



Determinants of high economic growth – Empirical evidence from Germany between 1860 and 1913

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ABSTRACT

We contribute to the controversy about the contribution of German banks to the high-growth income formation process from 1860 to 1913. We use recent improvements in integrating banks in economic modelling, deploy a more robust econometric modelling methodology, and use a broad dataset including all types of banks. Our statistical findings suggest a significant link between broad credit creation (as measured by total assets of the banking system) and nominal Net National Product (NNP), confirming earlier studies and contradicting some studies finding no such relationship. The findings support the case that banks exert a significant influence on economic activity and development. Furthermore, the controversy concerning the ‘too much finance’ argument may be resolved: Small local banks continued to act as conservative financial services providers and no financial excess was observed during the period.

1. Introduction

This paper engages with a number of ongoing debates in the economic literature. Firstly, Nakamura and Steinsson (2018) conceded that there has been a distinct lack of progress in equilibrium macroeconomics over the past century, whereby the three fundamental questions remain unanswered, namely what determines economic growth (both in the short-term and in the long run), how does monetary policy work, and how does fiscal policy work. The relevant research question we pursue in this context is: what determines economic growth in the long run, especially the rare and instructive cases of high economic growth for several decades (in the 20th century as delivered by Japan, Korea, Singapore as well as China and its regions, first in Taiwan and East-North China and since 1978 all across China). We consider the case of high growth in Germany in the decades up to 1914.

Concerning the identification strategy, given the lack of evidence for equilibrium, let alone general equilibrium, we adopt the empirical research methodology. As will be discussed in the literature review section, this paper constitutes another contribution in the strand of literature that considers bank credit creation a key macroeconomic factor. While this most basic macroeconomic model that incorporates banks as creators of the money supply (Werner, 1997) has been tested for a number of economies, including high growth countries, it had not yet been applied to pre-World War I Germany. Using a more complete dataset on bank credit, we confirm support of the role of bank credit creation in explaining economic growth. We point out the limitations of this contribution and indicate future

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avenues of further work to expand this line of research.

In the process of the above research, we also point out how this links with other strands of literature that do not recognise the role of banks as creators of the money supply, such as the debates on the stock market (or “Anglo-Saxon”) oriented economies vs. bank-oriented economies, the debate about the time horizon of banks' investment decisions, for instance in the UK vs. Germany; the degree of centralisation vs. decentralisation of the banking sector; and the debate about the regulatory environment, specifically the contrast between universal banking systems (such as in Germany) and specialised banking (such as in many ‘Anglo-Saxon’ economies).

With respect to the historical influence of bank credit on German income formation and economic growth, much literature has limited their analysis to the few large banks (joint-stock credit banks), generalised their findings, and reported mixed results. This presents a gap in the literature, since the vast majority of banks in Germany at the time, with an estimated share of more than 90%, were small, local community banks, numbering in excess of 10,000. There is a need for analysis that reflects the role of these thousands of small, local banks lending to small and medium-sized enterprises (SMEs), which account for ca. 99% of all companies in most countries, including in Germany during the observation period. They also accounted for the vast majority of employment (and still do today) and hence their performance – and ability to receive external funding, which mostly is from banks – determine productivity (Werner, 2012b; Werner, 2016b).

Diekmann and Westermann (2012) find that bank lending has generally not had a homogeneous effect on the German economy. Meanwhile, in the UK the banking system became dramatically more concentrated during the pre-1914 decades, with the number of banks falling from over 1000 as recently as 1821 to less than 300 in 1907 (Mitchie, 2016), and the ‘Big Five’ having emerged by 1913 as the dominant banks. By contrast, in Germany the banking system did not become significantly more concentrated during this time period. To the contrary, the number of banks only peaked in the mid-1920s, at over 20,000. Furthermore, the market share of the ‘big banks’, i.e. the joint-stock banks, measured by assets, did not even double before the first world war (it rose from 15.8% in 1860 to 28.2% in 1910), while the market share of all other banks except central banks increased more significantly: Co-operative banks increased their market share from 0.5% in 1860 to 8.6% in 1910, mortgage banks from 2% to 23.6% and savings banks from 28.6% in 1860 to 33.2% in 1910. (By comparison, in 2010 savings banks accounted for about 40% and co-operative banks about 30% of bank assets).

This makes it clear that a new methodology that reflects the many small banks ‘lending to the real economy’ should be adopted. In this way, the more decentralised and less concentrated nature of the German banking system is better reflected in the analysis.

We contribute to the literature by empirically examining the pre-1914 German high growth experience from the perspective of banks as creators of credit and the money supply (Werner, 1997, 2014, Werner, 2016a). This is the most basic macroeconomic model that incorporates banks as creators of money.

We also contribute a rigorous econometric methodology to the debate, namely the general-to-specific (GETS) empirical methodology (Hendry & Krolzig, 2005; Hendry & Mizon, 1978). This allows for a more transparent research process where hypotheses are tested in relation to alternative hypotheses.

The findings support the case that banks exert a significant influence on economic activity and development. Furthermore, the controversy concerning the ‘too much finance’ argument may be resolved: Small local banks continued to act as conservative financial services providers and no financial excess was observed during the period.

2. Literature

North (1981) argues that the organisation of society is a basic force of development. This insight is scarcely controversial, although it is sometimes questioned on the basis of theoretical models, which however describe quite different universes than are subject to historical discussion. Glaeser et al. (2004) define institutions only as political institutions and report no evidence for the role of political institutions in the economy. The idea that institutions are key causal factors in determining economic growth has been empirically supported, among others, by Acemoglu, and JohnsonRobinson (2001) and Rodrik et al. (2004). Auer (2013) and others compare colonized countries and non-colonised countries, thereby identifying and providing evidence for the importance of institutions. For a survey of the literature on comparative economic development, see for instance Spolaore and Wacziarg (2013).

Meanwhile, among economic institutions the existence and design of the financial system appear to be important for economic growth, as recognised notably by Bagehot (1873) and Schumpeter (1912), as well as more recent empirical evidence by King and Levine (1993, 1997), Levine and Zervos (1998) and Levine (2005).

One of the most-intensely analysed cases with regard to the theory of bank-induced growth is pre-1914 Germany, which experienced high, and even for several years double-digit growth (cf. Collins, 1990; Fohlin, 1999b; Guinnane, 2002). Authors see differences in the banking system of Germany, and thus suggest that a different relationship between the financial structure and economic development existed, compared to the UK and France. For instance, Cassis (1991) notes: “The differences between the English, French and German banking systems are relatively well known and the relationships between financial structure and economic development have been for several decades a central issue in economic and business history” (p. 53).

The thesis that banks may act as catalysts or drivers of economic development has often been stated, but remains controversial as debates about the perceived merits of bank vs. stock market based financial structures continue (see e.g. Dore, 2000; Goldsmith, 1969) and as authors such as Arcand et al. (2015) have advanced the thesis that there may also be “too much finance” for the good of a country's development.

A large empirical study by Gosh (2017) found that the banking sector may hinder growth, if it becomes too much dominated by foreign banks. On the other hand, Wegner (2024) shows in a theoretical model based on the German banking system that economic growth is likely to decline if a formerly de-centralised banking system with local decision-making providing credit to small and

medium-sized enterprises switches to centralised decision-making within a consolidated and more concentrated banking system.

One distinguishing feature of different financial system designs that has been examined is the time horizon of banks' investment decisions. This has been an important feature in the literature in general and specifically concerning the performance of the German economy, often in contrast with the UK. Cassis Youssef (1985) notes that before 1914 "German banks earned praise from certain British contemporaries, if few British bankers, and some later historians, for their long-term investments in industrial development." (p. 301). On the other hand, as the Colwyn Committee (1918) concluded, the big English banks, known as the Big Five clearing banks, focused on granting short-term loans (up to two years), discounting of bills (largely 3 months maturity) and the granting of overdrafts (also of limited, if undefined maturity, see Cassis, 1985; Billings et al., 2019). It was a major criticism by the Colwyn Commission that the English big banks "did not engage in long-term loans, nor in long-term investment in other companies, nor invest in firms in order to exert managerial direction. Their investments were mainly in Consols, with some shift to a more diversified portfolio in the early 1900s as the price of Consols dropped" (Cassis, 1985, p. 301). Gerschenkron (1962) in particular contrasted the British banks' concern with money market investments and the maintenance of a high degree of liquidity with the German banks who invested heavily in long-term engagements supporting German industry. Dore (2000) made the case for a wholesale contrast between a bank-based economic system that was oriented towards general welfare seen in Germany and Japan and a stock market-based system as seen in Anglo-Saxon countries.

Best and Humphries (1986) and Tolliday (1987) argue that institutional rigidities indeed prevented UK banks from providing the sort of financing industry needed. As a contemporary banking observer put it:

"the [English] banks have never shown any interest in the newly founded companies or in the securities issued by these companies, while it is a distinct advantage of the German system that the German banks, even if only in the interest of their own issue credit, have been keeping a continuous watch over the development of the companies, which they founded" (Riesser, 1909, p. 555, as cited in Baliga & Polak, 2004).

However, such debates do not focus on the direct and quantifiable impact of bank activity on economic growth, which thus remains a subject of debate in this literature.

In the words of Collins (1990):

"There has long been a deep interest in the relationship between finance and industry in Britain before World War I. It is both an issue that occupies a prominent position in the analysis of the role of ruling elites and a major area of concern in the debate over the UK's alleged relative industrial retardation from the last quarter of the nineteenth century. It is a debate that directly concerns the efficiency of financial market allocation and the relative importance of institutional constraints in inhibiting economic growth. ... it is generally accepted that deposit banks were not significant suppliers of industrial finance" (p. 198).

While Collins (1991) argues that Gerschenkron was correct in his assessment of British banks being short-term financial investors, ultimately failing British industry, while German banks provided long-term capital for industry (p. 201), these views are not uncontested. In their seminal empirical analysis of the breakdown of industrial financing by English commercial banks in the three and a half decades before the first world war Capie and Collins (1999) note that the literature had been emphasising the British banks'

"failure to provide long-term loans to industrial firms and a failure to establish close, supportive relations with their industrial clients. The contrast is frequently drawn with the practices of central European banking, particularly the German model of universal banking, which is said to have been superior in the support it gave to industry" (p. 37).

However, their empirical work concluded that "such contrasts have been overdone".

Likewise, Fohlin, 2001 challenged the common view that the universal relationship banking systems of Germany and Japan had given those countries an advantage in industrial development and economic growth during industrialisation and beyond, presenting findings that, compared to the British banks, German banks maintained significantly higher levels of liquid assets relative to their short-term liabilities and a similarly small share of their assets in non-government securities:

"These results suggest that the commonly perceived gulf between specialised and universal banking may exaggerate the real, quantitative differences between the systems. Such a conclusion falls in line with recent work that finds that the qualitative differences between British and Continental banks appear less significant than in the previous literature" (p. 2).

We note that such debates are not settled and pose that this is due to a missing factor that empirical research has hitherto neglected, and which our work highlights.

There is another angle, namely socio-political factors. Researchers argued that financial interests established a position of significant political control and thus were able to pursue their own goals (Ingham, 1984; Overbeek, 1980). The latter view seems to explain the developments since the 1980s, when Margaret Thatcher appeared to be siding with City interests while showing less concern with industrial policy. It remains a topical issue, since the notion that industrial policy is necessary to support industry under certain circumstances has staged a revival under recent Conservative and Labour governments (see the Industrial Strategy White Paper, Department for Business, Energy and Industrial Strategy, 2017).

Similarly, Cassis (1991) emphasised the powerful role of the City of London 'aristocracy' that did not seem interested in industrial development, but pursued different goals, due to the City's role in the Empire, thus creating a division between industrial capitalists and finance capitalists unlike Germany. At the same time Cassis (1991) finds in his comparative analysis of UK, French and German 'financial elites' ('financial aristocracy')

“the earlier emergence of a professional banking elite in Germany appears unlikely to have had long-term economic implications.”

But his finding seems influenced by the fact that he only considers the major ‘financial centres’, namely in this case, Berlin and its big banks, at a time when Germany, unlike the UK, had a highly decentralised banking system with thousands of provincial, local and community bankers deeply embedded into their local villages and towns. Neither their status nor their behaviour would have qualified them as ‘financial aristocracy’, yet they were conducting the majority of banking business in Germany – something that needs to be reflected in new research. As a result, such comparative business history that focuses the scope of analysis on such a big five comparison in both countries (see, e.g. Cassis, 1985; 1991) is not likely to be able to shed light on the difference in role of the banking sector as a whole in economic development. For this, research on the entire banking systems is required. There is thus a need to recognise the role and implications of the German decentralised banking system – as we shall do – at a time when the UK banking system had come to be highly concentrated:

“The British banking system emerged from World War I with a degree of centralization unprecedented among major industrial nations. Five major clearing banks formed a collusive oligopoly that constituted one of the most powerful and enduring monopoly positions in any major British industry,” *Scott and Newton (2007, p. 881)*.

On this aspect, namely the topic of the link between increased concentration and the degree of competition (and hence ultimately the quality and quantity of service provided by banks to their customers) of banking sectors, the literature also remains inconclusive, although research at least supports the notion that bank amalgamations (as happened in the first half of the 19th century in the UK, but not in Germany) reduces competition and also the quantity and quality of bank loan services to corporate borrowers (Werner, 2016b; Braggion et al., 2017). Meanwhile, the German banking sector has remained one of the most fiercely competitive in the market for corporate bank loans, due to the unusually large number of banks (even today by far the largest in the EU, with ten times as many banks in Germany as in the UK), as well as the different types of banks (whereby competition also exists between various types of banking groups and associations, Werner, 2016b).

We make the case that a missing dimension in the above discussions is rooted in the macroeconomic role of banks. This emerges from empirical work, such as that by Schularick and Taylor (2012), who examined the role of banks in the propagation of boom-bust cycles and financial crises, on the basis of a disaggregation of bank lending, although they do not identify the issue we emphasise. However, the capacity of the banking industry to be implicated in large boom-bust cycles and crises is not only evidenced by UK banks, but also was a feature of pre-World War I German banking: The German Empire suffered one of the most severe economic crises soon after the victory in the Franco-Prussian War of 1871 – the so-called *Gründerkrise*. Our approach also has implications for this aspect of the impact of banks.

We note that a significant proportion of the literature on the link between banks and growth in the pre-1914 era in Germany focuses on the small number of large banks (joint-stock credit banks). For instance, Neuburger and Stokes (1974) in their examination of the influence of bank credit on German income formation and growth conclude that bank credit for productive purposes by joint-stock credit banks inhibited German growth. Edwards and Ogilvie (1996) suggest that joint-stock credit banks were too small compared to the size of German income in order to influence economic development significantly. Becht and Ramírez (2003) argue that German mining and steel firms with close links to joint-stock credit banks were not as liquidity-constrained as firms without such a close link. Burhop (2006) reports that joint-stock credit banks played an important role with regard to capital formation only in the early phases of industrial development in 19th century Germany. In the data period from 1860 to 1913, no leading role with respect to net national product (NNP) was detected. On the other hand, Tilly (1986) states that banks fostered growth via portfolio diversification and the expansion in risk-capital. Kindleberger (1993) argues that, despite their relatively small size, the so-called great banks were affecting economic growth significantly. Fohlin (1999a) provides evidence for a minor though statistically significant positive impact of joint-stock credit banks on German economic growth.

In conclusion, considering the literature, even though we do so only selectively here, it can be stated that there is no consensus on the issues at hand. Indeed, there seems to be a disconnect between the widely-held impressionistic view that the German bank-centred economic system served as a model for the East Asian high growth countries and that banks are indeed important for high growth on the one hand, and the carefully presented empirical and quantitative evidence published in journals, such as cited, which suggests at the very least that the story is far from straight-forward.

However, the conventional literature on these issues has neglected another strand of literature identifying the role of banks as creators of the money supply. This has quietly gathered an increasing number of researchers and thus earlier studies not reflecting this would appear to suffer from omitted variable bias. There are two central aspects of the role and tasks of banks that have been neglected and that have not been sufficiently taken into consideration in the above debates:

It is now empirically established that banks are not financial intermediaries that transfer existing purchasing power, as most textbooks and many policy-makers maintain, but instead creators of the money supply, whereby the extension of a loan by a bank allows each bank to newly create credit that adds to the money supply in the economy (Werner, 2014a, Werner, 2016a).

Secondly, this money creation power renders the specific credit allocation decision by banks crucial in order to determine the macro-economic impact of bank credit. Werner (1997, 2005, Werner, 2012a, 2013) resolved the puzzles surrounding the traditional quantity equation ($MV=PY$), such as the observed velocity decline (e.g. Goodhart, 1989) by addressing its two weakness, namely,

- I) It is a special case that assumes all money M is used for transactions that contribute to nominal GDP (PY), while in actual fact in many economies the majority of money or newly created money is used for asset purchases (which are, according to the international standards in national income accounting, not included in national income, GDP or GDE, as they do not add value).
- II) Empirical applications have focused on deposit aggregates, but, as already Milton Friedman and Anna Schwartz lamented, “We have no way of dividing the money stock into parts used for investment and parts used for consumption” (Friedman and Schwartz, 1982, p. 47).¹

Werner does so by encompassing the traditional quantity equation $MV=PY$ with his quantity equations of disaggregated credit, which render $MV=PY$ a special case that applies when asset transactions are negligible, while the disaggregated credit equations constitute the general case (with C_R = credit contributing to national income or the ‘real economy’ and C_F = credit for asset purchases):

$$(1) C_R V_R = P_R Q_R = P_R Y$$

$$(2) C_F V_F = P_R Q_F$$

This General Quantity Theory enabled Werner (2005) to identify three macro-economic scenarios based on the particular credit allocation of banks, namely:

- a) When banks create credit for asset purchases, this does not contribute to national income or GDP and instead result in capital gains due to their effect of causing asset inflation. In aggregate, such asset inflation processes are Ponzi schemes that last while banks keep creating more money for asset purchases and that end abruptly when this ‘music’ stops. Then they are followed by bankruptcies, non-performing loans and a downturn due to the heightened risk-aversion by banks dampening credit creation further.
- b) When banks create credit for consumption, this contributes to nominal GDP, but not to an expansion in real growth. Instead, this causes inflation.
- c) When banks create credit for business investment, this contributes to real GDP, by allowing companies to increase productivity, implement new technologies and generally add value.

There is a growing body of literature supportive of this framework. For instance, Calza et al. (2006) present data on loans to the real economy being correlated with GDP, conceding that credit supply driving GDP could be an explanation. Lyonnet and Werner (2012) found that UK credit for GDP transactions explains nominal GDP over several decades, beating monetary aggregates in a reduction from the general to the parsimonious form. These findings are all in line with equation (1) above.

Werner (1997, 2005) shows that credit for real estate transactions explains and uni-directionally Granger-causes commercial real estate prices. Liang and Cao (2007) report that there exists unidirectional causality running from bank lending to property prices in China. Davis and Zhu (2011) on Hong Kong, and Goodhart and Hofmann (2003) on a panel of countries, find significant relationships between bank credit for asset purchases and property prices. These findings are in line with equation (2).

Werner (1997, 2005) also emphasises that increased credit growth for non-GDP (financial) transactions creates unsustainable asset price rises, followed by banking crises. Werner points out that the ratio of financial credit to total credit is a predictor of banking crises, which can also be approximated by the ratio of total credit growth to nominal GDP growth (Werner, 1995c). Jorda et al. (2011) applied this rule and found a close relationship between credit growth relative to GDP in the expansion phase and the severity of the following recession for 14 advanced countries over almost 140 years.

Buyukkarabacak and Valev (2010) found that household credit expansions have been a statistically and economically significant predictor of banking crises, while enterprise credit expansions are weaker and less reliable in predicting banking crises.

In this Werner (1997 2005; Werner, 2012a, 2013) framework, it is recognised that the fundamental factors identified in the conventional economic growth literature affect potential growth (the quantity of factor input mobilisation and their quality, i.e. total factor productivity), while generally it is to be expected that actual growth is held back by the lack of bank credit for the real economy: The framework does not rely on the canonical assumptions, such as profit maximisation by rational agents acting always independently from others, perfect competition, complete markets, perfect information, zero transaction costs, flexible and instantaneously adjusting prices and absence of time constraints. Consequently, the conditions for market equilibrium are not presupposed. In rationed markets, the short-side principle applies, which in the market for money and credit is the supply-side (as demand for money and credit is virtually unlimited). Thus the quantity of bank credit extended for productive business investment is the limiting factor of economic growth.

By adopting this approach and framework, this paper contributes to a better understanding of the role played by the German banking sector in delivering income and economic growth. It also resolves various apparent contradictions: When bank credit is used for ‘lending to the real economy’ in the form of corporate credit, then economic growth rises, in line with equation (1) (and as argued recently by the ECB, 2020). When bank credit is used for asset purchases, it does not result in economic growth (but rather asset

¹ The full quote is: “We have no way of dividing the money stock into parts used for investment and parts used for consumption. The money that a businessman borrows to build a factory and the money that a consumer borrows to buy a car are indistinguishable once they are deposited in a bank. Both are part of $M1$ or $M2$; both are entries on the liability side of the bank's balance sheet. The aggregates tell us nothing about the *uses* to which money is put — whether it finances capital formation or current consumption, whether it is active or idle, whether it is held for transactions or for speculation. That is both their great virtue and their fatal flaw” (1982, p. 47).

inflation), as equation (2) indicates, and may indeed harm growth, as argued by [Arcand et al. \(2015\)](#). The framework also explains why the diverse banking sector in Germany pre-1914 delivered very high economic growth, while the still diverse banking sector of post-1945 delivered much more modest (although still respectable) growth: The composition of bank credit had shifted away from business lending to property lending, especially from the 1980s onwards, as directly incentivised by the Basel framework introduced by the BCBS for international banks and adopted even for small local banks that are not internationally active throughout the EU by the European Commission in implementation of its anti-growth policies.

The literature on Germany however has often focused on the five Berlin big banks, while the research works that include the many other banks, including private banks and thousands of local co-operative banks and savings banks, remains limited.

The above framework suggests that the debates about short-term vs. long-term lending, universal banking vs. specialised banking and concentration of banking systems can possibly be reconciled, as soon as the above two dimensions of banks as creators of money, and disaggregation of bank credit for business investment vs. bank credit for inflationary purposes are introduced. We contribute at least part of this effort.

The remaining parts of this paper are organised as follows: The next section describes the research methodology. This is followed by a discussion of the data deployed. After this, we present our findings and conclude.

3. Econometric methodology

One of the most-widely used econometric techniques in cliometric studies is by far the cointegration-based VAR approach.² However, the General-to-Specific (GETS) approach, originally published by [Hendry and Mizon \(1978\)](#), represents a more powerful econometric testing approach, as no priors are required and the researcher is forced to let the data speak, without being able to influence the results unduly.³

Thus there is a gap in the existing literature on the determinants of the high economic growth of pre-1914 Germany also in terms of econometric methodology: We are not aware of research that has adopted the general-to-specific (GETS) empirical methodology.

When empirical findings are not conclusive or contradictory, a research methodology should be applied that essentially allows a horse race between various theories and hypotheses. To do this, first a general model is formulated, which includes many potential explanatory variables, including those of rival theories. Then an objective estimation technique is used to sequentially simplify the general model and arrive at the parsimonious formulation (while using linear restriction tests to confirm the validity of eliminating apparently insignificant variables). We believe we are the first to adopt this methodology in an evaluation of the determinants of high growth in Germany before 1914.

Thanks to the development of multi-path GETS algorithms, the GETS approach has witnessed major advances in recent years.⁴ The quintessence in the new literature about multi-path GETS modelling is that it can be superior to single-path GETS modelling. We therefore deploy the multi-path GETS modelling approach presented by [Sucarrat and Escibano \(2012\)](#) which can be viewed as an augmented version of the [Hoover and Perez \(1999\)](#) algorithm. In order to do so, we employ the R statistical software in combination with the AutoSEARCH-package developed by [Sucarrat \(2012\)](#) for the estimation of the mean specification.

The GETS modelling approach starts with a general unrestricted model (GUM) which is tested against a selected set of misspecification tests. Thereafter, a stepwise elimination procedure is undertaken by testing whether parameter restrictions are valid so that parameters can be dropped without losing explanatory power or necessary statistical properties. The step-by-step elimination and re-estimating ends when all parameters have significant coefficients and a further restriction is rejected, by linear restriction tests, by misspecification tests and an additional backtest (BaT) against the GUM. The outcome is the parsimonious (or 'specific') model (see [Sucarrat & Escibano, 2012](#), p. 718).

This procedure likely entails multiple terminal models. However, selection procedures between these multiple terminal models are also implemented.⁵ More specifically, the mean specification of the "SEARCH model" or GUM is defined by:

$$r_t = \phi_0 + \sum_{m=1}^M \phi_m r_{t-m} + \sum_{n=1}^N \eta_n x_{nt} + \varepsilon_t \quad (1)$$

$$\varepsilon_t = \sigma_t z_t, z_t \sim IID(0, 1) \quad (2)$$

ϕ_0 represents the intercept whereas M is the number of autoregressive (AR) terms while N represents the number of explanatory variables (lagged and/or contemporaneous). We assume the standardised errors z_t to be IID with zero mean and unit variance.

4. Data

We deploy a newly-gathered data-set on German banking. Moreover, we use a different estimate of nominal Net National Product (NNP) to shed new light on the question of the role of banking in economic development in the case of Germany.

² See [Greasley and Oxley \(2010\)](#) for a survey.

³ For a discussion of its advantages, please see [Hendry and Krolzig \(2005\)](#). Analytically it is superior, as it satisfies Ockham's Razor.

⁴ See [Hoover and Perez \(1999\)](#), [Hendry and Krolzig \(2001, 2005\)](#), and [Doornik \(2009\)](#).

⁵ See also [Sucarrat and Escibano \(2012\)](#), pp. 721-22 for a detailed description of the selection procedure.

While we would have liked to obtain a clear breakdown of bank credit to single out bank credit for the real economy from bank credit for asset purchases, alas such disaggregation has not (yet) been possible. For bank lending data we are thus restricted to a dataset almost identical to the one employed in [Diekmann and Westermann \(2012\)](#), who however did not adopt the GETS methodology, who did not include the central bank and whose work had a different focus. Thus, we aggregate the total assets of the following banking groups: Savings Banks (*Sparkassen*) ([Hoffmann et al., 1965](#), pp. 733-4), Co-operative Credit Associations (*Kreditgenossenschaften*) ([Hoffmann et al., 1965](#), pp. 736-7), Mortgage Banks (*Hypothekenbanken*) ([Hoffmann et al., 1965](#), pp. 739-40), Central Banks (*Notenbanken*) ([Hoffmann et al., 1965](#), pp. 751-2), and Joint-Stock Credit Banks (*Aktien-Kreditbanken*) ([Burhop, 2002](#), p. 128) from 1860 to 1883 and post-1883 from the *Bundesbank* (1976, p. 56). All data is annual. We will refer to this aggregate as “total assets of the banking system” (henceforth TA), which measures total bank credit and hence money creation ([Werner, 2014](#)), in line with [Burhop \(2006\)](#), as well as the [Polak \(1957\)](#) IMF model for developing countries.⁶

The aggregate is dominated in terms of the number of banks by the tens of thousands of small local banks, mainly in the two groups of savings banks and co-operative banks, and overall there is a predominance of small-firm financing.

Concerning the use of bank assets to measure bank credit creation, as noted this has been done before in the literature and by influential policy-makers, such as the IMF. There is now a better empirical and theoretical reason for doing so: Since the empirical tests of the three theories of banking by [Werner \(2014a, Werner, 2016a\)](#) it is recognised that banks create the money supply and, more generally, create virtually all fungible purchasing power in the economy (this is all banks, including the central bank) by purchasing assets (securities, such as promissory notes, whether in the form of loan contracts or government bonds, or even equity) and recording the resulting accounts payable liabilities as another type of liability known as “customer deposit” (as [Werner, 2014b](#) showed). The corollary is that it is not only valid to consider bank assets as a measure of the broad money supply, but it is likely to be a better measure than the conventional “M” deposit aggregates, which measure merely sub-sets of private sector assets, while suffering from the problem that it is not clear which cut-off should be chosen (M0, M1, M2, M3, M4 etc.), as Milton Friedman (1956) conceded (“there is no hard-and-fast line between ‘money’ and other assets”, p. 158).

The period from 1860 to 1913 is chosen due to the availability of banking statistics and is identical to the period investigated by [Burhop \(2006\)](#).

It should be noted for those not routinely working with 19th century monetary or financial data that a caveat is that the bank balance sheet data may still be prone to measurement error, because historical finance information cannot be considered as reliable as present-day data. However, since we are considering growth rates, as long as the error remains reasonably stable, it would not change the results. The complete dataset on Germany's community banks is listed in the appendix to this paper.

As is common in the development economics literature, we use a national income accounting measure to gauge economic development. We note the critique raised by [Sarferaz and Uebele \(2009\)](#) as well as [Uebele and Ritschl \(2009\)](#) of the estimate of German real NNP by [Burhop and Wolff \(2005\)](#). For instance, [Uebele and Ritschl \(2009\)](#) argue that the procedure to use real (i.e. “deflated”) time series in a regression, might induce spurious correlation between dependent and independent variables. We avoid this issue by deploying nominal variables. We prefer nominal rather than real variables also for theoretical reasons: the macroeconomic equations linking the economy and the monetary system - the General Quantity Equations (as well as the traditional Quantity Equation) - are stated in nominal terms, so that in the first instance this relationship should be examined.⁷

Despite the extensive utility of the [Burhop and Wolff \(2005\)](#) estimate of German NNP over the individual estimates by [Hoffmann et al. \(1965\)](#), contrary to [Burhop and Wolff \(2005\)](#), who made the arbitrary choice to assign different weightings for the respective NNP, we prefer a simple equally-weighted estimate of nominal NNP of the four different income series (i.e. 25% weighting each), which does not allow the researcher to influence the estimation. We make use of the NNP-deflator inherent in the real and nominal expenditure series presented in [Hoffmann et al. \(1965\)](#), pp. 825-8) in order to “reflate” the newly-created estimated NNP time series.

Unlike the supply-side literature that is based on stringent assumptions of perfect information, complete markets, perfect competition, rational agents, profit maximisation, instantaneous adjustment of flexible prices, zero transaction costs, absence of time constraints and other frictions, and hence assumes that potential output is equal to actual output, we do not make any of those (unlikely) assumptions and hence expect actual output to be commonly below potential. This renders it sufficient to focus on demand-side factors (rather like in traditional Keynesian analysis), whereby here we conduct our horse race between the conventional variables in the literature (traditional narrow and broad money supply aggregates, and short and long-term interest rates) and our measure of bank credit.

There are further innovations. Since the GETS-methodology is adopted, we can evaluate the validity of a range of potential empirical models of NNP, by including other competing independent variables, which have traditionally been identified as being key determinants of economic growth as well, in the general unrestricted model (GUM) against our preferred measure of TA. These variables include:

- average private discount rate in Hamburg/Berlin ([Spree, 1978](#), p. 183).
- average official discount rate.⁸

⁶ To avoid spurious correlation, we do not follow [Burhop \(2006\)](#) in defining a ‘financial depth’ variable (the ratio of total assets of the banking system to NNP). For the same reason we are also not additionally deploying the price level as an explanatory variable, since it is part of the dependent variable (cf. [Uebele & Ritschl, 2009](#)).

⁷ See e.g. [Werner \(2005\)](#), p. 114f) for a discussion and further literature.

⁸ [Spree \(1977\)](#), p. 379) for data up to 1875; post-1875 data from [Bundesbank \(1976\)](#), p. 278).

- average government bond yield.⁹
- proxies for narrow and broad monetary aggregates “G(2)” and “G(3)”, respectively (Sprenger, 2006).

A table which contains the abovementioned statistics is provided in the Appendix.

5. Empirical results

In the above econometric framework, we use the 'gets. mean' function of the AutoSEARCH-package developed by Sucarrat (2012) to perform our estimations. We consider one period lagged terms only in the GUM since we employ annual data. This decision is also supported by a minimum in the respective Schwarz information criterion. Additionally, we include a constant and an AR term for NNP in the GUM as well. A confidence level of 99% is chosen. All time series are log-differenced by one period (YoY) in order to ensure stationarity. After having log-differenced the data, no time series exhibits a significant unit root using the Augmented Dickey-Fuller Test (ADF).

The gets. mean algorithm terminates after an iteration of 11 paths and arrives at the following parsimonious model (t-stats in parentheses and p-values in square brackets):

$$\Delta \widehat{NNP}_t = 0.298 \Delta TA_t - 0.072 \Delta PDR_t + 0.138 \Delta ODR_t + 0.259 \Delta G3_{t-1} \quad (3)$$

(7.24) (-3.07) (3.29) (4.50)

$$R^2 : 0.59 \text{ } AR_{1-2} : 0.84 \text{ } ARCH_{1-2} : 0.13 \text{ } JB : 0.14 \text{ } T : 52$$

[0.66] [0.94] [0.93]

NNP: Net National Product, **TA:** Total Assets of the Banking System, **PDR:** Private Discount Rate, **ODR:** Official Discount Rate, **G3:** Broad Monetary Aggregate.

The constant term and the lagged term of NNP have been eliminated throughout the reduction process as well (similar to findings reported by Werner, 1997). The parsimonious model passes various specification tests: The Ljung and Box (1978) test for serial correlation in the standardised residuals up to the second order (AR_{1-2}) as well as the Ljung and Box (1978) test for serial correlation in the squared standardised residuals up to the second order ($ARCH_{1-2}$) indicate no serial correlation. Additionally, the parsimonious model exhibits homoskedasticity as implied by the Jarque and Bera (1980) test (JB). Notwithstanding, only TA appears to Granger-cause NNP: Granger-causality runs uni-directionally from a change in TA to a change in NNP, which is a significant result that rules out potential simultaneity bias (see Table 1, Table 2). The finding is in line with other tests of Werner's (1997, 2005, (Werner, 2012a, 2013) Quantity Theory of Disaggregated Credit (or 'General Quantity Theory':

If we plot the growth rate of TA vis-à-vis the growth rate of NNP it becomes evident that the so-called *Gründerzeit* era was not only characterised by extraordinarily high growth rates of national income (>10% p. a.) but also excessive growth rates in the total assets of the banking system (>30% p. a.) (Fig. 1). The excessive growth in total assets (TA) was partly caused by the Franco-Prussian War of 1870/71 and the influx of reparations payments (Thorwart, 1906), but is in any case reflective of an increase in bank credit for asset purchases, which fuelled the stock market boom (and entailed the subsequent bust). It should in this context not be forgotten that since 1876 a largely independent and fully privately-owned central bank played an important role in steering bank credit aggregates.

This classic asset bubble period is followed by a severe recession (*Gründerkrise*), coinciding also with stagnating growth rates of bank assets (TA). On the basis of our earlier finding that TA appears to be a causal factor with respect to income formation and the fact that domestic bank credit in its various forms is the main component of TA, we can pose that restrictive domestic bank credit appears to have been a main cause of the so-called *Gründerkrise*, similar to the post-bubble Japanese stagnation beginning in the early 1990s (Werner, 2005). In a theoretical framework of imperfect information, Stiglitz and Weiss (1981) have demonstrated that banks ration the supply of credit in order to maximise profits, thereby rendering short the supply of bank credit.¹⁰ Furthermore, bank credit creation plays a pivotal role with regard to income formation since the supply of money primarily originates from the domestic (commercial) banking system, providing the crucial macroeconomic link (Werner, 1997). When banks are impeded by non-performing assets (deriving from the prior bank lending-fuelled asset boom), they subsequently restrict credit, which can potentially last for many years (Werner, 2005, on Japan).

As robustness check we expand the model in the following ways: We include some supply side and/or real economy variables as control variables, namely population data (for the states that were to join Imperial Germany from 1860 to 1871, and then from 1871 Imperial Germany), railway length in km, a harvest index to reflect potential impact of weather conditions (a proxy based on the grain yields), gold reserves of the central bank (estimates prior to 1871) and US industrial production growth as a control for international demand conditions.

Having run the GUM, we proceed to the general-to-specific downward reduction and report here only the final result:

$$\Delta NNP_t = 35.2 + 0.384 \Delta NNP_t - 1 + 0.171 \Delta TA_t + 0.735 \Delta MO_t - 84.7 PDR_{t-1} + 6.92 HarvestIndex_t + 0.031 \Delta Railway_t + 9.84 US_IP_growth_t$$

⁹ Spree (1977, p. 378) for data up to 1869 (i.e. average effective yield of Prussian government bonds); post-1869 data from Bundesbank (1976, p. 278) (average effective yield of fixed income securities).

¹⁰ This is also known as the short-side principle: In rationed markets, the market supply (of bank credit) determines the quantity transacted.

Table 1

Non-causality test results for the parsimonious model.

Variable	Granger	
	H0: NNP does not cause	H0: NNP is not caused by
<i>p-value</i>	<i>p-value</i>	<i>p-value</i>
TA	0.231	3.613 ^{e-05***}
PDR	0.07045.	0.5086
ODR	0.098.	0.7826
G3	0.01749 *	0.1875

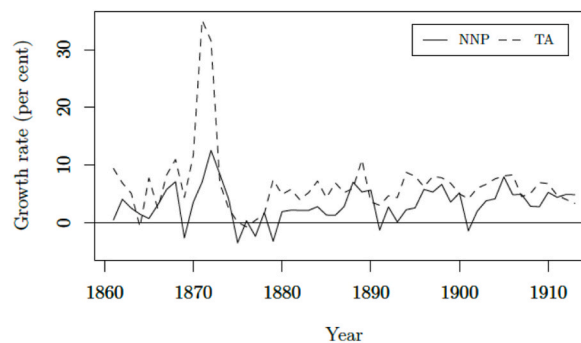
Significance codes: *** 0.001 ** 0.01 * 0.05. 0.1.

Table 2

Non-causality test results for TA sub-components.

Variable	Granger	
	H0: NNP does not cause	H0: NNP is not caused by
<i>p-value</i>	<i>p-value</i>	<i>p-value</i>
CB	0.8061	0.0001006 ***
PMB	0.7818	0.3466
CC	0.05341.	0.5141
SB	0.06175.	0.7435
JSCB	0.865	0.001293 **

Significance codes: *** 0.001 ** 0.01 * 0.05. 0.1.

**Fig. 1.** German bank asset growth and income formation.

$$R^2 = 0.687 \quad F = 17.24 \quad DW = 1.876 \quad ARCH(1) = 0.085 \quad ARCH(2) = 0.942 \quad JB = 1.058 \quad T = 52$$

- ΔNNP = Annual change in German nominal Net National Product (million Mark)
- $\Delta TA \Delta TA_t$ = Annual change in total bank assets (million Mark)
- $\Delta M0$ = Annual change in narrow money (million Mark)
- PDR = Private discount rate in previous year (%)
- $HarvestIndex$ = Agricultural harvest index (1860 = 100)
- $\Delta Railway$ = Annual expansion of railway network (km)
- $US_IP_growtht$ = US industrial production growth rate (%)

We note that the residual properties are satisfactory. It is a well-specified model.

We conducted structural break tests and found no evidence for structural breaks in 1871, 1876 or 1883 (the Chow breakpoint test yielded a test statistic of between 1.613 and 1.889, and no significance at the 5% level).

Our interpretation is as follows: The constant term is relatively small, compared to the annual average change in national income, suggesting our variables capture most fluctuations. The most important explanatory variable of national income growth is found to be bank credit creation, measured by total bank assets. The GETS modelling provided for a horse race between different potential explanatory variables, but many dropped out, including several interest rates and broad money. Apart from the railway control (during a time of rapid railway expansion), the banking sector variable had the highest t-statistic. The banking sector likely interacted with other control variables via infrastructure financing (railways), and harvest financing (agricultural cycle smoothing).

On the basis of these findings, we can continue our analysis by turning our attention to the question which sub-components of TA, i.

e. which banking sectors, have actually been the most significant in determining income formation. A Granger-causality test yields the following results:

What we can infer from this result is that, during the period of our investigation (1860 - 1913), both the central bank sector as well as joint-stock credit banks have exerted a significant influence on German income formation. In both cases, Granger-causality runs unidirectionally from a change in the respective amount of assets to a change in income (NNP). On the other hand, the change in savings banks' as well as credit co-operatives' assets has rather been caused by a change in income. This finding is likely to be due to the fact that these community banks have consistently been highly conservative lenders, with low loan-deposit ratios, but also the fact that they lend to the real economy which may respond within the same year of reporting, while we are restricted to annual data. This finding does not affect the result of uni-directional Granger-causality for aggregate bank assets on economic growth.

Tilly (1973) notes that savings banks and credit cooperatives have only been regarded as "producers of bank money" (as opposed to mere intermediaries) since the 1920s. He argues that their respective stock turn rates (i.e. the ratio of the amount of deposits and withdrawals as a percentage of total deposits) were significantly lower (0.6) than the credit banks' stock turn rates (20 - 30) which he interprets as having a limited impact on the money supply. No doubt, leverage was higher with the large banks, the central bank sector and the joint-stock credit banks, thus numerically contributing more to total credit creation. This only underlines the importance of credit creation in income formation: Likely an even higher economic growth rate would have been possible if the community banks in Germany had extended greater amounts of bank credit to the small firm sector, which hardly had any access to the budding capital markets.

Lastly, there appears to be no causal relationship between income formation and the change in private mortgage banks' assets whatsoever, which is in line with Werner's (1997) disaggregation of credit theory, which postulates that bank credit for asset purchases (such as property) does not affect nominal national income (but instead affects property prices).

These findings are at odds with those reported by many researchers. For instance, Burhop (2006) has not detected a significant influence of overall banking sector asset growth with regard to German income formation. Additionally, he could not find statistical evidence for the importance of any particular banking sector with respect to income formation.

On the basis of our results, we suppose that the omission of the central bank sector (i.e.

Preußische Bank/Reichsbank as well as private note banks of issue) was probably one of the main reasons why Burhop (2006) did not find strong statistical evidence for the importance of overall bank asset growth with respect to income formation. Also, Burhop (2006) used real instead of nominal time series, likely causing endogeneity on account of the "financial depth" parameter (the inverse of the income velocity) in the VAR-specification and possibly the unequal weightings assigned to the different constituents of the NNP estimate.

Although we have considered the majority of the banking sector in our total assets aggregate, a time series of the relatively large assets of private bankers has not been included due to its non-existence. Moreover, though this problem is mitigated through aggregation and the use of growth rates, the fact that there was no uniform accounting standard across individual banks, let alone different banking groups, imposes a limit on the reliability of any such data (see Bundesbank, 1976). By analysing the velocity relationship between TA and NNP, which is declining throughout our period of investigation (Fig. 2), we note that this has in most major instances of 'velocity decline' been due to increased use of bank credit for asset purchases (Werner, 1997), while our variable TA includes both "real" and "financial" transactions.

If we had the data to fully disaggregate total bank credit into loans for 'real economy' transactions and those for asset purchases, our empirical results likely would be even stronger. Unfortunately, historical statistics about German banking do not offer data on sector-specific allocations of bank credit across different banking groups which would be necessary in order to differentiate between "real" and "financial" transactions. The differentiation between particular types of bank assets or "real" and "financial" transactions is also inadequate. E.g. even the circulation of bills of exchange whose evolution is assumed to be closely related to the evolution of trade and commerce (i.e. "real" economic activity) may be partially distorted by "financial" and "speculative" flows (Prion, 1907).

A limitation of our research may appear to be our lack of explicit modelling of foreign trade and capital flows and their respective influence on income formation.¹¹ This can be justified on a theoretical basis by the fact that their net effect as a proportion of NNP is small and, more importantly, in volume terms, most international transactions at the time already took place via the banking system, following the rules of international and correspondent banking. Thus the external sector likely has been largely reflected in the total assets of the banking system variable, which includes external assets. As we know, changes in external assets of the banking sector are a reflection of changes in foreign trade and capital flows.

6. Conclusion

We adopted the general to specific econometric methodology (GETS) and used it to put a version of the Quantity Theory of Disaggregated Credit (Werner, 1997) to its harsh test, applied to the high growth period in Germany from 1860 to 1913.

In conclusion, contrary to some other recent studies, we have found a strong link between broad bank credit creation (the change in total assets of the banking system) and national income formation by using the GETS modelling approach presented in Sucarrat and Escribano (2012), and by deploying a more comprehensive measure of bank credit for pre-1914 Germany. The assets of the central bank sector as well as joint-stock credit banks at times appear to exhibit the highest degree of explanatory power with respect to

¹¹ Foreign trade and capital flows were not negligible throughout the pre-1914 period. Diekmann and Westermann (2012, p. 20) report that the share of exports to Net Domestic Product fluctuated between 12.8% and 17.7% in the period from 1880 to 1913.

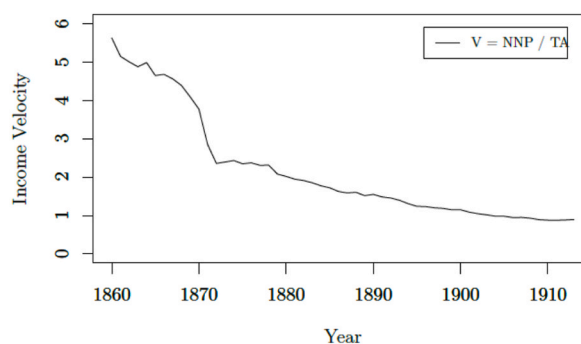


Fig. 2. German income velocity of circulation.

nominal NNP.

On the basis of these results, we have further hypothesised that the Wernerso-called *Gründerkrise* recession was probably caused by an initial excessive growth of bank credit creation for asset transactions, followed by the typical result of non-performing assets subsequently resulting in subdued balance sheet expansion of the banking system, i.e. restrictive bank credit. This conclusion entails valuable implications for modern policy since recessionary tendencies in a range of European economies today are also associated with subdued bank credit creation – and especially bank credit for the ‘real economy’ (see ECB, 2020; Lyonnet & Werner, 2012).

If we deploy total bank credit as a proxy for bank lending for productive business investment then it can also explain the high growth rates recorded. This means the question of whether there could be “too much finance” can be answered positively based on the Quantity Theory of Disaggregated Credit (the General Quantity Theory), in two dimensions: there can be too much finance in both a quantitative sense, and in a qualitative sense: Bank credit for consumption and asset purchases is not helpful for economic growth and instead results in inflation. On the other hand, bank credit creation for the real economy in the form of business loans to fund investment cannot be too high, as it advances economic growth without inflation. This argument is consistent with the East Asian high growth economies, where several decades of double-digit economic growth were realised based on such bank credit to the real economy, which were guided towards this sector by the central bank (on ‘window guidance’, see Werner, 2002, 2018).

In other words, the findings by Arcand et al. (2015), who found that “too much finance” has a negative effect on growth, do not contradict the finance-growth thesis. The realisation is important that bank credit can be used either for ‘lending to the real economy’ in the form of business loans (as argued to be important for growth by the ECB, 2020) or consumer loans (the former non-inflationary, the latter inflationary, as seen in 2021/2); or in the form of loans for asset purchases, resulting in asset inflation (and, if large enough, in banking crises when the loan expansion stops). So it is merely a question of whether finance has been mainly used for funding greater activity in the ‘real economy’ or whether finance has mainly facilitated purchases of assets (not part of the ‘real economy’). When bank credit is directed to the former, the credit/GDP ratio should rarely exceed the threshold of 100% identified by Arcand et al. (2015) as the tipping point for turning the growth-enhancing economic institution of bank credit into a growth-harming one. So the credit-GDP ratio is an approximation of Werner’s disaggregated credit approach. To ensure bank credit is mainly extended to the real economy and the credit-GDP ratio does not exceed 100% is important for successful development and to avoid boom-bust cycles and banking crises.

This study suffers from obvious data limitations. Specifically, we would ideally have liked to disaggregate broad bank credit into credit creation used for productive business investment, as opposed to credit used for asset purchases or for consumption; or at least we would have liked to be able to differentiate between bank credit for transactions contributing to national income and those that don’t (asset purchases). Subsequent studies might enhance our analysis by finding better data, by enlarging the period of investigation, by conducting cross-country comparisons or by improving data quality, such as by compiling individual banks’ ledgers.

The findings are also topical where governments and central banks have been stepping up efforts to ensure bank credit is channelled to ‘the real economy’ in general and small firms in particular (see US Treasury Secretary Scott Bessent’s comment that the US could introduce ‘window guidance’ to achieve this). Since banks have been shown to be pivotal in the East Asian ‘high growth’ system, adopted by Japan, Korea, Taiwan, Singapore and, from 1979, also China (e.g. Werner, 2005), it is of note that Germany, the country whose pre-1945 development was most carefully studied by the East Asian policy makers and their strategic thinkers, did indeed also experience a high growth period, and that banks were also a key factor. This calls for further research (Kun et al., 2023, 2024).

CRedit authorship contribution statement

André Dragosch: Data curation, Investigation, Writing – original draft. **Richard A. Werner:** Conceptualization, Methodology, Project administration, Supervision, Validation, Writing – review & editing.

Declaration of competing interest

Andre Dragosch, PhD has no competing interests.

Richard Werner, D. Phil. (Oxon) has no competing interests.

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Appendix A

Table 3
Net National Product Statistics

Date	New Compromise Real NNP (mn Mark)	NNP Deflator (EH)	New Compromise Nominal NNP (mn Mark)
1860	13,888	0.71	9831
1861	13,695	0.72	9879
1862	14,058	0.73	10,289
1863	14,895	0.71	10,553
1864	15,400	0.7	10,710
1865	15,595	0.69	10,789
1866	15,688	0.71	11,126
1867	15,408	0.77	11,787
1868	16,223	0.78	12,656
1869	16,430	0.75	12,328
1870	16,573	0.77	12,773
1871	17,015	0.81	13,707
1872	17,883	0.87	15,540
1873	18,613	0.91	16,901
1874	19,193	0.92	17,597
1875	19,630	0.87	16,995
1876	19,830	0.86	17,054
1877	19,805	0.84	16,657
1878	20,680	0.82	16,953
1879	20,863	0.79	16,418
1880	2,03,375	0.82	16,737
1881	21,148	0.81	17,106
1882	21,463	0.81	17,479
1883	22,468	0.79	17,858
1884	23,493	0.78	18,362
1885	24,175	0.77	18,609
1886	24,680	0.76	18,851
1887	25,325	0.77	19,389
1888	26,605	0.78	20,802
1889	27,213	0.81	21,941
1890	27,960	0.83	23,217
1891	27,873	0.82	22,923
1892	28,490	0.83	23,558
1893	30,305	0.778	23,588
1894	31,193	0.77	24,125
1895	32,163	0.77	24,754
1896	33,435	0.78	26,227
1897	34,528	0.8	27,661
1898	36,640	0.81	29,560
1899	36,628	0.84	30,638
1900	37,310	0.86	32,265
1901	37,348	0.85	31,818
1902	38,165	0.85	32,463
1903	39,735	0.85	33,720
1904	41,133	0.85	35,148
1905	43,243	0.88	38,052
1906	43,335	0.92	39,946
1907	45,020	0.93	41,951
1908	46,980	0.92	43,167
1909	47,348	0.94	44,383
1910	48,090	0.97	46,783
1911	50,323	0.97	48,892
1912	51,663	0.99	51,353
1913	53,910	1	53,910

Table 4

Total Assets of the Banking System and Sub-Components

Date	Total Assets of the Banking System (TA) (mn Mark)	Central Bank Sector Assets (CB) (mn Mark)	Joint-Stock Credit Banks' Assets (JSCB) (mn Mark)	Private Mortgage Banks' Assets (PMB) (mn Mark)	Credit Co-operatives' Assets (CC) (mn Mark)	Savings Banks' Assets (SB) (mn Mark)
1860	1782	945	281	37	9	510
1861	1959	1039	294	42	19	565
1862	2054	1042	323	47	25	617
1863	2162	1055	326	53	38	690
1864	2146	928	333	119	54	712
1865	2319	1001	344	134	78	762
1866	2376	1010	343	159	93	771
1867	2582	1118	371	171	113	809
1868	2881	1181	520	183	153	844
1869	3010	1188	503	212	196	911
1870	3383	1411	534	255	212	971
1871	4807	1734	1268	437	267	1101
1872	6591	2173	2123	671	347	1277
1873	7055	2169	2121	835	418	1512
1874	7230	2065	1905	1047	457	1756
1875	7236	1829	1662	1265	498	1982
1876	7185	1603	1538	1368	513	2163
1877	7214	1470	1359	1518	549	2318
1878	7326	1395	1319	1622	555	2435
1879	7893	1558	1511	1675	558	2591
1880	8290	1570	1506	1846	587	2781
1881	8783	1623	1664	1942	601	2952
1882	9142	1653	1699	2019	619	3152
1883	9633	1646	1872	2091	638	3386
1884	10,354	1741	2122	2195	658	3638
1885	10,811	1738	2229	2272	676	3896
1886	11,585	1914	2283	2486	698	4204
1887	12,205	1946	2339	2680	726	4514
1888	12,956	1990	2430	2953	733	4850
1889	14,449	2120	3156	3244	744	5185
1890	14,979	2060	3150	2501	804	5464
1891	15,440	2075	3104	3786	792	5683
1892	16,176	2048	3152	4200	809	5967
1893	16,896	2031	3167	4525	833	6340
1894	18,439	2201	3594	5026	897	6721
1895	19,984	2334	3933	5482	961	7274
1896	21,270	2248	4215	5974	1082	7751
1897	23,050	2326	4718	6504	1256	8246
1898	24,920	2376	5673	6828	1334	8709
1899	26,687	2407	6466	7286	1515	9013
1900	28,058	2569	6958	7495	1675	9361
1901	29,242	2619	6643	7855	1985	10140
1902	31,048	2627	7085	8140	2230	10966
1903	33,188	2715	7571	8657	2459	11786
1904	35,808	2792	8460	9183	2737	12636
1905	38,835	2867	9827	9749	2947	13445
1906	42,203	3032	11395	10265	3308	14203
1907	44,153	3155	12076	10614	3634	14674
1908	46,456	3246	12662	11288	3869	15391
1909	49,809	3354	13739	11956	4227	16533
1910	53,298	3386	15015	12558	4618	17721
1911	55,891	3366	15649	13110	4978	18788
1912	58,196	3889	15854	13406	544	19623
1913	60,184	4028	16230	13552	5732	20642

Table 5

Competing Monetary Independent Variables

Date	Average private discount rate (PDR) (%)	Average official discount rate (ODR) (%)	Average government bond yield (GBY)(%)	Narrow monetary aggregate (G2) (mn Mark)	Broad monetary aggregate (G3) (Mn Mark)
1860	1.75	4.00	4.25	1680	2872
1861	2.56	4.00	4.14	1758	3110
1862	3.00	4.00	4.11	1889	3377
1863	3.19	4.07	4.24	1940	3577
1864	4.19	5.30	4.12	1946	3624
1865	3.56	4.96	4.13	2022	3803

(continued on next page)

Table 5 (continued)

Date	Average private discount rate (PDR) (%)	Average official discount rate (ODR) (%)	Average government bond yield (GBY)(%)	Narrow monetary aggregate (G2) (mn Mark)	Broad monetary aggregate (G3) (Mn Mark)
1866	4.69	6.21	4.38	2059	3867
1867	2.12	4.00	4.40	2215	4109
1868	2.12	4.00	4.57	2257	4249
1869	3.87	4.24	4.74	2309	4454
1870	4.00	4.90	4.60	2462	4706
1871	3.62	4.15	4.44	2360	4825
1872	3.94	4.28	4.26	2841	6103
1873	4.50	4.95	4.30	2913	6876
1874	3.25	4.38	4.24	2902	6948
1875	3.75	4.72	4.25	2935	6910
1876	3.04	4.15	4.21	2809	6871
1877	3.17	4.42	4.22	2586	6644
1878	3.06	4.34	4.23	2546	6761
1879	2.60	3.70	4.17	2647	7193
1880	3.03	4.24	4.05	2626	7383
1881	3.50	4.42	3.96	2648	7750
1882	3.89	4.54	3.94	2533	7828
1883	3.07	4.05	3.92	2449	8143
1884	2.90	4.00	3.88	2511	8673
1885	2.85	4.12	3.81	2372	8815
1886	2.16	3.28	3.74	2472	9408
1887	2.30	3.41	3.70	2399	9666
1888	2.10	3.32	3.64	2403	9759
1889	2.62	3.68	3.60	2561	11101
1890	3.78	4.52	3.68	2492	11301
1891	3.02	3.78	3.71	2445	11568
1892	1.79	3.20	3.68	2538	11986
1893	3.17	4.07	3.65	2548	12373
1894	1.74	3.12	3.56	2610	13415
1895	2.01	3.14	3.36	2940	14618
1896	3.03	3.66	3.35	2938	15177
1897	3.08	3.81	3.36	2942	16162
1898	3.54	4.27	3.40	3136	17408
1899	4.45	5.04	3.55	3258	18570
1900	4.05	5.33	3.68	2241	19467
1901	3.05	4.10	3.70	3377	20555
1902	2.18	3.32	3.50	3524	22151
1903	3.00	3.84	3.50	3674	23587
1904	3.14	4.22	3.60	3864	25674
1905	2.85	3.82	3.60	4145	27904
1906	4.04	5.15	3.60	4594	30320
1907	5.12	6.03	3.80	4565	31952
1908	3.52	4.76	3.80	4574	33408
1909	2.87	3.93	3.70	4662	35900
1910	3.54	4.35	3.80	4758	38583
1911	3.54	4.40	3.88	4835	40374
1912	4.22	4.95	3.90	5399	42348
1913	4.98	5.89	4.10	5247	43667

Table 6

Descriptive Statistics

Variable	Min	Q1	Median	Mean	Q3	Max	Std Dev	Unit
NNP	9831	17,106	24,125	25,492	32,265	53,910	12,447	Million Mark
TA	1782	7230	21,270	23,665	35,808	60,184	17,889	Million Mark
M0	1680	2533	2848	3046	3674	5399	985	Million Mark
M2	2872	6761	11,301	17,019	25,674	43,667	12,264	Million Mark
PDR	1.74	2.87	3.14	3.21	3.78	5.12	0.82	%
ODR	3.12	3.93	4.15	4.36	4.95	6.21	0.85	%
BondYield	3.35	3.68	3.92	3.96	4.25	4.74	0.37	%
Population	37,511	42,532	48,938	47,614	53,360	58,696	7066	Thousands
Railway	11,632	21,102	35,902	36,140	50,942	66,892	17,747	km
HarvestIndex	92.3	105.8	113.5	111.3	119.1	128.5	8.7	Index (1860 = 100)
GoldReserves	120	385	580	507	730	925	265	Million Mark
US_IP_growth	-8.9	-0.5	4.1	4.2	7.3	13.4	4.8	%

Data availability

Data will be made available on request.

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