



Central bank reform, spatial diversity and monetary policy in Germany, 1876-1890

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Declaration

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Abstract

“One size does not fit all.” The aim of the thesis is to investigate conduct, impact and spatial dimension of monetary policy in Germany in 1876-90. Germany established one of the most successful monetary unions in the nineteenth century amid strong economic growth and stable bank note issuance. Yet, the role of monetary policy during its early years remains largely unexplored. This may lead to an incomplete understanding of the relationship between monetary policy and economic developments in the latter part of nineteenth century Germany.

The 1875 bank act (Bankgesetz) in Germany, following introduction of a single currency and the gold standard, adopted a unique mixed central banking system with the German Imperial Bank (Reichsbank) at federal and the private banks of issue (Privatnotenbanken) at federal state level. The thesis analyses monetary policy with emphasis on the monetary policy framework, transmission mechanism and reaction function. The findings show that competition between the Reichsbank and Privatnotenbanken influenced monetary policy conduct and established the stability conditions of the system; that the Reichsbank’s monetary policy was effective but had an undue negative impact on output while the impact of the Privatnotenbanken was mixed highlighting some scope for monetary policy spatial differentiation; and that the Reichsbank maintained considerable monetary policy discretion and acted more in line with a commitment under reputational forces than the rules of the game of the classical gold standard.

The thesis uses new monthly bank balance sheet, economic and financial data and employs advanced statistical estimation techniques based on structural vector autoregression models. The study relies extensively on narrative accounts based on archival parliamentary records and new Reichsbank reports.

Nineteenth century Germany offers important lessons for the establishment of central banking in monetary unions and conduct of monetary policy under spatial diversity and reveals that decentralisation in a monetary union can be effective.

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0. Introduction

The 1875 bank act (Bankgesetz) in Germany, following introduction of a single currency and the gold standard in 1871-73, adopted a unique mixed central banking system with the German Imperial Bank (Reichsbank) at federal and the private banks of issue (Privatnotenbanken) at federal state level. The aim of the thesis is to advance understanding about the conduct and stability conditions of the central banking system, the impact of monetary policy on economic developments, the formulation of monetary policy under the gold standard and the spatial dimension of monetary policy amid the interaction of the Reichsbank and Privatnotenbanken during 1876-90.

The thesis intends to help recalibrate the importance of the monetary reforms for Germany's nineteenth century political, economic and monetary history and enhance awareness about the relationship between monetary and economic change. It also intends to contribute to the history of monetary unions.

The thesis further tries to identify relevant lessons for a constructive debate about strengthening the monetary policy framework of the Euro Area. It also seeks to foster knowledge about fundamental motivations and concerns for establishing central banks.

Monthly monetary, demographic, economic and financial data of Germany for the period 1876-90 including bank data on the Privatnotenbanken have been assembled and digitised for the first time, to the author's best knowledge. This allows the use for the first time for the period of a quantitative multivariate approach of advanced statistical estimation techniques based on structural vector autoregression models (SVAR) with monetary, spatial and economic data.

Period session reports of the German Imperial Parliament (Reichstagsprotokolle) are reviewed extensively to support the quantitative analysis with narrative evidence. The research also located for the first time, to the author's best knowledge, reports about the monetary policy discussions of the Reichsbank providing period narrative evidence on the formulation of its policy on

the basis of session reports of the supervisory board of the Reichsbank (Reichsbankkuratorium).

The study covers 1876 to 1890. The period corresponds to the beginning of the operations of the Reichsbank and the end of its original 15-year life in 1890 under the 1875 bank act before subsequent amendments and modifications.¹ The period coincides with the tenures of Otto von Bismarck as first German Imperial Chancellor (March 1871 - March 1890) and Hermann von Dechend as first President of the Reichsbank (January 1876 - April 1890).

Motivation

“One size does not fit all.”² The thesis has been motivated by the Euro Area crisis that began in 2008 and the persistent difficulty of restoring adequate economic conditions throughout the Euro Area in particular amid the limitations of a single monetary policy.³ The call by European Union Commission President Jean-Claude Juncker in September 2017 to make all E.U. member countries adopt the euro by 2019 reinforces the need to rethink the adequacy of the architecture of the Euro Area.⁴

At the same time, while Germany established one of the most successful monetary unions during the nineteenth century amid high economic growth and stable bank note issuance, important aspects of the underlying monetary reforms, impact and conduct of monetary policy remain largely unexplored. A reassessment of one of the Euro Area’s most important predecessor monetary policy regimes and ancestor of the Bundesbank and European Central Bank (ECB) may therefore offer

¹ The act (Bankgesetz vom 14. März 1875) became law on 14 March 1875 and expired on 31 December 1890 with subsequent 10-year renewal intervals. During the nineteenth century, the bank act was renewed on 18 December 1889 (Novelle) and 7 June 1899 (Novelle).

² See on the notion of one size fits all monetary policy e.g. Bini Smaghi (2011).

³ Schwartz (2000) summarises: “*EMU faces two divisive issues: one is cyclical, the other structural. A common monetary policy must gloss over the fact that on any given date not all the members will be in the same phase of the business cycle. Those in a recessionary phase would be helped by expansionary monetary policy; those in a business upturn would not be. [...] The structural problem related to the mixture of high and low unemployment levels among the members. [...] [S]ome countries may argue in favour of monetary expansion rather than labour market reform as the way to reduce structural unemployment.*”

⁴ Juncker in state of the union address 2017, 13 September 2017 (E.U. Commission, 2017): “*My hope is that on 30 March 2019, Europeans will wake up to a Union where we all stand by our values. [...] Where being a full member of the euro area, the Banking Union and the Schengen area has become the norm for all EU Member States.*”

new elements towards understanding the relationship between public policies and economic developments in nineteenth century Germany and building a more robust and resilient Euro Area.⁵

The central bank reform features only rarely in Germany's general political and economic history of the nineteenth century. As such, it does not seem to form an integral part of Germany's history. This seems inconsistent with the importance of central banking and monetary conditions for general political and economic developments and in particular given the perceived economic crisis following the formation of the Empire (Gründerkrise).

The reforms are undoubtedly among if not the most important reforms implemented under Bismarck's political leadership. However, the reforms are rarely associated with or referred to by Bismarck which seem to diminish their status and importance.⁶ Bismarck's private financial advisor and close confidante Gerson Bleichröder urged the Chancellor early to adopt a Reichsbank and recommended Hermann von Dechend to become its first president suggesting that Bismarck may have had a more active role in the establishment of the Reichsbank than generally documented.⁷

The absence in the German banking historiography of regional differences in bank behaviour has also motivated the exploration of the Privatnotenbanken and spatial diversity.⁸

⁵ The lesson from the history of monetary unions are mostly studied with regard to the relationship between political, fiscal and monetary union, see e.g. Bordo and Jonung (2000), Holtfrerich (1989). Few lessons are being drawn from the operational side of historical monetary unions. James (1997) highlights the relationship between the Reichsbank and modern German and European monetary institutions. Marsh (1992) similarly traces the institutional and operational arrangement of the Bundesbank to the Reichsbank.

⁶ E.g. Thiemeyer (2013) highlights that Bismarck was not interested in economic context but saw in the international exchange rate policy an important international policy lever. Sommer (1931) writes that the literature says almost nothing about Bismarck and his relationship to the Reichsbank and notes that in Bismarck's three-volume memoirs "Gedanken und Erinnerungen" there is not a single reference to either the Reichsbank or to Hermann von Dechend (its first president).

⁷ In a letter from 20 December 1872, Bleichröder urged conversion of the Preußische Bank to a Reichsbank and in a letter of 19 December 1874 recommended von Dechend (Bleichröder, 1872-1874).

⁸ See e.g. Tilly (2001) to address priorities for Cliometrics: "A series on regional differences in bank behaviour still remains as a desideratum [for] which would involve study of bank balance sheets, a dissertation (or equivalent monograph) is needed."

Thesis organisation

The thesis is based on three related papers and consists of five sections. The introduction offers the motivation for the thesis, literature review and implications for the literature and broad-based background on the economic circumstances accompanying the bank act, monetary developments and the bank act itself. It also outlines the sources used. The papers are presented in sections 1, 2 and 3. The last section provides some concluding remarks summarising the findings of the thesis.

Paper 1. The Reichsbank, central banking competition and monetary stability in Germany, 1876-90

The paper studies the functioning and stability conditions of the monetary policy framework under Germany's 1875 bank act to show the relationship between institutional arrangements and monetary policy conduct. The act established the Reichsbank, introduced strict regulation of the operations of the Privatnotenbanken, uniform bank note reserve requirements and issuance ceilings. Reform intent and impact on monetary policy have rarely been analysed.

The contribution of the paper is to reveal the importance of the decentralised reform elements for monetary policy conduct in Germany in 1876-90. The paper highlights that the system was intended to rely to some important extent on competition between Reichsbank and Privatnotenbanken in main central banking operations to induce prudent monetary policy behaviour offering an early example of addressing fundamental incentives problem in monetary policy. Competition is approximated as a Bertrand game with capacity constraints. The paper exploits new detailed monthly statistics on bank balance sheets for 1876-90. To test the incidence of inter-bank competition, a structural vector-autoregression model with exogenous variables is used to estimate the contemporaneous and dynamic relationships between the Reichsbank and Privatnotenbanken. The results show that the Reichsbank and Privatnotenbanken interacted and that the interaction was conducive towards monetary stability affirming that the reform intent was achieved. The analysis illustrates that nineteenth century Germany offers an

important alternative approach to central banking in monetary unions and that decentralised central banking systems can be stable.

Paper 2. Monetary policy transmission and regional monetary policy differentiation in Germany, 1876-90

The paper studies the impact of monetary policy on output in Germany in 1876-90 and the ability of the mixed central banking system to accommodate regional shocks. Germany experienced a significant slowdown of economic activity from 1873 through 1886 (Gründerkrise). The origin of the slowdown has been attributed largely to external and structural factors. Little attention has been paid to the role of monetary policy in causing or prolonging the Gründerkrise. The impact of the Privatnotenbanken has also been discarded.

The contribution of the paper is to demonstrate using advanced statistical models the impact of monetary policy on economic growth at federal and at federal state level. The paper uses new monthly data on emigration by federal state as a proxy for adverse regional economic shocks in a structural vector-autoregression approach. It shows that the Reichsbank's policy is effective and that the measure of contractionary monetary policy is associated with output decline and an increase in overseas emigration. For the Privatnotenbanken, the impact of monetary policy is mixed but allows to support the view that monetary policy differentiation in a monetary union can address adverse regional shocks. Nineteenth century Germany may therefore present important lessons towards policy decentralisation in monetary unions.

Paper 3. The Reichsbank, commitment credibility and the rules of the game, 1876-90

The paper studies the policy reaction function of Germany's central banking system in 1876-90 to reveal that high commitment credibility allowed important discretion in monetary policy implementation. The Reichsbank was one of the dominant central banks during the last quarter of the nineteenth century and beginning of the twentieth century. Yet, the formulation of its monetary policy has been analysed mostly within the rules

of the game of the classical gold standard that may not offer a sufficiently adequate framework to assess the nuanced and evolving nature of the Reichsbank's policy.

The paper demonstrates that the Reichsbank during 1876-90 somewhat initially but not intermediately followed the rules of the game, maintained important policy discretion and strengthened adjustment to money market shocks while at the same time signalled strong commitment to convertibility. The findings are more consistent with the gold standard as a commitment rule with reputational forces than the notion of automaticity under the rules of the game. This coincided with a weakening of the Bank of England bank rate for the Reichsbank's policy formulation. The paper also shows that the Privatnotenbanken, in contrast to their pledges, had not supported the Reichsbank's policy.

The paper uses new monthly data and advanced statistical estimation based on vector autoregression models to offer detailed analyses of the Reichsbank's policy reaction function during the beginning of its operations and amid difficult economic conditions in Germany. It is complemented by extensive narrative accounts by the Reichsbank to outline policy intent.

The Reichsbank's dual accommodation of national and international objectives under the gold standard affirms doubts about the relevance of the classical exchange rate trilemma. The paper supports earlier findings that strong perceived commitment credibility offers monetary policy autonomy under the gold standard.

0.1. Literature review

The historiography of Germany's central bank reform and monetary policy during the first fifteen years of the Reichsbank remains largely incomplete. Existing studies are mostly descriptive of the operations of the Reichsbank, the gold standard and associated rules thereof but offer no comprehensive analysis of the monetary policy framework, role of the Privatnotenbanken, transmission of monetary policy and a more complete monetary policy reaction function. Advanced statistical

analyses of policy conduct and effect of monetary policy have remained rare and the importance of spatial diversity, one of the most relevant features of nineteenth century Germany, for monetary policy continues mostly unstudied.

The monetary and financial reform has only rarely been referenced in the general political and economic history of nineteenth century Germany. Abelshauser (2004), Borchardt (1982), Carr (1969), Henderson (1975), Ogilvie and Overy (2003), Planze (1998) offer no mention or only very limited references if any to the Reichsbank in their accounts of Germany's political and economic history. Landes (1972) provides a rare though only brief account of linking cyclical developments and industrialisation in Germany to monetary policy. Otto (2002) affirms that the analysis of Germany's nineteenth century monetary reforms and developments have been mostly neglected by economic history. This is in contrast to the National Monetary Commission (1910d, p. 11) that highlights the centrality of the monetary reform for the development of Germany: *"The newly established German Empire found in the organization of the coinage, paper money, and bank-note systems an urgent and difficult task. Probably in no department of the entire national economic system were the disadvantages of the political disunion of Germany so clearly defined as in this; in no economic department were greater advantages to be expected from a political union."*

The operations and policies of central banks under the gold standard were reviewed comprehensively (Bloomfield, 1959, Lindert, 1969). The central bank reform and operations of the Reichsbank, coinage reforms and introduction of the gold standard in 1871-76 have been covered extensively (Borchardt, 1976; Holtfrerich, 1993 Kroha, 2009; National Monetary Commission, 1910d; Otto, 2002).⁹

Money market integration in nineteenth century Germany has remained understudied. Schneider and Schwarzer (1990) offer a compendium of German currency quotations and provide 8-day sight sterling mark exchange rates as quoted in London for different German cities in 1876-90. The Economist (1871-1890) provides quotes for discount rates in 1876-90 for Berlin, Hamburg and Frankfurt constituting an appropriate source to assess market integration (see under 0.5

⁹ Holtfrerich (1989) argues that the process of monetary unification was far more important than the central bank reform.

below). Studies on monetary developments based on federal money stock estimates by e.g. Hoffmann (1965) and Sprenger (1982) may thus only offer more limited approximations of underlying monetary conditions.

The monetary policy of the Reichsbank has been mostly examined with regard to the implied constraints of the gold standard. Lindert (1969) presents a comprehensive account of the international dimension of the Reichsbank's policy. Borchardt (1976) describes Reichsbank's policy mostly through implementation of the coinage reform, important cyclical gold drains and recurrent debate about the advantages of bimetallism; the discount policy was viewed as determined by the reserve position, foreign interest rates and exchange rates as indicators of future gold movements highlighting that there was no conflict between domestic and external objectives.¹⁰ Hentschel (1997) argued that the discount rate did not solely serve to support the international gold standard and was therefore available to accommodate domestic policy objectives arguing that external factors played no or only a small role in influencing the policy of the Reichsbank. The importance of the adequate reserve and in particular gold reserve position as central to determining the policy stance was expressed by Plenge (1913), Friedhofen (1963); Wühle (2011). The studies lack a systematic assessment of the relative importance of domestic and external factors in determining the Reichsbank's policy stance.

The study of the transmission of monetary policy has been rare. Estimations of money demand functions as in Kroha (2009) and Craig and Fisher (1997) use conventional approaches and find stability of money demand under the gold standard in 1873-1913 despite different specifications but made no attempt to assess the impact of monetary policy on economic activity. Borchardt (1976) and McGouldrick (1984) argue that the Reichsbank had a dampening impact on the business cycles but do not offer rigorous statistical verifications.

The analyses of the Reichsbank's monetary policy reaction function were mostly confined to the rules of the game of the classical gold standard. At the same time, Bloomfield (1959) stressed that the rules of the game only offer a very loose framework to analyse monetary policy under the gold standard and that the notion of "automaticity" was a misconception. Bloomfield (1959) and McGouldrick (1984)

¹⁰ This view is shared by Bloomfield (1959).

find that the Reichsbank mostly did not adhere to the rules amid a mostly negative correlation between its assets and gold reserves.¹¹ Sommariva and Tullio (1986) and Eschweiler and Bordo (1993) find that the Reichsbank adhered mostly to the rules although domestic considerations were important. Morys (2013) underscores that the Reichsbank's policy stance was geared towards maintaining the exchange rate within the gold points. He also finds for the Reichsbank that important monetary policy autonomy was preserved under the gold standard.

The studies about the Reichsbank's policy have largely disregarded alterations in the policy reaction function over time, e.g. with regard to the role of the Bank of England bank rate, the adaptive nature of policy conduct in the short to medium term.¹² The studies mostly cover extended periods usually 1876 to 1913 (Eschweiler & Bordo, 1993; McGouldrick, 1984; Morys, 2013; Sommariva & Tullio, 1986). While the period is congruent with the period normally associated with the classical gold standard, it limits insights into the varied and critical period of the first years of operations of the German central banking system.

The importance of commitment and reputation to enhance policy conduct has not been analysed in the context of the Reichsbank (Barro & Gordon, 1983). Bordo and Kydland (1995) identify the gold standard as a commitment mechanism and offer a good basis for the relationship between commitment and reputation; the gold standard as a contingent rule was seen as a major weakness in the German debate against adopting strict bank note issuance limits as Great Britain did under the 1844 Bank Charter Act (Peel Banking Act) and had not appealed to Germany during the nineteenth century (Deutscher Reichstag, 1875).¹³ Bordo and Rockoff (1996) provide verification through asset pricing of the credibility effect of adhering to the gold standard although their results are contested (Mitchener & Weidenmeier, 2015).

The relationship between the Reichsbank and Privatnotenbanken is mostly lacking. James (1997), Kroha (2009), Otto (2002) refer to the Privatnotenbanken

¹¹ Bloomfield (1959) stressed though that his results for 11 central banks should be considered with care as his study was based on annual observation. However, he did consider his results as "striking" calling into question to what extent central banks did facilitate net gold flows.

¹² Sommariva and Tullio (1986) uses two different long period 1878-1895 and 1896-1913.

¹³ See comments made by Otto Michaelis, member of the Reichstag and leading protagonist of the central bank reform on 25 January 1875.

but no attempt is made to analyse their role for the stability conditions of the central banking system, policy impact and conduct and formulation of monetary policy. This implies only a partial understanding of the institutional framework underpinning central banking in Germany during the observation period. Tilly (2001) deplored the lack of studies on the regional differences in bank behaviour for nineteenth century Germany.¹⁴ The role of the Privatnotenbanken in setting monetary conditions has been generally disregarded. Reference to narrative evidence to assess policy intent have also been mostly absent.

The notion of monetary policy decentralisation in monetary union remains broadly underexplored. It can safely be assumed that Germany did not constitute an optimum currency area in the nineteenth century. The political debate leading to the 1875 bank act in Germany evoked the fundamental constraints of monopolies in monetary policy conduct and due limitations amid the importance of local business practices and spatial diversity (Deutscher Reichstag, 1874, p. 170). In contrast, in the United States, decentralisation in central banking is well established. The 1913 Federal Reserve Act adopted extensive decentralisation with the creation of the twelve federal reserve district banks (Glass, 1927; Morawetz, 1911, Parker Willis, 1923). The importance of decentralisation for the establishment of the Federal Reserve was in large part due to concerns about the effectiveness of monetary policy by a single institution across the diverse territory of the United States.

The parallels between Germany and the U.S. for the establishment of their respective central banking system remain unstudied. The optimum currency area literature surprisingly had not made any reference to the historical precedent of decentralisation for either the Reichsbank or the Federal Reserve System (Mundell, 1961). This is all the more remarkable amid the considerable effort to establish the twelve federal reserve districts on the basis of some implied optimum currency area considerations and the multiple beauty contests between cities vying for the location of a federal reserve bank lasting several months during 1914.

The statistical studies on monetary policy in nineteenth century Germany are mostly conducted on the basis of data of the Reichsbank only (Darné & Diebolt,

¹⁴ See footnote 8.

2007, Eschweiler & Bordo, 1993, Morys, 2013). The absence of higher frequency activity and price data in nineteenth century Germany limits the possibility to estimate high frequency contemporary policy reaction functions. McGouldrick (1984) and Sommariva and Tullio (1986) combine bank with economic variables but based on annual data.

The statistical methods employ to study Germany's nineteenth century monetary policy have mostly been descriptive and univariate. This does not allow to analyse the more realistic interactions and co-movements among groups of time-series variables.

The use of narrative evidence for the studies on central bank reform and monetary policy in nineteenth century Germany remains rare with Friedhofen (1963) being a notable exception. This limits assessment of the studies against period public perception and policy intent of the Reichsbank.

0.2. Political and economic developments in Germany, 1815-90

Germany at the end of the Napoleonic Wars was a patchwork of hundreds of independent states. The political and economic integration of Germany occurred only gradually during the nineteenth century.¹⁵ The formation of the German Confederation (Deutscher Bund) with the Congress of Vienna of 1815 brought important consolidation of Germany's political entities amid the establishment of 39 independent and sovereign federal states and free cities (Figure 0-1). The 1834 Customs Union (Zollverein) advanced economic integration with the suspension of internal tariffs among the signatory countries including most German states but excluding Austria and its possessions. The 1864 Prussian-Danish and the 1866 Prussian-Austrian wars (Einigungskriege) resulted in further territorial consolidation and increasing dominance of Preußen. The adoption of the 1867 Constitution of the North German Federation (Norddeutscher Bund) laid the foundation for political unification under a federal structure and leadership of Preußen. Political union with the integration of the Southern German states was established with the 1871 formation of the German Empire (Deutsches Reich) after

¹⁵ See e.g. Bergman et al. (1989), Gunlicks (2003), and Tipton (2003).

the 1870-71 Prussian-French war. The German Empire was constituted of 26 federal states (Bundesländer) and free cities (Appendix table 0-1).

Figure 0-1. German Confederation 1815-1866



Source: Putzger – Historischer Weltatlas, 89. Auflage, 1965 (Wiki Commons)

The total population of Germany in 1871 was 41.0 million.¹⁶ The average population per state was 1.58 million ranging from Schaumburg-Lippe with 32 thousand inhabitants to the largest state Preußen with 24.6 million, representing 60 percent of the total population. The next largest states, excluding Elsaß-Lothringen, by population were Bayern with 4.9 million, Sachsen with 2.6 million, Württemberg with 1.8 million and Baden with 1.5 million. The

¹⁶ In the borders of the German Empire including Elsaß-Lothringen with a population of 1.5 million. Data based on the censuses of 1871, 1880, 1890 and 1895 and data published in Statistisches Jahrbuch für das Deutsche Reich (Kaiserliches Statistisches Amt, 1880-1895).

population growth was rapid with the total population increasing to 45.2 million in 1880 and to 49.4 million in 1890. The population growth rates differed significantly, with the population of Hamburg increasing by 83 percent between 1871 and 1890 while the population of Mecklenburg-Strelitz grew by 1 percent.

Economic developments

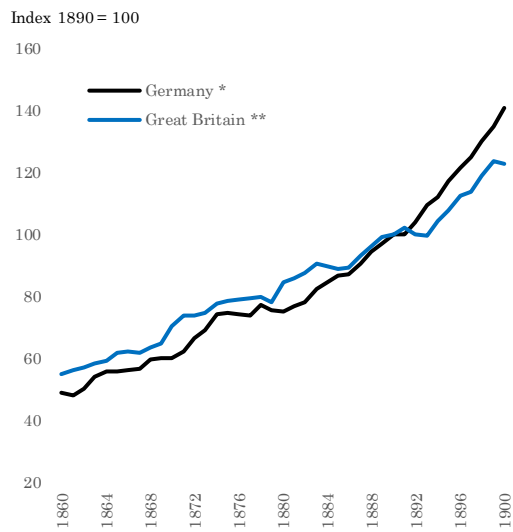
The economic developments in Germany in 1876-90 were marked by stagnation, severe deflation and recovery. The period followed rapid economic growth in 1870-74 of 4.4 percent on average during the foundation years of the German Empire and preceded sustained strong growth through 1900 (Figure 0-2).¹⁷ The significant war indemnities received from France after the Franco-Prussian war contributed to fuelling an economic boom. The subsequent economic slowdown was initiated by the stock market crash of May 1873 in Vienna that had broad international repercussions and propagated intermediately to Germany.¹⁸ The annual growth of the German net social product slowed to 0.6 percent in 1875 and declined by 0.6 percent in 1876 and 1877 and, following a brief rebound in 1878, declined again in 1879-80. In 1880, output was broadly similar to the level of 1874. General sentiment was dominated by a profound pessimism amid the lack of anticipation of the duration of the perceived crisis. While the period has been coined *Gründerkrise*, it was marked more by stagnation than an outright contraction of output.¹⁹ In 1881-86, the economy stabilised amid weak growth and initiated a sustained though uneven recovery from 1887 onwards.

¹⁷ For a detailed description of economic developments in nineteenth century Germany see e.g. Borchart (1982), Carr (1969), Hoffmann (1965), Ogilvie and Overy (2003), Wehler (1985), Pierenkemper and Tilly (2004).

¹⁸ At the peak of the boom in 1871-73, 2.9 billion mark (8 percent of national income) was raised in stocks through initial public offerings, more than in the previous twenty years and the same amount as in 1874-1896 (Rosenberg, 1967).

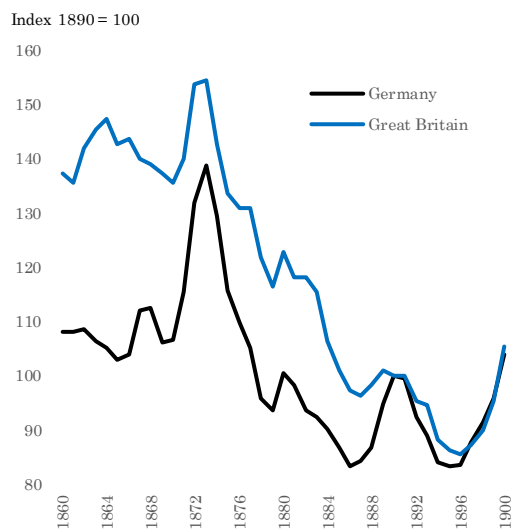
¹⁹ The term *Gründerkrise* means foundation crisis as in the crisis following the foundation of the German Empire. See Borchart (1976) for a description of the *Gründerkrise*.

Figure 0-2. Output



Source: Hill et al (2015); Hoffmann (1965). * Net social product. ** Gross domestic product. At constant prices at factor costs.

Figure 0-3. Prices



Source: Hill et al (2015); Hoffmann (1965). Wholesale prices rebased.

The period was accompanied by a significant decline in prices amid a sharp decrease in the average return on capital and unprecedented increase in real wages.²⁰ The price deflation was prolonged with wholesale prices in 1890 still below their 1860 level and significantly lower than their 1873 local peak.

²⁰ Rosenberg, 1967 underscores the significant increase in real wages as one of the most important social phenomena of second half of the nineteenth century in Germany quoting Julius Wolf in

The price and output trends were broadly consistent with international economic developments (Figure 0-2 and Figure 0-3).

Spatial diversity

Germany's economy was spatially highly diverse. The German states exhibited marked differences in the distribution and development of agricultural, industrial and commercial and services sectors.²¹ The differences in the share of industrial employment across the states is considered to be representative of a marked spatial diversity in general cyclical and structural economic developments.

The incidence of industrialisation was progressing increasingly since the 1860s but remained uneven.²² The states differed significantly in their level of industrialisation and progress (Figure 0-4). The share of agriculture in Germany's net social product fell from a local peak of 38 percent in 1874 to a local low of 18 percent in 1885.²³ The shift in employment from agriculture to industry between 1871 and 1895 affirms the disparities in economic conditions across different German states.²⁴ Of the largest states, Sachsen exhibited a significantly higher level of industrialisation than Preußen and many other states and was a leader in further industrialisation between 1871 and 1895; Preußen saw important advances while Württemberg and Bayern remained industrial laggards. Preußen itself was highly diverse with large agricultural provinces (Ostpreußen and Posen) and rapidly industrialising provinces (Brandenburg, Schlesien).

1888 that the crisis was much more a crisis of the rich than of the poor. However, he reminds that reliable unemployment and under-employment statistics were rare.

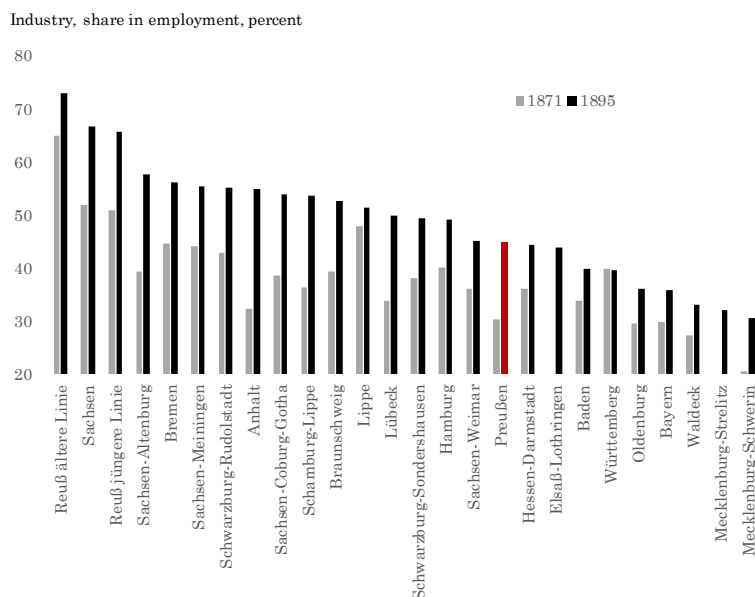
²¹ See e.g. Kieseewetter (1989), Pierenkemper and Tilly (2004), Pollard (1980).

²² See e.g. regional GDP estimates for different German regions in Caruana Galizia (2011).

²³ See Hoffmann (1965) Table 103. Rosenberg (1967) underlines that the agricultural output continued to decline relative to the population size and approached only since the middle of the 1890s its level of the 1870s; this contributed to a loss of dominance of agriculture in the overall economy.

²⁴ Wehler (1969) noted that industry only become dominant in certain regions, the Ruhr, Oberschlesien, Saar (all part of Preußen) and Sachsen.

Figure 0-4. Industrialisation



Source: Kaiserliches Statistisches Amt (1880-95). No data for 1871 for Elsaß-Lothringen and Mecklenburg-Strelitz.

0.3. Monetary developments, 1830-1890

Nineteenth century Germany was a coinage and banking muddle.²⁵ The Congress of Vienna preserved sovereignty for coinage, custom tariffs, units and weights with the 39 federal states.²⁶ In the early 1870s, there were 7 coinage systems (Appendix table 0-2) and 53 paper currencies in circulation, comprising bank and state treasury notes.²⁷ Throughout the nineteenth century there were numerous attempts to harmonise coinage and bank note issuance.²⁸

²⁵ Schultz (1976, p. 11) quotes Alexander Lips, professor at the University of Marburg lamenting in 1822 about the multitude of coinage, units and weights in Germany: “*In keiner Hinsicht sieht Deutschland verworrenen und zerrissener aus und einem Volke weniger gleich als durch die so ganz grund- und inhaltsleere Verschiedenheit seines Geldes [...].*“

²⁶ See e.g. Hellferich (1898, p. 4): “*Das innerste Wesen eines Staatengebildes kommt in wenigen seiner Institutionen so deutlich zum Ausdruck, wie in seiner Münzverfassung. Strenge Centralisation und einheitliches Regiment, Ohnmacht der Centralgewalt und kleinstaatliche Zersplitterung spiegeln sich hier deutlich wieder.*“

²⁷ Kaiserliches Statistisches Amt (1880).

²⁸ Hellferich (1898) highlights that coinage and paper currency reforms were pursued independently whereby the paper currency reform was seen as part of the banking reforms.

The 1871-73 coinage acts adopted monetary union under a single currency, the mark, and the gold standard.²⁹ The 1875 bank act (Bankgesetz) established the Reichsbank and harmonised rules for the Privatnotenbanken to regulate bank note issuance.

Coinage

Germany maintained two main coinage systems after the Congress of Vienna with the thaler system (14-Thalerfuß) in the Northern German states and the gulden system (24 ½-Guldenfuß) in the Southern German states.³⁰ Austria maintained its own system based on the gulden (20-Guldenfuß or Konventionsfuß). The systems were mostly based on a silver standard with the exception of the state of Bremen that maintained a gold standard.³¹ Other German states adhered to derivatives of either system, had their own systems, i.e. a thaler of one state was not equal to a thaler of another, and in addition foreign coins circulated freely.³² In 1837, the Munich Coinage Treaty (Münchner Münzkonvention) among the Southern German States set a standard for minting gulden coins on the basis of common specifications including for small coins (Scheidemünzen). In 1838, the Dresden Coinage Convention (Dresdner Konvention), comprising all member countries of the Zollverein, established further coinage harmonisation by obligating member countries to opt for either thaler or gulden, introduction of fixed parities between standards and adoption of a common coin, the union coin (Vereinsmünze or Doppelthaler) to circulate in parallel as legal tender in the Zollverein.³³ The coinage convention did not achieve to merge the thaler and gulden systems nor the withdrawal of other coins but it set stricter minting standards.

The Vienna coinage convention (Wiener Münzvertrag) of 1857 established a common coinage between the Zollverein and Austria and set fixed parities between

²⁹ See Holtfrerich (1989) for a detailed account of coinage harmonisation in Germany.

³⁰ For a detailed survey of German coinage, see e.g. Rittmann (1975).

³¹ Preußen introduced in 1750 a gold coin the Friedrichsdor but it remained marginal. Gold played generally in Germany only a small role. The coinage conventions of Munich and Dresden only referred to the silver standard.

³² The free cities of Bremen (Pistolen), Lübeck and Hamburg (Lübische Kurantwährung) and the federal state (Reichsland) of Elsaß-Lothringen (Franc) had their own coinage systems.

³³ The set parity was 1 Vereinsmünze = 2 thaler = 3 ½ gulden, see Rittmann, 2003.

the standards of the Zollverein and Austria with Austria adopting a new gulden.³⁴ The crown (Krone) was introduced as a common gold coin to be used across the Zollverein and Austria. The coins declared as union coins were elevated to be accepted as legal tender in all local currency payment obligations and common minting standards were reinforced.³⁵ In 1867, following the Prussia-Austrian war, Austria left the coinage convention but the union coins remained legal tender in Germany and Austria through 1870. The proliferation with the Vienna coinage convention of the union coins throughout the Zollverein laid the foundation for a common currency in Germany.³⁶ The 1867 constitution of the North German Confederation made coinage a federal concern.

The coinage act of 1871 (Münzgesetz) initiated monetary union with the introduction of a common currency, the mark, for Imperial Germany as a gold currency (Reichsgoldmünze).³⁷ The coinage act of 1873 (Münzgesetz) advanced decisively the mark as a single currency with the suspension of all existing state currencies and the mark to be phased in throughout Germany by January 1876. The mark became the effective single currency with the adoption of the 1875 bank act (Bankgesetz) that established the Reichsbank as the main central bank with the obligation to redeem its bank notes in mark and ensure adequate circulation of marks.³⁸

Paper currency

The adoption of paper currencies was linked to the issuance of treasury notes by state governments and bank notes by state and private banks of issue. The first

³⁴ The set parity was 2 thaler = 3 ½ gulden (Southern Germany) = 3 gulden (Austria), see Rittmann (2003). Several German states were not members of the Zollverein including Bremen, Hamburg, Lübeck, Mecklenburg.

³⁵ The Doppelthaler, the Einthalerstück and Thalerstück (14-Thalerfuß) were legal tender in all Zollverein member states. The Einthalerstück allowed the thaler system to proliferate in the Southern German states, see Hellferich (1898)

³⁶ Hellferich (1898) indicates in 1857-1871, the union coins (Vereinsthaler) were minted in the amount of 229 million thaler compared with a total of state thaler and state gulden of 6 ¼ million thaler.

³⁷ The adoption of the gold standard followed an intensive debate about the advantages of gold against silver or a bi-metallic standard and was decided largely on international monetary considerations amid the increasing role of gold currencies in international exchange as led by Great Britain. The initiative to introduce a gold currency was led in particular by Ludwig Bamberger, a member of the Imperial Parliament (Reichstag) and leading monetary authority, see e.g. Schultz (1976).

³⁸ The German system remained a partial gold standard (hinkende Goldwährung) as the silver thaler remained in circulation through 1907.

paper currencies in Germany appeared in the early eighteenth century.³⁹ The widespread introduction of paper currencies occurred after the Napoleonic wars. The emergence of paper currencies was seen as essential to facilitate payments amid rapidly rising economic transactions. Paper currencies also offered a means to extend critical credits to governments.

The state of Preußen issued paper currency from 1806 (Tresorscheine) followed by other states. The first important bank of issue in Germany was the Königliche Giro- und Lehnbank in Preußen, established in 1765, that acquired the right for note issuance in 1766.⁴⁰ The bank was transformed into the Preußische Bank in 1857.⁴¹ The Reichsbank was de facto the successor institution of the Preußische Bank amid the 1875 agreement to transfer the Preußische Bank to the German Empire.⁴² The proliferation of bank notes occurred during the second half of the nineteenth century with the establishments of various private banks of issue (see below).

The issuance of paper currencies was restricted significantly with the adoption of new laws in 1870. The 1870 bank licensing act (Gesetz über die Ausgabe von Banknoten) suspended the rights of states to issue bank note licenses and to extend or augment existing ones.⁴³ The 1870 law of paper currency issuance (Gesetz über die Ausgabe von Papiergeld) froze the issuance of state government treasury notes and announced its replacement.⁴⁴ The 1873 coinage act (Münzgesetz) regulated the obligation to withdraw from circulation by end-1875 all state government treasury notes. The 1874 law of Imperial treasury note issuance (Reichskassenscheingesetz) regulated the issuance of government notes and substituted state government notes with federal government notes (Reichskassenscheine). The bank notes were normally subject to fractional specie-based reserve requirements as regulated by the host states.

³⁹ Rittmann (1975) cites the establishment of Banco di gyro d'affrancatione in Cologne in 1706 as the first bank of issue. Austria introduced paper currency in 1762.

⁴⁰ See Schultz (1976). The bank was later renamed Königliche Hauptbank.

⁴¹ The Preußische Bank was half private half state with the capital being private while the management was by civil servants.

⁴² Vertrag zwischen Preußen und dem Deutschen Reiche über die Abtretung der Preußischen Bank an das Deutsche Reich, 24 May 1875. The first president of the Reichsbank Herman von Dechend was the last president of the Preußische Bank.

⁴³ The law applied only the states of the Northern German Confederation but expanded to the Southern German states in 1871.

⁴⁴ Also as per footnote 43.

Monetary aggregates

The development of monetary aggregates in Germany shows a rapid monetary deepening of the German economy during the nineteenth century and shift from metal coins towards other media. The relative decline of metal coins, representing the largest share of narrow money, defined as the sum of currency, state treasury notes and bank notes, from 76 percent in 1860 to 59 percent in 1871 illustrates the rise of paper currencies in particular of bank notes by volume. The value of bank notes in circulation increased from 24 percent of metal coins in 1860 to 56 percent in 1872 before moderating to 40 percent in 1875.⁴⁵ Broad money, being the sum of narrow money and bank deposits, was increasingly dominated by bank deposits amid the emergence of commercial banking and mounting financial deepening from the 1860s (Table 0-1).

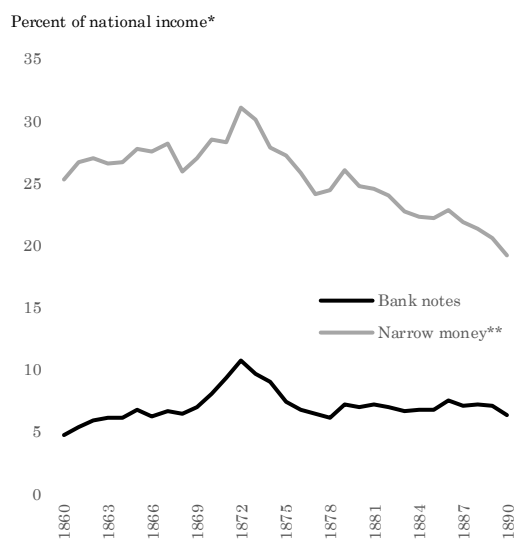
Table 0-1. German money

	1860	1867	1871	1876	1890
Average annual growth, percent (per interval)†					
Currency (metal coins)	...	2.3	1.5	7.1	-0.3
State treasury notes	...	5.4	15.1	-6.9	-2.5
Bank notes	...	6.8	14.3	-0.2	2.1
Bank deposits	...	7.2	6.5	11.3	5.8
Narrow money, thereof percent					
Currency (metal coins)	76.1	70.4	58.7	68.9	63.6
State treasury notes	5.2	5.9	8.1	4.7	3.2
Bank notes	18.7	23.7	33.2	26.4	33.3
Broad money, thereof percent					
Currency (metal coins)	47.4	40.6	32.7	32.8	19.3
State treasury notes	3.2	3.4	4.5	2.2	1.0
Bank notes	11.7	13.6	18.5	12.6	10.1
Bank deposits	36.9	41.3	42.8	51.5	68.8
Net National Product, thereof percent					
Narrow money *	25.3	28.2	28.3	25.9	19.1
Broad Money **	40.7	48.9	50.8	54.4	62.9

Source: Holtfrerich, 2006; Kroha, 2009; Sprenger, 2006. † Year in heading to earlier year in heading. ... Not available. * Currency, state treasury notes, bank notes. ** Currency, state treasury notes, bank notes, bank deposits.

⁴⁵ See e.g. Sprenger (1982).

Figure 0-5. Monetary aggregates



Source: Hoffmann (1965); Sprenger (1982). *Net national income (Volkseinkommen). ** Stückgeld comprising metal coins, bank notes and government securities.

The period 1876-90 was characterised by a significant contraction of monetary aggregates following the 1873 crisis. Total narrow money, comprising metal coins, bank notes and government securities declined from a local peak in 1872 of 31.1 percent of national income to a local trough in 1877 of 24.1 percent of national income (Figure 0-5).⁴⁶

Money market integration

Germany maintained limited money market integration. While different coinages complicated money market integration through 1873-75, after 1875 the level of integration remained broadly unchanged based on the level of open market, that is prime bills of exchange discount rates across different locations. Prima facie evidence suggests that open market discount rate differences for the cities Berlin, Frankfurt and Hamburg were sustained in 1876-90 attesting that market integration remained weak.⁴⁷

⁴⁶ Data from Hoffmann (1965).

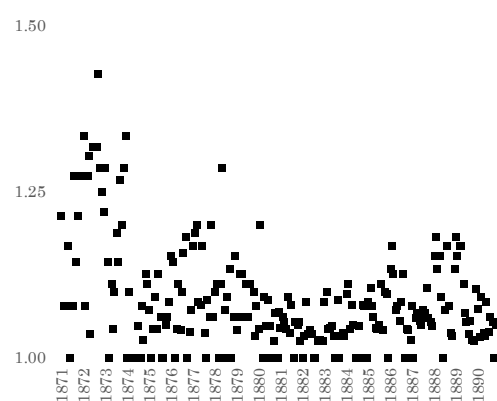
⁴⁷ The Economist in 1876-90 offers discount quotations for different cities of European countries only for Germany including for Berlin, Frankfurt and Hamburg and also for Bremen from July 1872 through January 1876 and Leipzig from May 1872 through January 1876. Also see e.g. The Economist (1881): “The rate of discount in Germany appears to differ much in different parts of the country. In the East of Germany 6 to 8 percent appears to be wanted for bills which may be done at 4 percent at the same date elsewhere. The difficulty which the Bank of Germany [Reichsbank] experiences seems inseparable from the conduct of business by a bank having so many (upwards of 200) branches. When a lower rate than the published rate is allowed in some place, questions of favouritism arise.”

The level of money market integration is based on the ratio of the highest to the lowest discount rates of Berlin, Hamburg and Frankfurt.⁴⁸ The closer the ratio to unity the smaller the variations between discount rates in different locations and the more integrated the market. The ratio was high in 1871-73 and remained elevated through 1876-90 (Figure 0-6).

The persistence of discount rate differences can be associated with government regulation, nonprice competition and the nature of bills of exchange. The former refers mostly to bank licenses extended by state or later federal charter restricting entry to the bills of exchange market for banks of issue that may have affected the pricing level in the open market. The second denotes relationship banking as credit screening was to a large extent local. The third concerns the bills of exchange that were mostly local bills (Platzwechsel) payable only in the circuits of the purchasing branch.⁴⁹ The consigned bills (Versandwechsel) that were payable throughout Germany declined in relative importance during 1876-90.

Figure 0-6. Regional discount rate

Ratio of maximum to minimum, discount rates Berlin, Hamburg, Frankfurt, end of period



Source: The Economist (1871-90).

⁴⁸ The ratio is chosen due to the small sample size per period. The coefficient of variation is normally used as a standard measure for market integration, see e.g. Chilosi and Volckart (2011). The data are from the latest available The Economist edition per month from The Economist (1871-1890).

⁴⁹ Platzwechsel accounted for 56 percent of all bills purchased by the Reichsbank in 1900. In 1876, 57 percent of all bills were consigned bills (Versandwechsel) that are payable at any other banking place (The Reichsbank, p. 150). E.g. for Bayern, Heil (1900) indicates that the bills payable outside Bayern played only a small role compared with the dominant local bills.

Privatnotenbanken

The establishment of various private banks of issue (Privatnotenbanken) in Germany occurred from the 1830s-50s with the Bayerische Hypotheken- und Wechselbank in 1835, Leipziger Bank in 1838 and others.⁵⁰ In Preußen from 1848 amid legislative changes, several Privatnotenbanken were established including the Frankfurter Bank in 1854. The right of note issuance was normally extended by the host state through a concession. The bank notes circulated also outside the host states. The provisions for note issuance differed significantly between institutions. In 1875, there were 33 Privatnotenbanken.

0.4. International central banking developments, 1844-1913

The foundations of modern central banking systems were mostly laid during the nineteenth century.⁵¹ The institutional organisation of the systems was dominated by concerns for prudent bank note management amid contesting arguments in favour or against monopolisation of bank note issuance.⁵² Most nineteenth century systems evolved from some form of decentralised note issuance at national level. By the early twentieth century, there was near universal acceptance of centralised central banking systems with the exception of the Federal Reserve system in the United States.⁵³

The proliferation of paper currencies, due in large part to increasing needs for readily available means of payments, and mounting concerns about disorderly monetary conditions mostly motivated considerations for central banks during the nineteenth century.⁵⁴ In the U.S. in contrast, in the discussion about the Federal

⁵⁰ In Bayern, the Bayertische Hypotheken -und Wechsel Bank transferred its note issuance rights to the Bayerische Notenbank in 1875.

⁵¹ See Smith (1936) on the evolution of central banks towards single institution systems.

⁵² Smith (1936) argues that the modern functions of central banks were mostly derived as secondary functions from the note issuance monopolies.

⁵³ See e.g. Smith (1936, p. 3): “*In the present century [20th] centralised central banking systems have come to be regarded as the usual concomitant, if not one of the conditions of the attainment of an advanced stage of economic development.*”

⁵⁴ Goodhart (1988) contends that early central banks e.g. in Germany have been founded to unify “*a somewhat chaotic system of note issue, to centralise, manage and protect the metallic reserve of the country and to facilitate and improve the payments system. In any case, prior to 1900, most economic*

Reserve act during 1912-13, the accommodation of bank liquidity by supply of “elastic currency” was dominant.

The emergence of single central banking systems followed in large part the example of the Bank of England. The 1844 Bank Charter Act (Peel Banking Act) established a separate department for note issuance (Issue Department) at the Bank of England and granted de facto a note issuance monopoly to the bank under provisions of a non-reserved (fiduciary) fixed amount of bank notes and fully reserved note issuance requirements.⁵⁵ Sole bank note issuance rights were granted to e.g. in 1848, the Bank of France; in 1882, the Bank of Japan; in 1888, the Bank of Portugal; in 1897 the State Bank of the Russian Empire; in 1907 the Swiss National Bank.⁵⁶ The Bank of France may be considered the first modern central bank being a public sector controlled institution with its notes being legal tender and amid its monopoly in note issuance.

Multiple central banks systems remained through the early twentieth century e.g. in Canada, Mexico and Scotland (de Kock, 1974; Smith, 1936).⁵⁷ The Canadian system operated through its 29 chartered banks that maintained note issuance rights but the system was closely linked to the New York clearing house.⁵⁸ In Mexico with the adoption of a new banking law in 1897, there were 7 banks of issue amid a system of state-based licensing.⁵⁹ The Scottish system had 7 banks of

analysis of the role of central banks concentrated on the issue of whether the note issue should be centralised, and, if and when centralised, now controlled by the central banks.”

Similarly Smith (1936) argues that nineteenth century writers confronted the problem of note issuance with the following question: “*Is it preferable that the note issue should be in the hands of one single bank, or at any rate a definitely limited number of banks specially authorised to undertake it [...] or is it preferable that there should be as many banks of issue as find it profitable to enter the note-issuing business?*” James (1997) also highlights that in general in the debate about central banking, “*the issue at stake [...] was the extent to which monetary power should be federalised, decentralised or dissipated among private actors, such as commercial banks.*”

⁵⁵ The fiduciary amount was set at 14 million pounds. Provincial banks of issue (country banks) remained in operation in England. On the 1844 Act see Horsefield (1944). The Bank of England operated through the nineteenth century 15 branches. Of the 15 branches, Leicester, Norwich and Swansea were closed in 1872, 1852 and 1859, respectively.

⁵⁶ See e.g. Conant et al. (1910) on the assumption of note issuance monopolies.

⁵⁷ The Bank of Canada initiated operations in 1935. For Scotland, the U.K. 2009 Banking Act subordinated strictly bank note issuance by Scottish institutions to U.K. Treasury and Bank of England oversight. Bank notes issued by the 3 authorised Scottish banks are not legal tender though generally accepted throughout the U.K. In Scotland and Northern Ireland only Royal Mint coins are legal tender. The U.K. 2009 Banking Act specifies that Scottish bank notes are issued under provisions of a currency board (backing assets) and can be exchanged at 1:1 for Bank of England notes. The 1845 Act to Regulate the Issue of Bank Notes in Scotland set the amounts of notes to be issued and the number of institutions with note issuing rights to those prevailing at the time of the act. Scotland adopted the British pound with the political union with England of 1707.

⁵⁸ See e.g. National Monetary Commission (1910d).

⁵⁹ See e.g. National Monetary Commission (1910a).

issue sharing note issuance rights in direct coordination through the early twentieth century but seen as closely connected to the Bank of England.⁶⁰ Norway until the late nineteenth century maintained decentralised elements amid important central bank branch autonomy (Klovland & Oksendal, 2017).

The German mixed system under the 1875 Bank Act adopted elements of a single and multiple central banks systems with a dominant institution at federal level (Reichsbank) and smaller institutions at regional level (Privatnotenbanken).⁶¹

The 1874 Italian bank act, guiding the Italian central bank system in 1874-93, authorised six banks of issue to operate throughout Italy with a dominant institution Banca Nazionale nel Regno d'Italia present in all regions and smaller institutions operating in one or several regions but under different statutes and operational limitations (Sannucci, 1989).⁶² In Spain under the 1856 bank of issue act and through adoption of a note issue monopoly by the Bank of Spain under the 1874 decree, local banks of issue operated in locations where the Bank of Spain had no local branch (Moro et al., 2015; Schreiner, 2004).

The U.S. had no central bank through 1913 apart from two ante-bellum institutions. The United States introduced an entirely decentralised system in the early twentieth century with the adoption of the 1913 Federal Reserve Act (Cohen-Setton, 2016; Lowenstein, 2015; Meltzer, 2003).⁶³ The established 12 Federal Reserve Banks maintained broad-based independence in monetary policy. The adoption of the decentralised system rested on concerns for the U.S.' spatial economic diversity and undue concentration in monetary policy influence.⁶⁴

⁶⁰ See e.g. National Monetary Commission (1910b).

⁶¹ For the expression mixed system (gemischtes System), see e.g. Muss (1924), Wagner (1875). The Reichsbank bank notes became legal tender in 1909 and the Reichsbank assumed sole note issuance rights in 1935.

⁶² Differences prevailed in terms of accepted maturities of bills of exchange, number of signatures, rediscounts, and collateral acceptance. (Sannucci, 1989, p. 260) concludes: "*Their [the banks of issues] different modi operandi nevertheless survived at least partially, in spite of the fact that territorial expansion led to the simultaneous presence of more than one bank of issue in certain locations. Thus the coexistence of several banks of issue would have had a limited impact on increasing competition in the credit market [...].*"

⁶³ The establishment of the Federal Reserve System in 1913 attracted equally opposing views as in Germany, see e.g. West (1977), Morawetz (1911), National Monetary Commission (1913).

⁶⁴ See e.g. Glass (1927), Morawetz (1911), Parker Willis (1923). The 1935 Banking Act suspended monetary policy independence and shifted the previous powers of the Federal Reserve Banks to the Federal Reserve Board.

0.5. 1875 bank act

The 1875 bank act (Bankgesetz) established a central banking system for the first time in Germany. The act complemented critically the coinage and paper currency reforms of 1870-73.⁶⁵ It established the right of bank note issuance under Imperial law, prescribed central banking operations and minimum bank note reserve requirements and bank note convertibility and set prudential and disclosure requirements. The German Imperial Parliament (Deutscher Reichstag) was the principal driver for reforming the central banking system largely amid concerns about monetary stability and perceived undue bank note proliferation.⁶⁶ The main motivations for a mixed system were concerns about the effectiveness of a single central bank to maintain monetary discipline and a desire for the preservation of local banking practices.⁶⁷

Organisation

The act established a mixed central banking system with the German Imperial Bank (Reichsbank) at federal and the private banks of issue (Privatnotenbanken or Zettelbanken) at federal state level.⁶⁸ The legislation treated the Reichsbank and the Privatnotenbanken on the same footing but the Reichsbank was equipped with important privileges.⁶⁹ The Reichsbank was established as the dominant institution with the main tasks of regulating monetary circulation throughout the Empire, facilitating payments and mobilising available capital and

⁶⁵ The organisation, operations and policy framework of the Reichsbank were described comprehensively in National Monetary Commission (1910d); Otto (2002); Wühle (2011).

⁶⁶ Simon (1884): *“Der Hauptzweck des Bankgesetzes sollte es sein, das Banknotenwesen zu regeln, insbesondere den übermäßigen Banknotenumlauf einzuschränken. [...] Der ganze deutsche Markt, insbesondere der Kleinverkehr, wurde mit [...] papierenden Zahlungsmitteln überschwemmt.”* President of the Chancellery, Rudolph von Delbrück presenting the bank bill for the first reading of the Reichstag (Deutscher Reichstag, 1874, p. 150): *“Diese beiden Übelstände [große Menge von Banknoten; die Zirkulationsmittel in einem äusserlich unbegrenzten Masse zu vermehren] zu beseitigen, erschien uns als Hauptaufgabe des ausgestellten [Gesetzes] Entwurfs. Zur Erreichung dieser Aufgabe liessen sich nun aber freilich sehr verschiedene Mittel denken. In der Resolution des Reichstags vom vorherigen Jahre [...] war auf eine Reichsbank hingewiesen.”*

⁶⁷ The Privatnotenbanken had acquired the rights of note issuance and cancellation of such rights was seen as difficult also legally. Delbrück (Deutscher Reichstag, 1874, p. 152): *“Es konnte in der That nicht wohl daran gedacht werden, über diese Privilegien einfach zur Tagesordnung überzugehen und eine Centralbank zu errichten, der man allein die Banknotenemission im Reiche gibt.”*

⁶⁸ The notion of mixed system was well understood in Germany. The National Zeitung wrote in 1901 on the 25-year anniversary of the Reichsbank (National Zeitung, 1901): *“Die darin in Erscheinung tretenden Mißstände des zwischen Centralisation und Decentralisation stehenden Zwittersystems [...]”*

⁶⁹ Heil (1900) outlines that while the legislation treated both institutions formally similarly, there were important material differences in particular the obligation for the Privatnotenbanken to restrict operations to their home state significantly constraining the existence of Privatnotenbanken of smaller federal states.

had sole rights to establish branches throughout Germany. The Privatnotenbanken were de facto restricted to operate in their home federal states. The system offered no explicit specie-flow, reserve or other inter-institutional accommodation mechanism for linking the Reichsbank and the Privatnotenbanken.⁷⁰ However, the Reichsbank was understood to be the lender of last resort.⁷¹ All bank notes were accepted by all institutions at par and were not legal tender.⁷²

The Reichsbank was a public-private institution. Its shareholders were private individuals. The management of the institution was conducted by civil servants. The President, appointed by the Emperor for life, Vice-President and Directors, constituted the Directorate (Direktorium) made of seven members. The Direktorium met at least monthly and was the representative body of the Reichsbank. The branches kept the Direktorium informed on their activities on a continuous basis. The Imperial government de jure supervised its operations through the Advisory Board (Reichsbankkuratorium) and nominally chaired by the Imperial Chancellor. The Reichsbankkuratorium met every three months and consisted of five members of which three were appointed by the Upper Chamber of Parliament (Bundesrat). The shareholders of the bank exercised their influence on the bank through the annual general meeting and through the Central Committee (Zentralausschuss), the permanent representative body of the shareholders. The Zentralausschuss met at least monthly and was consulted on monetary policy measures but the final say was with the Directorate. The Zentralausschuss included prominent period bankers including e.g. in 1880, Gerson von Bleichröder, Simon von Oppenheim, Karl von Rothschild, Theodor Stern.

⁷⁰ The Reichsbank maintained a system of monthly cash balance adjustments to meet cash shortfalls in branches whereby the different branches were instructed to perform transfers (Barsendungen) to other branches comprising transfers between independent sector branches (Reichsbankhauptstellen) and between intra-sector branches (Reichsbanknebenstellen). The cash transfers were important and amounted on average in 1895-1900 to 2,500 million mark compared with an average stock of cash (Barvorrat) of the Reichsbank of 850 million mark.

⁷¹ The Reichsbank maintained that it did not perform rediscounting of bills in the market and with other institutions. National Monetary Commission (1910c, p. 356), interview with Otto von Glasenapp, Vice-President, and Karl von Lumm, Director of the Reichsbank on the discount policy of the Reichsbank in the event the reserve coverage falls below the legal minimum requirement: *"We should have to go on discounting bills. We should simply have to it. We could not stop it. If we did it would bring about the greatest panic that we have ever experienced."*

On the rediscounting of bills by the Reichsbank, see e.g. National Monetary Commission (1910d, p. 215): *"[The Reichsbank] wants to be the last resort of German monetary operations, never disposes further of inland bills discounted by it [...], and depends on no other bank, but, standing alone, meets the fluctuations of credit demands; the private banks of issue depend on the Reichsbank and, in case their funds run short, procure for themselves new means by disposing again of the bills discounted by them."*

⁷² In comparison, the Bank of England notes became legal tender in 1833; the Bank of France notes in 1848 though suspended in 1850 and resumed in 1870.

The Reichsbank preserved relative autonomy in its day-to-day operations and direct interventions by the government were very rare although the bank was subject to repeated government influence.⁷³ The Privatnotenbanken were private institutions normally with a profit-sharing arrangement with their home federal states.

The mixed central banking system implied that the Reichsbank and Privatnotenbanken maintained parallel operations at federal state level through their respective local branch networks. The Reichsbank maintained 223 branches (Reichsbankstellen, Reichsbankhauptstellen and Reichsbanknebenstellen) in 1880 and 243 in 1890 in Germany. For example, in Bayern including Pfalz (Kingdom of Bavaria including Bavarian Palatinate), the Bayerische Bank had 47 and 52 branches and the Reichsbank 15 and 19 in 1880 and 1890, respectively; in Sachsen (Kingdom of Saxony), the Sächsische Bank had 7 and 8 branches, and the Reichsbank 10 and 10 branches, in 1880 and 1890, respectively.⁷⁴ The Privatnotenbanken in addition also maintained branches in either Frankfurt or Berlin.

Privatnotenbanken

The act conserved the operations of the Privatnotenbanken. The number of Privatnotenbanken in operation was significantly reduced with the adoption of the 1875 bank act amid the significant perceived restrictions imposed on the Privatnotenbanken. 15 Privatnotenbanken abandoned their note issuance rights on adoption of the act. In 1876, there were 19 Privatnotenbanken in operation, 13 by 1890 and 7 by 1900.

⁷³ National Monetary Commission (1910c, p. 336) in interviews with von Glasenapp and von Lumm: *“In the Chancellor lies supreme power, although he has never exercised it but once in the history of the Bank.”* The incidence refers to the suspension of the discounting of Russian securities amid foreign policy concerns, see e.g. The Economist (1887). Sommer (1931) maintains a more critical stance and highlights that in particular the discussion about the failed nationalisation of the Reichsbank in 1889 was indicative of the political pressure.

⁷⁴ The 8 Reichsbanknebenstellen of the Pfalz (Palatinate) depended on the Reichsbankhauptstelle Mannheim in Baden. The Sächsische Bank had one branch located in Hof, Bayern close to the border between Bayern and Sachsen. The Reichsbank in 1890 also had a branch in Hof, Bayern. See Reichsbank annual reports of 1880 and 1890 (Reichsbank, 1881, Reichsbank, 1891) and Bayerische Notenbank annual reports (Bayerische Notenbank, 1881, Bayerische Notenbank, 1891). For Sachsen, see Lewin (1914).

The position of the Privatnotenbanken was further eroded with the 1899 bank act revision that abolished an important decentralising element with the new obligation for the Privatnotenbanken to follow the discount rate of the Reichsbank. The 1909 modification of the bank act (Änderung des Bankgesetz) made the Reichsbank bank notes legal tender from 1910.

Operations

The act regulated central banking operations for the Reichsbank and Privatnotenbanken. The principal operations were bills of exchange discounting with commercial banks, other banks of issue, non-bank corporate entities and individuals. Bills of exchange comprised local bills (Platzwechsel) and consigned bills (Versandwechsel).⁷⁵ All bills were subject to a given credit quality and to holding two signatures as pledge. Credit screening was performed locally through “information bureaus” at branch level that determined the capacity for credit assessed mostly on the basis of personal relations.⁷⁶

The bill of exchange is an unconditional order in writing issued by the drawer addressed to another person the drawee to pay usually at a fixed future time a certain sum of money to the bearer. When a banker acquires a bill, the bill is normally purchased outright for a sum less than its face value by way of a discount, reflecting an advance of the security of the bill against interest charged.⁷⁷ The Reichsbank and Privatnotenbanken only accepted bills with a remaining life not exceeding three months.

The other main operations included on the asset side extension of secured loans or advances against collateral (Lombard credits), effects business, foreign bills of exchange and on the liability side some deposit taking.⁷⁸ The Reichsbank also developed the important cash-less transfer business (Giroverkehr) and managed the deposits of the Imperial government.

⁷⁵ See Money market integration page 31 for an explanation of Platz- and Versandwechsel.

⁷⁶ See e.g. The Reichsbank p. 129.

⁷⁷ On the definition of bills of exchange, see e.g. Hanson (1985).

⁷⁸ The amount of bills drawn on foreign countries represented in 1876-90 between 0.4 and 2.9 percent of total bills drawn; the amount of deposits represented in 1879-90 0.1 percent of bank notes in circulation (Reichsbank, 1900).

The lending operations were funded primarily through bank note issuance constituting the banks' principal liabilities. Bank notes were to be reserved uniformly by one third ("Dritteldeckung") by eligible collateral including German currency (metal coins), Imperial Government securities (Reichskassenscheine), gold in bars and foreign coins. All bank notes were accepted at face value by the Reichsbank and the Privatnotenbanken. The act provided for the Reichsbank and the Privatnotenbanken to exchange its bank notes on demand for gold.

The bank notes of the Privatnotenbanken could only be used for payments at the place of issue or for settlement of balances with another Privatnotenbank but could be presented for redemption at any Privatnotenbank throughout Germany. The notes of the Reichsbank could be used as payments by the Privatnotenbanken. The Reichsbank maintained as a policy to present for redemption bank notes from Privatnotenbanken once a month at their branches and for immediate redemption at their head offices.⁷⁹

The bank notes were subject to quotas (Kontingentierung) for unreserved bank note issuance by the Reichsbank and Privatnotenbanken (Table 0-2). Non-reserved bank note issuance beyond the quotas attracted a 5 percent note tax (Notensteuer). The reserve system corresponded to a hybrid system between a fiduciary and a proportional system.⁸⁰

⁷⁹ Compare Reichsbank (1900), p. 312. The provision was meant to support regular circulation of the bank notes of the Privatnotenbanken in their respective states. The Privatnotenbanken complained about unscheduled redemption requests by the Reichsbank that made it more difficult for them to manage their note issuance with this being raised in parliament (Reichstag), e.g. (Deutscher Reichstag, 1880, p. 136): "*Am Anfang hat die Bankverordnung dem entsprechend gehandelt; sie hat alle 8 Tage ungefähr, wie es im Geiste des Gesetzes liegt, eine Präsentation [der Banknoten] stattfinden lassen, damit zur Zeit des Bankausweises keine überflüssigen Beträge von Privatnotenbanken im Portfeuille blieben. Das ging so mehrere Jahren hindurch. Plötzlich kam eine allgemeine Aenderung. Man fing nun mit einem Mal an, die Noten täglich einzukassieren. [...] Aber seit Mitte 1879 hat die Reichsbank auch diese Praxis wieder verändert, sie läßt nunmehr in ganz unregelmäßigen Zeitabschnitten einkassieren, so daß die Banken immer in Besorgnis sind, es werde heute oder morgen eine größere Notenmenge vorkommen.*"

⁸⁰ Bloomfield (1959) distinguishes between a fiduciary system where all notes above a given uncovered (fiduciary) issue have to be fully reserved and a proportional system where notes have to be covered by a minimum in legal reserves.

Table 0-2. Bank note quotas

	Non- reserved note issuance quota in 1875 (000 Mark)	Share of total quota (percent)	End of note issuance (year)
Reichsbank	250,000	64.9	
1 Preußische Bank, Berlin 1846			
2 Bayerische Notenbank, München 1875	32,000	8.3	1934
3 Sächsische Bank, Dresden 1865	16,771	4.4	1934
4 Frankfurter Bank, Frankfurt a.M. 1854	10,000	2.6	1901
5 Bank für Süddeutschland, Darmstadt 1855	10,000	2.6	1902
6 Badische Bank, Karlsruhe 1870	10,000	2.6	1934
7 Württembergische Notenbank, Stuttgart 1871	10,000	2.6	1934
8 Hannoverische Bank, Hannover 1856	6,000	1.6	1889
9 Leipziger Bank, Leipzig 1838	5,348	1.4	1875
10 Bremer Bank, Bremen 1856	4,500	1.2	1889
11 Mitteldeutsche Creditbank, Meiningen 1855	3,187	0.8	1875
12 Braunschweigerische Bank, Braunschweig 1853	2,829	0.7	1905
13 Weimarerische Bank, Weimar 1853	1,971	0.5	1875
14 Oldenburgerische Landesbank, Oldenburg 1868	1,881	0.5	1875
15 Thüringische Bank, Sondershausen 1855	1,658	0.4	1875
16 Gerarer Bank, Gera 1855	1,651	0.4	1875
17 Leipziger Kassenverein, Leipzig 1867	1,440	0.4	1890
18 Privatbank zu Gotha, Gotha 1856	1,344	0.3	1875
19 Communalständische Bank, Oberlausitz 1866	1,307	0.3	1875
20 Städtische Bank zu Breslau, Breslau 1848	1,283	0.3	1893
21 Danziger Privat-Aktienbank, Danzig 1857	1,272	0.3	1890
22 Kölnische Privatbank, Köln 1855	1,251	0.3	1886
23 Ritterliche Privatbank, Pommern 1825	1,222	0.3	1875
24 Provinzial-Aktienbank, Posen 1857	1,206	0.3	1890
25 Magdeburger Privatbank, Magdeburg 1856	1,173	0.3	1890
26 Rostocker Bank, Rostock 1850	1,155	0.3	1877
27 Bank des Berliner Kassenvereins, Berlin 1850	963	0.3	1875
28 Kommerzbank in Lübeck, Lübeck 1856	959	0.2	1887
29 Anhalt-Dessauische Landesbank, Dessau 1847	935	0.2	1875
30 Niedersächsische Bank, Bückeburg 1856	594	0.2	1875
31 Lübecker Privatbank, Lübeck 1856	500	0.1	1875
32 Chemnitzer Stadtbank, Chemnitz 1848	441	0.1	1875
33 Homburger Bank, Bad Homburg 1853	159	0.0	1875
Total	385,000	100.0	

Source: Kaiserliches Statistisches Amt (1880-95).

The balance sheet of the Reichsbank and Privatnotenbanken remained broadly stable in percent of Net National Product. Bills of exchange and secured loans held by the Reichsbank and Privatnotenbanken declined from 5.7 percent of national income in 1876 to 4.9 percent of in 1890. Bank notes in circulation similarly decreased from 6.8 percent of national income in 1876 to 6.4 percent in 1890. Bills of exchange were the dominant asset operation of the system at 40.8 percent of total assets in 1890. The Reichsbank was the dominant institution with Reichsbank bank notes increasing from 77.4 percent of total bank notes outstanding in 1876 to 85.2 percent in 1890. The Reichsbank remained a major holder of bills of exchange acquiring 38.7 percent of all bills of exchange brought into circulation in 1890 (Table 0-3).

Table 0-3. Central banking system

	1876	1880	1885	1890
Reichsbank and Notenbanken				
Million Mark, unless otherwise stated				
Total assets	1,603	1,570	1,738	2,006
percent of Net National Product	11.0	10.9	11.0	9.9
Bills of exchange and secured loans	825	780	844	1,001
percent of Net National Product	5.7	5.4	5.4	4.9
Notes in circulation	989	1,008	1,062	1,295
percent of Net National Product	6.8	7.0	6.7	6.4
Unreserved notes in circulation†	218	217	220	273
percent of Net National Product‡	1.5	1.5	1.4	1.3
Percent of total assets, unless otherwise stated				
Metal reserve	43.2	44.3	44.1	44.6
Bills of exchange	45.2	41.3	42.4	40.8
Secured loans	6.2	8.4	6.2	9.1
Notes of other banks	2.2	2.7	2.5	1.9
Effects	1.2	2.5	3.5	2.6
Reserve (ratio) *	0.6	0.6	0.6	0.5
Percent of system assets, unless otherwise stated				
Reichsbank				
Metal reserve	81.1	83.6	85.6	88.0
Bills of exchange	61.6	60.9	62.7	74.9
Secured loans	60.7	72.4	73.1	80.3
Notes of other banks	46.4	51.9	37.7	35.2
Effects	3.7	61.5	77.4	71.9
Bank notes	77.4	80.0	80.9	85.2
Unreserved bank notes	68.9	71.9	68.7	78.7
Reserve ratio	0.7	0.7	0.8	0.7
Note denominations, percent of total notes				
1000 mark	29.6	32.3	33.6	33.0
100 mark	46.4	53.9	61.1	65.1
Germany				
Bills of exchange, brought into circulation (million Mark)	12,374	11,558	12,060	14,020
percent acquired by Reichsbank	33.3	30.1	29.5	38.7
Bills of exchange, average circulation (million Mark)	3,169	2,960	3,089	3,590
percent of bills held by Reichsbank	13.0	12.1	12.5	15.5
percent of bills held by Notenbanken	5.3	5.2	5.9	5.1

Source: Hoffmann (1965); Reichsamt des Inneren (1876-90); Reichsbank (1900). End of period. * Unweighted Reichsbank, Badische Bank, Bank für Süddeutschland, Bayerische Notenbank, Frankfurter Bank, Sächsische Bank, Württembergische Notenbank. † Annual average. ‡ Of bills average circulation. †† Mark notes. 500 mark notes were phased out in 1900. 50 and 20 mark notes phased in in 1906.

The Reichsbank and Privatnotenbanken were subject to strict disclosure requirements with an obligation to advertise their main balance sheet items on a weekly basis to inform the public about their financial and prudential strengths including payment of the note tax.

The act had strict provisions for adherence to the regulation. Members of the banks' executive boards were personally liable for elevated fines and could face jail sentences for breaching the prudential regulations under the act on note issuance or payment of the note tax.⁸¹

⁸¹ Penalties under paragraph 59 of the 1875 bank act.

Bills of exchange, reserves and bank notes

The fractional reserve requirement establishes a close relationship between bills of exchange, reserves and bank notes. This relationship is normally expressed with the reserve ratio or liquidity ratio. The reserve ratio is the ratio of legal reserves to bank notes in circulation but alternative calculations are equally valid.⁸² The ratio varies normally from the minimum reserve coverage of one third to unity, where unity denotes a fully reserved bank note. Under fractional reserves, an increase in the reserve ratio indicates a net absorption of liquidity and a decline in the reserve ratio a net injection of liquidity.

The relationship between bills of exchange, reserves and bank notes is positive and linear at a given reserve ratio. The acceptance of bills of exchange is broadly an increasing function of reserved note issuance.

The relationship between bills of exchange, reserves and bank notes can be illustrated with Figure 0-7. At a given schedule of reserves, an increase in bank notes higher than an increase in reserves, e.g. due to most bill drawers accepting notes as payment and the bank rediscounting some bills for currency, implies a decline in the reserve ratio. The decline in the reserve ratio can take place up to the limit of the note quota and otherwise incurs a note tax payment. In the event of a cash call at point *a*, bank notes are redeemed from *Bank note* to *Bank note'* in an equivalent amount of reserves from *Reserves* to *Reserves'*. Under fractional reserves, this results in a decline in the reserve ratio from *Reserve ratio* to *Reserve ratio'*. The closer the bank is to the statutory minimum reserve requirement of 0.3, the greater the risk that a cash call may result in an insufficient reserve coverage. The level of note issuance is therefore also a function of contingent cash calls.⁸³

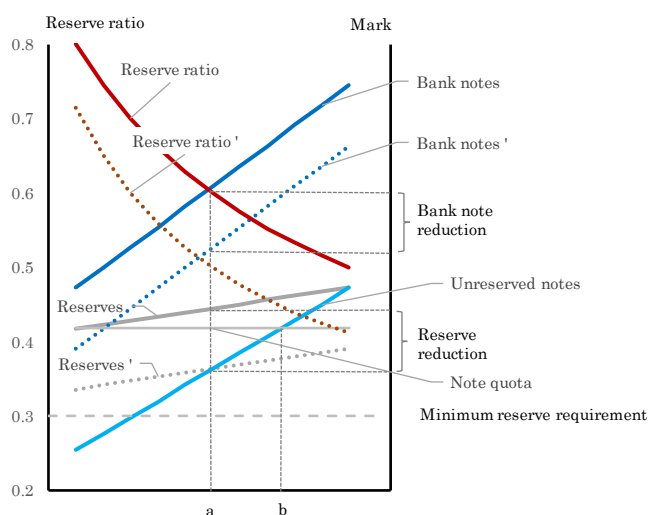
The reserve ratio schedule indicates the increase in unreserved notes. At point *b*, unreserved notes exceed the note quota and payment of the note tax would be due (Figure 0-7).

⁸² The reserve ratio herein is based on all legally reservable assets. Bloomfield (1959) argues that different reserve ratios are feasible amid considerations for including all metals, only gold, excluding silver, not including foreign coins.

⁸³ The Reichsbank would regularly present the bank notes of the Privatnotenbanken to the Privatnotenbanken for redemption, see footnote 79.

Banks ought to be indifferent between acquiring bills against reserves or against notes within the limits of the note quota as both reserves and bank notes are non-interest bearing. However, this is a function of the estimated implied call option value of maintaining reserves for further bills purchases and the estimated put option value of bank notes of converting notes into reserves. Only, if the estimates of the call and put option values are similar, would banks be indifferent to funding bills purchases by notes or reserves.

Figure 0-7. Bank notes, reserves and reserve ratio



Gold parity

The act stipulated that all banks notes are to be exchanged unconditionally on demand for gold at a rate of 1392 mark per pound (500 grams) of gold fine.⁸⁴

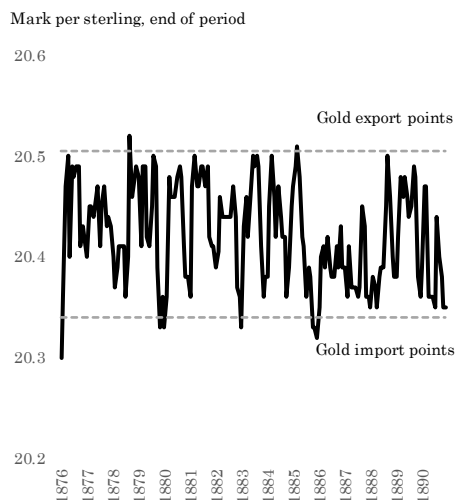
Exchange rate and gold points

The mark was traded in the most important exchange rate markets at the time including London, Paris, Amsterdam. With 1 mark equivalent to 0.3584 gram of gold and 1 pound sterling equivalent to 7.3224 gram of gold, the implied mark

⁸⁴ The gold content was fixed with the 1871 coinage act. The act stipulates that 139 ½ 1 mark coins are to be minted of 500 grams of fine gold minus 3 Mark minting fee.

sterling gold-mass-based exchange rate was 20.4294 mark per pound sterling.⁸⁵ Foreign exchange operations were typically conducted by sterling bills of exchange trading in Berlin or mark bills trading in London. Reference bills during 1876-90 were normally bills with 8 days sight.⁸⁶

Figure 0-8. Exchange rate



Source: Schneider und Schwarzzer (1990). Berlin 8 day sight (8 Tage dato). Gold points from Morgenstern (1959) table 74 for period 1880-1914)

The bilateral exchange rates fluctuated due to supply and demand. The exchange rate was stable with the average exchange rate in 1876-90 being near identical to the gold parity exchange rate and without trend or drift using an augmented Dickey Fuller test for stationarity. The exchange rate movements from parity based on the partial autocorrelation confidence interval at 5 percent significance level constituting an upper bound of 20.58 and a lower bound of 20.28 implied a 0.7 percent band around parity. The fluctuations offered the possibility to arbitrage between making or receiving a payment locally or exporting or importing gold. The limits of the fluctuation band were known as gold points to describe the exchange rates relative to the gold parity at which exporting or importing of gold would be profitable. The gold points represent estimations taking into account cost of transport of gold, insurance and other transaction costs and vary with the

⁸⁵ 1 pound (Zollpfund) of gold fine was equivalent to 500 grams on the basis of the 1857 Vienna coinage act. The sterling gold equivalent was set with the 1870 coinage act (An Act to consolidate and amend the law relating to the Coinage and Her Majesty's Mint) at 1 pound sterling (Sovereign) equal to 7.9881 gram weight with a standard fineness of 11/12.

⁸⁶ 8 day sight signifies the usance for bills of exchange, that is, the maturity date after the drawee accepts the bill of exchange.

respective exchange markets. Morgenstern (1959) proposes a range of median gold points for 1880-1914 of 20.34-20.505 mark per sterling for Berlin-London representing a band of 0.4 percent below and above parity. The Reichsbank (1912) advertises the gold points as 20.34 for gold imports and 20.50 for gold exports for 1896-1910 for 8-day sight mark per sterling for Berlin-London and Fischel (1910) indicates that the gold points around 1908 were 20.35 for gold imports and 20.56-20.53 mark per sterling for gold exports for Berlin-London.⁸⁷

Gold reserves and current account

The Reichsbank was the main repository for monetary gold in Germany. Most business involving net exports of gold was conducted through the Reichsbank. Its metal reserves during 1876-90 held on average an estimated 50 percent in gold.⁸⁸ Persistent current account surpluses in 1876-90, in large part due to surpluses in the services and income balances, were accompanied by net gold imports. While the Reichsbank initially lost gold reserves, it subsequently made significant net accumulation of gold reserves through 1888 increasing the estimated stock of gold reserves from 319 million mark in 1876 and 223 million mark in 1878 to a peak of 702 million mark in 1888 before declining to 537 million mark in 1890. The Reichsbank dominated net gold flows and constituted the bulk of net gold movements.⁸⁹ Total net gold inflows in 1878-1890, excluding gold in transit to third countries, were 141.8 tons of gold bars, ingots and minted coins equivalent to 356 million mark. In 1877-78, the Reichsbank had near record high inflows of gold bars that it passed to the mint for coining.⁹⁰

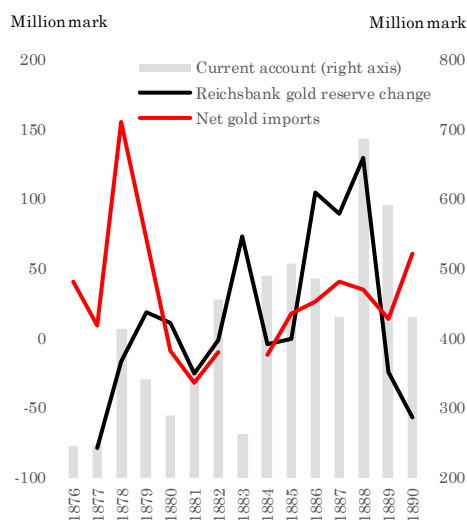
⁸⁷ On the derivation of the gold points, see e.g. Esteves et al. (2009).

⁸⁸ The Reichsbank during the nineteenth century never published its reserves by metal only offering the highest and lowest level of gold reserves per year.

⁸⁹ The Reichsbank states that “*all gold destined for monetary purposes is in reality delivered to the Reichsbank, and the Reichsbank is the only private concern which makes use of the free right of coining. It follows of necessity that the demand for gold for consignments abroad must finally be covered from the bullion of the central bank*” (National Monetary Commission, 1910d, p. 31-32).

⁹⁰ See Reichsbank (1900) table 16. The Reichsbank records as reserve inflows foreign coins and bars and as outflows foreign coins and bars passed to the mints for coining.

Figure 0-9. Gold flows



Source: Hoffmann (1965); Kaiserliches Statistisches Amt (1877, 1878, 1879); Kaiserliches Statistisches Amt (1880-1895). Gold composed of gold ingots and minted coins. For gold imports no data for 1883. Reichsbank gold reserves based on estimated gold stocks.

Gold flows represented less than 2 percent of gross exports and imports. However, in 1876-90, the sum of average German gross gold exports and imports represented about 25 percent of the average German current account balance indicating that physical gold movements were important for net external payments.

Discount policy

The act stipulated a dual policy mandate for the Reichsbank and a narrower mandate for the Privatnotenbanken. Both institutions were obligated to maintain bank note convertibility into gold, to redeem their bank notes on demand for lawful German money.⁹¹ The Reichsbank was also mandated to facilitate money circulation and payments throughout Germany and mobilise credit in addition to other operations for the Federal government. The Reichsbank and Privatnotenbanken saw their roles as a public policy mandate but pursued profitability objectives.⁹²

The Reichsbank’s monetary policy framework was influenced by a mix of quantity theory—Currency School rules—and Antibullionists—real bills doctrine—

⁹¹ The notion of convertibility under the gold standard refers strictly to convertibility into gold and not to the contemporary notion of exchange restrictions.

⁹² See e.g. National Monetary Commission (1910c, p. 343) in interviews with von Glasenapp and von Lumm: “Our shareholders have secondary consideration.”

Banking School provisions.⁹³ The Reichsbank's monetary policy was set by a combination of external and domestic objectives including the maintenance of convertibility of bank notes into gold, orderly domestic money market conditions, support of domestic economic activity and balance sheet profitability. While price developments were followed to some extent, policy was not geared towards price stability.⁹⁴ The Privatnotenbanken addressed regional monetary issues and supported the discount policy of the Reichsbank, performed some supervisory functions at federal state level and facilitated local monetary transactions.⁹⁵

The official discount rate was the main monetary policy instrument of the Reichsbank.⁹⁶ The discount rate signalled alterations in the monetary policy stance that materialised in net injections of monetary aggregates. The discount rate was adjusted to meet a given policy objective including to attract net gold flows (Figure 0-8), desire to accommodate credit demand and/or dampen perceived undue speculative behaviour.

The unreserved note quotas allowed banks under the fractional reserve standard to pursue expansionary and contractionary monetary policy through gold flow sterilisation. Variations in the reserve ratio, being the rate of bank notes in circulation to reserves, indicates changes in the monetary policy stance, that is, a net accommodation. The discount rate and reserve ratio tend to show an inverse relationship as the discount rate is adjusted upward in the event of a falling reserve ratio. The data similarly affirm that the relationship was more complex indicating that other factors were also at play (Figure 0-10).

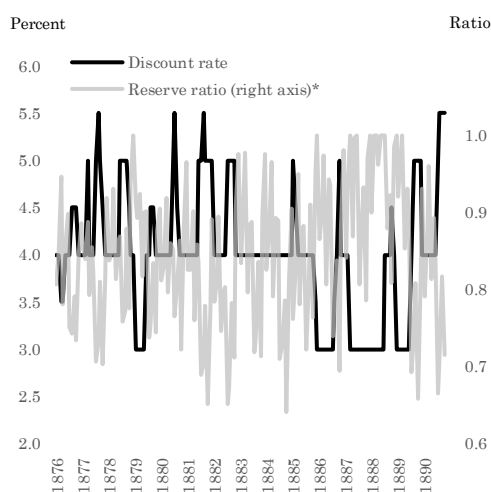
⁹³ For an overview of the quantity theory and its historic evolution see e.g. Humphrey (1974).

⁹⁴ Influencing the price level or inflation were not seen as part of the task of the Reichsbank. The National Monetary Commission (1910d) in its comprehensive coverage of the Reichsbank operation makes no reference to inflation; see also Bopp (1953).

⁹⁵ See e.g. Muss (1924, p. 201): *“Im Wesentlichen stellt das Bankgesetz den Privatnotenbanken zur Aufgabe: territorial begrenzte Handhabung des Notenausgaberechtes unter Unterstützung der der Diskontpolitik der Zentralbank [Reichsbank], Befriedigung und Ueberwachung des provinziellen und lokalen Kreditwesens, Organisation von Verkehrserleichterungen, Pflege des Depositenswesens.”*

⁹⁶ The discount rate was typically by far the most important monetary policy instrument under the classical gold standard, see e.g. Bloomfield (1959). National Monetary Commission (1910a, p. 204): *“The Bank's investment are determined chiefly by the domestic demand for short-term credit. Owing to the preponderating importance of investment in bills, the discount rate is practically the only one to be taken into account. As in the case of merchandise, a high rate restricts and a low rate stimulates the demand.”*

Figure 0-10. Discount rate and reserve ratio



Source: Reichsamt des Inneren (1876-90); Reichsbank (1925). Reichsbank. * Metal reserve to bank notes in circulation.

The Reichsbank normally lent to sub-prime entities and received bills for re-discounting from other banks but did not sell bills for re-discounting itself.⁹⁷ The Privatnotenbanken followed the official discount rate of the Reichsbank but conducted large bills of exchange operations at private or prime rates (Privatdiskont). The Reichsbank from 1880 similarly discounted bills below its official rate at prime rates.

The Reichsbank kept an average discount rate of 4 percent with occasional deviations throughout 1876-1890 with a latter phase since 1886 of average lower rates accompanied by variations of the central banking system's average reserve ratio.

0.6. Sources

The thesis compiled and digitised bank's balance sheet, financial, tax, price and migration data on a monthly basis for the period 1876-90.

⁹⁷ National Monetary Commission (1910c, p. 340), interview with von Glasenapp and von Lumm on the operations of Reichsbank: “[Prime bills] are on the market [...], which sell at a lower rate than that of the Reichsbank and are therefore taken by the banks.”

Geographic names and spelling

The names of German federal states and cities are spelled in contemporary German. While several German geographical names have an anglicised form, many do not; to allow a homogenous treatment, the native form for geographical names is therefore being used throughout.

The narrative accounts in German when quoted preserve the period spelling.

Data

Table 0-4. Data variables

Entity	Variable	Unit	Period	Source
Baden	Overseas emigration	thousand mark	Apr 1883-Dec 1890	Statistik des Deutschen Reichs, Monatshefte
Badische Bank	Reserve ratio	ratio	Jan 1876-Dec 1890	Centralblatt für das Deutsche Reich
Badische Bank	Bills of exchange	thousand mark	Jan 1876-Dec 1890	Centralblatt für das Deutsche Reich
Bank für Süddeutschland	Reserve ratio	ratio	Jan 1876-Dec 1890	Centralblatt für das Deutsche Reich
Bank für Süddeutschland	Bills of exchange	thousand mark	Jan 1876-Dec 1890	Centralblatt für das Deutsche Reich
Bank of England	Discount rate	percent	Jan 1876-Dec 1890	Vergleichende Notenbankstatistik
Bayerische Notenbank	Reserve ratio	ratio	Jan 1876-Dec 1890	Centralblatt für das Deutsche Reich
Bayerische Notenbank	Bills of exchange	thousand mark	Jan 1876-Dec 1890	Centralblatt für das Deutsche Reich
Bayern	Overseas emigration	thousand mark	Apr 1883-Dec 1890	Statistik des Deutschen Reichs, Monatshefte
Berlin Börse	Discount rate	percent	Jan 1876-Dec 1890	Vergleichende Notenbankstatistik
Deutsches Reich	Inland taxes	million mark	Mar 1878-Dec 1890	Centralblatt für das Deutsche Reich
Deutsches Reich	Inland taxes and customs	million mark	Mar 1878-Dec 1890	Centralblatt für das Deutsche Reich
Deutsches Reich	Wholesale prices	million mark	Jan 1879-Dec 1890	Statistik des Deutschen Reichs, Monatshefte
Deutsches Reich	Agricultural wholesale prices	million mark	Jan 1879-Dec 1890	Statistik des Deutschen Reichs, Monatshefte
Deutsches Reich	Overseas emigration	thousand mark	Jan 1876-Dec 1890	Statistik des Deutschen Reichs, Monatshefte
Frankfurter Bank	Reserve ratio	ratio	Jan 1876-Dec 1890	Centralblatt für das Deutsche Reich
Frankfurter Bank	Bills of exchange	thousand mark	Jan 1876-Dec 1890	Centralblatt für das Deutsche Reich
Hessen	Overseas emigration	thousand mark	Apr 1883-Dec 1890	Statistik des Deutschen Reichs, Monatshefte
Privatnotenbanken	Reserve ratio	ratio	Jan 1876-Dec 1890	Centralblatt für das Deutsche Reich
Reichsbank	Discount rate	percent	Jan 1876-Dec 1890	Vergleichende Notenbankstatistik
Reichsbank	Reserve ratio	ratio	Jan 1876-Dec 1890	Centralblatt für das Deutsche Reich
Reichsbank	Bills of exchange	thousand mark	Jan 1876-Dec 1890	Centralblatt für das Deutsche Reich
Reichsbank	Gold	thousand mark	Jan 1879-Dec 1890	Die Reichsbank (1900)
Sachsen	Overseas emigration	thousand mark	Apr 1883-Dec 1890	Statistik des Deutschen Reichs, Monatshefte
Sächsische Bank	Reserve ratio	ratio	Jan 1876-Dec 1890	Centralblatt für das Deutsche Reich
Sächsische Bank	Bills of exchange	thousand mark	Jan 1876-Dec 1890	Centralblatt für das Deutsche Reich
Württemberg	Overseas emigration	thousand mark	Apr 1883-Dec 1890	Statistik des Deutschen Reichs, Monatshefte
Württembergische Notenbank	Reserve ratio	ratio	Jan 1876-Dec 1890	Centralblatt für das Deutsche Reich
Württembergische Notenbank	Bills of exchange	thousand mark	Jan 1876-Dec 1890	Centralblatt für das Deutsche Reich

Reserve ratio: Metal reserve to notes in circulation.

Bank data

The statistical analyses use monthly balance sheet data of the Reichsbank and Privatnotenbanken from January 1876 through December 1890. The data were digitalised as published in the monthly statistical series Central-Blatt für das

Deutsche Reich by the Imperial Ministry of the Interior (Reichsamt des Inneren, 1876-1890).⁹⁸ The data were located at the Geheimes Staatsarchiv Preußischer Kulturbesitz, Berlin.

The data cover on the asset side metal reserves, bills of exchange (Wechsel), secured loans or advances against collateral (Lombard), notes of other banks and currency holdings and on the liability side bank notes in circulation and unreserved bank notes. The data are complemented by the annual reports of the Reichsbank (e.g. Reichsbank, 1881) and Privatnotenbanken (e.g. Bayerische Notenbank, 1881) and the compilation by the Reichsbank Vergleichende Notenbankstatistik (Reichsbank, 1925). The annual reports of the Privatnotenbanken were located at the library of the Reiss-Engelhorn-Museen, Mannheim, Hessisches Wirtschaftsarchiv, Darmstadt and the library of the Georg-August-Universität, Göttingen.

The banks were subject to disclosure requirements that consistent of weekly notifications of the their main balance sheet items in the Deutscher Reichsanzeiger (Deutscher Reichsanzeiger und Preußischer Staatsanzeiger, 1885).

⁹⁸ The Reichsbank and the Privatnotenbanken under the publication obligations of the bank act were required to publish main balance sheet items on a weekly basis in the Deutscher Reichsanzeiger und Preußischer Staatsanzeiger (see Figure 0-14 for an example of a disclosure notification) that were compiled on a monthly basis in the Central-Blatt.

Figure 0-12. Annual report Reichsbank

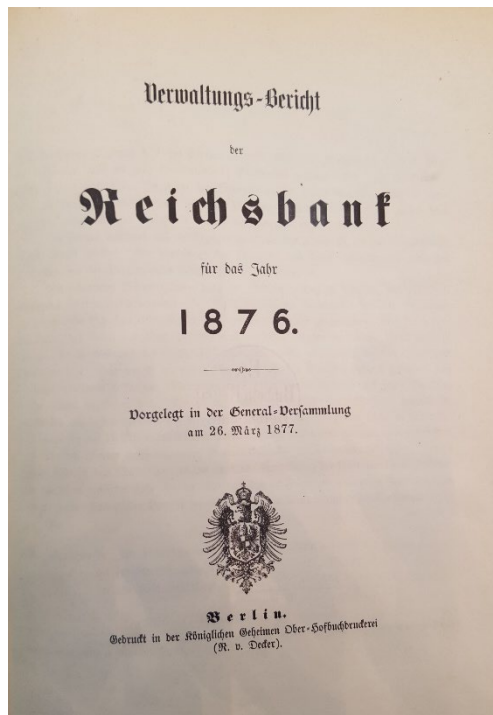


Figure 0-13. Annual report Bayerische Notenbank

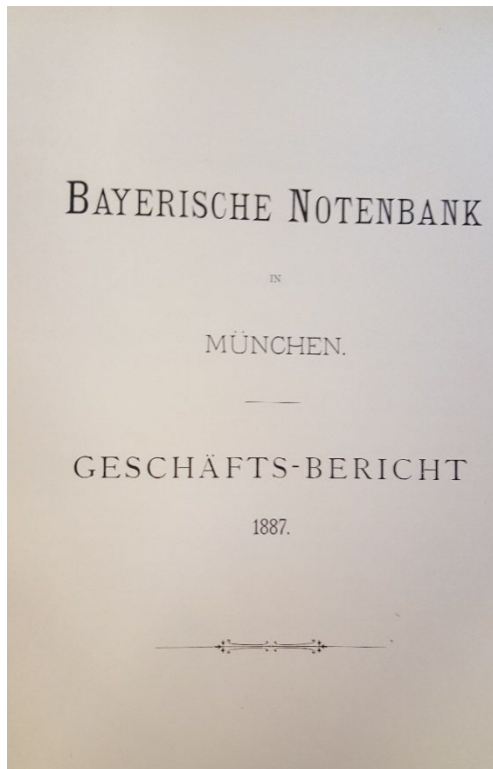


Figure 0-14. Weekly banks of issue notification

0875) **Wochen-Anzeige der deutschen Zettelbanken.**
Wochen-Uebersicht
der
Reichs-Bank
vom 28. Februar 1885.
Activa.

1) Metallbestand (der Bestand an coursfähigem deutschen Gelde und an Gold in Barren oder ausländischen Münzen, das Pfund fein zu 1392 Mark berechnet) . . .	578,269,000
2) Bestand an Reichsbanknoten . . .	20,062,000
3) „ an Noten anderer Banken . . .	19,385,000
4) „ an Wechseln . . .	357,964,000
5) „ an Lombardforderungen . . .	46,521,000
6) „ an Effecten . . .	31,087,000
7) „ an sonstigen Activen . . .	25,140,000
Passiva.	
8) Das Grundkapital . . .	130,000,000
9) Der Reservefonds . . .	20,308,000
10) Der Betrag der umlaufenden Noten . . .	682,056,000
11) Die sonstigen täglich fälligen Verbindlichkeiten . . .	244,103,000
12) Die sonstigen Passiva . . .	349,000

Berlin, den 3. März 1885.
Reichsbank-Direktorium.
von Dechend, Boeck, von Kottb., Gallenkamp, Herrmann, Koch, von Kottb.

Deutscher Reichsanzeiger und Preussischer Staatsanzeiger, 3 March 1885.

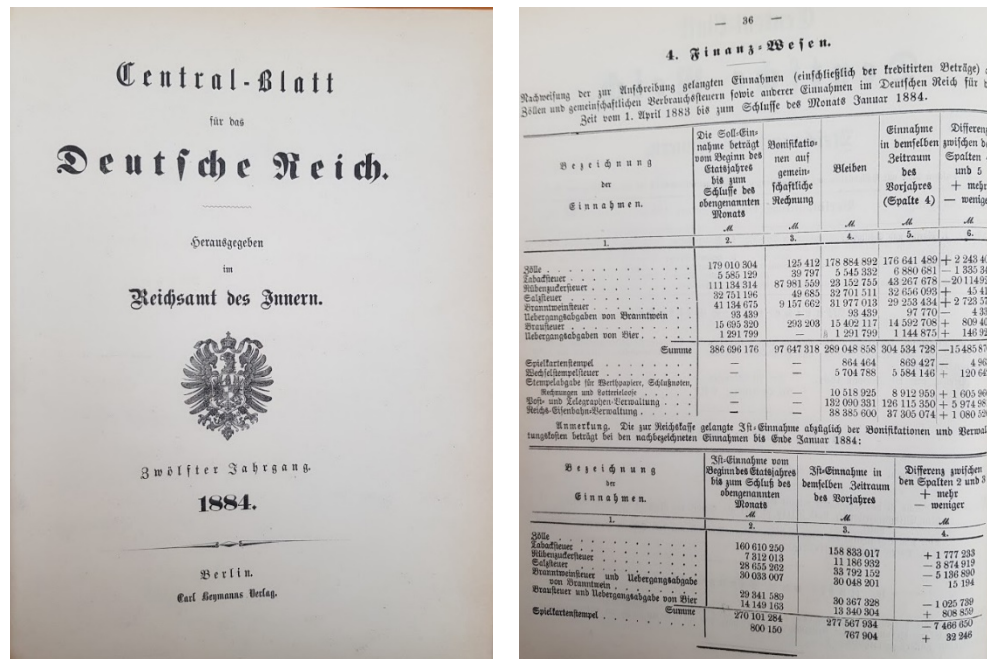
Monetary data

The data on monetary aggregates and other monetary statistics including total bills of exchange unless otherwise indicated were from the appendix of Reichsbank (1900), the Statistics Yearbooks *Jahrbücher der Statistik für das Deutsche Reich* by the Imperial Statistical Office *Kaiserliches Statistisches Amt* (1880-1895) and Hoffmann (1965).

Tax and customs revenue

The tax and customs revenue data include German federal taxes on salt (Salzsteuer), beer (Brausteuern) and custom duties were digitalised as published monthly of actual revenue (Ist-Einnahme) from March 1878 in the *Central-Blatt für das Deutsche Reich* (Reichsamt des Inneren, 1876-1890). The tax revenue data naturally only represent a subset of tax collection in Germany in 1876-90. The majority of taxes was levelled at federal state level and not covered here.

Figure 0-15. Centralblatt für das Deutsche Reich Finanzwesen



The German federal government had only limited tax raising powers during 1876-90 in large part as tax administration remained with the federal states.⁹⁹ The prerogative to levy direct taxes remained entirely with the federal states until the 1906-09 tax reform. The empire was dependent on receiving transfers from the federal states (Matrikularbeiträge), had income from railways, post office, the banking sector including the Reichsbank and levied excises including duties on commodities and customs.¹⁰⁰

The spirits duty (Branntweinsteuer) featured exemption as the federal states of Baden, Bayern and Württemberg started to contribute only from 1887 onwards. Other indirect tax collection on sugar (Rübenzuckersteuer und Zuckermaterialsteuer) and tobacco (Tabaksteuer) exhibited strong dependence on harvest outcomes.

The inland tax revenue represented on average 0.4 percent of Germany's net inland product in 1879-90.¹⁰¹ The inland tax on salt, beer and customs revenue at federal level represented on average 1.4 percent of Germany's net inland product in

⁹⁹ See e.g. Gerloff (1916).

¹⁰⁰ See Wagner (1910) for the imposition of custom duties as a prerogative of federal states.

¹⁰¹ Excluding taxes on tobacco, sugar beet and spirits.

1879-90. The two inland taxes plus custom revenue represented in 1878/79 78 percent and in 1888 68 percent of total federal tax and customs revenues.¹⁰²

The custom revenue was subject to significant tariff increases in 1879-88. The 1879 custom tariff reform (Zolltarifgesetz) represented a comprehensive introduction and increase of custom tariffs. The aimed custom revenue increase was estimated at almost 90 percent of scheduled custom revenues from 82 million mark to 154 million mark (1 percent of net national product).¹⁰³ Previously exempt categories like iron and grains became subject to a tariff. Subsequent custom tariff amendment in 1885 and 1888 provided for further increases though for only a small range of products (Table 0-5).

Table 0-5. Custom duties

	Unit	Tarif per unit, mark				Wholesale prices, mark, average			Tarif, percent of wholesale price		
		prior to 1879	1879	1885	1888	1879	1885	1888	1879	1885	1888
Rye	1000kg	0.00	5.00	30.00	50.00	132.81	140.56	134.46	3.8	21.3	37.2
Potatos	1000kg	0.00	0.00	0.00	0.00		32.15	37.92		0.0	0.0
Sugar raw	100kg	12.00	24.00	24.00	24.00	62.58	47.81	44.52	38.4	50.2	53.9
Coffee raw	100kg	17.50	20.00	20.00	20.00	118.48	81.56	136.55	16.9	24.5	14.6
Cotton*	100kg	18.00	30.00	48.00	48.00	123.90	109.58	105.74	24.2	43.8	45.4
Wool**	100kg	0.00	1.00	24.00	24.00	334.83	267.50	260.83	0.3	9.0	9.2
Pig iron***	1000kg	0.00	10.00	10.00	10.00	55.58	53.43	56.29	18.0	18.7	17.8
Hard coal	1000kg	0.00	0.00	0.00	0.00		18.43	18.25		0.0	0.0

Source: Deutscher Reichstag (1879); Kaiserliches Statistisches Amt (1877-90). Select items. German custom tariff laws of 15 July 1879; 13 May 1885; 17 December 1887. * tarif item no 2c position 4 and 5. ** tarif no 41 c 2. *** tarif no 6 a.

The tax and customs revenues increased significantly during 1879-90. Taxes including salt and beer remained broadly stable as percent of national income at 0.4 percent in 1879 and 0.3 percent in 1890.¹⁰⁴ Customs increased from 1.0 percent of national income 1879 to 1.8 percent in 1890.

The tax and custom revenue data exhibit a close relationship with national income. The correlation coefficient of national income and tax in 1879-90 is 0.98 and of national income and tax and customs is 0.99.¹⁰⁵

¹⁰² Wagner (1910, pp. 316-317)

¹⁰³ The estimation tariff revenue was calculated in the supporting document for the tariff bill, see Deutscher Reichstag (1879b).

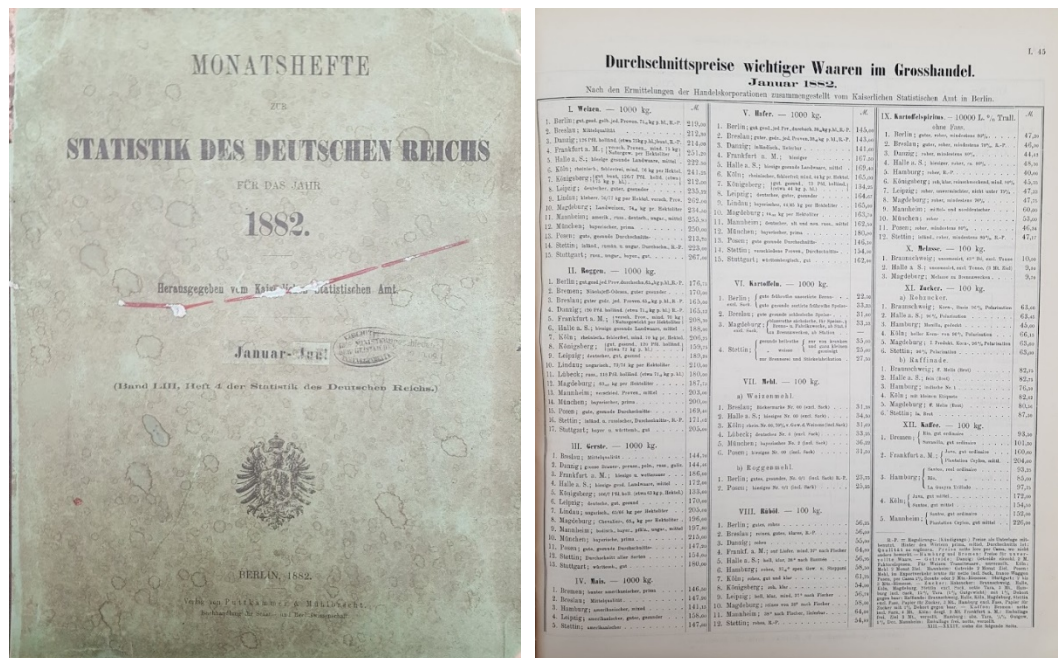
¹⁰⁴ National income is from Hoffmann (1965): Nettoinlandsproduct zu Faktorkosten zu laufenden Preisen (Volkseinkommen).

¹⁰⁵ It is recognized that the small sample size due to the availability of only annual data for national income, reduces the reliability of the correlation coefficient.

Wholesale prices

The wholesale prices for 10 items of agricultural and industrial products for Germany were digitalised as published monthly from January 1879 in Monatshefte zur Statistik des Deutschen Reichs (Kaiserliches Statistisches Amt, 1877-1890). The price data do not indicate to what extent local prices were representative of price developments at federal level.

Figure 0-17. Statistik des Deutschen Reichs, Monatshefte, Durchschnittspreise



The wholesale price index is constructed using the weights of total index as published for the period 1850-1931 at constant weights by Jacobs and Richter (1935) (Table 0-6):

The prices comprise (English translation, city where price is quoted): Roggen (rye, Berlin), Kartoffeln (potato, Berlin), Rinder (cattle, Berlin), Zucker (sugar, Braunschweig), Kaffee (coffee, Hamburg), Baumwolle (cotton, Bremen), Wolle (wool, Berlin), deutsches Roheisen (German pig iron, Breslau), englisches Roheisen (English pig iron, Berlin) and Steinkohle (hard coal, Berlin). An agricultural index

was constructed by reweighting the three agricultural items as a proxy for agricultural prices.

Table 0-6. Wholesale price index weights

Ware und Notierung	Wägung in v.H.*		Ware und Notierung	Wägung in v.H.*	
	des Gruppen index**	des Gesamt index***		des Gruppen index**	des Gesamt index***
I. Agrarstoffe		50	II. Industriestoffe		50
1. Pflanz. Nahrungsmittel	100	20	6. Steinkohlen	100	10
Roggen	35		deutsche	75	
Weizen	20		englische	25	
Gerste	10		7. Roheisen	100	10
Hafer	10		deutsches	66 1/3	
Kartoffel	20		englisches	33 1/3	
Erbsen	5		8. Nichteisen-Metalle	100	5
2. Vieh	100	15	Kupfer	40	
Rinder	50		Blei	20	
Schweine	50		Zink	20	
3. Vieherzeugnisse	100	10	Zinn	20	
Milch	40		9. Textilien	100	10
Butter	40		Wolle	35	
Schmalz	20		Baumwolle	10	
4. Zucker	100	1	Baumwollgarn	10	
5. Kolonialwaren	100	4	Rohseide	5	
Reis	15		Flachs	15	
Kaffee	40		Leinengarn	20	
Tee	5		Hanf	5	
Kakao	5		10. Häute und Felle	100	4
Rohtabak	25		Rindshäute	75	
Palmöl	10		Kalbfelle	25	
			11. Chemikalien	100	2
			Soda	50	
			Salpeter	50	
			12. Ole und Fette	100	2
			Leinöl	40	
			Talg	30	
			Wachs	20	
			Harz	10	
			13. Baustoffe	100	7
			Mauersteine	32	
			Dachziegel	4	
			Kalk	8	
			Zement	6	
			Kiefernholz	38	
			Fichtenholz	12	

Source: Jacobs and Richter (1935). Constant weights 1850-1931. *Weight in percent. **of the group index. ***of the total index.

Narrative accounts

The study relied for the narrative accounts to an important extent on session records of the German Imperial Parliament (Reichstag). The records are published on-line at http://www.reichstagsprotokolle.de/en_index.html (see example Figure 0-18). The annual reports of the Reichsbank do not contain qualitative records except for 1876.¹⁰⁶ Session reports of the meetings of the Direktorium of the

¹⁰⁶ The Bundesbank Archiv in Frankfurt transferred all Reichsbank-related documents to the Bundesarchiv-Lichterfelde.

Reichsbank could not be located and are believed to have been destroyed according to the German Federal Archive Bundesarchiv Berlin-Lichterfelde. Reports of a member of the Reichsbankkuratorium to his government were located for 1880 to 1887 at the Hauptstaatsarchiv Stuttgart (see example, Figure 0-19). The annual reports of the Privatnotenbanken hold some narrative accounts.

The research located letters from Gerson Bleichröder, Bismarck's private financial advisor and close confidante, on the Reichsbank at the Otto von Bismarck Foundation in Friedrichsruh (Figure 0-20).

The U.S. National Monetary Commission constituted an important source of information and narrative evidence. The main publication used was National Monetary Commission (1910d) that is a translation into English of Reichsbank (1900).

Figure 0-18. Reichstag session report

Deutscher Reichstag. 57. Sitzung am 30. Januar 1875.	1435
<p style="text-align: center;">57. Sitzung am Sonnabend, den 30. Januar 1875.</p> <p>Mittheilung von Beschlüssen der XI. Kommission. — Dritte Berathung des Entwurfs eines Bankgesetzes (Nr. 27 und 243 der Anlagen). — Mündlicher Bericht der Geschäftsordnungskommission, betreffend die Frage über die Fortdauer des Mandats des Abgeordneten Gump (Nr. 231 der Anlagen). — Berathung des achtzehnten Berichts der Petitionskommission (Nr. 241 der Anlagen). — Schluß der Session.</p> <p>Die Sitzung wird um 11 Uhr 45 Minuten durch den Präsidenten von Forckenbeck eröffnet.</p> <p>Präsident: Die Sitzung ist eröffnet. Das Protokoll der vorigen Sitzung liegt zur Einsicht auf dem Bureau offen. Als Kommissar des Bundesraths für den 18. Bericht der Kommission für Petitionen wird der Sitzung beizuhören: der königlich preussische Major Herr Spitz. Wir treten in die Tagesordnung ein: Erster Gegenstand der Tagesordnung ist:</p>	<p>Abgeordneter Windthorst: Wenn man den Mitgliedern des Hauses die Befugniß gibt, formulierte Anträge zu stellen, dann müssen die Mitglieder des Hauses auch Kenntniß haben von dem Laufe der Verhandlungen in der Kommission. Um diese Kenntniß zu gewinnen, würde eine Mittheilung der Protokolle erforderlich sein. Ich weiß nicht, ob in der Kommission diese Frage erörtert worden ist, und namentlich, ob man auch in Aussicht genommen hat, daß die Kommission uns demnächst einen schriftlichen Bericht erstattet. Es würde mir angenehm sein, wenn der verehrte Herr Vorredner darüber uns etwas sagen wollte.</p> <p style="text-align: center;">(Zuruf.)</p> <p>Ich höre hier an meiner Seite, daß der Wunsch nach einem schriftlichen Berichte ein Unbehagen herbeiführt. Ich begreife wohl, daß das nicht ganz angenehm ist. Aber die Herren müssen sich doch auch vergegenwärtigen, daß wir in den Fall gesetzt werden müssen, die Arbeit der Kommission vollständig beurtheilen zu können. Bei den Gesetzen, die hier in Frage sind, kann der Galopp nicht gehen, den wir uns sonst angewöhnt haben.</p> <p>Präsident: Der Herr Abgeordnete Miquel hat das Wort.</p> <p>Abgeordneter Miquel: Indem ich als Vorsitzender der Kommission mich nicht für berechtigt halte, persönlich irgend eine Ansicht über die von dem Herrn Vorredner angeregte Frage auszusprechen, kann ich nur berichten, daß bis jetzt über die fraglichen Gegenstände irgend ein Beschluß der Kommission nicht vorliegt.</p> <p>Präsident: Der Herr Abgeordnete Windthorst hat das Wort.</p> <p>Abgeordneter Windthorst: Wenn ein solcher Beschluß nicht vorliegt, so freue ich mich doppelt, die Sache zur Sprache gebracht zu haben, indem ich hoffe, daß die Kom-</p>

Figure 0-20. Letter from Bleichröder to Bismarck

20/12 72
BERLIN

Berlin den 20. Dezember 1872

Hr. Fürstbischof

meinen meine Bedauern entgegenzunehmen, daß ich Sie
ein länger andauerndes Kranksein gefindert, nicht
die Ihr sehen kann. Ihnen persönlich meine Aufwartung
zu machen. Ich habe Sie bereits ganz verlassen und
zu lassen und betlage es, daß Ihnen die betreffende Mit-
teilung nicht gemacht wurde.

Hr. Fürstbischof sind so gütig, mein Brief über die
ausgesprochenen Bedingungen der Geldanleihe für Sie
und bespreche ich mich. Hr. Fürstbischof meine Aufwartung
in Solingen zu machen.

Ich habe Ihnen im Mai d. J. die Ihre, die Kaufmännische
zu betonen, daß dieser für die Bauart eine rechtliche
Bauart werden würde bei jeder der jetzigen Bauart,
die als Gut zu fungieren sollte, weil, um es überhaupt zu machen,
Verpflichtung glaube, in vielen Momenten der politischen Auf-
fassung finanzieller Verhältnisse wichtig ist, die Sie nicht
haben.

Was nun speziell die vorliegende Angelegenheit betrifft, so muß
ich in einer Beziehung gerade gegen die Bauverwaltung
sind: ich kann nur noch sagen, daß die Stelle der Bauart nicht
die Präsidenten der Bauart leicht zum Mitwirken vorgelegt
werden, diejenige der Bauart nicht die Maßregeln über
die Verfügung einer größeren Summe, die Sie nicht getroffen sind
Sind Sie nicht ganz die geeigneten.

0.7. Appendix

Appendix table 0-1. German political divisions

	German Confederation (Deutscher Bund) 1815	German Empire (Deutsches Reich) 1871	Federal Republic of Germany (Bundesrepublik Deutschland) 1990
	39 federal states and free cities ¹	26 federal states and free cities	16 federal states
1	Baden***	1 Baden***	
2	Hohenzollern-Hechingen‡‡		
3	Hohenzollern-Sigmaringen‡‡	2 Preußen* Preußen	1 Baden-Württemberg
4	Württemberg*	3 Württemberg*	
5	Bayern*	4 Bayern*	
6	Sachsen-Coburg‡‡	5 Sachsen-Coburg-Gotha‡	2 Bayern
7	Bremen‡‡‡	6 Bremen‡‡‡	3 Bremen
8	Preußen* Brandenburg	2 Preußen* Brandenburg	4 Brandenburg
8	Preußen* Brandenburg	2 Preußen* Berlin ⁷	5 Berlin
8	Preußen* Jülich-Cleve-Berg	2 Preußen* Rheinprovinz	
8	Preußen* Westfalen	2 Preußen* Westfalen	6 Nordrhein-Westphalen
9	Detmold-Lippe‡‡	7 Lippe‡‡	
10	Hamburg‡‡‡	8 Hamburg‡‡‡	7 Hamburg
11	Hessen**		
12	Frankfurt‡‡‡‡	2 Preußen* Hessen-Nassau	8 Hessen
13	Nassau-Weilburg‡		
14	Waldeck‡‡	9 Waldeck‡‡	
15	Mecklenburg-Strelitz****	10 Mecklenburg-Strelitz****	
16	Mecklenburg-Schwerin****	10 Mecklenburg-Schwerin****	
8	Preußen* Pommern	2 Preußen* Pommern	9 Mecklenburg-Vorpommern
17	Hannover*	2 Preußen* Hannover	
18	Oldenburg****	11 Oldenburg****	
19	Braunschweig‡	12 Braunschweig‡	
20	Schamburg-Lippe‡‡	13 Schamburg-Lippe‡‡	10 Niedersachsen
21	Waldeck‡‡	14 Waldeck‡‡	
8	Preußen* Niederrhein	2 Preußen* Rheinprovinz	
	Birkenfeld‡‡	15 Oldenburg****	
5	Bayern*	4 Bayern*	11 Rheinland-Pfalz
22	Hessen-Darmstadt****	16 Hessen-Darmstadt****	
8	Preußen* Niederrhein	2 Preußen* Rheinprovinz	
5	Bayern*	4 Bayern*	12 Saarland
23	Sachsen*	17 Sachsen*	13 Sachsen
24	Anhalt-Köthen‡		
25	Anhalt-Bernburg‡	18 Anhalt‡	
26	Anhalt-Dessau‡		14 Sachsen-Anhalt
23	Sachsen*	2 Preußen* Sachsen	
8	Preußen*	2 Preußen* Preußen	
27	Holstein und Lauenburg‡	2 Preußen* Schleswig-Holstein	15 Schleswig-Holstein
28	Lübeck‡‡‡	19 Lübeck‡‡‡	
29	Sachsen-Altenburg‡		
30	Sachsen-Hildburghausen‡	20 Sachsen-Altenburg‡	
31	Sachsen-Gotha‡		
32	Sachsen-Weimar****	21 Sachsen-Weimar****	
33	Schwarzburg-Sondershausen‡‡	22 Schwarzburg-Sondershausen‡‡	
34	Schwarzburg-Rudolstadt‡‡	22 Schwarzburg-Rudolstadt‡‡	16 Thüringen
35	Sachsen-Meiningen‡‡	23 Sachsen-Meiningen‡‡	
36	Reuß‡‡	24 Reuß ältere Linie‡‡	
		25 Reuß jüngere Linie‡‡	
37	Liechtenstein‡‡ ²		
38	Luxembourg**** ³		
39	Austria† ⁴		
		26 Elsaß-Lothringen‡‡ ⁵	
8	Preußen* Ostpreußen		
8	Preußen* Westpreußen	2 Preußen* Preußen ⁶	
8	Preußen* Pommern	2 Preußen* Pommern ⁶	
8	Preußen* Posen	2 Preußen* Posen ⁶	
8	Preußen* Schlesien	2 Preußen* Schlesien ⁶	

Source: Federal states' websites and other sources. 1 excluding Birkenfeld, † Empire (Kaiserreich), * Kingdom (Königreich), ** Grand Duchy (Kurfürstentum); Hessen-Kassel Electorate, *** Grand Duchy (Großherzogtum), ‡ Duchy (Herzogtum), ‡‡ Principality (Fürstentum), ‡‡‡ Free City (Freie Stadt), †† Imperial Land (Reichsland) 2 Liechtenstein; 3 Luxembourg; 4 Austria; 5 France; 6 Poland, 7 Separate entity since 1881.

Appendix table 0-2. German coinage 1871

Standard (specie)	Thaler (silver)		Curant (silver) *	Southern German (silver)	Thaler (gold)	French Franc (gold)	
	Units	Units					
	Thaler 30 Groschen 12 Pfennig	Thaler 30 Groschen 10 Pfennig	Thaler 48 Schilling 12 Pfennig	Mark 16 Schilling 12 Pfennig	Gulden 60 Kreuzer	Louisd'or, Pistole 5 Thaler 72 Grote 5 Schwaren	Franc 100 Centimes
States (German Empire 1871)							
Anhalt	■						
Baden					■		
Bayern					■		
Braunschweig	■						
Bremen						■	
Elsaß-Lothringen							■
Hamburg				■			
Hessen-Darmstadt					■		
Lippe	■						
Lübeck				■			
Mecklenburg-Schwerin			■				
Mecklenburg-Strelitz			■				
Oldenburg	■						
Preußen **	■				■		
Reuß ältere Linie	■						
Reuß jüngere Linie	■						
Sachsen		■					
Sachsen-Altenburg		■					
Sachsen-Coburg-Gotha ***		■			■		
Sachsen-Meiningen					■		
Sachsen-Weimar	■						
Schamburg-Lippe	■						
Schwarzburg-Rudolstadt ****	■				■		
Schwarzburg-Sondershausen	■						
Waldeck	■						
Württemberg					■		

Source: Deutscher Reichstag (1871).

Multiple coinages per state are possible due to territorial rearrangements.

* For wholesale transactions also Hamburger Bankvaluta of silver bullion at 59 1/3 Mark.

** Gulden in Hohenzollern Hechingen, Hohenzollern Sigmaringen, Frankfurt a.M.

*** Gulden in Sachsen-Coburg and Thaler in Sachsen-Gotha.

**** Gulden Schwarzburg-Rudolstadt Oberherrschaft and Thaler in Schwarzburg-Rudolstadt Unterherrschaft.

0.8. References

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1. The Reichsbank, central banking competition and monetary stability in Germany, 1876-1890

1.1. Introduction

The paper studies the organisation of central banking under the 1875 bank act in Germany with a focus on the role of competition in bills of exchange discounting among the Reichsbank and Privatnotenbanken. It reviews narrative evidence of reform intent and uses new detailed monthly banking data and advanced statistical time series estimation techniques. The analysis offers for the first time statistical evidence that central bank competition constrained monetary policy conduct and is tentatively supportive of the view that decentralised central banking systems can have a stabilising impact.

The act established a mixed central banking system with the Reichsbank at federal and Privatnotenbanken at regional level where the Reichsbank and Privatnotenbanken competed locally in main central banking operations. Competition was seen as a critical element to induce prudent central banking behaviour and is to be understood as imperfect competition in bills of exchange discounting where institutions are profit maximisers constrained by bank note issuance and have Bertrand conjectures.

The importance of competition for the central banking system in Germany during its early years has been generally acknowledged (Bopp, 1953; Holtfrerich, 1989; National Monetary Commission, 1910b; Otto, 2002). However, no statistical evidence has been offered on the incidence and effect of competition in the system and its relevance has remained contested (Kroha, 2009). The history and general aspects of the central bank reform and operations of the Reichsbank and Privatnotenbanken have been documented comprehensively (Bopp, 1953; James, 1997; Holtfrerich, 1993; Kroha, 2009; McGouldrick, 1984; National Monetary Commission, 1910b; Otto, 2002).¹ The behaviour of the Reichsbank has been

¹ The National Monetary Commission (1911) provides a detailed overview of the establishment of the Reichsbank. Holtfrerich (1989) outlines the monetary conditions in Germany leading up the foundation of the Reichsbank. The history of the Privatnotenbanken is described in Pohl (1982).

analysed mostly within the provisions of the classical gold standard (Bergman et al., 1989; Bloomfield, 1959; Bundesbank, 1976; Morys, 2013; McGouldrick, 1984; National Monetary Commission, 1910b; Seeger, 1968; Sommariva & Tullio, 1986).

The contribution of the paper is to reassess the institutional arrangement of the central banking system and offer statistical evidence of the role of competition in bill discounting among the Reichsbank and Privatnotenbanken for bank behaviour and the stability of the system. For illustrative purposes, competition can be approximated by an oligopsony at federal and federal state levels amid strict entry restrictions, atomised bill drawers, importance of local branch networks, use of local bills and weak market integration and local price formation.² Competition is treated as a Bertrand game with capacity constraints on the basis of strict reserve requirements (Froeb et al., 2003; Kydland, 1975; Kreps, 1990; Kreps & Scheinkman, 1983; Peters, 1984). The paper argues that competition played a fundamental role to address modern central banking concerns of incentives in monetary policy and strategic delegation (Barro & Gordon, 1983; Persson & Tabellini, 2002; Rogoff, 1985). With emphasis on the decentralised reform elements the paper aims to offer a more complete assessment of central bank reform intent and outcome, assess whether reform objectives were attained and the reform was effective. The study intends to differentiate Germany from dominant period central banking trends and serve as a reminder of alternative approaches to central banking in monetary unions during the formative stages of modern central banking.

The paper tests statistically for the incidence of competition and stability of the system. It offers a new monthly dataset of main balance sheet items of the Reichsbank and the Privatnotenbanken. It uses a structural vector-autoregression (SVAR) model with exogenous variables to analyse the interactions among the Reichsbank and Privatnotenbanken similar to a competitive reactions approach from industrial organisation (Horváth et al., 2005; Steenkamp et al., 2005). Stabilisation is assessed through the pattern and duration of the responses to

Seeger (1968) offers a detailed account on the Reichsbank's policy under the gold standard. Bopp (1953) and Simon (1884) provide detailed accounts of the Reichsbank operations. Helfferich (1896) describes the Reichsbank operations and discount policy with emphasis on the note quota system. Hartung (1891) outlines a detailed account of the adaptation of the Privatnotenbanken to the provisions of the 1875 bank act. On the operations of individual Privatnotenbanken see e.g. Heil (1900) on the Bayerische Notenbank, Lewin (1914) on the Sächsische Bank, Ruby (1911) on the Badische Bank.

² See Thesis Introduction on market integration in Money market integration page 31 and on the types of bills in Operations page 39.

monetary impulses where stability is seen as consistent with a rapid reversion of the responses. The results are supportive of the presence of and stabilising impact from competition.

The analysis focuses on the years 1876-90. The period marks the beginning of operations of the Reichsbank in January 1876 to the end of the scheduled life of the original bank act in December 1890. The paper covers the largest Privatnotenbanken that maintained operations through the observation period: Bayerische Notenbank, Sächsische Bank, Frankfurter Bank, Badische Bank, Württembergische Bank and Bank für Süddeutschland.

The paper acknowledges that the importance of the Privatnotenbanken for Germany's central banking remains contested.³ The dominance of the Reichsbank amid its large note quota and projected and actual developments were interpreted by some as granting the Reichsbank a quasi-monopoly and ability to act as a single central bank.⁴ The later movement towards increasing dominance of the Reichsbank appears to reflect a shift in policy focus away from stabilisation

³ The shift in the relative importance of the Privatnotenbanken has been publicly acknowledged amid an increasing dominance of the Reichsbank. The *Kölnische Zeitung* wrote on the 25-year anniversary of the Reichsbank (*Kölnische Zeitung*, 1901): "*Die Reichsbank aber stellt sich am Ende der 25jährigen Periode in weit höherem Maße als die gebietende Centralnotenbank des Reiches dar, als bei ihrem Beginne.*" Arthur Posadowsky-Wehner, Count, State Secretary of the Interior and Vice-Chancellor of Germany in his remarks on the bank act revision in February 1899, highlighted that the aim to oblige the Privatnotenbanken to adopt the discount rate of the Reichsbank was to harmonise the German banking system, see *Deutscher Reichstag* (1899). Friedrich von Prayer, Member of the Reichstag, underlined during the parliamentary debate in his view unjustified that the main motivation for forcing a common discount rate for all banks was the fact that the Privatnotenbanken undermined the policy of the Reichsbank (*Deutscher Reichstag*, 1899); von Prayer argued that the motion will significantly undermine the existence of the Privatnotenbanken.

⁴ *Deutscher Reichstag* (1873, p. 1150): "[...] daß überall da, wo die Bankpolitik der Zukunft in entfernten Anzeichen schon jetzt zu skizzieren sei, das letzte Ziel nach ihre Auffassung [Centralisation] im Auge gehalten werden müsse."

Ludwig Bamberger, a leading member of the Reichstag and main architect of the Reichsbank (*Deutscher Reichstag*, 1874, p. 134): "*Wir haben im Widerstreit mit einer weit verbreiteten Meinung in Deutschland die Organisation der Reichsbank so angelegt, daß sie bereits dreiviertel eines Monopols der Emission von Papiernoten in Deutschland hat. Wir haben die Sache ferner darauf angelegt, daß in gegebener Zeit das gesamte Monopol der Ausgabe von fiktiven Werthzeichen, von Papiergeld dieser Reichsbank zufallen soll.*" Reichstag Member Sonnemann contested (*Deutscher Reichstag*, 1874, p. 136): "*Sie wissen, meine Herren, daß, als das Bankgesetz im Jahre 1874/75 beschlossen wurde, wir damals bezüglich der Reichsbank, die wir gegründet hatten, und der Privatbanken, die existierten, eine Art Waffenstillstand für fünfzehn Jahre abgeschlossen haben; die Privatnotenbanken sollten weiter existieren und in ihrer Existenz nicht weiter geschmälert werden [...].*"

Kroha (2009) e.g. described the central bank reform as a "triumph" for the centralising elements. See e.g. Muss (1924, p. 204): "*Sie [Privatnotenbanken] hatten sich nun innerhalb mehr als 30 Jahren als wirtschaftlich nützlich und lebenskräftig erwiesen, und die beteiligten Regierungen legten im volkswirtschaftlichen Interesse ihrer Territorien das größte Gewicht auf den Fortbestand ihrer Mittelstaatsbanken.*"

The state governments of the Southern German states in particular continued to insist on the importance for their local economies of the Privatnotenbanken.

concerns dominant in the 1870s, in part also amid satisfaction with monetary developments since inception of the Reichsbank, towards policy effectiveness and pressure for greater centralisation in the 1890s echoed concurrently in persistent demands to nationalise the Reichsbank.⁵ The Privatnotenbanken eventually lost in importance and by 1890 only 9 banks of issues remained and by 1900 only 7 with the last banks losing their note issuance privileges in 1934. The revised bank act of June 1899 stipulated in Article 5 that the Privatnotenbanken from 1 January 1901 were bound not to offer a discount rate below that of the Reichsbank and thereby greatly reduced the ability of the Privatnotenbanken to compete.

Germany's mixed central banking system was aligned with the continued existence of decentralised elements in central banking throughout the nineteenth century. However, as a newly established system during the last quarter of the nineteenth century and with a common regulatory framework for the Reichsbank and Privatnotenbanken it was particular. It defies the widely held view that the organisation of central banking was settled by the second half of the nineteenth century (Goodhart, 1988).⁶ Notwithstanding, most leading countries adopted single central bank systems with sole bank note issuance rights (Kisch & Elkin, 1932).⁷

The second section reviews reform intent and offers a literature review on central banking competition in Germany in 1876-90. The third provides basic data on the main central bank operations. The fourth section outlines the econometric analysis and statistical results. The last section offers some concluding remarks.

1.2. Central banking competition

The notion of central banking competition is consistent with the well-known incentives problems in central banking amid the actual or perceived inability to constrain policy makers optimally (Barro & Gordon, 1983; Rogoff, 1985). Central

⁵ Attempts to nationalise the Reichsbank were acute during the debate leading to the 1890 bank act renewal but less during the 1899 debate and ultimately failed.

⁶ Goodhart (1988, p. 1) indicates that the "*discussions on free banking (i.e., banking freed from the presence of a Central Bank), and the role, if any, for a Central Bank, were particularly lively during the early and mid-nineteenth century [...]. Subsequently the subject fell dormant, and issues appeared largely settled.*"

⁷ See Thesis Introduction under International central banking developments, 1844-1913, page 33 for an overview of international central banking trends.

bankers may be too constrained achieving too little bills of exchange discounting or credit accommodation (too low inflation) or too little constrained resulting in too high credit supply or too high note issuance (too high inflation). Uncertainty about the optimal level of credit supply (inflation) also limits the possibility to define the optimal intermediate target or policy rule.

The 1875 bank act was motivated in large part by concerns about monetary stability and perceived undue bank note proliferation (Deutscher Reichstag, 1874; Simon, 1884).⁸ The reform was the outcome of opposing forces of centralisation and decentralisation. Bopp (1953) indicates: “*Politically, the Germany established by Bismarck was torn by conflict between the forces of centralisation and federalism. In the Bank Act of 1875, the centralizers were able to establish the Reichsbank [...] but the federalists were able to continue the authority of other banks to issue notes.*” Otto (2002) similarly outlines the “*compromise character of the reform amid the collision of differing interests between centralising and decentralising forces*” that has also been highlighted by Tilly (2003). Holtfrerich (1989) affirms that the abolition of the Privatnotenbanken would also have met with fierce opposition from the government of the respective federal states.⁹ It also reflected the operations of banks of issue in German states prior to political union and a desire to maintain existing banking practices.

The role of competition was to induce prudent note issuance behaviour to attain aimed stability objectives. It rested on fundamental concerns about the advantage of fixed monetary rules, support for free banking principles and fundamental period apprehensions about the effectiveness of monetary monopolies (Bopp, 1953; Giannini, 2011; Goodhart, 1988; Smith, 1936; Wagner, 1875).¹⁰ The

⁸ Simon (1884): “*Der Hauptzweck des Bankgesetzes sollte es sein, das Banknotenwesen zu regeln, insbesondere den übermäßigen Banknotenumlauf einzuschränken. [...] Der ganze deutsche Markt, insbesondere der Kleinverkehr, wurde mit [...] papierenden Zahlungsmitteln überschwemmt.*” Delbrück presenting the bank bill for the first reading of the Reichstag (Deutscher Reichstag, 1874, p. 150): “*Diese beiden Übelstände [große Menge von Banknoten; die Zirkulationsmittel in einem äusserlich unbegrenzten Masse zu vermehren] zu beseitigen, erschien uns als Hauptaufgabe des ausgestellten [Gesetzes] Entwurfs. Zur Erreichung dieser Aufgabe liessen sich nun aber freilich sehr verschiedene Mittel denken. In der Resolution des Reichstags vom vorherigen Jahre [...] war auf eine Reichsbank hingewiesen.*”

⁹ The Privatnotenbanken had acquired the rights of note issuance and cancellation of such rights was seen as difficult also legally. Delbrück (Deutscher Reichstag, 1874, p. 152): “*Es konnte in der That nicht wohl daran gedacht werden, über diese Privilegien einfach zur Tagesordnung überzugehen und eine Centralbank zu errichten, der man allein die Banknotenemission im Reiche gibt.*”

¹⁰ Simon (1884) refers to “Anhänger der Monopolzettelbank” and “Antimonopolisten” and indicated that all chambers of commerce supported the continuation of the banks of issue. On free banking, see e.g. Glasner (1989).

Bank Act Special Parliamentary Commission (Deutscher Reichstag, 1875b) stresses the need for competition to instil discipline: “[o]nce competition ceases, it will also lead in this field [banking] to slackness, one-sidedness and bureaucratic arbitrariness.”¹¹ Wagner (1875), a leading period commentator highlights also that a mixed system reflects better existing banking traditions in Germany:¹² “Monopolization would be inferior to a mixed system crowned by a strong central bank also in reflection of the historic and political tradition of the German empire; the multitude of central banks implies that competition will ensure sufficient safeguards against excessive note issuance.” James (1997) underscores that the institutional design was geared towards restraining speculative tendencies and banking abuses. Holtfrerich (1993, p. 519) indicates that the “free-banking movement of the 19th century in Germany [...] advocated competition among private note issuing banks and opposed central banks with monopolistic positions.”

The relevance of competition for the operations of the system remains contested. The National Monetary Commission (1910b, p. 216) affirms existence of competition between the Reichsbank and Privatnotenbanken and constraints for the Reichsbank’s policy implementation.¹³ The Bundesbank (1976) and Reichsbank (1940) sustain that the Reichsbank adjusted its operations to withstand the pressure from the Privatnotenbanken. Sommariva and Tullio (1986) highlight that the analysis of Germany’s monetary developments is complicated as the Reichsbank

See also e.g. Hans von Kanitz, Count, member of the Reichstag and member of the Conservative faction and main opposition to the 1899 bank act revision stressed: “I cannot agree to the aim that the domestic banks [Privatnotenbanken] should no longer be a competition to the central institute [Reichsbank]. One should allow the price of money to form freely at the different market places” (Deutscher Reichstag, 1899, p.714).

Otto Michaelis, member of the Reichstag and leading protagonist of the central bank reform “felt that the English principle of limiting the fiduciary issue was sound, but that Peel’s Act was too rigid and provoked or aggravated panics when the fixed limit was approached.” See Bopp (1953) for an interpretation of Michaelis’ viewpoint. Michaelis presented his views in the Reichstag on 25 January 1875 (Deutscher Reichstag, 1875a).

¹¹ Deutscher Reichstag (1875b, p. 1149): “Sobald die Konkurrenz aufhöre, sie auch auf diesem Gebiete [Bankwesen] Erschlaffung, Einseitigkeit und bürokratische Willkür nur zu leicht in Versuchung geführt [...]”

¹² Wagner (1875): “Die Monopolisierung möchte auch im Allgemeinen volkswirtschaftlich dem gemischten, durch eine starke Reichsbank gekrönten System an Ersparlichkeit nachstehen. Umso mehr finden hier die geschichtlich überkommenen Verhältnisse und der politische Charakter des Deutschen Reiches, wenigstens für jetzt, ihre berechnete Beachtung. Bei einer Mehrheit oder Vielheit von Zentralbanken bietet gerade hier einmal das Prinzip der Concurrenz unter den Banken, verbunden mit der richtigen gesetzlichen Vorschrift [...] meist schon genügende Garantie [vor Überemission].”

¹³ National Monetary Commission (1910b, p. 216): “The difficulty is increased by the natural endeavour of private banks of issue to make the greatest possible use of the funds at their disposal; frequently these banks collide with the aims of the Reichsbank. The domination of the money market by a central bank is possible only within certain bounds, and the Reichsbank’s task is, of course, rendered more difficult when private banks issue notes to furnish money to the market at a rate lower than that which the Reichsbank, from an economic standpoint, deems desirable and right.”

was not the only bank of issue. Bopp (1953) indicates that the Reichsbank adjusted its discount rate policy to compete with the Privatnotenbanken.¹⁴ Diebolt (2017) also observes that the Reichsbank had to discount at below the official rate to preserve control of the money market during periods of excess liquidity. The public similarly acknowledged that competition between the Reichsbank and the Privatnotenbanken constrained Reichsbank policy.¹⁵ Kroha (2009) and Otto (2002), the two most comprehensive contemporary studies on the bank act, validate that the Reichsbank was in competition with the Privatnotenbanken but while Kroha (2009) disregards the relevance of the decentralised elements for policy implementation, Otto (2002) affirms it. Kroha (2009) argues that the centralised elements by far dominated and that the few concessions offered “*no control*” over any monetary aggregate. Smith (1936) similarly argues that the act offered sufficient provisions for the Reichsbank to perform like a “modern central bank;” de Kock (1974) while acknowledging the continued operations of the Privatnotenbanken also implies that the Reichsbank assumed a near monopoly in bank note issuance.

The relationship between competition and the operation of the system has not been tested statistically. National Monetary Commission (1910a) stresses that the Privatnotenbanken took advantage to compete with the Reichsbank on price but offers no statistical evidence.¹⁶ Similarly, Bopp (1953) highlights that during periods of “*easy money*” the Reichsbank found it difficult to generate sufficient earnings due to the competition of the Privatnotenbanken but does not statistically support his observations. Kroha (2009) and Otto (2002) offer no statistical evidence for the existence or relevance of competition.

The role of competition was also acknowledged in other period central banking systems. Competition was naturally important in systems without a dominant central bank. Decentralised systems remained through the nineteenth century in for example Canada, Scotland and Mexico (de Kock, 1974; Smith, 1936).

¹⁴ Bopp (1953): “From 1880 to 1896 the Reichsbank frequently discounted prime bills at preferential rates, primarily to meet the competition of independent banks of issue.”

¹⁵ See e.g. National Zeitung (1901): “*Die Reichsbank hat sich in ihrer Wirksamkeit als Centralbank oft dadurch behindert gefühlt, daß sie neben ihr fortbestehenden Privatnotenbanken durch Unterbieten ihres Diskontsatzes vermittelst ihrer Notenausgabe ihre Diskontpolitik durchsetzen.*” See in light of the Convention, see below, between the Reichsbank and the Privatnotenbanken e.g. Der Deutsche Oekonom (1888): “[*Die Convention*] bildet immerhin eine gewisse Schranke gegen allzu zügellose Concurrenz.“

¹⁶ See also footnote 13.

The emergence of dominant central banks in Europe has led mostly to circumvent competition. In England, provincial banks of issue (country banks) continued to exist although because the Bank of England maintained branches in only 15 cities and a monopoly in London, co-existence in one location of a Bank of England branch and country banks were rare (Capie et al., 1994; Giannini, 2011).¹⁷ Similarly in Spain in 1856-74, local banks of issue operated but only in locations where the Bank of Spain had no local branch (Moro et al., 2015; Schreiner, 2004). The Italian central banking system in 1874-93 exhibited several parallels with the German system. The 1874 bank act authorised six banks of issue to operate throughout Italy with a dominant institution Banca Nazionale nel Regno d'Italia present in all regions and smaller institutions operating in one or several regions but different statutes and operational limitations allowed some though constrained competition (Sannucci, 1989).¹⁸ However, as in the case of Spain, Italy's lack of firm adherence to the gold standard complicates comparisons with Germany (Tattara, 2003).

The possible advantages of competition in banking have been recognised. In commercial banking, Carlson and Mitchener (2009) find that branch banking increased competition in the 1920s and 1930s in the United States that lead to greater efficiency and stability. Berger and Hannan (1998) argue that concentration in commercial banking exhibits lower cost efficiency.¹⁹ In central banking, Hayek (1990) advocated currency competition as a discipling device for monetary stability.

1.3. Central bank operations

The 1875 bank act, as is well known, established a regulatory framework for central bank operations.²⁰ The main operations comprised bills of exchange discounting funded by bank note issuance. Note issuance adhered to prudential

¹⁷ The Bank of England operated through the nineteenth century 15 branches. Of the 15 branches, Leicester, Norwich and Swansea were closed in 1872, 1852 and 1859, respectively. The rights of issue of country banks in England lapsed in 1921.

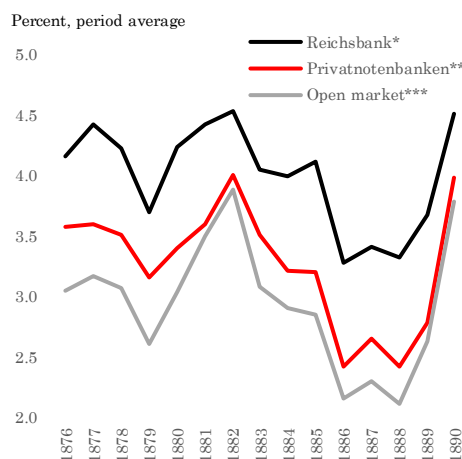
¹⁸ Differences prevailed in terms of accepted maturities of bills of exchange, number of signatures, rediscounts, and collateral acceptance. (Sannucci, 1989, p. 260) concludes: "*Their [the banks of issues] different modi operandi nevertheless survived at least partially, in spite of the fact that territorial expansion led to the simultaneous presence of more than one bank of issue in certain locations. Thus the coexistence of several banks of issue would have had a limited impact on increasing competition in the credit market [...].*"

¹⁹ The advantages of competition in commercial banking is contested. See e.g. Berger et al. (2009) on arguments supporting the notion that competition increases fragility.

²⁰ For an overview of the provisions of the act see Thesis Introduction page 36.

requirements to ensure unconditional convertibility into specie on demand and was subject to set unreserved bank note quotas and a 5 percent note tax.²¹ The prudential requirements can be represented by the liquidity or reserve ratio, being metal reserve to bank notes in circulations, and payment of the note tax.

Figure 1-1. Discount rates



Source: Privatnotenbanken annual reports; Reichsbank (1925). *Official discount rate. ** Simple average return on bills of exchange holdings. *** Berliner Börse (Berlin Stock Exchange).

The Reichsbank and Privatnotenbanken conducted credit and bank note operations through their respective local branch networks. The Reichsbank's monetary policy was set by a combination of external and domestic objectives including the maintenance of convertibility of bank notes, orderly domestic money market conditions, support of domestic economic activity and balance sheet profitability. The Privatnotenbanken followed broadly the policy of the Reichsbank subject to local conditions. The discount rate was the main instrument to regulate credit demand and determine balance sheet profitability.

The discount rates comprised official, prime and open market rates. The official discount rate was set by the Reichsbank and was normally the highest rate in the system; private or prime rates were set by the Privatnotenbanken; the open market discount rates, the lowest rate in the system, were set by commercial banks

²¹ The tax was levied on the amount of unreserved notes in circulation in excess of the quota.

(Figure 1-1). The formation of discount rates remained broadly local amid incomplete money market integration and use of local bills (Platzwechsel).²²

The discount rate differentiation was curtailed with the 1887 agreement (“Convention”) by which the Privatnotenbanken acquiesced not to deviate significantly from the private discount rate offered by the Reichsbank.²³ The Reichsbank in 1886 initiated the Convention to reign in on the competition from the Privatnotenbanken and allow the Reichsbank to exercise greater control of market rates. In 1887, the Reichsbank also started to offer important concessions in its discounting by reducing for large denomination bills the day count for the calculation of interest and lowering the fees charged for small denomination bills. By 1888, most Privatnotenbanken had abandoned the Convention.²⁴

Table 1-1. Bills of exchange discounting

	1876	1880	1885	1890
Return on bills of exchange discounting (percent)				
Reichsbank	4.1	4.0	3.8	4.4
Badische Bank	3.6	3.4	3.2	4.1
Bank für Süddeutschland	3.5	3.3	3.1	4.0
Bayerische Notenbank	3.7	3.5	3.5	3.7
Frankfurter Bank	3.2	3.1	2.7	3.7
Sächsische Bank	4.0	4.0	3.6	4.6
Württembergische Notenbank	3.4	3.1	2.9	3.9
Reichsbank				
Discount rate (percent)	4.5	4.0	4.0	5.5
Bills discounted at below discount rate (percent of total bills)*	0.0	18.0	34.8	11.8
Share in bills discounting of central banking system (percent)	61.6	60.9	62.7	74.9

Source: Privatnotenbanken Annual Reports, Reichsbank (1900). *Preferential or private rate.

²² On money market integration, see Thesis Introduction page 31. Platzwechsel accounted for 56 percent of all bills purchased by the Reichsbank in 1900. In 1876, 57 percent of all bills were consigned bills (Versandwechsel) that are payable at any other bank banking place (National Monetary Commission, 1910b, p. 150). E.g. for Bayern, Heil (1900) indicates that the bills payable outside Bayern played only a small role compared with the dominant local bills.

²³ The Reichsbank agreed in 1887 with the Privatnotenbanken that the latter will not discount at less than $\frac{1}{8}$ percent below the prime discount rate of the Reichsbank as long as it does not exceed the Berlin stock exchange discount rate by more than $\frac{1}{4}$ percent and in the event of a gold drain not to discount by less than $\frac{1}{8}$ percent below the official discount rate of the Reichsbank; see e.g. Heil (1900). This agreement was gradually abandoned by different Privatnotenbanken from 1888 onwards; see e.g. Der Deutsche Oekonom (1888).

The harmonisation of all discount rates became law with the 1899 bank renewal act by which the Privatnotenbanken from January 1901 were obligated not to discount below the official rate of the Reichsbank when the official rate was at or exceeded 4 percent and not to discount below the Reichsbank rate by more than $\frac{1}{4}$ percent and not to discount below the Reichsbank’s prime discount rate by more than $\frac{1}{8}$ percent.

²⁴ See e.g. Heil (1900) and Lewin (1914).

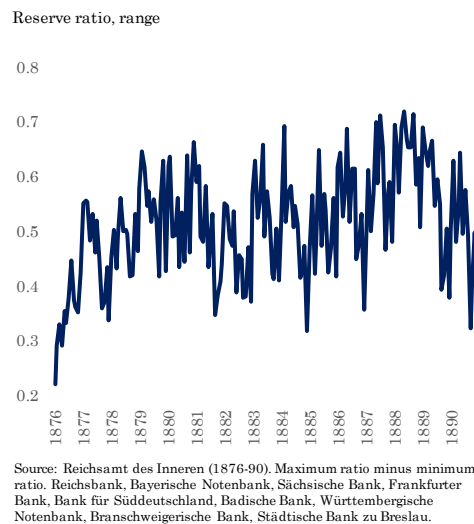
Table 1-2. Reichsbank bills of exchange at federal state level ²⁵

	1876	1880	1885	1890
Reichsbank branches, share in bills of exchange holdings, percent [†]				
Baden	23.9	41.1	49.7	58.0
Bayern ^{††}	22.4	29.9	35.0	49.9
Sachsen	32.9	25.8	31.8	41.7
Württemberg	23.1	25.6	26.2	33.6

Source: Reichsamt des Inneren (1876-90); Heil (1900); Reichsbank (1900). [†] Bills of exchange holdings of the Reichsbank and Notenbanken. Other Reichsbank branches are not confined to States boundaries. ^{††} after Heil Wechselverkehr der Reichsbank in Bayern und der bayerischen Notenbank 1876-1899 (Tabelle II).

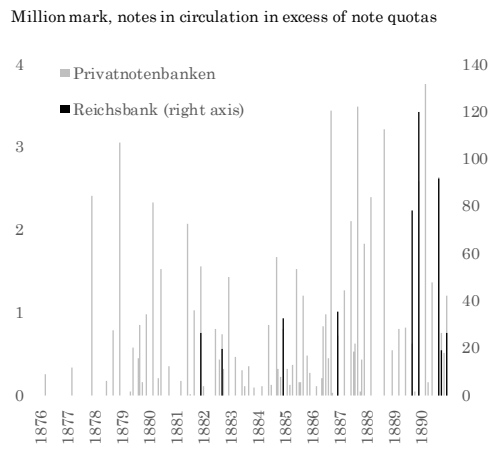
The Reichsbank dominated bill discounting in aggregate. The Reichsbank from 1880 followed the Privatnotenbanken in accepting bills at prime rates and discounted an increasing proportion of bills at prime rates (Table 1-1). In 1876, it represented 62 percent of bills of exchange holdings and increased its share through 1890 to 75 percent. However, the Reichsbank's share in bills discounting in some federal states advanced since 1885 but remained significantly lower compared with the national average representing in 1890 e.g. 34 percent in Württemberg and 42 percent in Sachsen (Table 1-2).

Figure 1-2. Reserve ratio range



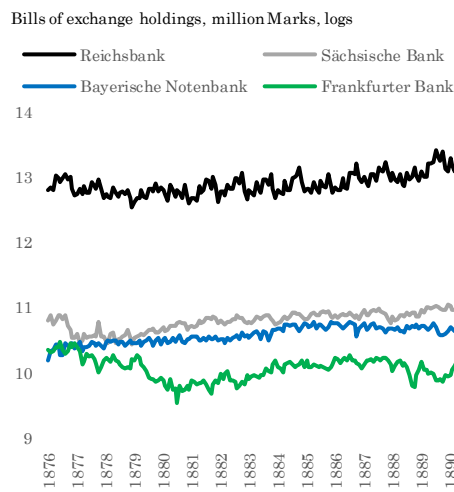
²⁵ Data comprise bills of exchange presented locally (Platzwechsel) and consigned bills (Versandwechsel), bills presented for discounting (Diskont-Wechsel) and encashment (Inkasso-Wechsel). In Bayern, Hessen and Preußen, the Reichsbank maintained branches (Reichsbankanstalten) that operated across federal state boundaries and therefore do not allow for direct comparisons with local Privatnotenbanken.

Figure 1-3. Note tax



Source: Reichsamt des Inneren (1876-90). Reichsbank, Bayerische Notenbank, Sächsische Bank, Frankfurter Bank, Bank für Süddeutschland, Badische Bank, Württembergische Notenbank, Brunschweigerische Bank, Städtische Bank zu Breslau.

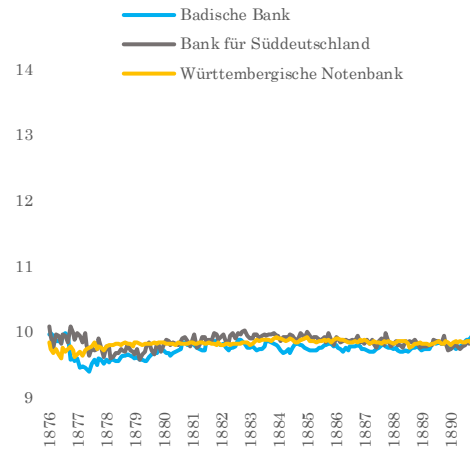
Figure 1-4. Bills of exchange



Source: Reichsamt des Inneren (1876-90).

Figure 1-5. Bills of exchange (cont.)

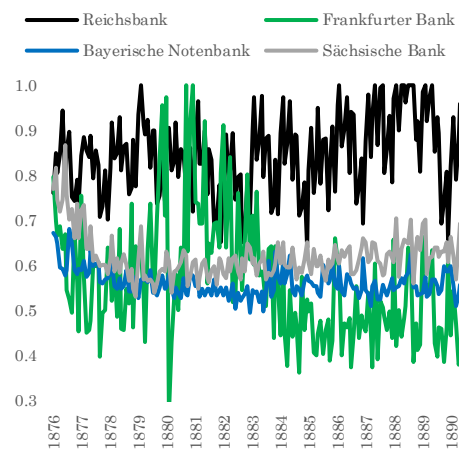
Bills of exchange holdings, millionMarks, logs



Source: Reichsamt des Inneren (1876-90).

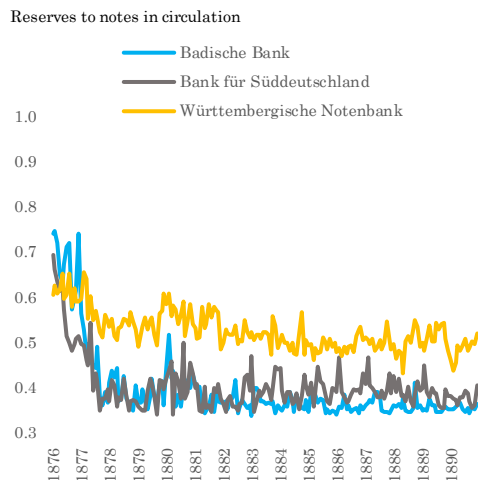
Figure 1-6. Reserve ratios

Reserves to notes in circulation



Source: Reichsamt des Inneren (1876-90).

Figure 1-7. Reserve ratios (cont.)



Source: Reichsamt des Inneren (1876-90).

The reserve ratios differed significantly between the Reichsbank and Privatnotenbanken and varied importantly over time (Figure 1-2). Payments of the note tax were frequent including from 1881 by the Reichsbank (Figure 1-3).²⁶

The pattern of bills of exchange among the Reichsbank and the Privatnotenbanken shows broad constancy in holdings. The Reichsbank sees a marked increase in bills holdings from 1887. The Sächsische Bank shows after an initial decline a gradual increase in bills while the other Privatnotenbanken see some decline in bills from the mid-1880s (Figure 1-4 and Figure 1-5).

The reserve ratios indicate important differences in terms of level and stability. The Reichsbank maintains on average the highest reserve ratio while its ratio is marked by a high level of fluctuation. The Bayerische Notenbank and Sächsische Bank keep broadly stable reserve ratios albeit an important reduction in the level of the reserve ratios through 1880. The reduction in reserve ratios is also followed by the Badische Bank and Bank für Süddeutschland. The Frankfurter

²⁶ The Reichstag expected that the Reichsbank would stay within the limits of its allocated unreserved note quotas but thought that the Privatnotenbanken would attempt to exploit it (Deutscher Reichstag, 1875b, p. 1154): *“Es wurde dabei besonders hervorgehoben, daß es überhaupt noch sehr zweifelhaft sei, ob die sogenannte indirekte Kontingentierung in gleicher Weise bei einem Zentralinstitut wie bei den Landesbanken [Privatnotenbanken] wirken werde. Im Allgemeinen versprochen sich die Verteidiger dieser Methode von der fünfprozentigen Steuer eines unbedeckten Notenüberschusses überhaupt keinen bedeutenden Einfluß auf die Ausgabe von Noten bei den Privatbanken. Anders werde sich die Sache gestalten, insoweit sie auf die Reichsbank Anwendung finde.”*

Bank maintains significant expansion and contraction cycles and the Württembergische Notenbank pursues a continuous accommodation with the reduction of its reserve ratio over the observation horizon (Figure 1-6 and Figure 1-7).

The competition among the Reichsbank and Privatnotenbanken occurred in the main central banking operations. The Reichsbank and Privatnotenbanken were profit maximisers net of public policy considerations. The mixed central banking system implied an oligopsonistic market structure where imperfect competition existed through the credit channel amid mostly local discount rate differentiation in bills of exchange acceptances and the prudential channel. Local discount rate differentiation was the main competition tool for bills.²⁷ Direct competition with commercial banks was not seen as material.²⁸ The ability to bid for bills of exchange discounting outside a local branch network, by out-of-home state institutions, is considered small.

The credit channel involved the Reichsbank and Privatnotenbanken bidding for bills of exchange at full allotment, that is, bills were accepted in any quantity at the given discount rate given the bill drawer was meeting set credit attributes. The funding capacity was mostly determined by the bank's ability to issue bank notes that depended on its metal reserves and the note quota.²⁹ The Reichsbank and Privatnotenbanken accepted each other notes at face value and while the bank notes of the Reichsbank were taken for payments the notes of the Privatnotenbanken were mostly presented for redemption at the Privatnotenbanken. The Reichsbank maintained as a policy to present for

²⁷ The use of private discount rates was a significant point of contention between the Reichsbank and Privatnotenbanken. The Reichsbank filed a motion against the use of private discount rates with the Bundesrat in 1880 who sustained the legality of private discounts.

Bopp (1953, p. 17) states: "From 1880 to 1896 the Reichsbank frequently discounted prime bills at preferential rates, primarily to meet the competition of independent banks of issue [Privatnotenbanken]." The Reichsbank argued that it "felt the competition of private banks of issues to be doubly disagreeable," National Monetary Commission (1910b).

²⁸ See e.g. National Monetary Commission (1910a) interview with von Glasenapp and von Lumm: "Question: What is the relation between this [the Reichsbank] and other banks, such as the Deutsche and the Dresdner—that is, as to the character of business transacted? Are you not competitors? Answer: It may be said that the Reichsbank is more restricted by law. At a private bank the rate of discount may be much cheaper than at the Reichsbank. The private banker knows his clients, and he may be willing to accept from them a bill that the Reichsbank would not and could not accept. Question: Then there is to some extent competition? Answer: Yes, but that competition is not large. It is not felt that the Reichsbank is a competitor of other banks, but it is a public institution."

²⁹ Deposits did not play a major role. In 1890, the Reichsbank had deposits of 837,173 Mark compared with bank notes in circulation of 1,862,800,625 Mark (Reichsbank, 1891).

redemption bank notes from Privatnotenbanken promptly at their branches and for immediate redemption at their head offices.³⁰

The prudential channel operated on the basis of the reserve ratio and note tax.³¹ Banks maintained local relationships and bill drawers acted at federal state level while note holders acted at federal and at federal state level. The banks were obligated to disclose their main balance sheet items on a weekly basis to allow the public to assess the banks' financial strength.³²

The competition in the credit channel, as a simple illustration, can be approximated by a Bertrand game with capacity constraints (Edgeworth-Bertrand model).³³ The Bertrand game with capacity constraints implies that banks are not price takers and have rivals and take into account possible reactions of their rivals in pursuit of maximal profits. Banks simultaneously set prices, that is, the private discount rate, at a given level and accept bills at that rate up to being capacity constrained, that is, funding constrained either because reserves are too low or the unreserved note quota is reached. Banks set discount rates without knowing the amount of bills tendered. Rates are normally above marginal costs but banks may be willing to incur the note tax for strategic reasons. Bill drawers will tender bills to the bank with the lowest rate net of relationship aspects and credit attributes and bounded by branch proximity; at similar rates the distribution of demand is indeterminate.³⁴ At the capacity constraint point all unsatisfied demand shifts demand to the other institution or demand cannot be satisfied.³⁵ The demand shifts imply that a Nash equilibrium as a pure strategy equilibrium does not exist.³⁶

³⁰ See Thesis Introduction under Operations page 39 and in particular footnote 79 page 40 on the bank note redemption policy of the Reichsbank vis-à-vis the Privatnotenbanken.

³¹ See Thesis Introduction on an explanation of the reserve ratio under Bills of exchange, reserves and bank notes page 43. The frequent occurrence of the note tax can be seen as indicative that the banks were also pursuing strategic objectives (Figure 1-3).

³² The bounds of the quota and the note tax were considered key prudential indicators, see e.g. Deutscher Reichstag (1875b, p. 1154): “[...] *In kritischen Zeiten werde [die Reichsbank] dann ihr Mögliches thun, um innerhalb der mäßigeren Schranke zu bleiben und nicht der außerordentlichen Steuer zu verfallen, schon um das damit unvermeidlich verbundene Gefühl des Schreckens bei dem Publikum nicht hervorzurufen.*” See Figure 0-14 for a weekly notification in Thesis Introduction.

³³ The Bertrand game with capacity constraint is adapted here. The model normally treats price-setting firms in an oligopoly with homogenous products where consumers want to buy from the cheapest seller and where there is a limit to the output firms can supply (Froeb et al., 2003; Kydland, 1975; Kreps, 1990; Kreps & Scheinkman, 1983; Peters, 1984).

³⁴ The Bertrand game normally requires goods to be homogenous. As bills of exchange vary amid differential credit attributes of the bill drawers, the assumption of strict homotheticity cannot be made. This is considered to modify though leave the fundamental aspects of the game intact.

³⁵ See for a formalisation of that set-up e.g. Froeb et al. (2003) and Peters (1984).

³⁶ See e.g. Froeb et al. (2003) and Peters (1984) on the non-existence of a pure strategy equilibrium in competition with capacity constraints.

The competition in the prudential channel rests on the continuous assessment by the public of bank note convertibility. The public adjusts its holdings of bank notes of a particular institution if it perceives the bank note to constitute an undue convertibility risk and switch to bank notes it considers sufficiently safe where the perception of convertibility risk is not linked to a particular level of the reserve ratio as long as the reserve ratio is significantly above the prudential minimum.³⁷ Acceptance of bank notes is also determined by transaction demand and liquidity preference.

The stabilising function of competition can be appraised on the basis of capacity constraints and bank note redemption threats. Banks will limit bill discounting to preserve market share and maintain stable relations with clients if capacity constraints result in bill drawers shifting demand to another institution and if issuance of bank notes impairs note convertibility and causes the public to perform note switches.³⁸ Banks therefore set discount rates so as to avoid coming close to being capacity constrained to preserve market shares.

The competition was limited by the lender of last resort function of the Reichsbank and money market discount rates. The former represents a ceiling for bills holdings while the latter represents a floor. The intensity of competition is a function of the distance from the ceiling and floor. The Reichsbank as lender of last resort and the note tax constitute buffers around the capacity constraint. The Reichsbank's lender of last resort function was implicit in the fact that the Reichsbank had not rediscounted its notes and accepted notes from the Privatnotenbanken.³⁹

The stability conditions of the system rest on the capacity constraint. The capacity constraint can be assumed to prevent convergence of key operational

³⁷ For example, the Reichsbank commits to gold conversion at its branches only to the extent that sufficient gold is available at the branch, see e.g. National Monetary Commission (1910a) interview with von Glasenapp and von Lumm.

³⁸ On the relationship between bills of exchange, reserves and bank notes, see Thesis Introduction page 43.

³⁹ National Monetary Commission (1910a, p. 356), interview with Otto von Glasenapp, Vice-President, and Karl von Lumm, Director of the Reichsbank on the discount policy of the Reichsbank in the event the reserve coverage falls below the legal minimum requirement: "*We should have to go on discounting bills. We should simply have to it. We could not stop it. If we did it would bring about the greatest panic that we have ever experienced.*"

parameters, a winner-take-all outcome and/or race to the bottom unlike in a normal Bertrand model. The competition in the short run is considered compatible with the preservation of operational autonomy outside the short run. The dominant position of the Reichsbank and lender of last resort position is expected to allow the Privatnotenbanken to free ride on the financial strength of the Reichsbank and sustain differences in prudential standards.

1.4. Statistical analysis

The incidence of competition can be tested through the responses of one institution to monetary impulses from another in the credit and prudential channels where competition is assumed to exist where the responses are significant following the approach in competitive reactions in industrial organisation.⁴⁰ Stabilisation is assessed through the pattern and duration of the responses of one institution to monetary impulses from another where stability is seen as consistent with a rapid petering out of the responses to monetary impulses. Given the feedback loop between the credit and prudential channel, bank interactions are tested at federal level. The incidence of non-significant responses to a given impulse is interpreted as consistent with the operational autonomy of the institution.

The statistical analysis uses monthly balance sheet data of the Reichsbank and Privatnotenbanken from January 1876 through December 1886. The period marks the beginning of the operations of the Reichsbank and the adoption in 1887 of the discount rate convention with the Privatnotenbanken.⁴¹ The data comprised bills of exchange (Wechsel), bank notes in circulation and metal reserves from the Central-Blatt für das Deutsche Reich by the Imperial Ministry of the Interior (Reichsamt des Inneren, 1876-1890). The discount rates of the Privatnotenbanken are normally not available on a monthly basis or where they are available correspond to the official rate only and not the actual rates, that is prime rates, at which bills were often discounted.

⁴⁰ See Horváth et al. (2005) and Steenkamp et al. (2005) for the use of SVARs to analysis the inter-firm competitive reactions to innovations in price and marketing measures.

⁴¹ See footnote 23 on page 80.

The statistical analysis also uses tax revenue to include German Imperial taxes on salt and beer from the Central-Blatt für das Deutsche Reich (Reichsamt des Inneren, 1876-1890) as a high frequency proxy for output amid its high correlation and its relative stable relationship with national income; it is recognised that the use of federal tax revenues as a proxy for output may be constrained by possible variations in elasticities of tax revenue to output over time.⁴² The monthly market discount rate advertised by the Berlin stock exchange to serve as control for domestic money market conditions and the monthly Bank of England bank rate to control for specie flow pressure are also used as published by the Reichsbank in Vergleichende Notenbankstatistik (Reichsbank, 1925).⁴³

The data are tested for stationarity. The bills of exchange and federal tax revenue series are found to be non-stationary using an augmented Dickey-Fuller test. The series is made stationary by taking the first-differences of the logs of the values. The reserve ratio series is found to be stationary.⁴⁴ The Bank of England bank rate and Berlin market discount rate were also transformed to first-differences of the logs of the values.

The identification of the number of lags to be included in the statistical tests is performed using the Hannan and Quinn's information criterion (HQIC) and the Schwarz Bayesian information criterion (SBIC) for a system with up to 10 lags. The appropriate lag length based on HQIC is 2 and SPIC is 0 lags. A 1 lag structure, as a proxy between the HQIC and SPIC criteria is chosen for the estimation of the bills of exchange. For the reserve ratios the HQIC and SPIC criteria show 1 lag.

The relationships among the Reichsbank and Privatnotenbanken can be illustrated with a simple correlation matrix (Table 1-3). The Reichsbank maintains low correlations in bills of exchange holdings with most Privatnotenbanken except the Sächsische Bank. The Privatnotenbanken similarly show very low correlations among themselves in bills of exchange holdings. For the reserve ratio, the

⁴² See Thesis Introduction under Sources, Data, Tax and customs revenue page 54 for an overview of taxes. Imperial inland tax revenues comprised salt tax (Salzsteuer), spirits tax (Branntweinsteuer) and beer tax (Brausteuern). Agricultural taxes (tobacco and beet sugar) were omitted due to high dependence on crop outcomes and strong seasonality. The spirits tax was excluded as Baden, Bayern and Württemberg did not contribute to the tax during the observation period. Customs were excluded amid the important tariff increases during the observation period.

⁴³ The Bank of England discount rate was checked against (Hill et al., 2015).

⁴⁴ Darné and Diebolt (2007) find that the underlying series (nominator) of reserve holdings of the Reichsbank is non-stationary.

Reichsbank maintains a low correlation with all Privatnotenbanken. However, the Privatnotenbanken maintain low to high correlations among themselves. The low correlation in bills of exchange holdings is consistent with the notion of autonomous central banking operations. The modestly negative correlation among the Reichsbank and the Privatnotenbanken offers additional indication of some divergence in central banking behaviour. The higher correlations among the Privatnotenbanken in the reserve ratio reflect relatively similar reserve ratios among the Privatnotenbanken. The bills of exchange holdings and reserve ratios indicate that the credit and prudential channels operated with important variations among the Privatnotenbanken.

Table 1-3. Correlation

Correlation coefficient, 1876-90

	Reichs bank	Badische Bank	Bank für Süddeut schland	Bayeri sche Noten bank	Frankfur ter Bank	Sächs ische Bank	Württem bergische Noten bank
Bills of exchange holdings (log, first differences)							
Reichsbank	1.0	0.1	0.4	0.2	0.0	0.5	0.1
Badische Bank	0.1	1.0	0.1	0.0	-0.2	0.2	0.1
Bank für Süddeutschland	0.4	0.1	1.0	0.1	0.0	0.2	0.3
Bayerische Notenbank	0.2	0.0	0.1	1.0	0.1	0.1	0.1
Frankfurter Bank	0.0	-0.2	0.0	0.1	1.0	-0.1	0.0
Sächsische Bank	0.5	0.2	0.2	0.1	-0.1	1.0	0.0
Württembergische Notenbank	0.1	0.1	0.3	0.1	0.0	0.0	1.0
Reserve ratios							
Reichsbank	1.0	-0.1	0.1	0.1	-0.1	0.1	-0.2
Badische Bank	-0.1	1.0	0.8	0.5	0.1	0.6	0.7
Bank für Süddeutschland	0.1	0.8	1.0	0.5	0.1	0.6	0.6
Bayerische Notenbank	0.1	0.5	0.5	1.0	0.0	0.4	0.4
Frankfurter Bank	-0.1	0.1	0.1	0.0	1.0	0.0	0.3
Sächsische Bank	0.1	0.6	0.6	0.4	0.0	1.0	0.3
Württembergische Notenbank	-0.2	0.7	0.6	0.4	0.3	0.3	1.0

Source: Central-Blatt für das Deutsche Reich. Monthly observations.

The interactions among the Reichsbank and Privatnotenbanken can also be shown as inter-temporal relationships with a simple Granger causality test. The Granger causality test reveals whether there are lead-lag relations among the variables. It can be seen as a proxy for the intertemporal influence that some institutions are exerting on others.

The Granger causality tests for stationary time series y_1 and y_2 the null hypothesis that y_2 does not Granger cause y_1 .

$$(1-1) y_1 = v + v_1 y_{1,t-1} + v_2 y_{2,t-1} + \epsilon_t$$

where y_1 to y_k are bills of exchange or reserve ratios and their lags of the Reichsbank and Privatnotenbanken. The number of lags is 1 based on the HQIC and SPIC. The null hypothesis that y_2 does not Granger cause y_1 is accepted when $v_2 y_{2t-1}$ is statistically insignificant at the 5 percent confidence interval.

Table 1-4. Granger causality

T-statistics of y_{2t-1} , 1878-86†

y_{1t}, y_{1t-1}	y_{2t-1}						
	Reichs bank	Badische Bank	Bank für Süddeut schland	Bayeri sche Noten bank	Frank furter Bank	Sächs ische Bank	Württem bergische Noten bank
Bills of exchange holdings (log, first differences)							
Reichsbank		0.30	** -2.83	** -3.37	-0.89	** 3.66	0.73
Badische Bank	* 2.80		0.23	1.24	0.13	1.78	-0.43
Bank für Süddeutschland	0.88	-0.25		-1.09	0.21	1.10	** 2.41
Bayerische Notenbank	0.79	-0.45	1.64		-0.04	1.00	1.48
Frankfurter Bank	-1.41	-0.36	-0.96	-0.29		-0.96	** 2.09
Sächsische Bank	* -2.85	-0.68	* -2.85	-1.65	* -2.25		1.64
Württembergische Notenbank	-1.84	0.17	-1.49	0.05	0.29	* -3.28	
Reserve ratios							
Reichsbank		0.79	-0.66	-1.71	-0.49	1.58	-0.62
Badische Bank	1.20		* 2.20	0.64	** 3.33	-0.71	** 2.17
Bank für Süddeutschland	** -2.24	0.12		-1.58	-0.50	1.40	1.81
Bayerische Notenbank	0.11	-0.53	0.34		** -2.01	0.77	-0.26
Frankfurter Bank	-1.80	0.87	-0.21	-1.20		** -2.05	** 3.36
Sächsische Bank	0.47	-1.84	** 2.18	0.33	-0.58		-1.52
Württembergische Notenbank	-1.75	1.69	** -2.41	** -2.56	** 2.11	-1.31	

Source: Central-Blatt für das Deutsche Reich. Monthly observations. †Granger causality tests of type y_2 does not Granger cause y_1 . * Unidirectional significant at 5 percent confidence interval. ** Not unidirectional significant at 5 percent confidence interval. Italic bilateral causality at 5 percent confidence interval.

The Granger causality test shows several significant inter-temporal interactions among the Reichsbank and the Privatnotenbanken. For bills of exchange, most of the interactions with the Reichsbank are unidirectional and the interaction with the Sächsische Bank is bilateral.⁴⁵ The Reichsbank Granger causes the Badische Bank and the Sächsische Bank and Bank für Süddeutschland, Bayerische Notenbank and Sächsische Bank Granger cause the Reichsbank. For the reserve ratios, the interactions among the Privatnotenbanken is more pronounced consistent with relatively similar pattern of reserve ratios among the Privatnotenbanken.

The correlation matrix and Granger causality tests affirm relatively weak coincident and several important intertemporal interactions, respectively, among the Reichsbank and Privatnotenbanken. However, the correlation coefficients and

⁴⁵ See e.g. Gujarati (1988) for an interpretation of the Granger causality results: Unidirectional when the coefficients of y_{2t-1} is significant and v_{1t-1} is not significantly different from zero. Bilateral causality when sets of the coefficients of y_1 and y_2 are significantly different from zero.

Granger causality tests are inconclusive, e.g. for bills of exchange, a low correlation coefficient between the Reichsbank and the Bayerische Notenbank but a significant though not unidirectional Granger causality from Bayerische Bank to the Reichsbank. The implied one-month lead-lag relationship is too long to reveal the relevant interactions between the institutions. The Granger causality test also does not allow to show the response of one variable in a system to a number of variables.

Vector autoregression models can show the joint distribution of the contemporaneous and lagged elements and allows to analyse the in-between time steps interactions that is considered a more realistic representation of the interactions among the Reichsbank and Privatnotenbanken. The model used here is a structural vector autoregression (SVAR) model to make explicit identifying assumptions about the short-term causal contemporaneous relationships between variables. SVARs are popular to study the effect and relative importance of shocks.⁴⁶ They require only minimal restrictions and are driven mostly by the data themselves. Limitations of SVAR analyses are noted in particular with regard to the importance of and sensitivity to the identifying assumptions and some counterintuitive results like e.g. the price puzzle.⁴⁷

The SVAR uses as endogenous variables monthly balance sheet data of the Reichsbank and Privatnotenbanken from January 1876 through December 1886 as per above. The exogenous variables for consideration of inclusion comprise monthly tax revenue, the market discount rate and the Bank of England bank rate. The designation as exogenous variables is based mostly on the assumption that those are not of immediate interest to the analysis but are required to control for external conditions. The large size of the SVAR system also precludes further inclusion of a greater number of variables as endogenous variables. The control variables have not been adjusted for seasonality as the contemporaneous relationships of the data represent critical elements of analysis.⁴⁸

⁴⁶ The Panzar-Rosse H-statistic to assess competition among banks has not been considered (Panzar & Rosse, 1987). It requires as input bank revenues and factor prices that are observable only on an annual basis for the institutions under investigation in the present paper. The Panzar-Rosse approach has been increasingly discarded amid identification problems, see e.g. Shaffer and Spierdijk (2015).

⁴⁷ For an overview of the limitations of SVARs, see e.g. van Aarle et al. (2003). The price puzzle is the tendency refers to the results in SVAR of a temporary increase in prices after a contractionary monetary policy shocks, see e.g. (Christiano et al., 1996).

⁴⁸ See Lütkepohl (2005) on the problems of using seasonally adjusted data as it can change the dynamic structure of the variables and thus may lead to different impulse response functions.

The SVAR represents a linear combination of a vector of endogenous variables, the variables of interest, either bills of exchange or reserve ratios of the Reichsbank and Privatnotenbanken and their respective lags, a vector of exogenous variables in addition to coefficient matrices and a random error vector. The exogenous variables are not affected by the endogenous variables but do exert an effect on the latter. As is normal in VAR analyses, as even a small VAR contains a lot of parameters and it is nearly impossible to interpret the relationships in a VAR by inspecting the estimated parameters, the impulse response functions (IRFs) are used as summary information.⁴⁹ The IRFs serve to analyse the dynamic effects of the orthogonalized shocks and represent the responses of the variables with respect to innovations in the errors of the system as one-step to multiple steps ahead forecast errors.

The SVAR model rests on the identification of the errors of the system which are interpreted as exogenous shocks. The structural shocks of the model are identified by imposing restrictions to allow making inferences based on the dynamic impact of mutually uncorrelated (orthogonal) shocks. The restrictions rest on a gravity model approach to impose the ordering of the variables in the model.

The gravity model approach assumes that relations among the Reichsbank and the Privatnotenbanken are defined largely by the distance between the individual institutions such that the closer an institution is to another institution the more likely it is to influence this institution similar to that used to study cross-border asset holdings and bank and credit customer relationships in a domestic context as determined by geographic distance as a proxy for information costs.⁵⁰ The Reichsbank, maintaining branches in all German states, is considered to be the closest to all other banks. The inter-bank distances are based on the geographic air distance (Table 1-5). The distances determine the bank's position in the ordering of the model and the possibility to influence other banks as a Wold causal chain.⁵¹ The model ordering implies that the Reichsbank thus affects contemporaneously all Privatnotenbanken. The Bank für Süddeutschland affects contemporaneously the Badische Bank, Frankfurter Bank, Württembergische Notenbank, Bayerische

⁴⁹ See e.g. Becketti (2013).

⁵⁰ On the distribution of cross-border equity flows see e.g. Portes and Rey (2000); on the relationship between proximity and small firms and lenders see e.g. Petersen and Rajan (2002).

⁵¹ On the Wold causal chain, see e.g. Breitung et al. (2004).

Notenbank and Sächsische Bank but not the Reichsbank. Similarly, the Badische Bank affects the Frankfurter Bank, Württembergische Notenbank, Bayerische Notenbank and Sächsische Bank but not the Reichsbank and Bank für Süddeutschland. The Sächsische Bank is not allowed to affect the other institutions (see Table 1-5).⁵²

Table 1-5. Distance

Air, kilometres	Reichsbank, Berlin	Bank für Süddeutsch land, Darmstadt	Badische Bank, Mannheim	Frankfurter Bank, Frankfurt a.M.	Württem bergische Notenbank, Stuttgart	Bayerische Notenbank, München	Sächsische Bank, Dresden
Reichsbank, Berlin		443	483	424	512	505	165
Bank für Süddeutschland, Darmstadt	443		45	27	128	228	383
Badische Bank, Mannheim	483	45		71	95	274	413
Frankfurter Bank, Frankfurt a.M.	424	27	71		153	305	372
Württembergische Notenbank, Stuttgart	512	128	95	153		191	413
Bayerische Notenbank, München	505	228	274	305	191		360
Sächsische Bank, Dresden	165	383	413	372	413	360	
Sum of distances excluding Berlin		811	898	928	980	1358	1941

Source: Google. Distance from Berlin calculated as 0 amid the Reichsbank's local branch network.

The SVAR model used is specified on the basis of a structure matrix of the form AB .⁵³ The VAR specifies K variables as linear functions of p of their own lags and p lags of the other $K - 1$ variables. A p -order VAR model $VAR(p)$ can be written as:

$$(1-2) \ y_t = v + \Delta x_t + \Gamma_1 y_{t-1} + \dots + \Gamma_p y_{t-p} + \epsilon_t$$

where

$y_t = (y_{1t}, \dots, y_{Kt})'$ is a $K \times 1$ vector of endogenous variables

x_t is a $M \times 1$ vector of exogenous variables

Γ_1 through Γ_p are $K \times K$ matrices of coefficients

Δ is a $M \times K$ matrices of coefficients

ϵ_t is assumed to be the random error term, that is,

⁵² See Klovland and Oksendal (2017) on the notion of lead institutions to drive discount rate changes.

⁵³ See e.g. Amisano and Giannini (1997).

$$E(\epsilon_t) = 0$$

$$E(\epsilon_t \epsilon_t') = \Sigma$$

Equation (1-2) can be rewritten after absorbing the constant v into the y_t vector and using the lag operator L and where I is the identity matrix:

$$(1-3) y_t = \Delta x_t + \Gamma_1 L y_t + \dots + \Gamma_p L^p y_t + \epsilon_t$$

$$(1-4) y_t = (I - \Gamma_1 L - \Gamma_p L^p)^{-1} (\Delta x_t \epsilon_t)$$

It can be shown that

$$(1-5) y_t = \Delta x_t + \Delta_1 x_{t-1} + \Delta_2 x_{t-2} + \dots + I \epsilon_t + \Phi_1 \epsilon_{t-1} + \Phi_2 \epsilon_{t-2} = \sum_{i=0}^{\infty} \Phi_i \epsilon_{t-i} + \sum_{i=0}^{\infty} \Delta_i x_{t-i}$$

where $\Phi_0 = I$, which is the moving average representation and Φ are the IRFs and Δ are the dynamic multiplier functions (DMs) which show the response of the endogenous variables to shocks to the exogenous variables.

The SVAR approach orthogonalizes the error terms, i.e. finds new linear combinations of the error terms which are independent or orthogonal to each other. The SVAR is transformed to a new model such that the new errors e_t can be expressed as a function of the old errors ϵ_t where $A \epsilon_t = B e_t$ for some invertible matrices A and B and where A and B are chosen such that A and B are diagonal, then $\epsilon_t = A^{-1} B e_t$ and $e_t = B^{-1} A \epsilon_t$.

The identification is provided by placing restrictions on A and B where A is a lower triangular matrix with one on the diagonal and B a diagonal matrix and where A and B are nonsingular. The P structural matrix for the short run model is $P_{sr} = A^{-1} B$ obtained by imposing restrictions on A and B . Since Σ is symmetric, it has only $\{K(K+1)\}/2$ free parameters and so only $\{K(K+1)\}/2$ parameters may be estimated in an exactly identified P_{sr} . With $2K^2$ total parameters in A and B , the order condition for identification requires at least $2K^2 - K(K+1)/2$ restrictions be placed on those parameters.

The P matrix is constructed as the Cholesky decomposition of the error covariance matrix of the original VAR model with optional additional restrictions

placed on the P matrix in terms of short-run restrictions on the contemporaneous covariances between shocks.⁵⁴ These restrictions are testable.

In the estimation of the model A and B are defined as 7×7 matrices in account of the Reichsbank and Privatnotenbanken where a and b are freely estimated coefficients. The form of the A matrix imposes the recursive structure used for orthogonalising the errors, while the diagonal B serves to scale the structural errors.

$$A = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & 0 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{bmatrix}$$

and

$$B = \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & b_{55} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & b_{66} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & b_{77} \end{bmatrix}$$

The estimation is performed with the lower triangular matrix A set such that all coefficients in the upper half are set to zero and all remaining coefficients in the lower half are freely estimated. The matrix is ordered based on the gravity model approach such that the sum of distances determines the bank's position in the ordering with the bank that is closest to all other banks, that is with the lowest sum of distances, occupying the first position in the far left column and the bank with the highest sum of distances occupying the far right column.

The SVAR model on the basis of equation (1-2) is derived following equations (1-2) through (1-5) to rewrite the new model in its moving average representation as:

$$(1-6) \ y_t = \sum_{j=0}^{\infty} \Theta_j e_{t-j} + \sum_{i=0}^{\infty} \Delta_i x_{t-i}$$

⁵⁴ The effect of the Cholesky decomposition can be replicated by defining A and B appropriately.

where $\Theta = \Phi_i P$ are the structural IRFs. The transformations of the errors allow to analyse the dynamics of the system in terms of a shock to the orthogonalized structural errors e_t .

The estimation comprises two models. The first model measures the interactions among the Reichsbank and Privatnotenbanken of the credit channel on the basis of bills of exchange holdings. The restrictions are taken from the gravity model. The model includes in the following order for the period January 1876 to December 1886: Reichsbank bills of exchange (log first difference), Bank für Süddeutschland bills of exchange (log first difference), Badische Bank bills of exchange (log first difference), Frankfurter Bank bills of exchange (log first difference), Württembergische Notenbanken bills of exchange (log first difference), Bayerische Notenbank bills of exchange (log first difference), Sächsische Bank bills of exchange (log first difference) and as exogenous variables the market discount rate as quoted at the Berlin stock exchange (log first difference) and federal tax revenue (log first difference). The coefficients of the Bank of England bank rate were insignificant in a post-estimation Wald test and dropped. A post-estimation Durbin-Watson d-statistic shows no serial correlation between the main endogenous variables and the exogenous variables.

The second model measures the interactions among the Reichsbank and Privatnotenbanken of the prudential channel on the basis of the reserve ratios. The restrictions are taken from the gravity model. The model includes in the following order for the period January 1876 to December 1886: Reichsbank reserve ratio, Bank für Süddeutschland reserve ratio, Badische Bank reserve ratio, Frankfurter Bank reserve ratio, Württembergische Notenbanken reserve ratio, Bayerische Notenbank reserve ratio, Sächsische Bank reserve ratio and as exogenous variables the market discount rate as quoted at the Berlin stock exchange (log first difference). The coefficients of the federal tax revenue and Bank of England bank rate were insignificant in a post-estimation Wald test and dropped. A post-estimation Durbin-Watson d-statistic shows no serial correlation between the main endogenous variables and the exogenous variables.

The IRFs for the bills of exchange affirm the incidence of competition through the credit channel (Figure 1-8). The competition materialises as expected between the Reichsbank and the Privatnotenbanken consistent with the view that the

operations of the Privatnotenbanken were mostly confined to their federal states. The Reichsbank influences significantly the Badische Bank, Frankfurter Bank, Württembergische Notenbank and Sächsische Bank. The Badische Bank also influences the Frankfurter Bank and the Sächsische Bank. The graph shows that the responses to impulses are very short lived and peter out mostly during the first 5 months ahead. The data affirm that responses are predominantly positive, indicating that a positive shock to lending in one institution induces a positive adjustment in lending in another institution. This is consistent with the notion of competition herein. The view that competition should induce stability is also supported. The system absorbs shocks quickly and impulses do not have lasting effects. The results were robust with the use of different Privatnotenbanken ordering.

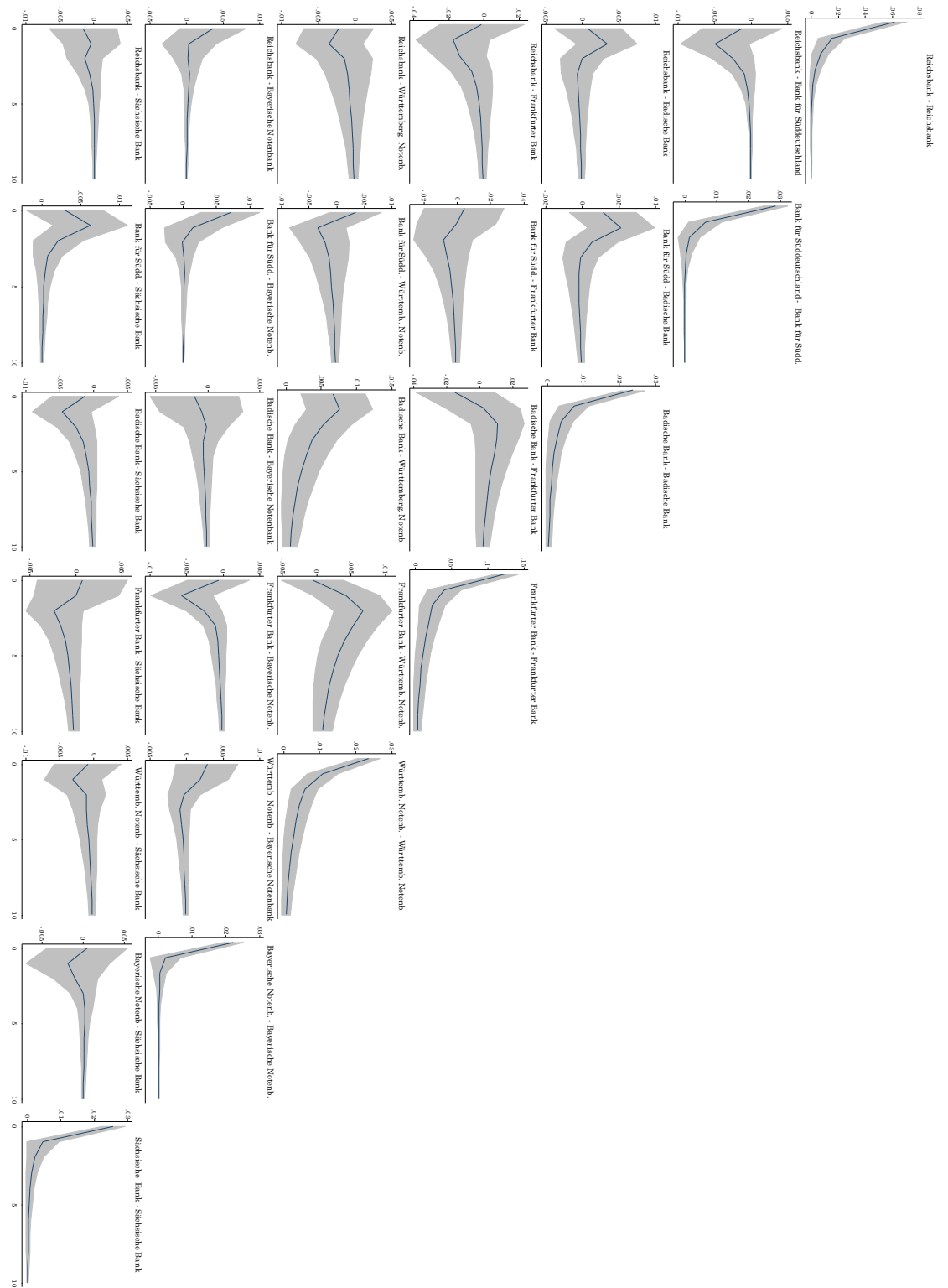
The IRFs for the reserve ratio series with the Berlin market discount rate as exogenous variable show a very limited impact of the prudential channel. The Reichsbank exerts no influences on the Privatnotenbanken. This is consistent with the notion that Privatnotenbanken were free-riders in the system based on the reputational strength and persistent high reserve ratio of the Reichsbank. There is some evidence for the regional clustering consistent with the gravity model approach as the Bank für Süddeutschland influences the Badische Bank and the Bayerische Notenbank; the Badische Bank influences the Württembergische Notenbank, the Frankfurter Bank with a lag the Württembergische Notenbank. The prudential channel overall is not very effective in influencing bank behaviour. The results were robust with the use of different Privatnotenbanken ordering.

Figure 1-8. SVAR bills of exchange impulse response functions



STATA 14.1 output. 95 percent confidence interval, 10 steps. SIRF, impulse variable - response variable. March 1878-December 1886.

Figure 1-9. SVAR reserve ratios impulse response functions



STATA 14.1 output. 95 percent confidence interval, 10 steps. SIRF, impulse variable - response variable. March 1878-December 1886.

1.5. Conclusions

The paper supports the incidence and relevance of competition among the Reichsbank and Privatnotenbanken for the operations and stability conditions of the German central banking system in 1876-90. While narrative accounts and adoption of the 1887 Convention support relevance and existence of competition, the paper provides supportive statistical evidence of competition offering new elements to assess central bank behaviour. It is consistent with the observations of competition and impact on the conduct of monetary policy (Holtfrerich, 1993; National Monetary Commission, 1910b; Bundesbank, 1976; Otto, 2002). The results refute assertions by Kroha (2009) that the Privatnotenbanken played no meaningful role in the system and attenuate indications that the Reichsbank operated like a monopoly central bank (de Kock, 1974; Smith, 1936). The implied constraint on central banking behaviour can also be seen as tentatively in line with a central-bank-disciplining device in Hayekian currency competition.⁵⁵

The German mixed central banking system combined important incentives- and rules-based elements. Legislators intended for competition, to be understood as oligopsonistic competition, among the Reichsbank and the Privatnotenbanken to induce prudent note issuance behaviour. The statistical tests lend support to the notion that the Reichsbank was influential in affecting the Privatnotenbanken in the short-term through lending operations while the Privatnotenbanken maintained a considerable degree of autonomy. The Reichsbank was less effective in influencing prudential standards in the system consistent with the notion that the Privatnotenbanken were free-riding on the financial strength and lender of last resort function of the Reichsbank. Stabilisation was effective as the lender of last

⁵⁵ Hayek (1990, p. 51): “The question we have to consider is whether competition between the issuers of clearly distinguishable kinds of currency consisting of different units would not give us a better kind of money than we have ever had, far outweighing the inconvenience of encountering (but for most people not even having to handle) more than one kind. In this condition the value of the currency issued by one bank would not necessarily be affected by the supplies of other currencies by different institutions (private or governmental). And it should be in the power of each issuer of a distinct currency to regulate its quantity so as to make it most acceptable to the public-and competition would force him to do so. Indeed, he would know that the penalty for failing to fulfil the expectations raised would be the prompt loss of the business. Successful entry into it would evidently be a very profitable venture, and success would depend on establishing the credibility and trust that the bank was able and determined to carry out its declared intentions. It would seem that in this situation sheer desire for gain would produce a better money than government has ever produced.” Also Mandeng (2010) for a summary of the currency competition argument in the international context and Vaubel (1990) for the European context.

resort function of the Reichsbank could not act as substitute for the capacity constraint.

The data are supportive of the view that competition induces a stabilising impact on monetary conditions. The data show that shocks to the system affecting structural innovations in bills discounting and reserve ratios were relatively short-lived and self-correcting. The rapid petering out of responses to a given impulse can be attributed to the stabilising forces within the system. This supports the hypothesis that a mixed central bank system can produce monetary stability. The Privatnotenbanken exercised some pressure at regional level through the lending and prudential channels validating the gravity model approach for the SVAR model identification.

Germany's nineteenth century banking reform appears to be the outcome of modern central banking thought. The reform addressed agency delegation problems by forgoing vesting note issuance in a single institution amid concerns about not meeting set public policy objectives. Competition and disclosure requirements were seen as important to preserve reputation and discipline in the system.

The shift in policy focus in the 1890s in Germany away from stabilisation amid increasing emphasis on centralisation and efficiency may have unduly superseded the main motivation for reform during the 1870s. At the same time, the system allowed for a gradual process of endogenous adaptation.⁵⁶ Yet, the calls for greater dominance by the Reichsbank with the 1899 bank act revision may unintentionally have laid the foundations for a period of increasing monetary instability that started in earnest with World War I and culminated with extreme monetary instability in 1921-24. It seems that the original reform intent to seek stability through decentralisation was not providing sufficient safeguards to remain effective amid increasing centralisation.

⁵⁶ Leading period monetary commentator Karl Helfferich commented on the 25-year anniversary of the Reichsbank (Helfferich, 1901): *“Die Deutsche Reichsbank verdankt ihrer Begründung dem Siege der Erkenntnis, daß die Banknotenausgabe, wenn sie ihre wichtigen volkswirtschaftlichen Functionen erfüllen soll, einer einheitlichen Leitung nicht entbehren kann. Aber die deutsche Gesetzgebung fand zur Verwirklichung des Gedankens einer Centralbank keine Tabula rasa vor. Sie konnte die bestehenden Notenbanken in ihren wohlverworbenen Privatreechten nicht so weit verkürzen, daß dadurch der zu begründenden Reichsbank von vorneherein die volle Leitung der deutschen Notenausgabe gesichert worden wäre. Sie konnte keinen in sich abgeschlossenen und fertigen Zustand schaffen, sondern musste sich damit begnügen, der Reichsbank ein gewisses thatsächliches Uebergewicht zu geben und die Entwicklung in der Richtung der Centralisierung zu begünstigen. Für die Reichsbank blieb innerhalb dieses Rahmens Spielraum genug, der Schmied ihres eigenes Schicksals zu sein.“*

Nineteenth century Germany addressed agency delegation and stabilisation concerns through market solutions. It showed that co-existence of multiple central banks in monetary unions is consistent with stability. As such, it may offer important insights into possible employment of decentralised elements in monetary unions to address the constraints of undue centralisation of monetary policy.

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2. Monetary policy transmission and regional monetary policy differentiation in Germany, 1876-1890

2.1. Introduction

The paper studies the effectiveness and impact of monetary policy on economic activity and its spatial dimension in Germany in 1876-90 using new detailed monthly banking data and advanced statistical time series estimation techniques. The analysis offers for the first time statistical evidence on the relationship between monetary policy and output at federal and federal state levels using a contemporary monetary policy transmission framework. While the Reichsbank at federal level had a significant effect, the effect of the Privatnotenbanken at federal state level was mixed. The findings are supportive of the view that decentralised central banking systems can allow for some policy differentiation. There is supportive evidence that the Reichsbank dampened economic activity prolonging adverse economic conditions.

The German empire was subject to a well-known period of economic stagnation (Gründerkrise) in 1873-86 and sustained large spatial economic differences amid a pronounced imbalanced process of industrialisation. The relationship between monetary policy, spatial diversity and economic conditions in Germany remain largely unexplored. This implies only a partial understanding of the effect of monetary policy and causes of the duration of the Gründerkrise.

The 1875 bank act established a mixed central banking system in Germany with the Reichsbank at federal and the Privatnotenbanken at federal state level following adoption of a single currency with the 1871-73 coinage acts. Monetary policy was implemented at federal level by the Reichsbank and complemented at federal state level by the Privatnotenbanken.

The monetary policy framework, policy operations and discount rate policy of the Reichsbank have been analysed comprehensively (Hellferich, 1898; Pohl, 1982; National Monetary Commission, 1910; Seeger, 1968; Sommariva & Tullio, 1986; Wühle, 2011). Monetary policy under the gold standard has been reviewed widely

(Bordo & Kydland, 1995; Eichengreen, 1995; Jeanne, 1995; Obstfeld & Taylor, 2002). However, studies on the monetary policy transmission have been rare, have not been based on contemporary approaches and disregarded the role of the Privatnotenbanken. Several accounts also dismiss the effectiveness of the Reichsbank's policy (Hentschel, 1989; Seeger, 1968; Wühle, 2011). The relationship between central banking and cyclical economic conditions in nineteenth century Germany has generally not been addressed. In a contemporary context, the monetary policy transmission mechanism and impact of monetary policy on aggregate demand and targeted policy variables have been studied extensively (Bernanke & Blinder, 1992; Bernanke & Mihov, 1995; Christiano et al., 1996; Sims, 2012; Svensson, 1999). Carlino and DeFina (1998) and Di Giacinto (2003) offer analyses of the spatial impact of monetary policy for the contemporary United States and Cecchetti (1999) for the European Union.

The contribution of the paper is to demonstrate and test statistically the effect of a monetary policy shock on Germany's output and its regional effects during 1876-90. The paper follows Bernanke and Blinder (1992) and Christiano et al. (1996) to assess monetary policy transmission using a structural vector autoregression model (SVAR). SVARs allow to analyse contemporaneous interactions of time series in a multivariate settings and represent a common method for monetary policy analysis. The paper does not employ the outlier method as an alternative to analyse shocks amid its focus on simulated shocks (Demeulemeester et al., 2011). The paper shows that an innovation in the Reichsbank's policy stance during 1883-90 had a negative impact on output. The Privatnotenbanken had a mixed impact with the Badische Bank and Sächsische Bank exhibiting a significant impact.

The paper uses new detailed monthly data on tax and customs revenues at the federal level as proxy for high frequency economic activity. A monthly wholesale prices index has been constructed as proxy for domestic relative price changes and output. The impact of regional shocks will be measured on the basis of a new set of monthly overseas emigration data by federal state. Regional divergence is assumed as given and no attempt is made to assess possible patterns of regional specialisation or the effect of policy on specialisation (Betran, 2011; Ciccarelli &

Proietti, 2013).¹ The quantitative analysis is supplemented by detailed period narrative accounts.

The study focuses on the period 1876-90 marking the beginning of operations of the Reichsbank in January 1876 and the end of the scheduled life of the original bank act in December 1890.

The second section offers a literature review. The third section outlines briefly the economic conditions and spatial diversity in Germany in 1876-90. The fourth section presents the data used and the statistical estimation and results. The last section offers some concluding remarks and tentatively links the findings to select contemporary central banking themes with emphasis on the Euro Area.

2.2. Monetary policy transmission

The study of the monetary policy transmission of the Reichsbank is rare and there are few detailed statistical accounts. The role of the Privatnotenbanken and their impact on economic activity has been evoked seldom. The relationship between monetary policy effectiveness and spatial diversity has also not been analysed. This may lead to an incomplete understanding of the impact of public policy on cyclical economic conditions in Germany towards the end of the nineteenth century.

The Reichsbank described economic developments during 1876-90 as follows: *“When the Reichsbank began its activity on January 1, 1876, German economic activity was still suffering from the effects of the great commercial crisis of 1873. A heavy depression prevailed in most of the important branches of industry until 1879. The purchasing power, not only of the German market but also of the whole international market, was severely shaken; sales ceased, and the prices of the most important commodities showed a distinct decline. [...] From 1879 to 1882-83, the general economic situation again improved. [...] In 1883, the decline began to set in. The construction of railways, which since 1879 had been carried on in various states with great activity, came everywhere to a standstill. The products of mining industry did not have sufficient sale, and prices sank. [...] The year 1887 had brought a*

¹ Betran (2011) analyses Spain and Ciccarelli and Proietti (2013) Italy.

*decided renewal of economic activity in England and in the United States. In Germany, the improvement of conditions was first felt in 1888 [...]. The upward movement developed rapidly, and was communicated to the whole of Europe. [...] The severe crisis of 1890 ushered in a period of economic standstill, with a short break in 1893, extended into 1895.”*²

The Reichsbank viewed its impact on aggregate demand through its credit operations amid its ability to influence the demand for money with the discount rate distinguishing between structural and seasonal demand shocks: “A money demand based on over speculation and over production requires sharper restrictions than the normal, periodically recurring increased demand for money at the turn of the month and year.”³ The impact was broadly understood by the public: “[The Reichsbank] under objective and calm assessment of the situation by loosening or tightening of the discount rate influenced commercial activity in a propulsive or restraining manner.”⁴

The relationship between monetary policy effectiveness and spatial diversity was recognised by the Reichsbank: “You will find that the interest rate is different in the West and South compared with the East and North-East. In Southern Germany, an interest rate of 4 percent is unusually high, one of 3 percent and below entirely normal; in the East, it is unheard of for someone to discount a bill of exchange at 4 percent, one there requires a rate of 6 to 8 percent and more for bills not accepted by the banks. I ask myself how should the Bank under these circumstances set the discount rate? If we set it very low, it would satisfy the Southern and Western provinces but be inappropriate for the other parts of the country and vice versa.”⁵

The accounts of economic developments in Germany during 1876-90 with particular focus on the Gründerkrise refer mostly to real indicators only and do rarely if at all analyse the effect of economic policies generally. Two main classical accounts about Germany’s economic crisis during 1876-90 make no reference to the role of monetary policy at all: Wehler (1995) in an account of the “depression” in

² National Monetary Commission (1910, pp. 217-256).

³ National Monetary Commission (1910, p. 206).

⁴ Translated from German from the newspaper Kölnische Zeitung of 1 January 1901 on the 25-year anniversary of the Reichsbank (Kölnische Zeitung, 1901)

⁵ Translated from German based on President of the Reichsbank Hermann von Dechend’s testimony in the Reichstag of 8 March 1881 (Deutscher Reichstag, 1881).

1882-86 and Rosenberg (1967) in his book entitled “great depression” equally makes not a single reference to the Reichsbank. This is all the more surprising as fiscal policy rested mostly with the federal states making monetary policy next to tariffs one of the few federal policy instruments.⁶ Tilly (2003) offers a rare reference arguing that German monetary policy was somewhat responsible for the scope and duration of the Gründerkrise.

Period commentators criticised a restrictive Reichsbank monetary policy with regard to the gold standard and discount rate policy (Deutscher Reichstag, 1879a; Deutscher Reichstag, 1880; Deutscher Reichstag, 1881).⁷ The gold standard and the Reichsbank’s discount policy were often viewed as unduly tight. The former was based largely on a perceived lack of gold leading to repeated calls for reintroducing silver as legal tender (Thiemeyer, 2013).⁸ The latter was regularly criticised for undermining the real economy by deploying too elevated discount rates.⁹ In that context, the local impact of the Privatnotenbanken was generally acknowledged as positive.¹⁰

Period observers saw as important countercyclical measures only fiscal policy, protectionism and exports (Rose, 2013). The introduction of comprehensive custom tariffs in Germany with the 1879 custom tariff act (*Zolltarifgesetz*) was seen as an attempt to protect domestic industries to stimulate economic activity.¹¹ The absence

⁶ See e.g. Ziegler (2005): “[d]ie Wirtschaftspolitik im Kaiserreich [war] in erster Linie eine Angelegenheit der Einzelstaaten geblieben [...]”

⁷ Tilly (2003) argues that the scarcity of money in Germany had been repeatedly evoked by period commentators from the second quarter of the nineteenth century.

⁸ Reichsbank president von Dechend presents a plan to reintroduce silver that has been attributed to the “monetary stringency” due to the scarcity of gold (The Economist, 1882). Leading Member of Parliament and proponent of curbing free trade Wilhelm von Kardorff argued in favour of adopting a bi-metallic standard as the level of gold in circulation per capita in Germany was the lowest and only comparable to that in the United States in a parliamentary debate on 24 February 1880 (Deutscher Reichstag, 1880, p.110): “*Ich mache darauf aufmerksam [...], daß von allen Ländern der Welt mit Ausnahme der nordamerikanischen Freistaaten Deutschland dasjenige Land ist, welches pro Kopf der Bevölkerung den geringsten Metallbetrag als Umlaufsmittel besitzt.*” See also e.g. proposed bills to change the coinage acts (Münzgesetze) and reintroduce silver of 25 January 1883 and 6 February 1886.

⁹ See e.g. Member of Parliament and founder of popular newspaper *Frankfurter Zeitung* Leopold Sonnemann severely criticised the monetary policy stance of the Reichsbank arguing that it put the real economy at a disadvantage and failed in acting in the spirit of the bank act in a parliamentary debate on 3 March 1881 (Deutscher Reichstag, 1881): “[...] *die gegenwärtige Diskontopolitik, diese Begünstigung der Bankiers gegenüber den Kaufleuten, den Industriellen und den Privaten dem Geist des ganzen Bankgesetzes widerspricht [...].*”

¹⁰ During the parliamentary debate about the renewal of the bank act in 1899, member of parliament Otto Büsing, National Liberal, indicated that it was often perceived that Preußen not having Privatnotenbanken was at a disadvantage compared with credit accommodation in the other states and that remedy was obtained with the establishment of the Zentralgenossenschaftskasse in Preußen in 1895 (Deutscher Reichstag, 1889).

¹¹ Bismarck addressed the Reichstag on 2 May 1879 to plead for the adoption of the custom tariff act reasoning that the over-production of other countries causes adverse pressure on prices and industry

of a meaningful fiscal union and lack of automatic stabilisers restricted the federal government.¹² There is no narrative evidence to suggest that the Reichsbank viewed the 1879 custom tariff act as a substitute or complement to its policy stance.¹³

The historiography of the Reichsbank expresses mixed views about the effects of the Reichsbank's monetary policy stance and generally employs only descriptive and verbal methods. Tipton (2003) notes the restrictive policy of the Reichsbank during 1876-90. Ziegler (2005) similarly alerts about the pro-cyclical policy of the Reichsbank during the latter half of the 1870s to protect its gold reserves with a notable adverse impact on economic activity. Morgenstern (1959) also outlines the pro-cyclical pattern between the business cycle and short-term market interest rates in 1878-1913 and Tilly (2003) argues that monetary policy was pro-cyclical in 1871-1913. Borchardt (1976) indicates that the Reichsbank to protect its gold reserves had a countercyclical impact.

McGouldrick (1984), offering a rare statistical analysis and most comprehensive study on the transmission mechanism of Reichsbank policy, finds that the Reichsbank had a dampening impact on the business cycles. He argues that the Reichsbank succeeded in "leaning against the wind" by avoiding a pro-cyclical movement in its monetary liabilities but also that its bills of exchange portfolio, its

due to Germany's liberal trade policy (Deutscher Reichstag, 1879a): "*Wir sind bisher durch die weitgeöffneten Thore unserer Einfuhr die Ablagerungsstätte aller Überproduktion des Auslandes geworden. [...] [die] Überproduktion anderer Länder ist es, was unsere Preise und den Entwicklungsgang unserer Industrie, die Belebung unserer wirtschaftlichen Verhältnisse meines Erachtens am allermeisten drückt.*" The custom tariff act was principally aimed at raising federal fiscal revenue and easing state direct taxes, see e.g. objectives of the custom tariff act (Deutscher Reichstag, 1879b).

The adoption of trade tariffs caused significant controversy and is often seen as marking a turning point in the prior liberal principles that had guided Germany's economic policies since the 1850s. Similar measures were taken by other countries notably Russia in 1877, Italy in 1879, France and Great Britain in 1881 and the U.S. in 1883. Stolper (1940) attributed the shift away from liberal principles to external pressures: "*The strain of the world-wide depression; the change in the international agricultural situation; the progress of British iron, which threatened to stifle the flourishing German iron industry. It was this concentric pressure, not the triumph of Bismarckian Prussia over Germany, that brought about the gradual collapse of the free-trade policy in Germany.*" See Planze (1998) for a review of the political process leading to the adoption of more protectionist policies as a struggle between the liberal and conservative forces in the German parliament. Wehler (1969) highlights that Bismarck's personal involvement in agriculture made him susceptible to supporting the protectionist movement (Schutzzöllner).

¹² See Thesis Introduction under Sources, Data, Tax and customs revenue page 54 for an overview of tax and customs revenues and the tariff reform. The administrative and fiscal capacity of the Empire remained significantly constrained and was limited to the armed forces, customs, the post office and later colonial administration. The internal administration including police, judiciary, fiscal administration including the prerogative for direct taxation remained with the federal states.

¹³ For a review of the substitutability between exchange rate and tariff policy, see e.g. Eichengreen and Irwin (2010).

preferred policy instrument, exhibited large pro-cyclical changes.¹⁴ Bordo and MacDonald (1997) find a negative impact of short-term German interest rate on German output for 1880-1913.

Wühle (2011) and Seeger (1968) indicate fundamental doubts about the effectiveness of monetary policy of the Reichsbank.¹⁵ Seeger (1968) argues that low interest rates are unlikely to be effective when economic conditions are weak. Similarly, Wühle (2011) and also Borchardt (1976) view external conditions notable the London open market rate and other external influences as dominating monetary conditions in Germany.¹⁶ Hentschel (1989) similarly underlines that the Reichsbank “*did not affect cyclical conditions at all*” and that there was no relationship between its policy and the business cycle.¹⁷

Statistical evidence on the transmission mechanism remains rare. Borchardt (1976) and Hentschel (1989) offer no statistical evidence. McGouldrick (1984) provides only simple regression analysis. Bordo and MacDonald (1997) use an SVAR model but focus on the formulation of monetary policy and not its effect on output.

2.3. Economic development and spatial diversity

The economic developments in Germany in 1876-90 were marked by a well-known pattern of stagnation, severe deflation and recovery and important spatial

¹⁴ McGouldrick (1984) accounts seem inconsistent and are therefore difficult to interpret. He asserts that “the best index of what the Reichsbank intended to do was the bill portfolio, not the total portfolio [showing] much larger procyclical changes in the former than the latter” (p. 316). At the same time, he argues that “open market [discount] rates rose during business upswings, so did the [Reichsbank] discount rate, *but by less* than the rise in the former. [...] And this “perverse” behaviour was remarkably consistent.” (italics and quotation marks as per original, p. 317-318). He further indicates that “while the Reichsbank portfolio moved procyclically, its total money liabilities moved countercyclically, averaging a greater percentage rise during recessions than business upswings” (p.319). McGouldrick (1984) also stresses that “[t]he bank’s portfolio was a better indicator of Reichsbank policy than was Reichsbank money” (p. 325).

¹⁵ Wühle, 2011 #336@author-year} and Seeger (1968), despite their extensive accounts of the monetary policy framework in Germany in 1876-1914 do not offer an analysis about the impact of monetary policy on economic developments.

¹⁶ Borchardt (1976): “*Wegen der Mobilität der Gelder hielt sich die Reichsbank im allgemeinen verpflichtet, den Londoner Diskontsatz zur Richtschnur ihrer Zinspolitik zu machen.*”

¹⁷ Hentschel (1997) indicates that “[h]ence financial policy did not guide the state of the economy automatically, let alone try to do consciously.” See Thesis paper 3 for a discussion about the formulation of monetary policy at the Reichsbank that is inconsistent with this assertion.

diversity in industrialisation.¹⁸ In 1870-74, output grew 4.4 percent on average per year followed by economic slowdown amid the intermediate effects from the May 1873 stock market crash in Vienna accompanied by various bank and corporate failures.¹⁹ Economic activity moderated sharply in 1875-80 amid a profound pessimism linked to the duration of the perceived crisis.²⁰ In 1881-86, the economy stabilised amid weak growth and initiated a sustained though uneven recovery from 1887 onwards.²¹ Economic developments were largely in line with international economic developments and accompanied by severe price deflation.²² Wholesale prices in 1890 were still below their 1860 level and significantly lower than their 1873 local peak and were broadly consistent with international price developments.

The economic developments were highly uneven across Germany in terms of output growth and the spatial and sectoral distribution of employment.²³ The impact of a decline in agriculture and sectoral contribution to employment marked the disparities in economic conditions across different German states. While most German states increased employment in industry between 1871 and 1895, Sachsen

¹⁸ See also Thesis Introduction under Economic developments page 23 and Spatial diversity page 25.

¹⁹ Stern (1979, p. 182) outlines the 1873 crisis as follows: *“By the summer and fall of 1873, the stock markets of New York and Berlin suffered calamitous losses, credit became scarce, and businesses began to fail. In the early days of 1874 61 banks, 116 industrial enterprises and 4 railroad companies announced their bankruptcies. To the surprise of many [...] the crash turned into the longest and most pervasive depression of the century.”*

²⁰ Wehler (1985, p. 33) describes the stagnation as follows: *“The downturn in the economy halved the growth rates over a six-year period and led temporarily even to stagnation and a fall in production in some sectors. This was accompanied by a generally constant price deflation. The depression thus constituted the longest and most sudden interruption to German industrial growth up to that point.”*

²¹ The timing of Germany’s business cycle remains controversial amid poor data availability. Hoffmann (1965) offers a comprehensive review of economic developments in nineteenth century Germany; he assigns 1874-1880 as a period of stagnation or decline and 1886-1890 as a period of above-average growth. Burns and Mitchell (1946) provide an early schedule for Germany’s business cycle during the second half of the nineteenth century that is close to Hoffmann (1965) and also Wehler (1985) and has also been supported by Uebele and Ritschl (2009). Burhop and Wolff (2005) show estimates for German net national product different from earlier estimates of boom and bust during the 1870s.

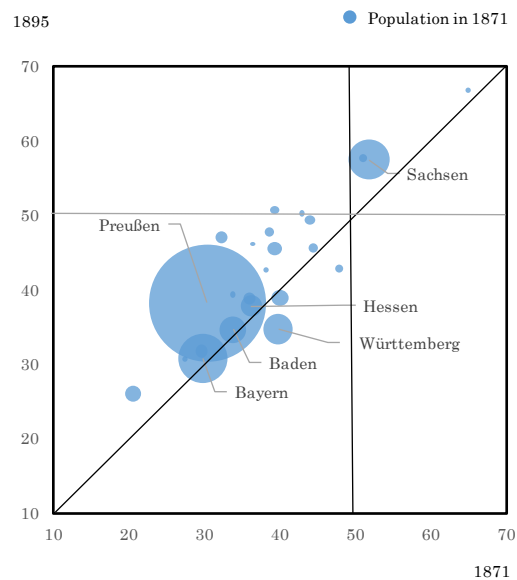
²² Burns & Mitchell, 1946 show that the peak and trough points for calendar years for the U.S., France, U.K. and Germany were 1873-78, 1873-78, 1873-79 and 1872-78, respectively and 1882-85, 1882-87, 1883-86 and 1882-1886, respectively.

²³ Kiesewetter (1989) highlights that the long tradition of German territorial and political fragmentation may have led to a competition between federal states causing a “hunt for prosperity” as industrialisation was regional in nature. Fremdling et al. (1979) argue similarly that European industrialisation is to be understood as a process of regional differentiation; Germany’s industrialisation produced “leader regions” and “territories of stagnation.” Wehler (1985, p. 32) indicates that *“industry became dominant only in certain regions, e.g. the Ruhr, the Saar, [Ober Schlesien] and [Sachsen] [Ruhr and Upper Silesia are provinces of Preußen]. Elsewhere relatively traditional conditions continued to prevail for a long time. [...] The process of economic growth in Germany continued, therefore, in a characteristically uneven manner.”* Borchardt (1982) offers an overview of regional variations in growth rates in nineteenth century Germany.

was significantly more developed in industry, Bayern, Baden and Württemberg were laggards (Figure 2-1).²⁴

Figure 2-1. Industrialisation

Employment in industrial sector by federal state, percent of population



Source: Kaiserliches Statistisches Amt (1880-95). Excludes Elsaß-Lothringen and Mecklenburg-Strelitz.

Monetary conditions appeared uneven among the federal states. The discount rates in the federal states exhibited important differences during the observation period.²⁵ The differences can be approximated by the returns from bills of exchange holdings by the Reichsbank and Privatnotenbanken (Figure 2-2).²⁶ The range in discount rates can be attributed to the use of local bills (Platzwechsel), the importance of local branch networks and information asymmetry due to branch-based credit screening.²⁷

²⁴ Data points based on 1871 and 1895 census data. The German empire conducted censuses during the nineteenth century only in 1875, 1882 and 1895.

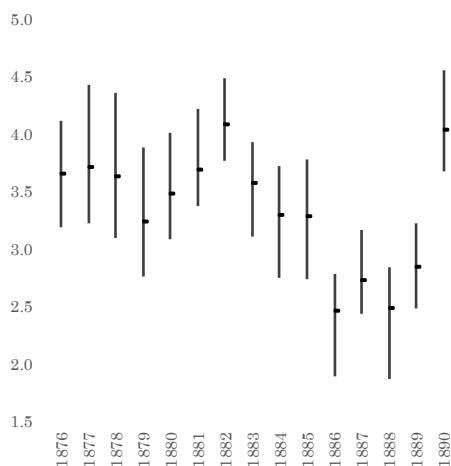
²⁵ This is consistent with findings of persistent discount rate differences in Norway in 1850-92 (Klovland & Oksendal, 2017) and in the United States during 1913-35 (Cohen-Setton, 2016).

²⁶ See Thesis Introduction on differences in local money market rates in Money market integration page 31.

²⁷ Compare Klovland and Oksendal (2017) for the notion that credit in the nineteenth century was personal reflecting as most economic agents would obtain better credit in their home town than elsewhere.

Figure 2-2. Effective discount rates

Percent, annual average, highest, lowest and average discount rates, Reichsbank and Privatnotenbanken



Source: Reichsbank and Privatnotenbanken annual reports.
Actual returns on holdings of bills of exchange.

The Reichsbank and Privatnotenbanken maintained broadly equal shares in main credit operations at federal state level (Table 2-1). The Reichsbank only assumed a majority share in bills of exchange in Württemberg in 1890.

Table 2-1. Reichsbank bills of exchange at federal state level ²⁸

	1876	1880	1885	1890
Reichsbank branches, share in bills of exchange holdings, percent [†]				
Baden	23.9	41.1	49.7	58.0
Bayern ^{††}	22.4	29.9	35.0	49.9
Sachsen	32.9	25.8	31.8	41.7
Württemberg	23.1	25.6	26.2	33.6

Source: Reichsamt des Inneren (1876-90); Heil (1900); Reichsbank (1900). [†] Bills of exchange holdings of the Reichsbank and Notenbanken. Other Reichsbank branches are not confined to States boundaries. ^{††} after Heil Wechselverkehr der Reichsbank in Bayern und der bayerischen Notenbank 1876-1899 (Tabelle II).

The Reichsbank and Privatnotenbanken conducted differential credit policies. The former maintained on average in 1876-90 a more expansionary stance but reduced average credit extension, through holdings of bills of exchange and secured advances (Lombard), during the period of economic stagnation in 1879-83. The latter are characterised by rapid credit expansion in 1879-83 and credit contraction in 1884-88 (Table 2-2).

²⁸ Data comprise bills of exchange presented locally (Platzwechsel) and consigned bills (Versandtwechsel), bills presented for discounting (Diskont-Wechsel) and encashment (Inkasso-Wechsel).

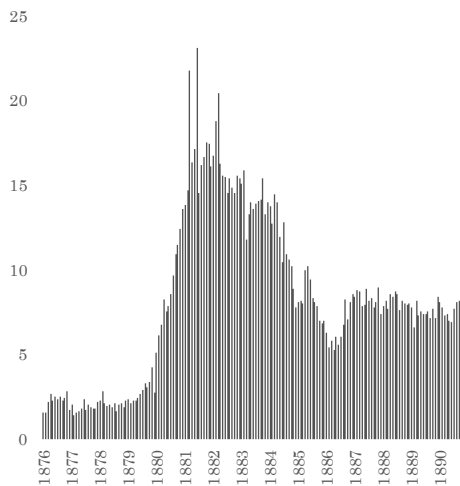
Table 2-2. Credit extension

	1876-90	1879-83	1884-88
Bills of exchange and Lombard holdings (Million Mark, average)			
Reichsbank	475.1	428.8	480.3
Badische Bank	17.7	18.1	18.0
Bayerische Notenbank	42.3	39.3	46.7
Sächsische Bank	53.5	50.3	56.5
Württembergische Notenbank	19.2	19.1	19.6
Privatnotenbanken*	132.6	126.8	140.8
Bills of exchange and Lombard holdings (percent change)			
Reichsbank	2.8	1.6	3.1
Badische Bank	-0.4	3.5	-1.0
Bayerische Notenbank	2.3	2.5	1.9
Sächsische Bank	1.2	4.3	1.0
Württembergische Notenbank	0.9	1.2	-0.3
Privatnotenbanken*	1.0	2.9	0.4

Source: Reichsamt des Inneren (1876-90). Based on monthly observations. *Only Privatnotenbanken in table.

Figure 2-3. Overseas emigration

Germans leaving the German Empire, from German and Dutch ports, thousand per month



Source: Kaiserliches Statistisches Amt (1877-90). Seasonally adjusted.

The uneven industrialisation process across Germany was accompanied by significant overseas emigration. Overseas emigration has been attributed to both push factors, poor economic conditions, and pull factors, more perceived favourable conditions in the host countries, predominantly the United States.²⁹ In 1876-90,

²⁹ Wehler (1985) indicates that in 1879 the average annual income in the agricultural sector fell below that of 1872.

The overseas emigration took place in three large waves of 1845-54, 1867-73 and the largest in 1880-93. German emigration data from Besser (2007) including all ports and population data. On the emigration waves, see e.g. Inoki (1981).

total overseas emigration were 1.6 million persons (3.4 percent of the average population) of which almost 1.0 million in 1880-85 (Figure 2-3).³⁰ Overseas emigration differed between states with the highest share of emigration in the total population in Württemberg and the lowest share in Sachsen which coincided with among the lowest and the highest share in industrial employment (Table 2-3).³¹

Table 2-3. Employment and emigration

	Employment in agriculture			Employment in industry			Overseas emigration	
	Percent of total*			Percent of total*			Cumulative, 000†	Percent of population**
	1871‡	1882	1895	1871‡	1882	1895	1883-90	1883-90
Preußen	49.7	43.6	35.7	30.4	34.4	38.3	542	2.0
Bayern	51.5	50.9	45.5	29.8	28.3	30.8	94	1.8
Sachsen	28.1	20.0	14.9	51.8	56.3	57.5	25	0.8
Württemberg	40.8	48.2	44.9	39.8	34.4	34.8	49	2.5
Baden	49.1	49.1	42.3	33.8	31.6	34.7	30	2.0
Deutsches Reich	47.3	42.5	35.4	32.8	35.5	38.7	841	1.9

Source: Kaiserliches Statistisches Amt (1877-90); Kaiserliches Statistisches Amt (1880-95). † From April 1883. ‡ Excludes Elsaß-Lothringen and Mecklenburg-Strelitz. *Of German Empire population. **Population in 1882.

2.4. Statistical analysis

The paper analyses the relationship between monetary policy and the business cycle in Germany during 1883 and 1890. The period length is due to data availability for overseas emigration by federal state. The paper takes a similar approach as in Christiano et al. (1996) using a short-run SVAR model to test if the monetary policy stance of the Reichsbank was effective in influencing economic activity and if it can be concluded that it unduly constrained the economic recovery. The paper also tests if the Privatnotenbanken pursued regional monetary policy

³⁰ Overseas emigration increased significantly during the nineteenth century with total overseas emigration of Germans of 5.1 million in 1820-1899 (20.0 percent of the average annual population).

During 1880-93, emigration has been associated with strong emigration from the agricultural sector from the Ost-Elbische regions correlated with low population density, rapid population growth and large farm sizes. The land tenure system produced a bias towards emigration. The system distinguished between very large estates in the East (Gutsherrschaft), especially East of the river Elbe in Preußen, held by a land owning aristocracy and cultivated by rural workers and relatively small holdings (Grundherrschaft) in the West, South and most parts of central Germany owned by smallholders farmed mostly with the help of family members, the outcome of continuous land divisions due to inheritance provisions. The rural emigration comprised both internal migration to urban centres and overseas migration.

³¹ See e.g. Clark et al. (2004) on contemporary emigration out of Latin America to the U.S. Borjas (1994), analysing immigration to the U.S., similarly finds that emigration is negatively correlated with the mean earnings in the source country and positively correlated with the mean earnings in the host country net of emigration costs. On a summary on migratory behaviour including migration costs and timing see e.g. Cogneau et al. (2000).

differentiation against the background of regional shocks as approximated by overseas emigration by federal state.

The paper uses monthly balance sheet data of the Reichsbank and Privatnotenbanken from April 1883 through December 1890 from the monthly statistical series Central-Blatt für das Deutsche Reich by the Imperial Ministry of the Interior (Reichsamt des Inneren, 1876-1890).³² The paper covers only the largest German federal states where the main Reichsbank branches (Hauptstellen) are consolidated within the borders of the federal state to establish a geographical delineation of monetary policy: Baden, Bayern, Sachsen und Württemberg and the Privatnotenbanken of these states: Badische Bank, Bayerische Notenbank, Sächsische Bank and Württembergische Notenbank. The federal state of Preußen will be linked to the operations of the Reichsbank and not identified separately. While the Reichsbank maintained a wide local branch network, policy parameters were set at federal level and the Reichsbank recognised that it was difficult to adjust policy to regional needs.³³

The economic variables used in the statistical analysis include monthly tax and customs revenue, wholesale prices and overseas emigration by federal state. The tax and customs revenue data include German federal taxes on salt (Salzsteuer), beer (Brausteuern) and custom duties from the Central-Blatt für das Deutsche Reich (Reichsamt des Inneren, 1876-1890). The inclusion of the custom data is seen as appropriate as the estimation period had not seen marked increases in tariffs. The tax and customs revenue data are used as proxy for economic output amid the high correlation coefficient between national income and tax and customs revenues (Table 2-4).³⁴ No data was found on possible tax transfers between federal states or from the federal to the federal state level. Prima facie evidence suggests that fiscal policy was pro-cyclical amid a very high positive correlation between tax revenue and GDP (Table 2-4). The wholesale price index is constructed from 10 items at constant weights as published by Jacobs and Richter (1935) out of agricultural and industrial products for Germany monthly from January 1879 from

³² The Reichsbank and the Privatnotenbanken under the publication obligations of the bank act were required to publish main balance sheet items on a weekly basis in the Deutscher Reichsanzeiger und Preußischer Staatsanzeiger (see Figure 0-14 in Thesis Introduction).

³³ See footnote 5.

³⁴ See Thesis Introduction under Sources, Data, Tax and customs revenue page 54. See Ploeckl (2015) for the use of postal data for Germany in 1877-96 as proxy for economic activity based on annual volumes of incoming and outgoing mail.

Monatshefte zur Statistik des Deutschen Reichs (Kaiserliches Statistisches Amt, 1877-1890).³⁵

The emigration data, comprising overseas emigration from Germany by federal state via German and Dutch ports, are from January 1876 and for the German federal states from April 1883 from Monatshefte zur Statistik des Deutschen Reichs (Kaiserliches Statistisches Amt, 1877-1890).

The overseas emigration data by federal state are chosen as a proxy for regional shocks. In a monetary union, emigration or labour mobility is seen as a strong predictor of adjustment under fixed exchange rates.³⁶ In a normative framework of income maximisation and under the assumption of good information and labour substitutability and some rational motivation, emigration is expected to be positively correlated with the incidence of economic crisis and/or large income differentials between the source and the host country net of emigration costs. The relationship between economic conditions and emigration is not linear and may be subject to important lags also due to times needed to accumulate resources for the payment of passages that are themselves conditional on economic conditions.³⁷ It is acknowledged that emigration may arise amid a multitude of influences that may somewhat limit its usefulness as proxy for employment or economic shocks. High frequency data on inter-federal-state migration has not been found.

Table 2-4. Economic activity, tax revenue and emigration

Germany, correlation coefficient	GDP*	
	1879-90	1883-90
Tax revenue (salt and beer taxes) **	0.99	0.99
Tax revenue (custom duties, salt and beer taxes) **	0.96	0.98
Overseas emigration ***	-0.28	-0.58

Source: Kaiserliches Statistisches Amt (1877-90); Kaiserliches Statistisches Amt (1880-95).

Annual data. * Nettosozialprodukt at current prices 1890 = 100 Hoffman (1965)..

** Billion of marks. *** From German and Dutch ports.

The relationship between economic activity and emigration can be shown with the correlation between GDP and emigration. The negative correlation

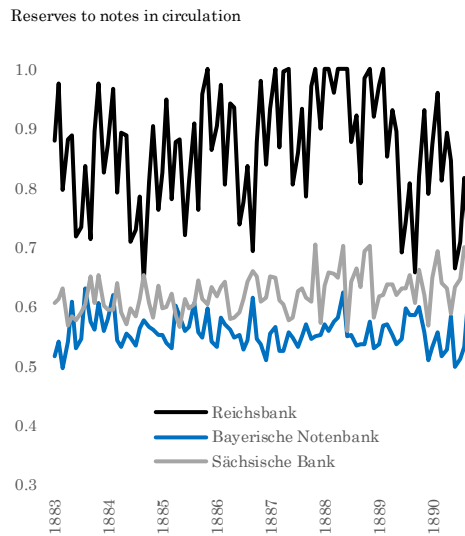
³⁵ See Thesis Introduction section Wholesale prices page 58.

³⁶ See e.g. Eichengreen (1991).

³⁷ Other factors like existing family and friends in the host country, gender, immigration policy of the host country, emigration barriers of the source country and skill levels are also important. See Inoki (1981) for a list of factors supporting emigration in nineteenth century Germany.

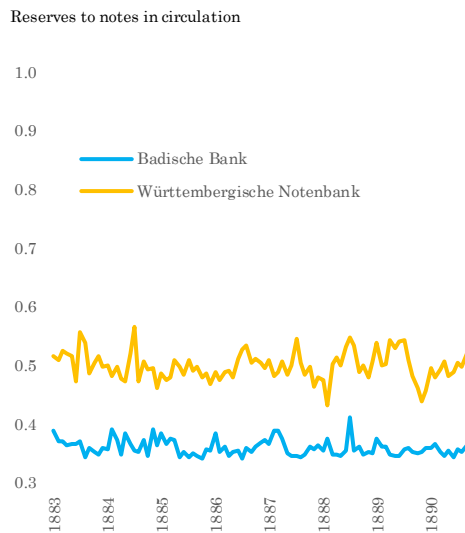
between annual GDP and overseas emigration affirms that emigration coincided with negative GDP growth in particular for the observation period 1883-90. The importance of taxes as a proxy for economic activity can be illustrated by the high positive correlation between tax revenue and GDP (Table 2-4).

Figure 2-4. Reserve ratios



Source: Reichsamt des Inneren (1876-90).

Figure 2-5. Reserve ratios (cont.)



Source: Reichsamt des Inneren (1876-90).

The monetary policy stance is approximated by the reserve ratio. The reserve ratio measures a change in the monetary policy stance by denoting a decline in the reserve ratio as a net monetary injection and an increase in the reserve ratio as a monetary contraction.³⁸ The significant fluctuations in the reserve ratio in particular by the Reichsbank is seen as evidence that it pursued both reserve and note issuance activities actively.³⁹ The Reichsbank's reserve ratio, based on annual averages, is broadly stable in 1876-82 with an average level of 0.82 and increases from 1883 reaching an average of 0.95 in 1888 with an average of 0.87 in 1883-90 (Figure 2-4, Figure 2-5).

The level of money market integration, as is well understood, in large part determines the effectiveness of monetary policy transmission. Weak money market integration in Germany implied that money market conditions differed locally. The policy rate pass-through depends on whether local or federal conditions dominate and to what extent interest rate equalisation materialises. Differences in interest rates under a single currency could not deviate unduly from the level of prevailing arbitrage-related transaction costs. At the same time, the lack of market integration is seen here to offer opportunities for conducting decentralised monetary policies and for monetary conditions to differ spatially.

The data are found to be stationary using an augmented Dickey-Fuller test. The identification of the number of lags to be included in the statistical estimations is performed using the Schwarz Bayesian information criterion (SBIC). The lag length based on the SBIC is 4 lags and a 4-lag structure is chosen.

The relationship between two time series and their lags can be explored on the basis of simple cross correlations. The cross correlation can be defined as a set of sample correlations between variables y_t and x_{t+p} where p is the number of lags for $p = 0, \pm 1, \pm 2, \pm 3, \pm 4$ where e.g. a negative correlation coefficient implies a negative correlation between x_{t+p} at time p and y_t at time t (current time).

³⁸ Koch at the Reichstag at the parliament during the bank act revision debate in February 1899 (Deutscher Reichstag, 1899): *“Meine Herren, gerade der wechselnde Verkehr mit seinen Bedarfsschwankungen erfordert die Elastizität der Umlaufmittel; eine Stagnation zeigt sich in einem gleichmäßigen Metallvorrath, Notenumlauf und Anlagebestand. Aber wenn das wirtschaftliche Leben in die Höhe geht, dann nehmen die Anlagen [Wechsel and Lombard] und die Noten zu, das Metall ab.“*

³⁹ The reserve ratio would not provide an adequate indication of the policy stance where the ratio is kept constant reflecting in the event of a reserve decline a contraction of monetary liabilities.

The cross correlations between the reserve ratio, as a proxy for the policy stance, and emigration shows important differences between the Reichsbank and the Privatnotenbanken and their respective correlation with emigration by federal state and changes over time. The cross correlations of the Reichsbank indicates that past increases in the reserve ratio, a policy tightening, are correlated with increases in emigration showing some lead-lag relationship. At the same time, future policy tightening appears to be correlated with a decline in emigration. The pattern is somewhat reversed for the Privatnotenbanken, the Bayerische Notenbank, Sächsische Bank and Württembergische Notenbank indicating that past policy stances are correlated with a decline in emigration. For future policy stances, the pattern is less clear. For Baden, the correlation for the Reichsbank and Badische Bank are similar and for Sachsen past correlation are stronger for the Sächsische Bank than for the Reichsbank but not future ones (Table 2-5).

Table 2-5. Policy stance and emigration

Cross correlations, correlation coefficient with lead and lags, 1883-90					
Log of emigration (current)	Germany	Baden	Bayern	Sachsen	Württemberg
Reserve ratios	Reichsbank	Reichsbank	Reichsbank	Reichsbank	Reichsbank
Lags					
-4	0.0288	0.1293	0.0842	0.0458	0.1050
-3	0.2404	0.4103	0.3418	0.2533	0.3436
-2	0.2672	0.3750	0.3783	0.2551	0.3361
-1	0.1669	0.2691	0.3571	0.1399	0.3513
0	0.0727	0.1431	0.2104	0.0192	0.2068
1	-0.9600	-0.1897	-0.0992	-0.2196	-0.1460
2	-0.1444	-0.2305	-0.1186	-0.3466	-0.1723
3	-0.1000	-0.1864	-0.1376	-0.3360	-0.2193
4	-0.1465	-0.2877	-0.2639	-0.3918	-0.3667
Reserve ratios		Badische Bank	Bayerische Notenbank	Sächsische Bank	Württembergische Notenbank
Lags					
-4		0.1008	-0.0143	0.1917	-0.1433
-3		0.1931	0.0574	0.0984	-0.3440
-2		0.2014	-0.0734	-0.1451	-0.3150
-1		0.3331	-0.1945	-0.3307	-0.0926
0		0.3430	-0.2606	-0.3599	0.0646
1		0.2195	-0.1374	-0.2079	0.2832
2		-0.0300	0.1068	-0.2164	0.3568
3		-0.1948	0.2001	-0.2545	0.2416
4		-0.2591	0.0655	-0.2341	0.2621

Source: Kaiserliches Statistisches Amt (1877-90); Reichsamt des Inneren (1876-90); Monthly observations April 1883-December 1890. STATA 14.1.

The instability of the correlation coefficients may indicate changes in the underlying relations or changes in policy behaviour. However, no indication about the statistical significance is provided and the bivariate relations do not present a complete characterisation of the joint probability of policy stance and emigration. Also, no causal inferences from the results can be established.

The short-run SVAR approach allows to make explicit identifying assumptions about the short-term causal contemporaneous relationships between the endogenous variables. The SVAR represents a linear combination of a vector of endogenous variables, the variables of interest and their respective lags in addition to coefficient matrices and a random error vector. The usual difficulty of distinguishing between policy action and movements in other variables due to the policy action is noted.⁴⁰ Limitations of SVAR analyses are acknowledged in particular with regard to the importance of and sensitivity to the identifying assumptions and some counterintuitive results like e.g. the price puzzle.⁴¹ As is normal in VAR analyses, as even a small VAR contains a lot of parameters and it is nearly impossible to interpret the relationships in a VAR by inspecting the estimated parameters, the impulse response functions (IRFs) are used as summary information that represent the responses of the variables with respect to innovations in the errors of the system as one-step to multiple steps ahead forecast errors.⁴² In addition, the variance decomposition is provided to show the attribution of the error variances.

The SVAR model is based on the identification of the errors of the system that are interpreted as exogenous shocks. The structural shocks of the model are identified by imposing restrictions to allow making inferences based on the dynamic impact of mutually uncorrelated (orthogonal) shocks. The restrictions are taken

⁴⁰ The paper acknowledges criticism of the use of SVARs for the analysis of monetary policy transmission. SVARs have had great appeal for studying monetary policy transmission amid the possibility to identify the effect on policy without a complete structural model of the economy. It is recognised that the difficulty rests in the ability to correctly distinguish endogenous from exogenous factors, see e.g. Rudebusch (1998) for a critique of the use of vector autoregression models to measure the effect of monetary policy. In this paper, partial remedy is provided by the fact that the variables other than the policy variable (discount rate or reserve ratio) do not include other asset prices, the Bank of England bank rate can safely be considered exogenous, and that thereby the assumption that monetary policy responds to contemporaneous nonmonetary shocks is plausible, see e.g. Stock and Watson (2017) also on other remedies e.g. use of external information.

⁴¹ For an overview of the limitations of SVARs, see e.g. van Aarle et al. (2003). The price puzzle is the tendency refers to the results in SVAR of a temporary increase in prices after a contractionary monetary policy shocks, see e.g. (Christiano et al., 1996).

⁴² See e.g. Becketti (2013).

from Christiano et al. (1996) to impose the ordering of the variables in the model and rest on the assumption that policy shocks have no contemporaneous impact on the economic variables.

The short-run SVAR model used is specified on the basis of a structure matrix of the form AB.⁴³ The VAR specifies K variables as linear functions of p of their own lags and p lags of the other $K - 1$ variables. A p -order VAR model $VAR(p)$ can be written as:

$$(2-1) \mathbf{y}_t = \mathbf{v} + \Gamma_1 \mathbf{y}_{t-1} + \dots + \Gamma_p \mathbf{y}_{t-p} + \boldsymbol{\epsilon}_t$$

where

$\mathbf{y}_t = (y_{1t}, \dots, y_{Kt})'$ is a $K \times 1$ random vector

Γ_1 through Γ_p are $K \times K$ matrices of parameters

$\boldsymbol{\epsilon}_t$ is assumed to be the error term, that is,

$$E(\boldsymbol{\epsilon}_t) = 0$$

$$E(\boldsymbol{\epsilon}_t \boldsymbol{\epsilon}_t') = \Sigma$$

Equation (2-1) can be rewritten after absorbing the constant \mathbf{v} into the \mathbf{y}_t vector and using the lag operator L and where I is the identify matrix:

$$(2-2) \mathbf{y}_t = \Gamma_1 L \mathbf{y}_t + \dots + \Gamma_p L^p \mathbf{y}_t + \boldsymbol{\epsilon}_t$$

$$(2-3) \mathbf{y}_t = (I - \Gamma_1 L - \Gamma_p L^p)^{-1} \boldsymbol{\epsilon}_t$$

It can be shown that

$$(2-4) \mathbf{y}_t = I \boldsymbol{\epsilon}_t + \Phi_1 \boldsymbol{\epsilon}_{t-1} + \Phi_2 \boldsymbol{\epsilon}_{t-2} \dots = \sum_{i=0}^{\infty} \Phi_i \boldsymbol{\epsilon}_{t-i}$$

where $\Phi_0 = I$ is the moving average representation and Φ are the IRFs.

The SVAR approach orthogonalises the error terms, i.e. finds new linear combinations of the error terms which are independent or orthogonal to each other. The SVAR is transformed to a new model such that the new errors e_t can be expressed as a function of the old errors $\boldsymbol{\epsilon}_t$ where $A \boldsymbol{\epsilon}_t = B e_t$ for some invertible matrices A and B and where A and B are chosen such that A and B are diagonal, then $\boldsymbol{\epsilon}_t = A^{-1} B e_t$ and $e_t = B^{-1} A \boldsymbol{\epsilon}_t$.

⁴³ See e.g. Amisano and Giannini (1997).

The identification is provided by placing restrictions on A and B where A is a lower triangular matrix with one on the diagonal and B a diagonal matrix and where A and B are nonsingular. The P matrix for the short run model is $P_{sr} = A^{-1}B$ obtained by imposing restrictions on A and B . Since Σ is symmetric, it has only $\{K(K+1)\}/2$ free parameters and so only $\{K(K+1)\}/2$ parameters may be estimated in an exactly identified P_{sr} . With $2K^2$ total parameters in A and B , the order condition for identification requires at least $2K^2 - K(K+1)/2$ restrictions be placed on those parameters.

The P matrix is constructed as the Cholesky decomposition of the error covariance matrix of the original VAR model with optional additional restrictions placed on the P matrix in terms of short-run restrictions on the contemporaneous covariances between shocks.⁴⁴ These restrictions are testable.

In the estimation of the model A and B are defined as 4×4 matrices where a and b are freely estimated coefficients. The form of the A matrix imposes the recursive structure which orthogonalises the errors, while the diagonal B serves to scale the structural errors.

$$A = \begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 \\ a_{41} & a_{42} & a_{43} & 1 \end{bmatrix}$$

and

$$B = \begin{bmatrix} b_{11} & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 \\ 0 & 0 & b_{33} & 0 \\ 0 & 0 & 0 & b_{44} \end{bmatrix}$$

The estimation is performed with the lower triangular matrix A set such that all coefficients in the upper half are set to zero and all remaining coefficients in the lower half are freely estimated.

⁴⁴ The effect of the Cholesky decomposition can be replicated by defining A and B appropriately.

The SVAR model on the basis of equation (2-1) is derived following equations (2-1) through (2-4) to rewrite the new model in its moving average representation as:

$$(2-5) \mathbf{y}_t = \sum_{j=0}^{\infty} \Theta_j \mathbf{e}_{t-j}$$

where $\Theta = \Phi_i P$ are the structural IRFs. The transformations of the errors allow to analyse the dynamics of the system in terms of a change to the structural errors e_t .

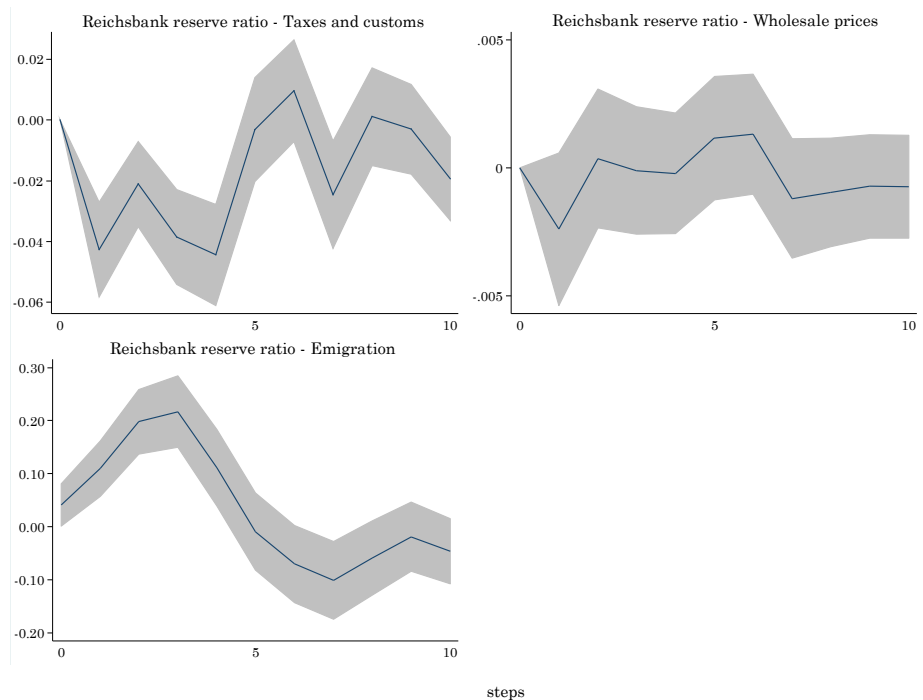
The estimation comprises two models each with 4 lags and for the period April 1883 through December 1890. The estimations are based on the assumption that the reduced-form responses of economic variables to innovations in the reserve ratio measure the effect of monetary policy. The first model measures the monetary transmission mechanism at federal level and includes in the following order: Log of tax and custom revenue, log of wholesale price index, Reichsbank reserve ratio and log of overseas emigration at federal level. A commodity price index has been omitted amid absence of the well-known price puzzle as part of the model results. The second model measures the monetary transmission at federal state level with the following order: Log of tax and customs revenue, Reichsbank reserve ratio, the reserve ratio of the home Privatnotenbank of a given federal state, and log of home emigration of a given federal state. The log of the wholesale price index has been dropped amid the estimation results of the first model. In general, the main results are robust to different orderings of the variables. The estimations of the first model were also performed with the log of bills of exchange holdings instead of the reserve ratios and the results were similar. For the second model estimations were also performed with the log of bills of exchange holdings, where an increase in bills of exchange holdings can be associated with a credit extension and hence a policy easing and reported separately. The stability conditions of the SVARs are tested based on the modulus of each eigenvalue of the matrix A being strictly less than unity and hence found to be stable.⁴⁵

The statistical results need to be interpreted with caution in particular amid the assumed lags with which emigration is likely to react to economic activity. The

⁴⁵ See Lütkepohl (2005).

SVAR shows the incidence of a shock on average over the observation period. The IRFs should therefore be seen largely as indications of the significance of the incidence of a shock rather than the exact time path and propagation of the shock.

Figure 2-6. Monetary policy transmission

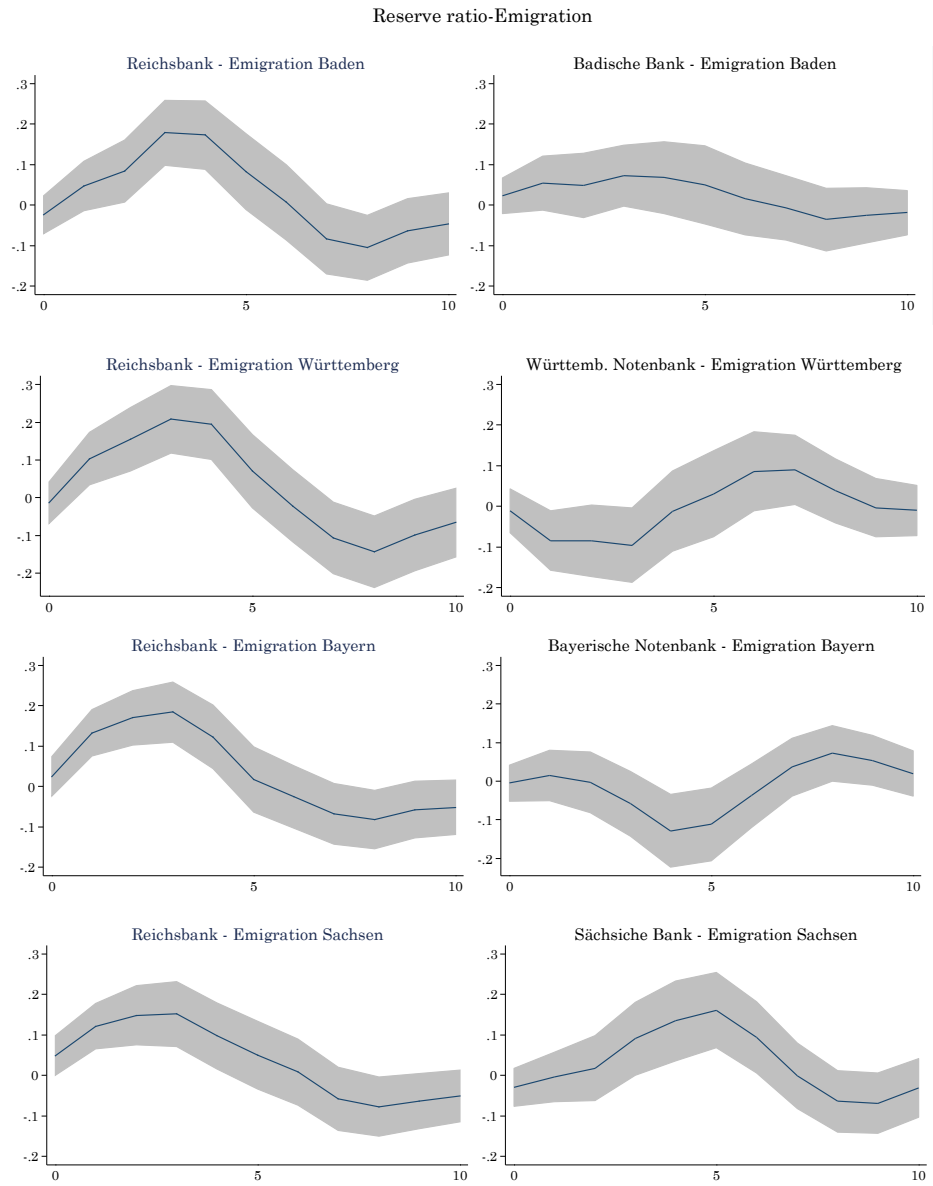


STATA 14.1 output. Shaded area 95 percent confidence interval, 4 lags, 10 steps. SIRF, impulse variable - response variable. April 1883-December 1890.

The results show that the effect of a monetary policy tightening is negative on economic activity. The impact of an unexpected one-standard-deviation shock to the error term of the reserve ratio of the Reichsbank is shown to have a negative effect on output as approximated by tax and customs revenue during 2 to 4 months ahead. The effect of monetary policy shocks to wholesale prices is neutral. Emigration is shown to react significantly to monetary policy; a monetary policy tightening causes an increase in emigration (Figure 2-6). The results are consistent with estimated effects of contemporary monetary policy.⁴⁶ The lack of an impact on prices is surprising but may be due to the fact that price contractions during the period were also an international phenomenon.

⁴⁶ See e.g. Bernanke and Blinder (1992), Christiano et al. (1996).

Figure 2-7. Regional monetary policy differentiation (reserve ratio)



Steps

STATA 14.1 output. Shaded area 95 percent confidence interval, 4 lags, 10 steps. SIRF, impulse variable (reserve ratio) - response variable (emigration). April 1883-December 1890. Monetary policy stance is based on reserve ratio.

Table 2-6. Variance decomposition (reserve ratio)

Percent of forecast-error variance, 1883-90

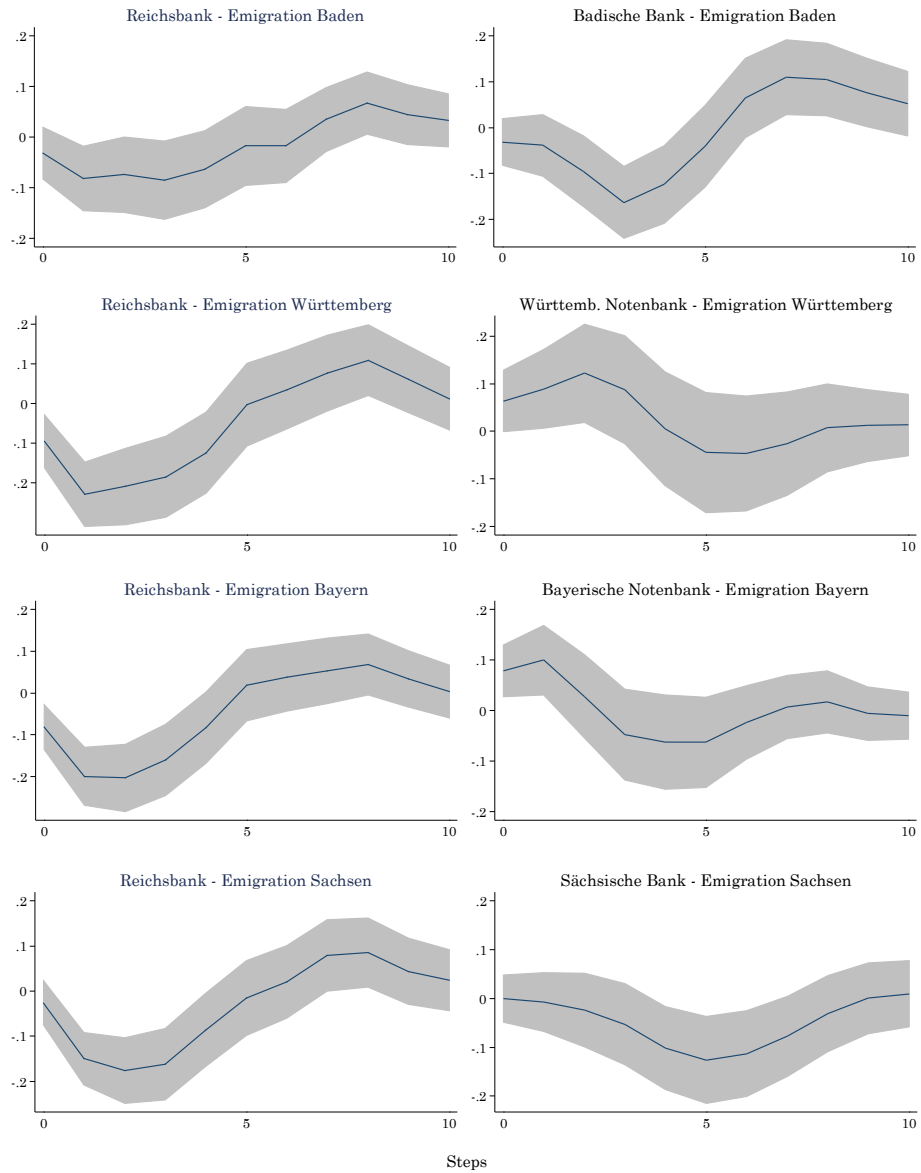
	Reichsbank - Emigration Baden	Badische Bank - Emigration Baden	Reichsbank - Emigration Württemberg	Württemb. Notenbank - Emigration Württemberg	Reichsbank - Emigration Bayern	Bayerische Notenbank - Emigration Bayern	Reichsbank - Emigration Sachsen	Sächsische Bank - Emigration Sachsen
Steps								
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0086	0.0080	0.0020	0.0017	0.0090	0.0003	0.0363	0.0127
2	0.0215	0.0268	0.0670	0.0444	0.1279	0.0017	0.1319	0.0066
3	0.0586	0.0348	0.1578	0.0651	0.2563	0.0014	0.2154	0.0064
4	0.1927	0.0513	0.2783	0.0839	0.3533	0.0160	0.2807	0.0423
5	0.2505	0.0549	0.3399	0.0695	0.3355	0.0705	0.2818	0.1081
6	0.2442	0.0565	0.3297	0.0671	0.3112	0.1053	0.2590	0.1862
7	0.2433	0.0570	0.3226	0.0849	0.3104	0.1088	0.2492	0.2088
8	0.2536	0.0548	0.3301	0.0995	0.3092	0.1075	0.2494	0.2000
9	0.2704	0.0553	0.3536	0.0957	0.3095	0.1158	0.2555	0.2027
10	0.2769	0.0561	0.3665	0.0933	0.3125	0.1216	0.2602	0.2109

STATA 14.1 output. Based on model 2. 95 percent confidence interval. Percent of forecast-error variance attributed to impulse variable. 4 lags, 10 steps. FEVD, impulse variable (reserve ratio) - response variable (emigration). April 1883-December 1890. Monetary policy stance is based on reserve ratio.

The results for the second model on the effects of a monetary policy tightening on output at the regional level are mixed. There are significant differences in the effect of the Reichsbank and the Privatnotenbanken as shown by the IRFs (Figure 2-8). The results for the Reichsbank affirm a significant impact on federal state economic activity as approximated by shocks to overseas emigration at state level although the effect is not homogenous across states. The different Privatnotenbanken mostly exhibit no significant impact and impacts were delayed relative to the Reichsbank. The Badische Bank shows an impact somewhat consistent with the Reichsbank though it is not significant. The Sächsische Bank exerts a significant impact similar to the Reichsbank albeit more delayed. The other Privatnotenbanken on the basis of the reserve ratio do not exhibit a significant impact on output. The variance decomposition affirms the result showing that an increase in the reserve ratios by the Reichsbank explains 0.26 to 0.37 of the variance of state emigration while the Privatnotenbanken explain 0.06 to 0.21 of the variation of state emigration after 10 steps ahead. The Sächsische Bank affirms the correlation results (Table 2-5) and explains a significant though delayed portion of the variance of state emigration (Table 2-7).

Figure 2-8. Regional monetary policy differentiation (bills of exchange)

Bills of exchange-Emigration



STATA 14.1 output. Shaded area 95 percent confidence interval, 4 lags, 10 steps. SIRF, impulse variable (log of bills of exchange holdings) - response variable (log of emigration). April 1883-December 1890. Monetary policy stance is based on bills of exchange holdings .

Table 2-7. Variance decomposition (bills of exchange)

Percent of forecast-error variance, 1883-90

	Reichsbank - Emigration Baden	Badische Bank - Emigration Baden	Reichsbank - Emigration Württemberg	Württemb. Notenbank - Emigration Württemberg	Reichsbank - Emigration Bayern	Bayerische Notenbank - Emigration Bayern	Reichsbank - Emigration Sachsen	Sächsische Bank - Emigration Sachsen
Steps								
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0130	0.0126	0.0820	0.0367	0.0835	0.0788	0.0118	0.0000
2	0.0543	0.0175	0.2730	0.0536	0.2670	0.0926	0.1979	0.0004
3	0.0767	0.0670	0.3490	0.0896	0.3885	0.0749	0.3239	0.0036
4	0.0953	0.1777	0.3926	0.0977	0.4315	0.0729	0.3900	0.0165
5	0.0948	0.2070	0.3897	0.0874	0.3999	0.0766	0.3791	0.0598
6	0.0908	0.2022	0.3669	0.0870	0.3784	0.0846	0.3514	0.1186
7	0.0900	0.2129	0.3639	0.0907	0.3755	0.0847	0.3309	0.1589
8	0.0875	0.2377	0.3672	0.0897	0.3605	0.0796	0.3281	0.1681
9	0.0957	0.2567	0.3777	0.0860	0.3536	0.0761	0.3342	0.1621
10	0.0990	0.2670	0.3760	0.0841	0.3479	0.0743	0.3301	0.1571

STATA 14.1 output. Based on model 2. 95 percent confidence interval. Percent of forecast-error variance attributed to impulse variable. 4 lags, 10 steps. FEVD, impulse variable (log of holdings of bills of exchange) - response variable (log of emigration). April 1883-December 1890. Monetary policy stance is based on bills of exchange holdings.

The results for the second model using logs of bills of exchange to estimate an effect of a monetary policy tightening on output at the regional level are equally mixed. Bills of exchange holdings highlight significant differences in the effect of the Reichsbank and the Privatnotenbanken (Figure 2-8). The effect of the monetary policy stance of the Reichsbank at regional level is mostly consistent with its effect at federal level except in Baden. The different Privatnotenbanken have different effects. In Baden, a tightening of the Badische Bank can be associated with an increase in emigration. In Württemberg and Bayern, the effectiveness of the Württembergische Notenbank and Bayerische Notenbank, respectively, is insignificant. In Sachsen, a tightening of the Sächsische Bank has a significant negative impact though it is smaller than a tightening by the Reichsbank. The variance decomposition supports the result showing that an increase in bills of exchange by the Reichsbank explains 0.10 to 0.38 of the variance of state emigration while the Privatnotenbanken explain 0.07 to 0.27 of the variation of state emigration after 10 steps ahead. The impact of the Reichsbank occurs prompter after 4 steps ahead and is maintained broadly stable thereafter. The Badische Bank can explain a significantly greater portion of the error variance of state emigration in Baden than the Reichsbank (Table 2-7).

2.5. Conclusions

The paper shows that for the Reichsbank a tightening of monetary policy in 1883-90 is associated unambiguously with an output decline as proxied by tax and customs revenue and overseas emigration. For the Privatnotenbanken, monetary policy tightening is associated with significant to insignificant effects on state output. The paper's statistical results support the notion that monetary policy differentiation in a monetary union can be effective in addressing adverse regional shocks.

The results do not support contentions that Reichsbank policy was ineffective and that external conditions dominated monetary conditions in Germany (Borchardt, 1976; Seeger, 1968; Wühle, 2011). They may offer incipient evidence for a reassessment of the role of monetary policy in Germany during the nineteenth century (Hentschel, 1989).

The results offer for the first time statistical support to the notion that the Reichsbank contributed to the duration of the Gründerkrise (Tilly, 2003). The combination of a sustained increase in the reserve ratio of the Reichsbank in 1883-90 and the negative impact of an increase in the reserve ratio on output suggests that the Reichsbank's policy induced a decline in output. This is consistent with affirmations of a negative policy effect of the Reichsbank (Morgenstern, 1959; Tilly, 2003; Ziegler, 2005). The findings are not supportive of the notion that the Reichsbank had a dampening impact on the business cycle (McGouldrick, 1984). They assert that a study of the Gründerkrise is incomplete without reference to the impact of monetary policy.

The results are consistent with the notion that Privatnotenbanken assumed in some federal states an important role in influencing local economic conditions. The findings are congruent with persistent local money market rate differences amid imperfect money market integration. However, at the same time the impact of the Reichsbank on state output, except in Baden when estimating bills of exchange holdings, does indicate that the Reichsbank was effective in influencing economic conditions overall. While its effect was not homogenous, it reveals that monetary market integration may have been more advanced than indicated by

actual discount rates of the Privatnotenbanken. The differential effect of the Privatnotenbanken with the significant impact of the Badische Bank, the somewhat lesser impact of the Sächsische Bank and the insignificant impact of the Bayerische Notenbank and Württembergische Notenbank indicate that the influence of the Privatnotenbanken was mixed. However, the Badische Bank and Sächsische Bank demonstrate that regional monetary policy differentiation was possible. The differences in the estimation results when using reserve ratios and bills of exchange affirm that different policy channels operated in parallel.

Nineteenth century Germany seems to offer several important lessons for monetary unions under regional economic diversity. The European Central Bank (ECB) is de facto the successor institution of the Bundesbank and as such of the Reichsbank. Yet, the ECB took few if any lessons from Germany's approach.

The relevance of the Reichsbank for the ECB remains ambiguous. Holtfrerich (1989) dismisses relevance of the Reichsbank for the ECB on the basis that nineteenth century central banks fulfilled different functions than contemporary institutions. Eichengreen (2008) finds that European monetary union has no direct historic precedent and that parallels with past monetary unions may be misleading. James (1997) contrasts that the Reichsbank facilitated internalising policy concerns of the German peripheral states similar to the ECB.⁴⁷ Bordo and Jonung (2003) equally stress the importance of the political economy in a monetary union and role of centre-periphery relationships among constituent members and see parallels between nineteenth century Germany and the E.U.

The ECB emphasises that "one size fits all."⁴⁸ The E.U.'s decision for a single central bank rested in large part on the assumption that a single central bank is required for a single currency. The Delors Report underscores the need for a single monetary policy institution to overcome coordination failures.⁴⁹ Krugman (1990) stresses that undue incentives of currency over-issuance due to seigniorage gains necessitates a single central bank under a common currency. Casella and Feinstein

⁴⁷ Welfens (1996, p. 264) wrote: "A common EC central bank that would replace the current overlordship of the Deutsche Bank in the continental EC countries is desired [...]."

⁴⁸ See e.g. Bini Smaghi (2011).

⁴⁹ See Committee for the Study of Economic and Monetary Union (1989): "A new monetary institution would be needed because a single monetary policy cannot result from independent decisions and actions by different central banks. Moreover, day-to-day monetary operations cannot respond quickly to changing market conditions unless they are decided centrally."

(1989) similarly show that the adoption of a single central bank allows to contain a risk that free-riding of the commitment to maintain the exchange rate regime may undermine the stability of the system and impair welfare. A single central bank was also considered to bring forward monetary unification and strengthen commitment to European monetary union.⁵⁰ In the context of the optimum currency area theory, Mundell (1961, p. 658) states: “A *single currency implies a single central bank.*”⁵¹ While the parallel currency and “hard ECU” approaches for the E.U. implied a supra-national money-issuing authority together with the existing national central banks, arguments in support of a decentralised central banking system under a single currency have been largely disregarded.⁵²

The establishment of the ECB ignored possible lessons learnt from nineteenth century Germany. While the ECB may indeed exhibit unique features that do not allow historical comparisons, the fundamental concern about monetary policy homogeneity under spatial heterogeneity still holds. The adoption of a single monetary policy may unduly weigh the disadvantages of free-riding against the advantages of regional monetary policy differentiation. In a second-best world, the adoption of decentralised features in central banking for the Euro Area may well have posed less net economic costs than a single monetary policy though it is recognised that some flexibility due to differential collateral policies across the Euro Area and small deviations in the proportion of asset purchases from the capital key have been practised. James (2013) and Brunnermeier (2010) highlight the need to give consideration to introducing more flexibility in the conduct of monetary policy in the Euro Area.

⁵⁰ de Cecco and Giovannini (1989) emphasise that the European Monetary System (EMS) was viewed as a transitory regime but failed to boost monetary integration indicating that the functioning of the EMS only resembles that of any other fixed exchange rate regime and as the European Currency Unit (ECU) has not functioned as an effective benchmark for monetary policy.

⁵¹ The theory of optimum currency areas offers some though limited practical guidance for nineteenth century Germany and contemporary Europe. The theory does not evoke overcoming the problem of optimal inclusion criteria for currency areas through central bank decentralisation. Surprisingly, it makes no reference to the formation of the German central bank system nor to the Federal Reserve Districts in 1914 with the Federal Reserve Act of 1913. The U.S. took the view that monetary policy differentiation is essential in large heterogenous economic spaces (National Monetary Commission, 1913). This holds for the U.S. Federal Reserve System prior to the 1935 Banking Act.

⁵² Propositions to allow decentralisation for exchange market interventions were considered, see Gros and Thygesen (1992). See Gros and Thygesen (1992) on the parallel currency and “hard ECU” proposals that favour competition as alternatives to the institutionalist approach in the Delors report. The competition approach found limited support. They explain that aims by some central banks to preserve some decentralised features were rejected for the final statute of the European System of Central Banks as emphasis was on homogenous policy and “indivisibility of monetary authority.”

The relevant contemporary parallel to a common currency and different central banks would be countries that use the currency of a third country as legal tender, e.g. Ecuador, Panama, or dollarisation.

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3. The Reichsbank, commitment credibility and the rules of the game, 1876-1890

3.1. Introduction

The paper aims to offer more realistic monetary policy reaction functions of Germany's central banking system in 1876-90 under the gold standard using new detailed monthly banking data and advanced statistical time series estimation techniques. The German mixed system exhibits unusual features with the German Imperial Bank (Reichsbank) at federal level and the private banks of issue (Privatnotenbanken) at federal state level under the common regulatory framework of the 1875 bank act. The analysis incorporates for the first time economic conditions and the Privatnotenbanken and offers statistical evidence how the Reichsbank adjusted policy shifting from external to domestic objectives.

The study of the monetary policy formulation of the Reichsbank has been largely conducted on the basis of the rules of the game under the classical gold standard (Bloomfield, 1959; Giovannini, 1986; McGouldrick, 1984; Morys, 2013; Sommariva & Tullio, 1986; Tullio & Wolters, 2003). It is generally based on policy and market-based indicators and focuses narrowly on gold reserve movements and gold point violations. This paper attempts a different approach by looking at a broader set of variables based on the Reichsbank's narrative accounts and akin to a contemporary analysis of the monetary policy reaction function. The findings are more in line with the gold standard as a commitment rule with reputational forces than the notion of automaticity under the rules of the game. Nineteenth century Germany may offer valuable early lessons for commitment credibility in monetary policy under fixed exchange rates.

The operations of the Reichsbank have been reviewed comprehensively (Hellferich, 1898; Pohl, 1982; National Monetary Commission, 1910b; Seeger, 1968). The policy of the Reichsbank was studied with regard to the interplay between discount rate, market rates and unreserved bank note issuance and at times conflictive objectives between ensuring adequate reserve levels and profitability (National Monetary Commission, 1910b; Seeger, 1968; Wühle, 2011). The monetary

policy study forms part of fundamental inquiries into the classical gold standard (Bordo, 1981; Bordo & Kydland, 1995; Eichengreen, 1995). It is also tied to the rules versus discretion debate in monetary policy (Clarida et al., 2000; Dwyer, 1993; Fischer, 1988; Simons, 1936; Taylor, 1999) and commitment, reputation and credibility in monetary policy (Barro & Gordon, 1983; Barro, 1986; Kydland & Prescott, 1977; Obstfeld & Taylor, 2002; Rogoff, 1987).

The contribution of the paper is to offer fresh evidence about the Reichsbank's monetary policy formulation using new data and a contemporary approach to estimate the policy reaction function including economic indicators and the Privatnotenbanken and be guided by the Reichsbank's narrative accounts. The paper tests the hypothesis if economic conditions, gold reserves, the Bank of England, market rates and the Privatnotenbanken played a role in the formulation of the Reichsbank's monetary policy and whether there was constancy in policy formulation. The paper offers a simple test about exchange rate credibility based on uncovered interest rate parity similar to Svensson (1990) and Mitchener and Weidenmeier (2015). It shows that the Reichsbank built up credibility through a tightening grip on the money market.

The results are linked for the first time to reputation and credibility in monetary policy to demonstrate that monetary policy formulation was significantly more nuanced and varied than conventional discussions about the rules of the game suggest. Following Barro and Gordon (1983) on the notion of reputational forces as a substitute for a formal monetary policy rule and consistent with the need for credibility enhancement mechanism in policy à la Barro (1986), the findings are consistent with a Reichsbank that “masqueraded” to be perceived as a “strict convertibility type” to gain room for policy discretion.

The study uses newly located reports of the Reichsbank Advisory Board (Reichsbankkuratorium) to substantiate policy concerns and intent. The analysis employs a new periodisation and finds important changes in the policy reaction function between 1879-83 and 1883-88. In the latter period, the Reichsbank shifted increasingly emphasis towards national objectives while strengthening adjustment

to adverse money market shocks.¹ This also coincided with a weakening of the impact of the Bank of England bank rate for the Reichsbank's policy supportive of the view that the Bank of England did not play an overly dominant role under the classical gold standard (Morys, 2013). The results show contrary to Bordo and MacDonald (1997) that economic activity had a significant effect on policy formulation in the subperiod 1879-83. The analysis also affirms that central bank cooperation was indecisive (Flandreau, 1997) in contrast to the widely held notion that central bank cooperation was essential for the stability of the gold standard (Eichengreen, 1995). The findings of the Reichsbank's narrative accounts also support the notion that the Reichsbank was well aware of its policy impact in contrast to the assumption that the notion of influencing cyclical conditions was absent with nineteenth century central banks (Bloomfield, 1959; Eichengreen, 1995). The paper also establishes that the Privatnotenbanken in contrast to their pledges did not back the Reichsbank in the event of gold outflows.

The paper uses new monthly data to test the policy reaction function of the Reichsbank and the Privatnotenbanken based on a structural vector autoregression model. The statistical analysis follows a contemporary framework to test monetary policy reaction functions by Clarida and Gertler (1996).²

The paper focuses on the period 1876-90 covering initiation of the operations of the Reichsbank in January 1876 and the end of the scheduled life of the original bank act in December 1890.

The second section provides a literature review of the fundamental principles of commitment under uncertainty in monetary policy and the rules of the game under the classical gold standard with a focus on the Reichsbank. The third reviews narrative accounts of the main elements of the monetary policy formulation of the Reichsbank and Privatnotenbanken. The fourth section outlines the data and statistical analysis. The last section offers concluding remarks and links the findings to a reputations framework, discusses the statistical results and refers to implications for the formulation of monetary policy under fixed exchange rates.

¹ At the same time as the Reichsbank accumulated a larger gold reserve, it may have become less susceptible to external disturbances similar to the Banque de France (Bordo & MacDonald, 1997).

² Bordo and MacDonald (1997) use a comprehensive structural vector autoregression model approach including non-financial variables but limit reporting for Germany to financial variables for responses to U.K.-related shocks.

3.2. Rules of the game

The historiography of the Reichsbank's monetary policy formulation focuses mostly narrowly on convertibility, the importance of gold reserve movements and gold point violations. This is based in large part on the assumption that the Reichsbank pursued a very narrow policy objective defined by the nature of the gold standard, the lack of data and that the notion of influencing cyclical conditions was absent with nineteenth century central banks (Bloomfield, 1959; Eichengreen, 1995; Sommariva & Tullio, 1986). Wühle (2011) summarises that the Reichsbank's objective is to "*ensure convertibility and not to promote economic growth.*" Tullio and Wolters (2003) similarly argue that there was limited concern for business cycle conditions.³

The monetary policy framework of the Reichsbank and Privatnotenbanken was defined by the well-known provisions of the 1875 bank act and central bank operations.⁴ The monetary policy stance was the outcome of the interplay between bank note convertibility and credit accommodation and its possible seasonal demands, money market conditions, public policy mandate and profitability objectives.⁵ The roles of deposits and bills of exchange drawn on foreign countries were small.⁶

The rules of the game, as is well known, advocate that central banks observing a decline in gold reserves respond with a contraction in domestic credit normally by adjustments in the central bank's discount rate (Bloomfield, 1959; Committee on Currency and Foreign Exchanges after the War, 1918; Sommariva &

³ Tullio and Wolters (2003): "*Reaction functions of Central Banks estimated for the post World-War II period usually include inflation, unemployment or deviations of real GDP from trend or from potential GDP and sometimes the changes in international reserves (to measure the degree of sterilization). However, the classical gold standard was a different period characterized by the absence of national accounts, by the fact that unemployment was not a major issue and by a predominance of concerns about financial stability over concerns about the business cycle. As a result this difference in specification of the reaction functions of Central Banks between then and now seems perfectly justified by the different historical background of the two periods.*"

⁴ See Thesis Introduction under 1875 bank act page 36 for the organisation and operations of the Reichsbank and Privatnotenbanken

⁵ See Bopp (1953, p. 6) quoting von Lumm: "*In the general interest of stimulating national economic activity, the central bank must constantly take into consideration maintenance of as low and stable a discount rate as conditions permit.*"

⁶ The amount of bills drawn on foreign countries represented in 1876-90 between 0.4 and 2.9 percent of total bills drawn; the amount of deposits represented in 1879-90 0.1 percent of bank notes in circulation (Reichsbank, 1900).

Tullio, 1986).⁷ The rules imply a notion of automaticity of policy measures to facilitate orderly balance of payments adjustments through influencing net gold flows (Bloomfield, 1959; Bordo, 1984).⁸ An increase in the discount rate would reduce lending and induce an increase in the market rate. The rise in interest rates would facilitate balance of payment adjustment by attracting capital from abroad and reduce domestic absorption. The importance of the market discount rate for the conduct of the discount rate policy would depend on the relative importance attributed to non-official capital flows.

The importance attributed to the rules of the game for the policy conduct of the Reichsbank varies. Giovannini (1986), McGouldrick (1984), Morys (2013) find that the Reichsbank adhered mostly to the rules of the game.⁹ Seeger (1968) and Sommariva and Tullio (1986) point out that the rules represent an undue oversimplification of the policy conduct. Flandreau and Jobst (2005) stress that the rules “never existed.” Bordo and MacDonald (1997) find that the Reichsbank was able to preserve some policy autonomy. Contamin and Denise (1999) similarly highlight that the Reichsbank was able to pursue other objectives apart from preserving convertibility and Seeger (1968) highlights that the Reichsbank was inclined to accommodate credit demand of the economy. Deviations from the rules of the game were attested by other studies of, for example, the Bank of England (Committee on Currency and Foreign Exchanges after the War, 1918; Dutton, 1984; Jeanne, 1995; Pippenger, 1984), the Bank of France (Bazot et al., 2016; Contamin

⁷ The rules of the game can be interpreted to different degrees of narrowness (Sommariva & Tullio, 1986): i) under the most narrow definition, the central bank adjusts its discount rate to changes in the liquidity ratio, the ratio between reserves and bank notes and other reservable liabilities; ii) under a broader definition, the central bank changes its domestic assets in the same direction as changes in its foreign assets to help the balance of payments adjustment process; and iii) under the broadest definition, the central bank changes its discount rate to adjust its balance sheet anti-cyclically.

The definitions are consistent with the “Cunliffe Committee Report” (Committee on Currency and Foreign Exchanges after the War, 1918, pp. 3-6) that advanced the notion that the gold standard operated on the basis of some automaticity: “*There was therefore an automatic machinery by which the volume of purchasing power in this country was continuously adjusted to world prices of commodities in general. [...] The recognised machinery for this purpose is the Bank of England discount rate.*”

⁸ Bloomfield (1959, pp. 9-10): “*The exchange rates of the various countries moved within narrow limits approximating their respective gold points without the support of exchange restrictions, import quotas, or related controls [...]. Only a trifling number of countries were forced off the gold standard, once adopted, and devaluations of gold currencies were highly exceptional. Yet all this was achieved in spite of a volume of international reserves that, for many of the countries at least, was amazingly small in spite of only a minimum of international cooperation, or of international agreements or commitments, on monetary matters. [...]*”

⁹ See e.g. Dutton (1984). The notion “rules of the game” was not a period concept but emerged as an ex-post rationalisation of central bank monetary policy under the gold standard; see e.g. McKinnon (1993) notes that the expression “rules of the game” is often attributed to a reference in *The economic consequences of Mr Churchill* by John Maynard Keynes.

& Denise, 1999), the Bank of Belgium (Ugolini, 2012) and the Bank of Portugal (Reis, 2007).

The statistical analyses of the rules of the game are mostly focused on exchange rate, reserves and money market variables and mostly omit any economic indicators. Giovannini (1986) focuses on gold imports. McGouldrick (1984) and Morys (2013) use the exchange rate as principal objective although McGouldrick (1984) also discusses the role of the Reichsbank's profitability objectives. Contamin and Denise (1999) and Seeger (1968) offer no statistical evidence for the Reichsbank's broader policies. Sommariva and Tullio (1986) test for the difference between the market discount rate and the Reichsbank's discount rate. Bordo and MacDonald (1997) use a proxy for industrial production in a policy reaction function for Germany in 1880-1913 but find that the shock to output had an insignificant effect on short-term rates.¹⁰ Sommariva and Tullio (1986) employ annual data and take into account deviations from trend in consumer prices and output to assess the Reichsbank's short-run behaviour but find output to be significant only for the period 1896-1913. The importance of a core-periphery relationship or network effects under the rules of the game is studied by Morys (2013) and Flandreau and Jobst (2005).

The rules of the game are congruent with the trilemma debate and monetary policy autonomy in a contemporary context (Obstfeld et al., 2004, Rey, 2016). Obstfeld et al. (2005) argue that the gold standard did not offer monetary policy independence while Bordo and MacDonald (1997) and Flandreau and Komlos (2006) following Svensson (1994) finds that the credibility commitment to gold convertibility allowed central banks to temporarily depart from following the rules consistent with a framework of exchange rate target bands and pursue some domestic policy goals independent of the concern for convertibility.

The constancy of policy formulation has normally been assumed during the entire period of the classical gold standard of 1876-1913 and a sub-periodisation during 1876-90 to cover economic stagnation under the "Gründerkrise" and recovery has generally not been attempted. McGouldrick (1984) compares changes of the

¹⁰ The proxy is pig iron production that may be too limited to be representative of economic conditions.

Reichsbank's discount policy to cyclical up -and downswings concluding that the Reichsbank avoided procyclical movements of its monetary liabilities. Tullio and Wolters (2003) divide the period into two subperiods 1876-95 and 1896-1913 and find significant differences with regard to the effect of the liquidity ratio and Bank of England bank rate. Morys (2013) distinguishes different sub-periods 1896-1913 and 1904-13 and smaller sub-periods to denote financial crises but reports country-specific estimations including for Germany only for the entire period 1876-1913.

The role of the Privatnotenbanken in influencing the Reichsbank has been acknowledged but generally discarded in statistical analyses. The National Monetary Commission (1910b, p. 216) affirms that the Privatnotenbanken constrained the Reichsbank's policy implementation. Bopp (1953), Bundesbank (1976) and Reichsbank (1940) also confirm that the Reichsbank adjusted its policy to the behaviour of the Privatnotenbanken.

The studies of the classical gold standard have incorporated some non-monetary and non-financial considerations. Esteves and Khoudour-Castéras (2009), excluding Germany, identify emigrants' remittances as a possible factor that may have eased balance of payments constraints. López-Córdova and Meissner (2003) study adoption of the gold standard as a source of increased international trade integration that by implication may also have an impact on monetary policy formulation. Tattara (2003) highlights the relevance of fiscal policy and debt for the choice of exchange rate regimes.

3.3. The Reichsbank's monetary policy views

The narrative evidence supports the notion of a Reichsbank confronted with a dual objective of adhering to the gold standard and supporting the recovery of the German economy subject to recurrent convertibility credibility deficits.¹¹ The Reichsbank was concerned about cyclical conditions and sensitive to public concerns

¹¹ National Monetary Commission (1910b, p. 208): "*The extent and difficulty of the Reichsbank's tasks at its establishment, an appreciation of which is essential in forming an opinion on its discount policy, are attributable to the development of German national economic activity in the last twenty-five years, to the incomplete state of German coinage, at that time still in the process of transformation, finally, to the Reichsbank's position in the whole German bank system, and to the apparent attempts of private banks of issue [Privatnotenbanken] to make difficult the execution of its policy.*"

about the bank's commitment to convertibility.¹² The implementation of monetary policy was complicated amid large gold drains during the early years of the Reichsbank's operations. The Reichsbank was repeatedly criticised for neglecting adverse domestic conditions often attributed to the constraints imposed by the gold standard.¹³ Members of the Reichstag persistently aimed reintroducing silver and force the adoption of a bimetallic standard during the 1880s in large part on the basis that the gold standard was perceived as deflationary. The narrative evidence indicates that the Reichsbank generally abstained from direct foreign exchange market interventions, use of gold devices except during a brief interval and did not pursue price stabilisation.

The Reichsbank saw its policy as a careful balancing act between meeting domestic and external objectives: *"In its prudent discount policy, the Reichsbank followed above all the conditions of the domestic money market and in turn influenced the latter, at times to warn about undue speculation; on the other hand it knew to take advantage of the German monetary system and its international relations to strengthen the gold reserve of the country that suffered at times from the coinage reform and other circumstances."*¹⁴

The discount rate was the main instrument to influence monetary conditions: *"[Y]ou can only earn respect for your currency if you are willing to increase the discount rate as high as need be until the public recognises that one is willing to protect its metal."*¹⁵ At the same time, the Reichsbank affirmed possible conflicts

¹² President of the Reichsbank Hermann von Dechend defended in the Reichstag (German Federal Parliament) the decision to increase the discount rate with reference to public perception about the strength of the mark (Deutscher Reichstag, 1881b, p.121): *"[...] [W]ir haben den Diskontsatz heraufgesetzt nicht deshalb, weil uns die Mittel in Folge der Diskontierung unter Banksatz ausgegangen sind, auch nicht aus Furcht vor der Entziehung von Gold, sondern hauptsächlich um dem Treiben der Presse entgegen zu treten, als wenn unsere Valuta in Frage wäre."*

¹³ See e.g. comment made by Ludwig Bamberger, member of parliament and leading protagonist for the establishment of the Reichsbank, in defense of the adequacy of the Reichsbank's discount rate for commerce and trade during a parliamentary debate on 3 March 1881 (Deutscher Reichstag, 1881a, p.123): *"Der offizielle Zinssatz ist im ganzen auch im vorigen Jahre nicht sehr hoch gewesen, und ich glaube, daß im Durchschnitt mit dem Satze [...] weder Handel noch Gewerbe geschädigt worden sind."*

¹⁴ Translated from German of remarks made by Reichsbank President Richard Koch on the 25-year anniversary of the Reichsbank published in the official gazette *Deutscher Reichsanzeiger* und *Preußischer Staatsanzeiger* (Deutscher Reichsanzeiger und Preußischer Staatsanzeiger, 1901).

¹⁵ Translated from German. Von Dechend in a testimony to the Reichstag (Deutscher Reichstag, 1881b, p. 122): *"Man kann seiner Valuta nur Respekt verschaffen, wenn man sich nicht genirt, ordentlich mit dem Diskont in die Höhe zu gehen, bis die Leute sehen, daß man sein Metall zu schützen weiß."* See also von Dechend in a testimony to the Reichstag on the importance of the discount rate policy to preserve the gold stock (Deutscher Reichstag, 1891, p.1184): *"Das wesentlichste und wichtigste Mittel aber, den Goldvorrath auf der erforderlichen Höhe zu halten, ist die Diskontopolitik, und die ist von der Reichsbank so geübt worden, daß, wie ich sagen kann, unser Kredit noch keinen Augenblick angezweifelt worden ist."*

between bank note convertibility and money market condition: *“The most important and likewise the most difficult task of the Bank is to bring about the greatest possible equalisation of fluctuations in money demands and to be at all times in a position to redeem its notes and to meet its other demand liabilities. The maintenance of the Bank’s solvency coincides with the maintenance of the imperial standard. The notes issued by the Bank form so large a part of the total Germany currency that a refusal to redeem them for sterling money and the subsequent depreciation of the notes would bring about a collapse of the German monetary system.”*¹⁶

The Reichsbank viewed its discount policy in large part constrained by movements in gold due to external pressures, political pressure for the remonetisation of silver, the policy of the Bank of England and domestic economic developments. From the meetings of the Reichsbankkuratorium:¹⁷

17 September 1880: *“The Bank administration was criticised vehemently on four grounds: a) the suspension of May of last year of the silver sales; b) the needed increase in the discount rate; c) the alleged complications in making gold payments; d) the publication of the metal stock that does not distinguish between gold and silver.”*¹⁸ *The current crisis was the product of an artificial agitation [...] to pressure for the move from a pure gold currency towards bimetallism.”*

24 September 1881: *“The situation of the Reichsbank is more relaxed [...]. Meanwhile, the danger of significant gold outflows subsided [...].”*

29 March 1882: *“The fundamental flaw of the coinage acts was twofold in grossly underestimating the supply of silver and in exceedingly overestimating the amount of available gold.”*

National Monetary Commission (1910a, p. 357) in interviews with von Glasenapp and von Lumm: *“The real remedy [to increase gold imports] is to raise the rate of discount [...].”*

¹⁶ National Monetary Commission (1910b, p. 202).

¹⁷ Reports to the Royal State Ministry (Königliche Staatsministerium) of Württemberg by Oberfinanzrath Carl Joseph von Schmid, Württemberg representative of the Reichsbankkuratorium. Translated from German (von Schmid, 1880-1887).

¹⁸ The Reichsbank adopted payments in gold for export only to be made in Berlin.

30 September 1882: “*The necessary increase of the discount rate to 5 percent on 8 September of this year was conducive to slowing though not stopping the gold outflow amounting to millions in losses.*”

20 September 1884: “[...] *while the discount rate of the Bank of England since June was only 2 percent; while there is abundance in the money market, the high discount rate of the Reichsbank will thwart a gold outflow [...].*”

23. March 1887: “[...] *the very satisfactory metal stock of the Bank frustrates the aims of the bimetallists [...].*”

The policy formulation can be approximated by the Reichsbank’s summary of its discount rate policy in 1876-90.¹⁹ It mentioned the words gold 154 times, economic activity and related concepts 40 times, money market 30 times, prices excluding reference to gold and silver prices 9 times, profitability 8 times and Bank of England once.

The policy concerns of the Reichsbank shifted over time. The Reichsbank identified 10 occasions of discount rate increases during 1876-90 as due primarily to avoid gold outflows, 7 due to heightened inland money needs and 8 due to inland and external needs.²⁰ Up to 1883, more than half of the discount rate increases were attributed to gold outflows while only 20 percent in the period 1883-90 attesting that prior to 1883, the Reichsbank’s discount policy “*was dominated more by international gold currents than by home transactions,*” while afterwards “*the great concern about a sufficient stock of gold [...] disappeared.*”²¹

The Reichsbank divided its policy during 1876-90 into four different phases:²²

1876-79: The period was marked by “*the effects of the great commercial crisis of 1873*”, an outflow of specie undermining the foundation of the gold standard, transition from the Preußische Bank to the Reichsbank, lack of

¹⁹ See National Monetary Commission (1910b).

²⁰ Count based on table 84 of Reichsbank (1912). Koch at the Reichstag during the bank act revision debate in February 1899 in response to criticism to the high discount rates of the Reichsbank stressed that the Reichsbank only occasionally raised its discount rate to fend off external pressure (Deutscher Reichstag, 1899).

²¹ See National Monetary Commission (1910b).

²² See National Monetary Commission (1910b).

working funds, and implementation of the new monetary reforms including withdrawing of silver coins and state treasury notes.

1879-83. The period was hailed as *“an important turning point in the history of the discount policy of the Reichsbank.”* The discount rate was generally increasing *“with the growing domestic demand for money and the difficulties of the situation respecting the monetary standard.”* The economic conditions improved from 1879 to 1882-83 and the coinage reform was concluded in 1879. The Reichsbank introduced private or prime rates of discount in 1880 as the bank *“felt the competition of private banks of issue [Privatnotenbanken]”* and need to *“keep in touch with the money market.”*²³

1883-88: The period was marked by *“economic depression”* as *“in 1883 the decline began to set in”* and only in *“1888 did men’s minds become quieter, permitting a vigorous economic advance”* and *“the years 1887 and 1888 show again a considerable increase in investments.”* *“[T]he increase in metal holdings, especially in gold reserve, and the cessation of the strong demand for credit, enabled the Bank to maintain a low rate of interest during those years. [...] On the other hand, the official discount rate during these years had to be raised twice up to 5 per cent, first, in March 1885, on account of the Anglo-Russian complications and a resulting outflow of gold to England [...].”*

1888-90: The Reichsbank viewed *“in Germany, the improvement of conditions was first felt in 1888.”*

The Privatnotenbanken followed the discount policy of the Reichsbank but conducted large transactions at preferential or prime discount rates. They pledged a policy of supporting the Reichsbank. At the same time, they pursued their own objectives with a focus on local developments.²⁴ They acknowledged the importance of following the discount rate of the Reichsbank in particular through guarding

²³ The importance of controlling the money market is similarly observed by Diebolt (2017).

²⁴ E.g. Badische Bank (1880): *“An der aufsteigenden Bewegung, welche das Jahr 1879 im Überigen charakterisierte, konnte unser Institut keinen Theil nehmen, da ihm die Bestimmung zufällt, seine Mittel vorzugsweise dem Diskont- und Lombardverkehre auf dem heimischen Gebiete in Bereitschaft zu halten.”* Bayerische Notenbank (1881): *“Diese decentralisierte Thätigkeit (durch ein Netz an Zweiganstalten), mit welcher wir unsere volkswirtschaftliche Aufgabe am besten zu erfüllen glauben [...].”*

against a gold outflow.²⁵ The institutions considered important to maintain a stance independent of the market discount rate.²⁶

3.4. Statistical analysis

The Reichsbank's views on policy credibility and adherence to the rules of the game can be tested. The first is verified by a simple convertibility credibility test based on uncovered interest rate parity. The latter can be estimated with a monetary policy reaction function. The analysis takes into account the Reichsbank's own monetary policy views and concerns and periodisation to guide estimations of actual policy formulation.

The monetary policy reaction function aims to establish how the Reichsbank set its discount rate and altered its reserve ratio on the basis of changes in key economic, external and market variables. The paper follows Clarida and Gertler (1996) for the identification of the empirical relationship between changes in the Reichsbank's policy instruments and changes in relevant economic and market variables.²⁷

The usual caveats for estimating a monetary policy reaction hold. The identification of the set of information to which the Reichsbank responds is problematic amid the lack of sufficient knowledge about the true information set, including the use of intermediate targets, and significantly constrained by data availability. The problem of simultaneity between the policy instrument and the information set, as the information set is influenced by the policy instrument and vice versa, necessitates the imposition of restrictions on the contemporaneous interactions, that may not reflect the true interactions, between the policy instrument and the economic and market variables.

²⁵ Bank für Süddeutschland (1889): “[...] die um diese Zeit erfolgte Erhöhung der offiziellen Rate der Reichsbank von 3% auf 4%, welche von diesem Institut—unter gleichzeitiger Einstellung seiner Discontirungen zum Privatsatz—vorgenommen worden ward, um der damals befürchteten Gefahr eines starken Goldexports wirksam zu begegnen.”

²⁶ Bayerische Notenbank (1887): “Unsere decentralisierte Verfassung macht es uns möglich, uns von den niedrigen Privatsätzen der Börsenplätze einigermaßen unabhängig zu machen, ohne dass wir hierbei die auf die Qualität der Wechselbestände gebotene Rücksicht zu vernachlässigen brauchen.“

²⁷ Clarida and Gertler (1996) analyse the policy reaction function of the Bundesbank, the Reichsbank's successor institution.

The specie flow mechanism implies that net gold flows may not be fully captured by the monetary gold reserves and the role of autonomous gold flows and accommodating capital flows may also affect the central bank policy reaction function. However, the Reichsbank maintained that most balance of payments adjustment through gold was reflected in its gold holdings and that all net gold flows were ultimately covered by the reserves of the Reichsbank amid its dominance in net balance of payments gold inflows.²⁸

The paper uses monthly balance sheet data of the Reichsbank and Privatnotenbanken from March 1878 through December 1890. The data were digitalised as published in the monthly statistical series *Central-Blatt für das Deutsche Reich* by the Imperial Ministry of the Interior (Reichsamt des Inneren, 1876-1890). The bank data comprise the reserve ratios. The gold stock of the Reichsbank was estimated on the basis of intra-annual data published by the Reichsbank (Reichsbank, 1900) and monthly data on metal reserves as published in *Central-Blatt für das Deutsche Reich*.²⁹ The data cover the Reichsbank and the largest Privatnotenbanken that maintained operations through the observation period. The discount rates of the Reichsbank, Bank of England and the Berlin market discount rate were digitalised as published by the Reichsbank in *Vergleichende Notenbankstatistik* (Reichsbank, 1925). The exchange rate data are from Schneider and Schwarzer (1990) for the 8-day sight sterling mark exchange rates as quoted in Berlin in 1876-90.

The economic variables include tax revenue and wholesale prices. Economic activity is approximated by monthly tax revenue data comprising German federal taxes on salt (Salzsteuer) and beer (Brausteuern) and were digitalised as published monthly from March 1878 in the *Central-Blatt für das Deutsche Reich*.³⁰ The tax

²⁸ See Thesis Introduction under Gold reserves and current account page 46 on the relationship between net gold inflows and Reichsbank reserve accumulation. Compare also National Monetary Commission (1910b), p. 211: "*the Reichsbank is the medium for the influx of gold from abroad [...] and National Monetary Commission (1910b): "It follows of necessity that the demand for gold for consignments abroad must finally be covered from the bullion of the central bank."* On the gold points see Morys (2013) and Thesis Introduction Figure 0-8.

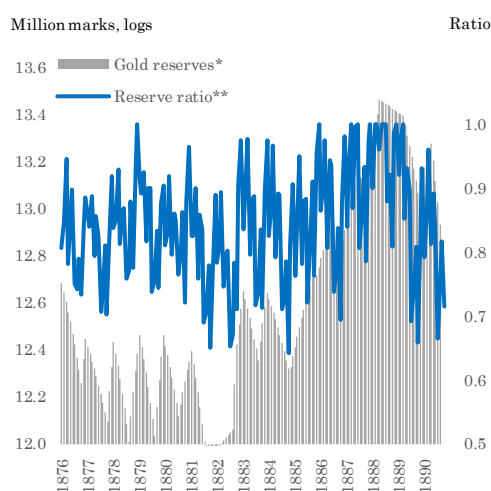
²⁹ The Reichsbank did not publish its gold stock. See e.g. von Dechend explaining to the Reichstag that both the federal government and the Reichsbank do not consider it appropriate to distinguish between gold and silver holdings (Deutscher Reichstag, 1889, p. 600).

³⁰ The federal states of Baden, Bayern and Württemberg were exempt to contribute to the spirits (Branntweinsteuer) and beer duties. The spirits duty is not included as the three states started contributing to the spirits duty from 1887 onwards. Other indirect taxes on sugar (Rübenzuckersteuer und Zuckermaterialsteuer) and tobacco (Tabaksteuer) have been omitted due to strong dependence on harvest outcomes.

revenue exclude customs revenues due the important increase in tariffs in 1879 with the custom tariff act (Zolltarifgesetz) that may not warrant consistency of the revenue base over the observation period. Wholesale prices are also used as proxy for domestic price developments and an index is constructed covering 10 items at constant weights by Jacobs and Richter (1935) of agricultural and industrial products for Germany monthly from January 1879 in Monatshefte zur Statistik des Deutschen Reichs (Kaiserliches Statistisches Amt, 1877-1890).³¹

The implementation of monetary policy of the Reichsbank in 1876-90 was marked by one period of relatively high discount rates and one of low discount rates. The Reichsbank maintained on average a discount rate in 1879-83 of 4.2 percent compared with 3.6 percent in 1884-88. The higher discount rate period was accompanied by relatively low levels of gold reserves. The estimated gold stock on average in 1879-83 was 250 million mark compared with 419 million mark in 1884-88 (Figure 3-1).

Figure 3-1. Reserve ratio and gold



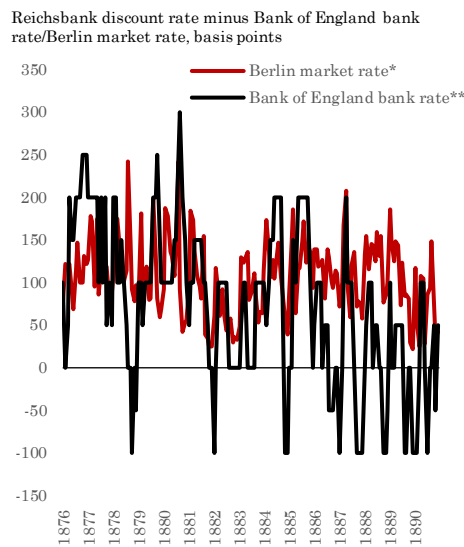
Source: Reichsamt des Inneren (1876-90). * Linearly interpolated.
 ** Metal reserve to bank notes in circulation.

The Reichsbank's discount rate normally was the highest in system. The market discount rate quoted at the Berlin stock exchange was representative of prime borrowers and attracted a lower average rate. The rate spread between the Reichsbank discount rate and the Berlin market rate was 95 basis points in 1879-

³¹ See Thesis introduction under Sources page 49 for an explanation of the data.

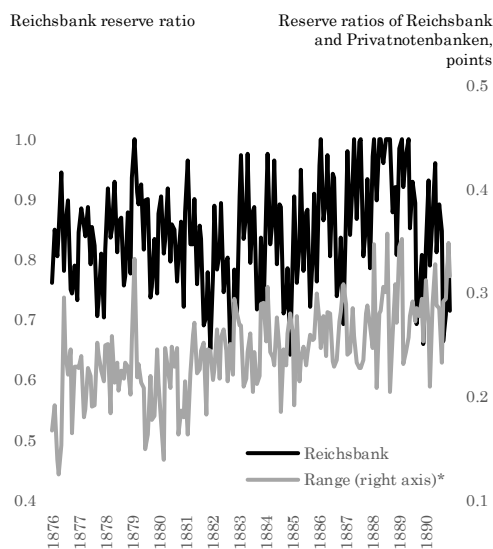
83 and 117 basis points in 1884-88. The Reichsbank maintained on average a higher discount rate than the Bank of England in 1879-83 of 92 basis points. The rate spread declined to 53 basis points in 1884-88 as the Reichsbank reduced its average discount rate while the Bank of England increased its average bank rate (Figure 3-2).

Figure 3-2. External and market rates



Source: Reichsbank (1925). *Reichsbank rate: end of period, Berlin market rate period average. ** End of period.

Figure 3-3. Reserve ratio range



Source: Reichsamt des Inneren (1876-90). *Badische Bank, Bank für Süddeutschland, Bayerische Notenbank, Sächsische Bank, Württembergische Notenbank.

The reserve ratios of the Reichsbank and Privatnotenbanken show marked differences in the levels of reserve ratios and increasing divergence in the system between 1876 and 1890. The Reichsbank maintained the highest reserve ratio of 0.8 while the Badische Bank and Bank für Süddeutschland had the lowest of 0.4 on average in 1876-90.

The paper tests the hypothesis that the Reichsbank is influenced by economic variables including output and domestic price developments, the market discount rate, its gold stock, the Bank of England bank rate and the Privatnotenbanken distinguishing developments from January 1879 through December 1883 and from January 1884 through December 1888. The periods are chosen on the basis of the periodisation identified by the Reichsbank to assess whether the Reichsbank shifted its policy as it claimed. An alternative test, e.g. like a Chow test, to estimate a structural break in the series is not attempted herein amid a focus on the relationship between stated policy intent and monetary policy reaction function.

The tests will show if the Reichsbank set monetary policy as it indicated mostly on the basis gold reserve movements, followed by considerations for economic activity and money market conditions and largely ignored the Bank of England and price developments. The test will also aim to verify if the Reichsbank adapted its behaviour in light of the exchange rate regime credibility deficit in the first period. A test on whether bank profitability was determining monetary policy conduct will not be performed amid lack of monthly profitability targets. The paper also tests the hypothesis that the Privatnotenbanken supported the Reichsbank against gold outflows.

The series are found to be stationary using an augmented Dickey-Fuller test except for the Reichsbank gold series, tax revenue and wholesale price index. The Reichsbank gold reserve, tax revenues and wholesale price index are made stationary by taking first differences of the logs of the series.

The credibility deficit of the Reichsbank can be approximated by the well-known uncovered interest rate parity that equalises the expected home currency return with a foreign investment. The expected exchange rate relative to the exchange rate band, as given under the gold standard by the gold points, can be

established. The exchange rate regime is considered credible if the expected exchange rate lies within the band.³² Using monthly observations of the Berlin 8-day sight rate mark per sterling and the Berlin and London open market discount rates, the implied expected exchange rate shows a gradual convergence with the exchange rate band.³³ Distinguishing between the periods 1879-83 and 1884-88, the expected exchange rate in the first period indicates a somewhat reduced credibility amid the significant amount of expected exchange rate data points outside the gold points, in particular outside the gold export points hinting at an expected depreciation bias. The second period in contrast shows significantly fewer points outside the band suggesting that credibility was established gradually (Figure 3-4). The first period saw 24 gold point violations out of 60 months, of which 17 gold export point violations, compared with 8 gold point violations out of 60 months for the second period. The convertibility credibility test suggests that the Reichsbank's behaviour changed over time and needs to reflect at least two different periods consistent with the Reichsbank's own account comprising 1879-83 and 1884-88.³⁴

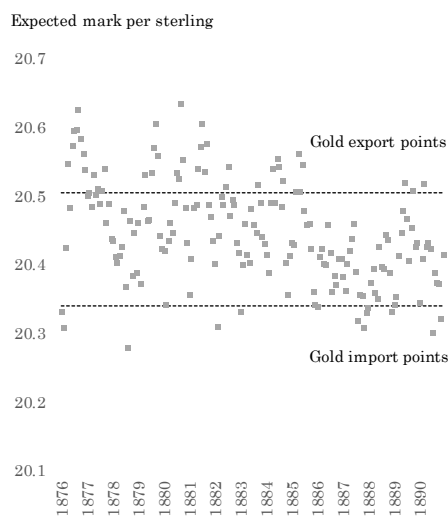
The rules of the game can be illustrated by simple descriptive statistics. The correlation coefficients between reserve ratio and discount rate show the expected sign albeit a weak correlation. The correlation between gold reserves and the discount rate similarly has the expected sign and is relatively strong during 1879-83. The relation between gold reserves and domestic assets is weak hinting that domestic assets did not expand with gold reserves. The distinction between 1879-83 and 1884-88 appear relevant given important differences between the correlation coefficients between the two periods in particular for the reserve ratio and the discount rate and the gold reserves and the discount rate (Table 3-1).

³² Officer (1986) stresses that “if there is confidence in the gold points, then [...] exchange market speculators [...] will transact to turn the exchange rate away from the gold points. Therefore, a well-functioning gold standard would have the exchange rate neither going beyond (“violating”) the gold points not concentrated near them.”

³³ Berlin 8 day sight mark per sterling from Schneider and Schwarzer (1990) and discount rates from Reichsbank (1925). The uncovered interest rate parity after Svensson (1990) is: $s_e = s((1 + i_{Berlin})^\tau / (1 + i_{London})^\tau)^{1/12}$, where s_e is the expected exchange rate, s the spot exchanger rate in terms of mark per sterling, i_{Berlin} the Berlin open market discount rate, i_{London} the London open market discount rate and τ is term in months of the underlying bills of exchange and where τ is estimated to be 2 months.

³⁴ Darné and Diebolt (2007) find in a detailed time series analysis about the reserve holdings of the Reichsbank that the years, coinciding with the herein observation period, 1880, 1883 and 1888 corresponded to crisis years. The Reichsbank's perceived periods of policy developments do not coincide with business cyclical developments. Gordon (1952, p. 562) shows for Germany business cycle turning points troughs in January 1879 and August 1886 and peaks in January 1882 and January 1890.

Figure 3-4. Exchange regime credibility



Source: Schneider und Schwarzer (1990). Based on uncovered interest rate parity and Berlin 8 day sight (8 Tage dato) rate assuming average maturity of underlying bills of 2 months. Gold points from Morgenstern (1959) table 74 for period 1880-1914.

Table 3-1. Rules of the game

Reichsbank (change)	Reserve ratio **	Gold reserves ***
Correlation coefficient		
1879-83*		
Domestic assets †		-0.08
Discount rate	-0.14	-0.40
1884-88*		
Domestic assets †		-0.15
Discount rate	-0.33	-0.11

Source: Reichsamt des Inneren; Reichsbank. *Monthly observations. ** Notes in circulation to metal reserves. ***Estimated on basis linear interpolation of data for high, low and average annual gold stocks. † Bills of exchange, secured loans (Lombard), notes of other banks, effects.

The estimation of the policy reaction function is based on a short-run SVAR approach that allows to make explicit identifying assumptions about the short-term causal contemporaneous relationships between the endogenous variables. The SVAR represents a linear combination of a vector of endogenous variables, the variables of interest and their respective lags in addition to coefficient matrices and a random error vector.

The SVAR model is based on the identification of the errors of the system that are interpreted as exogenous shocks. The structural shocks of the model are identified by imposing restrictions to allow making inferences based on the dynamic impact of mutually uncorrelated (orthogonal) shocks. The restrictions are taken in

line with Clarida and Gertler (1996) to impose the ordering of the variables in the model and rest on the assumption that policy shocks have no contemporaneous impact on the economic variables. The paper employs only relatively few restrictions on the model and will not use the two-pronged approach in Clarida and Gertler (1996) amid the lack of sufficient prior information.

The limitations of SVAR analyses are noted in particular with regard to the importance of and sensitivity to the identifying assumptions and some counterintuitive results like e.g. the price puzzle.³⁵ As is normal in VAR analyses, as even a small VAR contains a lot of parameters and it is nearly impossible to interpret the relationships in a VAR by inspecting the estimated parameters, the impulse response functions (IRFs) are used as summary information.³⁶ The IRFs represent the dynamic effects of the orthogonalized shocks with respect to innovations in the errors of the system as one-step to multiple steps ahead forecast errors.

The short-run SVAR model used is specified on the basis of a structure matrix of the form AB.³⁷ The VAR specifies K variables as linear functions of p of their own lags and p lags of the other $K - 1$ variables. A p -order VAR model $VAR(p)$ can be written as:

$$3-1) y_t = v + \Gamma_1 y_{t-1} + \dots + \Gamma_p y_{t-p} + \epsilon_t$$

where

$y_t = (y_{1t}, \dots, y_{Kt})'$ is a $K \times 1$ random vector

Γ_1 through Γ_p are $K \times K$ matrices of parameters

ϵ_t is assumed to be the error term, that is,

$$E(\epsilon_t) = 0$$

$$E(\epsilon_t \epsilon_t') = \Sigma$$

³⁵ For an overview of the limitations of SVARs, see e.g. van Aarle et al. (2003). The price puzzle is the tendency refers to the results in SVAR of a temporary increase in prices after a contractionary monetary policy shocks, see e.g. (Christiano et al., 1996).

³⁶ See e.g. Becketti (2013).

³⁷ See e.g. Amisano & Giannini, 1997. For the use of SVAR to analyse central bank behaviour and reaction to external shocks see e.g. Jeanne, 1995.

Equation (3-1) can be rewritten after absorbing the constant v into the y_t vector and using the lag operator L and where I is the identify matrix:

$$(3-2) y_t = \Gamma_1 L y_t + \dots + \Gamma_p L^p y_t + \epsilon_t$$

$$(3-3) y_t = (I - \Gamma_1 L - \Gamma_p L^p)^{-1} \epsilon_t$$

It can be shown that

$$(3-4) y_t = I \epsilon_t + \Phi_1 \epsilon_{t-1} + \Phi_2 \epsilon_{t-2} \dots = \sum_{i=0}^{\infty} \Phi_i \epsilon_{t-i}$$

where $\Phi_0 = I$, which is the moving average representation and Φ are the IRFs.

The SVAR approach orthogonalises the error terms, i.e. finds new linear combinations of the error terms which are independent or orthogonal to each other. The SVAR is transformed to a new model such that the new errors e_t can be expressed as a function of the old errors ϵ_t where $A\epsilon_t = B e_t$ for some invertible matrices A and B and where A and B are chosen such that A and B are diagonal, then $\epsilon_t = A^{-1} B e_t$ and $e_t = B^{-1} A \epsilon_t$.

The identification is provided by placing restrictions on A and B where A is a lower triangular matrix with one on the diagonal and B a diagonal matrix and where A and B are nonsingular. The P matrix for the short run model is $P_{sr} = A^{-1} B$ obtained by imposing restrictions on A and B . Since Σ is symmetric, it has only $\{K(K+1)\}/2$ free parameters and so only $\{K(K+1)\}/2$ parameters may be estimated in an exactly identified P_{sr} . With $2K^2$ total parameters in A and B , the order condition for identification requires at least $2K^2 - K(K+1)/2$ restrictions be placed on those parameters.

The P matrix is constructed as the Cholesky decomposition of the error covariance matrix of the original VAR model with optional additional restrictions placed on the P matrix in terms of short-run restrictions on the contemporaneous covariances between shocks.³⁸ These restrictions are testable.

In the estimation of the model A and B are defined as matrices where a and b are freely estimated coefficients. The form of the A matrix imposes the recursive

³⁸ The effect of the Cholesky decomposition can be replicated by defining A and B appropriately.

structure which orthogonalises the errors, while the diagonal B serves to scale the structural errors.

The estimation is performed with the lower triangular matrix A set such that all coefficients in the upper half are set to zero and all remaining coefficients in the lower half are freely estimated. The matrix is ordered based on conventional ordering provisions where the policy variable is ordered last as in Clarida and Gertler (1996).

The SVAR model on the basis of equation (3-4) is derived following equations (3-1) through (3-4) to rewrite the new model in its moving average representation as:

$$(3-5) \ y_t = \sum_{j=0}^{\infty} \theta_j e_{t-j}$$

where $\theta = \Phi_i P$ are the structural IRFs. The transformations of the errors allow to analyse the dynamics of the system in terms of a change to the structural errors e_t .

The estimation comprises two models. The first model measures the monetary policy reaction function of the Reichsbank and includes in the following order: Log of tax revenue, log of German wholesale price index, Bank of England bank rate, Berlin market discount rate, Reichsbank interpolated gold stock, average reserve ratio of the Privatnotenbanken as a proxy for the Privatnotenbanken behaviour and Reichsbank reserve ratio. The ordering of the market discount rate before the Reichsbank's discount rate rests on the narrative account and the ordering of the Privatnotenbanken before the Reichsbank corresponds to the narrative evidence that indicates that the Reichsbank was influenced by the Privatnotenbanken. The model will also be estimated using the Reichsbank discount rate in lieu of the reserve ratio. The estimation with the Reichsbank discount rate is presented here amid more conclusive results. The ordering of the first model was also changed with the log of wholesale price index first followed by tax revenue but the results were unchanged. The first model was also estimated using total metal reserves of the Reichsbank and the log of British wholesale price index in lieu of the German wholesale price index as a proxy for exogenous development but the results were

similar.³⁹ The second model measures the monetary policy reaction function of the Privatnotenbanken with the following order: Log of tax revenue, Berlin market discount rate, Bank of England bank rate, Reichsbank discount rate, the reserve ratio of a Privatnotenbank. The ordering of the Reichsbank discount rate before the Privatnotenbanken corresponds to the pledge of the Privatnotenbanken to support the Reichsbank. The wholesale price index was dropped from the second model amid its inclusive results in the first model. The data series used are not adjusted for seasonality to avoid the common seasonality pattern to influence the estimation. In general, the main results are robust to different orderings of the variables.

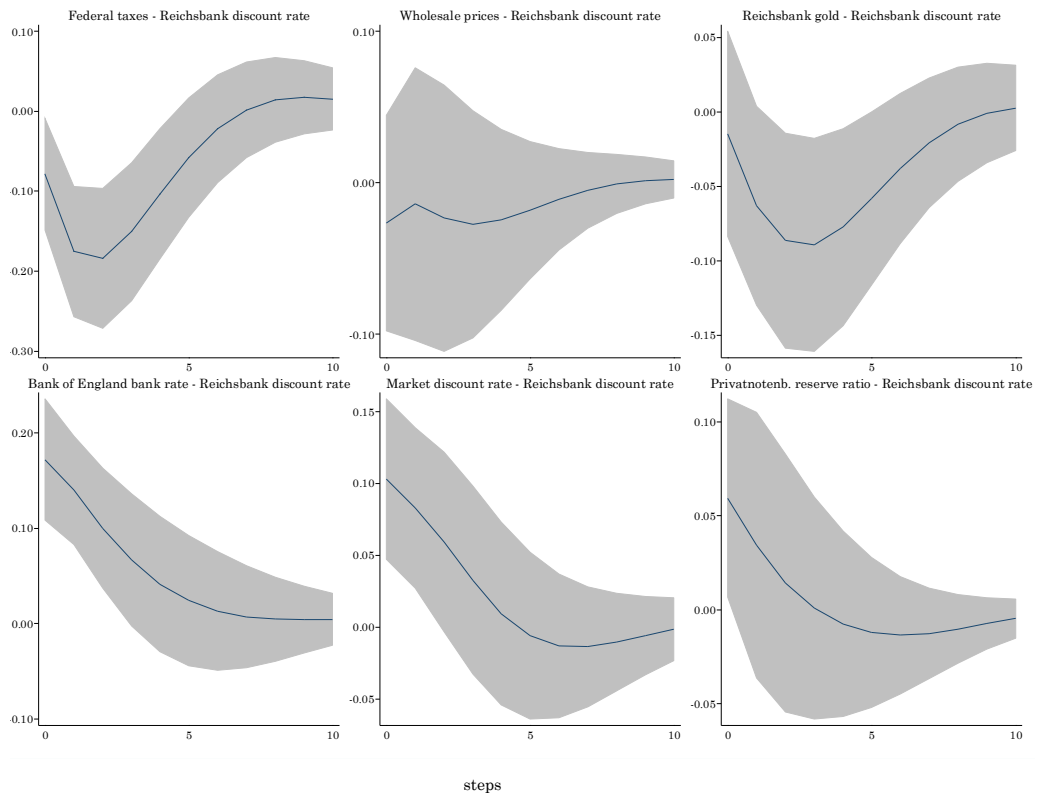
The identification of the number of lags to include in the VAR is performed using the Hannan and Quinn's information criterion (HQIC) and the Schwarz Bayesian information criterion (SBIC). The appropriate lag length based on HQIC and SPIC is 1 and a 1 lag structure is chosen. The stability conditions of the SVARs are tested based on the modulus of each eigenvalue of the matrix A being strictly less than unity and are found to be stable.⁴⁰

The estimation of the policy reaction function of the Reichsbank for 1879-83 shows that the bank was guided predominantly by the Bank of England and money market conditions. The IRFs are shown with 90 percent confidence intervals to indicate a significant though small response to gold holdings and the reserve ratios of the Privatnotenbanken. The IRFs show that the Reichsbank adjusted the discount rate upwards with a decline in its gold reserve from 3 months ahead in a small but statistically significant way. The Reichsbank discount rate responded positively to an increase in the Bank of England bank rate and the impulse from the Bank of England lasted up to 7 months. The Reichsbank equally reacted promptly to shocks in the market discount rate with the effect lasting up to 5 months. The Reichsbank discount rate responded pro-cyclically to shocks to tax revenue but was not influenced by shocks to wholesale prices. The Privatnotenbanken influenced the Reichsbank within 1 month (Figure 3-5).

³⁹ The British wholesale prices are retrieved from FRED (Federal Reserve Bank of St Louis). The fact that the substitution of British for German wholesale prices did not result in significant estimation differences is due to the high correlation between British and German wholesale prices during the observation period.

⁴⁰ See Lütkepohl (2005).

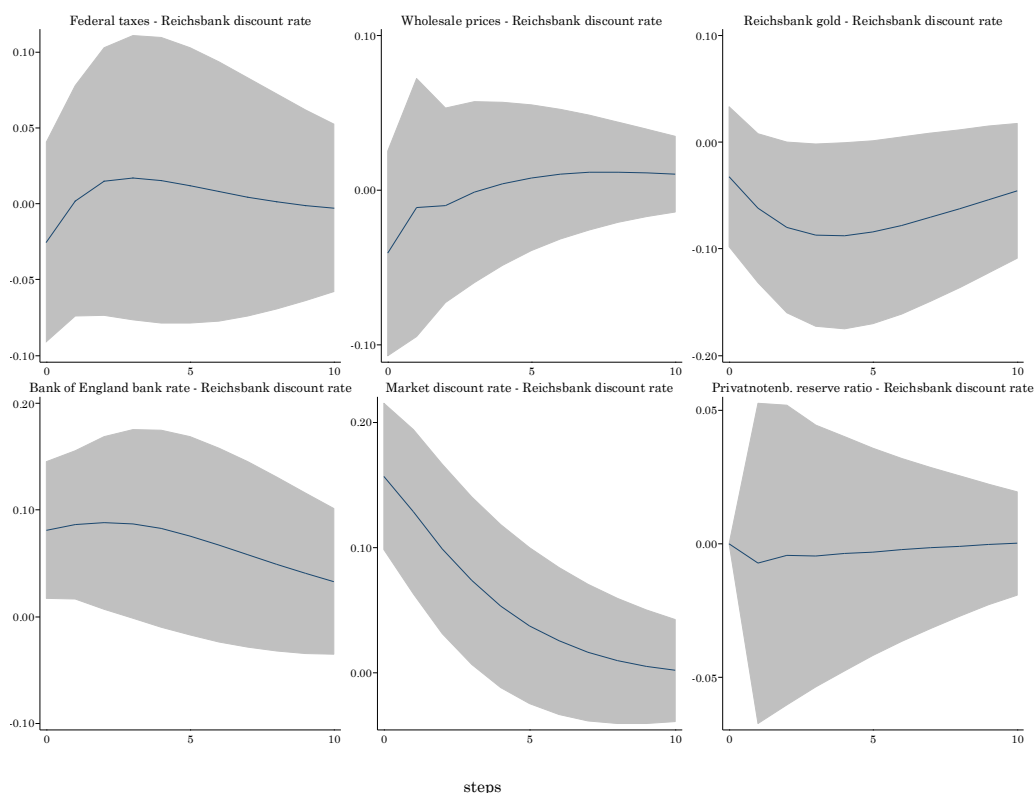
Figure 3-5. Reichsbank policy reaction function 1879-83



STATA 14.1 output. 90 percent confidence interval, 10 steps. SIRF, impulse variable - response variable. January 1879-December 1883.

The policy reaction function of the Reichsbank for the period 1884-88 indicates greater concerns for monetary market developments. The Reichsbank responded neutrally to shocks to tax revenues. The response to wholesale price movements was neutral as before. Its discount rate responded significantly to shocks to the market discount rate and much stronger than in 1879-83. The Reichsbank was not influenced by shocks to its gold reserves. Shocks from the Bank of England bank rate played a far less significant role compared with 1879-83. The Privatnotenbanken exert no influence on the Reichsbank (Figure 3-6).

Figure 3-6. Reichsbank policy reaction function 1884-88

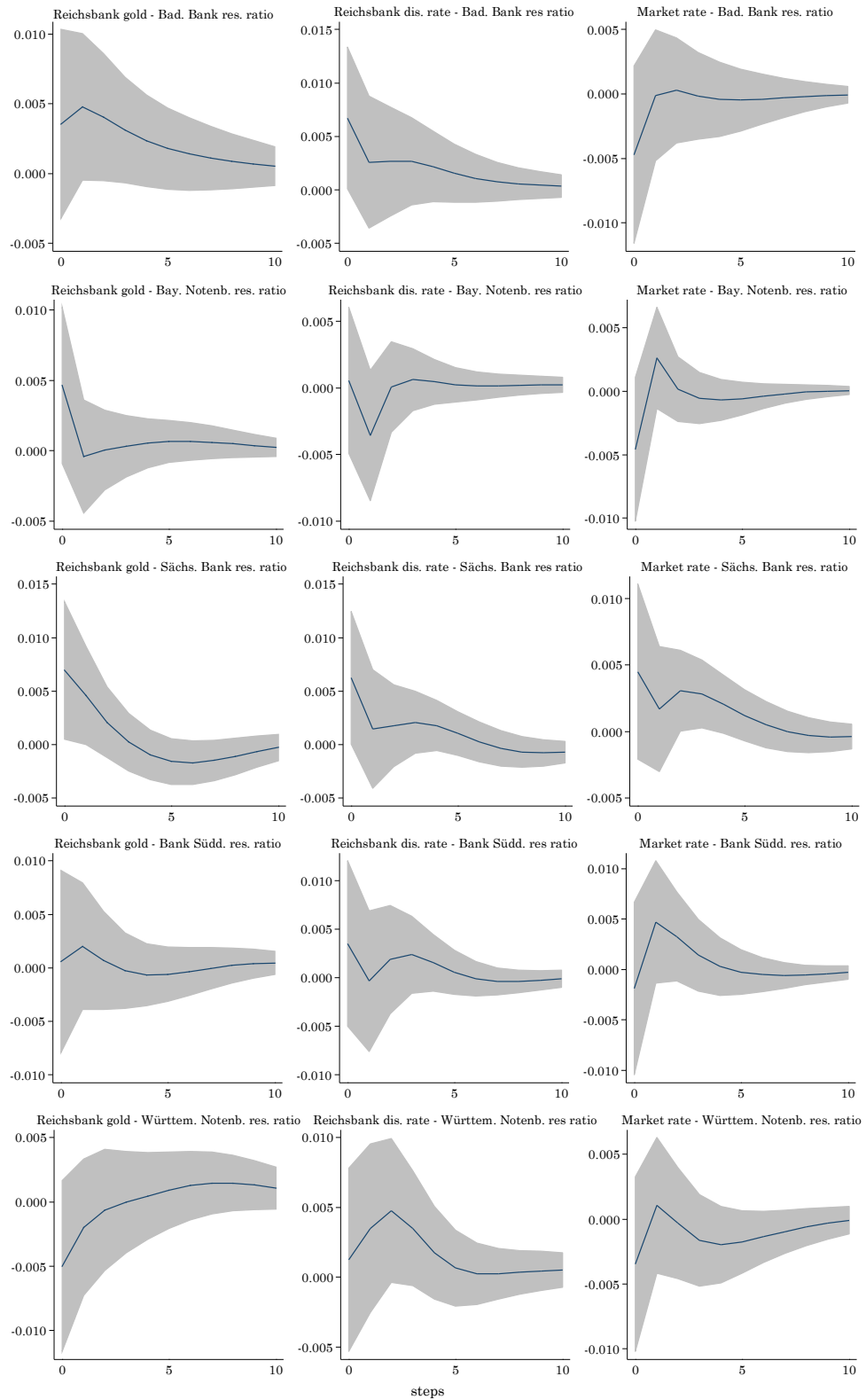


STATA 14.1 output. 90 percent confidence interval, 10 steps. SIRF, impulse variable - response variable. January 1884-December 1888.

The differences in the policy reaction functions of 1879-83 and 1884-88 is consistent with a shift towards domestic policy concerns while strengthening policy adjustment. In 1884-88, the Reichsbank responded more neutrally to shocks to economic activity as shown in the upper left charts of Figure 3-5 and Figure 3-6. At the same time, the Reichsbank responded more firmly to shocks in the market discount rate as shown in the lower middle charts of Figure 3-5 and Figure 3-6 amid a higher amplitude and steeper slope of the response curve compared with the period 1879-83. Similarly, shocks to the Bank of England bank rate in 1884-88 brought no longer a significant response from the Reichsbank as shown in the lower left charts of Figure 3-5 and Figure 3-6 and responses to shocks from the Privatnotenbanken were no longer significant.⁴¹ The Reichsbank in 1884-88 maintained a less firm response to shocks to its gold reserve as illustrated in the upper right charts of Figure 3-5 and Figure 3-6.

⁴¹ The very limited response of the Reichsbank to changes in the Bank of England bank rate is also consistent with the results in Morys (2013).

Figure 3-7. Privatnotenbanken policy reaction functions 1879-83



STATA 14.1 output. 95 percent confidence interval, 10 steps. SIRF, impulse variable - response variable. January 1879-December 1883.

The policy reaction functions of the Privatnotenbanken in support of the Reichsbank policy stance show no significant or very limited responses. The responses vary to similar shocks in the Reichsbank's gold reserve, discount rate and the market discount rate affirming the relative autonomy of the Privatnotenbanken (Figure 3-7). The lack of response in the liquidity ratios of the Privatnotenbanken to shocks in the Reichsbank discount rate, as shown in the middle charts of Figure 3-7 is also consistent with the fact that the Privatnotenbanken conducted discount rate operations mostly at private discount rates below the official Reichsbank discount rate. The period 1884-88 shows a similar pattern.

3.5. Conclusions

The paper offers a more realistic policy reaction function of the Reichsbank for the period 1876-90. The study incorporates economic activity indicators, identifies different policy phases and includes the Privatnotenbanken to show that the Reichsbank's policy was predominantly influenced by domestic factors and shifted over time. The results indicate that the Reichsbank may have initially adhered to the rules of the game but affirm as others have done that the rules may not represent an adequate approach to describe its policy behaviour.

The findings seem more in line with a central bank behaviour under a reputations framework than the rules of the game. The reputations framework presumes that there is uncertainty about the commitment credibility of the policy maker to a given monetary policy objective (Barro, 1986). The reputational forces imply that a central bank has incentives to appear highly committed to minimise the cost of being perceived as uncommitted.⁴² Under the gold standard, the central bank needs to signal strongly its commitment to convertibility to build trust in the gold standard. Because the public cannot be certain that the policy maker will always commit to convertibility, the policy maker has an incentive to build up reputation as a "strong commitment type." The public on observing a behaviour consistent with a strong commitment revises upward the probability that the policy maker is a strong commitment type. The central bank can choose between being a type 1 policy maker strictly bound and able to meet convertibility at all times or a

⁴² The ideas herein follow closely the set-up in Barro (1986).

type 2 policy makers committed to convertibility but keen to pursue other policy objectives too. Because the public may misinterpret a commitment to pursue other policy objectives as undermining convertibility, the type 2 policy maker is motivated to “masquerade” as a type 1 policy maker.⁴³

The Reichsbank’s behaviour seems consistent with masquerading as a type 1 policy maker as it signalled strong commitment to convertibility but acted to meet other policy objectives. Since the Reichsbank knew the public was learning from experience to correctly identify the policy type, it initially overcommitted to be seen as a type 1 policy maker amid a constant risk of being identified as a type 2 policy maker. The successful perception as a strong convertibility type provided the Reichsbank with desired policy discretion.

The findings are supportive of the notion that the Reichsbank was aware of the effect of its policy actions on economic activity. The perception that period monetary policy ignored its influence on the business cycle and was only to a limited extent aligned with modern monetary policy frameworks therefore seems inconsistent with the period monetary policy debate, measures led by the Reichsbank and period public commentaries.⁴⁴ The paper thereby contests the assumption that the nineteenth century Reichsbank cannot in principle be compared with a modern central bank (Bloomfield, 1959; Eichengreen, 1995; Sommariva & Tullio, 1986; Tullio & Wolters, 2003; Wühle, 2011).

The findings show that the Reichsbank’s policy actions were mostly inconsistent with its stated policy intent mostly with regard to gold movements. The paper offers a simple test about exchange rate credibility based on uncovered interest rate parity and affirms that the Reichsbank suffered a credibility deficit initially but managed to build-up credibility over time by strengthening adjustment to money market shocks.

⁴³ The notion of masquerading and type 1 and type 2 policy makers are from Barro (1986).

⁴⁴ The notion of monetary policy impact is upheld for the Reichsbank by Sommer (1931): “[when] the Reichsbank held the reins of the expansion of the economy as the “golden brake” of credit is pulled, critique about the bank policy can immediately be heard.” Similarly, the prominent daily National Zeitung commented on the publication of the 25-year anniversary of the Reichsbank that the discount policy can be interpreted as the inter-relationship between central bank and the economy (Reichsbank, 1900): “Die Darstellung der Discontpolitik, ihrer Aufgaben und ihrer Gestaltung in den letzten 25 Jahren mußte [...] selbst den Character einer Wirtschaftsgeschichte annehmen, sich zu einer Geschichte der Wechselwirkung zwischen Bank und Volkswirtschaft gestalten.”

The results are supportive of the notion that some monetary policy autonomy can be preserved under fixed exchange rate regimes (Bordo & Flandreau, 2001; Bordo & MacDonald, 1997; Krugman, 1991; Morys, 2013; Svensson, 1994; Ugolini, 2012). The paper offers some statistical evidence though not strongly that the Privatnotenbanken influenced the Reichsbank's discount policy but refutes the notion that the Privatnotenbanken supported the Reichsbank (Bopp, 1953; National Monetary Commission, 1910b).

The statistical estimations thus confirm earlier studies that the Reichsbank deviated from the rules of the game under the classical gold standard (Bloomfield, 1959; Giovannini, 1986; Contamin & Denise, 1999; McGouldrick, 1984; Morys, 2013; Sommariva & Tullio, 1986). The results also support the notion that the Bank of England was less influential (Contamin & Denise, 1999). The findings show contrary to Bordo and MacDonald (1997) that the effect from economic activity was significant in the subperiod 1879-83. The findings also do not support Tullio and Wolters (2003) that the internal convertibility of banknotes are the main concern and that the Bank of England discount rate cannot be neglected.

The paper offers supportive statistical evidence that the Reichsbank shifted its policy stance increasingly towards pursuing domestic money market accommodation. The results highlight that the policy phases the Reichsbank's identified correspond to actual changes in policy formulation underlining the importance of using narrative evidence to guide the statistical estimations.

The findings show that the importance of external interest rates was significant in the first phase but no longer in the second phase. The reduced role of external interest rate shocks in 1884-88 seems to affirm that the international interest rate transmission mechanism was less pronounced than conventionally assumed and may weaken the assumption that the gold standard was a critical transmission channel for external shocks (Bernanke, 1993, Eichengreen, 1995).

The paper also demonstrates that the dual accommodation of national and international objectives affirms doubts about the relevance of the classical exchange rate trilemma. Nineteenth century Germany supports the notion that the trilemma is only binding under insufficient perceived commitment credibility. For fixed exchange rates, this may suggest that the accommodation of domestic policy

objectives can be achieved amid certainty that the exchange rate standard is sustained. For currency unions, it indicates that domestic policy objectives can be pursued if there is sufficient confidence that redenomination risk is small. In a broader context, nineteenth century Germany supports the view that the exchange rate is simply an outcome of economic policies. The trilemma seems more a function of policy credibility than of the incompatibility between fixed exchange rates, capital flows and monetary policy autonomy. Weak policy credibility can therefore reduce monetary policy autonomy even under flexible exchange rates. The Reichsbank operated in a framework not of rules *versus* discretion but rules *and* discretion.

3.6. References

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4. Conclusion

The success of Germany's nineteenth century monetary union is believed to have rested to an important extent on its mixed central banking system. The system was able to address, though only modestly, the perceived economic crisis of 1873-86 (Gründerkrise) with its capacity to respond to spatial economic diversity while facilitating the subsequent economic recovery and maintaining monetary stability. It offered a gradual path towards increasing monetary integration while preserving important elements of decentralisation. The rising centralisation of the system towards the end of the nineteenth century may be due to a fundamental lack of appreciation of the gains from regional monetary policy differentiation against the gains from centralisation.

The thesis illustrates that Germany's 1875 central bank reform represented an important and integral part of Germany's political and economic developments in 1876-90. The reform was the outcome of institutional innovation and modern central banking concerns and endowed monetary policy with a critical role in particular during the early years of the German Empire.

The thesis demonstrates that Germany's mixed central banking system addressed stability concerns in monetary policy, was able to respond to differential spatial economic developments and facilitated pursuing domestic policy objectives under the gold standard.

The implication of the thesis for the literature about nineteenth century Germany's central bank reform and monetary policy conduct covers at least six aspects: i) the central bank reform preserved important decentralised elements and as such distinguished itself from prevailing period central banking trends and offers an early example for the agency delegation in monetary policy literature; ii) the role of the Privatnotenbanken merits to form an integral part of the study of nineteenth century monetary reforms and monetary policy conduct; iii) the importance of spatial diversity in Germany for public policies needs to be incorporated into the economic policy analysis of nineteenth century Germany; iv) the impact of monetary policy on economic activity needs to be included into the analysis of the Gründerkrise and economic developments more generally; v) the monetary policy

conduct of the Reichsbank was more nuanced and flexible; vi) the importance of period narrative evidence to guide economic and statistical analyses.

The thesis contributes to one leading cliometric theme on Germany's monetary and banking history amid absence in the banking historiography of regional differences in bank behaviour and ambivalent treatment of the Reichsbank under the gold standard.¹ The compilation of key monthly monetary and economic data allow to use more advanced statistical methods to analyse monetary and economic developments in Germany in 1876-90.

The implication for the literature about the classical gold standard is that monetary policy was adaptive and reputation and policy autonomy important. The rules of the game offer too narrow a framework of analysis for the conduct of monetary policy under the gold standard and need to be complemented with references to commitment and reputational forces.

The implication for the literature about monetary unions is at least fourfold. Nineteenth century Germany offers an example for decentralisation under monetary unions and that adoption of a single currency must not mean a single monetary policy. The thesis supports the notion that decentralisation in monetary policy conduct is compatible with monetary stability. It offers tentative evidence that local adverse shocks can be effectively accommodated by monetary policy differentiation. The thesis may motivate explorations of early historical examples of optimum currency areas considerations and concerns.

The first paper asserts that the 1875 central bank reform in Germany combined important incentives and rules-based elements. Legislators intended for competition among the Reichsbank and the Privatnotenbanken to induce prudent note issuance behaviour. The findings affirm that the Reichsbank was influential in affecting in the short term the Privatnotenbanken through lending operations while the Privatnotenbanken maintained a considerable degree of autonomy. The Reichsbank was less effective in influencing prudential standards in the system consistent with the notion that the Privatnotenbanken were free-riding on the financial strength and lender of last resort function of the Reichsbank. Overall, the

¹ See footnote 8 on page 16 of the Thesis introduction.

autonomy preserved by the Privatnotenbanken indicate that they constitute an important factor in any monetary study of nineteenth century Germany.

The second paper attests that the prolonged economic difficulties in Germany in 1876-90 can be attributed at least in large part to an unduly negative impact of monetary policy. The Reichsbank's monetary policy stance may have contributed to delaying a sustained recovery. Regional monetary policy allowed some policy differentiation. This may have prevented a more adverse economic outcome. The paper's statistical results support tentatively the notion that monetary policy differentiation in a monetary union can be effective in addressing adverse regional shocks.

The third paper supports the assertion that the Reichsbank in 1878-90 maintained important policy discretion and had initially but not intermediately followed the rules of the game of the classical gold standard. The results are more consistent with the gold standard as a commitment rule with reputational forces and affirm that the rules of the game may not serve as an appropriate framework for analysing monetary policy under the gold standard. The findings demonstrate that the Reichsbank shifted emphasis towards domestic policy concerns while strengthening its policy adjustment to money market shocks bolstering its commitment credibility to establish greater policy autonomy. The paper also finds that external interest rate shocks were less important indicating that the international interest rate transmission mechanism was less pronounced than conventionally assumed affirming doubts about the relevance of the classical exchange rate trilemma. The Privatnotenbanken maintained operational autonomy and had not supported the Reichsbank including in guarding against adverse shocks to its gold reserve.

The mixed system through increasing centralisation amid the mounting dominance of the Reichsbank offered a process of gradual endogenous adaptation of the German federal states to the central banking system and the Reichsbank and the Privatnotenbanken to the circumstances of the Empire. At the same time, the dominance of the Reichsbank undermined the basis of competition-induced policy discipline and therefore the system's safeguards. This may have contributed to reducing the system's resilience to the increasing monetary instability in Germany during the 1920s.

The thesis offers different indicative lessons for the Euro Area. Those lessons naturally can only be tentative amid the significant differences between nineteenth century and contemporary financial markets and economic conditions. However, the advantages of a mixed central banking system to address spatial diversity suggests that fundamental considerations could be given to the reintroduction of the national central banks to strengthen the Euro Area and the euro. This must not mean mobilisation of all national central banks, as national boundaries may not be congruent with spatial central banking needs but could imply activation of some on the basis of common structural patterns in the Euro Area. While the reintroduction of national monetary policies may constrain financial market integration, though it must not, the benefits of monetary policy differentiation may significantly outweigh its costs. Nineteenth century Germany should serve as a reminder that the adoption of monetary union is a continuous process and that a single currency must not mean a single central bank and a single monetary policy. Decentralised central banking seems an organisational approach to central banking that is relevant not only for Germany's past but for the Euro Area's future.