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Department of Economics

Economic Research Paper No. 00/5

**Poland: A Successful Transition
to Budget Sustainability?**

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March 2000

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POLAND: A SUCCESSFUL TRANSITION TO BUDGET SUSTAINABILITY?

by

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Preliminary Draft: Not for Quotation

JEL Classification: E61, H60

Keywords: Budget sustainability, seignorage, Poland, cointegration

ABSTRACT

In this paper we evaluate the sustainability of the current fiscal policy regime in Poland, which has been in place for almost 10 years since the start of the economic reform process. We use the intertemporal budget constraint (IBC) as a framework, and evaluate the sustainability of current policies. Consistency of fiscal policy with the IBC is evaluated using unit root and cointegration tests. In contrast to much previous research on fiscal sustainability in western economies, we explicitly take account of the possible role of seignorage from money creation as a source of government revenue. Sustainability tests are conducted excluding and then including seignorage. We find firm evidence that Polish fiscal policy is sustainable, and that the fiscal regime is "expenditure-led", adjusting tax revenues to the planned levels of government expenditures. This would appear to bode well for Poland's prospective entry to the EU and possible subsequent consideration of membership of the monetary union.

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1. Introduction

Fiscal policy sustainability has been an important issue in the last two decades. See Buiter (1983) and Blanchard (1984) for two early contributions to the literature. Concern arose initially because of the deficits experienced by most of the major industrial countries in the early 1980s. Subsequently, it was a recurrent theme in the run-up to European Monetary Union (EMU), with the Maastricht Treaty making fiscal sustainability an explicit criterion for a country's eligibility for EMU. Fiscal sustainability is also a central issue for the transition economies of central and eastern Europe. Indeed, Dabrowski (1996) argued that "...the state of the public finances usually serves as a litmus test of the progress achieved and the degree of internal consistency and far-sightedness of the transformation policy." Policy-makers in the transition economies face a combination of historic expenditure commitments, uncertainty about new revenue sources, and uncertainty about the economy in general. Under these circumstances, if fiscal policy is not "consistent and far-sighted", there is a substantial and continuing risk that budget deficits can mushroom out of control and become unsustainable¹. See Budina and van Wijnbergen (1996 and 1997) and the collection of papers in Ambrus-Lakatos and Schaffer (1997).

There has been a substantial volume of research on fiscal sustainability in the US and, to a lesser extent, Western Europe. See Vieira (1999) for a survey of this literature. However, there has been much less comparable research on the transition economies. Most research on these countries has focussed on the immediate effectiveness of fiscal reforms. Exceptionally, Buiter (1996) and Budina and van Wijnbergen (1997) calculated measures of fiscal sustainability for a sample of the transition economies. However, they did not conduct any formal statistical tests of sustainability. They argued that if a country is not in default, the current ratio of government debt to aggregate output is revealed to be sustainable. From this normalization, current fiscal policy is defined to be unsustainable if current or projected economic data imply that the debt-output ratio will increase over time from its current level. Because of its simplicity, this is a clear and sometimes useful criterion, but it does embody some strong assumptions. See Blanchard (1990) for an appraisal of the uses and limitations of this particular concept of sustainability.

In this paper we take up in more depth than previous papers the issue of fiscal sustainability in the transition economies. We also sharpen the focus of the research by concentrating on one particular economy: Poland. Poland is of interest for several reasons. It was one of the first countries to embark on the transition to a market economy, beginning in 1989; and it therefore has one of the longest histories of transition experience. Moreover, once the transition was under way, Poland moved faster than other countries by implementing essential reforms in a “big bang”, with the key tax measures put in place at an early stage. It is generally reckoned that the economy stabilized and resumed growth after about 2 years. See Balcerowicz (1994) and Blanchard (1994). Overall, the Polish fiscal policy *regime* has enjoyed some 8 years of relative stability. This stability provides a more favourable economic and statistical environment for evaluating fiscal sustainability than is found in most other transition economies. Moreover, it is 10 years since Poland began the transition to a market economy: evidently an opportune time at which to take stock. Poland therefore offers a particularly interesting and appropriate setting within which to study fiscal sustainability, as we do in this paper.

The rest of the paper is structured as follows. Section 2 discusses the concept of sustainability, and sets out our framework for testing for fiscal sustainability in Poland. In section 3 we summarize the basic facts about the Polish economy and describe the data used in this study. Section 4 sets out the empirical methodology used to implement our sustainability tests. The empirical results are discussed in section 5. Section 6 contains some concluding remarks.

2. Sustainability

“Sustainable” policies are those which, in a certain sense (to be defined), can be continued indefinitely without modification. Conversely, “unsustainable” policies will, at some time in the future, have to be changed, otherwise they will lead to insolvency or a collapse of the policy regime. Sargent and Wallace (1986) were among the first to explain how a fiscal sustainability problem can arise if monetary and fiscal policies are not properly co-ordinated. Monetary control over inflation may prove ineffective if it is not supported by fiscal policies which involve a reduction in the budget deficit. If the authorities rely exclusively on open market operations to

control money growth in the face of persistent budget deficits, the stock of interest-bearing government debt may increase in an unsustainable manner. To restore sustainability, money growth (and hence inflation) must rise in order to generate the seignorage necessary to meet the increased interest payments on the government debt. This necessarily postpones the reduction in money growth which is required to bring down inflation. This “unpleasant monetarist arithmetic” is a particularly severe risk for the transition economies. In theory, the abolition of price controls should have produced a once-over adjustment in prices; but in practise, it was often difficult to prevent compensating wage increases which generated strong inflationary pressures. Moreover, the absence of well-functioning markets in government debt meant that, in many cases, budget deficits could only be financed by the central bank, which necessarily monetized the debt. See Bahra, Green, and Murinde (1997). Thus the link between budget deficits and inflation was (and is) particularly direct in the transition economies. This underlines the importance of controlling the budget deficit and, more generally, of pursuing a sustainable fiscal policy in these countries.

The link between current fiscal policy and the outstanding government debt which constrains future policies is summarized, in an accounting sense, in the government’s intertemporal budget constraint (IBC)². For empirical purposes, this is usually written in real terms and with all variables expressed as ratios to GDP³:

$$d_t = d_{t-1}(1 + r_t)/(1 + f_t) - s_t - (m_t - m_{t-1})/(1 + p_t)(1 + f_t) \quad \dots 1$$

Here: d_t = the stock of interest-bearing government debt outstanding;

s_t = the primary budget surplus (ie: excluding debt interest and seignorage);

and: m_t = base money; all expressed at end-of-period constant prices as ratios to real GDP.

Also: r_t = the average real interest rate on outstanding government debt

f_t = the growth rate of GDP

p_t = the inflation rate

Solving (1) forwards yields:

$$d_t = \lim_{n \rightarrow \infty} E_t g_{t,j} d_{t+n} + \sum_{j=1}^{\infty} E_t g_{t,j} [s_{t+j} + (m_{t+j} - m_{t-1+j})/(1 + p_{t+1})(1 + f_{t+1}))] \quad \dots 2$$

where the discount rate of the model is the difference between the real interest rate and the growth rate of output. Hence the discount factor is given by:

$$g_{t,n} \equiv \prod_{i=1}^j (1 + f_{t+i}) / (1 + r_{t+i}) \quad \dots 3$$

Equation (2) states that outstanding government debt (d_t) must equal the present value of the stream of funds needed to finance the interest and principal on that debt. To rule out Ponzi-type financing schemes⁴, we must impose the (transversality) condition:

$$\lim_{n \rightarrow \infty} E_t g_{t,n} d_{t+n} = 0 \quad \dots 4a$$

$$\text{hence: } d_t = \sum_{j=1}^{\infty} E_t g_{t,j} [s_{t+j} + \Delta m_{t+j} + m_{t-1+j} [1 - 1/(1 + p_{t+1})(1 + f_{t+1})]] \quad \dots 4b$$

Equation (4) provides a framework for defining *solvency*: the government is solvent if the value of its outstanding debt equals the present value of funds generated by future primary budget surpluses and money creation (seignorage). However, solvency and sustainability are not the same concept. According to Buiter (1990) for example, "only if there exists no economically and politically feasible set of tax, spending and seignorage plans that permit the existing stock of debt to be serviced, can one truly speak of [government] insolvency." The problem with (4) is that it does not by itself restrict the relationships between revenues, expenditures and debt sufficiently to provide useful, testable hypotheses about the sustainability of *current* fiscal policy. Thus, the transversality condition (4a) restricts the evolution of the discounted stock of debt only asymptotically. Likewise, the IBC (4b) imposes restrictions only on the long-run relationships between revenues and expenditures, so that almost any short-run path for the primary budget surplus is consistent with budget balance in present value terms.

To test fiscal sustainability in practise therefore, requires making additional assumptions to give more structure to the framework provided by (4); and two main types of assumptions have been utilized. The first approach is to postulate the existence of a "collateral constraint" on the debt-GDP ratio (d_t), typically requiring that the growth in d_t be bounded more strictly than by the real interest rate. A popular special case, proposed by Buiter (1983), is to require that the debt-GDP ratio be stabilized at its current level. The implications of this assumption can be worked out by setting $d_t = d_{t-1}$ in (1) and solving for d . The second approach, originated by Hamilton and Flavin (1986), is to assume that current fiscal policy will remain unchanged indefinitely and to evaluate whether policy is consistent with the IBC. In practise, this usually means assuming that fiscal

policy has been stable over a period which is sufficiently long as to enable time series modelling of revenues, expenditures and debt; and to check if the processes generating these variables are consistent with (4). Although both these approaches are based on the IBC, the first is more forward-looking as it typically involves forecasting *future* revenues and expenditures to determine if they are consistent with the debt constraint. The second approach relies instead on the underlying stability of *past* data processes. Although both approaches are popular, the second has been more extensively used in academic research, as it does not rely on forecast data. Clearly though, a complete evaluation of the sustainability of fiscal policy in any particular country must at some stage make assumptions about future policies⁵.

Previous evaluations of fiscal policy in the transition economies in general and Poland in particular have utilized the first approach to sustainability. See Buiters (1996) and Budina and van Wijnbergen (1997). This was undoubtedly sensible in the early stages of transition when policy was evolving rapidly, and there was no relevant stable historical experience on which to base an analysis. In this paper however, we adopt the second approach, treating Polish fiscal policy as given and stable, and inquiring whether, if pursued indefinitely, it would satisfy the IBC. Given the rapid pace of the early fiscal reforms and subsequent stability in Polish fiscal policy over the succeeding years, we believe that this approach is now more appropriate. If current fiscal policy is not consistent with the IBC, it would suggest that further reform may be needed. However, if it is consistent with the IBC, we would conclude that with current policies, Poland appears to have a sustainable fiscal position; and clearly this would be an important achievement in the transition process.

3. *Polish Data*

The transition economies faced an essentially common set of fiscal problems. In the early stages of transition, there was a sharp cut in subsidies, as price controls were abolished and assistance to state enterprises phased out. These measures immediately improved the fiscal balance, sometimes dramatically. Subsequently, as state enterprises shed labour, output declined and unemployment rose, there was a sharp rise in expenditures on state benefits, and the budget

lurched into deficit. See Portes (1994). Fiscal problems of a more structural nature included: the establishment of “hard” budget constraints for government and state entities; the redesign of the tax system to replace turnover and payroll taxes by income tax and VAT; and the reform of social security and pension funds. See Kopits and Offerdal (1994) for a summary.

Turning specifically to Poland, there was a prolonged public debate about the move to a market economy during the run-up to the demise of the communist state during 1987-89. By the end of this period, the economy was on the verge of collapse. Inflation was over 600% *per annum* in 1989, and the pre-reform fiscal deficit amounted to more than 7% of GDP, the highest of all the transition economies outside the former Soviet Union. The reform process was begun late in 1989, with the gradual lifting of price controls. By January 1990, the state was setting about 14% of prices (by value of sales), with a further 10% subject to indirect control. The key tax reforms were put in place in the following two years. Following the initiation of market reforms, the economy as a whole stabilized relatively quickly. Inflation peaked at 110% *per month* in January 1990, and averaged only 51% *per annum* in the remaining 11 months of 1990, with a further fall to 36% *per annum* in 1991. Economic growth was resumed after about 2 years.

The budget deficit responded more slowly to the reform effort. Immediately after the abolition of price controls and the associated subsidies, there was a budget surplus of about 3% of GDP in 1990. This was followed by two years of large deficits, as the income tax and VAT came into effect. Subsequently, the deficit stabilized at around 2.5% of GDP. Public expenditure remained high throughout the 1990s, at about 50% of GDP. However, in the later part of the decade, the fiscal position benefitted from substantial revenues from the privatisation of state enterprises; and this contributed to an improvement in the fiscal position⁶. See table 1. Clearly though, privatisation only contributes a once-over increase in revenues; and fiscal policy must ultimately generate revenue streams which are sustainable on a continuing basis. A further problem is the creation of a market-oriented fiscal culture, particularly in the area of tax-compliance. In the 1990s, tax arrears varied from as little as 3.5% of revenues for the main indirect taxes (in 1996) to over 20% for social security contributions (in 1993). More detailed analyses of the Polish

reform effort can be found *inter alia* in Balcerowicz (1994), Blanchard (1994), and Czarny and Czarny (1992).

Table 1 about here

It is important to bear in mind that fiscal sustainability is a long-run concept. If economic policy in general, or the economy itself is undergoing structural change, it is difficult to establish the right benchmarks to evaluate the sustainability of certain particular policies. Thus, in transition economies such as Poland, pre-reform economic data are of no use in assessing the sustainability of post-reform policy. Likewise, the assumption that a particular set of post-reform policies will remain unchanged may be seriously misleading. However, since the start of the reform process, the policy *regime* in Poland has remained remarkably stable, a fact which provides a relatively favourable economic and statistical environment for evaluating fiscal sustainability.

We chose the start date of the data with the objective of avoiding the inflationary episode which took place just before and immediately after the abolition of price controls, but as soon as possible thereafter, reflecting the generally-held view that the policy regime (and the economy) did stabilize relatively quickly after the initial reforms. Accordingly, the data run from January 1991 to March 1998. They are monthly and seasonally-adjusted⁷. Data on government revenues and expenditures, and on money and prices are all readily available on a monthly basis⁸. We used the index of industrial production as a monthly aggregate output measure: a proxy for real GDP⁹.

Most previous comparable tests of long-run sustainability ignore the possible impact on government revenues of seignorage from money creation, presumably considering it to be negligible.¹⁰ See for example Bohn (1991). As a general point, it is obviously important to establish that seignorage is indeed negligible. Moreover, a key point of Sargent and Wallace's unpleasant monetarist arithmetic is that debt service will eventually have to be met by inflationary finance if the budget deficit is not kept under control to support monetary restraint. As far as Poland is concerned, the authorities succeeded in bringing inflation under control during 1990.

Hochreiter and Rovelli (1999) show that seignorage in Poland declined substantially over the 1990s. However, money growth and inflation remained at somewhat higher and more variable rates than those prevailing in most western industrial economies. In our data period, from January 1991 through March 1998, money growth varied from +10.6% to -9.3% *per month* and inflation varied from +9.8% to +0.1% *per month* (seasonally unadjusted). Meanwhile, the market for government debt remained relatively undeveloped. These arguments suggest that it would be sensible to allow for seignorage in evaluating fiscal sustainability in Poland. We therefore carried out sustainability tests, first assuming no seignorage, and then allowing for the impact of estimated seignorage on government revenues. The most popular (and practical) measure of seignorage (x_t) is the cash flow measure, which is given by the change in the nominal value of the monetary base. We express this as a ratio to nominal GDP, proxied by the product of the industrial production index and the price index. Definitions and mnemonics for the data are given in table 2.

Table 2 about here

4. Empirical Methods

Sustainability tests which check the consistency of fiscal policy with the intertemporal budget constraint are generally based on cointegration and unit root tests. In principle, interest rates are an important factor in such tests. High interest rates increase the cost of servicing future government debt, and therefore increase the value of the primary surplus which is required to ensure that the trajectory of outstanding government debt is sustainable¹¹. In fact, most early studies of sustainability assumed a constant interest rate. Subsequently, Trehan and Walsh (1988 and 1991) established that a sufficient condition for sustainability is that the total budget surplus (not the primary surplus) should be $I(0)$, irrespective of the time series behaviour of the interest rate. Our first step therefore is to perform a unit root test on total revenues and expenditures. If both are $I(0)$, then the overall budget surplus is also $I(0)$, and we can immediately conclude that the transversality condition (4a) is satisfied, and therefore that fiscal policy is sustainable. If

either revenue or expenditure is $I(0)$, and the other is $I(1)$, (4a) cannot be satisfied, and policy is unsustainable.

In general though, we would expect both the revenue and expenditure series to be $I(1)$. If so, our second step is to perform a unit root test directly on the overall budget surplus. Following Trehan and Walsh, if the surplus is stationary, fiscal policy is sustainable. Stationarity of the surplus is a sufficient condition for sustainability. Hakkio and Rush (1991) suggested that necessary and sufficient conditions for sustainability may be somewhat weaker, namely that revenues and expenditures be cointegrated, with cointegrating vector $(-1, \mathbf{b})$, and with $0 < \mathbf{b} \leq 1$. However, if $\mathbf{b} < 1$, the budget surplus is $I(1)$ ¹² and outstanding government debt is unbounded, because positive shocks to expenditures (say) generate permanently lower revenues through the cointegrating relationship: $t = \mathbf{b}g$. Even if this is interpreted as "sustainable", governments with ever-growing debt presumably have a greater incentive to default through repudiation or high inflation, as Sargent and Wallace argued. We therefore take the view that cointegration of revenues and expenditures and a cointegrating vector of $(-1, 1)$ are probably both necessary conditions for sustainability in this framework.

Nevertheless, the test for stationarity of the budget surplus is a joint test: it requires that revenues and expenditures be cointegrated, and that the cointegrating vector is $(-1, 1)$. If we cannot reject the hypothesis that the surplus is $I(1)$, it could be either because revenues and expenditures are not cointegrated, or because the cointegrating vector is not $(-1, 1)$. The Hakkio-Rush argument does suggest that it would be useful to know which of these two factors are more important, if indeed the surplus turns out to be $I(1)$. As a third step therefore, we test these two hypotheses separately using the procedure of Johansen (1995): first to test the null hypothesis that revenues and expenditures are cointegrated, and second to estimate the cointegrating vector and test whether it is $(-1, 1)$. We interpret these tests as an elaboration and check on the results of the unit root test on the surplus. The unit root test on the surplus and the Johansen test on revenues and expenditures should produce the same results asymptotically. However, the small sample properties of the tests may produce different results in practise. Moreover, if the surplus turns

out to have a unit root, the Johansen procedure enables us to determine more precisely the source of this root - whether in non-cointegration of revenues and expenditures, or in $\mathbf{b}$ 1.

Johansen's method is based on the general vector error-correction model (VECM):

$$\Delta Z_t = a_0 + a_1 D_t - \Pi Z_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Z_{t-i} + u_t \quad \dots 5$$

Here: $Z_t = \begin{pmatrix} (t/y)_t \\ (g/y)_t \end{pmatrix}$; D_t is a time trend; u_t is a white noise error; and the vectors and matrices of parameters (a_0 , a_1 , Π , Γ_i) are dimensioned conformably. The hypothesis of cointegration between (t/y) and (g/y) is formulated as a test of the rank of Π , which can be decomposed into $\Pi = \alpha \beta'$, where β is a matrix of long-run coefficients and α is a matrix of speed of adjustment coefficients. Thus, $\mathbf{b}'Z_{t-1}$ represents the cointegrating relationship and α provides information on the short-run response of revenues and expenditures to a shock that has disturbed the long-run relationship. Pesaran, Shin, and Smith (1996) pointed out that the solution for Z_t implies that there may exist restrictions among the nuisance parameters (a_0 , a_1), depending on the rank of Π and on the precise form in which the nuisance variables (the constants and trends) enter the model. We used Pantula's principle (Pantula, 1989) to determine whether there should be a constant and time trend in each equation before finalizing our estimate of the VECM.

As a final step, we carried out causality tests on revenues and expenditures. Causality tests are a useful adjunct to the Johansen procedure. First they provide further evidence on the cointegrating relationship between the two variables. According to the representation theorem of Engle and Granger (1987), there must exist an error correction representation among cointegrated variables and this implies that at least one-way causality must also exist. Causal orderings are also a useful guide to the appropriate normalization of the cointegrating vector. Clearly, if (g/y) causes (t/y) and the reverse is not true, it makes sense to normalize the cointegrating vector on (t/y) , treating it as the left-hand side variable in a regression context. Pesaran and Shin (1999) show that a single normalizing restriction on the cointegrating vector is a necessary and sufficient condition for identification when the VAR is based on two variables, as is the case here.

Causality tests are also of interest in their own right, as estimates of the authorities' reactions to fiscal imbalances. There are four possibilities:

1. One-way causation from revenues to expenditures. This suggests that the authorities adjust spending to the level of revenues. See Friedman (1978). Unless the cointegrating vector is (-1,1), tax increases may not reduce fiscal deficits without a change of strategy.
2. One-way causation from expenditures to revenues. This suggests that the authorities adjust revenues to the level of planned expenditures. See Peacock and Wiseman (1979). As before, unless the cointegrating vector is (-1,1), expenditure cuts may reduce the size of government without necessarily solving a deficit problem.
3. Bidirectional causality. This is the classical view of public finance. See Musgrave (1966).
4. No causality. This is consistent with no cointegration and a sustainability problem.

It should be emphasized that causality *per se* has implications only for the dynamics of the fiscal adjustment process, and not for sustainability. The latter depends on the existence and value of the cointegrating vector. See Vieira (1999) for a detailed discussion. However, since causality tests do give estimates of the authorities' reactions to past fiscal imbalances, they also provide a useful indicator of the way in which the authorities may react to such imbalances in the future.

Causality tests are based on:

$$\Delta Z_t = g_0 + B e_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Z_{t-i} + u_t \quad \dots 6$$

Here: Z_t and u_t are as before (equation 5); e_{t-1} is the (2x1) error-correction vector derived from estimates of the normalized cointegrating vector; and the parameter matrices ($\hat{\Pi}_0$, B , Π_i) are again dimensioned conformably. Equations 5 were estimated by Johansen's procedure and the AIC was used to identify the optimal lag length in each system, excluding and including seignorage. Causal orderings were checked using Wald tests. The sequential structure of all the tests is summarized in table 3.

Table 3 about here

5. *Empirical Results*

We will discuss our findings on a test-by-test basis, comparing the results from the raw data (ie. excluding seignorage) with the results including seignorage as we proceed. Table 4 shows the results of the augmented Dickey-Fuller tests which we carried out on all the variables of interest (Dickey and Fuller, 1979)¹³. The Dickey-Fuller regressions were run with and then without a linear time trend. In general, the time trend was significant. The revenue and expenditure variables are clearly all $I(1)$, irrespective of the inclusion or exclusion of seignorage. The results for the budget surplus are more ambiguous, with the raw surplus clearly $I(0)$, but the seignorage-inclusive surplus more nearly $I(1)$. As can be seen in chart 1, seignorage has had a non-negligible impact on the overall budgetary position¹⁴. This result lends some support to our argument that seignorage may be an important factor in fiscal sustainability in transition economies such as Poland, although we might have expected that the inclusion of seignorage would help make the surplus more nearly $I(0)$, rather than the other way round, as we in fact find. We therefore proceed next to the Johansen estimation to check the robustness of these results.

Chart 1 about here

Johansen tests for cointegration are shown in table 5. Following application of the Pantula principal, these are tests with restricted intercepts and no trends in the VAR¹⁵. We used the maximum eigenvalue test (MET) and the trace test (TT) to check the number of cointegrating vectors. Both tests have as null a pre-selected number of cointegrating vectors (r). The MET tests this against the alternative that there are $r+1$ cointegrating vectors; the TT tests against the alternative that $r = \text{rank}(\square)$, ie. that the whole system is in fact $I(0)$. See Johansen (1995). We began by choosing $r = 0$ and then $r = 1$. Since we are estimating a 2×2 system, the MET and TT give identical results when $r = 1$. Table 5 suggests that Polish government revenues and expenditures are cointegrated, irrespective of whether allowance is made for revenues from seignorage. Table 6 gives estimates of the cointegrating vector, excluding and then including seignorage. Based on the results of the causality tests (table 7), we normalize on revenues. It is

clear from table 6 that the hypothesis of a unit coefficient on expenditures cannot be rejected, irrespective of whether seignorage is included in or excluded from revenues.

Tables 4, 5, 6, 7 about here

For the raw revenue and surplus data, the results of the Johansen tests are clearly consistent with those of the unit root tests. For the seignorage-inclusive data, the finding that revenues and expenditures are cointegrated and that the cointegrating vector is $(-1,1)$ is, in principle, not consistent with the results of the unit root test (that the seignorage-inclusive surplus is $I(1)$). Such a conflicting result is not unusual in test procedures of this kind, because of the different powers of the various tests. See Vieira (1999). In this case, the Dickey-Fuller test probably has the lower power because we are using it to test a joint hypothesis: cointegration of revenues and expenditures, and a cointegrating vector of $(-1,1)$. We would argue that greater weight should be given to the results of the Johansen tests, because of their power to discriminate between these two underlying hypotheses. Therefore, we conclude tentatively that the balance of the evidence is that Polish fiscal policy is sustainable, irrespective of the inclusion or exclusion of seignorage.

Finally in table 7, we report causality tests. These show that causality runs one-way from expenditures to revenues, once again irrespective of the exclusion or inclusion of seignorage. This is consistent with the view that Polish tax reforms were indeed effective in producing a tax system capable of generating the revenues required to finance planned expenditures in the new market-oriented regime. Interestingly, the impact of expenditures on revenues occurs through the error-correction term and not at all through the dynamics. The coefficients giving the speed of adjustment of revenues to expenditure changes were estimated to be -0.182 for the raw data and -0.294 for the seignorage-inclusive data. These estimates imply respective half-lives for the adjustment process of 3.45 months (raw data) and 1.99 months (seignorage-inclusive). This suggests that seignorage revenues help to provide a more rapid return to equilibrium following a fiscal shock. This result is intuitively reasonable, and lends further indirect support to our argument that the seignorage-inclusive fiscal position is indeed sustainable.

6. *Concluding Remarks*

In this paper we have examined the sustainability of Polish fiscal policy, treating the policy regime as given and stable, and inquiring whether, if pursued indefinitely, current policies would satisfy the IBC. Our results have to be treated with some caution, as we are using relatively high-frequency (monthly) data, covering a period (eight years) which is relatively short in the context of the sustainability debate in the industrialized economies. However, we would argue that, in the context of the rapid changes in Poland, it is a more reasonable time period over which to check the progress towards stabilization within the new market economy. Although the budget deficit remains high, our results suggest that Poland has made substantial progress towards fiscal sustainability. Unit root and cointegration tests generally indicate that Polish fiscal policy is currently sustainable: the budget surplus is $I(0)$; revenues and expenditures are each $I(1)$, and are cointegrated with cointegrating vector $(-1,1)$. Exceptionally, we find that the seignorage-inclusive budget surplus is more nearly $I(1)$. However, the results of Johansen tests indicate that seignorage-inclusive revenues and expenditures are cointegrated with a cointegrating vector equal to $(-1,1)$. In this study, we argue that it is appropriate to place somewhat greater weight on the Johansen test results. In addition, fiscal policy appears to be "expenditure-led", with the authorities adjusting taxes to ensure that planned expenditures can be financed within the framework of a sustainable budget balance. In this context, seignorage is a factor in increasing the speed of adjustment of revenues to a fiscal shock. Clearly these are likely to be important considerations in the longer-term, as Poland prepares for EU membership and subsequently gives consideration to joining the monetary union.

Footnotes

- * The research for this paper was funded by the EU's Phare/ACE programme under contract P96-6152-R. The usual disclaimer applies.
1. For some countries, the problem was exacerbated by a high foreign debt burden. This was true particularly of Poland, Hungary, and Bulgaria.
 2. The following discussion draws particularly on Vieira's (1999) comprehensive review.
 3. Equation (1) is derived from the government budget constraint expressed in real terms as: $D_t = (1 + r_t)D_{t-1} - S_t - \Delta M_t / P_t$; where: D_t = the stock of real interest-bearing government debt; S_t = the real primary budget surplus; ΔM_t = nominal base money creation; and P_t = the general price level. Dividing by real GDP at time t , and using f_t and p_t , gives equation (1).
 4. That is, the government cannot indefinitely pay debt interest by issuing further debt.
 5. Doubts about the practical application of sustainability analyses based on the intertemporal budget constraint led Perotti, Strauch, and von Hagen (1998) to develop as an alternative the concept of "controllability" in their evaluation of the fiscal experience of EU governments in the last two decades.
 6. Until 1998, Poland classified its privatisation proceeds "above the line" as revenues, and therefore as deficit-reducing. This is substantially in line with the IMF's classification. However, since 1998, privatisation proceeds have been treated more logically as a source of deficit financing. Our data ends before the change of classification, and we therefore followed the pre-1998 procedure and treated privatisation proceeds as government revenues.
 7. The data were pre-seasonally-adjusted using Lovell's (1963) least-squares dummy-variables procedure.

8. Our measure of inflation is the producer price index (PPI) rather than the consumer price index (CPI). The CPI suffers from various problems. It is generally based on somewhat lower quality data than the PPI; it has been subject to more changes in its method of calculation during the sample period of the data; and it was subject to greater distortion as a result of the introduction of VAT and of a new system of excise duties.
9. Data on the government budget, production, and prices were taken from the monthly *Statistical Bulletin* of the Polish Statistical Office (*Biuletyn Statystyczny GUS*). Monetary and interest rate data were taken from the monthly *Bulletin* of the central bank (*Biuletyn Informacyjny NBP*).
10. The only exceptions, as far as we are aware, are Trehan and Walsh (1988), and Vieira (1999).
11. Of course, the precise magnitude of this effect depends on the maturity structure of current and future debt.
12. If $b < 1$, the budget surplus is proportional to expenditure, which, by construction, is $I(1)$.
13. The lag length in each Dickey-Fuller regression was determined by Akaike's information criterion (AIC: Akaike, 1973). The AIC was also used subsequently to determine the lag lengths in the VAR component of the Johansen VECM model, and in the causality tests. The unit root, cointegration, and causality tests were done in MICROFIT.
14. The ratio of seignorage to the reported budget surplus (the modulus of (x_t/s_t)) averaged just over 62% during our data period.
15. The restrictions on the intercepts arise from the cointegration of (t/y) and (g/y) and its consequence that Π is of reduced rank. See Pesaran, Shin, and Smith (1996).

References

- Akaike, H. (1973), "Information theory and the extension of the maximum likelihood principle", in *Proceedings of the Second International Symposium on Information Theory*, eds B.N. Petrov and S. Csaki, Budapest, pp. 267-281.
- Ambrus-Lakatos, L., and Schaffer, M.E. (eds) (1997), *Fiscal Policy in Transition*, Forum Report of The Economic Policy Initiative, no 3, London, Centre for Economic Policy Research.
- Bahra, P. Green, C.J., and Murinde, V. (1997), "Coping with financial sector reforms in transitional economies: what have we learnt?", Ch 1 in T. Kowalski (ed), *Financial Reform in Emerging Market Economies: Quantitative and Institutional Issues*, Poznan, Poznan University Press.
- Balcerowicz, L. (1994), "Transition to the market economy: Poland 1989-93 in Comparative Perspective", *Economic Policy*, no. 19, Supplement, December, pp57-100.
- Blanchard, O.J. (1990), "Suggestions for a new set of fiscal indicators", *Economics and Statistics Department Working Papers*, OECD.
- Blanchard, O.J. (1984), "Current and anticipated deficits, interest rates and economic activity", *European Economic Review*, vol. 25, pp. 7-27.
- Blanchard, O.J. (1994), "Transition in Poland", *Economic Journal*, vol. 104, no. 126, September, pp. 1169-1177.
- Bohn, H. (1991), "The sustainability of budget deficits with lump-sum and income-based taxation", *Journal of Money, Credit and Banking*, vol. 23, no. 3, part 2, pp. 580-604.
- Budina, N. and van Wijnbergen, S. (1997), "Fiscal policies in eastern Europe", *Oxford Review of Economic Policy*, vol. 13, no. 2, pp. 47-64.
- Budina, N. and van Wijnbergen, S. (1996), "Inflation stabilization, fiscal deficits and public debt management in Poland", *Tinbergen Institute Discussion Paper*, TI 96-179/4.

- Biuletyn Informacyjny NBP*, (Bulletin of the National bank of Poland), various issues.
- Biuletyn Statystyczny GUS*, (*Statistical Bulletin* of the Polish Statistical Office), various issues.
- Buiter, W. (1983), "Measurement of the public sector deficit and its implications for policy evaluation and design", *IMF Staff Papers*, vol. 30, no. 2, pp. 306-349.
- Buiter, W. (1990), *Principles of budgetary and financial policy*, Harvester Wheatsheaf, London
- Buiter, W. (1996), "Aspects of fiscal performance in some transition economies under Fund-supported programmes", *Centre for Economic Policy Research*, Discussion paper, no. 1535.
- Czarny, E. and Czarny, B. (1992), "From the plan to the market. The Polish experience 1990-1991", *Economic and Social Policy*, no. 22, Friedrich Ebert Foundation.
- Dabrowski, M. (1996), "The struggle for fiscal consolidation during the economic transition", *Acta Oeconomica*, vol. 48, nos. 1-2, pp. 31-58.
- Dickey, D. and Fuller, W. (1979), "Distribution of the estimators for autoregressive time series with a unit root", *Journal of the American Statistical Association*, vol. 74, pp. 427-431.
- Engle, R. and Granger, C. (1987), "Cointegration and error correction: representation, estimation, and testing", *Econometrica*, vol. 55, no. 2, pp. 251-276.
- Friedman, M. (1978), "The limitations of tax limitation", *Policy Review*, vol. 5, no. 78, pp. 7-14.
- Hakkio, C. and Rush, M. (1991), "Is the budget deficit too large?", *Economic Inquiry*, vol. 29, pp.429-445.
- Hamilton, J. and Flavin, M. (1986), "On the limitations of government borrowing: a framework for empirical testing", *American Economic Review*, vol. 76, no. 4, pp. 808-819.

- Hochreiter, E. and Rovelli, R. (1999), "The generation and distribution of central bank seignorage in the Czech Republic, Hungary, and Poland", *EU ACE/Phare Programme Paper*, July.
- Johansen, S. (1995), *Likelihood-based Inference in Cointegrated Vector Auto-Regressive Models*, Oxford, Oxford University Press.
- Kopits, G. and Offerdal, E. (1994), "Fiscal policy in transition economies; a major challenge", *Finance and Development*, vol. 31, no. 4, December, pp. 10-13.
- Lovell, M. (1963), "Seasonal adjustment of economic time series and multiple regression analysis", *Journal of the American Statistical Association*, vol. 61, pp. 800-802.
- MICROFIT, Pesaran, M.H. and Peseran, B. (1997), *Working with Microfit 4*, Oxford, Oxford University Press.
- Musgrave, R. (1966), "Principles of budget determination", in H. Cameron and W. Henderson (eds), *Public Finance: Selected Readings*, Random House, pp. 15-27.
- Pantula, S.G. (1989), "Testing for unit roots in time series data", *Econometric Theory*, vol. 5, pp. 256-271.
- Peacock, A. and Wiseman, J. (1979), "Approaches to the analysis of government expenditures growth", *Public Finance Quarterly*, vol. 7, pp. 3-23.
- Perotti, R., Strauch, R. and von Hagen, J. (1998), *Sustainability of public finances*, London, Centre for European Integration Studies and CEPR.
- Pesaran, M.H., Shin, Y. and Smith, R.J. (1996), "Structural analysis of vector error correction models with exogenous I(1) variables", *DAE Working Paper no. 9706*, Department of Applied Economics, University of Cambridge.
- Pesaran, M.H. and Shin, Y. (1999), "Long-run Structural Modelling", *DAE Working Paper no. 9419*, Department of Applied Economics, University of Cambridge.

- Portes, R. (1994), "Transformation traps", *Economic Journal*, vol. 104, no. 126, September, pp. 1178-1189.
- RATS: Doan, T. (1992), *Regression Analysis of Time Series*, Evanston, Illinois, Estima.
- Sargent, T. J., and Wallace, N. (1986), "Some unpleasant monetarist arithmetic", Ch 5 in T.J. Sargent, *Rational Expectations and Inflation*, New York, Harper and Row, pp. 158-190.
- Tanzi, V. (1999), "Transition and the changing role of government", *Finance and Development*, vol. 36, no. 2, June, pp. 20-23.
- Trehan, B. and Walsh, C. (1988), "Common trends, the government budget constraint and revenue smoothing", *Journal of Economic Dynamics and Control*, vol. 12, pp. 425-444.
- Trehan, B. and Walsh, C. (1991), "Testing intertemporal budget constraints: theory and applications to U.S. federal budget and current account deficits", *Journal of Money, Credit, and Banking*, vol. 23, no.2, pp 206-223.
- Vieira, C. (1999), "The sustainability of fiscal policy: an application to the European Union", *Unpublished PhD Dissertation*, Loughborough University.

Table 1: Poland: Fiscal Position and Related Data

	Budget deficit/ surplus (-/+) (m zł)	Budget deficit/ surplus (-/+) (% GDP)	Inflation (annual % change in PPI)	Money Growth (annual % change in M0)	Industrial production (annual % change)
1989	-888	-7.5	653.0	474.5	34.7
1990	+1681	+3.0	192.9	160.6	-37.6
1991	-3097	-3.8	35.7	31.8	-22.6
1992	-6914	-6.0	31.4	34.6	15.4
1993	-4389	-2.8	37.8	17.8	0.0
1994	-5740	-2.6	27.9	22.9	13.3
1995	-7448	-2.4	19.0	44.6	0.3
1996	-9167	-2.4	11.2	20.6	4.4
1997	-5904	-1.3	11.3	23.7	10.1

Sources: *Biuletyn Statystyczny GUS; Biuletyn Informacyjny NBP; Dabrowski (1996); International Financial Statistics*

Table 2: Data definitions

Mnemonic	Definition	Description
g		real government spending (including debt interest)
t		real government revenues
y		real income (proxied by the index of industrial production)
$\circ$		inflation rate (producer price index: PPI)
Y		nominal income (proxied by the product of y and PPI)
M		money stock (M0)
s	$t-g$	real government budget surplus
x	$\lambda M_t/Y_t$	seignorage: cash flow definition

Table 3: Summary of Sustainability Tests

	Null hypothesis	if:	then:	else:
1	t and g both have unit roots	rejected: $t \sim I(0), g \sim I(0)$	fiscal policy is sustainable	proceed to test 2
2	s has a unit root	rejected: $s \sim I(0)$	fiscal policy is sustainable	fiscal policy is not sustainable
			proceed to test 3	
3a	t and g are not cointegrated	rejected: $t = \uparrow \rightarrow + \uparrow g$	fiscal policy is sustainable;	fiscal policy is not sustainable;
3b	cointegrating vector for t and $g = (-1,1)$	not rejected: $t = g$	fiscal policy is sustainable and debt/GDP ratio is bounded	debt/GDP ratio is unbounded - fiscal policy is not sustainable
4	if t and g cointegrated, conduct causality tests on t and g			
5	repeat tests 1-4 allowing for the impact of seignorage on government revenues			

Table 4. Unit Root Tests

	No trend		Trend	
	Dickey-Fuller	Lag Length	Dickey-Fuller	Lag Length
<i>excluding seignorage</i>				
<i>g/y</i>	-1.068	0	-2.770	0
<i>t/y</i>	-2.312	10	-2.280	11
<i>s/y</i>	-3.009**	10	-2.585	10
<i>including seignorage</i>				
<i>x</i>	-5.134***	8	-5.127***	10
<i>(t/y)+x</i>	-2.770*	10	-2.444	10
<i>(s/y)+x</i>	-2.428	11	-2.316	10

Notes: Time trend insignificant in the cases of *s/y* and *(t/y)+x*.

Lag length is chosen by the AIC

Rejection of the null: at the 1% significance level (***)

at the 5% significance level (**)

or at the 10% significance level (*).

Table 5. Johansen Tests for Cointegration

Null: r = number of cointegrating vectors	Maximum Eigenvalue Test		Trace Test	
excluding seignorage: cointegration between g/y and t/y				
	lag length of VAR = 11 months			
	Statistic	5% cv	Statistic	5% cv
r=0	17.552**	15.870	20.698**	20.180
r=1	3.145	9.160	3.145	9.160
including seignorage: cointegration between g/y and (t/y + s)				
	lag length of VAR = 4 months			
	Statistic	5% cv	Statistic	5% cv
r=0	17.7251**	11.0300	18.7175**	12.3600
r=1	.99243	4.1600	.99243	4.1600

Notes: ** denotes rejection of the null of non-stationarity at the 5% significance level.

Lag length is chosen by the AIC

Table 6. The Long-Run Relationship between Revenues and Expenditures

	constant	(g/y)	χ^2	P value
<i>excluding seignorage</i>				
(t/y)	-0.191	0.949	0.007	0.94
<i>including seignorage</i>				
$(t/y)+x$	0.0	0.958	2.133	0.14

Notes: χ^2 Test of the null that (g/y) has a coefficient of unity

P Probability of not rejecting the null

Table 7. Causality Tests

<i>excluding seignorage</i>				
		$e(t-1)$	lagged $D(t/y)$	lagged $D(g/y)$
	DoF	1	10	10
$D(t/y)$	χ^2	5.675***	36.043***	15.257
$D(g/y)$	χ^2	2.280	6.619	16.478*
<i>including seignorage</i>				
		$e(t-1)$	lagged $D((t/y)+x)$	lagged $D((g/y)+x)$
	DoF	1	3	3
$D((t/y)+x)$	χ^2	12.115***	13.003***	4.882
$D((g/y)+x)$	χ^2	0.644	2.455	5.497

Notes: $e(t-1)$ is the error correction term derived from table 6

D is the first difference operator

DoF are the degrees of freedom of the χ^2 test

Lag length is chosen by the AIC

*** rejection of the null of joint zero restrictions at the 1% significance level.

** rejection of the null of joint zero restrictions at the 5% significance level.

* rejection of the null of joint zero restrictions at the 10% significance level.

Chart 1. Poland: Budget Deficit and Seignorage
(seasonally adjusted)

Surplus(+)/Deficit(-)
(million zlotys)

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- ¹ In some countries, fiscal problems were exacerbated by a high foreign debt burden. This was true particularly of Poland, Hungary, and Bulgaria.
- ² The following discussion draws particularly on Vieira's (1999) comprehensive review.
- ³ Equation (1) is derived from the government budget constraint expressed in real terms as: $D_t = (1 + r_t)D_{t-1} - S_t - \Delta M_t / P_t$; where: D_t = the stock of real interest-bearing government debt; S_t = the real primary budget surplus; ΔM_t = nominal base money creation; and P_t = the general price level. Dividing by real GDP at time t , and using f_t and p_t , gives equation (1).
- ⁴ That is, the government cannot indefinitely pay debt interest by issuing further debt.
- ⁵ Doubts about the practical application of sustainability analyses based on the intertemporal budget constraint led Perotti, Strauch, and von Hagen (1998) to develop as an alternative the concept of "controllability" in their evaluation of the fiscal experience of EU governments in the last two decades.
- ⁶ Until 1998, Poland classified its privatisation proceeds "above the line" as revenues, and therefore as deficit-reducing. This is substantially in line with the IMF's classification. However, since 1998, privatisation proceeds have been treated more logically as a source of deficit financing. Our data ends before the change of classification, and we therefore followed the pre-1998 procedure and treated privatisation proceeds as government revenues.
- ⁷ The data were seasonally-adjusted using Lovell's (1963) least-squares dummy-variables procedure.
- ⁸ Our measure of inflation is the producer price index (PPI) rather than the consumer price index (CPI). The CPI suffers from various problems. It is generally based on somewhat lower quality data than the PPI; it has been subject to more changes in its method of calculation during the sample period of the data; and it was subject to greater distortion as a result of the introduction of VAT and of a new system of excise duties.
- ⁹ Data on the government budget, production, and prices were taken from the monthly *Statistical Bulletin* of the Polish Statistical Office (*Biuletyn Statystyczny GUS*). Monetary and interest rate data were taken from the monthly *Bulletin* of the central bank (*Biuletyn Informacyjny NBP*).

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- ¹⁰ The only exceptions, as far as we are aware, are Trehan and Walsh (1988), and Vieira (1999).
- ¹¹ Of course, the precise magnitude of this effect depends on the maturity structure of current and future debt.
- ¹² If $b < 1$, the budget surplus is proportional to expenditure, which, by construction, is $I(1)$.
- ¹³ The lag length in each Dickey-Fuller regression was determined by Akaike's information criterion (AIC: Akaike, 1973). The AIC was also used subsequently to determine the lag lengths in the VAR component of the Johansen VECM model, and in the causality tests. The unit root, cointegration, and causality tests were done in MICROFIT.
- ¹⁴ The ratio of seignorage to the reported budget surplus (ie: $\text{mod}(x_t/s_t)$) averaged just over 62% during our data period.
- ¹⁵ The restrictions on the intercepts arise from the cointegration of (t/y) and (g/y) and its consequence that is of reduced rank. See Pesaran, Shin, and Smith (1996).