persistency of disparities in firm performance, empirical evidence in the past two decades revealed that firms' performance in a given industry *could* remain different for a relatively long period of time (Roller and Desgagne, 1996).

5.2.2.2 Approaches in TE Explanation

Traditionally, the frontier paradigm has focused much more on measuring TE than on improving the methodology for explaining TE differentials among firms and industries. After numerous studies have confirmed the hypothesis that technical inefficiency is positive and significant, research on improved techniques for determining sources of TE variation is recently getting more attention (Battese and Coelli, 1995; Coelli et al., 1999; Koop et al., 1999). But this new research direction did not yet focus on developing a coherent and sound theoretical framework for explaining TE. Instead, it seems to be currently preoccupied by the way in which a pre-defined set of predictors can be used to measure *and* explain TE in *one stage*, using panel data, instead of the traditional two-stage model.

Studies that seek to explain TE can be classified into two main approaches. First, and the most common, is research on inter-firm variation in TE prevalent in industry case studies. Here, scores of firm efficiency obtained in the measurement stage are regressed on firm-specific factors such as firm size, age, ownership structure, as well as technological capabilities and export intensity. The second approach is the inter-industry model, which adopts the SCP paradigm in industrial organisation. Each has its advantages and pitfalls, but both use TE measures of firms and industries, respectively, as the dependent variable that needs to be explained.

The main shortcoming of industry case study research is that its conclusions are industry-specific and cannot claim the level of generalisation needed for the purpose of designing *broad* public policy (Schmalensee, 1988). On the other hand, this research design (advocated by 'new' industrial organisation) has the potential for providing accurate analysis that fit more properly the idiosyncrasy of individual industries (Bresnahan, 1989).

The main virtue of inter-industry research is the search for empirical "regularities which hold good across the general run of industries" (Sutton, 1990: 510). But adherents of 'new' industrial economics, basing their criticism on industrial heterogeneity, suggest that industries are so individual that researchers cannot learn much from broad cross-section studies (Waldman and Jensen, 1998). Furthermore, in the context of small LDCs with limited number of manufacturing industries, another possible shortcoming of this research design is the lack of satisfactory number of successful TE estimates sufficient to run a broad-based regression analysis.

A common disadvantage of both approaches encountered in cross-section studies is the simultaneity bias (also known as the endogeneity problem, see Chapter 3) arising from the fact that "predictors respond to industrial [or firm] efficiency as well as influence it" (Tybout, 1992b: 186). Obviously, the existence of more than one plausible structural interpretation of estimated parameters is a research pitfall (Schmalensee, 1988). To alleviate this problem in inter-firm TE research, recent work on methodology has criticised the two-stage approach and suggested a possible one-stage solution (see Battese and Coelli, 1995)[10].

If TE performance in the SCP model feeds back into structure (industrial concentration), then the model suffers from simultaneity bias. Whether or not this econometric problem is acute in a specific setting is a function of the data sample and specification (Martin, 1993). In this Chapter, we follow both CB (1990) and Mayes et al. (1994), among many others, in adopting the single-equation OLS approach rather than the simultaneous-equation approach in modelling inter-industry variation in TE (see Chapter 3). Two additional arguments can be provided in favour of such a choice: (i) strategic behaviour using R&D and/or advertising expenditures is less common in JMIs. For example, out of 51 JMIs included in the sample, only 6 industries have an advertising intensity (advertising expenditures to domestic sales) in excess of 1 %; (ii) previous empirical findings on intertemporal changes in TE have shown weak relation among TE scores over time, which could imply that the omission of feedbacks is not a significant concern (Caves, 1992a). Nevertheless, both the possible endogeneity of producer concentration and foreign trade as

[10] This approach cannot be utilised in an inter-industry research design since this entails using aggregate industry-level data to measure *and* explain TE, thus violating the first basic assumption of SFA (see above).

well as the potential superiority of the structural approach are acknowledged for future research.

5.3 Previous TE Research in Manufacturing: An Overview[11]

Since 1977, SFA has been utilised in diverse applications and contexts[12]. In the 1970s and 1980s, due to data availability, the focus was on regulated sectors and non-profit organisations. In manufacturing, microdata were generally considered as confidential. Consequently, emphasis in manufacturing was on the case study approach where a single or 'selected' number of industries were investigated.

SFA research using inter-industry design was popularised in early 1990s when CB (1990) applied this technique to the U.S. census manufacturing establishments. The aim was not only to measure TE at the industry-level, but also to explain inter-industry variation in TE. After the U.S. study, many industrial countries have applied the same research design such as the UK, Japan, and Australia. Very few NICs, transition economies or LDCs implemented the same inter-industry research. According to the best knowledge of the researcher, Korea (in CA, 1992) is the only case[13]. Consequently, this study is novel in its context.

Establishing stylised facts regarding TE patterns in global manufacturing, or even summarising findings of TE research in manufacturing (as done by Tybout, 2000), is constrained by two severe limitations[14]:

1. **Differences in sample design and selection.** The existence of pervasive differences in national practices in compiling census data, particularly with respect to truncation point of small firms (Caves, 1998) limits research comparability. While some countries, like Jordan, include even single-person enterprises in their industrial censuses, others adopt a larger threshold (five, ten or more workers). Furthermore, in many case studies using non-census data, samples are selected non-randomly based on some criteria such as the desire of firms to register in a private or public organisation; the legal structure of the

[11] A comprehensive and recent survey of SFA studies in manufacturing is still lacking. CB (1990) briefly summarised studies done before 1990. The work of CA (1992) embodies country-specific studies for six nations. Tybout (2000) compares very briefly average TE generated by different studies, including those done in the 1990s, classified by the technique used.

[12] SFA was proposed independently by Aigner et al. (1977) and Meeusen and Van den Broeck (1977).

[13] Corbo and de Melo (1986) employed both stochastic and deterministic approach to a cross-section of Chilean industries but the focus was on comparative efficiency measurement using different techniques rather than on TE explanation. More recently, Krishna and Sahota (1991) used panel data to estimate, inter alia, technical efficiency in 30 Bangladeshi manufacturing industries, but the research took an inter-firm design in the explanation stage. In transition economies, Brada et al., (1997) used SFA in 12 and 15 aggregated manufacturing industries for Czechoslovakia and Hungary, respectively, but the explanation was at the level of the firm not industry. Finally, Sun et al. (1999) employed DEA to measure TE for 28 Chinese manufacturing industries, and attempted to explain inter-firm efficiency disparities in seven broadly defined industries.

[14] Naturally, using DEA or other deterministic techniques is a basic source of research incomparability.

firms (e.g. being public shareholding companies); or ownership structure (e.g. being foreign firms or state-owned enterprises).

It is noteworthy that if small enterprises are less efficient than large firms (see below for evidence), then excluding the former will raise the industry's average efficiency in comparison with studies that include them.

2. **Differences in frontiers positions**: even in case of standardising sample design and selection, TE research comparability is constrained by the fact that efficiency estimates are relative and based on clearly different (and industry-specific) production frontiers (Bhavani, 1991; Lundvall and Battese, 2000). Thus, the existence of a subgroup of firms that are uncommonly efficient in an industry lowers industry-level efficiency compared with an industry consisting of uniformly inefficient producers (Tybout, 1992b). To these comparability distortions, CB (1990: 15) add many options associated with the definition of variables and form of production function.

That is said, empirical findings with various research designs have generated the following regularities:

1. **At the level of measurement:**

- Estimation in SFA is not a smooth operation due to maximum likelihood (ML) convergence problems, even with the simplest structure imposed. In an inter-industry context, success rate in efficiency estimation using half-normal inefficiency distribution ranges between 40 % and 80 % of total industries (Caves, 1992a: 7).
- Average efficiency level typically ranges from 60% to 90% (CB, 1990: 51; see also Torii, 1992: 32).

2. **At the level of explanation:**

A. Inter-industry studies:

- Although the explanation stage of SFA is smoother than the measurement stage, inter-industry variation in TE, as indeed all cross-section explanation endeavours, is a complex task mainly because of natural variability of industries.
- Nevertheless, producer concentration, *mainly in industrial economies*, is consistently found hostile to TE (CB, 1990; CA, 1992; Mayes et al., 1994; Hay and Liu, 1997), either in a linear or quadratic relationship, even after controlling for import competition. Other predictors, in general, lack such a robust association (see Caves, 1992a).

B. Industry case studies:

- The link between firm-specific TE and its predictors is mainly an industry-specific and a country-specific relationship (Taymaz and Saatci, 1997; Lundvall and Battese, 2000); systematic association that applies across all industries and countries appears difficult to find.

- Nevertheless, firm size in manufacturing tends to have a non-negative (positive or a zero) association with firm-level TE *mainly in the context of developing and transition economies* (CB, 1990; Brada et al., 1997; Lundvall and Battese, 2000).

Finally, a brief comparison between this study and the standardised international research of CA (1992) is presented in Table (5.1).

Table 5.1
A Comparison between the Current Study and the International Research of Caves and Associates (1992)

Comparison dimension	Al-Homsi (2001)	Caves and Associates (1992)
The context and year	A developing country (1994)	Industrial and newly industrialising countries (1977 or 1978)
Number of industries	51 industries	140 - 434 industries
Estimator used in measuring TE	Maximum likelihood (ML)	Corrected OLS, except Harris (1992)
Research design	Cross-section	Cross section, some studies analysed TE over time
Data editing focus	Raw data and OLS residuals	Raw data except Harris (1992) who utilised both approaches
Estimation success rate	69 %	41 to 80 %
Form of production function	Cobb-Douglas (CD)	Translog (TL)
Truncation point of firm-size distribution	Single-person enterprises	Higher truncation point
Inefficiency distribution form	Half-normal and truncated-normal	Half-normal, except Harris (1992) who used both distributions
The use of principal component method to construct a 'grand' TE measure	Yes	No
Model specification	Single-equation model	Single-equation model, except in Torii (1992) where limited type of simultaneous equation analysis is used
Potential predictors	Mainly competition and industrial heterogeneity factors	Competition, organisational, structural heterogeneity and dynamic factors for most studies
Approximate variation explained (adjusted R^2) and number of predictors in the 'core' model	60% , 6 predictors	20 - 50%, 4 - 9 predictors
Estimation of technical scale Economies	Yes	No

SOURCE: Researcher, based on CA (1992).

5.4 Measurement of TE in JMIs: A Stochastic Frontier Approach

The Database

The *raw* database available for estimating efficiency scores for JMIs consists of 8398 firms in 51 industries taken from the latest 1994 Industrial Census, covering all enterprises including single-person firms[15]. Since most manufacturing firms in the JE are single-establishment firms, the terms 'firm' and 'establishment' are treated as synonymous. Manufacturing firms are classified at a fine level of disaggregation (four-digit ISIC2), which is the most disaggregate industrial grouping available under the United Nations industrial classification. Table (5.2) shows some features of the database compared with its counterpart in other countries.

Table 5.2
A Comparison among Selected 'Raw' Databases for Manufacturing Firms Used in SFA

	Jordan (1994)	UK (1977)	Australia (1977)
No. of establishments	8398	19023	26000 (approximately)
No. of industries	51	151	166
Truncation point for employment size distribution (worker)	Null	Less than 20	Less than 4
Average number of establishments per industry	165	126	157

SOURCES: Researcher, based on Mayes et al. (1994).

Data Preparation and Editing

As revealed by Table (5.2), Jordan's average number of plants per industry is greater than that of the UK and Australia. This is due to inclusion of small enterprises and the difference in year of study. Two features of JMIs complicate the estimation and explanation of TE in an inter-industry research design. First, firm-size distribution is more skewed towards small firms compared with the case of UK or Australia (Table 2.15, Chapter 2) with possible implications on producer heterogeneity and data quality. More generally, the data on *all* size classes in JMIs are probably of lower quality than that of industrial economies. Second, as shown in Table (5.2), total number of industries is clearly lower in Jordan

[15] For more information on the coverage and characteristics of the database, see Appendix 1.

compared with other countries, and this can affect the viability of the second stage, i.e., explanation of inter-industry disparities in TE in JMIs.

Since microdata in LDCs are considered as noisy (Tybout, 1992a), and in view of the severe skewness of firm-size distribution in JMIs, this study adopts the following procedures to alleviate data problems:

1. Adopting SFA instead of DEA, a more robust estimation method to *accommodate* data errors in the dependent variable.
2. Utilising a 'prudent' data diagnostic approach for both raw data and regression residuals, and aiming at cleaning extreme outliers in all variables (both dependent and independent variables) after checking for plausibility.
3. To address possible classification errors, a decision was taken to exclude single-person microenterprises from SFA analysis. This step excludes 1460 data points or 17 % of the *raw* database. The above truncation point was chosen, after initial investigation, as a compromise between two factors: avoiding potential measurement and classification errors, on one hand, and getting the information content of small enterprises, thus increasing sample size necessary for ML estimation, on the other[16].

In this research, where firms with less than three persons represent 42 % of raw database, the choice of truncation point is a sensitive issue, particularly in TE analysis where sample size matters. Three reasons can be provided in favour of minimising the truncation point of firm-size distribution. The first is to leave sufficient data points in small samples (industries with limited number of firms), thus allowing a good fit and enhancing the precision of ML estimation[17]. Second, a large truncation point can lead to a serious sample selection problem[18]. Third, disregarding a proportionally large number of firms in many industries will distort the nature of such industries, thus affecting the results of the second stage of the research, which attempts to explain inter-industry variation in efficiency using industry-wide predictors. After initial experimentation with industries that exclude two-

[16] Initial analysis revealed that trimming up to two-person enterprises would leave much to be desired; omitting additional 2029 data points or 24 % of the raw database with substantial impact on sample size and predictors' variation in many industries. Moreover, Eurostat, in its official report *Enterprises in Europe* (EC, 1996a), comments on the idiosyncrasy of one-man (sole proprietorship) businesses in terms of volatility and data quality: "every year a great number are created but at the same time many cease their activities, change owner, change location, etc" (p.39).

[17] According to Koutsoyiannis (1977: 444) ML estimates are biased for 'small' samples. Long (1997: 53-54) suggests that "ML estimators are not necessarily bad estimators in small samples", but he proposes a minimum of 100 points to ensure reliability of ML estimates. In general, a larger sample is required in case of the TL production function or three-input CD function.

[18] Ideally, the truncation point decision should try to take into consideration sample selection problem known in microeconometrics (see Breen, 1996). Sample selection problem arises when the observed and used data are not selected randomly from the population, either because of data availability or intentional research design.

person firms, it becomes evident that this truncation point leaves much to be desired in terms of reliability of estimates.

As a result of this trade-off between the benefits of including small enterprises and the costs incurred as a result of this, a decision was taken to omit just one-person enterprises from the sample. It seems that any truncation for small enterprises that exceeds the single-person threshold means loosing much of the information included in the database. Other studies might take a larger threshold (e.g. less than three or five workers) in larger economies.

Because scepticism concerning the value of including small enterprises (i.e. firms with 2-4 persons) in a formal frontier-production function approach might still be raised, a simple but novel empirical test for the conjecture that small enterprises suffer from lower data quality has been made. The test is based on an examination of studentised deleted residuals (SDRs)[19] generated by *industry-level* regressions (using the two-input CD production function) that exceed (+4) or less that (-4). Including enterprises of all sizes and excluding firms with negative value added or zero input, the number of outliers was 41 firms.

The examination of outlier firms led to a mixed conclusion. Although the size analysis of those firms confirms a larger absolute number of outliers by small firms, the share of outlier firms to total firms, according to size class, provides a different interpretation. As Table (5.3) shows, the above ratio is actually inversely related to the firm-group size[20]. Eliminating the effect of aggregation, the correlation coefficients between firm size, as measured by number of workers and value added, and absolute value of SDR were -0.16 and 0.10, respectively[21], indicating an overall weak relationship between firm size and data quality (of output and inputs). On the other hand, although the number of outliers in small firms class is somewhat smaller in relative terms, its average SDR size is slightly higher than all other size classes.

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[19] SDRs are refined measures of OLS residuals (see footnote 22).

[20] To test the robustness of this result, a similar test is done for SDR> |3|. The result reaffirms the same conclusion.

[21] These quantities are -0.03 and +0.08 respectively when the threshold for SDR is eased to become greater than the absolute value of 3.

Table 5.3
Large Outliers by the Firm-Size Group

Size Class	Less than 5 workers	5- 19 workers	20 workers and above	All firms
No. of Firms	5943	1877	499	8319
No. of Outliers (SDR> | 4 |)	24	10	7	41
Ratio of Outliers to Total No. of Firms (%)	0.40	0.53	1.40	0.49
Average Absolute SDR	5.4	5.0	4.8	5.2

SOURCE: Researcher's calculations.

An overall assessment indicates that there is insufficient evidence to suggest that Jordan's small manufacturing sector, across all industries, has notably lower reported data quality on output and inputs in 1994 in comparison with medium or large firms if the criterion used is their fit to a CD production function. It seems that small firms are as good as larger enterprises in their distance around an average industry production function. This might be explained by the fact that smaller enterprises have restricted scale and simple structure and scope: i.e., it is easy to estimate and report error free data concerning their production activity. On the other hand, large firms might have the capabilities that enable them to employ 'creative' accounting practices to distort their true activities (e.g. for taxation considerations).

Outlier Editing in JMIs: The Adopted Specific Rules

In this research, both univariate outliers (i.e., in Y and X values) and residual outliers (i.e., $y-\hat{y}$) will be prudently edited. Generally speaking, automatic or unwise elimination of residual outliers is not recommended even in regression (average relationship) analysis (Draper and Smith, 1998; Kleinbaum et al., 1998). This is particularly true in frontier analysis where outlier firms are influential (i.e., have a crucial impact on the position of frontier production function and thus on inefficiency estimates). According to Caves (1992b: 204), "TE is sensitive to outliers resulting from bad data, but it is *most undesirable* to exclude plants that really are either very efficient or very inefficient" (emphasis added).

For the purpose of this research and to help alleviate misuse of this approach for managing extreme observations, outliers are classified into three types according to their studentised deleted residual (SDR)[22]:

- Suspected outliers: defined as outliers that take a value for SDR ranged between | 2 | and | 4 |.
- Highly suspected outliers: defined as outliers that take a value for SDR ranged between | 4 | and | 6 |.
- Bad outliers: defined as outliers that take a value for SDR greater than (6) or less than (-6).

In this research, we adopted an asymmetric treatment of different kinds of outliers:

- 'Bad' outliers are automatically deleted whether this will ensure convergence in estimation or not, because they probably reflect measurement or classification error.
- Suspected outliers are deleted only if that ensures estimation success: i.e., if convergence happens in the presence of suspected outliers, these outliers would remain in the sample. This rule, affecting only limited industries, is based on a trade-off between: (i) allowing for natural variability of firms on one hand; and (ii) facilitating convergence in ML estimation, on the other.
- Highly suspected outliers are conditionally deleted either to eliminate data errors *or* to ensure convergence in estimation. Conditions required to delete a highly suspected outlier, even if convergence happened automatically, are one of the following cases:

  1. VA/L > Mean (VA/L) + 6 SD (VA/L). I.e. if a firm's labour productivity (LP) does exceed 6 standard deviations above the mean LP or below it[23].
  2. Firm age = 0. I.e., start-up firms or enterprises that began its operation in 1994, the year under study (see CB, 1990 for a rationale).

  The logic behind discarding these firms is that, in addition to their statistical abnormalities, they logically reflect suspected high LP performance in the first case, and disequilibrium or irregular situation in the second.

Summing up, data preparation is an important and sensitive step in TE research. Table (5.4) lists rules adopted in this research for editing data, the logic behind them, as well as number of excluded firms affected.

[22] SDR, sometimes called externally studentised residual or studentised residual (Belsley et al., 1980), is an elaborate measure of 'raw' or ordinary residual. It makes outliers more obvious to the data analyst and less hidden by its own effect. For more information on different measures of residuals see, for example, Kleinbaum et al. (1998) and Neter et al. (1989). Belsley et al. (1980) consider a value of SDR larger than |2| as an outlier in regression analysis.

[23] CB (1990) adopted a somewhat less restrictive condition, deleting firms reporting LP that exceeds 4.5 standard deviations over sample mean. CB present the logic behind such an editing rule.

Table 5.4
Data Editing Rules: Logic and Effect

Editing Rule	Rationale	Effect	
		No. of firms excluded	Share in total (%)
Editing Raw Data			
Value added < 0	To allow for logarithmic specification; the firm is not in a steady state situation	74	0.88
Total capital (owned and rented) = 0	To allow for logarithmic specification; the firm is not in a steady state situation	3	0.04
Intermediate consumption of goods = 0	The firm is not in a steady state condition	2	0.02
Total employment < 2	To minimise producer heterogeneity and potential measurement errors	1460	17.40
Editing OLS Residuals (CD Regression Outliers)			
| 4 | > SDRs > | 2 |	To ensure ML convergence; suspected outlier	3	0.04
| 6 | > SDRs > | 4 | & VA/L > Mean (VA/L) + 6 SD (VA/L)	Highly suspected outlier; extreme LP performance	6	0.07
| 6 | > SDRs > | 4 | & Age = 0	Highly suspected outlier; the firm is not in a steady state condition	8	0.10
| 9 | > SDRs >= | 6 |	'bad' data points lead to distorted estimation	9	0.11
Total	-	1550	18.5 %

NOTE: Grand totals do not correspond to the sum of components due to overlaps in the effect of editing rules (for raw data).

The first stage of data cleaning focused on raw data. Firms excluded in this stage are: (i) those recording 'abnormal' values for output or inputs. Any firm that registers negative value added, or zero capital or intermediate consumption of goods, is omitted from analysis to allow for estimation of the CD production function; and (ii) single-person enterprises. The second stage of data cleaning dealt with regression outliers. Using the studentised deleted residual (SDR), the total number of firms excluded was 26 only. Overall, the conservative editing strategy led to the exclusion of 1550 firms or 18.5 % of total number of firms in the raw database. Thus the data set actually utilised for TE estimation consists of 6848 firms.

TE Model and Estimation in JMIs

In this study, both the common half-normal and the more general truncated-normal will be utilised and compared. Moreover, instead of imposing the following two-factor CD production function:

$$\mathbf{LnY_i = A + B1\ Ln\ L_i + B2\ Ln\ K_i + (u_i - \nu_i)}$$

A statistical test will be undertaken to examine whether the CD production function is an adequate representation of the data, given the specification of the translog (TL) function, expressed as:

$$\mathbf{LnY_i = A + B1\ (Ln\ L_i) + B2\ (Ln\ K_i) + B3\ (Ln\ L_i)^2 + B4\ (Ln\ K_i)^2 + B5\ (LnL_i\ .\ LnK_i) + (u_i - \nu_i)}$$

One can add to the above equations a vector Z comprising a number of control or 'compositional' variables to account for firm heterogeneity in combining various types of labour and capital in the production function. In this research, output, inputs and potential control variables are defined as follows:

Y is the reported value added for the enterprise (in thousands of JDs), defined as gross output minus intermediate consumption of goods and services.

L is total number of employees (both paid and unpaid employees; production and non-production workers). The Industrial Census does not offer reliable data for hours worked.

K is fixed capital stock (at historical cost). More specifically, it is measured as the average value of owned stocks of machinery, buildings and transport equipment at the beginning and end of the year, plus estimates of leased capital of building and machinery (see **Appendix 1** for the methodology of deriving variables used in estimation). Data on used capital stock (i.e., corrected for capital utilisation) at current replacement cost (i.e., corrected for capital vintage) are not available.

PL/L is the share of production workers to total employees.

M/K is the proportion of (owned and leased) machinery in total capital stock.

F/M is the cost of fuel and electricity as a percentage of intermediate consumption of goods.

The above three 'control' variables are used in the pilot study based on information available in the database (see Mayes et al., 1994 for a longer list).

The Pilot Study and Preliminary Analysis

In his conclusion summarising the research findings of *Industrial Efficiency in Six Nations*, Caves (1992a: 25) suggests that TE investigations "can be usefully applied in a mechanical way to large number of industries". This proposition still to be proved in the case of small and developing economies; since an inter-industry study is lacking in this special context, it is necessary to undertake a preliminary investigation before committing to such a relatively large-scale research. Hence, the main aim of the pilot study is to investigate the applicability of this relatively new TE technique to the context of JMIs and, if so, to examine the appropriate modelling specification to be applied later in all 51 JMIs.

Eight industries (or 16 % of all industries) were selected for this pilot study. They are representative, and vary according to size (number of firms), capital intensity (capital/labour ratio), and nature or end-use of the industry (Table 5.5).

Table 5.5
Summary Statistics of Industries Included in the Pilot Study

Industry	Industry ISIC code	No. of firms*	Capital intensity (K/L) in JDs*	Nature of industry by end-use
Vegetable and animal oil & fat	3115	94	32350	Consumer good
Bakery products	3117	1064	3080	Consumer good
Food products n. e. c.	3121	104	7390	Consumer good
Wearing apparel	3221	375	3260	Consumer good
Plastic products	3560	165	11760	Intermediate good
Cutlery and general hardware	3811	30	5240	Capital good
Machinery and equipment (non-electrical)	3829	75	6890	Capital good
Jewellery	3901	53	5489	Consumer good

* Industries truncated at microenterprises with one-person.

SOURCE: Researcher's calculations based on the 1994 Industrial Census (microdata).

Modelling specification and variables examined and reported include the functional form of the production function; the distribution form of the inefficiency component; the output measure and, finally, number of outliers removed (Table 5.6). Other relevant factors investigated but not reported include capital stock measure; control variables in the production function; and data editing rules, including the truncation point of the size distribution of manufacturing firms.

Table 5.6

Pilot TE Investigation: Specification Options and Estimation Success [1]

ISIC Code	No. of Observations	Functional Form		Inefficiency Distribution (CD)		Output Measure (CD)		Outliers Rule and Cases	
		CD	TL	Half-normal	Truncated-normal	Value Added	Gross Output	For CD Function	For TL Function
3115	**94**	S	S*	S	S [2]	S	F	None	SDR> 3.4 (1)
3117	**1064**	S*	S*	S	S [2]	S	F	>5.6 SDR <-4.1 (5)	>5.6 SDR <-4.1 (5)
3121	**104**					F			
3221	**375**	S*	S*	S	S [2]	S	F	>5.6 SDR <-5.6 (1)	>5.5 SDR <-5.5 (1)
3560	**165**	S	S	S	S [2]	S	F	None	None
3811	**30**					F			
3829	**75**	S	S	S	S [2]	S	F	None	None
3901	**53**	S	S	S	S [2]	S	F	None	None

(1) S stands for smooth ML estimation; F for estimation failure and S* means success after isolating outliers.
(2) The truncated distribution always led to abnormal exit (convergence problem) in the LIMDIP software, but worked out using the Frontier 4.1 program (Coelli, 1996).
SOURCE: Researcher.

The main lessons drawn from the preliminary analysis were:

1. Adopting 'prudent' data editing rules, the method of stochastic frontier production function seems to be applicable to the context of JMIs. Sample success rate after omitting (limited) extreme values is 75 %, a rate that compares favourably to similar studies. However, this rate is just 50 % if the outlier problem is not faced.

2. The initial empirical investigation did not provide a clear-cut evidence concerning the most appropriate functional form; both CD and TL led to same convergence success rate. While considerations of sample size (of many industries) and estimation method (ML)

were in favour of a simpler functional form that consumes less degrees of freedom (i.e. the CD), the flexibility of TL is an attractive feature particularly in dualistic industries that combine both small enterprises and large corporations[24]. As a revealing leading indicator of estimation success, the number of industries (out of total 51 industries) with negative skewness of OLS residuals using both functional forms was nearly the same. Since theoretical considerations and convergence rate were not successful selection criteria, statistical tests for the functional form were done for the same sample of industries (Table 5.7). The CD function imposed on the model was tested against the TL specification using the likelihood ratio (LR) test. The null hypothesis that the CD technology is appropriate is not rejected in most cases; the CD function seems to fit data properly given the TL function. Although the CD production form does not have the flexibility of the TL function, it can claim the features of avoiding multicollinearity and consuming less degrees of freedom, both are essential conditions for reliable estimates in small samples[25].

Table 5.7
Likelihood Ratio (LR) Test for Functional Form

ISIC code	Log Like. (CD)	Log Like. (TL)	LR	Chi-square Critical Value (5%)	Decision
3115*	-97.2	-87.6	19.2	7.81	Reject CD
3117	-823.5	-814.6	17.8	7.81	Reject CD
3121	Estimation Failure				
3221	-254.5	-253.5	2	7.81	Accept CD
3560	-165.1	-161.5	7.2	7.81	Accept CD
3811	Estimation Failure				
3829	-80.5	-79.8	1.4	7.81	Accept CD
3901	-52.0	-48.2	7.6	7.81	Accept CD

* The estimation of likelihood functions for CD and TL function is based on similar but not identical samples because of convergence requirement of SFA.

[24] More specifically, the TL function allows input elasticities and substitution relationships to vary among firms of different sizes. See CB (1990) for more details.

[25] Many previous studies (mainly cross-section design) did not reject the CD specification. In economies of scale research see GR, 1971; Corbo and Meller, 1979; Baldwin and Gorecki, 1986. In stochastic frontier estimation see Corbo and de Melo, 1986; Harris, 1991; Tybout, 1992a; Brada et al., 1997; Sheehan, 1997. In other research areas see Haddad (1993). S. Nickell has argued strongly for simplicity in the representation of the production technology in empirical work (see Haynes and Thompson, 1999: 831).

3. Both the simple and the flexible inefficiency distributions worked well in the frontier estimation using *Frontier* software (see Coelli, 1996). This is quite an interesting result in view of the scarcity of successful research utilising the truncated-normal distribution *particularly in an inter-industry design.* According to Coelli (1995: 248), "the vast majority of applied [SFA] papers involve the estimation of a single equation half-normal stochastic frontier". Two main factors can explain this trend. First, half-normal is the distribution that historically succeeded in generating plausible TE estimates[26]. Secondly, adopting this distribution is thought to guarantee research comparability.

4. Consistent with previous research in micro production function (GR, 1971; CB, 1990; Caves, 1992a), the value added measure of output in production function clearly provides better results than gross output. In the pilot study, gross output measure did not deliver any case of success in frontier estimation (with the same number of outliers deleted using value added), due to high and positive skewness patterns associated with the gross output function. In any case, while previous empirical work indicated that levels of TE are highly sensitive to whether value added or gross output is adopted as the dependent variable, findings on inter-industry determinants of TE are comfortably robust (Caves, 1992b: 204).

5. Overall, OLS estimates appear to reveal the good quality of data extracted from the 1994 Industrial Census, evaluated by the standards of LDCs. In all cases labour factor was significant; in a majority of industries capital factor was significant; and adjusted R^2 ranged from 0.65 to 0.86.

Other investigations undertaken in the preliminary analysis revealed the following:

1. The derived estimates of capital stock (K2), combining both owned and leased capital (see Appendix 1), showed better results than owned capital stock (K1) in terms of both OLS estimates and, in limited cases, ML convergence. This can be explained by the fact that, in Jordan, certain types of capital goods are typically rented rather than owned. Indeed, most Jordanian industrialists (88 % in the sample) appear to prefer leasing to buying their industrial (non-residential) buildings.

[26] Green (1993: 79), in his widely cited survey on TE, affirms that the "estimation of a nonzero μ often inflates the standard errors of the other parameters considerably, and quite frequently impedes or prevents convergence of the iterations". Furthermore, he suggested that "[t]he truncated normal model routinely defied convergence and, as often as not, produced nonsense estimates. For...[his] data, the assumption of $\mu=0$ seems warranted" (p. 107). Moreover, Caves (1992b: 203), the leader in applying SFA to an inter-industry design, comments on Harris (1992) unique attempt to utilise the truncated-normal as "not very successful".

2. The use of control variables in the production function did not generally improve OLS estimates, as they were insignificant in most industries in the case of PL/L, and in many industries in the case of M/K. In the latter case, the inclusion of M/K variable led to the insignificance of the capital factor, probably indicating a collinearity problem. Thus, it was decided to disregard the inclusion of any control variable in SFA.

3. The absolute level of TE estimates is sensitive to the sample coverage, particularly in the case of small samples. Thus, caution should be observed in data filtering rules employed to 'clean' or 'smooth' data, as well as when truncating small enterprises[27].

Final Estimates of Technical Efficiency in JMIs

After decisions have been taken regarding the technique used in measuring TE; the specification of the production function including measure of output and control variables; form of inefficiency distribution; and finally data editing rules including the truncation point for small firms, this section presents patterns of TE in JMIs. After adopting 'prudent' data editing rules, frontier estimation had resulted in plausible estimates in 35 industries out of total 51, with a success ratio of 69%, an above average rate in comparison with previous research in industrial countries (see Table 5.1). The success rate did not vary by inefficiency distribution. *Unlike (limited) previous work, the truncated-normal distribution did not pose special difficulties*. On the contrary, it proved to be more successful in the explanation stage of the research. This overall research outcome can be due to the following factors:

1. The use of ML method coupled with an appropriate parameterisation proposed by Battese and Corra (1977)[28]. This combination seems preferable to the method known as corrected OLS (see Coelli, 1995), or indeed ML itself but with the original parameterisation proposed by Aigner et al. (1977). As a result, case (2) failures have been solved (in seven industries), and plausible estimates using the truncated inefficiency distribution have been successfully generated.

[27] In the preliminary analysis, the exclusion of two-person firms coupled with stricter rules for data filtering had resulted in less overall success rate, less automatic convergence rate and more outliers needed to be rejected. More specifically, the exclusion of firms with 'labour compensation exceeding value added' had led to noticeable unfavourable effect on the findings. It was later discovered that these (146) firms were clearly inefficient (probably incurring losses) and excluding them omits what is intended to be measured in the first place. The same outcome could happen in case of excluding small enterprises either by census coverage or research design if these enterprises are less efficient than larger firms, particularly if the truncation point is large.

[28] The original parameterisation suggested by Aigner et al. (1977) expressed the SFA model in terms of $\sigma^2_s = \sigma^2_v + \sigma^2_u$ and $\lambda = \sigma_v / \sigma_u$. Later, Battese and Corra (1977) proposed a preferred parameter $\gamma = \sigma^2_v / \sigma^2_s$ since it must lie between 0 and 1, whereas the λ parameter could be any non-negative value. Thus, the γ parameterisation has the clear advantage in solving the non-linear optimisation problem with minimum search process. See Coelli (1995) and Coelli et al. (1998) for more details on the impact of the parameterisation on case (2) failures.

2. The use of a 'sensible' strategy for outlier deletion, which contributed about 14 % of total success cases (five industries)[29].
3. Another possible explanation of high estimation success is the inclusion of small enterprises in the analysis, assuming these firms were less efficient (see Chapter 6 for evidence).

Industries which fit the SFA model smoothly without the need to omit certain firms or without showing abnormalities in frontier estimation in terms of number of iterations and plausibility of results, tend to have the following combined features:

1. Large sample size (a minimum of 30 firms, and the larger the better). The average size of success industries in this study was 184 firms, whereas it was just 25 firms in failure industries.
2. The skewness of the OLS residuals (composed error) should be negative but not so large in absolute terms (typically less than 0.5).
3. The absence of highly suspected or bad residual outliers (as defined above).
4. As indicated by CB (1990: 31) the minimum and maximum values for OLS residuals are quite revealing; an industry regression which shows a minimum residual larger (in absolute values) than the maximum (positive) residual tend to have negative skewness and thus, a bigger opportunity to fit the model.

On the other hand, failure (16) industries share the feature of positive skewness of OLS residuals (even after omitting limited extreme points) coupled with small sample size.

Table (5.8) shows JMIs registering the highest and lowest four TE scores, ranked according to MTET. As stressed earlier, efficiency scores need careful interpretation both in their positive and normative connotations. Jordan's pharmaceutical and spinning industries are two of the best performers in export performance, but as revealed by the Table they are two of the least efficient industries!. TE is not revealed comparative advantage (see Chapter 4). It is an intra-industry and relative measure of performance. More clearly, it is a measure of performance disparity among firms within an industry. Thus, the presence of exporting firms in an industry appears to *reduce* overall TE score for this industry, even though such high-performing firms strengthen its average performance. In addition, it is worth noting that the least efficient industries have, on average, smaller number of firms (N), and thus tend to have an oligopolistic market structure.

[29] It should be emphasised that the adopted strategy for outlier deletion did not aim at ensuring convergence *per se*; some outliers were excluded just because they were statistical and logical outliers even though the estimation proceeded smoothly without omitting them, and some industries that achieved convergence through high deletion rate were excluded from analysis in the second stage.

Table 5.8

The Four Most and Least Efficient JMIs Ranked According to TE (MTET) Scores

Industry	ISIC Code	N	MTET	MTEH	ETET	ETEH
Least Efficient Industries						
Spinning, weaving and finishing textiles	3211	20	0.44	0.43	0.42	0.44
Manufacture of spare parts for motor vehicles	3843	31	0.46	0.48	0.45	0.51
Manufacture of drugs and medicines	3522	15	0.49	0.47	0.51	0.48
Manufacture of electrical apparatus and supplies n.e.c.	3839	15	0.53	0.46	0.52	0.44
Most Efficient Industries						
Upholstery	3322	315	0.79	0.74	0.78	0.74
Manufacture of bakery products	3117	1059	0.79	0.75	0.79	0.75
Manufacture of agricultural machinery	3822	21	0.80	0.75	0.80	0.75
Manufacture of prepared animal feeds	3122	22	0.87	0.87	0.87	0.87

SOURCE: Researcher.

Table (5.9) presents summary statistics for eight (in)efficiency measures describing patterns of productive efficiency in 35 JMIs. The overall findings seem internally consistent and externally compatible with previous research. The efficiency measures ETEH, MTEH, ETET and MTET reveal similar characteristics. Furthermore, inefficiency measures (ETIH and GAMMAH) share alike features. Other measures (SKEW and LAMBDAH) show greater variability and, by their very nature, are hard to interpret and compare with other measures. The following are some remarks on the above measures:

1. Interpretable measures of TE show that, in the sample studied, JMIs achieved, on average, about 60 % of its potential output. Notwithstanding research comparability, this outcome is in line with the lower limit reported in previous research.
2. Efficiency measures using different forms of inefficiency distribution are quite in agreement as far as central tendency and variability is concerned, with the flexible distribution revealing a higher efficiency level.
3. Efficiency and inefficiency measures signal somewhat different assessment regarding the exact size of technical inefficiency in JMIs, but agree in the overall qualitative assessment; there exist a large opportunity to expand output without increasing inputs.

Table 5.9

Descriptive Statistics for Various (In)efficiency Measures

	N	Minimum	Maximum	Mean	Std. Deviation	Range
SKEW	35	-1.53	0.04	-0.49	0.40	1.57
ETEH	35	0.44	0.87	0.63	0.11	0.43
MTEH	35	0.43	0.87	0.63	0.10	0.44
ETET	35	0.42	0.87	0.67	0.10	0.46
MTET	35	0.44	0.87	0.68	0.10	0.44
LAMBDAH*	30	0.35	6.10	1.62	1.12	5.75
ETIH	35	0.14	1.10	0.57	0.25	0.96
GAMMAH	35	0.04	1.00	0.50	0.28	0.96

* LAMBDAH measure is not available for five industries, due to case (2) failures.

To have a preliminary (bivariate and linear) investigation regarding the effect of competition pressures on level of TE in JMIs, Table (5.10) presents correlation coefficients between market structure as approximated by number of firms (N) and various (in)efficiency indices. All measures agree in showing a positive but somewhat weak relationship between competition and TE. Excluding the most dispersed measures (SKEW and LAMBDAH), the linear relationship is significant at 10% level, and measures based on the flexible inefficiency distribution are significant at 5%. Overall, the results are consistent with the well-established positive link between competitive discipline and the tendency to avoid wasting resources.

Table 5.10

Correlation Between Number of Firms (N) and (In)efficiency Measures

	Pearson Correlation	Sig. (2-tailed)
SKEW	0.14	0.408
ETEH	0.32	0.063
MTEH	0.31	0.071
ETET	0.397	0.018
MTET	0.398	0.018
LAMBDAH	-0.21	0.269
ETIH	-0.33	0.05
GAMMAH	-0.30	0.081

SOURCE: Researcher.

To examine whether various industry-specific (in)efficiency measures are rank-preserving of manufacturing industries in TE performance, a ranking statistic is utilised. This provides a preliminary signal concerning the robustness of the second stage of TE investigation; explaining inter-industry variation in TE. Table (5.11) exhibits Spearman correlation coefficient among eight indices. All correlation coefficients are high and statistically significant[30]. Similar to patterns of univariate descriptive statistics, bivariate order measures reveal the clustering of certain measures; in the efficiency front, the two pairs ETEH, MTEH, and ETET, MTET showed the highest correlation; in the inefficiency front, LAMBDAH and GAMMAH exhibit the same strong association; and between efficiency and inefficiency indices, ETEH and ETIH registered the highest correlation. The least performers as far as rank-preserving is concerned are SKEW and LAMBDAH but the coefficient is still significant.

An interesting finding of this investigation is that, as previous research has revealed, the inefficiency distribution assumption appears to make little difference as far as rank-preserving is concerned; the ordering of industries using the simple and general distribution is similar, with the rank correlation coefficient averaging 0.90 (Table 5.11).

Table 5.11
Correlation Coefficients among (In)efficiency Measures
Spearman's rho Ranking Coefficient**

	SKEW	ETEH	MTEH	ETET	MTET	LAMBDAH	ETIH	GAMMAH
SKEW	1							
ETEH	0.80	1						
MTEH	0.81	0.996	1					
ETET	0.67	0.90	0.88	1				
MTET	0.67	0.90	0.89	0.996	1			
LAMBDAH	-0.86	-0.73	-0.73	-0.73	-0.75	1		
ETIH	-0.80	-1.00	-0.996	-0.90	-0.90	0.73	1	
GAMMAH	-0.77	-0.70	-0.68	-0.81	-0.81	1.00	0.70	1

** All coefficients are significant at the .01 level (2-tailed).

[30] Using Pearson correlation coefficient, the result still holds.

Although one can argue that MTET represents the best TE measure since it imposes no restriction on the shape of inefficiency distribution and it is highly correlated with many other measures, it was decided to compare the regression results using all measures, and, furthermore, utilise a technique (principal component analysis) for combining information in various indices to get a composite measure. Thus, a new TE measure, the principal component (PC), is constructed to pick maximum patterns (variability) shared by six TE measures[31].

5.5 Explanation of TE in JMIs: An Inter-industry Economic Model

Potential Predictors of Industry-Level Efficiency

After measuring TE at the industry level, the second stage of TE investigation aims at explaining inter-industry disparities in TE levels. This *economic* stage suffers from a weak theoretical basis compared with the *statistical* methodology for measuring TE (Kerstens, 1996). Following previous studies in specifying variables that might affect TE at the industry level (CB, 1990; CA, 1992; Mayes et al., 1994), this study depends heavily on an established tradition in industrial economics, namely the SCP paradigm. This paradigm puts much emphasis on the structural elements of the market, such as producer concentration and entry rate, in explaining market performance. Because it considers the industry as its unit of analysis, little attention is given to firm strategy and characteristics, assuming those firm-specific factors to be affected by market structure and not vice versa. In a highly open economy such as Jordan, the definition of 'the market' extends to foreign sources of supply (i.e., imports), thus import penetration and export intensity will be included in the model. Furthermore, government policies that affect market contestability can easily be embodied in the model. An example is tariff policy. Finally, to account for apparent industry heterogeneity, the model includes control variables to account for differences among industries in input proportion and composition (capital intensity and the ratio of production to total workers), and share of small-scale enterprises in the industry. Factors causing all industries to be uniformly inefficient, such as unfavourable business environment, will not be

[31] LAMBDAH measure is excluded from the principal component (PC) because, unlike other measures, its scores are limited to 30 industries, while SKEW is omitted because of its relative theoretical weakness.

qualified in this research design. Although revealing, the SCP model still lacks strong theoretical basis[32].

Various potential predictors of TE in this research are described in Table (5.12). They include structural determinants of TE performance (HHI, CR4, N, NS, IMP, EXPO, ENTRY) including organisational factors (RTS, TOP50, RTOP50); industrial heterogeneity factors (SMALL, SD_L, SD_KI); and other policy variables (NTARIFF, FCI, SD_HCI). The expected sign reported in the Table is based on observed empirical regularities and theoretical considerations.

In general, there are many mechanisms through which producer concentration is expected to be negatively related with TE. These influences range from the role of competition as a threat to survival of inefficient firms, to the role of market power in inducing rent-seeking strategies of non-price competition. Furthermore, competitive markets tend to provide more information feedback concerning best practices in a given industry as a result of more trials and players (see CB, 1990; and Nickell, 1996 for more details).

While domestic and import competition affect TE through changing the incentive and informational structures facing the firm, some other potential factors affect TE through causing variation in performance. Exporting activities, according to Caves, "significantly reduce estimated TE, apparently because they are spread very unevenly among an industry's plants" (1992b: 204). Indeed, a growing body of empirical research indicates the superior performance of export-oriented firms (see Chapter 6).

Some comments on the list of variables are essential. Although there exist different measures for producer concentration, HHI seems to be the most respected index. According to Koller II and Weiss (1989: 26), this index:

> *"[D]erives directly from Cournot's and Stigler's oligopoly theories..., it summarizes the entire concentration curve, and it emphasizes the large firms and gives small firms little weight".*

[32] Schmalensee (1982: 255) harshly criticises this paradigm when he states that "a priori arguments are typically limited to verbal justifications for the inclusion or exclusion of particular variables on the right-hand side of a single linear equation", but see Schmalensee (1989) for a more balanced and comprehensive view.

Table 5.12
Expected Determinants of TE: An Outline for Variable Hypotheses, Definition and Source

Potential Predictors	Expected Sign	Definition and Source
Herfindahl-Hirschman index (HHI)	-	A measure of producer concentration in JMIs, unadjusted for foreign trade, 1994. It summarises the size distribution of firms in terms of employment (HHI_EMP) or value added (HHI_VAL). *Source*: Researcher's calculations based on 1994 Industrial Census (microdata).
Four-firms concentration ratio (CR4)	-	An alternative measure of producer concentration, representing the percentage of employment (CR_4EMP) or value added (CR_4VAL) due to the largest four firms, 1994. *Source*: see HHI.
Export intensity (EXPO)	-	The ratio of manufacturing exports in the JE to manufacturing domestic output (at current prices), averaged over 1990-94, and classified according to ISIC (Rev. 2) at the 4-digit level. *Source:* UNIDO (1998) Industrial Demand-Supply Balance Database 1998.
Import-output ratio (IMP)	+	The ratio of manufacturing imports to sum of manufacturing output plus imports (at current prices), averaged over 1990-94, and classified according to ISIC at the 4-digit level. *Source:* see EXPO.
Entry rate (ENTRY)	+	Firm gross entry rate in each (ISIC) manufacturing industry, 1994. It is defined as number of new firms divided by total number of incumbent and entrant firms producing in 1994. *Source*: Researcher's calculations based on Industrial Census 1994 (microdata), using starting production date of firm.
Tariff rate (NTARIFF)	-	Nominal tariff rate classified by ISIC industry, 1995. *Source*: data provided by Customs Department, Jordan.

Table 5.12- Continued

Potential Predictors	Expected Sign	Definition and Source
Share of small enterprises (SMALL)	+	The ratio of number of enterprises with less than 5 workers divided by total number of enterprises in each industry in 1994. *Source*: see HHI.
Standard deviation of human capital intensity (SD_HCI)	-	A dispersion measure of firms' share of non-production workers to total workers, as a proxy for human capital intensity 1994. *Source*: see HHI.
Number of firms (N)	+	Number of firms in the ISIC industry (1994).
Number of firms squared (NS)	-	Number of firms squared.
Absolute typical plant size (TOP50)	+ or 0	'Top 50 %' index is an absolute measure of typical plant size summarising firm-size distribution of an (ISIC) industry. It is calculated as the average employment size of the larger firms comprising the upper half of an industry's size distribution (see Scherer et al., 1975). *Source*: see HHI.
Relative typical plant size (RTOP50)	+ or 0	A measure of scale of typical plant relative to the market. It is gauged as 'Top 50 %' index divided by total employment in the industry. *Source*: see HHI
Standard deviation of firms' employment (SD_L)	?	A summary measure of the spread of firm size in an industry (1994). *Source*: see HHI
Foreign capital intensity (FCI)	-	The share of non-Jordanians in capital at the level of industry. *Source*: Industrial Census 1994.
Returns to scale (RTS)	?	An estimate of scale elasticity in the (ISIC) industry. *Source*: Researcher's calculations based on Industrial Census 1994 (microdata) using the value added CD production function.

Table 5.12- Continued

Potential Predictors	Expected Sign	Definition and Source
Standard deviation of firms' capital intensity (SD_KI)	-	A measure of inter-firm variation in the ratio of capital stock at book value (including leased capital) to total employment of an industry. *Source*: see HHI
Product differentiation (DIFFEREN)	-	The ratio of advertising expenditures to domestic sales. Source: Industrial Census 1994.

While there is a case in principle for adjusting concentration with international trade in open industries, there is no consensus on how this 'correction' should be done in practice using available data[33]. As a result, this study follows previous research in examining the impact of foreign trade on TE separately from concentration. This position avoids *ad hoc* adjustment method, and enables one to isolate the effects of domestic competition and import competition, which can have asymmetric pro-competitive influence. Table (5.15) shows that producer concentration, however measured, is potentially a good predictor of TE.

Typical plant size is an important summary statistic in the SCP paradigm (see Table 5.12 for definition) which, unlike average plant size, has the feature of robustness in skewed and truncated size distributions, since it ignores the lower tail of firm-size distribution. It can be measured in absolute terms (TOP50) or in relative terms (RTOP50). The obstacle limiting its usefulness in the SCP regression model is reflected in the fact that it is typically highly correlated with producer concentration (Davies, 1991a). In this application, the correlation coefficient ranged between 0.57 and 0.99 depending on how concentration and firm share is measured (Table 5.13); avoiding collinearity requires the exclusion of this variable from the core model, even though it appears to be highly correlated with TE measure (Table 5.15). The same appears to apply to inter-firm size dispersion (SD_L).

[33] Further to methodological weaknesses, it is worth noting that there are good theoretical considerations in favour of ignoring the adjustment question (see Auerbach, 1988). First, a large proportion of Jordanian manufacturing imports represent capital goods and raw materials (Chapter 2), which has no (close) domestic substitute. Second, manufacturing imports in Jordan have been subject to regulation via import licensing before 1997. Utton and Morgan (1983) discuss the issue of concentration and foreign trade in general, and Clarke (1993) provides a critical assessment of the methodology used in Utton and Morgan's work.

Table 5.13
Correlation among Domestic Structural Factors

	HHI_EMP	HHI_VAL	CR_4EMP	CR_4VAL	N	SD_L	ENTRY	FDI	TOP50	RTOP50	RTS	DIFFEREN
HHI_EMP	1.00											
HHI_VAL	0.87	1.00										
CR_4EMP	0.90	0.77	1.00									
CR_4VAL	0.80	0.83	0.92	1.00								
N	-0.46	-0.41	-0.59	-0.60	1.00							
SD_L	0.69	0.45	0.63	0.50	-0.26	1.00						
ENTRY	0.14	0.00	0.08	0.05	-0.18	0.04	1.00					
FDI	0.46	0.40	0.32	0.25	-0.16	0.32	-0.01	1.00				
TOP50	0.81	0.60	0.68	0.57	-0.29	0.95	0.07	0.39	1.00			
RTOP50	0.99	0.87	0.87	0.79	-0.44	0.68	0.12	0.45	0.82	1.00		
RTS	0.04	0.22	0.04	0.18	-0.11	-0.04	0.02	-0.08	-0.01	0.03	1.00	
DIFFEREN	0.32	0.15	0.32	0.21	-0.24	0.61	-0.18	0.37	0.51	0.28	-0.04	1.00

Within global structural factors, manufacturing export (EXPO) appears moderately correlated with manufacturing import (IMP) as Table (5.14) shows. Furthermore, as expected, IMP is negatively correlated with nominal tariff (NTARIFF).

Table 5.14
Correlation among International Structural Factors

	NTARIFF	**EXPO**	**IMP**
NTARIFF	1.00	-0.34	-0.53
EXPO	-0.34	1.00	0.47
IMP	-0.53	0.47	1.00

Many control variables of industrial heterogeneity (SD_L, SD_KI, SD_AGE) take the form of standard deviation of firm-specific characteristics. This is due to the nature of TE as a measure of performance dispersion within an industry; if the dependent variable represents average performance of an industry (such as LP or profitability), then predictors can take the form of average summary measures.

Table 5.15

Correlation between TE Measure and Industry Characteristics

	MTET			PC	
	Pearson Correlation	**Sig. (2-tailed)**		**Pearson Correlation**	**Sig. (2-tailed)**
HHI_EMP	-0.76	0.000		-0.70	0.000
HHI_VAL	-0.57	0.000		-0.48	0.004
CR_4EMP	-0.70	0.000		-0.64	0.000
CR_4VAL	-0.61	0.000		-0.52	0.001
N	0.40	0.018		0.36	0.036
IMP	-0.21	0.228		-0.23	0.188
EXPO	-0.46	0.005		-0.48	0.004
ENTRY	0.04	0.835		0.07	0.707
NTARIFF	0.07	0.710		0.14	0.410
RTS	0.10	0.561		0.096	0.584
FDI	-0.52	0.001		-0.49	0.003
TOP50	-0.71	0.000		-0.65	0.000
RTOP50	-0.76	0.000		-0.69	0.000
SMALL	0.52	0.002		0.47	0.004
SD_L	-0.69	0.000		-0.65	0.000
SD_KI	-0.44	0.008		-0.43	0.011
SD_HCI	0.20	0.259		0.17	0.331
DIFFEREN	-0.45	0.007		-0.39	0.020

To avoid the charge of data mining and extensive experimentation, one should ideally "find the best theoretical model, secure the right data, then perform and report a single test with no 'fishing' in the data set" (CB, 1990: 87). This best-practice methodology, alas, is not feasible in a cross-section research design, if at all[34]. **First**, as emphasised earlier, the theoretical basis of TE explanation is not strong enough, and validated empirical regularities are limited to the negative impact of (high) concentration on TE. Without sound theoretical framework, concepts such as 'omitted variable' and 'irrelevant variable' might be elusive. Moreover, the cross-section research is susceptible to the problem of multicollinearity with weak remedies except probably avoiding 'double counting' in including regressors (Jacquemin and De Jong, 1977). **Second**, many economic variables are not directly observable (Geroski, 1998) or have many rival proxies. To conclude, some amount of data mining is inevitable, but fortunately, in this study, the search is structured within known (theoretically based) boundaries and available potential predictors (Table 5.12).

[34] Charemza and Deadman (1997: 11) define data mining as "the general problem of not being in a position to conduct controlled experiments". If one accepts this view, then data mining is a general research pitfall in all social sciences.

The Empirical Model: Results and Interpretation

Due to limited sample size, a core model is specified using the most probable predictors based on results of previous research along with minimum 'duplication' of regressors. More specifically, this study adopts the following rules for building the preferred empirical model:

1. Including the 'basic' variables of the SCP paradigm, even if they are insignificant.
2. Making use of *previous empirical regularities*. Any relevant variable that is significantly and consistently related to TE in three out of six countries included in the CA (1992) should be included in this model, even if it is not significant (e.g. SD_HCI)
3. Taking into consideration *data-driven criteria* for selecting among non-nested models; Akaike information criterion (AIC), Schwartz criterion (SC)[35], in addition to adjusted coefficient of determination.
4. Minimising multicollinearity. But to avoid sacrificing information about the explanatory power of collinear variables, an 'alternative' model will be constructed excluding producer concentration, which seems to capture much of the variability in many structural predictors.
5. The size of the model should not violate the rule-of-thumb stating that 'at least 5 observations per predictor' (Kleinbaum et al., 1998).

After some experimentation, the above rules led to the following core model for inter-industry variation in TE using both the (MTET) measure and the principal component (PC) as the dependent variable:

$$\begin{aligned} MTET = 0.81 &\ - \underset{(-12.3)}{0.75\,HHI\_EMP} - \underset{(-2.6)}{0.13\,EXPO} - \underset{(-0.04)}{0.001\,IMP} \\ &+ \underset{(+1.57)}{0.39\,ENTRY} - \underset{(-2.15)}{0.86\,SD\_HCI} + \underset{(+2.52)}{0.09\,SMALL} \end{aligned}$$

$$Adj.\ R^2 = 0.70 \qquad N = 35$$

and

[35] Ceteris paribus, the model with smaller AIC and SC is considered better from a statistical point of view. See Green (1993) and Charemza and Deadman (1997) for more information.

$$PC = 1.13 \underset{(-7.5)}{- 2.43\ HHI\_EMP} \underset{(-2.8)}{- 0.57\ EXPO} \underset{(-0.19)}{- 0.021\ IMP}$$

$$\underset{(+1.78)}{+1.61\ ENTRY} \underset{(-2.05)}{- 2.89\ SD\_HCI} \underset{(+1.72)}{+ 0.28\ SMALL}$$

Adj. $R^2 = 0.61$ N = 35

A comparison between the above equations clearly shows the superior explanatory power of MTET model compared with the PC model. Both models show the same overall findings with the exception of ENTRY and, to some extent, SMALL.

Sticking to the PC equation, all predictors have the expected sign and are significant, with varying degrees, except import penetration. The most robust predictor of TE is found to be producer concentration (HHI_EMP); it is robust to the measure adopted and to the model specification. Significant at 1% and 5% levels but less robust are exports (EXPO) and dispersion in human capital intensity (SD_HCI), respectively. Finally, firm entry rate (ENTRY) and intensity of small enterprises (SMALL) are significant at 10% level. The overall explanatory power of the model as represented by the adjusted R^2 is quite high. One reason that might explain the high level of adjusted R^2 in comparison with previous studies is the successful adoption of the flexible inefficiency distribution. Indeed the MTET model is statistically (and theoretically) better than the MTEH model (see Table 5.16 below) in terms of data-driven criteria.

After describing the empirical findings, an assessment is necessary. Starting with entry, this predictor is significant only at 10% level. Entry can enhance TE through its competition effect, but consistent with Geroski's (1995) conclusion, the pro-competitive effect of entry is less significant than actual rivalry among existing firms, probably because most entrants are comparatively smaller.

As some previous research shows, export increases inter-firm performance dispersion and thus enhances inefficiency. Notwithstanding the high import penetration ratio, averaging 55 % in 1994, the sterile pro-competition effect of imports in Jordan[36] shared by, *inter alia*, Korea and Australia (see CA, 1992), is too important to be left without explanation. Indeed, one of the often-mentioned arguments in favour of trade liberalisation and economic integration is avoiding 'X-inefficiency' within domestic import-competing firms (Rodrik, 1992; Pelkmans, 1997).

There are two main possible explanations for this finding. One might respond that this result is a statistical fallacy arising from model misspecification, collinearity of import with other predictors in the core model, or trade data classification and imperfections[37]. A trial to include a quadratic term for imports predictor on one hand, and an examination of the correlation matrix for the core predictors, on the other, resulted in a refutation of the above proposition. Even the exclusion of exports variable, which has the largest correlation with imports among all predictors, did not change the results.

A theoretical explanation might do better. Indeed, the pro-competition effect of import penetration can be mitigated or even dampened through many channels. **First**, if imported goods do not seem to affect the efficiency of import-competing firms, then this might be due to the fact that imported goods are just *different* from locally-produced goods, either in variety or quality. In this case, product differentiation "tends to reduce the intensity of import discipline and to favour intra-industry trade" (Jacquemin and Sapir, 1993: 83). Actually, in Jordan, product quality in general is yet to reach international standards. **Second**, import-substitution firms might be sheltered from import rivalry through various natural (e.g. transport) and artificial (tariff and non-tariff) trade barriers, which decrease the price advantage of foreign goods[38]. Indeed, import licensing in Jordan (a type of non-tariff barrier fostering monopoly power) has been removed only recently in 1997 (Al Khouri, 2000). **Third**, the pro-competition effect of imports can be mitigated by strategic behaviour. Examples of such cases are: (i) the existence of monopoly power in the domestic distribution sector; (ii) the quest of foreign producers to form a small dominant group (Jacquemin and Sapir, 1993) that could lead to the contraction of domestic production; and (iii) the collusion between importers and domestic producers.

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[36] Nominal tariff (NTARIFF), a negative measure of manufacturing openness, is found also to be insignificant.

[37] Classification errors can result from imperfect concordance between trade (SITC or HS) data and output (ISIC) statistics.

[38] In Jordan, the average effective rate of protection for manufacturing sector is 43 % in 1997, and some industries enjoy a rate above 100 %.

Table 5.16
Inter-industry TE Explanation
(The Core Model, N=35) (1)

	Efficiency Measures				*Inefficiency Measures*		
Exogenous Variable	**PC**	**MTET**	**MTEH**	**SKEW**	**ETIH**	**GAMMAH**	**LAMBDAH**
Constant (C)	5.57	15.79	9.16	0.69	1.91	0.02	-0.82
HHI_EMP	-7.48	-12.29	-4.52	-1.96	4.05	5.96	2.59
EXPO	-2.84	-2.58	-1.88	-1.70	1.70	4.27	2.06
IMP	-0.19	-0.04	-0.02	0.83	-0.07	0.41	0.34
ENTRY	1.78	1.57	1.56	-0.20	-1.54	-1.72	-1.23
SD_HCI	-2.05	-2.15	-1.34	-2.00	1.26	1.43	1.56
SMALL	1.72	2.52	1.62	0.83	-1.42	-0.29	0.25
Adjusted R^2	**0.61**	**0.70**	**0.42**	**0.24**	**0.46**	**0.58**	**0.27**
Schwarz Criterion (SC)	**0.32**	**-2.45**	**-1.73**	**1.20**	**-0.07**	**-0.05**	**3.27**
Akaike Information Criterion (AIC)	**0.01**	**-2.76**	**-2.04**	**0.89**	**-0.38**	**-0.36**	**2.95**
Prob(F-statistic)	**0.000**	**0.000**	**0.001**	**0.029**	**0.000**	**0.000**	**0.035**

(1) **Figures represent (t) ratios using OLS estimator**, corrected for heteroskedasticity by means of White's (1980) procedure. Note that TE measures are relative (not absolute) measures of TE, thus they indicate 'spread in performance' within an industry.

Although the PC measure of TE can claim the feature of being representative of most TE candidates, it is interesting to compare the results of different individual measures using different forms of inefficiency distribution. Table (5.16) shows that:

1. TE measures differ in their statistical performance; as expected from previous univariate and bivariate analysis, MTET and MTEH perform better in multivariate analysis than ETIH and GAMMAH, and the former explain TE better than LAMBDAH and SKEW.
2. Partial relationships are *not* robust with changing the TE measure in three out of six predictors, namely ENTRY, SD_HCI and SMALL. An interesting case also appears; the link between TE and its predictors seems robust in most regressors using both MTET and MTEH. Only SD_HCI and SMALL are sensitive in their significance to the selected inefficiency distribution.

To test the impact of other interesting variables such as number of firms (N), typical plant size (TOP50) and size dispersion (SD_L) separately, an alternative model (Table 5.17) is built excluding domestic producer concentration which contain information on the above predictors.

Table 5.17
Inter-industry TE Explanation Using PC Measure
(The Alternative Model, N=35) (1)

	Model 1	Model 2	Model 3	Model 4	Model 5
C	3.54	3.54	3.21	3.38	4.09
N	2.88	2.10	2.98	2.76	3.11
NS	-3.12	-2.32	-3.09	-2.97	-3.21
TOP50	-4.80	..	-5.49	-5.20	..
SD_L	..	-3.68	..	..	-3.92
EXPO	-1.78	..	..	-2.14	
ENTRY	2.06	..	1.49	1.87	1.65
SMALL	0.42	0.76	0.81	-0.23	0.30
SD_HCI	-1.34	-0.78	-1.29	..	..
IMP	..	-1.66		..	-2.00
FCI	..	..	-2.05	..	..
Adjusted R^2	0.56	0.45	0.52	0.54	0.51
AIC	0.17	0.36	0.25	0.18	0.26

(1) **The figures represent (t) ratios**, corrected for heteroskedasticity by means of White's procedure. (..) indicates no test was made.

Broadly consistent with previous analysis, Table (5.17) shows that competition (as measured by number of firms) affects TE positively and robustly, but only in a quadratic relationship. Optimal N appears quite high (more than 600 firms). Plant size (TOP50) and dispersion of plant size (SD_L), on the other hand, seem to influence TE negatively. The negative coefficient of TOP50, our measure of average firm size, does not confirm the findings of most other studies (see Chapter 6), but is consistent with the pro-efficiency impact of domestic competition. Indeed, if TOP50 measure is interpreted as a proxy for entry barriers, then the result is quite plausible (Torii, 1992). As before, EXPO appears significant in most models and with the same expected sign, and the same applies to ENTRY variable. On the other hand, SMALL and SD_HCI are insignificant (when PC is used as the efficiency measure). Although IMP in certain specifications has better explanatory power, it is negatively associated with TE, probably signalling the competitive disadvantage of import-competing firms. As Mayes et al. (1994: 129) put it, "a high import ratio could actually indicate that the industry *is* inefficient relative to firms abroad, not that foreign competition drives out inefficient domestic firms". Furthermore, FCI appears significant for the first time with a negative link, while no impact is traced for RTS on TE (unreported).

Robustness Checks for the Core Model: Omitted Variables, Nonlinearities and Sample Splitting

While many variables that might affect industry-specific TE are omitted from the present analysis, it is fair to say that most of these are either irrelevant to the case of JMIs, expected to have limited impact, or simply unavailable. Examples of the first type of variables are geographical dispersion, industrial relation and multi-plant operation. The second type of omitted variables includes the use of part-time employees, which is not a common employment practice in JE in most industries. Finally, data on capital vintage and dynamic disturbances (such as expenditures on R&D) are not available. It is noteworthy that omitted variables can, to some extent, be captured in included variables.

The core model was found to be quite robust to variable exclusion and inclusion; including omitted but insignificant variables (such as SD_KI, NTARIFF, FDI and DIFFEREN) in the core model did not change the significance level of main variables, namely producer concentration, export intensity and import penetration. An interesting question to examine is whether the robust link between TE and producer concentration exhibits a significant non-linear relationship. Here it seems that different measures of producer concentration appear to lead to different conclusions. More specifically, while HHI measure (using employment and value added measures) did not reveal any significant nonlinearity, CR_4VAL, like N, did confirm the significance of the coefficients of both the linear term (with positive sign) and the quadratic term (with negative sign). The threshold level for concentration was at about 42 %.

A final robustness test was undertaken through re-estimating the model after omitting (5) industries lacking plausible estimates for LAMBDAH (i.e., industries subject to case (2) types of failure) to check for any abnormalities in these industries. The result of this exercise shows the stability of the core model to re-sampling.

5.6 Conclusions and Policy Implications

Technical efficiency analysis can be considered as one important tool in what this Thesis called *Competitiveness Analytical Tools* (CATs). In principle, it has much to offer in supporting industrial competitiveness in manufacturing sector through measuring and explaining the domestic efficiency gap between actual performance of manufacturing firms and their potential performance. On the other hand, TE analysis has limitations. It does not, for example, address issues of *positive* quality (see Chapter 4) and its domain is cost efficiency in a domestic context. Moreover, empirical findings can be time-specific (see Appendix 2).

This research aims at investigating empirically a relatively new approach for market performance (inter-industry variation in TE) in a new context (the case of a small and developing country). Following CB (1990) and Mayes et al. (1994), a two-stage SFA model is applied, for the first time, to the case of JMIs. The overall aim is to: (i) statistically measure TE in each of the 51 manufacturing industry at a fine level of disaggregation (four-digit ISIC); and, (ii) economically explain why industries vary in their TE performance using a single-equation setting. Several novel endeavours have been undertaken to extend the methodology: the successful use of a flexible specification for the inefficiency term; dealing with issues of small enterprises; the utilisation of the principal component tool; and finally testing the impact of using different measures of producer concentration. On the whole, the extension attempts were revealing.

The empirical findings of the first stage of investigation appear to confirm that the CD production function could be a reasonable representation of the production technology in JMIs. The first stage also confirms Caves's (1992a) remark that the technique is expensive in terms of computational complexity and research resources.

The empirical findings of the second stage were more interesting and were broadly consistent with those obtained in industrialised countries. More specifically, the outcome of both the core model and alternative model seems to be strongly consistent with the basic hypothesis of the SCP paradigm. The analysis does confirm the significant link between market structure, as measured by HHI or CR4, and market performance as measured by TE. Producer concentration (unadjusted for foreign trade) is found to be *negatively* related to TE in a significant and robust manner, *most probably in a linear relationship*. Exports also seem to lead to a higher dispersion of firm performance in a robust manner. The refutation of any positive and significant association between TE and import competition is interesting but not inconsistent with most previous studies. Beyond these partial relationships, the level of certainty and empirical robustness decreases. Entry might enhance TE through facilitating competition, and inter-firm dispersion in human capital intensity seems to explain part of inter-industry variation in TE.

Due to the complexity of policy assessment in general and the peculiarity of the TE research design in particular, the concrete policy implications of these empirical regularities are tentative and require careful interpretation. **First**, the evidence reveals the importance of domestic competitive discipline in achieving higher TE in JMIs and thus global competitiveness. Thus, consistent with previous research, there is evidence to suggest that strengthening competition, especially in concentrated markets, do matter in alleviating organisational slack in JMIs. Moreover, liberalising external trade does not seem to constitute a substitute for an explicit competition law and policy in JMIs as far as TE is concerned. Indeed, one of the potentially important areas for competition policy to tackle is seller concentration and conduct in wholesale distribution sector. **Second**, an investment promotion policy aiming at increasing entry rate, particularly of export-oriented firms, can improve industrial performance.

It is important to emphasise at this stage that, from the point of view of competitiveness strategy, the *optimal* market structure is somewhat an elusive target. Market performance, like market structure, is a multi-dimensional concept, and optimal structure can vary by performance criterion. More specifically, while adopting a strong competition policy can enhance TE and allocative efficiency, scale efficiency and export performance might be maximised by favouring less atomistic industries, an issue to be tackled empirically in Chapter (6).

CHAPTER SIX

Firm Size and Performance in Jordan's Manufacturing Sector: Explorations and Implications for Competitiveness

6.1 Introduction: Background and Main Issues

One of the crucial policy issues in designing industrial competitiveness strategy in a small economy is the expected impact of firm size on its competitive performance. The issue is broadly related to the policy emphasis that should be given to scale effect against competition effect in enhancing industrial performance. Extreme views expressed in the literature range from the necessity to create large 'national champions' and 'the bigger the better' to slogans such as 'small is beautiful' (Schumacher, 1973) and 'the bigness mystique' (Adams and Brock, 1988). These divergent views expressed above still have noticeable effects on business practices and industrial policy, although the attention in Western policy circles is currently reversed in favour of *small and medium enterprises (SMEs)*.

In the pro-bigness front, a *merger wave* is currently taking place in many industries, mainly in research-intensive manufacturing industries (such as pharmaceuticals, see Chapter 7) and deregulated services industries (such as financial services, communications and airlines). High costs of competition in the face of accelerating product development and process innovation, and the desire to enhance global competitiveness, can partially explain this trend. Furthermore, 'efficiency defences' in *antitrust policy* are still an integral part of a typical competition policy and law (World Bank and OECD, 1999). Finally, one of the often-mentioned economic justifications for the 1992 European Single Market, for example, is reaping unexploited scale economies by European firms (Pelkmans and Winters, 1988; Emerson et al., 1988).

At the other front, SMEs are recently getting much attention from both industrial world (Acs and Audretsch, 1990; Acs, 1999) and LDCs (Mead and Liedholm, 1998) due to their potential role in entry, innovation, and job creation. At the analytical side, after negligence of small firm sector and focussing on market power of big businesses, industrial economics is seriously analysing the 're-emergence of small enterprises' in industrial economies (Sengenberger et al., 1990). Furthermore, a recent research direction focusing on competitiveness of SMEs is attracting more attention in a globalisation era[1]. At the policy sphere, the disenchantment with the optimistic view, dominated in the post-war period, about the exceptional performance of large firms had led to a reconsideration of industrial policy towards firm size in favour of a more balanced policy stance. Thus, many countries are currently reviewing their incentive, legal and policy frameworks as well as institutional arrangements with a view to enhancing neutrality and removing bias *against* SMEs.

This changing perspectives on size and returns (Gold, 1981) or, more recently, public refocus from large firms to the other side of firm-size distribution can be considered as one of the major policy reversals in microeconomic policy since the 1970s. But many economists currently believe that substantial developments occurred in production technology and human tastes, in the last three decades or so, have certainly affected the minimum efficient size (MES) of manufacturing enterprises, at least in consumer goods industries. These developments contributed to a business environment that favours the viability of SMEs vis-à-vis the inflexibility of mass production. Recent literature cites the following possible explanations for the recent *shift* in firm-size distribution in most industrial nations[2]:

1. On the supply side, the implementation of new flexible production techniques, either in processes such as computerisation, or in arrangements like inter-firm co-operation. These changes mitigated cost disadvantage of small firms in many manufacturing industries.
2. On the demand side, the segmentation of markets and the differentiation of goods resulted from diverse tastes of an affluent society. These developments allowed small, sub-optimal scale, firms to adopt new survival strategies such as occupying strategic niches (Porter, 1979) and creating loyalty.
3. On market conditions, volatility of business activity and uncertainties of technical changes have led to a quest for flexible technologies.

In practice, a balance between small and large firms can properly guide active policy, but what constitutes an ideal balance can only be correctly established by resorting to robust empirical evidence, and tends to be country-specific and industry-specific. In his response to this central question, Murphy (1996: 15) suggests that "[t]here is just too little research by the

[1] See, for example, Pratten (1991) for a cross-section, firm-level, primary data research design, and Erzan and Filiztekin (1997) for a panel and aggregate data approach. See also Lall (2000b) for a policy-oriented statement.
[2] See Carlsson, 1989; Acs and Audretsch, 1990; Sengenberger et al., 1990; Stanworth and Gray, 1991. It is noteworthy that the focus here is on the *rise* in market shares of SMEs in *industrial economies* since the 1970s (i.e., on recent *temporal change* in firm-size distribution). For a *snapshot* explanation of the skewness of firm-size distribution prevailing in *all* countries, see Simon and Bonini, 1958; Ijiri and Simon, 1977; Lucas, 1978; and You, 1995. On *international differences* in firm-size distribution, see Pryor, 1972; Scherer, 1973; and Fukuyama, 1995.

economists to provide any clues. This, of course, does not deter the politicians from assuming that the UK economy [for example] needs more small firms". The question is even more crucial in the case of small and developing economies where: (i) SMEs sector constitutes a larger *share* of total number of enterprises (assuming a universal definition for SMEs); (ii) a substantially lower threshold of 'smallness' applies; (iii) the prevailing business environment is typically less favourable; and (iv) empirical research on scale economies is even more limited (Berry, 1992).

Against this background, this Chapter aims at investigating the expected impact of firm size on the performance of JMIs, and the competitiveness position of small firms vis-à-vis large firms in the same context. The fundamental research questions addressed by this Chapter are: what are the implications of a highly skewed firm-size distribution characterising JMIs on Jordan's manufacturing competitiveness? Should Jordan's industrial policy promote all businesses regardless of size or market structure? Should the government adopts a neutral industrial policy towards firm size and let market forces decide on the 'right' balance between small and large firms? Is there a strong case for an active industrial policy supporting entry, growth, or co-operation within a specific size class in JMIs? What is the expected impact of launching a free trade area with the EU, USA and Arab countries on the survival-ability of sub-optimal scale plants in JMIs? Does trade liberalisation strategy adopted in Jordan since 1989 lead to substantial size rationalisation or closure of small firms?

The empirical modelling will be based mainly on 1994 cross-section data using four different performance criteria; returns to scale (RTS)[3]; labour productivity LP; unit labour costs ULCs; and export intensity. The study examines the link between firm size and performance using different levels of aggregation and size measures. First, an exploratory approach is adopted where long-term survival-ability of small manufacturing firms is examined at the sector level using time-series data, followed by an econometric examination of scale elasticity at the industry (four-digit) level using cross-section microdata. Second, the impact of firm size on LP, ULCs and export performance is empirically evaluated at the manufacturing level (i.e., through pooling data of all industries). To ensure robustness, all

[3] It is worth emphasising that '(dis)economies of scale' is a more embracing concept than 'returns to scale'. The latter is a purely technical relationship -the efficiency of transforming inputs into output- assuming constant input prices. The former incorporates *all size-related factors* affecting long run average costs, whether these factors are controllable by the firm (internal economies of scale) or industry-level factors (external economies of scale). Thus, unlike increasing RTS (technical scale economies), economies of scale include pecuniary economies arising from paying lower input prices. See Shone (1981) and Perman and Scouller (1999).

four possible measures of firm size are adopted; employment (L), value added (VA), capital (K), and gross output.

6.2 Selected Theoretical Issues in Scale Efficiency Paradigm

6.2.1 Core Competencies of Small versus Large firms

Due to its adherence to perfect competition model, neoclassical economic theory has traditionally favoured small firms (Griffiths and Wall, 1999). In the aftermath of industrial revolution and the prevalence of mass production, business practices favoured large-scale firms, but economic theory acknowledged the existence of diseconomies of scale and the 'quiet life' of a monopolist (Hicks, 1935). In the midst of twentieth century, the scientific revolution in many new areas gave innovation more weight in policy making, supported by econometric studies that revealed technical progress to be the single most important source of economic growth in the Western world. Supporting this preoccupation with dynamic efficiency came the influential views of J. Galbraith and J. Schumpeter about the importance of big businesses' profit in financing R&D expenses. Since the 1970s, enchantment with big business has contracted, fuelled by new opportunities in technology and demand that favour smaller scale. It is now agreed that both small-scale and large-scale firms have strengths and weaknesses. The weight attached to these advantages and disadvantages can vary between LDCs and industrial countries. Table (6.1) presents points of strength and weakness facing small and large enterprises using various performance measures.

Table 6.1
Strengths and Weaknesses of Small versus Large Firms

Feature	***Small Firms***	***Large Firms***
Flexibility (including output flexibility, occupying niches market and reversibility)	√	X, particularly in the absence of diversification & large economies of scope
Proximity to consumer, better product customisation and customer services	√	X
Product liability, quality assurance and brand name recognition	Generally weak, particularly in LDCs	√ particularly in industrial countries
Resources availability (technical, financial and market information) and ability to mobilise resources and funds	X	√
Managerial incentive	√ as a rule	X unless subject to strong competitive, corporate or internal control
Overall technical efficiency	Firm size in manufacturing tends to have a non-negative association with firm-level TE in LDCs	
Operating and financial risk	√	X
Labour (wage and non-wage) costs	√ particularly in the absence of minimum wage	X
Labour productivity	Some evidence is against small firms	
Technical economies of scale	X	√ but depends on actual capacity utilisation and product standardisation
Pecuniary economies of scale (bargaining power with banks, suppliers and distributors)	X	√
Learning economies	X	√
Economies of scope	X as a rule	√ if the firm adopts a diversification strategy
Dynamic efficiency and innovation	Highly dynamic; talent-based invention (in industrial countries)	Resource-based innovation (in industrial countries)
Export commitment	Modest, particularly in LDCs	√

Note: √ stands for a strength point, X for a weakness point.
Sources: Researcher, based on Speight, 1970; Silberston, 1972; Boswell, 1973; Scherer, 1974; Fiegenbaum and Karnani, 1991; Bonaccorsi, 1992; EC, 1996a; OECD, 1998a; UNCTAD, 1998; Audretsch, 1999; Lundvall and Battese, 2000; Scarborough and Zimmerer, 2000.

Small firms are better equipped to occupy niche markets, adapt to a changing economic environment and exploit new opportunities within the *domestic* market (Hardwick et al., 1999), augmented by low fixed costs and limited financial risk. On the other hand, small firms lack sufficient resources to finance large indivisible R&D projects, absorb strong external shocks or sustain losses. Conversely, the flexibility feature of small firms includes their ability to exit or switch product line with minimum costs, partially because of their lower sunk costs[4]. Furthermore, although small firms are generally "more disciplined by competition" (Primeaux, 1977: 107) to minimise X-inefficiency, partly because large firms are likely to have more market power (Utton, 1982), empirical evidence on the association between firm size and TE in manufacturing, undertaken mainly in LDCs, tends to favour large businesses[5].

Finally, small firms might have more *incentive* to *invent*[6] because they are subject to more competition pressures than larger firms (market structure effect), able to occupy market niches in innovation (flexibility effect), and because of better-motivated ownership and organisational structure (entrepreneurial dynamism effect), but small firms typically lack *ability* (internal resources, financial and otherwise) *to innovate*, i.e. commercialise their inventions[7]. Indeed, small companies in all economies face difficulties in financing innovation (Mayer, 1992). The ability argument is particularly true in the case of: (i) LDCs where the research infrastructure is still weak and inter-firm cooperation is minimal; and (ii) many high-technology *manufacturing* industries HTMIs (such as pharmaceuticals and aerospace)[8] where the fixed costs of product development and marketing are typically not affordable by 'small' enterprises, and because of the existence of indivisibilities in R&D (see Symeonidis, 1996; EC, 1997a; Sutton, 1999). Nevertheless, Audretsch (1999), among others, believes that while small firms tend to be in an inferior position as far as static efficiency is concerned, they do have a crucial role in raising dynamic efficiency by acting as agents for change. This contribution is typically *not* noticeable in LDCs where entrepreneur creativity and market contestability are constrained by many market and institutional imperfections.

Lacking the agility of small enterprise, large firm can enhance its flexibility through diversification. The strengths of large enterprises include their ability to allocate larger resources for R&D activities (particularly in industrial countries); generally superior LP because of favourable capital intensity; and better access to global markets due to greater ability to finance fixed export costs. Moreover, large firms are better able to exploit economies of marketing, procurement, and R&D.

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[4] See Sutton (1991) on the concept of sunk costs.

[5] See CB, 1990; Brada et al., 1997; World Bank, 1997. See also Lundvall and Battese, 2000 for a recent survey.

[6] See Clark (1993) on Arrow's model. See also Freeman (1982) and OECD (1998a) for a general discussion on advantages of small firms in innovation.

[7] Empirical evidence on the effect of firm size on its innovativeness is inconclusive (Scherer, 1991; Torrisi, 1998; CEA, 1999), but the Schumpeterian hypothesis is recently under attack (Acs and Audretsch, 1991; Davies, 1991b; Symeonidis, 1996).

[8] Sutton (1999) cites scientific instruments industry as an example of HTMIs where scale economies in innovation seem weak.

In a business world characterised by the absence of product differentiation, market dispersion and excess capacity, large firms have dominance in many industries simply because of scale economies. But when non-price factors, demand deficiency, as well as market fluctuation and segmentation are taken into consideration, small firms in local markets have a natural ability to provide products at lower price for certain quality level and market niches, supported by lower labour costs (LCs) per worker and more customised service.

From the point of view of *export* competitiveness of SMEs, small firms are generally less effective and indeed loose many of their core competences. For example, proximity to consumer and related services are absent in global markets. On the contrary, small firms tend to be far away from foreign consumers, mainly because of high marketing costs and fixed export expenses. Product development and quality considerations are typically weak points for SMEs, particularly in LDCs. Moreover, a small firm's advantage of lower LCs per worker is not considered a strong and sustainable competitive advantage if accompanied by lower LP and inferior technological capabilities, particularly if the small firm produces price-inelastic product and sells to high-income groups in high-income economies.

To sum up, Table (6.1) clearly confirms Stigler's (1958) suggestion that firms of different sizes have different comparative advantages.

6.2.2 Measures of Firm Size

This section aims at examining alternative measures of firm size[9] and their relative strengths and weaknesses. The reliable measurement of firm size (or its average) is essential for empirical research in industrial organisation, as this variable constitutes one of the main potential predictors of firm (or industry) performance in the domestic economy, and performance gap among countries (Van Ark and Pilat, 1993). Unfortunately, the multi-dimensionality of 'firm size' might affect the model robustness in the face of the chosen dimension[10]. Table (6.2) presents major candidates for measuring firm size and their respective features. In theory and practice, there is no perfect measure.

[9] Measures of firm performance have been covered in Chapter (4).
[10] See Smyth et al. (1975) and Shalit and Sankar (1977) on conditions for interchangeability among alternative measures of firm size which, according to them, go beyond high correlation.

According to Pryor (1972), scale or size is essentially an output concept, but in practice other related measures are used for practical considerations. In general, data availability and insensitivity to differences in price structures (in international or interregional comparisons) and price changes (in intertemporal comparisons) make employment an attractive size measure (Wedervang, 1965; Siropolis, 1994). Consequently, most empirical research is undertaken using number of employees as the size measure (Page, 1984)[11]. On the other hand, caution should be exercised when a size comparison is made among industries with high differences in capital intensity, since using number of employees tends to underestimate firm size in capital-intensive industries and overestimate size in labour-intensive industries. Moreover, high variation in labour quality among firms, industries, regions and countries has to be taken into consideration when adopting this measure.

Table 6.2
Alternative Measures of Firm Size and Their Features

Size Measure	***Employment***	***Value Added***	***Sales***	***Capital***
Data availability	OK	?	OK	?
Robustness to valuation in international and intertemporal comparisons	OK	X	X	X
Data accuracy	OK	?	OK	X
Robustness to capital intensity	X	OK	OK	OK
Robustness to vertical integration	OK	OK	X	OK
Robustness to cyclical fluctuation	X	X	X	OK

SOURCE: Researcher, based on Adelman, 1958; Bates, 1965; Wedervang, 1965; Curry and George, 1983; Siropolis, 1994; Mayes, 1996.

Value added, if available at the firm level, is also a useful measure of size (Pearce, 1992; EC, 1997c), particularly in intra-country cross-section context, where the valuation problem is at its minimum. Capital stock is the least robust measure of firm size as far as the valuation problem is concerned, especially in periods of inflation. Capital stock is usually measured at historical (book) value, and as such it tends to undervalue long-term assets (and thus firm size) as time passes. The error will be greater, the larger the proportion of old equipment (Weiss, 1989b). Thus, using fixed capital as a measure of size, one can mistakenly consider a small start-up firm with new equipments and an expensive land *bigger than* a large established firm with old fixed assets. To sum up, different capital vintages within the firm

[11] Johnston (1960) concluded that number of employees is the first-best choice.

and among firms as well as inter-firm differences in accounting practices are potentially significant measurement problems. At the global level, international comparison of capital inputs is even harder to make (Kravis, 1976).

Finally, a serious defect of sales as a measure of firm size arises from inter-firm differences in vertical integration. As Adelman (1958: 8) has clarified: "two firms may each make ten per cent of an industry's sales; but if one merely purchases all the components, adds...[little value], and re-sells, it is obviously much smaller than the other, which undertakes all or much of the whole productive process". Thus, comparisons of company size based on sales, as done by *Fortune* magazine, should be interpreted carefully.

To conclude, although case-specific, practical considerations tend to favour employment as the common (if not always ideal) measure of firm size, particularly in cross-country context. In this research, a robustness check is adopted to investigate the sensitivity of empirical findings to the adopted size measure.

6.3 Scale Efficiency in Jordan's Manufacturing Sector

This core section aims at empirically exploring the link between firm size and performance in JMIs using different approaches[12]. The first section is based on time-series evidence, while latter sections use 1994 cross-section microdata. It should be emphasised that available techniques for assessing scale efficiency are plagued with certain conceptual and empirical difficulties (see Chapter 4). As a result, international empirical evidence on the *extent* of scale economies in manufacturing is not yet conclusive, even in industrial countries (see EC, 1997c).

6.3.1 The Survivor Technique: Time Series Evidence on the Competitiveness of Small Manufacturing Firms in Jordan

As noticed earlier in this Chapter, available statistics seem to show that most Western economies are witnessing a long-term rise in the employment share of their SMEs, as defined by these economies, over the last three decades (Sengenberger et al., 1990). According to survivor technique, which is based on analysing long run movement in market shares, this recent trend can reflect the relative efficiency of SMEs in a world characterised by

[12] See Chapter (4) for an overview on the nature and measurement of scale efficiency.

prevalence of business uncertainty, process flexibility, consumer diversity, and inter-firm cooperation. Against this interpretation in favour of the viability of SMEs, recent research done on firm entry and exit asserts that, as a stylised fact, small firms are characterised by their high infant mortality rate (i.e. lower likelihood of survival) in comparison with larger enterprises (see Geroski, 1995 and Audretsch et al., 2001 for evidence and references).

Some recent attempts have been made to reconcile these conflicting facts about industrial dynamics of small business sector with reference to product life-cycle effect (Agarwal and Audretsch, 1999). It seems that a relatively higher entry rate of small firms coupled with viability of small businesses *after* their critical infancy period (through occupying niches) can offer a possible and partial reconciliation. For the purpose of this research, and in view of the criticism against the survivor method, one can utilise the technique as a preliminary *descriptive* tool in competitiveness policy analysis.

The survivor technique relates firm-size group with its market share. According to Stigler (1958: 56), the method proceeds as follows:

> *"Classify the firms in an industry by size, and calculate the share of industry output [or employment] coming from each class over time. If the share of a given class falls, it is relatively inefficient, and in general is more inefficient the more rapidly the share falls".*

An application of this technique to JMIs is attempted, with the aim of assessing the competitiveness of small firms, defined as enterprises with less than 5 employees, vis-à-vis larger firms. The choice of these two main size classes, though arbitrary, is imposed by the availability of data. Furthermore, the choice of initial and final years (1990 and 1997) is imposed by data availability and similarity of demand conditions, but 1994 was included in the analysis to check for robustness and structural break that may arise because of changing growth dynamics in manufacturing after 1994 (see Figure 2.1, Chapter 2).

Table (6.3) and Figure (6.1) show two important salient features of small firms in JMIs; limited job creation and inferior viability over the period 1990-97. Despite their high proportional numbers, small firms, on average, seem to offer less than one-third of manufacturing employment. More interestingly, although employment share of small firms has risen in 1997 compared with 1994, 'long-term' share of small enterprises decreased in 1997 (compared with 1990), suggesting some type of size rationalisation. During 1990-97, loss of market share in small business sector is compacted during the period 1990-94. One possible explanation for the noticeable rise in the share of medium and large firms during

1990-94 is the sudden rise in domestic market size (population) after the Gulf war. On the other hand, the recent but limited fall in the market share of larger firms may due to the re-adjustment to a fall in real industrial growth in that period (see Chapter 2).

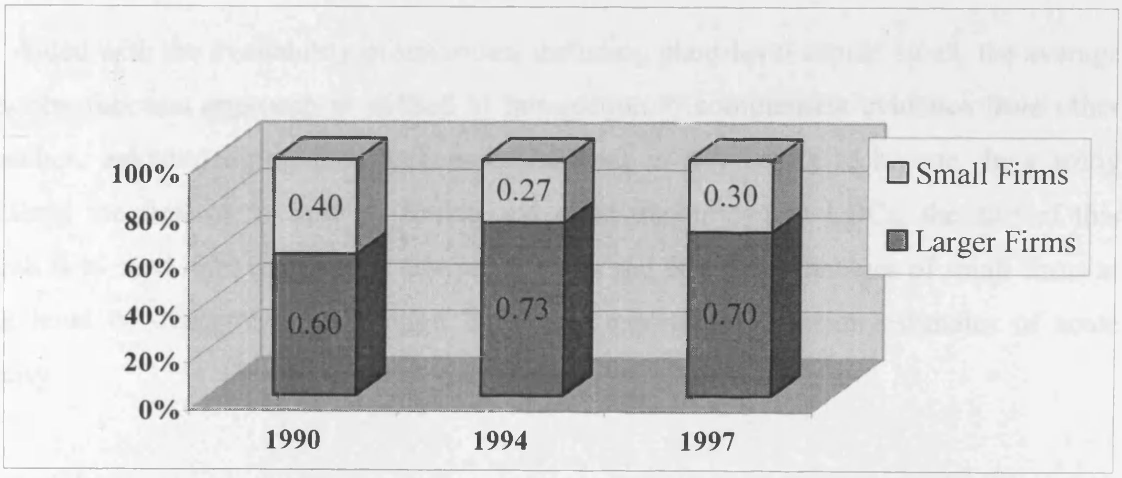
Table 6.3
Employment Share and Growth of Small Firms and Larger Firms in Jordan's Manufacturing Sector

	Small Enterprises		Medium and Large Enterprises	
	Share	Share's Annual Growth Rate	Share	Share's Annual Growth Rate
1990	0.40		0.60	
1994	0.27	-9.7	0.73	5.2
1997	0.30	-3.9	0.70	2.2

NOTE: Summary results are based on disaggregate data for 42 industries. To ensure that like is being compared with like, industries not accommodating small firms at all, and industries that did not exist in 1990, either in a small scale or larger scale or both, were excluded from analysis. Growth rates are calculated using 1990 as a base year, utilising the end-point technique.

SOURCE: Researcher's computation based on data provided by DOS.

Figure 6.1
Developments in Employment Market Share for Small and Larger Firms in Jordan's Manufacturing Sector



SOURCE: Data presented in Table (6.3).

To sum up, during the period under study and using 1990 as a base year, small enterprises in JMIs appear to loose their 'competitiveness', as defined by movements in employment market share, in favour of larger enterprises. Whether this fall in share will persist in the future is uncertain and left for future research.

6.3.2 Returns to Scale (RTS) in Jordanian Manufacturing Industries: A Cross-section Production Function Approach

Introduction

The production function approach to RTS is one of the main research designs that can be used to examine the existence and importance of scale economies in manufacturing production[13]. Its main strengths include its coverage of large number of plants and industries on a standardised basis (Pratten, 1988), and its relative robustness to measurement errors (GR [Griliches and Ringstad], 1971; Tybout, 1992a). The main weakness of this econometric approach is its dependence on strong *a priori* assumptions (see Table 4.2).

Reliable estimation of scale parameters has many implications on public policy in the spheres of small firm policy, policy towards economic integration and trade liberalisation, as well as competition policy (including merger guidelines, state aid and industrial licensing). At the analytical level, measuring RTS is central in modelling industrial growth using the neo-classical TFP analysis (Moroney, 1972) and modelling the market power-efficiency trade-off (Weiss, 1976; Dickson and He, 1997), thus enabling more educated conjectures regarding 'optimal' concentration in manufacturing industries in a specific context.

Aided with the availability of microdata including plant-level capital stock, the average production function approach is utilised in this section to complement evidence from other approaches, acknowledging the weaknesses inherent in any single technique. In a study considered the first of its kind in Jordan and quite uncommon in LDCs, the aim of this research is to shed light on the cost competitiveness and size disadvantages of small firms at a fine level of disaggregation (4-digit ISIC) via reporting regression estimates of scale elasticity.

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[13] While the production function approach, adopted here, is the most common research design in manufacturing studies, the cost function approach is popular in regulated industries applications, where input prices (including capital) are known. Both approaches have weaknesses, but an authority in applied production economics suggests that although cost functions are apparently more useful due to the availability of accounting data, they are "often more intractable, owing to the difficulties of defining and measuring cost" (Walters, 1968: 520). On this issue see also Baldwin and Gorecki (1986: pp. 53-54).

Previous Research and Evidence

Due to the constraint of microdata availability, little research is done to estimate RTS covering the majority of manufacturing industries, narrowly defined. The most notable studies are GR (1971) and Baldwin and Gorecki (1986) on industrial economies, and Corbo and Meller (1979) and Mamgain (2000) on LDCs. Industry case study and more focused research on 'selected' industries, on the other hand, are numerous. In a well-known example belonging to the last category, Little et al. (1987) focused on limited number of manufacturing industries with important presence of small-scale firms. Tybout (2000) provides an overview on empirical research done in LDCs.

The global evidence on scale elasticity in manufacturing sector -using the production function approach- is difficult to generalise; it tends to vary according to country, truncation point of small firms and level of aggregation. But empirical findings are in favour of increasing or constant RTS case[14], with little evidence supporting the decreasing RTS scenario (Lundvall and Battese, 2000). GR (1971) and Baldwin and Gorecki (1986) found, in extensive studies, strong evidence of increasing RTS at both the individual industry level and aggregate level in the Norwegian and Canadian manufacturing industries, respectively. In a much more condensed study, Corbo and Meller (1979), on the other hand, detected constant RTS in most Chilean individual industries. Mamgain (2000) found similar findings for more than half of the Indian industries studied.

Furthermore, according to Tybout (2000: 19), industry case studies undertaken on broadly and narrowly defined industries, excluding small firms, share a dominant finding of "constant or mildly increasing returns (between 1.05 and 1.10) in the various manufacturing sectors of Latin American, Asian and North African countries". Studies on the other side of firm-size distribution, i.e. research on small enterprises, tend to report RTS very close to unity (Tybout, 2000: 18-19)[15].

[14] Evidence from other approaches for measuring scale economies in production such as the engineering studies and simulation analysis tends to favour the increasing RTS case (see Stead et al., 1996; Tybout, 2000), but in such studies, sample selection is a clear problem (Chapter 4).

[15] Based on his survey regarding evidence on RTS in LDCs' manufacturing firms, Tybout (2000: 38) suggests that "although small-scale production is relatively common in LDCs, there do not appear to be major potential gains from better exploitation of scale economies". This conclusion seems provisional for at least two factors. First, studies covered either exclude the lower or the upper tail of the firm-size distribution, and this truncation can distort the empirical findings because of the sample selection problem. Second, case studies done in LDCs tend to favour atomistic industries because of the deliberate choice of the data user favouring large samples and confidentiality consideration of the data producer (the statistical agency).

As for Jordan, reliable previous evidence on technical scale economies in JMIs is bounded by several factors. First, many studies have utilised *aggregate* (industry or sectoral-level) time-series data[16], which are inadequate for measuring scale economies of manufacturing *plants* (McGee, 1974). Second, work based on *microdata* suffers from at least one of the following limitations:

- It takes the form of industry case study and cannot claim the warranted level of generalisation or comparability with other research[17].
- Its findings are flawed because of data inadequacies, which take some form of sample selection (non-randomness). This includes picking just public shareholding companies, analysing large manufacturing firms only or facing a low response rate in a self-administered questionnaire[18]. Furthermore, some studies assume parameter homogeneity of firms engaging in different industries.

Ignoring studies based on aggregate data, overall evidence from microdata is actually in favour of moderate increasing RTS hypothesis (around 1.1). More specifically, technical scale economies are observed in cement industry (Shana'a, 1997) and in chemical industry as a whole and certain narrowly defined chemical industries (Naser et al., 1991). Furthermore, increasing RTS is reported in large manufacturing enterprises employing at least 20 workers irrespective of their ownership structure (Kharabsha and Milkawi, 1988), and in public shareholding (large) manufacturing enterprises (el-Khatib et al., 1996). Clearly, previous research is biased towards large firms in highly concentrated capital-intensive industries, and cannot claim the fair representation of various industries.

The Production Function Model

A two-factor Cobb-Douglas (CD) production function will be used to estimate scale elasticity for 51 JMIs[19]:

$$Y = A\, K^{a}\, L^{b}$$

[16] See Bani-Hani and Shamia, 1989; Abu-Sbaikeh, 1994; Hammad, 1994; Al-Hammori and Al-Badri, 1996.
[17] See Naser et al. (1991) on the chemical industry and Shana'a (1997) investigating the cement industry.
[18] See el-Khatib et al. (1996) and Kharabsha and Milkawi (1988).
[19] The two-input CD function was selected after experimentation with the three-input CD and the two-input CES and translog functions. The gross output function has the advantage of including purchased materials and services but revealed a bad fit probably because of multicollinearity that affected the significance of both labour and capital; only 18% of industries exhibited simultaneous significance of labour and capital coefficients. despite very high adjusted R^2. For more information on the role of material input, see GR (1971). The additional quadratic term (capital intensity squared) in the CES function found insignificant (at 10 % level) in 84 % of industries. Finally, the functional form test in Chapter (5) indicates that the CD could not be rejected in most industries compared with the TL function. According to Tybout (1992a: 27), commenting on the use of the CD production function, "census data are unlikely to support more elaborate functional forms...and it affords maximum flexibility in dealing with data imperfections". Moreover, previous similar studies done by GR (1971), Corbo and Meller (1979) and Baldwin and Gorecki (1986) did not reject the *two-input* CD technology. For more arguments in favour of various forms of production function, see Chapter (5).

Where **a** represents capital elasticity, **b** labour elasticity and **(a+b)** is the targeted **scale elasticity**; percentage change in output **(Y)** as a result of x percentage change in *both* capital **(K)** and labour **(L)**. Output is measured by value added **(VA)**, labour by number of employees and capital reflects historical value of owned fixed assets plus an estimate of the capitalised values of rented assets (see Appendix 1).

Using the familiar double-log specification:

$$\mathbf{LnY = Ln\ A + a\ Ln\ K + b\ Ln\ L + u}$$

If **(a+b)** =1 $\Rightarrow$ production function is subject to constant RTS
If **(a+b)** >1 $\Rightarrow$ production function is subject to increasing RTS
If **(a+b)** <1 $\Rightarrow$ production function is subject to decreasing RTS

Another convenient form for computational purposes, adopted in this section, is transforming the above (VA) equation into labour productivity equation:

$$\mathbf{Y/L = A\ (K/L)^a\ L^h} \qquad \textbf{or}$$

Ln (Labour Productivity) = Ln A + a Ln (Capital Intensity) + h Ln (Labour)[20]

Where **h**, the labour coefficient, is the **scale parameter** and equals **(a+b-1).**

If **(a+b-1)** = 0 $\Rightarrow$ production function is subject to constant RTS and LP does not vary systematically between large and small firms.
If **(a+b-1)** > 0 $\Rightarrow$ production function is subject to increasing RTS and LP is positively correlated with firm size, as measured by employment.
If **(a+b-1)** < 0 $\Rightarrow$ production function is subject to decreasing RTS and LP is negatively correlated with firm size, as measured by employment.

Although there are multiple approaches for testing hypothesis regarding constant RTS, t-test for the significance of the scale parameter *in the LP form* will be utilised here[21]. This approach allows a *direct* test of whether the scale elasticity is significantly different from one. If the labour factor **LnL** is insignificant, then the scale parameter **h** is not statistically different from zero, and this means that the scale elasticity **(a+b)** equals one and technology reflects constant RTS.

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[20] The LP function is derived from the VA function through compensating the value of b (=h-a+1) in the original VA production function, dividing the two sides of the equation by L, then reducing terms in the right hand side of the equation.
[21] See Gujarati (1999) for the F test approach.

Data Description and Editing

The database used in RTS estimation is identical to the data set utilised in SFA. It consists of 6848 Jordanian manufacturing firms, representing about 70 % of 1994 total manufacturing employment. The 51 industries covered are classified according to the UN **ISIC2** at a fine level of disaggregation (4-digit). To allow for estimation, only those industries with a minimum of 10 firms (observations) or a maximum of some 1300 firms were covered in the analysis. These two-sided thresholds exclude 12 'non-strategic' JMIs (see **Appendix 1** for more details).

Certain editing rules were adopted before estimating RTS at the industry level (see Table 5.4)[22]. These rules aim at allowing for measurement errors, logarithmic specification and firm heterogeneity. While 90 firms were deleted from the data set to minimise measurement errors and permit logarithmic specification, 1460 single-person enterprises were omitted to allow for producer heterogeneity. The overall rejection rate is 18.5 % from the *raw* database (covering 8398 firms).

Estimation of Scale Elasticity in JMIs: Results and Assessment

Returns to scale (RTS) are first estimated at the aggregate (1-digit) level for the manufacturing sector as a whole (Table 6.4). Results for pooled data for all sample observations (51 industries) are in general consistent with theory and previous empirical research. The signs of coefficients are as expected, with capital intensity positively related to LP (in the LP specification). Both labour and capital coefficients are positive and not greater than one, as expected by economic theory, with labour coefficient being comfortably larger. The ratio of labour elasticity and capital elasticity is close to 1:4, *making scale parameter positive (0.23), and significantly so (as revealed by t-statistic in the LP form)*, revealing substantial increasing RTS in production[23]. This main result is broadly consistent with that of Baldwin and Gorecki (1986) and GR (1971), which showed a scale parameter of 0.15 and 0.06, respectively. Adjusted R^2 is high for the value-added form, but substantially lower in the LP form. This pattern of adjusted R^2 resembles that of GR (1971) study.

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[22] The editing rules adopted in this Chapter are identical to those used in Chapter (5).

[23] Scale parameter was 0.18 if industry dummies were included in the equation.

Table 6.4
Jordan: Production Function for 'Total' Manufacturing
(N= 6848)

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
The Value Added Form				
C	5.26	0.08	66.01	0.000
LNL	0.97	0.02	59.87	0.000
LNK	0.25	0.01	25.09	0.000
Adjusted R^2	0.80			
The Labour Productivity Form				
C	5.26	0.08	66.01	0.000
LNKI	0.25	0.010	25.09	0.000
LNL	0.23	0.011	21.36	0.000
Adjusted R^2	0.24			

NOTE: The OLS estimates are corrected for heteroscedasticity by means of White's procedure.

At a fine level of disaggregation (4-digit ISIC2), the econometric estimation of the production function reveals mixed results as far as RTS are concerned. After correcting for heteroscedasticity arising from the presence of small and large firms in the sample using White's (1980) procedure, the reported scale factor is positive for 44 out of 51 industries (Table 6.6) and significantly so in 29 industries (Table 6.8). The minimum and maximum values for the scale elasticity are plausible, and the mean reveals a relatively large cost disadvantage for small firms (Table 6.5). With 57 % of 1994 manufacturing industries included in the analysis exhibiting positive and significant scale parameter[24], one can say that a majority of JMIs is characterised by an increasing RTS technology, but not an overwhelming majority.

Table 6.5
Descriptive Statistics on (4-Digit) Industry-level Scale Elasticity (N=51)

Maximum	**1.60**(1)
Minimum	**0.81**(2)
Unweighted Average	**1.19**
Standard Deviation	**0.17**

(1) For 'manufacture of agricultural machinery'.
(2) For 'manufacture of jewellery'.

[24] Using the F general linear test (the restricted least squares) to test a linear equality restriction led to similar results. Moreover, the findings are robust to omitting small samples; excluding industries with less than 15 firms has led to a ratio of 60 % of industries exhibiting increasing RTS, but the simple (unweighted) average scale parameter rose to 0.27.

Table 6.6
Frequency Distribution of Scale Elasticity for 51 Jordanian 4-Digit Manufacturing Industries

Scale Elasticity Class	*Number of Industries*	*Percentage of Industries*
Less than 0.9	2	3.9
Less than 1.0	5	9.8
Less than 1.1	9	17.6
Less than 1.2	10	19.6
Less than 1.3	11	21.6
Less than 1.4	10	19.6
Less than 1.5	2	3.9
Less than 1.6	2	3.9
Total	**51**	**100**

SOURCE: Table (6.8) below.

Summarising 4-digit results by 2-digit industry, Table (6.7) suggests that the paper and fabricated metal industries have the highest scale elasticity. This outcome is in line with C. Pratten's survey of economies of scale in European industries (Pratten, 1988). Chemicals, the largest export oriented industry in JMIs, ranked the fourth (1.19) but still high. The relatively high scale elasticity for wood and food industries seems unexpected in view of the low technological content of such industries, but could be partially explained by the marketing and distribution economies in this industry (see below).

Table 6.7
Average Scale Elasticity for Jordanian (2-Digit) Manufacturing Industries

ISIC (2-Digit) Industry	*Unweighted Average of Scale Elasticity*	*No. of Industries (4-Digit)*	*No. of Industries with Significant Increasing RTS*
31 (Food)	1.18	10	6
32 (Textile)	1.11	8	5
33 (Wood)	1.22	5	2
34 (Paper)	1.28	4	3
35 (Chemicals)	1.19	9	6
36 (Glass and Glass Products)	1.01	1	0
37 (Basic Metal)	1.19	2	1
38 (Fabricated Metal)	1.26	10	6
39 (Other)	0.97	2	0

SOURCE: Table (6.8) below.

Table 6.8
Scale Parameter Estimates for the Jordanian (4-Digit) Manufacturing Industries

ISIC Industry	No. of Firms (Sample Size)	Scale Parameter (a+b-1)	t-Statistic	Adjusted R^2	Size of Industry (No. of Workers)	Relative Industry Size (%)
3111	17	-0.04	-0.29	0.81	772	1.16
3112	148	0.16	2.11	0.73	1371	2.05
3113	**11**	-0.03	-0.16	0.89	662	0.99
3115	94	0.27	4.08	0.77	1489	2.23
3116	46	0.14	1.09	0.81	663	0.99
3117	1059	0.13	4.75	0.66	7475	11.19
3119	39	0.39	2.32	0.74	502	0.75
3121	104	0.26	3.13	0.79	1553	2.33
3122	23	0.21	1.41	0.80	187	0.28
3134	20	0.31	3.71	0.87	1715	2.57
3211	20	0.06	0.45	0.65	1038	1.55
3212	123	0.20	2.49	0.66	536	0.80
3213	77	-0.09	-0.86	0.53	880	1.32
3214	24	0.26	2.88	0.96	606	0.91
3221	374	0.07	3.33	0.86	4906	7.35
3222	461	0.09	2.07	0.58	1724	2.58
3233	27	0.11	0.94	0.72	190	0.28
3240	170	0.20	3.38	0.73	940	1.41
3311	715	0.04	0.62	0.38	2152	3.22
3312	22	0.22	0.96	0.60	176	0.26
3319	81	0.29	1.49	0.52	266	0.40
3321	1308	0.16	5.13	0.64	5969	8.94
3322	314	0.37	4.49	0.47	864	1.29
3411	13	0.50	2.26	0.79	662	0.99
3412	29	0.34	3.83	0.88	862	1.29
3419	21	0.06	1.10	0.84	1655	2.48
3420	196	0.21	3.79	0.80	2881	4.31
3511	13	0.32	2.59	0.83	478	0.72
3512	**10**	0.13	2.26	0.93	1199	1.80
3513	27	0.28	2.02	0.78	971	1.45
3521	44	0.37	3.68	0.84	828	1.24
3522	15	0.12	0.96	0.83	2965	4.44
3523	56	0.10	0.68	0.78	1806	2.70
3529	14	-0.12	-1.47	0.93	138	0.21
3559	18	0.32	2.62	0.87	146	0.22
3560	165	0.19	3.91	0.83	4192	6.28
3620	35	0.01	0.04	0.71	260	0.39
3710	**10**	0.06	0.15	0.35	1202	1.80
3720	27	0.31	2.37	0.92	791	1.18
3811	30	-0.01	-0.03	0.66	181	0.27
3812	39	0.01	0.07	0.83	416	0.62
3819	507	0.29	7.12	0.77	3059	4.58
3822	21	0.60	2.38	0.60	61	0.09
3824	31	0.46	2.28	0.74	276	0.41
3829	75	0.26	4.82	0.84	2009	3.01
3831	**10**	0.49	2.61	0.72	174	0.26
3839	15	0.31	1.65	0.83	780	1.17
3843	31	0.31	2.60	0.89	1102	1.65
3851	41	-0.10	-0.34	0.32	232	0.35
3901	53	-0.19	-0.87	0.29	298	0.45
3909	25	0.13	0.83	0.79	524	0.78

NOTE: The regression analysis was carried out using Eviews 3.1. The OLS estimates are corrected for heteroscedasticity by means of White's procedure. R^2 is based on VA function. The sign of the capital parameter was positive in about 90 % of industries and, not unexpectedly, significant at 1 or 5 % level in only 53 % of industries.

Consistent with the findings of Baldwin and Gorecki (1986: 68), it was found that industries exhibiting significant increasing RTS are, *on average*, bigger in terms of employment and number of firms than other industries (Table 6.9)[25].

Table 6.9
Relative Size of Industries by Returns to Scale (RTS)

	Industries Exhibiting Significant Increasing RTS (N = 29)	Other Industries (N = 22)
Simple Average Scale Elasticity	0.28	0.06
Employment Share (%)	73.9*	26.1
Average Number of Firms	188**	63

* Equals 37.9 % after excluding the largest 6 industries.
** Equals 63 firms after excluding the largest 6 industries.
SOURCE: Table (6.8).

Three approaches will be explored to assess the plausibility of estimates for scale elasticity. The first is to assess the plausibility of the underlying assumptions. The second is to compare the research findings with those of previous studies, both in Jordan and globally. The third is to use the estimates as an independent variable explaining industrial concentration. The latter exercise has important policy implications besides its role in checking estimates of scale parameters. The following is a discussion of the three approaches:

1. The production function approach to technical scale economies assumes that capital and labour are actually measured without errors, an assumption held generally by the classical regression theory. In addition, this approach assumes given input prices for all firms including absence of regional wage differences. Finally, another relevant assumption is the absence of technical inefficiency.

   On the first assumption, the vintage problem in the evaluation of capital stock is always a pitfall in the efficiency and productivity research (Chapter 3). Fortunately, the

[25] Within the significant increasing-returns industries, the correlation between scale elasticity and number of firms equals -0.47. It is worth noting that number of firms is not the only indicator for identifying market power; other factors such as product differentiation, market size and firm size-inequality in the industry are also crucial.

bias resulting from this measurement error is not serious in the estimation of scale elasticity (GR, 1971; Tybout, 1992a)[26]. According to GR (1971: 77):

> *"[E]ven though...estimates of the capital elasticity may be seriously biased downwards, this does not imply that...estimate of economies of scale is biased in any particular direction".*

The second assumption raises the question of whether scale elasticity estimated for JMIs picks up pecuniary and external economies not related to technology. In Jordan, small manufacturing firms tend to have lower LCs vis-à-vis larger firms as a results of: (i) more intensive use of cheaper foreign labour as revealed by a recent survey-based study (Al-Hajji, 1997a: 68); (ii) lower non-wage costs due to small business' exemption from Social Security Law. On the other hand, pecuniary economies in the form of marketing and other economies affect favourably large firms. Thus, it seems that estimates of technical economies of scale embody some effect of inter-firm differences in input prices (see Shephered, 1990), but the size and direction of bias is hard to predict. Finally, estimated scale elasticity can be distorted by the confirmed existence of technical inefficiency in JMIs (Chapter 5). Literature of industrial economics is dubious in showing the possible interaction between technical (in)efficiency and production scale economies. Correlation between technical efficiency in JMIs, as measured by mean technical efficiency using the truncated normal distribution (MTET), and scale elasticity (N=35) suggests an insignificant positive association (0.10).

2. RTS findings do generally confirm two main empirical regularities shared by many empirical studies on technical economies of scale worldwide: (i) the *existence* of technical scale economies in manufacturing sector in general; and (ii) the *extent* or *importance* of such economies varies by industry. Furthermore, the research outcome is broadly in line with previous research undertaken in Jordan.

3. The findings above show that scale economies in production are an important element of market structure in JMIs. The extent to which inter-industry variation in technical scale economies 'explains' market concentration is an important issue in the design of competition policy (Gorecki, 1976), particularly with respect to assessing the extent of 'antitrust dilemma' in JMIs. This endeavour is a crucial empirical exercise in industrial

[26] A potentially more serious bias in the direct estimation of the production function is the simultaneity bias (Baldwin and Gorecki, 1986), but according to Zellner et al. (1966), the estimation will not suffer from inputs endogeneity problem if one can assume that the firm aims at maximising *expected* rather than *actual* profit, see Coelli et al. (1998: 54).

competitiveness policy, but usually constrained by measurement difficulties (of both competition and scale economies) and methodological weaknesses.

The positive association between scale economies and industrial concentration is a widely held hypothesis among alternative theories that try to explain industrial structure (Curry and George, 1983; Clarke, 1993; Stead et al, 1996). The conjecture that technology explains or even 'justifies' market concentration seems self-evident for the layman (Davies, 1991a). Limited available evidence shows that scale economies are likely to influence but not shape industrial concentration (Clarke, 1993)[27]. As stated by Weiss (1976: 134):

> "*In long run competitive equilibrium, MES [minimum efficient scale] would determine the minimum value of the concentration ratio, but of course concentration can (and ordinarily does) exceed that minimum value [justified by MES]. One would expect a positive, but far from perfect, correlation between MES and concentration*"[28].

To provide a preliminary check on the RTS estimates and assess the link between achieving scale economies and maintaining domestic competition in JMIs, a multivariate regression analysis is utilised. The model consists of HHI employment concentration measure (HHI_EMP) and three major potential predictors for market concentration (scale elasticity SCALEEL; market size MRSIZE; and advertising intensity ADVER). Market size is measured by total employment in the industry, and advertising intensity is measured by advertising expenditures to domestic sales. Furthermore, due to the common view that concentration (at least in some industries) is too high to be warranted by technological opportunity, an interesting question is whether the relationship between market concentration and technical scale economies exhibits some nonlinearities in the case of Jordan. This is done via introducing scale elasticity squared (SCALEELS) variable in the model.

The sample covers only those 42 industries in which estimates for scale elasticity are thought to be reliable in terms of sample size; industries with less than 15 firms are excluded.

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[27] This proposition applies to studies that measure scale economies directly (usually through engineering studies). Using proxies for minimum efficient plant taken from observed plant-size distribution in the form of a summary measure (such as 'top 50 percent' size index or 'midpoint plant' size index) can be misleading (Davies, 1980) because these proxies can actually represent concentration instead of scale economies ***(see Table 5.13, Chapter 5 for evidence from JMIs)***. Thus, the essence of such an exercise is explaining industrial concentration by some proxy for industrial concentration, with dramatic results!.

[28] Against this generalisation, there is some theoretical basis for finding a negative link between concentration and scale economies (see Weiss, 1976).

Table 6.10
Multiple Regression Results between Employment Industrial Concentration and Industrial Returns to Scale (N=42)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.77	0.34	-2.30	0.03
SCALEEL	1.49	0.57	2.59	0.01
SCALEELS	-0.62	0.24	-2.64	0.01
ADVER	4.71	0.67	7.04	0.00
MRSIZE	-0.00002	0.000005	-3.96	0.00
Prob. (F- Statistic)	0.002			
Adjusted R^2	0.29			

NOTE: The OLS estimates are corrected for heteroscedasticity by means of White's procedure.

As expected, the relationship between concentration and its predictors is complex (Table 6.10). The positive coefficient of scale elasticity is found significant only if the model includes a quadratic term for such a variable and after controlling for other major influences. The sign of the quadratic term is negative, suggesting that competition in the model, as inversely measured by HHI_EMP, is decreasing with higher production scale elasticity but up to a point (where elasticity equals 1.20), after which the link is positive and the 'anti-trust dilemma' disappears. This important result is not sensitive to the concentration measure used, and largely robust to sample coverage.

Consistent with some previous studies (Scherer, 1973; Gorecki, 1976), market size, after controlling for scale economies, appears negatively and significantly associated with industrial concentration, signalling the importance of market enlargement for endorsing both competition and scale efficiency in JMIs. Furthermore, as expected, the analysis suggests a positive and robust association between product differentiation and market dominance.

6.3.3 Firm Size, Labour Productivity and Unit Labour Costs in JMIs: Micro-evidence from Manufacturing Firms

Introduction

The relationship between firm size and LP is one of the research issues belonging to the important area of firm performance (Nickell et al., 1997; Geroski, 1998). Research on firm-level LP can be utilised to highlight the competitiveness of small firms vis-à-vis larger firms and thus provide insight on their performance in foreign markets.

In developing the model for estimating RTS above, it was found that LP implication of firm size and production scale economies are intimately related variables (see Caves et al., 1975)[29]. This section aims at supplementing the research done on RTS utilising a single-factor measure of productivity. *It extends RTS research in the following ways*:

- The focus is on overall performance of manufacturing sector. Industry dummy variables are introduced in the model to account for industrial heterogeneity.
- In addition to firm size and capital intensity, other possible predictors of LP, namely firm age, human capital and labour compensation, are included in the model specification.
- Nonlinearities in the impact of firm size on LP are investigated.
- Finally, the relation between firm size and ULCs is explored.

Theory and Previous Empirical Research

Economic theory, according to Majumdar (1997), is equivocal on the exact link between firm size and LP. On the one hand, the existence of important scale and scope economies let large firms enjoy cost advantages and other size-related benefits (see Table 6.1 and Geroski, 1998). On the other hand, large firms are normally subject to weaker competitive discipline from the market (Primeaux, 1977) and suffer from problems of motivation and co-ordination (Grant, 1998; Fiegenbaum and Karnani, 1991). This could increase technical inefficiency resulting from a 'quiet life'.

Previous research on firm size and LP, utilising different approaches, does broadly coincide with the above ambiguous theoretical basis; it shows an inconclusive outcome. Many works found a significant evidence for a positive relationship between firm size and LP (UNCTAD, 1998; EC, 1996a; Gupta, 1983; GR, 1971). Others failed to reveal any systematic pattern (Little et al., 1987; Ramaswamy, 1993, *both done on India*) or even found a negative

[29] As shown above, assuming: (i) that the CD technology properly fits the data; and (ii) the presence of increasing RTS, then LP is positively associative with firm size (as measured by employment).

relationship (Majumdar, 1997). Still some work emphasised the sensitivity of research findings to the size measure used (Johnston, 1960).

The Data Set and Empirical Model

Unlike many studies utilising grouped (aggregate) data (Miller, 1977-78; Gupta, 1983), the present research uses firm-level data. Moreover, the large data set embodies all firms engaging two or more persons, thus minimising the sample selection problem common in microdata research[30]. Using the latest available Industrial Census of 1994, the empirical investigation is based on 6872 Jordanian manufacturing firms covering 70% of total manufacturing employment and 51 JMIs. Only raw data are edited in this empirical modelling to allow for firm heterogeneity and measurement errors (see Table 5.4).

To examine the relationship between firm size and LP, four measures of firm size (labour **L**, value added **VA**, capital stock **K**, and gross output **TPR**) and two measures for LP (value added divided by labour **LP1** and gross output divided by labour **LP2**) are utilised. As emphasised in Chapter (3), a complete model of productivity levels is difficult to specify and test empirically (Caves, 1980; Pilate, 1996). Indeed, there are countless influences on industrial productivity, many of which are difficult to quantify or simply unavailable in LDCs. In our model, the choice of explanatory variables is influenced *by both economic theory and data availability*. A regression analysis is undertaken using the following specification:

LP [1,2] = F (SIZE, SIZES, KI, AGE, AGES, HCI, DUMMY)[31]

The model can be considered, theoretically, as an extension of the production function approach utilised above. Size squared (SIZES) is included in the model to test for possible nonlinearities in the relation. Other potential determinants included are: firm age AGE, capital intensity KI (K/L) and the ratio of non-production to total workers HCI. Finally, to account for differences among industries and among governorates in the relationship under

[30] Moreover, since one of the main aims of the research is to assess how small firms are likely to suffer from increased foreign competition as a result of trade liberalisation, it is desirable to minimise the truncation point for firm-size distribution. On this point, see Hart and Shipman, 1991.

[31] Because theory is of little help in choosing between the linear model and the log-linear model, the equation is estimated both in levels (reported) and in logs (unreported). The main qualitative conclusion appears insensitive to the functional form used. The logarithmic form, mitigating heteroscedasticity, has delivered better explanatory power but at the expense of trimming about half of the sample due to zero observations problem (in AGE and HCI variables) and facing colinearity between logarithm of SIZE and AGE and the logarithm of their squared terms (near singular matrix problem).

investigation, 50 industry dummies and 11 regional dummies are introduced in the model. While the literature on learning by doing provides an argument for the positive effect of AGE on LP (see Malerba, 1992), younger firms can have state-of-the-art technology and capital that could offset their modest experience; the overall expected impact on LP is ambiguous. The HCI variable can be thought as a proxy for human capital intensity or 'technological capability' of the firm, and is expected to enhance LP. Table (6.11) shows Pearson's correlation coefficients among various indicators of firm size and other potential explanatory variables of LP.

Table 6.11
Correlation Coefficients among Potential Predictors of Labour Productivity

	L	VA	K	TPR	AGE	HCI	KI
L	1.00						
VA	0.79	1.00					
K	0.80	0.69	1.00				
TPR	0.59	0.78	0.56	1.00			
AGE	0.14	0.10	0.09	0.08	1.00		
HCI	0.06	0.06	0.08	0.04	-0.05	1.00	
KI	0.17	0.14	0.42	0.09	-0.03	0.18	1.00

SOURCE: Researcher.

The Table shows moderate to strong correlation among various measures of firm size, ranged from 0.56 (for K and TPR) to 0.80 (for L and K). Since high correlation is a necessary but not sufficient condition for interchangeability between size measures (see above), the analysis will not exclude any measure from the empirical modelling. Furthermore, collinearity among potential predictors is favourably weak.

The OLS findings are presented in Tables (6.12 and 6.13)[32]. The partial effects of industry and regional dummies are not reported -to conserve space- but it appears that they exercise modest impact on overall fit. This might be explained by the fact that most industries exhibit the same positive pattern of relationship between LP and its predictors.

[32] Labour costs (wage and non-wage costs) per employee (COMPEN) is a possible predictor of LP, but probably suffers from a simultaneity problem with LP. Thus it is excluded from the core model. The theory of efficiency wage provides a theoretical argument in favour of the inclusion of COMPEN in the model (see, for example, Borjas, 2000). According to the theory, high wages reduces workers' shirking and quit. Moreover, it attracts a more qualified pool of workers, leading to an improvement in LP. Indeed, average wage can be interpreted as a proxy for skill intensity. A sensitivity test of our findings to the inclusion of COMPEN variable revealed that these findings are quite robust. The findings also confirmed the efficiency wage hypothesis; the COMPEN variable was positive, robust and significant at 1% level.

Table 6.12
Firm Size and Labour Productivity (LP1)

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
C	8243.97	3638.91	2.27	0.02
L	23.39	4.22	5.55	0.00
LS	-0.02	0.01	-2.95	0.00
KI	0.12	0.02	7.27	0.00
AGE	44.28	8.23	5.38	0.00
AGES	-0.57	0.16	-3.68	0.00
HCI	336.69	239.14	1.41	0.16
Adjusted R^2	**0.20**	**Prob (F-statistic)**		**0.000**
C	2009.30	2051.43	0.98	0.33
VAL	0.006	0.0007	8.16	0.00
VALS	-2.53E-10	3.62E-11	-7.00	0.00
KI	0.10	0.01	7.37	0.00
AGE	37.80	10.63	3.55	0.00
AGES	-0.66	0.30	-2.21	0.03
HCI	261.49	215.61	1.21	0.23
Adjusted R^2	**0.32**	**Prob (F-statistic)**		**0.000**
C	8191.47	3492.15	2.35	0.02
K	0.002	0.0003	5.20	0.00
KS	-1.17E-10	3.11E-11	-3.77	0.00
KI	0.09	0.02	5.24	0.00
AGE	46.92	8.45	5.55	0.00
AGES	-0.61	0.16	-3.78	0.00
HCI	385.80	238.93	1.61	0.11
Adjusted R^2	**0.20**	**Prob (F-statistic)**		**0.000**
C	3970.23	3012.45	1.32	0.19
TPR	0.0009	0.0001	6.17	0.00
TPRS	-3.19E-12	5.37E-13	-5.95	0.00
KI	0.11	0.02	7.45	0.00
AGE	46.42	10.45	4.44	0.00
AGES	-0.75	0.28	-2.69	0.01
HCI	366.50	231.85	1.58	0.11
Adjusted R^2	**0.25**	**Prob (F-statistic)**		**0.000**

NOTE: Results for industrial and regional dummies are omitted in the interest of conserving space. The OLS estimates are corrected for heteroscedasticity by means of White's procedure.

Table 6.13
Firm Size and Labour Productivity (LP2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	37951.43	13824.71	2.75	0.01
L	93.65	21.76	4.30	0.00
LS	-0.05	0.05	-1.00	0.32
KI	0.35	0.06	6.32	0.00
AGE	108.71	31.55	3.45	0.00
AGES	-1.37	0.77	-1.77	0.08
HCI	371.75	696.60	0.53	0.59
Adjusted R^2	**0.32**	**Prob (F-statistic)**		**0.000**
C	23454.22	9023.85	2.60	0.01
VA	0.02	0.003	5.56	0.00
VAS	-5.75E-10	1.79E-10	-3.21	0.00
KI	0.31	0.05	5.74	0.00
AGE	86.42	29.43	2.94	0.00
AGES	-1.19	0.78	-1.52	0.13
HCI	187.30	648.71	0.29	0.77
Adjusted R^2	**0.40**	**Prob (F-statistic)**		**0.000**
C	34856.93	13289.10	2.62	0.01
K	0.01	0.002	4.16	0.00
KS	-3.89E-10	2.54E-10	-1.53	0.13
KI	0.20	0.07	3.07	0.00
AGE	111.46	27.87	4.00	0.00
AGES	-1.34	0.65	-2.05	0.04
HCI	639.70	689.78	0.93	0.35
Adjusted R^2	**0.32**	**Prob (F-statistic)**		**0.000**
C	14690.43	10157.83	1.45	0.15
TPR	0.004	0.001	4.57	0.00
TPRS	-1.36E-11	3.68E-12	-3.68	0.00
KI	0.33	0.05	6.43	0.00
AGE	107.09	37.79	2.83	0.00
AGES	-2.05	1.18	-1.74	0.08
HCI	441.65	615.49	0.72	0.47
Adjusted R^2	**0.45**	**Prob (F-statistic)**		**0.000**

NOTE: Results for dummies are omitted for space considerations. The OLS estimates are corrected for heteroscedasticity by means of White's procedure.

The overall explanatory power of various model specifications, as represented by adjusted R^2, ranged between 0.20 and 0.45, not uncharacteristically low for a cross-section research design, but not particularly high in view of the large number of dummy variables. Table (6.14) summarises the information content of Tables (6.12 and 6.13). It reveals that there is an interesting empirical linear regularity between firm size, however defined, and LP; the larger the firm, the higher its LP. The variable SIZES is also significant in most specifications, but the optimal firm size seems quite high (more than 600 workers).

Table 6.14
Firm Size and Labour Productivity (LP)
(Using Alternative Measures for LP & Size)

LP1 \ LP2	L	LS	VA	VAS	K	KS	TPR	TPRS
L	+S, +S							
LS		-S, I						
VA			+S, +S					
VAS				-S, -S				
K					+S, +S			
KS						-S, I		
TPR							+S, +S	
TPRS								-S, -S

Key: +S denotes positively significant at 1 percent level, -S negatively significant at 1 percent level, I means insignificant predictor of LP.

SOURCE: Tables (6.12 & 6.13).

The above main finding coincides with the evidence on the importance of production scale economies in JMIs.

Firm Size and Unit Labour Costs (ULCs)[33]

The competitiveness of JMIs depends not only on their factor productivity but also on their production costs. Hence, LP disadvantage of small firms may be counterbalanced by lower wage rates or, more broadly, lower labour costs (LCs) per worker. Indeed, the above

[33] As production economics would suggest, both LP and ULCs models of *productivity differences* (closely related to tracking *productivity change* using the production and cost functions) should in principle lead to similar results under the condition of constant returns to scale (see Chambers, 1989). But since our estimates of RTS for total manufacturing reveal significant increasing returns to scale, this condition is not fulfilled in Jordan's case. Thus, there is a rationale for constructing a model linking costs with scale, alongside a model relating productivity with scale. On the measurement of ULCs, see Chapter (4).

LP model has revealed a positive and significant association between LP and labour compensation per employee in JMIs. Thus, ULCs, or labour costs per worker corrected for LP, are likely to be a more comprehensive measure of industrial competitiveness. To assess the simultaneous impact of LP and average labour costs on the competitiveness of firms with different sizes, the relationship between firm size and ULCs is examined in this section using the same predictors included in the LP model.

To pursue such a novel endeavour in LDCs, ULCs for 785 firms with zero labour costs (LCs) need to be imputed. The majority of these firms are small enterprises[34], and thus constitute basically of family businesses run by self-employed and non-paid family workers. The estimation of LCs for self-employed persons was undertaken using information available on LCs for paid employment in other firms[35].

After imputing ULCs for all family businesses, a regression analysis is undertaken using the following specification:

ULC [1,2] = F (SIZE, SIZES, KI, AGE, AGES, HCI, DUMMY)

Where ULC1 is defined as LCs divided by VA, and ULC2 is LCs divided by gross output. The aim of the DUMMY variables is to account for industry effects, as in the LP model. The results are summarised in Table (6.15) utilising various measures of size and ULCs[36].

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[34] 73 % of these firms are two-person businesses and 97 % have less than 5 workers.

[35] The estimation was based on two steps: (i) the exclusion of firms with very low labour compensation (less than 360 JD per person per year) probably erroneous or dependent on foreign workers who can afford lower subsistence wage level; and (ii) assuming labour compensation per self-employed to be equal to average compensation of employees (salaried employment).

[36] Here, to conserve space, only the significance of size variable is reported. The model's overall explanatory power in the linear model is clearly lower than that of LP model (adjusted R^2 does not exceed 0.10 and sometimes much less), but it improved noticeably using the log-linear model. The log-linear results are not reported because of the zero observations and colinearity problems associated with it (see footnote 31). But in general, both the linear and log-linear models yielded similar *qualitative* conclusions.

Table 6.15
Firm Size and Unit Labour Costs (ULCs)
(Using Alternative Measures for ULCs & Size)

ULC1 \ ULC2	L	LS	VA	VAS	K	KS	TPR	TPRS
L	+S, -S							
LS		-S, I						
VA			-S, -S					
VAS				+S, +S				
K					+s, I			
KS						-s, I		
TPR							I , -S	
TPRS								I , +S

NOTE: The OLS estimates are corrected for heteroscedasticity by means of White's procedure.

KEY: +S denotes positively significant at 5 percent level, +s denotes positively significant at 10 percent level, -S negatively significant at 5 percent level, -s negatively significant at 10 percent level, I means insignificant regressor of ULCs.

The following tentative conclusions can be derived from Table (6.15):

1. The pattern governing the relationship between firm size and ULCs seems much more complex and uncertain, compared with the link between size and LP, as revealed by the noticeably lower adjusted R^2.
2. The direction and significance of the relationship between firm size and ULCs, if anything, appears to be dependent on the chosen measure for ULCs and firm size. Overall, the findings deliver ambiguous conclusion[37].

The above empirical findings are to some extent consistent with previous research, undertaken in Jordan and abroad, which suggests that although larger firms can enjoy superior LP, they tend to have higher countervailing LCs per worker[38]. A recent survey-based study (Al-Hajji, 1997a: 68) shows that small manufacturing firms in JMIs tend to be more dependent on cheaper foreign labour, thus suggesting lower average LCs vis-à-vis larger firms. At the global front, the results are quite consistent with studies done by Audretsch et al. (2001) and Audretsch and Yamawaki (1992) regarding the positive impact of wage competitiveness of small firms on their viability. The findings are also in line with some international evidence on the positive association between firm size and the ratio of non-wage LCs to total LCs (Hart, 1984: 42). Finally, in manufacturing, a positive link between firm size and LCs per person is observed in the EU (EC, 1996a: 75).

[37] The same ambiguous finding appears to govern the link between capital productivity and firm size.
[38] The correlation between various measures of firm size and compensation rates averaged 0.34 in our sample.

6.3.4 Firm Size and Export Performance in JMIs

Introduction and Basic Facts

In a small open economy with limited domestic market and vulnerable external position, export performance of firms constitutes a strategic challenge for both private and public sectors. Because the firm-size distribution is highly skewed towards small enterprises in small economies, this stylised fact can affect overall export performance in these economies. Worldwide, most small enterprises simply do not own "the knowledge, resources, or confidence to go global alone" (Scarborough and Zimmerer, 2000: 385). This is particularly true in LDCs where the SMEs' support system is weak and private export intermediaries as well as inter-firm cooperation are nearly absent.

In Jordan, the apparent lack of export commitment by small manufacturing firms is one of the important stylised facts of Jordan's export profile (Table 6.16, see also Table 2.9). In Jordan's manufacturing sector, an examination of the 1994 database reveals the following:

- Only a small number of domestic producers penetrate foreign markets (196 firms in the sample, or some 2.3 percent), of which a negligible number of small manufacturing enterprises and a modest number of medium enterprises are 'international firms' (3 and 42 firms, respectively). In relative terms, although manufacturing SME sector in Jordan constitutes 93.9 percent of 1994 total number of manufacturing firms, only some 0.6 percent of total producers in this sector are exporters (not reported), compared with 29.3 percent of large firms.
- The average size of exporters (about 100 workers) is obviously larger than non-exporters (6 persons).
- Exporters in SME sector are geographically concentrated in Amman; 39 exporters or 87 percent of exporting firms are located in the Capital.
- Using tabular information, it is clear that there exists an inverse relationship between firm-size class and number of exporting firms and also between firm-size class and export intensity. Thus, firm size seems not only to affect the firm's decision to export, but also how much of its output (Table 6.16).

Table 6.16

Jordan: Export Performance of Manufacturing Firms by Major Size Classes (1994)

	Micro and Small Firms	Medium-sized Firms	Large firms	Total
Share as a Percent of Total Number of Producers (%)	71.3	22.6	6.13	**100**
Total Number of Exporter	3	42	151	**196**
In Percent of Total Number of Exporter (%)	1.5	21.4	77.0	**100**
In Percent of Number of Producers in the Class (%)	0.05	2.2	29.3	**2.3**
Export Intensity (%)	30.1	35.2	39.9	**38.7**

SOURCE: Researcher, based on firm-level database (N=8398 firms) representing 68 % of total number of 1994 Census *manufacturing* firms and 73 % of total manufacturing employment.

This section aims at exploring the link between firm size and another important dimension of industrial performance in global markets, namely export performance. This endeavour contributes to a better policy stance regarding the right balance between small and large firms in Jordan's industrial strategy. Since just a limited number of firms in 1994 JMIs are involved in exporting, the dependent variable (export intensity) in this case is *limited* (i.e. takes a value between 0 and 1) and *clustered* at zero value, making Tobit modelling an essential analysis tool[39]. As a robustness check for Tobit results, and since this type of microeconometric modelling is highly sensitive to violations in assumptions of normality and heteroscedasticity of the errors in comparison with ordinary regression model (Breen, 1996), both OLS and maximum likelihood (Tobit) estimators will be utilised and compared.

Theoretical Considerations and Previous Empirical Research

The link between firm size and export behaviour has been extensively examined and attracted the attention of many disciplines, namely industrial organisation, global marketing and international business. Both theory and empirical research tend to support the hypothesis of a robust relationship between firm size and export activity. In the words of Berry (1992: 48-49):

[39] On Tobit analysis, or so-called censored regression model, and the distinction between truncation and censoring see, for example, Breen (1996) and Long (1997).

"It was quickly confirmed that larger manufacturing firms were generally more successful at the exporting game. To the extent that this represented basic economies of scale either in production or in the export-marketing process it constituted an important argument in favour of large size".

The business literature refers to many possible *export barriers* hindering small firms from exporting, such as the existence of high transaction costs, including uncertainty and non-tariff barriers (e.g. technical standards), and the lack of production capacity and resources, including time (see Miesenbock, 1988; Paliwoda, 1995). Furthermore, a large part of export expenses constitutes fixed costs to the firm[40], suggesting the existence of scale economies in exporting as asserted by economic literature (Auquier, 1980; Caves, 1986) and representing a substantial obstacle deterring firms that are below a threshold size.

The empirical examination on the question has focused on two related research issues (Bonaccorsi, 1992):

- The probability of being an exporter increases with firm size.
- Export intensity is positively associated with firm size, *at least* in the initial range of size variable.

Much empirical work has been conducted to test the above conjectures. While there is a general consensus on the first proposition, the second hypothesis is confirmed by a *majority* of studies (Miesenbock, 1988; Bonaccorsi, 1992; Moen, 1999; Sterlacchini, 2001). Indeed, export *prospects* of SMEs seem to be affected by their business support system. Factors identified as critical to SMEs export success include: technological capabilities owned by SMEs (Moen, 1999) and the quality of industrial clusters and networks under which SMEs work (Nadvi, 1999). For certain regions, clusters and activities, it is quite possible for small firms to be as competitive as larger firms in global markets (Bonaccorsi, 1992).

The Data Set, Variables and the Empirical Model

The data set used in this model is identical to the LP model, consisting of 6872 firms with two or more persons (see above). Variables included in the model are:

- **Firm-specific influences:** Firm size (SIZE) as a proxy for firm's resources essential to penetrate international markets (e.g. having quality certification); size squared (SIZES) to test for possible nonlinearities in the relation between size and export performance. Further included variables are firm's *cost* competitiveness as measured by unit labour

[40] In the presence of fixed exporting costs, unit costs fall as output increases, as a result of 'spreading the costs'.

costs (ULCs)[41]; capital intensity (KI); firm experience as measured by its age (AGE) since operation year; and finally a proxy for human capital intensity (HCI) as measured by the ratio of non-production to total workers.

- **Industry-specific factors:** 50 dummy variables are included in the model to account for the fact that incidence of exporting varies substantially across industries.

Although there are omitted variables that could be influential in 'explaining' inter-firm variation in export intensity such as managerial characteristics, ownership structure and technological factors (as measured by R&D intensity)[42], such potential predictors are unavailable in the data set.

Table (6.17) presents summary results for censored and ordinary regressions on the effect of firm size on its export performance. Using employment as a measure of firm size, the regressions affirm the existence of a significant and positive association between size and export intensity. Furthermore, the relation is robust to the estimation method and measure of firm size[43]. The uncovering of a quadratic relationship is not revealing as it intuitively appears. Taken on its face value, it suggests that the largest dominant firms in JMIs are not necessarily superior in terms of export performance. But the estimated optimal size is found to be quite high (between 550-625 workers, depending on the estimation method). Although this optimum firm size is within the observed employment range, it covers only limited number of exceptionally large firms (6 firms out of 6872). Thus, one can conclude that, in general, the larger the manufacturing firm in JMIs the higher its propensity to export.

Among other interesting results is the positive effect of cost competitiveness on export performance of the firm (significant at 1 % level in the ML model, but just at 10 % in the OLS model). Firms with higher ULCs in JMIs tend to export less. This outcome is consistent with international robust evidence documenting the superior performance of exporting producers vis-à-vis non-exporting firms[44].

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[41] ULCs variable is defined here as compensation of employees divided by VA.
[42] See, for example, Miesenbock (1988) and Bleaney and Wakelin (1999).
[43] The significant relationship is robust using all four measures of firm size (unreported), but the quadratic term in the case of capital measure is insignificant.
[44] See Bernard and Jensen, 1995 and 1999; Aw et al., 2000.

Table 6.17
Firm Size and Export Performance:
Maximum Likelihood (ML) and OLS Estimates

	ML - Censored Normal (Tobit)			*OLS*		
Predictors	***Coefficient***	***t-Statistic***	***Prob.***	***Coefficient***	***t-Statistic***	***Prob.***
C	-1.23	-4.74	0.000	-0.08	-1.59	0.111
L	0.0069	11.40	0.000	0.0012	6.34	0.000
LS	-0.0000063	-8.65	0.000	-0.00000096	-3.58	0.000
KI	0.00001	3.45	0.001	0.00000032	1.08	0.280
ULC	-0.21	-3.06	0.002	-0.007	-1.87	0.061
AGE	-0.0005	-0.21	0.83	-0.0003	-2.92	0.003
HCI	0.24	1.59	0.111	0.002	0.42	0.673
	Adjusted R^2		**0.17**	**Adjusted R^2**		**0.26**
	Akaike info criterion		**0.15**	**Akaike info criterion**		**-2.5**
				Prob (F-statistic)		**0.000**

NOTE: Results for industry dummies are omitted for space considerations. In ML estimates, convergence achieved after 30 iterations. The OLS estimates are corrected for heteroscedasticity by means of White's procedure. Estimates were prepared using Eviews 3.1.

To sum up, this section provides support to the long held conjecture that small firms, particularly in LDCs, do not typically have access to sufficient resources (human, financial, and information) to profitably penetrate global markets. Although export orientation can affect firm size in JMIs, its impact is expected to be modest to reverse the relationship. Thus, some efficient type of government intervention might be necessary to alleviate this 'export failure' connected with small firms in JMIs. Moreover, the findings confirm that firm efficiency (as measured by ULCs) seems to be associated with export-orientation in JMIs.

6.4 Conclusions and Possible Policy Implications

Using a unique cross-section firm-level data set and multiple measures of industrial performance, the empirical investigation in this Chapter seems to affirm that size matters in JMIs. Firm size appears to be a good and robust predictor for certain quantifiable measures of industrial performance, notably LP and export performance, even after controlling for interfirm variation in capital intensity and industry effects. Furthermore, the preliminary evidence appears to suggest that larger scale plants generally perform better in terms of survival-ability and the capability to reap potential scale economies that prevail in more than half of JMIs. On the other hand, the investigation failed to reveal a systematic pattern between firm size and ULCs (an important proxy for cost competitiveness). It appears to be the case that larger firms (with superior LP performance) have higher labour remuneration per worker. In general, apart from the identified weaknesses of smaller firms in terms of the above-mentioned *quantitative* criteria, the research has failed to detect a specific size class that is generally optimal.

Thus, small firms in JMIs seem to be in an inferior position in terms of exploiting global *opportunities* and, possibly, avoiding global *threats*. **First**, in terms of export competitiveness, firm size (or more accurately the capabilities and resources of large firms) is found to be a significant factor in export success. **Second**, the size variable could be a significant factor affecting the survival capacity of domestic firms in many industries in the face of a more intense import competition and technology protection. The vulnerability of small enterprises in this regard arises from inferior LP, poorer resources and inability to exploit potential scale economies. **Third**, previous studies in Jordan do indicate that larger firms are superior in enhancing quality and technological capabilities (Al-Hajji et al., 1997a). Smaller firms in JMIs, however, can adapt to a more intense foreign competition through their *flexibility*, including their ability to occupy *domestic* market niches and through employing low-cost labour.

Overall, the empirical investigation suggests that small Jordanian firms could be more 'sensitive' or 'vulnerable' to trade exposure compared with larger firms. Limited international evidence regarding manufacturing adjustment in response to a more intensified import competition, however, offers mixed findings. While some work suggests that most of the adjustment costs of trade reform rests on small enterprises (Dutz, 1996), other research indicates that trade liberalisation reduces the size of all plants (Roberts and Tybout, 1991), or confirm a shift in firm-size distribution towards smaller firms in import-competing industries (NESC, 1989). A recent study by the European Commission found that the impact of the European Single Market on changes in firm size varies among industries depending on the existence of exogenous or endogenous sunk costs (EC, 1997c), i.e., according to competition type in an industry. Finally, a further possible finding can take the form of a neutral outcome, such as that of Scherer (1975) who found a negligible impact for EFTA (European Free Trade Area) on plant size. The lack of consistency in the above research findings can possibly be explained by asymmetric core competencies of small firms among countries (see Table 6.1) and/or by other idiosyncrasies pertaining to various research contexts and designs.

Based on the above findings related to JMIs, it appears that a *proactive* adjustment process might be needed to increase both the *boundary* and *size* of manufacturing enterprises in Jordan[45]. Adjustment processes and strategies that can be recommended are:

- Promoting various types of inter-firm cooperation in the small business sector, both in industrial districts and clusters (where firms typically share the same geographical location) as well as outside (where firms combine forces in the form of networks). Recently, this strategic option to overcome size disadvantage in face of international competition has attracted much attention in promoting industrial competitiveness (see Lichtenstein, 1993; Oughton and Whittam, 1997). Cooperation can be pursued through sharing resources, skills and facilities and developing the quality of sub-contracting links[46].
- Improving the SMEs' support system for competitiveness and growth (see Lall, 2000b). This typically takes the shape of various government initiatives and programmes, with a view of enhancing SMEs' export performance, product quality and technological capability. In this regard, a *holistic* approach to SMEs' competitiveness in the JE is needed. The government support should preferably focus, in the first instance, on intermediaries rather than directly on SMEs themselves. Moreover, the development of *entrepreneurs* should generally precede Jordan's endeavour to the development of small *enterprises*; otherwise the cost of state aid could be large.
- Encouraging mergers among SMEs using both incentive measures (e.g. tax system) and regulatory structure (e.g. competition law). This solution, though desirable from the point of view of both competition and competitiveness policies[47], is difficult to deliver the desired results among *small* Jordanian firms because of the high transaction costs and the desire for economic independence by small entrepreneurs.

If the evidence provided in this Chapter is confirmed by other subsequent Jordanian studies (including research that utilises panel data), then state programmes and aid should focus on expansion of small existing firms, rather than the establishment of new small firms

[45] This initiative should be coupled with a policy stance to improve governance control and competition in Jordanian corporate sector, embodying the largest manufacturing firms in Jordan, with a view of decreasing their technical inefficiency. Another important policy area is alleviating the excess capacity problem of larger firms through export incentives and information, otherwise ULCs will suffer. The aim of such policy measures is to avoid some of the pitfalls of large-scale operation.

[46] See Lichtenstein (1993) for a typology and examples of inter-firm cooperation.

[47] Mergers among SMEs can have pro-competition effect (Hart, 1975) and thus can be desirable if it leads to a new strong competitor to existing larger firm(s) but not to a dominant market position (Fingleton et al., 1996). It is noteworthy that HHI, a respectable measure of market concentration, depends on number of firms *and* firm-size inequality.

(unless the small firms have the potential for future growth in certain industries). In this case, Jordan's industrial competitiveness policy should emphasise creating a business environment that stimulate growth in size, rather than in number, of small manufacturing firms.

The focus of Chapters (5) and (6) was static efficiency of *given* resources, but dynamic efficiency, resulting in the creation of *new* resources, is at least as important as scale and technical efficiency as far as GC is concerned. Indeed, according to some economists, promoting innovation and dynamic efficiency is the overriding objective of industrial competitiveness policy (Westphal, 1990; Pratten and Deakin, 1999). Chapter (7) tackles the role of high-technology in JMIs in upgrading their dynamic competitiveness, taking the pharmaceutical industry as a revealing case study.

CHAPTER SEVEN

An Assessment of Jordan's Global Competitiveness in High-Technology Manufacturing Industries: The Case of the Pharmaceutical Industry

7.1 Introduction: Research Importance and Objective

The increasing significance of technological capabilities[1] in enhancing global dynamic competitiveness, and thus growth performance and external position, is recently attracting growing attention from researchers and policy-makers (Lall, 1990; UNCTAD, 1996b, 2000a; Kim and Nelson, 2000). Product and process innovations are seen as essential components in creating and sustaining quality (differentiation) advantage and cost leadership in modern global manufacturing industries. Consequently, many countries are implementing an industrial policy for science & technology (S&T) in general, and seeking consistently to identify and track the performance of the high-technology sector in particular, in an attempt to close their technology gap vis-à-vis the world technological frontier. Moreover, 'national innovation system' is recently considered an important line of inquiry (Lundvall, 1992a; Nelson, 1993a). Indeed, the issue is so important globally that an international regulatory framework, the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs), has been established and enforced in 1995 to regulate technological diffusion, a step considered by the South nations as a type of "technological protectionism" (Correa, 2000: 5).

Although Jordan is a low-wage country compared with industrial countries, this is not the case in comparison with many low-income developing and transition economies, such as Egypt, India and China. Therefore, if JMIs are to be able to compete globally, they must be ahead of these countries on the basis of non-price competition. More importantly, "countries

[1] According to Lall (1990: 17), technological capabilities can be broadly defined to refer to "the entire complex of human skills (entrepreneurial, managerial and technical) needed to set up and operate industries efficiently over time". Bell et al. (1984: 107) define the concept as "the ability to make effective use of technology".

cannot grow if their competitive edge *remains* low-wage, unskilled labour... competitiveness over time means upgrading simple labour-intensive activities to make higher-quality products that yield greater value-added" (UNCTAD, 2000a: 3, emphasis added). Thus, Jordan's competitiveness strategy needs to seriously consider the technological imperative for global competitiveness. With the above background in mind, this Chapter aims at investigating global competitiveness of **Jordanian pharmaceutical industry (JPI)**, one of the largest *high-technology manufacturing industries (HTMIs)* in the Kingdom. The assessment will be undertaken using multiple competitiveness determinants and measures. After exploring micro and meso foundations of JPI competitiveness, competitiveness outcome and potential strengths are assessed in terms of profitability, net trade index, 'world market share' family of measures, and unit labour cost (ULCs).

Adopting a case study and international benchmarking approach, the industry under study is one of the most promising research-intensive industries in Jordan. Exports generated from JPI constitute 10 % of Jordanian commodity exports, the second just after mining exports. This share represents 17 % of manufacturing exports and almost one third of chemical exports during the period (1995-2000). Although Jordan historically enjoys strong export performance in pharmaceuticals, many coming challenges could jeopardise the future health of the industry: (i) rapid technological innovation and stringent enforcement of *intellectual property rights (IPRs)*; (ii) progressive regional and global competition; and (iii) non-tariff barriers by actual and potential trade partners, including regional markets. Thus, analysing the competitiveness profile of this 'strategic' industry is an essential step towards alleviating the adjustment costs arising essentially from economic globalisation.

This Chapter is structured as follows. Section 7.2 outlines the nature, significance and development of HTMIs. Section 7.3 presents research design, scope and caveats. Section 7.4 highlights the profile and recent developments in Jordanian and global pharmaceutical industry. In section 7.5, an investigation of selected factors affecting the vulnerability and competitiveness of JPI is undertaken. Section 7.6 assesses global competitiveness in JPI using selected CATs (see Chapter 4). While section 7.7 outlines strategic responses of JPI to the technology challenge, section 7.8 ends with conclusions and possible policy implications.

7.2 Conceptual Issues: The Nature and Significance of High-Technology Industries (HTIs)

7.2.1 The Nature of HTIs

Though many economists would suggest that a larger share of 'high-technology' industries (HTIs) in output and export structure, ceteris paribus, is a sign of superior competitive position by an economy, HTIs defy easy definition (Sharp, 1987; Grupp, 1995)[2]. Apparently, the lack of consensus on the nature of HTIs inhibits the quest for a consistent monitoring mechanism. In principle, a HTI is one in which "knowledge is a prime source of competitive advantage" (Tyson, 1992: 18) and is characterised by "large research and development (R&D) expenditures and rapid technological progress" (Nelson, 1984: 1). Knowledge-based industries do exist in services (e.g. information technology) as well as in manufacturing industries (e.g. office machinery and computers). While the former industries are labelled high-technology because they are increasingly *users* of advanced techniques or inputs, the latter are primarily so because they are *producers* of technology (see OECD, 1998a)[3].

In practice, HTIs can be identified by an above-average spending on R&D, above-average employment of scientists and engineers, or both (Tyson, 1992), with at least 4 percent research intensity (Woods, 1987; cited in Jacobson and Andreosso, 1996). Even the last operational definition does not ensure international or intertemporal comparability of the term, particularly in the cut-off point. A review of industrial classification schemes by technology class for OECD, EU and UNIDO is sufficient to show the absence of consensus. The concept is even more blurred in the case of LDCs where: (i) indicators of innovativeness (e.g. R&D expenditure or patents statistics) are either absent or insignificant to record, at least at a fine level of industrial disaggregation; (ii) the technological content of a product may differ between LDCs and industrial countries (Lall, 1998), with much emphasis on imitation or assembling imported parts in LDCs.

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[2] In general, high-technology industries, knowledge-driven industries and research-intensive industries can be treated as synonymous terms.

[3] This rough classification could partially answer Porter's (1996c) conceptual criticism that the traditional distinction between high-technology and low-technology industries has little relevance, since "firms can be more productive in any industry- shoes, agriculture, or semiconductors- if they... use advanced technology, and offer unique products and services. All industries can be knowledge intensive" (p.209). At any rate, industries in real life *do* vary in R&D intensity. Krugman and Obstfeld (1991) suggest that although there is "no sharp line between high-tech and the rest of the economy", they conclude that "[t]here are clear differences in degree, however, and it makes sense to talk of a high-technology sector" (p.267)

The production of pharmaceutical products in LDCs, for example, is principally an imitation-based instead of being an innovation-based process. Consequently, statistics on technology transfer, such as licensing payments and joint ventures, might be more relevant to the case of LDCs.

Furthermore, a HTI in manufacturing is distinguished by two main characteristics: it involves "significant economies of scale, learning and scope, and the competition is between a limited number of large firms" (Jacquemin and Sapir, 1993: 88) as well as "high risk and possibly high returns, a high rate of change" (Macdonald, 1987: 224). Taking pharmaceutical products as an (admittedly extreme) example, evidence has showed that it takes 10 to 12 years to discover and develop a newly active substance into a marketable medicine (EC, 1994b), and the costs of developing an entirely new medicine and bring it to market are currently estimated to range from $200 to $600 million[4] (EC, 1994b; Smith, 1999). Hence, HTIs are often subject to shorter product life-cycles and technological uncertainty (Lambin, 1997) and a greater propensity to obsolescence due to faster introduction of new products and processes (Woods, 1987 cited in Jacobson and Andreosso, 1996). For example, evidence revealed that new pharmaceutical products have an average life expectancy of just five years (Ferguson and Ferguson, 1994). High-technology products are usually differentiated products, and high-technology firms generally adopt a differentiation strategy, at least in the early stages of product-life cycle, to enable them to charge a premium price (and thus recoup their high R&D expenses) and to enjoy some monopoly profits and market power.

7.2.2 A Proposed Definition for HTMIs in LDCs

Although economists and technology experts disagree on identifying HTMIs, most modern definitions (for industrial countries) list well-defined concentrated industries that manufacture exclusively some sort of machinery, equipment and chemical products. Notwithstanding the above definitional caveats, a consistent and *workable* definition of HTMIs for LDCs can be proposed to cover manufacture of: (i) industrial chemicals **(ISIC2 351)**; (ii) other chemical products **(ISIC2 352)** including pharmaceuticals (ISIC2 3522); and (iii) electric and non-electric machinery, transport equipment and 'professional & scientific'

[4] The estimate varies by the inclusion/ exclusion of costs of failures and opportunity costs (EC, 1997a).

equipment **(ISIC2 382-385)**[5]. As usually the case, this is an essentially contestable definition, but has the advantage of maintaining a balance between 'high-standard' definitions adopted by certain industrial countries or organisations, and loose definitions based on broadly-defined industries or product groups. It is worth noting that all taxonomies agree on including the pharmaceuticals industry in the HTMIs[6], and most classification schemes consider 'industrial & other chemical industries' as well as 'machinery & equipment industries' as medium- to high-technology manufacturing industries[7]. To keep the analysis manageable and compatible with the study approach, the present research focuses on the pharmaceutical industry.

Though the above HTMIs in LDCs are not strictly R&D-based industries in the standards of industrial countries, they however possess significant high-technology characteristics (e.g. high percentage of scientists) and own the technological opportunity to enhance their technical capabilities in the face of coming global challenges via foreign technology transfer.

7.2.3 The Significance and Development of HTIs

HTIs get their importance in policy spheres affecting production and export structures because they are comparatively sunrise or growth industries in local and global markets with potentially noticeable spillover benefits. According to DTI (1999), HTIs are "often characterised by rapid growth in demand, and by externalities in the production process which confer an additional benefit for the economy as a whole" (p.55). Furthermore, they "bestow national benefits on productivity, technology development and high-wage job creation" (Tyson, 1992: 2). Thus, active industrial policy might be needed (Okimoto, 1989; Stiglitz, 1999). In the real world, Japan is a case study where government and business emphasis on HTIs (vis-à-vis declining industries) could be a key factor in explaining its strong export performance (see Fodella, 1993).

On the other hand, there are sceptics who suggest that HTIs are not necessarily 'special' industries. According to this view, "[h]igh-technology processes or products may be more

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[5] Although sometimes imposed by data limitation, it can be misleading to identify HTMIs in terms of broadly defined industries (as done by Donek (1998)), such as defining HTMIs in terms of chemicals (ISIC 35) and/or manufactures of fabricated metal products, machinery and equipment (ISIC 38). This is due to the fact that these aggregate industries are heterogeneous and cover many low-technology industries.
[6] See, for example, Jacobson and Andreosso, 1996; OECD, 1998b.
[7] See, for example, UNIDO, 1997; OECD, 1998b.

easily imitable than some other sources of competitive advantage" (CPPBB, 1997: 43-44). Finding support from Nelson's (1993b) case studies, Mowery (1995) suggests that there is remarkably little compelling evidence that *overall* economic performance is determined by the strength of HTIs. A priori, the argument could be right if the share of HTIs is small compared with medium- and low-technology industries, with limited influence on overall growth or export success[8].

Developing HTIs in LDCs requires an enabling environment for technology acquisition and innovation. It is noteworthy that developing technology need not be an internal organisational activity; it can be acquired from external sources (Trott, 1998) or imported from abroad. As for **the acquisition of foreign technology**, transfer of technology is perhaps the largest single constraint on the development of domestic HTMIs in LDCs (UNIDO, 1978), particularly with the stringent global enforcement of TRIPs Agreement[9]. To be able to acquire, operate and adapt foreign technology, at least two conditions are required. **First**, the country must have a favourable *regulatory framework* for: (i) foreign investment promotion and trade; (ii) technology licensing and diffusion (e.g. compulsory licensing), whether in the context of competition law or otherwise (see Cabanellas, 1984); and (iii) technology protection. **Second**, it is widely believed that building *firm-level technological capabilities* is a requirement for the effective absorption of foreign technology (Lin, 1997). Table (7.1) shows main advantages and disadvantages of three main modes of foreign technology transfer[10].

[8] See Patel and Pavitt (1995).
[9] For an overview on technology transfer to LDCs, see Chen (1996).
[10] Kim (1994) provides a comprehensive conceptual framework for technology transfer. The framework considers imitation and purchase of machinery (that embody new technology) as important modes of foreign technology transfer.

Table 7.1
Channels for Foreign Technology Transfer:
A Host Country Perspective

	Foreign Direct Investment (FDI)	Foreign Technological Alliances	Licensing Agreements
Technology Direction	Intra-company one-way flow	Two-way flow	Extra-company one-way transfer
Requirements	A large and growing market; good governance; liberal investment and business policies (see UNCTAD, 1997a); protective IPR regime, particularly for high-tech industries (Mansfield, 2000); the existence of natural resources, cheap human resources or strategic assets	Adequate technological capabilities and a culture of partnership (UNCTAD, 1996c); mutual complementarities and moderate size asymmetries (Kesteloot and Veugelers, 1997; Telesio, 1984)	Adequate technological capabilities (UNCTC, 1990); protective IPR regime (Mansfield, 2000); an enabling framework for enhancing technology diffusion and limiting restrictive clauses in agreements (see Chen, 1996; Lall, 1996)
Advantages	The technology transferred via FDI can be much newer than the technology sold through licensing agreement (Mansfield and Romeo, 1980); tends to contribute to employment and export opportunities (Lall, 1996).	No direct costs in terms of royalties, or indirect costs in terms of remitting profits and industrial concentration	Can be a suitable strategy for small LDCs with a sizeable small business sector; cost-effective in comparison with in-house R&D; offering stronger differentiation advantage for domestic firms
Disadvantages	Positive technology spillovers could be limited (Haddad and Harrison, 1993; Dodgson, 2000; Hanson, 2001); a country's initial conditions might be unfavourable and incentives are only a minor element in locational decisions of multinationals (UNCTAD, 1997a); dominant position of multinationals could weaken the competition process and national sovereignty, especially in small economies (Dunning, 1996; Lall, 1996)	There may be differences in company culture and imbalances in benefits (Chee and Harris, 1998); technological partnership involves coordination costs which rises with size asymmetries between partners (Kesteloot and Veugelers, 1997); according to literature, only half of alliances eventually succeed (EC, 1994a)	New technology might not be commercially available (Haddad and Harrison, 1993) due to the fear of establishing future competitors and to moral hazards in global technology market; entails direct costs in terms of royalty fees that range between 1-20 % of sales, but 3-6 % is more typical for industrial products (Chee and Harris, 1998)

SOURCE: Researcher.

Turning to **domestic sources of technology**, three alternative technology development models are cited in strategic management literature; the corporate model, the Silicon Valley model and the two-stage model (see Grant, 1998). In the corporate model, the whole innovation process is done within large and mature corporations (e.g. aerospace industry in the USA). The second model is associated with small, start-up companies linked with various collaborative relationships (e.g. biotechnology industry in Britain). Finally, in the two-stage model for innovation, the technology is initially developed by a small, technology-intensive start-up firm, which then licenses to a large established firm that are more capable of internal commercialisation. Basing his analysis on the Silicon Valley model, Porter (1996a) has emphasised the role of dynamic agglomeration economies at the *cluster* level as a vehicle to enhance rate of learning and the capacity for innovation, and ultimately promoting competitive advantage. Examples of such dynamic economies are "concentrations of highly specialized knowledge, inputs, and institutions; the motivational benefits of local competition; and often the presence of sophisticated local demand" (ibid: 87).

Since patents have the effect of establishing property right for ideas, they are increasingly of particular significance for HTIs. Although the relative importance of patent protection to innovation varies by activity, country and stage of development, this protection is especially important for research-based multinational companies. Small, isolated, *manufacturing* firms in small LDCs, however, lack the distinctive capabilities, threshold size and domestic market size necessary for the independent development and marketing of innovations[11]. Although collaboration and two-stage models of innovation could offer limited opportunities for creative firms, small manufacturing firms in LDCs typically suffer from a 'lock in' effect of a path dependent process.

On the other hand, the situation is different in the *services* sector in small LDCs. Small firms in software industry, for example, can have *more* opportunities for innovation done by creative developers. This is due to the fact that software development is "an intellectual, labour-intensive activity, with negligible manufacturing costs" (Torrisi, 1998). Thus, patent protection is crucial for producers in the software industry (ibid), even in LDCs. Overall, patent protection is considered as *one* important factor for the development of HTIs in the long-term, particularly in the intermediate and late stages of technological development.

In general, technological change (new processes or products) is the outcome of a flow of activities and processes (shown below), and any weak variable or link could hamper rate of technical progress in LDCs:

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[11] Davies (1991b: 214) in his survey on the link between firm size and R&D states that "[w]ithout doubt, in virtually all industries in all countries studied, there is a threshold size of firms below which formal R&D is hardly conducted at all". See also ESCWA (1998) for the case of pharmaceuticals.

Favourable environment → R&D and/or technology transfer → Inventions (or new ideas) → Patents → New or improved products and processes (innovations) → Diffusion → Learning → Product and process development →

Many variables intervene in such a semi-circular diagram[12], such as culture (which shapes attitudes towards science and risk); productivity of R&D (which affects inventions); and finance (which facilitates the transformation of patents into new commercial products). Furthermore, technology transfer (e.g. licensing or importation of machines embodying new technology) can be a close substitute to firm R&D, particularly for SMEs in LDCs, in view of escalating R&D costs (see Gima, 1993). Finally, the regulatory framework that supports and co-ordinates R&D, protects patents, and promotes diffusion, as well as market size and firm capability and strategy, are also among important issues for competitiveness policy.

7.3 Research Design, Scope and Caveats

A survey of the literature reveals at least two main complementary approaches for investigating technological capabilities and dynamic competitiveness in LDCs. The first approach analyses the *whole structure* of manufacturing exports or output in an attempt to assess the 'technological content' in this structure (see, for example, Schnitzer, 1998; Lall, 1998). Here, export specialisation is investigated in terms of technology classes. The main technology groupings are high-tech, medium-tech and low-tech industries or products. The second research design is based on investigating a *specific technology grouping*, usually HTIs (see, for example, U.S. International Trade Commission, 1991). Both approaches are typically qualitative.

In addition to the definitional caveat shared by the above two approaches, the second perspective is ignorant to medium-technology industries, which can make a difference in providing a fair judgement of a country's overall technological positioning.

This Chapter pursues a variant of the second approach. It is based on a case study approach, where just one 'strategic' high-technology industry is thoroughly explored. Due to

[12] The diagram clearly indicates the simplification embodied in using the production function approach, considering R&D stock as an additional input, with the aim of modelling technical change, or even *process* innovation.

data limitation, no formal econometric modelling is undertaken. The case study approach has both its advantages and drawbacks. The main advantage is providing in-depth information on the industry, including international comparisons. The expected absence of small enterprises in 'strategic' concentrated industries could be another advantage, as this solves many practical issues such as the appropriate truncation point for small firms (see Chapter 5) and the imputation of labour compensation for single-person and family businesses. On the other hand, the lack of statistical analysis can be considered as one of the disadvantages[13]. Consequently, the research focus is not on assessing Jordan's *overall* technological capabilities or even Jordan's technological competitiveness in its manufacturing sector as a whole, but rather on investigating one of the significant, relatively research intensive, manufacturing industries in Jordan.

In conducting the study, both micro and meso-level data are utilised. Secondary data from both national and international sources are used. Qualitative information derived from primary (survey) data, although revealing, is not utilised owing to limited available research resources. As for data sources, the research is heavily dependent on data produced by the Department of Statistics (DOS) as far as national data is concerned. One noticeable exception is Jordan's analytical statistics on pharmaceutical exports and imports (e.g. statistics on net trade index and world market share). Because international sources do seek to provide an internationally comparable statistics, the study extracted analytical external trade data from specialised global trade databases, namely **TradeCan** (ECLAC and World Bank, 2000) and **IDSB** databases (UNIDO, 1998). As for competitor data, the study draws on: (i) OECD (1999) **STAN** database for general statistics on output and employment[14]; and (ii) country-specific information (for producer price index).

7.4 A Description and Recent Trends of the Pharmaceutical Industry

7.4.1 Introduction and Global Trends

The pharmaceutical industry is a large, high-growth and globalised industry (Gambardella et al., 2001). According to Trott (1998), the pharmaceutical industry[15] as it is

[13] Based on Jordanian industrial surveys, published pharmaceutical data series starts from 1986 with the adoption of four-digit level of (ISIC) disaggregation.

[14] TradeCAN stands for Trade **C**ompetitive **A**dvantage of **N**ations; IDSB refers to **I**ndustrial **D**emand-**S**upply **B**alance; STAN Database stands for **ST**ructural **AN**alysis Database.

[15] The United Nations defines the pharmaceutical industry in its output classification (ISIC2) as 3522 industry. In its trade classification (SITC2), pharmaceutical products are coded as 541 (of which medicaments 'finished drugs' (5417) are the most important).

known today is relatively young, largely a post-war phenomena. The industry is geographically concentrated in industrial countries[16]; over 70 percent of world production and consumption of pharmaceuticals is in the OECD countries (Tarabusi and Vickery, 1998). Moreover, the industry is dominated by multinationals; they supply 65 % of the world market and account for more than 80 % of the pharmaceutical R&D spending (EC, 1997a). The modern pharmaceutical industry possesses two distinctive features that are unique among other HTMIs. First, it is a highly regulated industry (OECD, 1985; Earl-Slater, 1997), subject to both economic regulation (of prices, profits and IPRs) as well as social regulation (marketing authorisation for safety considerations). Second, it is by far the most research-intensive industry, devoting in industrial countries some 15-20 % of its sales revenue to R&D (Smith, 1999; Yeutter, 1999).

The output of the pharmaceutical industry is highly heterogeneous, leading to a marketing-intensive activity. Owing to this wide variety of products, the pharmaceutical market can be divided into many separate sub-markets (including intermediates or active materials), each producing medicines with *different* therapeutic value. The drugs of one sub-market or therapeutic group are *not* close substitutes for those of another (Shaw and Sutton, 1976). Thus, there is much scope for competition within various segments or sub-markets but very little among them (Reekie, 1975). Consequently, the global market shares of the largest handful of multinational companies, which currently range from just three to six percent (Sutton, 1999), should be interpreted with care in assessing dominance in global drugs market[17]. For analytical and policy purposes, the pharmaceutical industry can be *broadly* segmented by product type, with very different elements of market structure and firm conduct, as follows (see Table 7.2):

1. Ethical (prescribed) drugs, which can be further segmented to:
   a) Brand-name products.
   b) Generic products.
2. Over-the-counter (OTC) or, if sold under brand names, proprietary medications.

A *generic drug* is an ethical drug produced after its patent protection has expired. It is a variety of a previously existing drug that is 'identical' in almost all respects to the previously available version (Griliches and Cockburn, 1996). The word 'identical' here means perfect

[16] The global leaders in drug industry are: Belgium, China, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, the UK and USA (see, Ballance et al., 1992).
[17] Based on the above figures, Sutton (1999: 6) suggests that "[t]he pharmaceutical industry, in contrast to many other high technology industries, remains fairly fragmented at the global level". This could be a strong conclusion, at least in certain therapeutic groups and patent products (see Lall, 1974: 145). See also Shaw and Sutton (1976: 84) for the problem of market definition.

substitutes or therapeutically equivalent to the branded version. Branded and generic drugs do, however, differ in packaging, labelling, shape and sometimes effectiveness. Branded drugs (in their protection stage) are called *in-patent drugs*, because they are subject to patent protection, while generic products are named *out-of-patent* drugs because they are not protected. In-patent drugs can be produced through, for example, getting a license from the innovator, as unauthorised reproduction is legally prohibited according to TRIPs.

Table 7.2
Product Typology and Market Segmentation in the Pharmaceutical Industry

Feature	***In-patent drugs***	***Out-of-patent drugs (generics)***	***Over-the - counter (OTC) drugs***
Consumption	On prescription	On prescription	Without prescription
R&D and Innovation	High and rising	Low	Relatively low
Market competition and contestability	Restricted by patent protection, but can be eased through new drugs, licensing, joint venture and alliance agreements	High and increasing	High and increasing
Profit margins	High	Low, unless branded	Fairly low
Market size	Large due partly to higher prices	Small but growing rapidly	Small but growing
Minimum efficient scale	Large	Medium and small	Medium and small
Dominant competitive strategy	Differentiation	Cost leadership and focus	Cost leadership and focus
Concentration	Concentrated markets	Fragmented market	Fragmented market
Government pricing policy	Regulated and subsidised	Regulated and subsidised	Mostly market-determined and not subsidised
Price elasticity	Low, but increasing with costs containment health policy	Low, but increasing with costs containment health policy	Fairly high

SOURCE: Researcher, based on UNIDO, 1978; OECD, 1985; EC, 1997a; Tarabusi and Vickery, 1998.

While the demand for pharmaceuticals is shaped by structural factors such as demography, living standards and health policy, the long-term supply side is greatly influenced by innovation. The major new trends in global pharmaceutical industry can be summarised as follows:

1. **New cost conditions**: Escalation of costs of developing and marketing new drugs within the limited period of patent protection. This has led to a sharp rise in R&D expenses and firm's resources needed for adopting a strategy for competitive advantage based on

differentiation and innovation superiority. Recent government cost-containment programmes in health sector fuelled this trend. Consequently, the pharmaceutical firm is facing a growing market emphasis on cost reduction strategies (EC, 1997a).

2. **New firm conduct**: As a result of (1) above, two main types of evolving conduct have been identified influencing the global pharmaceutical markets. These are: (i) a mergers, acquisitions, and strategic alliances wave is currently taking place in the industry (EC, 2000a); (ii) a progressive price competition in generic and OTC markets is taking place.

3. **New technological conditions**: A new technological window has been opened based on biotechnology, which constitutes an important source of new product innovation. Furthermore, the enforcement of TRIPs Agreement in LDCs has protected new drugs - developed mainly in the North- from unauthorised imitation with significant implications on the GC of drug firms in the South.

7.4.2 Industry Profile in Jordan

The history of JPI began in mid-1960s with the establishment of the Arab Pharmaceutical Manufacturing Company. The industry then expanded exponentially (see Table 7.7) benefiting from large regional market and availability of low-cost skilled manpower. In 1998, the number of firms reached 21 enterprises, six of which are public shareholding companies. The sector engaged some 3500 persons in 1998 or about 3.0 % of total manufacturing employment in comparison with an average of 1.9 % in the EU (Gambardella et al., 2001). Each firm employed an average of 167 workers with average sales (domestic and abroad) of some $9.0 million in 1998. Exports reached $155 in year 2000, while world market share amounted to 0.3 % in 1996[18] (ECLAC and World Bank, 2000). The product range is limited, probably due to a lack of R&D and a focus on most profitable drug segments. The ratio of value added (VA) to gross output, a measure of vertical integration, averaged 38 % during 1995-98, not uncharacteristically low compared with *average* EU countries (see EC, 1997a).

The domestic private sector dominates the industry, with limited foreign and government equity ownership (see Table 7.3). Thus, inward FDI is essentially lacking[19]. Public sector companies and subsidiaries of multinationals, unlike the case of Egypt

[18] According to the broad SITC=541 definition (finished drugs and intermediates or active materials), but world market share equals 0.5 % in SITC=5417 (finished drugs).
[19] Based on recommendations of the IMF Balance of Payment Manual for 1993 (see Chapter 2, Footnote 7), only one firm (foreign-minority-controlled), out of 21 companies, embodies FDI as opposed to foreign portfolio investment (Table 7.3).

(Subramanian and Abd-El-Latif, 1997), are actually absent in JPI[20]. The research capabilities in the industry are limited, and according to one typology of the world's drug industries, JPI is *not* classified within the country group with innovative capabilities (Balance et al., 1992).

Market size, as measured by nominal domestic consumption, increased from $72 million in 1987 to $114 million in 1994 (UNIDO, 1998), reflecting an annual growth rate of 8.5 %. As an export-oriented industry (see Table 7.17), annual real growth in VA varies considerably according to regional export opportunities, but the industry registered a high average real growth of 18 % during 1986-98[21]. More recently, the industry recorded a sharp average annual growth of 30 % during 1997-98 after a negative growth of 4 % during 1994-96.

Table 7.3
Jordan: Foreign Equity Ownership in Public Shareholding Pharmaceutical Companies (1997)

Company	Size*	Arab ownership ratio (%)	Non-Arab ownership ratio (%)	Total foreign ownership ratio (%)
Arab Pharmaceutical Manufacturing	809	6.0	0.6	**6.6**
Dar Al-Dawa	451	1.5	1.8	**3.3**
Arab Center for Pharmaceuticals and Chemicals	270	23.3	0.008	**23.3**
Middle East Pharm. & Chem. Med. Appliances	24	4.4	0.0	**4.4**
Al-Razi Pharmaceutical Industries	26	4.6	0.004	**4.6**
Advanced Pharmaceutical Industries	53	4.1	0.0	**4.1**
Weighted Mean Foreign Participation		**7.5**	**0.8**	**8.3**

* As measured by number of employees. Used as weight in the calculation of average foreign participation.
SOURCE: AFM (1997), Jordanian Shareholding Companies Guide (1997).

The industry's competitive strategy until now is based on the following elements:

- Cost competitiveness based on comparatively lower labour costs (LCs).
- Geographic focus, mainly for Arab countries, coupled with product differentiation strategy and sophisticated promotion policy (see World Bank, 1988). The differentiation element is dependent mainly on imitation (of in-patent drugs) rather than innovation; the

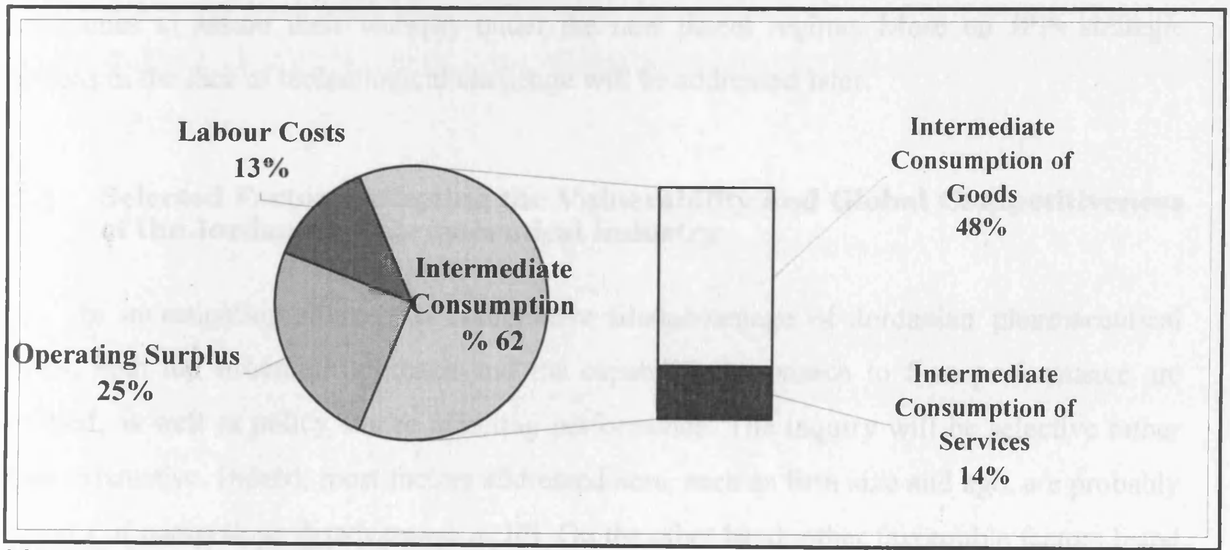
[20] Possible reasons for the absence of multinationals in JPI, despite the existence of skilled labour, include small *domestic* market, low tariff protection (see Caves, 1996), foreign ownership limitations (lifted in 1995) and late entry into WTO (in 2000). The lack of competitive related industries can be also an important factor. Small domestic market seems a significant constraint in view of the *domestic market orientation* of pharmaceuticals multinationals in general (see Ali and Kam, 1996).
[21] The standard deviation of annual growth rates amounts to a huge 26 % over the period 1987-98.

modification (some would say copying) of well known branded names, utilising skilled manpower, without licensing the drug. Such firm conduct is not inconsistent with Jordan's previous patent law, but the new TRIPs-consistent law renders such practices illegal.

In assessing the above strategy, two points are worth discussing:

1. The cost structure in JPI, exhibited in Figure (7.1), confirms the wage competitiveness of JPI; the share of LCs, including non-wage costs, in gross output is just 13 % compared with an EU average of some 21 % in 1993 (EC, 1997a). But the Figure also clearly affirms that significant future *improvement* in *cost* competitiveness of JPI is largely dependent not on wage competitiveness but on cost of materials, principally imported from abroad, as well as on technical efficiency of its usage. Overall, the cost structure of JPI indicates the importance of negative quality (see Chapter 4) and materials productivity for future competitiveness (Figure 7.2).

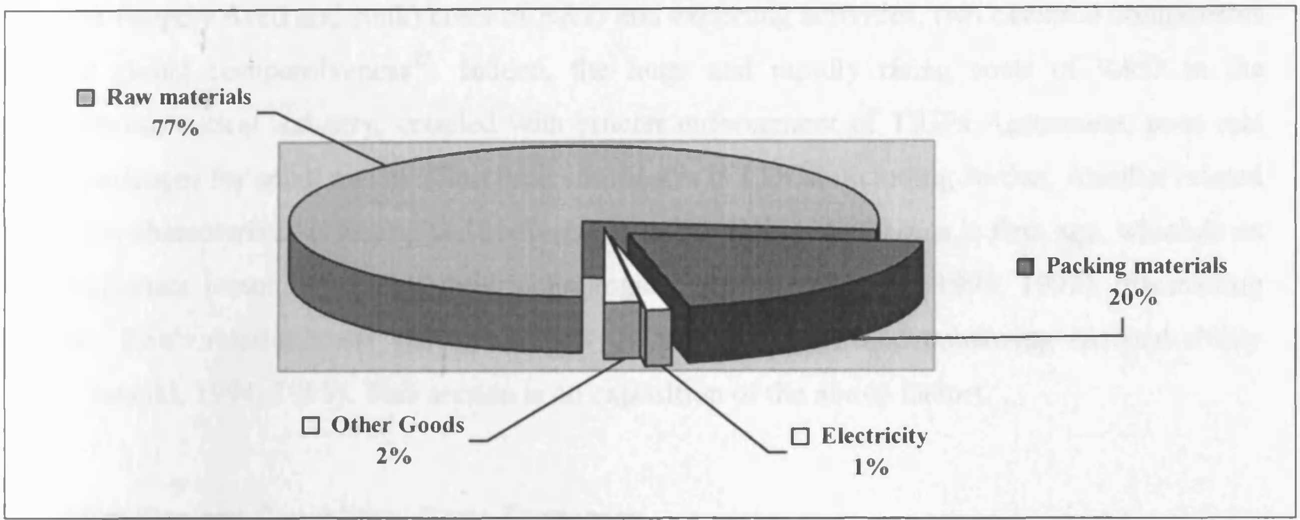
Figure 7.1
Jordan: Cost Structure in the Pharmaceutical Industry
(% of Gross Output, Average 1995-1998)



SOURCE: Researcher, based on industrial survey data (DOS).

2. The enforcement of TRIPs on in-patent drugs and progressive global competition in generics will render the above strategy vulnerable, suggesting the need for industrial restructuring and changes in business strategy.

Figure 7.2
Jordan: Components of Intermediate Consumption of Goods in the Pharmaceutical Industry (Average 1995-98)



SOURCE: Researcher, based on industrial surveys (DOS).

As part of their initial response to a changing and challenging environment, Jordanian firms are recently seeking joint ventures and new licensing agreements with foreign companies to assure their viability under the new patent regime. More on JPI's strategic options in the face of technological challenge will be addressed later.

7.5 Selected Factors Affecting the Vulnerability and Global Competitiveness of the Jordanian Pharmaceutical Industry

In investigating sources of competitive (dis)advantage of Jordanian pharmaceutical firms, both the structural approach and the capabilities approach to firm performance are utilised, as well as policy stance affecting performance. The inquiry will be selective rather than exhaustive. Indeed, most factors addressed here, such as firm size and age, are probably sources of competitive disadvantage in JPI. On the other hand, other favourable factors listed in the diamond model (Figure 7.3), such as wage competitiveness, are assessed later.

1. *The Capabilities Approach: Firm Characteristics Affecting performance in JPI*

Although firm size has lost *some* of its attraction as a critical success factor in view of the emergence of flexible production, segmented markets and inter-firm cooperation in industrial countries, this is generally not the case as far as HTMIs is concerned[22], particularly

[22] See Symeonidis (1996: 59) for a general argument. On the disadvantages of small companies in the pharmaceutical industry, see Burstall and Senior (1985) and Sutton (1998, 1999). See also the next footnote.

in small LDCs. In HTMIs, a certain *threshold level* of firm size is probably still considered a necessary (though *insufficient*) condition for sustaining competitive advantage and financing the (largely fixed and sunk) costs of R&D and exporting activities, two essential components of global competitiveness[23]. Indeed, the huge and rapidly rising costs of R&D in the pharmaceutical industry, coupled with stricter enforcement of TRIPs Agreement, pose real challenges for small and medium drug companies in LDCs, including Jordan. Another related firm characteristic affecting the performance of Jordanian drug firms is firm age, which is an important factor in accumulating technological capabilities (Lall, 1990, 1992), discovering the firm's relative costs and advantages (Jovanovic, 1982), and enhancing survival-ability (Gersoki, 1994, 1995). This section is an exposition of the above factors.

Firm Size and Capabilities: Scale Economies

Due to small domestic market and limited access to global markets, the average size of Jordanian pharmaceutical firm is relatively small; about 190 employees in 1994 compared with 640 employees in the UK. But this average hides large variance in firm size. Table (7.4) summarises 1994 size distribution of Jordanian firms. Based on the EU size classification (EC, 1996a), most firms are SMEs (less than 250 persons) and only four pharmaceutical firms are entitled to be called 'large' firms.

Table 7.4
Jordan: Employment Size Distribution of Pharmaceutical Firms (1994)

Employment Size Class (Worker)	No. of Pharmaceutical Companies
5 -10	2
Less than 51	5
Less than 251	5
Less than 501	3
Less than 1001	1
Less than 1501	0
Total	**16**

NOTE: Tables 7.4 and 7.3 differ in terms of ownership structure, year and source.
SOURCE: DOS, Industrial Census (1994), firm-level database.

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23 In addition to the tendency towards mergers and acquisitions currently taking place in the global pharmaceutical industry (EC, 2000a), Tyson (1992: 287) provides supporting evidence from small American innovator firms regarding their weakness in the transition from prototype development to full manufacturing. The size threshold, of course, varies across countries, regions and industries as well as over time based on many factors. Among important factors are: transaction costs of undertaking inter-firm cooperation in exports, R&D and other activities; the technological capabilities owned by SMEs; and the quality of high-technology clusters under which SMEs work. As emphasised in Chapter (6), for certain countries, regions, clusters and industries it is quite possible for small firms in HTMIs to be as competitive as larger firms in global markets.

Taking a worldwide view, Table (7.5) illustrates, using firm-level information, the wide disparity in size (and thus resources and capabilities) between Jordan's largest three pharmaceutical firms and world-class companies. In an international (not European) perspective, Jordanian firms are only of small, or indeed very small, size.

Table 7.5
A Comparison between Jordan's and Worldwide Largest Pharmaceutical Companies (1995, million $)

Rank	Name	Sales (Million $)	World Market Share (%)	R&D Expend. (Mill. $)	R&D/ Sales (%)
1	Glaxo Wellcome	12,586	4.4	1,894	15.0
2	Merck (US)	11,314	4.0	1,331	11.8
3	Novartis	10,571	3.7	1,691	16.0
4	Hoechst-Marion-Roussel (HMR)	8,438	3.0	1,200	14.2
NA	Hikma Pharmaceuticals	65	0.02	1.6	2.5
NA	Arab Pharmaceutical Manufacturing	42	0.01	1.05	2.5
NA	Dar Al-Dawa	31	0.01	0.8	2.5

SOURCE: Based on Oberlander (1998) and MOP (1999). Data for Jordanian firms are for 1997. World market shares and R&D expenditures in Jordan are estimates of the Researcher.

Indeed, the combined sales of all pharmaceuticals firms in Jordan, based on the industrial survey, did not exceed JD 133 million (or $188 million) in 1998, which is below the budget needed to discover and develop just one new drug. If size positively affects performance (quality and cost leadership) in the global pharmaceutical industry[24], then Jordanian small companies need to find an effective strategy to offset this weakness.

Firm Age and Capabilities: Learning Economies

Another potential predictor of firm capabilities and global competitiveness in JPI is firm age (a broad proxy for learning). Learning economies, i.e., the reduction in unit costs as a result of firm experience, is a significant dynamic process within all firms in general and high-technology firms in particular[25]. In Chapter (6), an empirical regularity appears to dominate the link between firm age and labour productivity (LP); firm age is *positively*

[24] Lall (1974) claims that the pharmaceutical industry enjoys practically no economies of scale in production, but confirms the importance of scale economies in R&D and marketing. This belief is consistent with the tentative empirical evidence of Chapter (6), based on a small sample for 1994, which suggests the absence of significant increasing returns to scale (RTS) in JPI. Lall's point is supported also by Mamgian's (2000) study, which failed to reject the hypothesis of constant RTS in the Indian drug industry.
[25] For a recent survey on firm learning, see Malerba (1992).

associated with firm-level LP, with a large threshold of at least 23 years. This link suggests the importance of learning-by-doing effect, possibly with diminishing returns through time. If the same sector-wide relationship applies to JPI, it signals the impact of firm age on the industry's global performance. According to information derived from the latest Industrial Census, the average firm age in JPI does not exceed 9 years in 1994. On the other hand, the history of British pharmaceutical industry, for example, can be traced back to 1851 (Corley, 1999). Table (7.6) exhibits the firm-age distribution in JPI.

Table 7.6
Jordan: Age Distribution of Pharmaceutical Firms (1994)

Age Class (Year)	No. of Pharmaceutical Companies
Less than 6	7
Less than 11	3
Less than 21	5
Less than 31	1
Total	**16**

SOURCE: DOS, Industrial census (1994), firm-level database

The Table shows clearly that most Jordanian firms are latecomers to the high-technology manufacturing world. Only two firms have an age that exceeds 25 years, and even this age is modest in comparison with the Western industry. This fact has implications on the competitiveness of Jordanian 'infant' drug firms. The literature on learning by doing proposes several arguments for the positive impact of firm's cumulative experience on its efficiency and thus competitiveness (Lundvall and Battese, 2000). According to UNCTAD (1996b: 14), "history counts" in accumulating dynamic technological capabilities. Thus, age structure of Jordanian firm can be a disadvantage in terms of building sustainable distinctive capabilities.

2. The Structural Approach: Industry Structure and Cluster in JPI

It is widely accepted that market structure (i.e. the distribution of firms in an industry in terms of number, size, and location as well as market contestability) has an influence on industrial performance. Furthermore, business environment surrounding the industry (i.e. its cluster) has also an impact. This section aims at discussing the above two factors in turn.

Market Structure: Competition Effect

The number of firms in JPI has witnessed a noticeable growth in the 1990s (Table 7.7); it increased from one firm in 1964 to 8 firms in 1990, and reached 21 firms in 1998. This increase in numbers is probably due to expanded export opportunities and enlarged domestic market in the aftermath of the currency devaluation and Gulf crisis, respectively. But as confirmed by Jordanian firm-level data and previous empirical work (Geroski, 1995), new entrants are comparatively smaller.

Table 7.7
Jordan: Number of Companies in the Pharmaceutical Industry

Year	No. of Firms
1964	1
1986	7
1990	8
1994	16
1995	16
1996	17
1997	20
1998	21

SOURCE: industrial surveys, DOS.

The pharmaceutical firms are geographically concentrated in Amman, with 75 % of enterprises situated in the Capital (the 'core' in Jordanian economy). This spatial pattern in firm location is common to other Jordanian industries, probably because of market size effect and lower trade costs[26]. In line with increasing number of firms in the JPI, the industry exhibited a decline in *producer* concentration (Table 7.8). This improvement in competitive discipline could lead to a higher TE[27] (see Chapter 5).

[26] See Krugman (1991) on the literature of 'geography and economics'.
[27] It is worth emphasising that the UN ISIC classification emphasises producer substitutability more heavily than consumer substitutability (Needham, 1969). As a result, the definition of the pharmaceutical industry in ISIC classification is too broad, including a wide range of therapeutic groups such as vaccines, serums and plasmas, antibiotics, vitamins, and veterinary products. On this point, see Waldman and Jensen (1998).

Table 7.8
Jordan: 3-Firm Producer Concentration Ratios in the Pharmaceutical Industry

Year	CR3
1974	100
1984	92(1)
1993	66
1994	61
1995	63
1996	56
1997	51

(1) Represents four-firm concentration ratios.
Note: Concentration ratios are based on employment, unadjusted for foreign trade.
SOURCES: for 1974, Alawin (1978); for 1984, Naser (1990); later years' information is provided by DOS.

The absolute level of *producer* concentration, though declining, still indicates the existence of large domestic market power. The combined market share -in terms of employment- of the largest three firms still exceed 50 % in 1997. In Egypt, for example, the top *five* pharmaceutical firms accounted for just 26 % of the market in 1995 (Subramanian and Abd-El-Latif, 1997). Based on *domestic* industrial concentration, JPI can be described as 'loose oligopoly'.

In addition to the structure of domestic production and vertical/ horizontal product differentiation common in HTMIs, competition intensity in JPI is affected by two main factors: import and export flows and government price regulation. These are considered in turn:

1. Import and export flows affect domestic supply and therefore can influence market power and structure in HTMIs. While omitting foreign trade in assessing industrial concentration ratios can generally be misleading (Shepherd, 1990), there are theoretical and practical difficulties in applying the 'right' correction procedure, particularly in HTMIs where product differentiation and intra-industry trade play a significant role. Indeed, the logic of adjustment depends crucially on the assumption that home and

foreign goods are substitutes in terms of variety and quality[28]. In this research, trade flows are examined separately, thus avoiding *ad hoc* correction.

Table 7.9
Jordan: Export Intensity and Import Penetration in the Pharmaceutical Industry [(1)]

Year	*Export Intensity*	*Import Penetration*
1987	0.79	0.80
88	0.74	0.78
89	0.70	0.73
90	0.81	0.80
91	0.68	0.70
92	0.69	0.69
93	0.72	0.70
94	0.89	0.86
Period Average	**0.75**	**0.76**

(1) Import penetration is defined as imports divided by domestic consumption. See Chapter (4) for more details on trade measures.

SOURCE: Derived from UNIDO (1998) Industrial Demand-Supply Balance Database. Exports and imports are originally product-based trade data.

Table (7.9) shows that JPI exports a sizable portion of its total sales (75 % on average). This quantitative strength is counterbalanced with a qualitative weakness; exports are geographically concentrated in LDCs, particularly Arab countries. According to MOP (1999), 72 % of total pharmaceutical exports are serving just three Arab markets in 1995. Moreover, the Table reveals that a large share (76 %) of Jordan's total consumption of pharmaceutical products is satisfied by imports.

2. In Jordan, the Ministry of Health strictly controls pharmaceutical prices[29]. The price ceilings of imported products are based upon prices in the country of origin, while prices of domestic products are set lower than the level of similar foreign products by a specific margin (IDB, 1997). The regulations allow for price review but the review is subject to an administrative lag.

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[28] See Jacquemin and Sapir (1993) for an argument suggesting precaution in accepting this implicit assumption. As emphasised in Chapter (5), product differentiation "tends to reduce the intensity of import discipline and to favour intra-industry trade" (ibid: 83).

[29] Actually, most countries regulate manufacturer and retailer prices for drugs, either directly or indirectly (Danzon and Chao, 2000). More detailed information about modes of regulation in the EU countries is presented in EC (1997a).

The above pricing policy is often justified by the premise that price competition is weak because "patents intentionally limit competition and lead to product differentiation...insurance makes patients insensitive to prices, and physicians who are primary decision makers may not know product prices and /or may be imperfect agents for patients" (Danzon and Chao, 2000: 311). Furthermore, price controls limit state expenditure on drugs (Burstall and Senior, 1985). In Jordan, the unintended consequences of such a policy can be summarised as follows:

- It weakens domestic competition.
- Although it can enhance business certainty, price regulation can hurt the profitability (and thus investment) of domestic producers, even in export markets where such a pricing policy is also adopted by the importer country, as an equal treatment arrangement.
- One possible 'desired' consequence of such a policy is the quest of Jordanian firms to penetrate regional markets where price margins are better than those in the domestic economy.

Industrial Cluster: Cluster (Agglomeration) Economies

Cluster analysis has the advantage of showing agglomeration economies and forward and backward *linkages* among private and public actors in an industry. The logic is that the whole is greater than the sum of its separate parts: *the synergy effect*. According to Porter (1996a), one can distinguish between static agglomeration economies and dynamic agglomeration economies. The former is related to appropriate physical infrastructure and availability of local markets (access to inputs and markets) that improve cost advantage for all industries. Dynamic economies, on the other hand, are concerned with cluster-specific agglomeration economies that enhance the cluster's technological capabilities and learning and thus its innovative superiority.

Figure (7.3) presents various factors affecting the competitive advantage of the pharmaceutical cluster in Jordan using the 'diamond' model. It is clear that dynamic economies still rank low in the cluster in comparison with the global frontier. Some potentially significant factors such as large markets and lack of FDI could be eased, to some extent, through recent policy measures aiming at initiating RIAs and enforcing TRIPs.

Figure 7.3
Jordan: Determinants of Competitiveness in the Pharmaceutical Cluster–'The diamond'

Firm Strategy, Structure and Competition

+ The penetration of regional markets through improved quality & effective promotion policy
+ High export intensity in many firms
+ Strong intra-industry trade
+ Private ownership structure
- High producer concentration
- Smallness of scale and limited research capabilities
- Excess capacity
- Modest organisational learning in comparison with multinationals
- High technical inefficiency (Chapter 5)
- Weak inter-firm cooperation (in R&D, exports, etc.)
- Absence of foreign direct investment (multinationals corporation)
- Geographical concentration of exports leading to exports vulnerability
- Absence of substantial licensing and foreign strategic alliances

+ - Domestic production of therapeutically equivalent products

The Government

+ Low corporate tax rate (15.0 %)
+ 100% foreign ownership is allowed
- Rigid price regulation
- Lack of a coherent industrial policy towards the cluster
- Limited state aid for R&D

+ - The industry is slightly 'disprotected' by the tariff structure

+ - Preferential pricing protection in government procurement

+ - Enforcement of TRIPs Agreement

Chance and External Shocks

+ Proximity to regional large markets
+ Demographic shocks due to forced migration
- Regional conflict and uncertainty

Factor Endowments

+ Abundant skilled manpower
+ Eight Jordanian pharmaceutical colleges
+ Wage competitiveness
- Lack of globally distinctive skills and capabilities
- Lack of mature finance for venture capital

Demand Conditions

+ Free trade areas with Arab countries, EU and USA
- Unsophisticated local demand
- Small *domestic* market
- Unstable export markets

Related & Supporting Industries

+ An emergent packaging industry
- Weak domestic linkages with competitive industries (inc. research institutions)
- Dependence on foreign suppliers

NOTE: The Researcher has benefited greatly from Mansur (1998) and MOP (1999).

3. Other Industry-level Vulnerability Factors

In addition to industrial competition and cooperation, there exist other industry-level vulnerability predictors, some of which are government-induced such as industrial protection, others are affected by market conditions such as capacity utilisation. The focus here is on tariff policy.

Industrial Protection

In Jordan, imported final drugs are currently either exempted from tariff or subject to a slight 5% rate. Table (7.10) shows that the level of effective protection[30] for JPI was relatively high in mid 1970s but since then it has probably declined (certainly in the 1990s in the aftermath of trade liberalisation programme) from its peak level, reaching a negative level during 1995-97[31]. This negative level suggests that average tariff on pharmaceutical inputs is *larger* than the average tariff on pharmaceutical output.

Table 7.10
Industrial Protection in JPI in Selected Years

Year	*Nominal Protection Rate*	*Effective Protection Rate*
1974	n.a.	30.0
1986*	16.3	15.8
1994	11.0	14.0
1995	4.3	-6.0
1996	4.3	-4.8
1997	4.1	-3.9

* For 'Industrial and Other Chemicals' sub-sector.

SOURCES: Alawin (1978) for 1974 figure; World Bank (1988) for 1986 figure; Hoekman and Djankov (1997) for 1994 estimate. Figures for later years are IMF staff estimates (unpublished).

Thus, JPI is not currently sheltered by the tariff structure. Ceteris paribus, this 'disprotection' could *contribute* towards motivating multinationals to choose an export strategy rather than FDI option as their mode of entry to Jordanian market[32]. Furthermore, though low tariff protection decreases vulnerability of *existing* domestic firms to progressive

[30] Effective tariff is the tariff imposed on VA (gross output *and* intermediate inputs) while nominal tariff is tariff imposed on gross output (final goods).

[31] For comparison, effective rate of protection for total manufacturing reached an average of 48 % over the period 1995-97.

[32] See Caves (1996) for various supporting evidence. See also Balasubramanyam and Greenaway (1993) and references cited therein for an opposing argument and evidence.

trade exposure, it can also affect the viability of new entrants, which are typically small (i.e. lack scale economies) and infant (i.e. lack learning economies), particularly if they do not own offsetting competitive advantage.

7.6 Measures of Global Competitiveness in Jordanian Pharmaceutical Industry

This section aims to assess JPI competitiveness using various measures; price-cost margins (PCMs), unit labour costs (ULCs) and trade performance.

1. *Profitability: Measurement and Vulnerability to Technology Licensing*

Profitability affects competitiveness of JPI through its impact on internal resources available for technology acquisition and through the influence of its components (price and average costs). If Jordanian pharmaceutical firms earn a lower rate of return, retained earnings, ceteris paribus, would suffer along with firm's ability to invest, innovate or buy technology from abroad. This is particularly true after the TRIPs Agreement and in view of the imperfections of Jordanian capital market. On the other hand, if higher profit reflects a premium price unaccompanied by superior efficiency or quality (i.e. process and product innovation), it is conducive to a loss of competitiveness. The impact of TRIPs introduction on JPI profitability is embodied in increasing production costs, and thus price competitiveness[33].

The aim of this section is two-fold: (i) assessing the profitability of JPI over time and via benchmarking with world leaders using industry-level data; and (ii) simulating the impact of the additional costs of drug licensing on firm profitability and survival-ability utilising 1994 firm-level data.

Despite being an imitation-based industry, the profitability of JPI during the period 1986-96 seems comparable to that of the UK but clearly less than its USA counterpart (Table 7.11)[34]. The comparatively high profitability level is due partially to Jordan's wage competitiveness.

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[33] The full impact would take place after a lag period because of the prospective nature of patent protection; none of the in-patent drugs produced by JPI *before* the implementation date would be eligible for protection.
[34] As measured by price-cost margins or more specifically: PCMs=(value added-labour costs)/ gross output. The OECD (1999) STAN database does not allow for more refined measure.

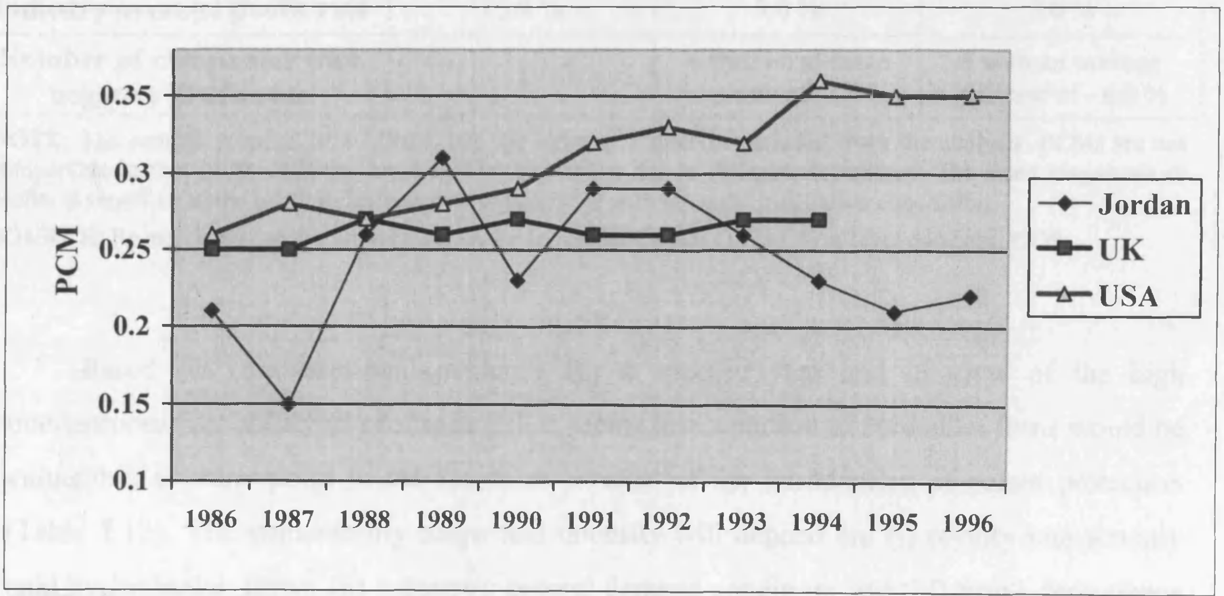
Table 7.11
Descriptive Statistics on Pharmaceutical Profitability: An International Comparison

	Period	Average	Standard Deviation	Least Square Growth Rate
Jordan	1986-96	24.4	4.67	0.88
UK	1986-94	26.3	0.01	0.92
USA	1986-96	31.0	0.03	3.23

SOURCE: for Jordan: industrial surveys; for the UK and USA: OECD (1999) STAN database. The UK data series in the database covers up to 1994.

Although the long-term profitability growth in JPI is encouraging, the variability of profits, however, is quite high (Figure 7.4), reflecting the vulnerability of the industry to external shocks and the lack of sustainable and diversified export markets.

Figure 7.4
Evolution of Pharmaceutical Profitability: An International Comparison



SOURCE: source of Table (7.11).

To test the viability of JPI to technology licensing in a post-TRIPs world, a simple but novel simulation analysis of the impact of new licensing fees on company profitability is undertaken using the 1994 census microdata. The choice of the year is dictated by the availability of data, but it seems that 1994 is moderately *below* average as far as industry profitability is concerned (1.5 percentage points less than the average for 1986-98). PCMs are calculated here more accurately to reflect total costs[35]. Three assumptions are explicitly made: (i) Jordanian firms, whatever their size, are not constrained by technology market imperfections; technology transfer is a smooth transaction hampered only by ability to pay; (ii) royalty payments are proportional to sales; there is no minimum lump-sum payments; and (iii) in-patent drug market is indispensable for firm viability. These assumptions are only partially realistic. In Jordan, the market for technology transactions is not regulated, and hence there are no 'guidelines' or ceiling on royalty rates. Since the valuation of intellectual property is quite a complex bargaining task (see Sullivan, 1995; Megantz, 1996), two scenarios for royalty rate are assumed, one assumes 6 % *of total sales* and the other assumes 12 %[36].

Table 7.12
Jordan: The Impact of Technology Licensing on the Profitability of Pharmaceutical Firms (1994)

	Before Licensing	Scenario (1): 6 % Royalty Rate	Scenario (2): 12 % Royalty Rate
Industry average profit rate	15.0 %	9.0 %	3.0 %
Number of companies with negative profit rate	1	4 with an average loss rate of -3.4 %	8 with an average loss rate of - 6.0 %

NOTE: The sample consists of 16 firms, but one extreme outlier is excluded from the analysis. PCMs are not comparable to that of the industry-level profitability above due to different definitions. The exact magnitude of profits is sensitive to the profitability measure adopted but with the same qualitative conclusion.
SOURCE: Researcher's computation based on the Industrial Census (1994), firm-level database, DOS.

Based on cross-sectional evidence for a specific year and in view of the high intertemporal variability of profits in JPI, it seems that a portion of Jordanian firms would be vulnerable at some point in the future as a result of the introduction of patent protection (Table 7.12). The vulnerability scope and intensity will depend on: (i) royalty rate actually paid by Jordanian firms; (ii) industry's general demand condition; and (iii) firm's dependence on in-patent drugs in generating its profits. According to the simulation analysis, it seems that *both* small and large firms are equally vulnerable.

[35] PCMs, in a post-TRIPs world, are measured here using annual industrial surveys as follows:
PCMs = {Value added at current prices - [compensation of employees + other expenses including land rents, **royalties** and interest payments + <u>assumed **new** licensing fees</u> + depreciation + indirect tax]} / total sales.
OECD (1999) STAN database does not cover detailed cost items in its industry-level data.
[36] See Megantz (1996) for recent industry standards. In Egypt, the rate varies between 7-10% of sales (Subramanian and Abd-El-Latif, 1997).

2. *Average Wage and Unit Labour Costs (ULCs)*

One way to assess competitiveness of JPI is to examine costs of production or, more conveniently, LCs. This is crucial in view of the adopted competitive strategy by the industry, both locally and globally (see above). If the government controls drug prices and thus these remain unchanged, a rise in costs will reduce profitability, perhaps reducing future investment and eventually future sales and competitiveness (see Griffiths and Wall, 1999). In this section, an assessment of JPI wage competitiveness will be undertaken through: (i) cross-country comparison in *levels* of average wage (including supplements) per worker; and (ii) cross-country comparison in *changes* in ULCs. Both endeavours do not necessitate the complex task of deriving inter-spatial, industry-specific, producer price indices to account for differentials in price structure across countries.

As expected, Table (7.13) indicates that Jordan's wage competitiveness in pharmaceutical products is ranked between larger, lower-income, LDCs and industrial countries. This relative position should not be interpreted as evidence of Jordan's *absolute price advantage* vis-à-vis industrial countries; lower LP level as well as higher costs of other inputs may counterbalance wage competitiveness enjoyed by JPI. Thus, ULC, or LCs per worker corrected for LP differentials, is a better indicator of cost competitiveness (see Chapters 4).

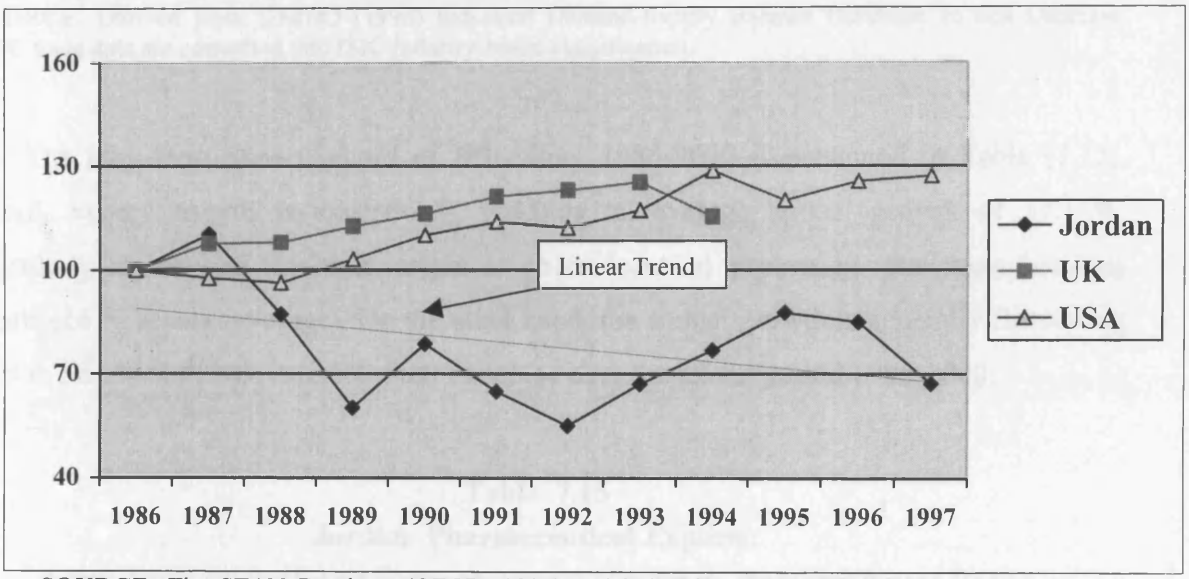
Table 7.13
Average Pharmaceutical Labour Costs per Employee: An International Comparison

Country	Year	Labour Costs (in US Dollars)	No. of Employees	Yearly Average Labour Costs (000$ per person)	Ratio to US Cost (%)
Jordan	1997	19,887	3,357	5.9	**8.5**
Egypt	1995	88,584	28,700	3.1	**4.5**
India	1995	345,576	204,600	1.7	**2.5**
UK	1997	2,720,220	68,000	40.2	**58.0**
France	1997	3,612,624	90,300	40.0	**57.7**
USA	1996	17,751,000	256,000	69.3	**100.0**

SOURCE: Researcher's calculation based on: (i) OECD (1999) STAN database (for USA) and UNIDO (2000) International Yearbook of Industrial Statistics (for other countries); and (ii) IMF (1998b), International Financial Statistics (for exchange rate data).

Changes in ULCs are important determinants of *catching up* effort in the competitiveness race in the medium term. ULCs measure LCs per unit of output produced. It will rise, reflecting a fall in labour competitiveness, when nominal labour compensation (per person) increases faster than real output (per person). Figure (7.5) shows that ULCs in JPI, calculated on the basis of national currency, has been fluctuating during the period 1986-97, but the long-term trend was favourable with a fall in ULCs by an annual average of 2.0 %[37]. This fall was the result of an *upsurge* in LP (VA per worker) by an average of 8.5 % and a somewhat smaller *increase* in labour compensation by an average of 6.2 % during the same period. In contrast, world manufacturers of pharmaceuticals recorded a modest increase in ULCs, calculated on national currency basis: in the UK by an average of 2.3 % during 1986-94 and in USA by 2.7 % during 1986-97. This rise could partially reflect an increase in R&D employment, resulting in higher average wage costs.

Figure 7.5
Evolution of Unit Labour Costs in the Pharmaceutical Industry: An International Comparison (1986=100)



SOURCE: The STAN Database (OECD, 1999) and industrial surveys (DOS) for data on VA and compensation of employees. Pharmaceutical production index rather than deflated VA is utilised for the UK, taken from www.statistics.gov.uk. Pharmaceutical producer price index for USA is taken form NBER-CES Manufacturing Industry Database www.nber.org/nberces.

3. *Export Performance and Revealed Comparative Advantage (RCA)*

In this section, foreign trade performance of JPI is assessed using various measures; at the industry level: net trade index, export growth, and world market share; at the firm level: export intensity. Using cross-country data on trade balance index, Table (7.14) shows that

[37] All growth rates were calculated using the least square growth rate method.

Jordan's trade balance position in pharmaceuticals is better than that of Egypt but worse than the UK. This applies also to export performance. Furthermore, JPI is characterised by a high intra-industry trade at the aggregate level, where average exports appears nearly equivalent to average imports, leading to a modest net effect on Jordan's long-term external position.

Table 7.14
Jordan's Trade Balance in the Pharmaceutical Industry in Selected Years: An International Comparison
(Million dollars, unless otherwise indicated)

	Jordan			Egypt			UK		
	X	M	NTI*	X	M	NTI*	X	M	NTI*
1984	29.8	35.9	**-0.092**	8.3	151.0	**-0.90**	1,512.3	688.0	**0.37**
1989	52.0	62.1	**-0.088**	11.1	126.3	**-0.84**	3,071.8	1,610.9	**0.31**
1994	130.7	98.0	**0.143**	24.5	173.6	**-0.75**	5,611.1	3,193.4	**0.27**
1995	124.8**	123.9	**0.004**	29.8	221.4	**-0.76**	7,258.0	4,037.1	**0.29**

* NTI (net trade index) is defined as (X-M)/ (X+M).
* * The figure is taken from CBJ, Monthly Statistical Bulletin.
SOURCE: Derived from UNIDO (1998) Industrial Demand-Supply Balance Database. In this Database, SITC trade data are converted into ISIC industry-based classification.

The long-term export record of JPI during 1985-2000 is presented in Table (7.15). Overall, export growth is exceptional, reaching an average annual growth of 17.1 %, particularly in view of the high weight of pharmaceutical exports in total *manufacturing* exports (16 % secular average). On the other hand, the annual growth is generally fluctuating and it is clearly well below its long-term average over the recent period 1995-2000.

Table 7.15
Jordan: Pharmaceutical Exports:
Long Term Growth and Share (National Currency, Nominal Prices Basis)

Period	Average Growth (least square)	Average Share (in % of manufacturing exports)
(1985-1989)	18.1	14.2
(1990-1994)	26.7	16.2
(1995-2000)	2.4	16.7
(1985-2000)	17.1	**15.7**

SOURCE: CBJ, Monthly Statistical Bulletin, various issues. Data are based on SITC classification (which is more timely than ISIC-based classification).

Turning to indicators of RCA in a global context. According to Balassa (1989), the proper assessment of RCA needs to take into account both: (i) relative world market shares; and (ii) relative export growth rates. While the first indicator expresses *position* or static snapshot of export performance, the second indicator addresses *changes* in performance. Table (7.16) and Figure (7.6) show the long-term exports competitiveness of *finished* pharmaceutical products in Jordan and five major competitors using a family of measures related to world market share[38]. The countries selected represent world export leaders to LDCs (and actually to the world as a whole). Because Jordan exports very little drugs to industrial countries (less than JD 0.5 million in 1999), it is sensible to assume that, at least in the short- to medium-term, the target market is that of LDCs. The findings clearly show that: (i) Jordan enjoys a marked RCA in pharmaceutical *exports* to LDCs, exceeding indeed all major competitors and suggesting a *potential* for future growth[39]; (ii) Jordan's export *position* in the world pharmaceutical industry is *modest* with a market share of less than 1 %; and (iii) Jordan export *growth* in pharmaceuticals, normalised by world growth, is *deteriorating* during the period 1986-96, a trend that shared by many of its large Western competitors, with the exception of Switzerland.

Table 7.16
Global Comparative Advantage Indicators in Pharmaceuticals (1986-96)

	Average World Market Share	Average Annual Growth in World Market Share	Average RCA
Jordan	0.6	-2.4	8.8
United States	8.5	-0.4	0.5
German (F. Republic)	9.1	-0.8	1.6
Switzerland	10.7	1.3	7.5
United Kingdom	11.4	-1.1	3.6
France	16.9	-3.2	4.6

NOTE: world market share is the value of pharmaceutical exports (SITC=5417) in a country to total pharmaceutical imports of LDCs, averaged over the period 1986-96. Growth rate in world market share is calculated using the least square method over the period 1986-96. RCA is measured by the ratio of a country's world market share in pharmaceuticals to the world market share of its total manufactured exports (see Chapter 4), averaged over 1986-96.

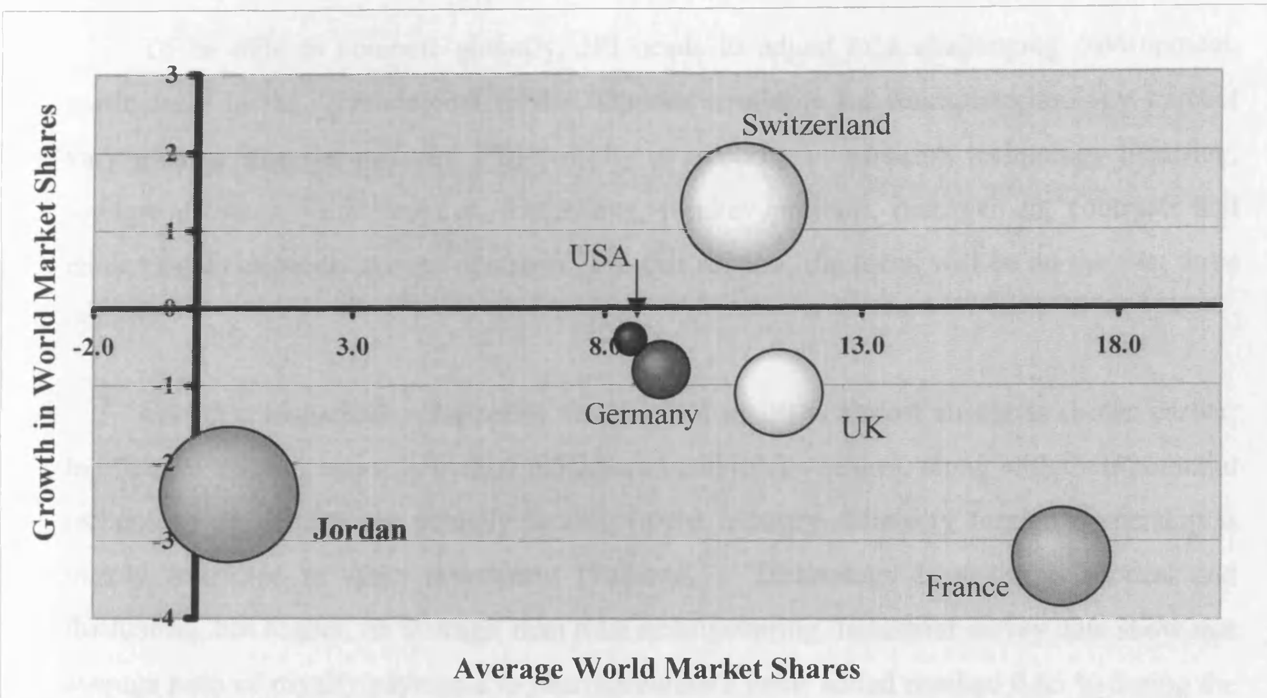
SOURCE: Researcher's computations based on **TradeCAN** Database and Software (ECLAC and World Bank, 2000).

[38] In competitiveness policy analysis, the two core questions are: 'what is our target market?' and 'who are our competitors?'. Regarding the first question, the 'world' in this context consists of LDCs. The Software used in analysis (TradeCAN) also requires such a plausible definition.

[39] According to Bowen (1983), the traditional way of calculating RCA is perhaps misapplied in the literature "since only exports are typically considered whereas comparative advantage is properly a net trade concept" (p. 464). Thus taking imports into account could affect the qualitative conclusion.

Figure 7.6

Global Comparative Advantage Indicators in Pharmaceuticals (1986-96)



NOTE: The size of the circle indicates the value of average RCA. For definitions of average and growth in world market shares, see the note of Table (7.16).

SOURCE: Researcher, based on Table (7.16).

Taking a micro perspective, firm-level census data show that Jordanian pharmaceutical firms vary considerably in their export orientation (Table 7.17); export intensity of firms varies between 0 and 83 % of total sales in 1994. Six companies, or about 40 % of total number of firms, are totally inward-oriented. The 1994 weighted average for export intensity equals 64 % compared with 42 % for the simple average. Correlation coefficient confirms the positive (0.50) association between firm size, as measured by total sales, and export intensity.

Table 7.17

Jordan: Export Intensity Distribution of Pharmaceutical Firms (1994)

Export Intensity Class	No. of Companies
0.0	6
Less than 0.4	0
Less than 0.6	3
Less than 0.8	5
Less than 1.0	2
Total	**16**

SOURCE: DOS, Industrial census (1994), firm-level database.

7.7 The Strategic Prospects of JPI to the Technology Challenge

To be able to compete globally, JPI needs to adjust to a challenging environment, particularly in the technological sphere. Options available for foreign technology transfer vary greatly. The list includes: FDI (wholly or majority ownership), technology licensing, foreign alliances, joint ventures, franchising, turnkey projects, management contracts and marketing & technical service contracts[40]. In this section, the focus will be on the first three options.

Taking a **historical perspective**, inward FDI in JPI is almost absent as shown earlier. In effect, wholly or majority owned subsidiaries and joint ventures, along with their potential technology spillovers, are actually lacking in the industry. Minority foreign ownership is mainly restricted to Arab investment (Table 7.3). Technology licensing is modest and fluctuating, but higher, on average, than total manufacturing. Industrial survey data show that average ratio of royalty payments to pharmaceutical's value added reached 0.66 % during the period 1990-98 in comparison with 0.35 % for total manufacturing.

As for foreign alliances[41], this form of technology transfer is basically new to the industry. In fact, inter-firm cooperation among *domestic* firms has only recently initiated with the establishment of the Jordanian Association of Manufacturers of Pharmaceuticals & Medical Appliances (JAPM) in 1996.

As for **future outlook**, the stringent and early enforcement of patent protection in Jordan could promote inward FDI in JPI vis-à-vis neighbouring countries, aided with: (i) expanding market size arising from the Jordan-US free trade agreement as well as the European Partnership[42]; and (ii) the availability and low cost of skilled labour, particularly in view of the growing importance of low-cost strategy in global pharmaceutical industry. Egypt is likely to be the strongest regional competitor in this field. In general, the overall FDI impact of introducing TRIPs is expected to be modest, at least in the short term, in view of the strong competition from other countries' investment regimes. Thus, a superior business environment, including a favourable price incentive, is an essential condition to offset the

[40] See UNCTC (1987).

[41] The term 'alliance' is defined by the EC (1994a) as any form of company cooperation, involving equity investment or not, designed to defend or improve the competitive advantage of participating firms. Thus, joint ventures can be classified as a type of alliances or a form of FDI.

[42] While many Mediterranean countries share with Jordan the European Partnership, Jordan is the only Arab country that concluded with the USA a free trade agreement.

initial disadvantages (a small *domestic* market plus higher LCs). UNCTAD (1997a) has summarised other cluster-related requirements for FDI promotion in HTIs:

> "*[W]ith a high-technology investment project, the investor may be swayed not only by the existence of a pool of highly skilled workers with specific types of training, but also by the existence of supplier industries producing speciality parts, components and other related materials and products, and of R&D facilities and even a technology park. Geographical proximity to main export markets may also be a factor*" (p.21).

On the other hand, while strict patent protection would probably promote technology licensing, particularly in 'large' firms, it is likely to have little impact on internal R&D[43], due partially to limited scale and resources of Jordanian pharmaceutical firms. After paying for royalties, the remaining limited resources would be invested in R&D just to adequately assimilate foreign technology rather than to discover new drugs[44].

Finally, alliances between domestic and foreign firms are expected to attract the attention of medium and large local firms as a potential option to ease the technological constraint. The complementarities between the Jordanian firm and its foreign partner, if any, could lessen the difficulties arising from size asymmetries (see Kesteloot and Veugelers, 1997). The foreign alliance might find in the marketing capabilities of domestic firms a valuable asset in penetrating regional markets.

7.8 Conclusions and Policy Recommendations

The pharmaceutical industry in Jordan is an example of a small and dynamic activity taking advantage of technology imitation and regional export opportunities. Its strengths are: a relatively high profitability, low LCs (in comparison with Western competitors), and a marked RCA (based on exports). This superior performance has been achieved with minimum tariff protection and inter-firm cooperation as well as strict price regulation. The weaknesses that make the industry vulnerable to external shocks are: **(i)** geographical concentration of exports coupled with high import penetration; during 1995-99, an average of

[43] See Scherer and Weisburst (1995); ESCWA (1998); Sequeira (1998). Scherer and Weisburst (1995), in their empirical investigation of the case of Italian pharmaceutical industry, reached the same conclusion, but they explain their finding by suggesting that tight price controls could have inhibited Italian firms from adopting a marked shift from imitation to innovation strategy. However, they expressed their belief that "factors that inhibited dramatic changes in the Italian environment are likely to operate even more strongly in the [less-developed] nations" (p.1024).

[44] Cohen and Levinthal (1989) argue that R&D has two faces: to generate innovations and to develop the firm's "ability to identify, assimilate, and exploit knowledge from the environment- what...[they] call a firm's 'learning' or 'absorptive' capacity" (p. 569).

71 % of JPI's exports are imported by Iraq, Saudi Arabia and Algeria[45]; **(ii)** modest scale, learning and agglomeration economies; and **(iii)** a weak research base. This contrast between the strengths and weaknesses of JPI can explain the coexistence of a high *average* performance in the industry along with a high *intertemporal variation* in performance, as assessed by multiple CATs. This contrast also signals a possible threat to the future health of the industry, with the acceleration of global business and technological challenges.

In the past, the JPI through high entry and imitation was capable of enhancing dynamic efficiency (via new product diffusion) without imposing any structural barrier on domestic competition arising from high R&D or patent protection. In a 'post-TRIPs' world, this strategy is not feasible. It is often argued that technology is not perfectly mobile across national boundaries due to asymmetric technological capabilities and infrastructure (see, Hart and Prakash, 1999; World Bank, 2000a). In a post-TRIPs world, state-of-the-art technology is certainly a costly resource. Unauthorised imitation will become illegal for patented products, leading to monopolisation of the innovator in the early stage of the product life cycle.

Considering the three general competitive strategies of cost leadership, differentiation and focus (see Porter, 1980) available to the JPI, it is concluded:

- With respect to the differentiation option, the small size of both the firm and its domestic market, *inter alia*, had historically the effect of diminishing the resources and incentive for R&D[46]. In terms of *domestic* standards, Jordanian pharmaceutical firms vary considerably in terms of size and resources; the large-scale sector consists of just four enterprises that have a minimum employment of 250 workers, while most firms are classified within the small-scale sector with its own characteristics (see Chapter 6). By international standards, however, both sectors suffer from size disadvantage in the face of high cost of product innovation, R&D indivisibilities and the existence of substantial economies of scale in innovation and marketing (Burstall and Senior, 1985). Thus, in-house R&D in JPI in the coming era is likely to be confined to: (i) enhancing absorptive capacity of firms to assimilate foreign technology; and (ii) developing modest new mixtures of known materials or new dosage forms.

[45] Source: DOS external trade database, http://www.dos.gov.jo.

[46] According to Lyons and Matraves (1996), "[a] key determinant of how much firms will wish to spend [on R&D] is the size of the market over which the increased consumer willingness to pay can be reaped" (p.96). See also Vanhoudt (1999).

Jordanian firms may seek cooperation with foreign firms through technology licensing and strategic alliances. In a post-TRIPs world, though large firms could engage in various modes of technology transfer and thus operate in the patented drugs segment, small Jordanian firms can primarily focus on making standard generics with limited modifications. In both cases, profitability and/or price competitiveness will suffer, at least in the transition period. The small firms have certain survival strategies, of which market niches, mergers and inter-firm cooperation (e.g. establishing exporting consortium) are the most probable. Mergers might be necessary to achieve economies of scale in the generics market where product differentiation and domestic niches are limited.

- Furthermore, wage competitiveness enjoyed by JPI, although critical in the early stages of the industry evolution, is probably not *a sustainable* strategy in the global generic market in the long-run. This is due to the following reasons: **(i)** currently, LCs in the JPI comprise a small proportion of total production costs; **(ii)** foreign firms might surpass Jordanian counterparts in terms of *other important cost drivers*; and **(iii)** multinationals can currently target low-wage economies in their locational decisions to achieve wage competitiveness.

Based on the Chapter's findings and conclusions, one can draw out the following policy implications:

- In view of size, age and limited technological capabilities of Jordan's pharmaceutical firms, it is extremely difficult for the JPI to catch-up with multinationals in their competitive weapon. Thus, a *global* niches strategy coupled with a *broad-based* cost leadership, in both generic and OTC markets, would be essential elements in an overall competitive strategy for JPI. Previous strategy based on *regional* niches and *low-wage* production appears vulnerable. Consistent with this view, Fiegenbaum and Karnani (1991) suggest that:

> "*It is generally accepted that small firms should seek market niches. A viable niche should be big enough for the small firm, and unattractive to large firms, thus enabling the small firm to utilize its limited resources and avoid head-on competition with the large companies. A niche can be defined along any of the three dimensions: product, customer, and technology*" (p. 102).

Moreover, although Taggart (1993) admits the possibility of adopting a mixed strategy by many world pharmaceutical companies, he proposes that:

> *"Certain generic-based companies could be classified in the general arena of cost leadership, while firms with market-leading drugs are able to command premium prices and so adopt a differentiation approach"* (p. 153).

- The proposed strategy does not preclude the importance of improving technological capabilities in JPI. **First**, the industry needs to adopt best practices in manufacturing and marketing to improve productivity and negative quality in producing generic and OTC products as well as to assimilate *new* product developments (through, for example, technology licensing). **Second**, process innovation is an imperative for the low-cost strategy, in view of the increasing global competition in the generic and OTC markets. **Finally**, JPI might need to be an innovator *(first-mover)* in certain *priority* fields. For example, Jordanian manufacturing firms could specialise in certain areas related to LDCs' diseases, which are mostly ignored by Western companies. In such a niche market, the local firms could easily face competition from other LDCs (e.g. India).

- As far as trade policy for JPI is concerned, a liberal trade policy seems desirable for reducing the threat of domestic monopoly power in the industry (see Jacquemin and Sapir, 1993). Furthermore, a stringent technology protection can offer long-term opportunities for the industry. But to minimise the adjustment costs facing this 'strategic' industry, the above measures can be supplemented with a transparent and coherent *horizontal* industrial policy for upgrading the pharmaceutical cluster and enhancing its static efficiency and technological capabilities. This is particularly true to counterbalance the size and age disadvantages of Jordanian firms as well as limited external economies.

Within such an industry-specific industrial policy, it might be necessary to reconsider the current pricing and tariff policy in pharmaceuticals in order to improve the incentive structure facing both domestic and foreign firms, with a view to promote domestic and foreign investment. In view of the high propensity to export by domestic firms and the lack of patented drugs invented by these firms, the price controls policy loses two of its strongest arguments (i.e. containing government health expenditures and patent-driven monopoly). One possible policy option is to allow prices to float within specific margins. Other potential areas of improvement include intra-industry and industry-university-government joint research (MOP, 1999) as well as industrial policy towards R&D, technology licensing and government procurement.

- At the methodological sphere, two lessons are learned:

1. This Chapter confirms the basic premise that, in competitiveness policy analysis, cross-section econometric modelling (Chapter 5), although revealing, is not a substitute for a careful case study (Davies and Caves, 1987). The case study can provide in-depth information that reveals industry idiosyncrasy.

2. Since LDCs are mainly users rather than producers of technology, they typically lack substantial R&D and patent activities and statistics. But R&D is not the only relevant input to the process of technical change (Lundvall, 1992b); indicators of technology transfer are particularly relevant in LDCs in a post-TRIPs world. Examples of such diffusion indicators are licensing payments, technology transfer agreements, joint ventures, inward FDI, and imports of high-technology capital goods. Financial incentives should support such diffusion arrangements, not just pure R&D (see UNCTAD and CSTD, 1999).

CHAPTER EIGHT

Main Findings, Policy Implications and Agenda For Future Research

The main objective of this Thesis is to explore *micro*foundations of global competitiveness in the Jordanian manufacturing industries (JMIs). It aims also to function as an input in informing debate over the future direction of Jordanian industrial competitiveness policy. Utilising a unique and large microdata set, extracted from the 1994 Industrial Census, as well as industry-level time-series data, the study examines the impact of selected cost and benefit drivers, namely *technical efficiency(TE), scale efficiency* and *technology*, on the competitive position of the JMIs. The Thesis utilises various research designs; an inter-industry design for TE, an inter-firm design for scale efficiency, and a case study for high-technology in Jordan. In addition, the Thesis puts forward a review chapter on the economics of global competitiveness and a survey chapter on the measurement and interpretation of manufacturing performance.

Due to the typical limitations of cross-section data and the inherent nature of economic research, the study's findings and policy recommendations can only be viewed as preliminary.

8.1 Main Findings, Conclusions and Policy Implications

8.1.1 CHAPTER-SPECIFIC:

Chapter (5): Technical Efficiency in JMIs

1. One of the potentially significant cost drivers in LDCs is the percentage of firms (of all sizes) that operates at best practice frontiers, i.e., average TE. This competitiveness driver is related to costs of over-manning, excess overhead costs and defected output.
2. Based on a sample of 35 manufacturing industries (representing 61 % of the 1994 manufacturing employment) and using the stochastic frontier production function

approach, JMIs achieved, on average, about 60 % of their potential output[1]. Notwithstanding research comparability, this finding is close to the lower limit reported in previous research (with a range of 50-80 %)[2], reflecting the importance of 'fat' trimming in Jordan's manufacturing enterprises. Producer concentration (unadjusted for foreign trade) is found to be *negatively* related to TE in a significant and robust manner and in a linear relation (using both HHI and CR4). It is also significant but imperfectly robust in a quadratic link (using CR4 only). Entry has a positive but weakly significant coefficient (10 % level).

3. Utilising a flexible truncated-normal distribution, the study managed to explain about two-thirds of the variation in inter-industry TE performance, with producer concentration and export intensity being the most significant and robust predictors. The last finding is broadly consistent with previous international research and Speight's remark that "[o]f all the compulsions and inducements to efficiency, the most effective and pervasive is competition" (1970: 231). It appears that domestic competition is an important 'stick' for maintaining cost discipline of firms (Comanor and Leibenstein, 1969) in JMIs. Moreover, even if scale economies proved to be a strong cost driver in many JMIs, competition is still needed since it is the chief mechanism through which efficiency gains are passed on to domestic consumers and global price competitiveness (EC, 1997b).
4. Based on the research's tentative empirical findings of TE determinants, the pro-competition effect of imports in JMIs appears to be insignificant in 1994, probably indicating that existing manufacturing firms (of all sizes) were somehow 'sheltered' from import discipline. This result, not inconsistent with most previous international research (see CA, 1992), can be explained by: (i) the existence of tariff and non-tariff barriers (e.g. import licensing); (ii) differences in product quality and variety between local and imported products, each of which has its own market niches; (iii) a statistical artefact resulting from data aggregation; and (iv) the monopoly power of importing firms (see Chapter 5) and the irregularity of imports flows. Furthermore, the finding confirms Porter's (1990) view that domestic competition is qualitatively different from competition with foreign firms. Clearly, more research in industrial economics is needed on the optimal mix of domestic and global competition as fat-trimming mechanisms (Scherer, 1995).

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[1] See **Appendix (2)** on possible reasons for downwards estimation bias in the level of technical efficiency.
[2] See Torii (1992).

5. The researcher came reluctantly to the conclusion that SFA can be usefully applied in a mechanical way to large numbers of manufacturing industries in small LDCs. In general, the SFA research design is costly in resources for LDCs; a cheaper design is *dispersion* of LP levels in well-defined industries (see Caves, 1992a)[3]. This study highlights the important impact of prudent outliers management, truncation point of firm-size distribution, and flexible inefficiency error distribution on improving the convergence success rate and the reliability of TE estimates in the context of noisy data and highly skewed firm-size distribution.
6. Based on 1994 evidence, as well as robust international evidence, it appears that a competition law and policy is needed in JMIs to alleviate organisational slack. But it is important to emphasise that in a small economy such as Jordan, there can be a significant trade-off between TE and allocative efficiency on one hand and scale and dynamic efficiency on the other hand, especially in industries enjoying substantial scale economies in production and innovation. Nevertheless, there is some evidence to suggest that *high* levels of concentration are detrimental to TE *and* not 'warranted' by technical scale economies (Chapters 5 and 6). Overall, it seems that emphasising a *rule of reason* approach in the implementation of Jordan's competition law, based on industry idiosyncrasy, can be more conducive to overall manufacturing efficiency.
7. Furthermore, in a small open economy, such as Jordan, both competition and scale considerations can be simultaneously facilitated in the context of an outward oriented growth strategy. A policy framework aiming at liberalising trade and integrating with regional blocks can support both enlarging numbers and average size of firms, thus alleviating the so-called anti-trust dilemma. But if the efficiency gains of such a policy are to be realised, the exports potential of SMEs should be fulfilled, and pro-competition measures in the distribution sector should complement the import liberalisation programme.

Chapter (6): Firm Size and Performance in JMIs

1. Scale economies, broadly defined, are potentially a crucial cost driver and quality ladder in LDCs. This is particularly true in the case of: (i) small LDCs (such as Jordan) lacking entrepreneur innovation and inter-firm cooperation, where minimum efficient scale is large relative to market size; and (ii) many high-technology industries (such as pharmaceuticals). Micro- and small-sized enterprises in small LDCs, with a

[3] This method, with lower data requirements, is utilised by Hart and Shipman (1991, 1992) but only at the measurement stage. The work of CA (1992) encloses two studies that utilised this method at both the measurement and explanation stages.

substantially lower 'smallness' threshold, own severely limited *internal* resources necessarily to cover the -largely fixed- costs of technology transfer and development, quality assurance and export activities, coupled with insufficient *external* resources and inter-firm cooperation. While many industrial economists have partially lost their belief in the significance of scale economies in *industrial countries* (Geroski, 1989), modern international economics in its 'new' trade theories, surprisingly, is stressing its importance (see Helleiner, 1992). The same applies to 'new' growth theories.

2. Broadly consistent with certain major studies undertaken in other *small* economies (GR, 1971; Baldwin and Goreki, 1986), and contrary to the generalisation stated by Tybout (2000) regarding the importance of scale economies in LDCs, internal technical scale economies in JMIs appear statistically significant and economically large in more than half of industries. Utilising a two-input CD production function, the empirical findings show that scale economies in production exist in 44 out of 51 JMIs (Table 6.8, Chapter 6) and significantly so in 29 cases. The simple average for scale elasticity in the 29 increasing-returns industries equals 1.28. Thus, it appears that a small majority of JMIs is characterised by a significant increasing RTS technology, but with a noticeable size disadvantage for small-scale firms. The above preliminary findings are based on a micro database representing 55% of total number manufacturing firms and 70% of total manufacturing employment in 1994.

3. As a result, technical scale economies seem to be an important element of market structure in JMIs, but the importance of this element varies from industry to industry. Scale elasticity, along with market size and product differentiation, is found to be associated with concentration in a significant relationship. The link between concentration and technical scale economies was found to be quadratic; concentration first *increases* with production scale economies but up to a point, after which the link is negative and the 'anti-trust dilemma' disappears. Interestingly, market size is found to be negatively and significantly correlated with industrial concentration, signalling the importance of enlarging market access for Jordanian firms to endorse both TE (competition) and scale efficiency.

4. After controlling for inter-firm variation in capital intensity and industry effects, the findings clearly report a positive and significant association between firm size (utilising four different measures of size), and labour productivity LP (using two different measures of LP). The quadratic term for firm size is significant in most cases, but the optimal level seems quite high in relation to the typical observed size distribution.

5. The investigation failed to reveal a robust and systematic pattern between firm size (using four different measures) and ULCs (an important measure for cost

competitiveness), a finding that has support from recent research (Audretsch et al., 2001 and references cited therein). It appears to be the case that larger firms (with superior labour productivity performance) have higher labour remuneration. The absence of ULCs disadvantage for small firms in JMIs, however, seems to be insufficient condition for small enterprises to globalise their activities.

6. The Tobit and OLS estimators clearly report a positive and significant relationship between firm size (using four different measures) and export performance (as measured by export intensity) in Jordan's manufacturing sector in 1994. The negative quadratic term for the size variable is also significant but the maximum size appears high. Small manufacturing firms in Jordan, as time series evidence confirms (Chapter 2), are obviously inward-oriented and appear incapable of exploiting new exports opportunities of globalisation. This unfavourable performance persists *despite* measures taken to promote manufacturing exports, including the elimination of anti-export bias in the trade regime since 1989 and the devaluation of the Jordanian Dinar in 1988/89.
7. Using multiple competitiveness analytical tools (CATs), the empirical findings of Chapter (6) have showed that, to a large extent, small is *not* beautiful in JMIs as far as GC is concerned. However, this is not to say that SMEs are *inherently* uncompetitive. SMEs in general do have their own *qualitative* core competences, such as flexibility (e.g. occupying niches and lower sunk costs), lower labour costs, and product customisation. What is worrying about these core competences, however, is that most of these competitive weapons are applicable only in the domestic market. Thus, rational government interventions could improve the situation.
8. Due to the apparent emphasis that Jordanian economic and social plans put on achieving higher growth of real income, it is plausible to assess SMEs in JMIs in terms of *efficiency*. Consequently, of the three distinct types of policy towards small industry, the passive, protective and the developmental (see Staley and Morse, 1965), the developmental approach seems the most recommended. The developmental approach "seeks to increase the productive efficiency of small industry, thus making it more viable" (ibid: 318). While adopting a passive policy means neglecting at least 95 % of total manufacturing enterprises in JMIs, a protective approach can reward smallness and hinder the creation of competitive viable enterprises capable of survival and growth without perpetual subsidy.

Based on the developmental approach, it is recommended to establish an Enterprises and Entrepreneurs Development Programme (EEDP) in Jordan that aims at promoting competitiveness of SMEs, taking an integrated cluster approach. The current fragmented approach, focusing on single-factor perspective to SMEs competitiveness, is likely to be ineffective and potentially wasteful (ibid; World Bank, 1997). Such a proposed programme would preferably move away from subsidy based assistance towards real service provision, with the aim of facilitating the exploitation of external economies of scale (Oughton and Whittam, 1997). Examples of such services are: consulting, training, technology and quality upgrading, marketing, management and finance. The ultimate aim of this programme would be to ease size disadvantage of smaller firms through providing cost-effective *external real resources*. In the words of Staley and Morse (1965: 426):

> *"[T]he provision of efficiency-increasing services for small industrial enterprises from **outside** the firm substitutes in some respects for services which are available to large industrial enterprises from **inside** the firm. Thus, some of the **economies of scale** which large firms achieve by their size may be achieved, with assistance, by small firms collectively".*

In such a proposed programme, hitherto fragmented responsibilities for SMEs in Jordan could be consolidated into just one single agency providing coordinated and integrated incentives and services. Furthermore, to enhance programme efficiency and sustainability, there could be initially a *floor* or minimum size (e.g. less than 4 workers) that excludes microenterprises. This floor is recommended to be in terms of employment (see Chapter 6). The exclusion of microenterprises is based on an established stylised fact that confirms the positive relationship between firm size and likelihood of survival (Audretsch et al., 2001). Faini et al. (1992: 70) confirm this point:

> *"While efficiency does not always grow in direct proportion to size, it is clear that very small firms may not be able to develop the technical structures, marketing organization and so on that are required to survive and, **a fortiori**, to prosper".*

In view of the severe weakness of SMEs in exports, the programme could give special attention to global marketing capabilities and infrastructure. According to Chee and Harris (1998: 284):

> *"The small firm may have limited choice, and will have to adopt an indirect exporting mode of entry in many cases. However, this is not a permanent constraint, the development of specialist international services such as freight forwarding, marketing agencies, etc. in combination with developments in logistics management and IT, have all facilitated international expansion by smaller companies".*

Chapter (7): Jordanian Pharmaceutical Industry

1. Upgrading products, processes and organisational forms are significant benefit and cost drivers in JMIs, which can be utilised through technology transfer and development. Due to Jordan's cost disadvantage in terms of LCs and scale economies compared with many low-income and larger (developing and transition) economies, such as Egypt, India and China, Jordan should be ahead of these countries on the basis of technological capabilities, if JMIs are to be able to compete globally.
2. Based on microdata for 1994 profitability, and in view of the high intertemporal variability of profits in JPI, it seems that a portion of Jordanian firms are vulnerable to the introduction of patent protection. The vulnerability scope and intensity will depend on: (i) royalty rate actually paid by Jordanian firms; and (ii) firm's dependence on in-patent drugs in generating its profits.
3. Despite superior *average* performance, in terms of exports, profitability and ULCs, both over time and across firms, the JPI can be considered as a sensitive or vulnerable industry in the face of new technological and marketing challenges. These concerns are due to: **First**, the lack of a diversified portfolio of export markets coupled with risks imposed by political barriers of traditional regional markets. Market niches are no longer protected from international competition (UNCTAD, 2000c). **Second**, a recognition that cost competitiveness enjoyed by the industry, due to low wage levels, is imitable and therefore not sustainable. **Third**, problems causes by the new costs of differentiation imposed by the recent introduction of TRIPs Agreement in Jordan. **Finally**, the fact that the industry suffers from weak external economies as well as size and learning disadvantages vis-à-vis world major competitors.
4. Taking into account that total annual sales of the JPI as a whole did not exceed JD 135 million (or US$ 190 million) during the last five years, well below the level necessary to develop just *one* new drug, the real challenge to JPI is not to become a research-based industry, but to acquire and absorb foreign appropriate technology in order to face the new competition.
5. Two opposing views govern the current attitude towards firm size in HTMIs. The first view reaffirms the role of scale in financing the high and rising fixed costs of R&D and achieving economies of scale in innovation and marketing. The second view finds in talent-based innovation and inter-firm cooperation an effective alternative for the internal resources of large firms. According to UNCTAD (1996c: x):

"[I]n contrast to traditional assumptions of the importance of firm size for R&D, the minimum size of the "system" needed to acquire the knowledge becomes relevant, rather than the size of the firm itself".

In view of indivisibilities of R&D and high transaction costs of cooperation in LDCs, it is unrealistic to assume that the advantages of large firms can be wholly achieved via inter-firm cooperation. A more robust solution is to combine the corporate model, the Silicon Valley model and the two-stage model (see Chapter 7) in achieving technological development in Jordan. For example, while larger pharmaceutical firms in JPI are more capable of technology licensing and exports, it is suggested to establish an exporting consortium for SMEs in JPI to facilitate the targeting and penetration of global markets.

6. A transparent and coherent horizontal industrial policy for upgrading the business environment (the cluster) and enhancing technological capabilities in JPI seems necessary. Better external economies should offset scale and learning disadvantages, and reinforce potential comparative advantage. Furthermore, a *global* niches strategy coupled with a *broad-based* cost leadership would be essential elements in an overall competitive strategy for JPI.

7. Since even the largest pharmaceutical firms in JPI could not be self-sufficient in terms of technology, foreign technology acquisition is an important element in achieving technical progress and competitiveness. Indeed, Lee et al. (1988) identify three main stages for technological development in LDCs: first, the technology *imitation* stage; second, the technology *internalisation* stage and, finally, the technology *generation* stage. Currently, Jordan's technology policy framework seeks to endorse technological change through promoting R&D and FDI (see Chapter 2), with emphasis on technology generation. But industrial modernisation, as defined by Antonelli et al. (1992), embodies more than just innovation. It involves further emphasis on imitation and diffusion of new techniques. This is actually the core of industrial modernisation in LDCs in the early stages of technological development. Thus, government policy instruments (e.g. laws and fiscal incentives) should give more priority to the dimension of technological diffusion, via promoting: (i) foreign and domestic technology transfer, including technology licensing; (ii) inter-firm technical cooperation; (iii) specialised overseas training in both corporate and government sectors; and (iv) contracts to young foreign experts as well as to foreign consultants in priority areas. This could entail

changes in the Companies Law and Tax Law, among others, as well as new policy directions and legal instruments.

8.1.2 GENERAL FINDINGS AND POLICY RECOMMENDATIONS

1. A main conclusion of Chapters (3) and (4) is that industrial competitiveness has no single cause, and there exists no unique and optimal criterion for assessing competitiveness performance. The concept of competitiveness has both emotive and objective content, and competitiveness strategy in small LDCs is a worthwhile research topic.
2. Although trade liberalisation and RIAs seem to offer JMIs substantial *potential* efficiency benefits, as revealed by the estimated scale elasticities and average TE scores (Chapters 5 and 6), the gains from scale and competition effects are *not* automatic (see World Bank, 2000b) and appear to require *strong* policy measures. **First**, to exploit potential scale efficiency gains in JMIs, SMEs should be able not only to survive, but also to grow through serious exporting. Chapter (6) seems to offer tentative opposing evidence to the survival-ability of small enterprises in JMIs. Furthermore, it seems questionable whether removing anti-export bias in the trade regime as well as tariff barriers via RIAs are *sufficient* conditions for promoting SMEs exports (see above). Indeed, according to Tybout (2000: 34):

> "*[M]icro panel studies consistently find that increases in import penetration are associated with* ***reductions*** *in plant size...Thus liberalization may work* ***against*** *scale efficiency, at least in the short run*".

According to this view, the small initial firm size in increasing-returns industries represents a competitive *dis*advantage, rather than reflecting an opportunity for reaping potential scale economies in RIAs (EC, 1997e). **Second**, to benefit from import competition effect in enhancing TE, monopoly power in the wholesale sector should be controlled and local producers should upgrade their product quality. **Third**, as previous research consistently indicates (Chapter 3), the competition effect of export rivalry (learning-by-exporting) seems weak in developed *and* developing countries (Bleaney et al., 2000). All of the above conclusions confirm the broad hypothesis that trade liberalisation *per se* is not a *sufficient* condition for industrial development and competitiveness in Jordan.

3. A crucial issue in Jordan's competitiveness agenda is whether the global business strategy of JMIs should emphasis cost-driven strategy or benefit-driven strategy, taking into account that low-cost strategy is unsustainable in the long term (Chapters 4 and 7). It can be argued that, as a general rule, JMIs should avoid competing with industrial countries based on their strongest competitive weapon; quality based on high-technology. This is particularly true after the global enforcement of patent protection. But this rule does not mean that Jordan can ignore benefit drivers (technology and quality) altogether in its competitive strategy. Indeed, technology has two-fold role in this context: (i) achieving minimum *product* quality necessary for Western markets access via satisfying their technical regulation, and creating differentiation advantage in other markets; and (ii) reinforcing initial cost advantage through *process* innovations. Combining foreign and local technological elements in achieving this potential role of technology in LDCs is a crucial issue (see Dahlman et al., 1985).

Consequently, the researcher suggests that a *mixed strategy* based on low-cost (low-wage and technically-efficient) production, minimum quality and global market niches can offer better chances for Jordan's industrialisation. The weakness of such a strategy is that it can be imitated by other LDCs with technological capabilities, suggesting the need for a *unique* combination based on Jordan's distinctive assets, industry idiosyncrasy and characteristics of the target market.

4. To facilitate competitiveness research in JMIs, it is strongly recommended to enlarge the coverage of annual industrial surveys, conducted by the Department of Statistics, to include competitiveness-related data. Important statistics include: training expenditures and labour turnover; educational attributes of employees and managers; R&D expenditures; patents and acquisition of foreign technology (via licensing agreements or technical cooperation); introduction of new embodied technology over the last three years; quality control systems and ISO certification; the utilisation of robots and information technology; indicators on marketing skills; vintage (age) of machinery; capacity utilisation; capital stock at replacement cost; inter-firm linkages; and perception towards the efficiency of government institutions. This proposal could be undertaken only for large firms (e.g. firms larger than 19 workers). Thus, to ensure effective implementation, the questionnaire of large firms can be separated from that of smaller firms.

5. This Thesis ends with an unconventional view. Economic and social complexity is recently seen as the root for many symptoms and malfunction of the economic system. While empiricism seeks to reduce complexity via analytical competence, this answer constitutes just one remedy out of three possible solutions (Moran, 1984); more technical rationality, more competition and more human trust. The problem with full dependence on more technical rationality (i.e., explanation, prediction and control of the economic system) is that it is constrained by bounded rationality and intellectual complexity. For example, it is difficult *in practice* to separate technical efficiency from scale efficiency or the technical element of scale economies from the pecuniary one (EC, 1997c). In the words of Dryzek (1983: 359):

> *"The poor state of theoretical understanding in the social sciences is often bemoaned. The positivist programme of a body of verified (or non-falsified) and generally accepted theory which would then serve as a basis for policy interventions has made little progress".*

Indeed, in pursuit of competitiveness, trust has many functions stemming primarily from *lowering transaction costs* of economic transactions, cooperation and contracts. **First**, trust contributes to TE and quality. Because TE is concerned with avoiding waste and reaching potential output, it is partly related to the achievement motivation of many economic actors; the worker, the corporate manger, the shareholder, the supplier, the government agency, to name but few. To trust all these actors to put forth their best efforts would save resources. **Second**, trust contributes to an enabling environment for inter-firm cooperation, in technical and other fields, particularly in SMEs sector. In brief, *social capital* matters in upgrading industrial competitiveness in small LDCs.

8.2 Agenda for Future Research

- To test the robustness of our cross-sectional TE findings, future research can replicate the SFA study (Chapter 5) taking a different year or using panel data. Moreover, to examine the robustness of scale elasticity estimates (Chapter 6), further research on scale economies may be undertaken using the same methodology but in a different year (as done by Ringstad, 1978), or adopting different specifications (e.g. using the TL or three-input production function) or data (panel data). The aim is to mitigate the potentially restrictive features of the cross-section data and the two-input CD function.

- To take into account capital productivity in examining scale efficiency in *ad hoc* modelling, a possible future research is exploring the link between firm size and TFP at the firm level. This is particularly important in view of the moderate share of labour compensation in the value added of JMIs (about 30 %). A variant of this research is examining the relationship between firm size and firm-specific TE using SFA and a one-stage model (e.g. Lundvall and Battese, 2000).
- Estimating the productivity gap in an important sub-sector (e.g. the pharmaceutical industry), between Jordan and one of its major competitors. The role of scale effect in explaining the gap size would be a further area for fruitful research (as undertaken by Baldwin and Gorecki, 1986).
- Modelling the trade-off between two important types of static efficiency, namely TE and scale efficiency, and investigating whether there is a 'critical' or 'optimum' level of industrial concentration that maximises both types of efficiency (e.g. Dickson and He, 1997) in JMIs in general, or in certain industries.
- In view of the recent focus on horizontal competitiveness policies in enhancing national competitiveness, one potentially fruitful endeavour is the benchmarking Jordan's business environment with regional partners, trade competitors and other advanced small economies, as done by OECD (1997b).
- Carrying out an *ex post* assessment surveys to investigate the impact of trade liberalisation policies, regional integration agreements and TRIPs Agreement on the strategies and operations of Jordanian manufacturing firms in general as well as on high-technology firms in particular.
- Undertaking an industry case study in knowledge-based services in Jordan (e.g. the IT sector or more specifically the software industry), with special emphasis on industrial linkages and forms of foreign technology transfer and cooperation.
- Investigating the role of non-price factors on the global competitiveness of JMIs. More specifically, an interesting research problem is assessing the impact of quality certification and technology licensing on the competitive performance (TE, ULCs and CA) of Jordanian manufacturing firms.

APPENDIX (1)

Basic Facts and Preparation of the 1994 Manufacturing Firms Data Set

Basic Facts

The data used in this research represent a large and unique firm-level sample, extracted from the 1994 Industrial Census undertaken by the Department of Statistics (DOS)[1]. The Census, as well as the sample, covers *all* manufacturing enterprises in Jordan in 1994, including single-person enterprises.

The sample consists of 51 manufacturing industries and about 8400 firms, out of total 60 manufacturing industries covering some 12350 manufacturing firms in 1994; a share of 68 % of the total number of firms. The Census sample covers 73 % of total manufacturing employment in 1994. The firms are classified according to the second revision of United Nations ISIC classification. Sample size for the individual industry ranges between 10 and about 1300 firms, but 45 % of industries have a sample size below 30 observations (firms).

The study sample excludes mining & quarrying and electricity industries, often covered in the Industrial Census. It also excludes 12 manufacturing industries (see the Table below) primarily because of analytical and confidentiality reasons (small number of observations or firms), or because of limited computational capability (very large number of firms for two 'non-strategic' industries). It is noteworthy that excluded firms are situated in the two extreme sides of firm-size distribution (of total manufacturing); those with high monopolistic characteristics and those with perfect competition features. Consequently, and owing to the fact that firm-size distribution of our sample is truncated from below and above, the so-called truncated sampling problem is expected to have no noticeable effect on the research findings.

[1] The data set was accessed under strict conditions of confidentiality, including concealing firm's name and address as well as all manufacturing industries with less than ten firms.

A Profile for Excluded Industries

S.N.	Industry's Name	ISIC2 Code	No. of Firms	Employment Size
1	Spirits, Wine & Beer	3131-3133	6	286
2	Tobacco	3140	6	1224
3	Cordage, Rope and Twine	3215	2	41
4	Textiles n. e. c.	3219	9	NA
5	Tanneries and Leather Finishing	3231	3	300
6	Petroleum Refineries	3530	1	3947
7	Pottery, China and Earthenware	3610	9	930
8	Cement, Lime and Plaster	3691-3692	4	2921
9	Non-metallic Mineral Products n. e. c.	3699	1891	9284
10	Structural Metal Products	3813	1994	6282
11	Ship Building & Repairing	3841	4	22
12	Musical Instruments	3902	2	NA

Source: Industrial Census (1994).

Data Coverage and Quality

The *raw* data set covers basic observations on: (i) employees, their number, composition and compensation; (ii) value added and gross output; (iii) cost structure (intermediate consumption of goods and services); and (iv) capital flows and stocks as well as depreciation. Data are also available on geographical distribution of firms, their age and indirect tax. Data on R&D expenditures, royalty payments, hours worked as well as educational and training characteristics of workers are not available. In addition, the database does *not* cover data on inputs/output prices (excluding average wage), capital stock *at replacement cost* and capacity utilisation. Finally, *qualitative* data are not available in the data set.

Overall data quality, as revealed by empirical analysis, is better than expected but not perfect. Missing data are clearly limited. Some variables embody “zeros” data problem. Capital and domestic sales data are good examples but can be partially explained. Number of firms with negative value added equals 74 enterprises. Finally, data on compensation of employees seem to suffer from certain abnormalities; for example about 350 firms recorded an average annual value below JD 360 per worker.

Preparing the Database

Although attracting more attention in recent years (Roberts and Tybout, 1996), analysis of microdata is still relatively uncommon in LDCs, due primarily to confidentiality considerations. This level of disaggregation (compared with industry-level data) involves increasing the number of observations from several dozen to several thousand data points with positive implications on estimation reliability and aggregation bias. Consequently, it is useful to clarify procedures used to prepare the database for analysis, for the benefit of future firm-level research in LDCs.

The original database, for manageability consideration, consists of three large separate (Excel format) files; the main file, the 'capital stock & flow' file and the intermediate consumption of goods and services file. Preparing the database for analysis involves many planned steps, beginning with adding additional raw variables to the main file, to deriving new variables, and finally editing and checking the master file for possible errors in variables through examining both raw data and regression residuals.

First, to build a *master file*, it was necessary to add some necessary variables from the capital and intermediate consumption files to the main file before editing data. Hence, it was necessary to *merge* the three separate files into a unified file. This cannot be done manually because of large missing data in the capital and material files (for example, most small and medium firms do not own residential buildings). As a result, to match the same record in the three files, a facility in SPSS computer software was used. This facility utilises certain *key variables* to identify which records (firms) from the main file match records of other two files. A key variable should exist in all data files. An examination of the validity of the master file was undertaken through checking a sample of complete records.

After building and checking the master file, the second major step was to derive some important variables from the raw data, primarily firm age and a more sound measure of capital. Indeed, 'date of starting operation' variable in the raw data was recorded using the full date format (Year/Month/Day). Moreover, it was defined as string (text) format, not useful for quantitative analysis. To convert the full operation date into age (measured by number of years), the researcher implemented the following steps: (i) a facility available in Excel to convert text into columns was utilised to separate and then delete the month and day data (choosing fixed width option); (ii) then the resultant year data was subtracted from 1994 to calculate age of the firm; and finally (iii) to convert the text format of the age variable into numeric format, a facility available in SPSS to define variable type (format) was employed.

Generally speaking, capital stock data are typically the main data deficiency in efficiency and productivity analysis and this is very true for firm-level research. This weakness is due to many factors related to the coverage, valuation and utilisation of capital. The following is a brief presentation of these data problems:

- Capital stock (in most manufacturing censuses), if available, is measured at historical (book) values whereas it should ideally be valued at replacement (current) cost. Attaining data on capital stock at replacement cost at the firm level is a very resource-intensive statistical task. This applies to both the direct measurement method (special assets census) and the Perpetual Inventory Method (PIM), a technique usually recommended for industry-level studies. The former method requires a longitudinal microdata on gross real investment and depreciation (or, alternatively, on gross investment and scrapped assets).
- Lack of data on *leased* capital, as production possibilities depend on capital available for use regardless of its ownership (Mayes and Green, 1992).
- The absence of data on capital utilisation to estimate *used* capital stock instead of capital *available* to the firm.

In this research, every effort has been made to improve the validity of capital stock data. First, a more appropriate measure of capital stock is derived through excluding furniture and other 'accounting' assets. Second, knowing that leased capital is a productive asset as owned capital calls for an extended measure of capital stock. Following Mayes and Green (1992), a measure of leased capital was calculated and added to values of owned capital. Estimates of leased capital were derived from the expenditures on hiring buildings and machinery using the formula:

$$\mathbf{KR = H / \{ r + (1 / N_1) \} \quad + \quad R / \{ r + (1 / N_2) \}}, \text{ where:}$$

KR: Rented capital.
H: Expenditures on hiring machinery and equipment (taken from the 1994 Industrial Census).
R: Rent paid for buildings (taken from Industrial Census).
r: Interest rate (10 % representing weighted average rate on licensed banks' credit facilities (loans and advances) in 1994 in Jordan).
N_1: Average life length for machinery (assumed 7.5 years based on provisions of Jordan's Tax Law).
N_2: Average life length for buildings (assumed 26 years based on provisions of Tax Law in Jordan).

In addition, it was decided to adopt average value of machinery, buildings and transport equipment at the beginning and end of the year as the most valid measure of capital stock. Measures at the beginning of the year, common in empirical research, are thought to be less accurate in view of the relatively high firm entry in 1994.

The valuation problem in capital data arising from age heterogeneity of capital goods is hard to solve in cross-section econometric works. Furthermore, as the raw database does not contain firm-level information on capital utilisation, it was impossible to derive data for used capital. However, this can be defended on the ground that capital utilisation is one aspect of inefficiency to be measured; to exclude idle capital stock from inefficiency estimation is to throw away part of what the research intends to measure (Amey, 1969: 57).

Outliers and measurement errors play a crucial role in Census quantitative analysis. Chapter (5) covers available approaches in the literature to deal with this problem. SPSS software has been utilised in deriving residuals and editing outliers of the database.

APPENDIX (2)

Intertemporal Stability in Empirical Findings of Chapters (5) and (6)

In Chapters (5) and (6), cross-section microdata for a single year (1994) were utilised in examining technical and scale efficiency in JMIs. This research design, with its insights, raises an important question regarding the intertemporal stability (or robustness) of empirical findings over time. Cross-section research, in general, presumes that observed differences across observations reflect differences in *long-run* equilibrium positions (Schmalensee, 1989), but in reality this core assumption might be untenable. This Appendix is intended to provide a preliminary assessment of this complex issue.

Chapter (5): TE Empirical Findings

Are the TE findings of Chapter (5) 1994-specific or can be generalised to a typical year? What is the expected impact of a relatively high manufacturing growth in 1994 on the main findings? In more practical terms, do the findings of 1994 describe the situation in 1994 and has little relevance to, for example, 2002 policy making? These questions are both important and difficult to answer.

In principle, the structure-conduct-performance (SCP) paradigm tends to suggest the stability of TE performance over time, assuming that the main elements of market structure (notably concentration) do not typically change over time in any significant manner. As clarified by CB (1990: 7):

> *"Interindustry differences in technical efficiency lay reasonable claim to represent the long-run consequences of interindustry differences in stable elements of markets' structures. In principle ...[TE] hypotheses could also be tested on changes over time in industries' structural elements and efficiency levels; however, this strategy provides little leverage in practice because few industries typically experience much change in most important elements of their structures".*

The problem with this argument is that TE can be affected also by structural or dynamic disturbances that might change dramatically over time. Moreover, the methodology seems to be overly sensitive to sample coverage and outlier firms. To put the issue in perspective, a relatively high growth could induce a general rise in inefficiency. The expected rise in inefficiency is due to the tendency of managers to pay less attention to costs in expansion years compared with contraction years (see EC, 1997c). In such a condition, "there is room for all players, even the inefficient" (Mayes et al., 1994: 185). In contrast, slow industrial growth leads to the intensification of competition (Coulter, 1998) and thus potential improvement in TE. Overall, available empirical evidence appear to reveal that TE "can vibrate extensively and unsystematically from year to year as such disturbances wax and wane. However...such vibrations...might take place around a stable and structurally determined mean value" (Caves, 1992a: pp.18-19).

In the case of JMIs, the sector witnessed a high real growth rate (17 %) in 1994 (Figure 2.1, Chapter 2). Thus, it appears that the estimated inefficiency could be *biased upwards* compared with a 'normal' year. Probably supporting the above conclusion is the high firm entry in 1994 (some 850 new firms, or 12.4 % of total firms) with somewhat lower labour productivity (LP)[1].

To sum up, TE findings of this Thesis should be seen as suggestive rather than conclusive as far as *future* policy stance is concerned. A potentially forward step in dealing with possible temporal instability in estimated efficiency is measuring TE *over time*, or using longitudinal database on individual firms.

Chapter (6): Scale Efficiency Findings

This Chapter is more diverse in terms of modelling, and thus its corresponding robustness. The survival-ability technique, being based on time-series evidence, is not basically affected by idiosyncrasy of year 1994. As for scale elasticity, high entry in 1994 with somewhat smaller scale[2] might overestimate scale elasticity in high-entry increasing-returns industries. However, available empirical evidence from other similar work shows

[1] Entry rate is calculated here from the microdata set, N=6872. It is defined as the number of new firms started operation in 1994 (850 firms) to total number of incumbent and entrant firms producing in 1994 (6872 firms). Average LP for new entrants is about JD 2400 compared with JD 2900 for the incumbent firms.
[2] Average employment size for new entrants is 6 workers compared with 10 workers for the incumbent firms producing in 1994.

that estimates of scale elasticity in different years, even with substantial structural differences, are quite stable over time (Ringstad, 1978; Baldwin and Gorecki, 1986). The same could apply to the LP and ULCs models, due to their linkage with scale elasticity based on the CD production function. Indeed, omitting firms started operation in 1994 from the sample did not affect the qualitative conclusions of the last two models. Finally, a sensitivity test of export performance of firms to the exclusion of the 1994 start-up firms revealed that the findings of export performance modelling are quite robust.

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