

Construction of the Database & Methodological Issues

“International short-term lending still awaits its historian”

Jacob Viner, *Studies in the Theory of International Trade*, London (1937), p. 407.

「私ノ意見テハ帳簿ハ銀行ノ生命テアル」

(In my opinion, account books represent the lifeblood of banks)

横濱正金銀行. 1904-.... 東洋支店長会議録. [横浜正金銀行]. Pp. 240-242.

1. Introduction: Yokohama Specie Bank primary materials

The Yokohama Specie Bank has had its fair share of historians, albeit it more or less exclusively in Japan. Or perhaps one should say ‘historiographies’ rather than historians, as literature on YSB could, at least until now, roughly be divided between two large strands –each of them related to discoveries of or access to large swaths of primary materials.

On the one hand, there has been a group of researchers focusing on the role of YSB in the (early) development of Japanese capitalism. Their origins must be traced

back to a research group on the history of the port city of Yokohama that published its findings as early as 1960 in a massive series with the generic title *History of Yokohama*.¹ The disclosure of related archives proved a boon for students of financial history. If anything, it drew the attention of many to the difficulties of fund raising in the difficult 1880s and 1890s, a mere three decades after the country's traumatic 'opening up' (*kaikoku* 開国) and the chaotic process that led to the Meiji Restoration. Saitō Hisahiko was one of the first to study YSB's relationship with the Bank of Japan, which functioned as the former's facilitator (through channeling funds or providing rediscounting facilities); yet it must also be remembered for having set clear limits to YSB's development into an exchange bank with a 100 percent commercial agenda.² Taira Tomoyuki, and later Ishii Kanji, established the interest in a network understanding of exchange banking that persists to today, and that also informs this book.³

Later, other publications started to draw attention to the role played YSB in Asian development before World War II. Again, having (priority) access to previously unavailable primary materials, this time batches of YSB primary holdings for the interwar period, proved instrumental. The publication of an edited volume on YSB's

¹ 横浜市. 1958-. 横浜市史. 横浜市. <http://ci.nii.ac.jp/ncid/BN01627322>.

² 斎藤寿彦. 1973. 「第一次世界大戦期の正貨獲得政策：日本正貨政策史研究(一).」 三田商学研究 16 (3): 112–45. <http://ci.nii.ac.jp/naid/110002555360>; 斎藤寿彦. 1976. 「第一次世界大戦期における「正貨の産業資金化」政策 (小竹豊治教授退任記念号).」 三田商学研究 19 (4): 148–216. <http://ci.nii.ac.jp/naid/110002555445>; 斎藤寿彦. 1978. 「大正期の日本正貨政策史研究-1-.」 千葉商大論叢 16 (2): p39–66. <http://ci.nii.ac.jp/naid/40004128698>; 斎藤寿彦. 1978. 「大正期の日本正貨政策史研究-2-.」 千葉商大論叢 16 (3): P. 65–96. <http://ci.nii.ac.jp/naid/40004128694>. For papers with direct reference to YSB, see: 斎藤寿彦. 1986. “日清戦争以後における横浜正金銀行の資金調達：準備的考察.” 金融経済 218: 35–72. <http://ci.nii.ac.jp/naid/110000174471>; 斎藤寿彦. 1986. “日清戦争以後における横浜正金銀行の外国為替業務の発展と信用.” 三田商学研究 28 (6): 43–75. <http://ci.nii.ac.jp/naid/110004059236>.

³ 平智之. 1984. 「第1次大戦前の国際金本位制下における横浜正金銀行–日銀の兌換制維持政策との関連において-上-.」 金融経済, no. 208 (October): p41–81. <http://ci.nii.ac.jp/naid/40000792001>; 平智之. 1984. 「第1次大戦前の国際金本位制下における横浜正金銀行–日銀の兌換制維持政策との関連において-下-.」 金融経済, no. 209 (December): p1–27. <http://ci.nii.ac.jp/naid/40000792007>; Ishii Kanji 石井寛治. 1999. *Kindai nihon kin'yū-shi josetsu* 近代日本金融史序説. 東京大学出版会. P. 250; Ishii Kanji. 1994. “Japanese Foreign Trade and the Yokohama Specie Bank, 1880-1913”, in Olive Checkland, Shizuya Nishimura, and Norio Tamaki (eds.), *Pacific Banking, 1859-1959: East Meets West*. New York: St. Martin's Press.

interwar activities must be credited for laying the groundwork of pretty much all later studies.⁴ Around the same time, Kaneko Fumio and Shibata Yoshimasa published about the role of YSB and other banks in upholding Japan's empire in East-Asia, most prominently in Manchuria.⁵ Taira's research, in the meanwhile, had started to concentrate on the role of several of YSB's key branches.⁶

Nowadays, the above dichotomy can be subverted thanks to the disclosure of the rich Yokohama Specie Bank Archives, held at the University of Tokyo (UTokyo). As described by Takeda Haruhito 武田晴人,⁷ until recently the archive's host, editor and compiler, the history of the archives' wanderings and their ultimate destination in a Japanese university library has been closely bound up with the travails of Japan's financial institutions after the bursting of the country's proverbial bubble in the early 1990s. In 1996, in the middle of a seemingly non-ending wave of banking mergers, the Bank of Tokyo - Mitsubishi Ltd. emerged as the world's largest bank in terms of total

⁴ 山口和雄, and 加藤俊彦. 1988. 両大戦間の横浜正金銀行. 日本経営史研究所.

<http://ci.nii.ac.jp/ncid/BN03449032>.

⁵ 金子文夫. 1977. “日露戦後の「満州経営」と横浜正金銀行.” 土地制度史学 19 (2): 28–52.

<http://ci.nii.ac.jp/naid/110007018199>; 金子文夫. 1979. “第一次大戦期における植民地銀行体系の再編成: 朝鮮銀行の「満洲」進出を中心に.” 土地制度史学 21 (2): 1–21.

<http://ci.nii.ac.jp/naid/110007018250>; 金子文夫. 1981. “1920年代における日本帝国主義と「満州」(一): 鉄道・金融問題を中心に.” 社会科学研究 32 (4): 149–224.

<http://ci.nii.ac.jp/naid/110000464168>; 金子文夫. 1981. “1920年代における日本帝国主義と「満州」(二): 鉄道・金融問題を中心に.” 社会科学研究 32 (6): 195–286.

<http://ci.nii.ac.jp/naid/110000464181>; 金子文夫. 1990. “対満州投資の構成と展開(1905～1930年).” 横浜市立大学論叢 人文科学系列 41 (1): p489–543. <http://ci.nii.ac.jp/naid/40003713622>;

柴田善雅. 1977. “日本の対「満州」通貨金融政策の形成とその機能の実態: 第一次大戦から二〇年代中頃にかけて.” 社会経済史学 43 (2):

145–73, 225–224. <http://ci.nii.ac.jp/naid/110001212636>.

⁶ 平智之. 1990. “再建金本位制下の横浜正金銀行.” 経済と貿易, no. 152 (March): p30–60.

<http://ci.nii.ac.jp/naid/40000896831>; 平智之. 1993. “経済制裁下の横浜正金銀行–ニュ-ヨ-ク支店を中心として.” 横浜市立大学論叢 社会科学系列 44 (1): p117–146.

<http://ci.nii.ac.jp/naid/40003713128>; 平智之. 1995. “日中戦争期の日英経済関係と横浜正金銀行ロンドン支店.” 横浜市立大学論叢 社会科学系列 46 (2): 95–141.

<http://ci.nii.ac.jp/naid/40003712668>; 平智之. 1994. “太平洋戦争下の横浜正金銀行(1).” 横浜市立大学論叢 社会科学系列 45 (3): 163–207. <http://ci.nii.ac.jp/naid/40003713145>; 平智之. 1995.

“太平洋戦争下の横浜正金銀行(2).” 横浜市立大学論叢 社会科学系列 46 (1): 101–41.

<http://ci.nii.ac.jp/naid/40003713151>.

⁷ See, for further information:

http://www.takeda.e.u-tokyo.ac.jp/shihonshijoh/shokin_kaidai01.htm. Visited 19th January 2015.

assets (in 2006, it was absorbed into the mega-institution called the Bank of Tokyo Mitsubishi UFJ, composed out of five former financial institutions). The merger of a large bank with an even larger bank spelled the total dissolution of the former, and its archives.

Reminiscent of the archives of YSB's British peer, the Hongkong & Shanghai Banking Corporation, they had been crammed into 656 boxes and kept in a nondescript warehouse in Moegino もえいぎ野 (near Yokohama) until 1999.⁸ The latter turned out to be unfit for the conservation of already brittle prewar bank archives; Takeda estimates that approx. 50 boxes were permanently lost due to humidity, unfavorable temperatures and so on. If anything, the fact that the collection could be preserved for posterity is not an example of 'survivor bias'.⁹ In Autumn 2000, when word about their imminent destruction¹⁰ reached Hamashita Takeshi 濱下武志 of UTokyo's Institute for Advanced Studies on Asia (東京大学東洋文化研究所; IASA),¹¹ the university decided to act. Although the inquiry for hosting the archives originally went to IASA, Takeda explains that the archives were too bulky to be hosted there, and that, for that reason, negotiations were taken up with the Library of the Faculty of Economics of the university. Up to this day, they are housed in that library's Rare Materials Reading Room or *shiryōshitsu* 資料室.¹²

⁸ The enormous work of finding a new home for the HSBC archives, and organizing them into material for the bank's official history is described in: King, Frank H. H. 1987. *The History of the Hongkong and Shanghai Banking Corporation*. Cambridge [Cambridgeshire]: Cambridge University Press.

⁹ See, in this context, the discussion of the archives of Hoare's Bank, by Temin and Voth: Temin, Peter, and Hans-Joachim Voth. 2013. *Prometheus Shackled: Goldsmith Banks and England's Financial Revolution after 1700*. OUP USA.

¹⁰ According to Takeda, the alarm bell over the destruction was rung in a pamphlet by former YSB staff member Yamada Hisao 山田寿雄 called 「敬礼! 横浜正金銀行資料始末記」; but I have not managed to locate a copy hereof.

¹¹ Relationships between the Institute and the Bank of Tokyo (BOT), the Yokohama Specie Bank's successor in the postwar era, have been close. Since the late 1950s, the Institute has housed the majority of research reports, statistics etc. compiled by the Yokohama Specie Bank's "Research Department" or *chōsabū* 横浜正金銀行調査部.

¹² See, for a history of the Rare Materials Reading Room, with particular mention of collections of business archives: http://www.lib.e.u-tokyo.ac.jp/?page_id=11

Importantly for our discussion, Takeda has also supervised a still-ongoing project aimed at the extensive disclosure of the YSB archives, including primary sources that were once deemed too sensitive to be included in the bank's earlier official histories.¹³ Microfilming started after 2003, after several years had passed for organizing the materials. Their current organization does not reflect the original order as thought out by the original archivist, but was determined by a combination of both logistical and commercial needs, i.e. on the basis of the plan to microfilm those parts which were considered of higher priority than others. And indeed, the release of large microfilm corpora (somewhat confusingly referred to as 'periods' or *ki* 期; hereafter, we will refer to them as 'series')¹⁴ can be said to be largely a function of their relevance to historians and, related to the latter, the collection's commercial appeal to university libraries.

For the discussion of this book, the following series have been of particular importance:

- Series I: in total 227 reels; containing among others YSB's business reports, YSB-related legislation, transcripts of board of directors meetings, shareholder meetings and meetings of the directors of Asian branches and
- Series II & III: respectively 156 reels and 163 reels; mostly focusing on the activities of and agreements among YSB branches, agreements with the Bank of Japan; and description of the economic situation within the respective regions of respective domains.¹⁵

¹³ One finds a discussion of the secrecy surrounding some of the YSB archives in a seminal work on the bank's activities in the interbellum, which is in itself the offspring of an academic working group: 山口和雄, and 加藤俊彦. 1988. 両大戦間の横浜正金銀行. 日本経営史研究所. The official histories are: 横濱正金銀行. 1920. 横濱正金銀行史. [私家複製版]. [横濱正金銀行]; 東京銀行. 1980-83. 横濱正金銀行全史. (6 vols.)

¹⁴ At the moment, 9 of such 'series' have been published, amounting to (at the estimate of Kojima Hiroyuki 小島浩之, head of the Rare Materials Reading Room) plusminus half of all YSB material.

¹⁵ For a more complete description of the series, see: http://kw.maruzen.co.jp/ln/mc/mc_doc/yokohama1.pdf; http://kw.maruzen.co.jp/ln/mc/mc_doc/yokohama2.pdf; and http://kw.maruzen.co.jp/ln/mc/mc_doc/yokohama3.pdf.

Being able to mine the granularity of daily exchange banking activity provided what could be called an ethno-historiographical insight that was necessarily absent from earlier literature, and turned out to be a extremely valuable feedback tool for movements in the data that did not warrant a straightforward explanation.

2. YSB semestrial reports

The marrow and bones of this book is composed on the basis of the Yokohama Specie Bank semestrial or ‘Midterm’ reports, called *hanki-hōkoku* 半季報告, or, originally, *kōkajō* 考課状 (literally ‘assessment report’), notably for the period January 1893 until July 1908.¹⁶ Although these reports occupy only a small part of the complete archival collection, their importance for our understanding of the activities and management of a late nineteenth century exchange bank can be hardly overestimated. Highly reliable for especially the period around 1900, they provide the necessary shortcut for inter-branch connections that would otherwise be painstaking to reconstruct, for instance on the basis of the ledgers of each individual branch.

At first sight, they have much in common with the business reports of other exchange banks of the time. Their very semestrial publication to start with was common among other exchange banks as, for instance, the *Hongkong and Shanghai Banking Corporation*, or the French *Comptoir d’Escompte*. Yet they do not have a unified format, which is due to the absence of internationally accepted accounting standards in the prewar period, shifts in management practices, and even the occurrence of certain political events. Just as is the case with HSBC reports and others, this makes their interpretation not always a straightforward matter (cf. *infra*).

In their most basic form, the Midterm reports almost all contain the following items:

¹⁶ They can be found in: 武田晴人. 2003. 横濱正金銀行 : マイクロフィルム版. 丸善. <http://ci.nii.ac.jp/ncid/BA70514593>. 第一期, reels E001-E018. Originals are kept in the Rare Materials Reading Room of the Faculty of Economics Library, UTokyo, boxes 32-42.

1. a balance sheet listing the bank's main assets and liabilities (mostly included as fold-out in the back-cover) (*kashakiri-taishōhyō* 貸借対照表)
2. a statement on the bank's shareholders fund; its reserve fund(s) (Jpn. *kabukin shotsumitatekin oyobi junbikin no koto* 株金諸積立金及準備金ノ事)
3. a statement on deposits (Jpn. *yokin no koto* 預金ノ事)
4. a statement of loans and bills discounted (Jpn. *kashikin oyobi tegata waribiki no koto* 貸金及手形割引ノ事)
5. a statement on its foreign exchange holdings and movements (Jpn. *kaigai kawase no koto* 海外為替ノ事)
6. a statement on inland bills (*naikoku kawase no koto* 内国為替ノ事)
7. a statement on rediscounting activity (*sai-waribiki tegata no koto* 再割引手形ノ事)
8. a statement on loans payable (*kari-irekin no koto* 借入金ノ事)
9. a statement on holdings of silver and gold money; cash on deposit (*kingin zaidaka oyobi yotakukin no koto* 金銀在高及預託金ノ事)
10. a statement on holdings of public loans and other securities (*kōsai shōsho no koto* 公債證書ノ事)
11. a statement on property (*shoyūbutsu no koto* 所有物ノ事)
12. a statement on holdings of gold and silver bullion and foreign currencies (*jigane gin oyobi gaikoku ka no koto* 地金銀及外国貨幣ノ事)
13. a statement of income derived from the selling and buying of stocks (*kabushiki baibai jōju no koto* 株式売買譲受ノ事)
14. a profit and loss statement (*son'eki kin no koto* 損益金ノ事); and
15. a statement with respect to the allocation of profits (*riekikin bunpaihō no koto* 利益金分配方ノ事)

For obvious reasons, the balance sheet (1) represents the gist of the bank's assets and liabilities for each respective semester. It aggregates the balance data that one can find broken down under categories (2)(3)(4)(7)(8)(9)(10)(11)(12)(13)(14)(15). Note, however, that (5) and (6) are *not* included here. The latter are *flow data*, meaning that they consist of origin-destination data documenting the flows or migration of assets acquired and liabilities incurred, within the bank's branch network. Because these data

comprise both assets and liabilities, they cannot conveniently be allocated under one of these categories. Rather, they help identify risks in interbranch dealings, in our case typically related to difficulties with regard to finding ‘matching funds’, the relative ‘exchange position’ of a branch within the network and so on. As we will see later, flow data are particularly revealing when assessing the characteristics of specific bank management systems.

In the case of the Yokohama Specie Bank (and, for that matter, in the case of any other exchange bank), flow data concern the transfer of both foreign (5) and inland (6) bills of exchange. Concretely, they document, on the basis of the distinction between ‘bills bought’ and ‘bills sold’, how branches exchange liabilities and assets among each other, and thus make it in principle possible to identify trade patterns between countries and/or regions. In later paragraphs we will discuss how the latter relate to the former.

第百貳拾九回貸借對照表

昭和拾九年參月參拾壹日現在

資 產 (借方)	金 額	負 債 (貸方)	金 額
債 權 勘 定	9,542,376,678 75	株 主 勘 定	252,300,690 30
政 府 貸 上 金	274,717 30	資 本 金	100,000,000 00
貸 付 金	3,196,798,762 69	積 立 金	148,000,000 00
滯 貨 金	1,798,280 30	特 別 積 立 金	2,500,000 00
當 座 貸 越	3,170,029,468 15	滯 貨 準 備 金	1,800,690 30
輸 出 爲 替 前 貸	218,218,704 49	債 務 勘 定	11,277,373,519 64
割 引 手 形	1,441,260,855 94	定 期 預 金	684,686,736 44
買 爲 替 手 形	294,176,503 50	當 座 預 金	2,724,500,433 87
利 付 爲 替 手 形	207,831,111 01	通 知 預 金	419,752,416 79
當 座 預 託 金	548,086,388 47	別 段 預 金	6,023,815,693 59
別 段 預 託 金	373,756,605 37	普 通 貯 金	23,382,671 69
公債元利支拂基預託金	96,120 16	据 置 貯 金	10,331,755 69
支拂承諾見返	60,049,161 37	軍票引換基預金	60,131 48
假 勘 定		公債元利支拂基預金	12,341,657 52
假 拂 金	794,637,768 88	手 形 內 入 金	39,870,583 93
他 店 勘 定		賣 爲 替 手 形	126,600,152 41
他 店 貸	60,196,898 44	借 用 金	251,771,695 74
公債並債券勘定	1,716,003,865 69	別 途 借 用 金	59,947,983 27
公 債 證 書	1,644,421,972 29	當 座 借 越	541,608,584 85
債 券	71,581,893 40	再 割 引 手 形	298,183,855 89
所 有 物 勘 定	20,922,127 48	引 受 軍 票	274,717 30
土 地	7,913,150 80	銀 行 券	195,287 81
建 物	11,488,746 30	支 拂 承 諾	60,049,161 37
什 器	809,152 50	假 勘 定	1,210,021,162 81
債權執行取得物件	711,077 88	未 拂 利 息	56,533,530 29
地金並外國貨幣勘定	5,769,669 37	未 經 過 益 割 戻	41,166,977 62
地 金	22,828 62	假 受 金	1,112,283,012 40
外 國 貨 幣	5,746,840 75	未 拂 配 當 金	37,642 50
金 銀 勘 定		他 店 勘 定	
現 金	635,888,721 19	他 店 借	6,000,374 11
合 計	12,775,795,729 80	損 益 勘 定	
		當 半 季 利 益 金	28,785,322 17
		(內 前 季 繰 越 金)	¥ 18,823,018.33
		爲替戻換算差金勘定	
		爲 替 戻 換 算 差 金	1,314,660 77
合 計	12,775,795,729 80	合 計	12,775,795,729 80

Fig. 1: a typical balance sheet in a Midterm report (this one from 1943, in the year Japan changed from the classical fiscal year (January-December) to the then newly used fiscal year (April-March). Courtesy of the National Diet Library.

3. Interpretative hurdles

This being said, the above accounting categories are not consistently uniform over time, or they are represented in a way that make longitudinal comparisons sometimes hard if not impossible. To a certain extent, this is to be expected. First of all, Mid-term report editing reflects the limitations imposed by the growing activity and corollary increase in the bank's branches worldwide. Especially after victory in the Russo-Japanese war, branches in Manchuria mushroom, in turn leading to further business activity in China proper, and so on. A comprehensive discussion of business activity for all branches would be a boon for business historians, but would at the time have made reports unnecessarily bulky. For later years, business results have therefore been aggregated by region, rendering a branch-level analysis much more difficult. The latter is also, to no small degree, an implication of a change in managerial style, which we shall discuss in later chapters.

Secondly, the midterm reports are to a certain extent a function of the political positioning of Japan and its institutions. As we will discuss further below, this has had –ironically– its fortunate implications for the discussion here. At a time when the country was factually too weak to unilaterally claim its place in the world order, YSB resorted to a sort of ‘news propaganda’¹⁷ that was carefully geared to the information-hungry investor in London, Paris, or any other global financial market.¹⁸ As

¹⁷ With a tip of the hat to: Akami, Tomoko. 2012. *Japan's News Propaganda and Reuters' News Empire in Northeast Asia, 1870-1934*. Dordrecht: Republic of Letters.

¹⁸ Although, to my knowledge, not being dubbed ‘news propaganda’ as such, a similar interest is at the core of several papers by Marc Flandreau. See, among others: Bignon, Vincent, and Marc Flandreau. 2011. “The Economics of Badmouthing: Libel Law and the Underworld of the Financial Press in France Before World War I.” *The Journal of Economic History* 71 (3): 616–53. <http://www.jstor.org/stable/23018333>; Flandreau, Marc, and Juan H. Flores. 2009. “Bonds and Brands: Foundations of Sovereign Debt Markets, 1820–1830.” *The Journal of Economic History* 69 (03): 646–84. doi:[10.1017/S0022050709001089](https://doi.org/10.1017/S0022050709001089); Flandreau, Marc, Norbert Gaillard, and Frank Packer. 2011. “To Err Is Human: US Rating Agencies and the

a result, early mid-term reports for 1893-1908 are very extensive, sensitively reflecting the market conditions that its branches faced, documenting the political and economic events that were to explain any volatility in its business record that to any extent could be considered extraordinary, and so on.¹⁹ Put differently, early reports cleverly play into the discourse of the European (mostly British) liberal economic ideas by which observers since the 1930s have wanted to remember the first gold standard period. It is beyond doubt that such reports would be followed by leading financial outlets of the day: subtly, but convincingly, YSB demonstrated to an international readership that its knowledge of the expanding Asian market, bolstered by its presence in all but the smallest trading centers in the region, was second to none, apart perhaps from the Hongkong and Shanghai Banking Corporation.

Alas, the darkening geopolitical climate of the twenties and thirties, and the economic and political bloc-ism that is so typical of the later period also reflected on the contemporary exchange banker's incentive to document business conditions, profits and/or losses, economic forecasts etc. The latter becomes painfully clear for the mid-term reports after 1931, the year in which rogue Japanese soldiers engineered the famous Mukden Incident (consequently drawing the country into a large-scale military operation in Manchuria) and set the stage for a collision course with the international community.²⁰ YSB official reports then instinctively followed a radical course *against*

Interwar Foreign Government Debt Crisis.” *European Review of Economic History* 15 (3): 495–538. doi:[10.1017/S1361491611000153](https://doi.org/10.1017/S1361491611000153).

¹⁹ As a matter of fact, the precision of the coverage in the reports between 1893 and 1908 was a topic at the first Meeting of the Managers of Asian Branches of YSB (*tōyō shitenchō kaigi* 東洋支店長会議; April 1908 at the Yokohama Head Office). Concretely, several managers worried that its foreign competitors might undertake a translation of the Mid-term reports, causing valuable “business secrets” of the bank to be “leaked” (*naibu no himitsu wo morasu osore ari* 内部ノ秘密ヲ洩ラス恐レアリ). 横濱正金銀行. 19--. 東洋支店長会議録. [横浜正金銀行]. <http://ci.nii.ac.jp/ncid/BN04887997>. P. 310. For HSBC too, secrecy was a continuing issue. See, especially: King, Frank H. H., and Frank H. H. King. 1987. *The Hongkong Bank in Late Imperial China, 1864-1902: On an Even Keel*. The History of the Hongkong and Shanghai Banking Corporation v.1. Cambridge [Cambridgeshire] ; New York: Cambridge University Press. Pp. 411-412.

²⁰ See, for an account of events: Ferrell, Robert H. 1955. “The Mukden Incident: September 18-19, 1931.” *The Journal of Modern History* 27 (1): 66–72. <http://www.jstor.org/stable/1877701>. The implications of the incident for Japan's international

transparency, for instance by aggregating results for all branches, and/or deceiving outsiders with respect to the accurate numbers of YSB foreign exchange holdings and so on.²¹ From flow-of-funds data, in particular, it is impossible to extract any meaningful information; the reports mention one total (and uncontrollable) amount of funds being transferred among branches, without any specifics.

4. The flow-of-funds between branches: construction of the dataset

As stated above, the latter is fortunately *not* the case for the mid-term reports that have formed the core of the following argument. Reports for the period under discussion are especially helpful as they provide non-aggregated data per *branch*, with clear indications of subcategories (as for instance types of deposits and their respective amounts, ...). For an analysis of the bank's flow-of-funds network (*shikin junkan* 資金循環), arguably the most defining feature of exchange banks, or, for that matter, all institutions selling trade insurance, we turned to the exceptionally rich flow data of foreign bills of exchange (*gaikoku kawase* 外国為替) and inland bills of exchange (*naikoku kawase* 内国為替), included towards the end of the Midterm reports. For every branch, here for matters of convenience called X, they are listed as follows:^{22 23}

posture thereafter are explored in: Nish, Ian. 2000. *Japan's Struggle with Internationalism*. 1 edition. London ; New York: Routledge.

²¹ This has been recently brought to light in: Miller, Edward S. 2007. *Bankrupting the Enemy: The U.S. Financial Siege of Japan before Pearl Harbor*. Annapolis, Md: Naval Institute Press.

²² Note that the "totals" in column 1, row 6 are not included in the original, but calculated by us; the Midterm reports do not mention total aggregates for the amounts of bills sold and bills bought, for reasons to which we will return; this is also valid for figure 3. We do however include it in anticipation of the simple formula needed to express, in a generic manner, the amounts of funds being transferred between branches as expressed in figure 4.

²³ T.T. stands for "telegraphic transfers"; we use it as such as it was a much employed abbreviation at the time.

1. Fig. 2: Bills sent from branch X to other branches:

		branch Y 支店	branch Z 支店	Total 合計
bills sold 買為替	bills of exchange 為替手形			
	T.T. 電信為替			
bills bought 売為替	bills of exchange 為替手形			
	T.T. 電信為替			
[Totals]		[amount a]		

2. Fig. 3: Bills sent from other branches to branch X:

		branch Y 支店	branch Z 支店	Total 合計
bills sold 買為替	bills of exchange 為替手形			
	T.T. 電信為替			
bills bought 売為替	bills of exchange 為替手形			
	T.T. 電信為替			
[Totals]		[amount b]		

For our analysis, however, a branch per branch organization of data is inadequate. Midterm report data have had to be organized into so-called ‘adjacency matrices’, or, in other words, into square matrices with as many rows and columns as there are actors (branches) in our data set. Also, the above distinction between foreign bills of exchange and inland bills of exchange cannot be maintained. Although strictly speaking different kinds of bills, a network analysis must treat them as necessarily isomorphic. After all, it concerns transfers of funds among branches, although obviously branches within Japan and thus transfers that do not imply a foreign exchange transaction.

Cells with a numerical value express 1) the existence of any relationship at all, and 2) the quantitative importance of that relationship, i.e. an amount being transferred between 2 branches. In the simple case of the aforementioned data for branches X, Y, Z of the above example, a typical spreadsheet looks as follows:²⁴

Fig. 4.: preparation of a spreadsheet for entries related to the flow-of-funds in a generic branch network with branches X, Y, Z

	A	B	C	D	E	F	G	H	I	J	K	L	M
1		X				Y				Z			
2	X	BS	b/e			BS	b/e	a		BS	b/e	a'	
3			TT				TT	b			TT	b'	
4		BB	b/e			BB	b/e	c		BB	b/e	c'	
5			TT				TT	d			TT	d'	
6	Y	BS	b/e	a''		BS	b/e			BS	b/e	a'''	
7			TT	b''			TT				TT	b'''	
8		BB	b/e	c''		BB	b/e			BB	b/e	c'''	
9			TT	d''			TT				TT	d'''	
10	Z	BS	b/e	a''''		BS	b/e	a''''		BS	b/e		
11			TT	b''''			TT	b''''			TT		
12		BB	b/e	c''''		BB	b/e	c''''		BB	b/e		
13			TT	d''''			TT	d''''			TT		

²⁴ The complete spreadsheets related to YSB's flow of funds have been formatted in this manner and were uploaded to figshare: Schiltz, Michael (2017): Yokohama Specie Bank flow-of-funds data, 1893-1908 I (originals) [multiple file formats, including .xlsx, .csv, and .pdf]. Figshare. <https://doi.org/10.6084/m9.figshare.4059786.v3> Retrieved: 14 06, May 31, 2017 (GMT); Schiltz, Michael (2017): Yokohama Specie Bank flow-of-funds data, 1893-1908 II (originals) [multiple file formats, including .xlsx, .csv, and .pdf]. These matrices contain calculations of the amount of funds transferred.. Figshare. <https://doi.org/10.6084/m9.figshare.4059807.v3> Retrieved: 14 08, May 31, 2017 (GMT); Schiltz, Michael (2017): Yokohama Specie Bank flow-of-funds data, 1893-1908 III (originals) [multiple file formats, including .xlsx, .csv, and .pdf]. These matrices contain calculations of the amounts of funds transferred, and their conversions into Japanese yen.. figshare. <https://doi.org/10.6084/m9.figshare.4059843.v3> Retrieved: 14 09, May 31, 2017 (GMT).

Notes:

- on abbreviations: BS: 'bills sold', BB: 'bills bought', b/e: 'bills of exchange', TT: 'telegraphic transfers'
- white cells contain 1) the amounts (a, b, c, d) as can be found in the Midterm Reports;
- the column next to the values amounts (a, b, c, d) is a) used for the inclusion of other types of bills (e.g. interest bills), some of which were –for reasons to be discussed– not included in the flow data, but mentioned under the balance data on 'loans and bills discounted. It is also used b) for calculations (aggregations/subtractions; conversions)

In simplified form, i.e. after the calculation of the total amount of funds transferred (as we shall see later, this is *not* the same as the aggregate of bills bought and bills sold (cf. infra)), this would amount to:

Fig. 5: a typical adjacency matrix for a simple banking network with 3 branches (X, Y, Z)

	X	Y	Z
X		[amount a] ↗	
Y	[amount b] ↖		
Z			

The direction is important: it must be remembered that in network analysis, by convention, the direction goes from from the *rows* to the *columns*; in the above matrix, we have therefore added the upwardly curving arrow. Hence, the flow from X to Y, which we generically defined as [amount a] in figure 2 can now be found as [amount a] in the second row, third column, under Y; *vice versa*, the flow from Y to X, defined as [amount b] in figure 3 can be found on row 3, column 2, under X. Note furthermore that we do, for obvious reasons, not allow flows from branches to themselves (so-called self-loops). As it concerns flows-of-funds within a banking network, we only want to consider transfers between different branches. Hence the diagonal can be left blank, filled with zeros, or represented as a concatenation of black cells. As we assume that matrix values can be zero or negative (as for instance in the case of a certain branch 'drawing' on another) (cf. infra), we prefer to represent the diagonal in black: after all, a

zero amount might as well imply that amounts sent and amounts received cancel each other out.

As a last remark, we add that the size of the matrices differs over time. This has to do with the growth of the YSB branches network: whereas, in the early 1890s, YSB had a limited number of branches in several of the world's financial centers, the number grows to include a lot of branches in relatively minor trading centers in the early 1900s, mostly in China and Manchuria.

5. A methodological issue: Amounts of bills sent or amounts of funds being transferred?

But how did nineteenth century exchange business work? How do we deal with the character of types bills listed in figure 2 and 3, but —for reasons of analytical convenience— left out of figure 4? As we have seen, bank branches sent both 'bills sold' (to importers in their country of location) and 'bills bought' (from exporters in their country of location) to each other. Can we conveniently aggregate these amounts in order to calculate the relative exchange position of certain branches within our network? Although this is certainly tempting, and may even be legitimate depending on the research question, for instance in the case of measuring *activity* at branches,²⁵ it is problematic in view of the accounting technicalities that were valid at the time.

²⁵ This was the subject of a first (and flawed) attempt at analysis. See: Schiltz, Michael. 2016. "Yokohama Specie Bank Flow-of-Funds Data, 1893-1908 (originals) [multiple File Formats, Including .xlsx, .svg, and .pdf]." https://figshare.com/articles/Yokohama_Specie_Bank_flow-of-funds_data_1893-1908_originals_multiple_file_formats_including_xlsx_svg_and_pdf_/4059786.

As noted by Ishii (still the most authoritative source on this matter),²⁶ *bills bought* is the category signifying a positive transfer of funds, as branch X, after buying a bill from an exporter in the country of X, sends it on to branch Y, which books it as a 'bill for collection' (*daikin toritate tegata* 代金取立手形). At maturity, it collects the money as 'adverse exchange' (*gyaku kawase* 逆為替 or, alternatively, *toritate kawase* 取立為替) from an importer in the country in which Y is located, and books the bill to its asset side as a 'bill collected'. In the case of export bills, *money thus follows*, or in other words, has the same direction of, *the goods*. In the case of *bills sold*, however, the direction of the transfer is reversed. Branch X sells a bill to an importer of country X (so the latter can remit his payment to an exporter in country Y), and receives an amount of domestic currency for the latter. Branch Y is in charge of the pay-out into to the account of the exporter in the country of Y, and therefore deals with the bill as a 'bill payable'. Clearly, the latter operation implies a transfer of funds from branch Y to branch X, or, in other words, a 'negative transfer'.²⁷

In its most rudimentary or pure form, i.e. when leaving out the concerns with relative liquidity, differences in institutional set-up and other dissimilarities, the direction of the flow of funds related and indication of a positive versus negative fund flow (+/-) between two countries would look as follows:

²⁶ Ishii Kanji 石井寛治. 1999. *Kindai nihon kin'yū-shi josetsu* 『近代日本金融史序説』. 東京大学出版会, esp. pp. 245 ff. A reconstruction of YSB's flow-of-funds has been attempted by many others, with varying degrees of success. As said in the introduction to this chapter, Taira's groundbreaking study is the first to bring a network theoretical understanding to YSB, but it unfortunately eliminated the data related to the interest bills (not included in the flow data for accounting reasons). Because the amount of interest bills is substantial, his analysis is not only mistaken with respect to the weight of transfers, but also with respect to their direction. This issue is given attention when discussing interest bills (chapter ?????????????). 平智之. 1984.

「第1次大戦前の国際金本位制下における横浜正金銀行-日銀の兌換制維持政策との関連において-上-」 『金融経済』, no. 208 (October): p41-81. <http://ci.nii.ac.jp/naid/40000792001>; 平智之. 1984. 「第1次大戦前の国際金本位制下における横浜正金銀行-日銀の兌換制維持政策との関連において-下-」 『金融経済』, no. 209 (December): p1-27. <http://ci.nii.ac.jp/naid/40000792007>.

²⁷ For a concise theoretical exploration hereof in accounting technical terms, see: 足立禎. 1970. 「<論説>外国為替決済勘定: 'Nostro', 'Vostro'および'Loro' Accountについて。」 『商學討究』 21 (2): 1-20. <http://ci.nii.ac.jp/naid/110000231064>..

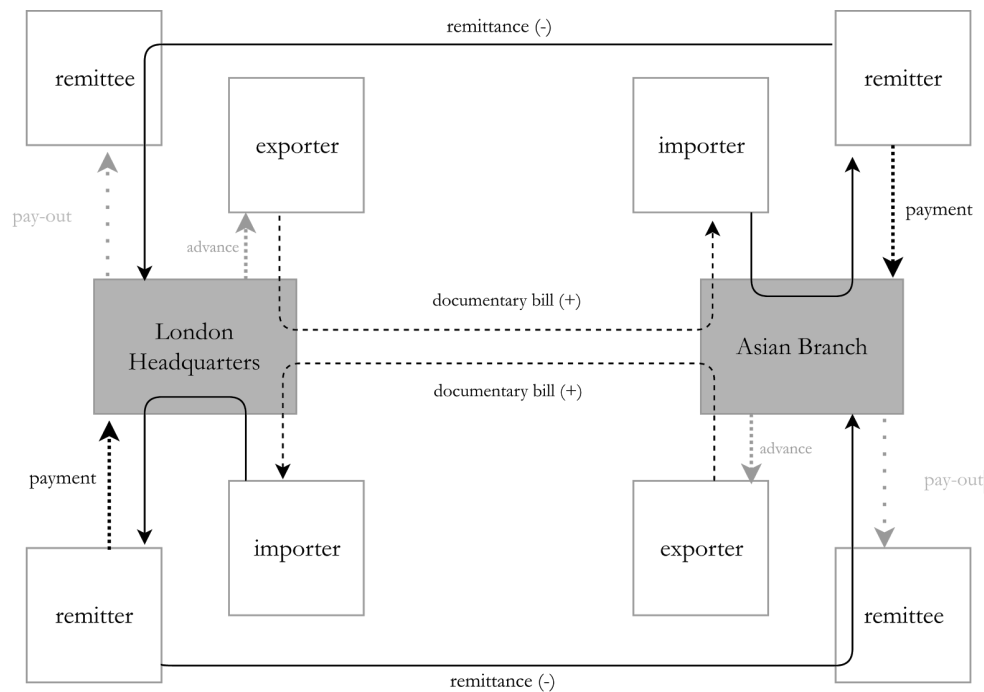


Fig. 6: International trade finance in a symmetric two country world

- Source: After: 鈴木俊夫. 2005. “オリエンタル銀行設立の一齣.” 三田商学研究 48 (5): 41–61. <http://ci.nii.ac.jp/naid/120000800144>. P. 50.

Compare as well: Suzuki, Toshio. 2012. “The Rise and Decline of the Oriental Bank Corporation, 1842–84.” In *The Origins of International Banking in Asia*, edited by Shizuya Nishimura, Toshio Suzuki, and Ranald C. Michie, 86–106. Oxford University Press. <http://www.oxfordscholarship.com/view/10.1093/acprof:oso/9780199646326.001.0001/acprof-9780199646326-chapter-4>. P. 93
- Note: as the reader may realize, the inclusion of a *remitter* respectively *remittee* is strictly speaking not required. Importers and exporters can deal directly with a branch of an international bank. We do include them, however, in order to allow for a situation in which these dealings were mediated by yet another institution. Historically, this was the case in India, where the Presidency Banks played the role of middlemen. In the metropolis, one may think of the role of clearing and merchant banks, whose ‘signing across’ (an expression of the promise to pay the bills at maturity) raised a bill’s creditworthiness, so the latter could easily be sold in the London discount market. Their ‘reputability’ was, in other words, integral to the smooth functioning of the mechanism of bill finance.

See: Brunyate, James Bennett. 1900. *An Account of the Presidency Banks*. Office of the Superintendent of Government Print.

Suzuki, Toshio. 2012. “The Rise and Decline of the Oriental Bank Corporation, 1842–84.” In *The Origins of International Banking in Asia*, edited by Shizuya Nishimura, Toshio Suzuki, and Ranald C. Michie, 86–106. Oxford University Press. <http://www.oxfordscholarship.com/view/10.1093/acprof:oso/9780199646326.001.0001/acprof-9780199646326-chapter-4>. P. 92.

This is, of course, an oversimplification and distortion of the historical reality. As explained in the preface and further explored in chapter ???, differences between capital markets in the core and those in the periphery were both numerous and enormous. They do not warrant the assumption that the finance of export to and import from the periphery would be the perfect mirror image of the finance of export to and import from the core countries.

We refer to the other chapters for the evolution of trade finance between Europe and Asia after 1870, but it is important to note here that, when calculating the flow of funds between branches, *one should subtract the amount of bills sold* (both bills of exchange and telegraphic transfers) *from the amount of bills bought* (again: both bills and telegraphic transfers). Returning to figure 4 and 5, calculating the flow of funds from will look as follows:

Fig. 7: calculating the flow of funds in a simple banking network with 3 branches (X, Y, Z)

	X	Y	Z
X		$(c+d) - (a+b) \text{ ‡}$	
Y	$(c''+d'') - (a''+b'') \text{ ‡}$		
Z			

The latter is crucial, as it factually makes it possible to conceive of net ‘negative’ flows or transfers. Such negative transfers are obviously the case in the event a branch ledger shows an amount of bills sold that was higher than the amount of bills bought, or, in other words, in the event a branch has engaged itself more in import- rather than export-finance *vis-à-vis* another branch.

This, in turn, endorses the ethno-historiographical problem consciousness that informs the book’s findings in the first place. YSB management expressed continuous concern about the fact that certain branches (for instance the Lyon branch for a large part of its history) were chronic net ‘withdrawers’, exactly because of persistent trade imbalances between such branches with other branches in the network. And

consequently, this demanded ever more creative ways to provide ‘matching funds’ (*kawase deai* 為替出合), e.g. through aggressively expanding its deposit base or else. Only in this way would the bank be possible to close (*kanketsu* 完結) its exchange circle, rather than have to rely on more costly arrangements with its network of correspondent banks.

Again referring to the discussions in the chapters, the accounting surrounding the above calculations is a little bit more complicated. As we have seen in chapter ????, the use of *interest bills* demand yet a different type of attention. Here, we simply point out that they should be added to the amounts of bills bought (i.e. they too constitute a positive transfer), because they stipulated that they were to be collected at the receiving end.

5. Fund-matching & Exchange Position

Returning to the vocabulary and thinking of social network analysis, the ultimate objective of the database has been to capture our exchange bank’s network of branches in terms of each node’s above-described ‘fund-matching’ *vis-à-vis* the network as a whole. Put simply, the questions are 1) whether, how, and to which degree we can define a branch’s position as ‘positive’ or ‘negative’ at a point in time, and 2) how we can describe this position longitudinally, i.e. over time.

As we only want to calculate the relative share of each and every node in closing the bank’s exchange cycle, we can suffice with a very straightforward measure. We aggregate the amounts of funds a certain branch *i* in the network sent to all other branches of the network (again: taking into account the bookkeeping technicalities laid out in earlier paragraphs), and deduct from the latter the total amounts of funds sent by all other branches of the network to branch *i*. Note that the latter gives us a (positive or negative) number for any branch in any semester. This number —which is, by definition, the *inverse of a branch’s exchange position* at semester_n— functions as the indicator of a

branch's contribution to providing exchange cover on the branch network. Branches with a positive number are 'givers', i.e. they enable other branches to accumulate net surpluses. *Vice versa*, branches with a negative number are net 'takers' or, in extreme cases, 'sinks', causing other branches to experience a drain on their capital. We call the ranking of every branch at any semester_n the 'flow-of-fund index' (FoF-index).

Returning to our simple matrix of a branch network existing of three branches (see figure 4), for node X, we subtract the sum of 'total amounts received' (in dark grey: SUM2) from the sum of 'total amounts sent' (in light grey: SUM1):

Figure 8: calculating the exchange position of branch X in a simple 3-branch network (X, Y, Z) at semester_n

	X	Y	Z	
X		X→Y : (bills bought minus bills sold)	X→Z : (bills bought minus bills sold)	SUM1: (X→Y)+(X→Z)
Y	Y→X: (bills bought minus bills sold)		Y→Z: (bills bought minus bills sold)	
Z	Z→X: (bills bought minus bills sold)	Z→Y: (bills bought minus bills sold)		
	SUM2: (Y→X)+(Z→X)			

The methodological innovation of this book lies with the realization that this can be done *for every branch* and *for every semester*, and thus allows for the construction of a time series, which describes the evolution of any branch's FoF-position over time. This can be found in the following table:²⁸

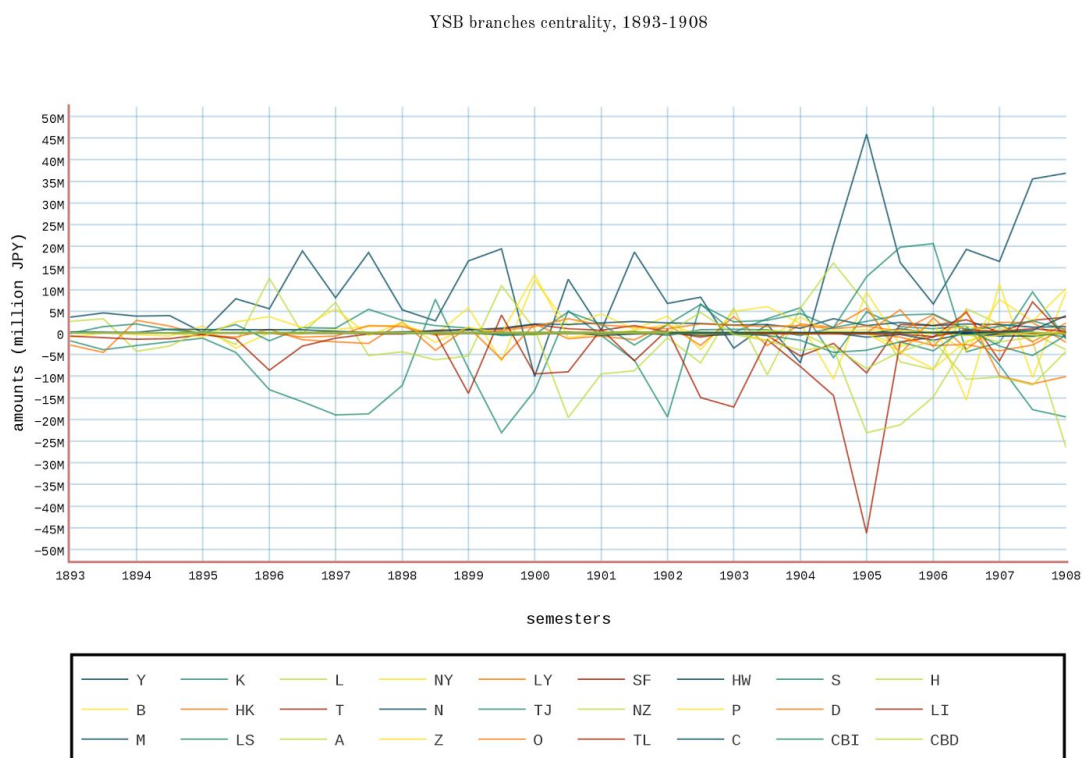
²⁸ For Yokohama Specie Bank data material for longitudinal visualization, see: Schiltz, Michael (2015): centrality tests YSB 1893-1908.xlsx. **figshare**.
<http://dx.doi.org/10.6084/m9.figshare.1309394>. Retrieved 09:39, Feb 14, 2015 (GMT)

Fig. 9: calculating the FoF-positions of branches in a simple 3-branch network (X, Y, Z) at several intervals (semesters)

	semester _n	semester _{n+1}	semester _{n+2}	...
X	$(X \rightarrow Y + X \rightarrow Z) - (Y \rightarrow X + Z \rightarrow X)$	
Y	$(Y \rightarrow X + Y \rightarrow Z) - (X \rightarrow Y + Z \rightarrow Y)$	
Z	$(Z \rightarrow X + Z \rightarrow Y) - (X \rightarrow Z + Y \rightarrow Z)$	

In the concrete case of the Yokohama Specie Bank, the FoF-index for the period between January 1893 and July 1908 can be visualized as follows:

Fig. 10: YSB branches FoF-index, 01-1893 - 07-1908



Legend: Y: Yokohama Head Office; K: Kobe; L: London; NY: New York LY: Lyon; SF: San Francisco; HW: Hawaii; S: Shanghai; H: Hankow; B: Mumbai (Bombay); HK: Hong Kong; T: Tokyo; N: Nagasaki; TJ:

Tianjin; NZ: Niuzhang; P: Beijing (Peking); D: Dairen; LI: Liaoyang; M: Mukden; LS: Lushun; A: Andong; Z: Yantai (Chefoo); O: Osaka; TL: Tieling; C: Changchun; CBI: correspondent banks (international); CBD: correspondent banks (domestic).

As a descriptive statistic, the above graph already contains some important clues to later findings. We note, first of all, a few instances in which the FoF-position of a certain branch is the approximate mirror image of another one, as for London and Lyon for the period around 1894, or for Yokohama and Tokyo in 1905. Second, it is striking that, for the whole period of analysis, the FoF-position of most branches constantly hovers around zero. For those branches, the amounts of bills bought is close to the amount of bills sold, i.e. their exchange position is more or less squared. Branches with values that are substantially plus or minus are a minority. However, these branches are 1) invariably located in major exchange centers, and 2) probably unsurprisingly, also mostly remain plus or minus throughout the whole period.

At the same time, however, the graph leaves important question marks. Not in the least, it is impossible to gain insights from the branch network as a whole, especially after 1897, when the Japanese branches turn their original silver unit of account into a gold one. And most importantly, the sharp increase of bank branches in the later period, mostly in the wake of the Russo-Japanese War of 1905 makes the graph difficult to read: the overlapping of values of branches in China and Manchuria appear as a tangled knot.

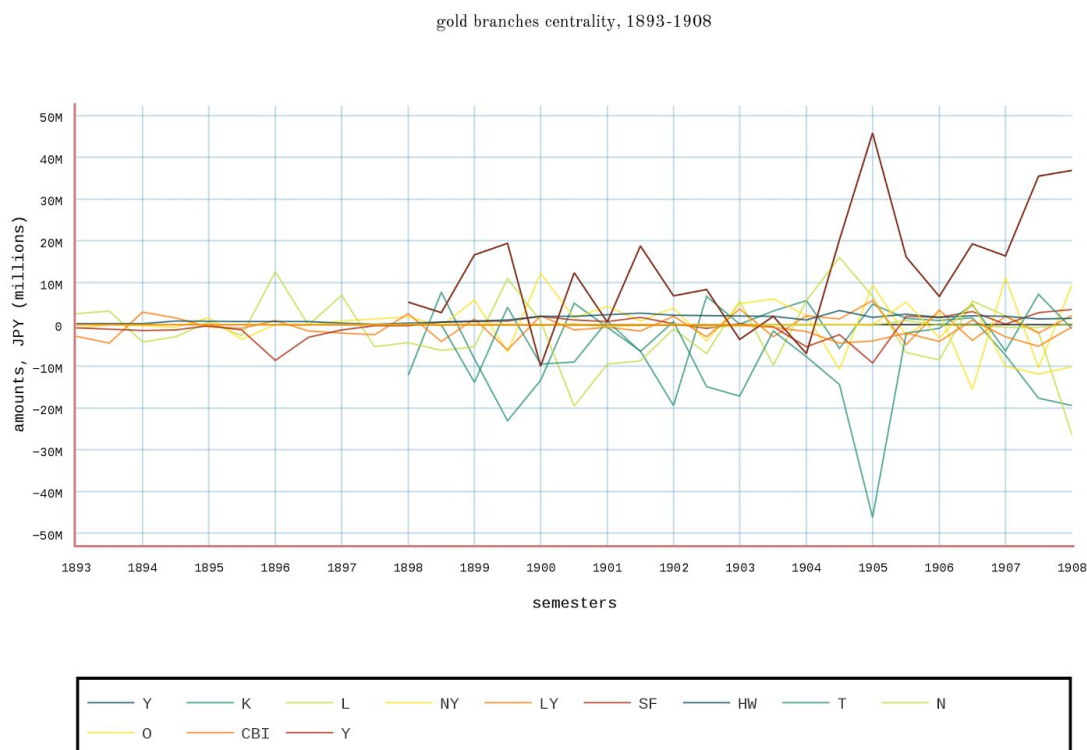
Although this clearly necessitated further analysis, it was not always obvious how to proceed. Descriptive evidence of exchange banking practice has turned out to be scarce, and what one finds as commentaries in newspapers at the time may be misleading. More often than not, the success of certain bank managers or chairmen in reading the course of the exchange has been inflated. One must only think of a moniker as “Lucky Jackson”²⁹ to understand how contemporaries (just as today) were inclined to ascribe a bank’s success to the chutzpah of its managers rather than the dictates of management practice. As this is reflected in many of the banking histories we possess,³⁰

²⁹ In reference to Sir Thomas Jackson, the third chief manager of the Hongkong and Shanghai Banking Corporation.

³⁰ It is appropriate not to include any references here. A singular exception to the latter, however, is the aforementioned: Muirhead, Stuart. 1996. *Crisis Banking in the East: The*

we were, out of necessity, the proverbial blind men touching the elephant in order to gain an understanding of its looks. Isolating the gold branches from the silver ones was, we believed, a legitimate and self-evident, although not very insightful, step.

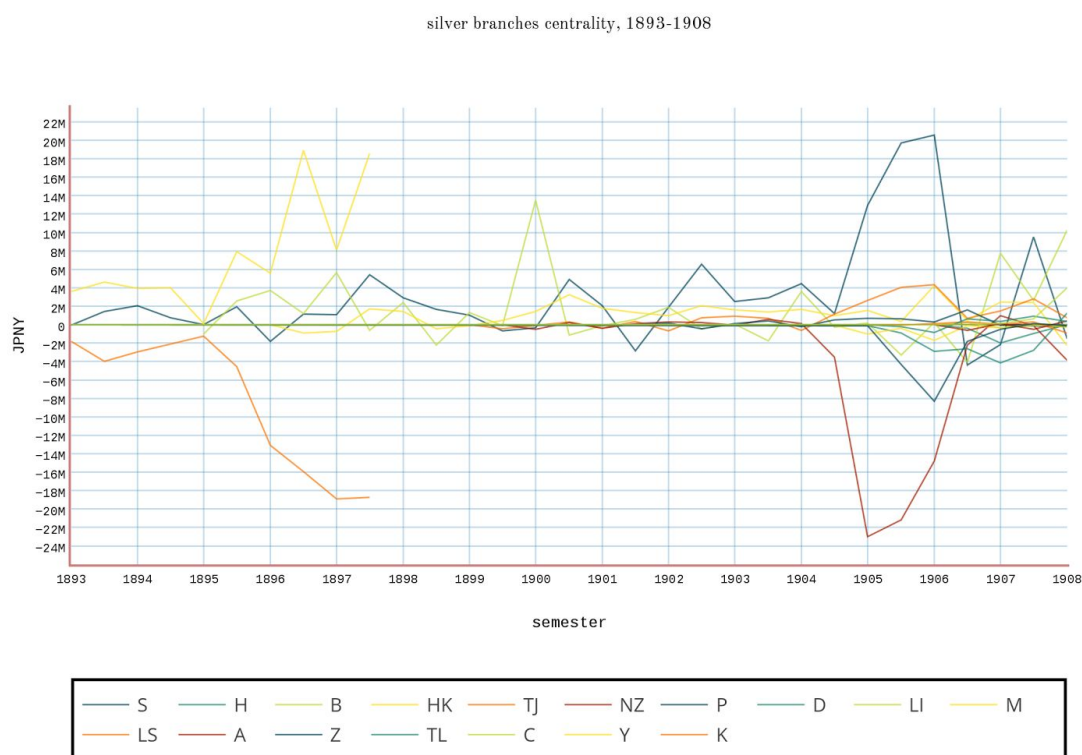
Fig. 11: YSB gold branches centrality, 01-1893 - 07-1908



Legend: Y: Yokohama Head Office; K: Kobe; L: London; NY: New York LY: Lyon; SF: San Francisco; HW: Hawaii; S: Shanghai; H: Hankow; B: Mumbai (Bombay); HK: Hong Kong; T: Tokyo; N: Nagasaki; O: Osaka; CBI: correspondent banks (international).

Fig. 12: YSB silver branches centrality, 01-1893 - 07-1908

History of the Chartered Mercantile Bank of India, London, and China, 1853-93. Aldershot, Hants, England : Brookfield, Vt., USA: Scolar Press ; Ashgate Pub. Co. Esp. chapter 9, “The Mechanics of the Bank’s Business, 1854-93”, pp. 199-232.

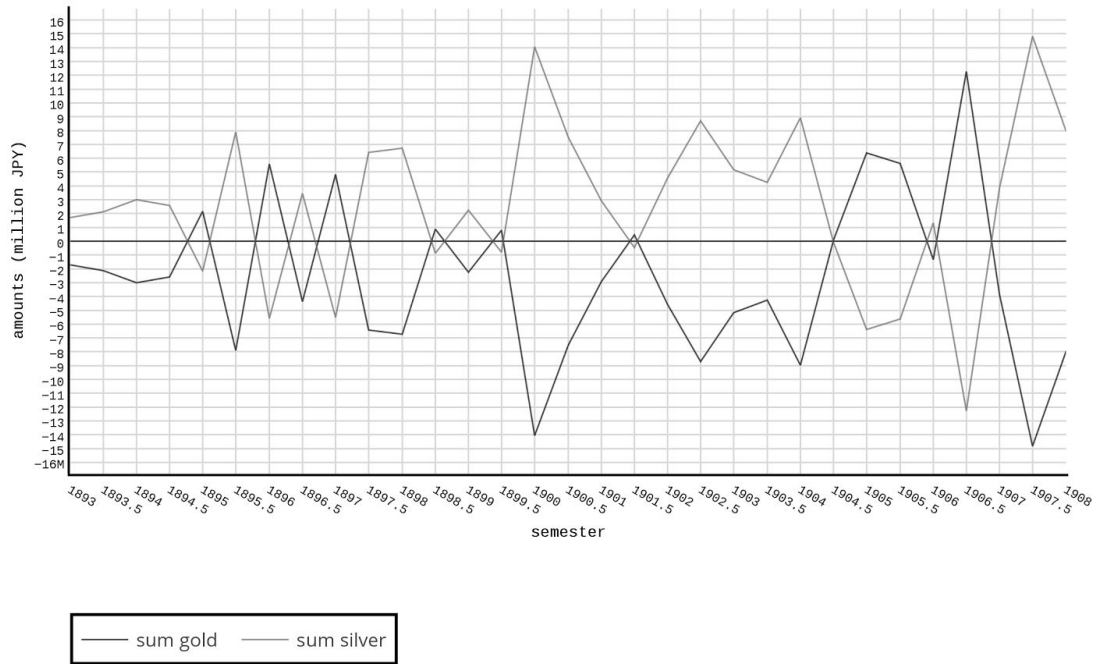


Legend: S: Shanghai; H: Hankow; B: Mumbai (Bombay); HK: Hong Kong; T: Tokyo; N: Nagasaki; TJ: Tianjin; NZ: Niuzhang; P: Beijing (Peking); D: Dairen; LI: Liaoyang; M: Mukden; LS: Lushun; A: Andong; Z: Yantai (Chefoo); TL: Tieling; C: Changchun; Y: Yokohama Head Office; K: Kobe.

Ultimately, however, the lively debate in the North China Herald (see chapter ???) made it clear that a hedging strategy, if in place, would have to shield the bank's operations against exchange risk arising from bill operations resulting in the holding of silver assets/liabilities. Indeed, plotting the aggregated FoF-position of branches of the gold area versus those of the silver area raised important issues with respect to accounting practices:

Fig. 13: YSB on an 'even keel' -plotting the FoF-position of aggregated gold branches and aggregated silver branches.

YSB on an even keel, 1893-1908



The descriptive analysis of this graph, in close relationship with the accounting workflow associated with certain types of bills, has therefore been at the heart of several chapters. First in chapter ???, and then in chapter ???, we have explored how contractual specifications relate to late nineteenth century strategies for hedging exchange risk.

6. Visual Presentation of Branch Relationships on the Cross-Sectional Level: ‘Multi-Dimensional Scaling’ Versus ‘Graph Layout Algorithms’

Given that we aim to discuss the flow-of-funds comprehensively, our analysis cannot be confined to the branch network level (*intra-network*), but should also take into account relationships between specific branches within the network (*inter-branch*), and this at

selective points in time. As we know that these relationships were modified according to short- and medium term needs (for instance: changes of unit of account of Japanese branches, extension of the branch network in silver-China etc.), this also implies a shift of focus from the longitudinal to the *cross-sectional* or *synchronic* dimension.

Speaking in strict accounting terms, one could suffice with a discussion of how inter-branch transfers affect the balance-sheets of all branches involved; and indeed, given the mere complexity of calculations in case the latter cannot be largely automated, this is how Japanese business historians have proceeded. Typically, they aggregated the balance sheet surpluses/deficits on the national level (and mostly into yearly rather than semestrial data), in order to obtain a two-dimensional representation of the flow-of-funds that is quite straightforward in terms of interpretation; snapshots of flow-of-funds can then be compared over time, i.e. by comparing them at fixed intervals, or as representative of periods in the bank's management history.³¹

As already hinted to above, however, contemporary advances in social network analysis have been impossible to ignore. Or perhaps it has been the sharply enhanced computability coming with corollary software packages that has made all the difference. Whereas SNA-central notions as 'centrality', 'connectedness', etc.³² have been mathematically defined a long time, sometimes decades ago,³³ it is nowadays possible to explore their significance for networks containing several thousands, even millions of nodes.

Of particular importance for our discussion has been the literature with respect to the visualization of proximity matrices in order to explore the structural set-up of networks at particular points in time. The number of incoming connections ('in-degree'), the amount of outgoing connections ('out-degree'), the degree to which nodes are connected to other nodes that are themselves well connected, and so on, all factor in a node's position among other nodes of the network. Designing algorithms that

³¹ See, in this respect, footnote ????

³² For an overview of the debate, see: John Scott, Peter J. Carrington. 2011. *The SAGE Handbook of Social Network Analysis*. London ; Thousand Oaks, Calif: SAGE Publications Ltd.

³³ Prell, Christina. 2011. *Social Network Analysis: History, Theory and Methodology*. Los Angeles ; London: SAGE Publications Ltd.

rank similarities have been instrumental in the visualization of how a node or ‘ego’ is embedded within its ‘neighborhood’ (the actors that are connected to ego, and their connections to one another) and to the larger graph (is ego an ‘isolate’ within the network, or a ‘pendant’?). In the case of our bank branch network, it may reveal...

- 1) ...which nodes were given more power than others to decide on the distribution of balance sheet imbalances in order to achieve the matching of gold and silver liabilities on the network level;
- 2) concretely, which nodes were in charge of flattening out or smoothing imbalances within currency clusters; and...
- 3) ...which nodes were pendants, i.e. branches at the very edges of the bank’s foreign exchange operations, in that they were characterized by a very small in- and/or out-degree (called *source vertices* respectively *sink vertices*).

Traditionally, multidimensional scaling or MDS has been used for these purposes.³⁴ Put simply, the MDS algorithm of a square item-by-item proximity matrix determines coordinates for each item in an k-dimensional (typically: two-dimensional) space such that the *Euclidean* distances among the points most fittingly approximates the input proximities. Input proximities are typically differentiated between similarities and dissimilarities. In the case of dissimilarities (e.g. geographic distances), the relationship between input proximities and the Euclidean distances on the MDS map are, for obvious reasons, positive: larger input proximities correspond to larger map distances; in the case of similarities, the same relationship is negative. Further

³⁴ Torgerson, Warren S. 1958. “Theory and Methods of Scaling.” <http://psycnet.apa.org/psycinfo/1959-07320-000>; Torgerson, Warren S. 1952. “Multidimensional Scaling: I. Theory and Method.” *Psychometrika* 17 (4): 401–19. <http://link.springer.com/article/10.1007/BF02288916>; Torgerson, Warren S. 1965. “Multidimensional Scaling of Similarity.” *Psychometrika* 30 (4): 379–93. <http://www.springerlink.com/index/h82o64ox289mj6o2.pdf>; Torgerson, Warren S. 1961. “Distances and Ratios in Psychophysical Scaling.” *Acta Psychologica* 19: 201–5. <http://www.sciencedirect.com/science/article/pii/S0001691861800723>.

specifications, for instance metric and nonmetric MDS, are still possible.³⁵ However, the point is that MDS representations must always be compatible with the defining characteristics of *Euclidean* space.

It will not come as a surprise that, when working with data that do not fit the limitations of these criteria, MDS representations suffer from considerable drawbacks. Analyses in the social and cultural domain, especially when the focus is on flows or transfers among nodes -as in the case of a flow-of-funds analysis-, often pose problems defying the constraints of Euclidean order. As we analyze a bank branch network in which all nodes are reasonably similar in that they have relationships to at least a few other nodes, and in which the number of nodes is still limited, *dimensionality* and *outliers* are thereby not so much of a problem.³⁶ Things that do matter, however, are issues of *transitivity* and *symmetry*.

Transitivity is otherwise referred to as triangle inequality, “which states that $d(i,j) \leq d(i,k) + d(k,j)$. This means that if an object k is close to both i and j , then in a Euclidean (e.g., physical) space there is a limit to how far away i and j can be from each other. Data in which the relationships among the items are not so constrained simply cannot be represented in a Euclidean space without distortion.”³⁷ Put in other words, the relationship between two relatively similar nodes (a,b) will be constrained in case there exists yet another node (c) that is considered similar to one of the above, yet dissimilar to the other: c cannot be close to a and far from b , because a and b are close to each other. Its consequences for the analysis of large-scale social networks are pertinent. Think, for instance, of a network that has introduced a three-tiered decision-making

³⁵ For some very good introductions, see: Kruskal, J. B. 1964. “Nonmetric Multidimensional Scaling: A Numerical Method.” *Psychometrika* 29 (2): 115–29. doi:[10.1007/BF02289694](https://doi.org/10.1007/BF02289694); Kruskal, J. B. 1964. “Multidimensional Scaling by Optimizing Goodness of Fit to a Nonmetric Hypothesis.” *Psychometrika* 29 (1): 1–27. doi:[10.1007/BF02289565](https://doi.org/10.1007/BF02289565); Kenkel, N. C., and L. Orlóci. 1986. “Applying Metric and Nonmetric Multidimensional Scaling to Ecological Studies: Some New Results.” *Ecology* 67 (4): 919–28. doi:[10.2307/1939814](https://doi.org/10.2307/1939814).

³⁶ For an evaluation of both MDS as graph layout algorithms for visualizing social network data, see: DeJordy, Rich, Stephen P. Borgatti, Chris Roussin, and Daniel S. Halgin. 2007. “Visualizing Proximity Data.” *Field Methods* 19 (3): 239–63. doi:[10.1177/1525822X07302104](https://doi.org/10.1177/1525822X07302104).

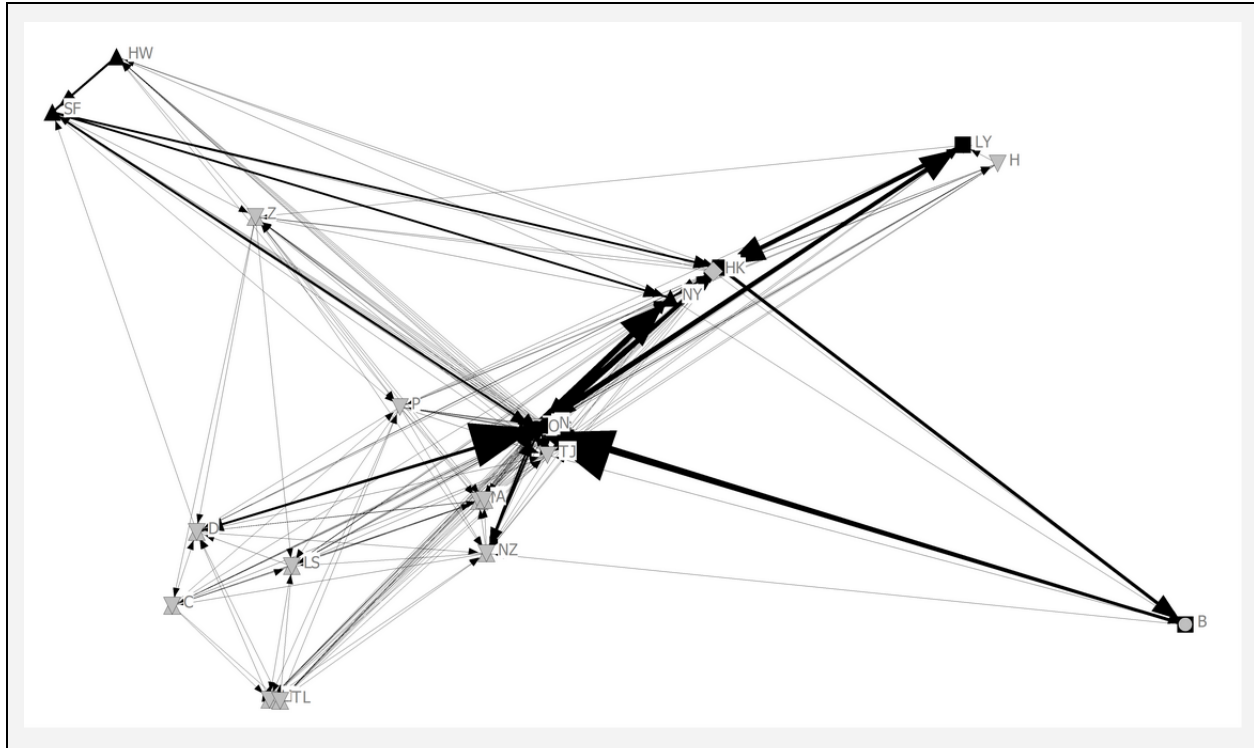
³⁷ DeJordy, Rich, Stephen P. Borgatti, Chris Roussin, and Daniel S. Halgin. 2007. “Visualizing Proximity Data.” *Field Methods* 19 (3): 239–63. doi:[10.1177/1525822X07302104](https://doi.org/10.1177/1525822X07302104). P. 255.

structure which leaves considerable variation in the organizational set-up among elements within each tier (our bank branch network after 1905): the stress-factor to be introduced in order to enable visualization might not be very large, but will be significant enough to hamper interpretability of the graph. As Euclidean distance is everything, MDS might very well create ambiguity with respect to the position of both dissimilar and similar nodes, a problem that is only exacerbated when the amount of items analyzed is increased.

Another, equally central property of Euclidean distances is symmetry, which states that the distance from a to b is the same as the distance from b to a. For many analyses in the socio-cultural domain, this is unproblematic, as the data are inherently symmetric. However, in case one deals with data sets consisting of semantic directional relationships ('is cause of', 'takes precedent over', etc.) or, relatedly, directional data (origin-destination data like money flows, ...), the resulting asymmetry ($A \rightarrow B \neq B \rightarrow A$) poses challenges not unlike the ones described in paragraph above. As noted long ago, the only way MDS can accommodate the asymmetry is by spreading out the error, i.e. locate so that their distance is construed as a compromise of the input proximities.³⁸ Again, MDS has a tendency towards obfuscating the location of points, possibly suggesting implicit explanations for certain constellations, whereas such interpretation need not exist at all.

Fig. 12 MDS plot of the Yokohama Specie Bank branch network for the period July 1907 - December 1907. The MDS algorithm performs very well in showing the grouping or clustering of branches in terms of currency type. Typically San Francisco (SF) and Hawaii (HW) are represented as very similar, just as the Manchurian branches (perhaps with the exception of Chefoo, the place of which is determined by its dissimilarity from the other Manchurian branches, rather than its similarity to, say, San Francisco). Remark, however, that the MDS algorithm is particularly weak in handling triangle inequality. In order to represent the axis of central (and close or similar) branches, it compresses the triangular relationships among these branches into a flat bow-like structure, thereby obscuring the location of several crucial nodes, as, for instance, London, Kobe and Shanghai.

³⁸ Kruskal, Joseph B., and Myron Wish. 1978. *Multidimensional Scaling*. SAGE Publications. P. ?????



For the above reasons, our discussion does not employ MDS, but relies on force-directed drawing (FDD) algorithms, concretely the graph layout algorithms (GLA) that are built into the UCINET software package. FDD algorithms proceed in a way that is rather different from MDS. They do not attempt to map a network's structure (i.e. its relations of similarities respectively dissimilarities) in terms of the raw distances of the proximity matrix, yet conceive of it in terms of energy. As put in the original formulation by Eades, "we replace the vertices by steel rings and replace each edge with a spring to form a mechanical system. The vertices are placed in some initial layout and let go so that the spring forces on the rings move the system to a minimal energy state."³⁹ Core to minimizing energy is strain. Typically, FDD algorithms are therefore referred to as 'spring embedders'. As the name suggests, they act as a system of springs, stretched between posts in a force field. If two posts with a spring between them are placed too close to each other, the spring is compressed and tries to push the posts apart (a property we also refer to as 'node repulsion'). If, on the other hand, the posts are too far

³⁹ Eades, Peter. 1984. "A Heuristics for Graph Drawing." *Congressus Numerantium* 42: 146–60. <http://ci.nii.ac.jp/naid/10000075358/>.

apart, the spring is stretched and tries to pull the posts together (a property called ‘node attraction’). In essence, the algorithms are methods of locating the posts in such a way as to bring the repulsive and attractive forces throughout the entire field in a stable, balanced state. Many variations are possible⁴⁰ (in our example, UCINET’s spring embedding function employs a slightly modified version of the Kamada-Kawai algorithm),⁴¹ but the principle remains the same.

Interesting for our discussion, FDD algorithms transcend the limitations of Euclidean space by abstracting from the precise values in the proximity matrix, concretely by dichotomizing the proximities. Ideally, social network analysis software packages allow the user to specify filtering criteria defining 1) when lines are to be drawn between nodes in the graph and 2) at what cut-off levels the length of lines is to be fixed. Clearly, this is also where inaccuracies are going to occur. Even then, accuracy is always to be compromised, and not only because of the static nature of the (two-dimensional) printed publication. In the end, what has been sacrificed in terms of accuracy has been gained in terms of aesthetic proportions, and more importantly, ease of interpretation.

Fig. 13 FDD plot of the Yokohama Specie Bank branch network for the period July 1907 - December 1907, using the algorithm built into the UCINET software package. As in the case of figure 12, the graph makes it possible to discern the network’s structure in terms of currency

⁴⁰ For a discussion, see: Kobourov, Stephen G. 2012. “Spring Embedders and Force Directed Graph Drawing Algorithms.” *arXiv:1201.3011 [cs]*, January. <http://arxiv.org/abs/1201.3011>.

⁴¹ Kamada, Tomihisa, and Satoru Kawai. 1989. “An Algorithm for Drawing General Undirected Graphs.” *Information Processing Letters* 31 (1): 7–15. doi:[10.1016/0020-0190\(89\)90102-6](https://doi.org/10.1016/0020-0190(89)90102-6). Related: Kamada, Tomihisa, and Satoru Kawai. 1991. “A General Framework for Visualizing Abstract Objects and Relations.” *ACM Trans. Graph.* 10 (1): 1–39. doi:[10.1145/99902.99903](https://doi.org/10.1145/99902.99903). Compare furthermore: “A key difference between their algorithm and that of Eades and Fruchterman and Rheingold is that Kamada and Kawai propose that the physical distance between points (in the GLA representation) should be proportional to the geodesic distance among the corresponding nodes in the network. Geodesic distance, known as degrees of separation in the popular press, refers to the number of links in the shortest path between a pair of nodes. Thus, the Kamada-Kawai algorithm is essentially a multidimensional scaling of the associated geodesic distance matrix.” In: DeJordy, Rich, Stephen P. Borgatti, Chris Roussin, and Daniel S. Halgin. 2007. “Visualizing Proximity Data.” *Field Methods* 19 (3): 239–63. doi:[10.1177/1525822X07302104](https://doi.org/10.1177/1525822X07302104). P. 248. Kodourov agrees with this interpretation.

groups; yet it corrects the location of Chefoo, and makes it clear that, within the Manchurian currency group, Dairen (D) has the position of a 'hub'. The most central nodes are clearly indicated. Of special relevance is Shanghai (S), which has clearly come to function as the node negotiating imbalances between branches in the gold and silver currency blocs. Note furthermore the location of Bombay (B) as an outlier: the algorithm only takes into account node similarity in terms of network specific characteristics; the calculation of similarity is indifferent to the weight of the vertices connecting the nodes.

