IBF Paper Series
07 – 19

Disaggregated Financial Flows and Economic Development: Evidence from Pre–1913 Germany

André Dragosch

Abstract:

In this paper we analyse income formation patterns throughout the German industrialisation process (1860–1913) through the analysis of different financial flows. Similar to Neuburger & Stokes (1974), we make use of flow statistics originally estimated by Eistert (1970) with regard to four different types of financing, i.e. bills of exchange credit, lombard credit, current account credit, and securities credit which together comprise the total flow of credit provided by the banking system. We also enlarge the data set of Eistert (1970) and Eistert & Ringel (1971) by making use of different sources in order to allow for a representative statistical analysis. To our knowledge, we have compiled the first dataset on German financial flows spanning from 1860 to 1913. Our goal is to provoke a fundamental discussion about the suitability of stock vs. flow statistics – a question which has been disregarded for too many years. Moreover, we would like to shed more light on the question whether a qualitative differentiation of the different types of financing is needed in order to make more precise estimations of the influence of finance on real economic activity in general and non–agricultural income formation in particular. This paradigm derives from the theory of disaggregated credit formalised by Werner (1997) which is amongst others advocated by Eistert & Ringel (1971) as well. Statistical analysis will be conducted by utilising the General–to–Specific (Gets) approach presented in Sucarrat & Escribano (2012). Contrary to Neuburger & Stokes (1974), we have found a significantly positive relation between current account credit flows and non–agricultural output among other findings. Besides, the results might lend further support to the theory of disaggregated credit and might have implications for renowned models of income formation especially the IMF Polak (1957) model (for developing economies).

JEL–Classification: N13, N23,011, 042, C32

IBF Paper Series
Banking and Finance in Historical Perspective
ISSN 2510-537X

Redaktion / Editorial Office
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Part I

Introduction

One of the most-intensely analysed cases with regard to the theory of finance-induced growth remains pre-1913 Germany (cf. Fohlin 1999, Guinnane 2002). The vast majority of studies on finance-induced growth in pre-1913 Germany have in common that they utilise stock statistics of credit or other financial assets as statistics or its growth rate thereof and compare these statistics with indicators of economic development and income formation. For instance, Burhop (2006) uses stock statistics of total assets of joint-stock credit banks from 1860 to 1913 in order to analyse the effects of financial deepening on German Net National Product (NNP). Diekmann & Westermann (2012) use stock statistics of bank financing in a structural VAR model from 1860 to 1912 in order to analyse the effects of statistical shocks from the banking system on different sectors of the economy. Most famously, the data set by Hoffmann et al. (1965), which has been used by many financial historians, is itself a stock statistic. The authors of the present study have used stock statistics of bank assets in a General-to-Specific (Gets) modelling framework on German NNP as well (cf. Dragosch & Werner 2015).

However, the issues with stock statistics of financing are well-known namely that, first, aggregate indicators of economic development such as NNP are flows and, second, the growth rate (1^{st} derivation) in stocks is not a reliable approximation for the change in financing as Eistert & Ringel (1971) have demonstrated empirically. They compare the change in the net financing statistic by Hoffmann et al. (1965) (*Nettofinanzierung*) to their own estimation of financial flows and its growth rate in the period from 1883 to 1913. For instance, they conclude that in almost 50% of cases the direction of change diverge between stock and flow statistics of lombard credit. They even argue that an analysis of bank credit stock statistics or their growth rate with respect to aggregate national income or investment is likely to lead to misleading conclusions.[1] Nonetheless, there are cliometric studies on the German finance-induced growth model that have utilised flow statistics as well. Most famously Neuburger & Stokes (1974) use the ratio of current account credit flows to total credit flows which has been originally estimated by Eistert (1970). Neuburger & Stokes (1974) findings imply that current account credit may have inhibited economic growth in Germany in the period from 1883 to 1913 and that current account credit has led to significant missallocations of capital and inefficiencies in German non-agricultural output. In the present study, we will not solely focus on current account

[1] Cf. (Eistert & Ringel 1971, p. 165)

credit flows but also on bills of exchange credit flows, lombard credit flows and securities credit flows as well which according to Eistert & Ringel (1971) comprise the total flow of credit provided by the banking system. In addition, we will include the central bank sector and private note banks of issue in our analysis as well which are also considered by Eistert & Ringel (1971). Neuburger & Stokes (1974) have focused on joint-stock credit banks only. In our previous study, we have found that the total assets of the central bank sector, private note banks of issue and joint-stock credit banks to be statistically Granger–causal with respect to German NNP.[2] Moreover, we will enlarge the data set and analyse the period from 1860 to 1913. All in all, our academic contribution is that we will extend the analysis of Neuburger & Stokes (1974) in terms of sample size, types of credit and types of banking sectors. Our goal is to provoke a fundamental discussion about the suitability of stock vs. flow statistics – a question which has been disregarded for too many years. Moreover, we would like to shed more light on the question whether a qualitative differentiation of the different financing channels is needed in order to make more precise estimations of the influence of bank credit creation on real economic activity in general and income formation in particular. This paradigm derives from the theory of disaggregated credit formalised by Werner (1997) which is amongst others advocated by Eistert & Ringel (1971) as well.

The remaining parts of this paper are organised as follows: The next chapter describes the data and their respective sources used in the analysis. Thereafter, the econometric methodology is explained. Chapter 4 presents our empirical results. Chapter 5 concludes. Readers not interested in the detailed technicalities of the data are advised to proceed to the third chapter.

Part II

Data

As we have mentioned before, we adhere to the same data methodology for flow statistics originally estimated in Eistert (1970) and Eistert & Ringel (1971). Since this data set is limited to the period from 1883 to 1913, further backwards estimation is needed in order

[2] Apart from the exclusion of private banks, we do not expect the absence of other banking sectors such as cooperative banks, savings banks or mortgage banks to be of statistical significance for our analysis. According to Tilly (1973), savings banks and cooperative banks have only been "producers of bank money" since the 1920s. In the same vein, mortgage banks have not been able to create bank money in our period of investigation but rather financed loans via bond issuances (so-called *Pfandbriefe*). Unfortunately, there are no reliable data on private banks.

to allow for a more representative statistical analysis and shed more light on important socio-economic events such as the so-called *Gründerkrise* from 1873 onwards. Eventually, our enlarged data set will range from 1860 to 1913.

1 Bills of exchange credit flows (1860 – 1882)

Similar to Eistert & Ringel (1971), the basis of the flow statistic on bills of exchange is the accrued government income from the stamp duty on bills of exchange (*Wechselstempelsteuer*). The estimation is complicated by the fact that many German states did not introduce stamp duty on bills of exchange as late as the 1870s. Fortunately, the state of Hamburg had started charging stamp duty on bills of exchange as early as 1853. In 1870, the stampy duty in Hamburg was replaced by the federal stamp duty of the North German Federation. Thus, we use the stamp duty income statistics by the state of Hamburg as the basis for our estimation in the period from 1860 to 1869 as depicted in Handelsstatistisches Bureau (1860-1870). We used a fixed exchange rate of 1.2 *Courant Mark* (Hamburg's Currency) in order to convert the stamp duty proceeds into *Reichsmark*.[3] From these proceeds we derived the amount of bills of exchange in circulation via the fact that the stamp duty amounted to $5/8^{\text{th}}$ of a 1000 of the nominal value of the bill, i.e. 0.0625%. Foreign bills, i.e. bills that were not drawn on Hamburg, and small bills with a nominal value lower than 100 *Courant Mark* were exempt from the stamp duty. In order to extrapolate the proceeds of the stamp duty for the entire German Empire, we used the percentage of Hamburg's proceeds from bills of exchange stamp duty in relation to the total proceeds which is depicted in Handelsstatistisches Bureau (1860-1870) for the period from 1870 to 1906. On average, Hamburg's accrued income from this stamp duty amounted to 11.64% of the total during the abovementioned period and ranged from 13.02% (maximum in 1896) and 10.12% (minimum in 1886) (median 11.76%) which is why we think that Hamburg's statistics display a reasonable sample for the entire German Empire. The inverse of this percentage is mulitplied with the proceeds from bills of exchange stamp duty in the state of Hamburg in order to estimate the proceeds for the German Empire as a whole in the period from 1860 to 1869.

For the period from 1870 to 1872, we make use of the bills of exchange stamp duty income statistics provided in Reichskanzler-Amt (1873). Data from 1873 to 1882 are taken from Reichsbank (1912). The average circulation of bills is calculated under the

[3] In general, we use a fixed exchange rate of 1 *Thaler* = 3 *Reichsmark* for conversions throughout this work.

assumption that the average time to maturity of bills was 75 days (i.e. 75/365) for joint-stock credit banks and private note banks of issue (i.e. the so-called *Geschäftsbanken*).[4] On the basis of this statistic, it is possible to calculate the amount of bills of exchange purchased by the banking system which consists of the central bank (*Preussische Bank* and *Reichsbank*), private note banks of issue and joint-stock credit banks. In order to avoid double-counting on account of rediscounting of bills of exchange, the average holding period has to be taken into account as well. On average, the average holding period of bills of exchange on the balance sheets of the *Geschäftsbanken* was 25 days according to Eistert & Ringel (1971). The holding period of the *Preußische Bank/Reichsbank* is available for individual years in Schauer (1912) and Lienhart (1936), respectively. We adhere to the same statistical methodology described in Eistert (1970, pp. 57 et seqq.) and Eistert & Ringel (1971, pp. 132 et seqq.), respectively. The complete data series is shown in table 1 on page 16.

2 Lombard credit flows (1860 – 1882)

In order to arrive at the newly granted amount of lombard credit by the banking system in a given year, we also follow the methodological steps described in Eistert (1970, pp. 83 et seqq.) and Eistert & Ringel (1971, pp. 139 et seqq.), respectively. First, we divide the total amount of lombard credit granted throughout a given a year by the corresponding end of the year stock statistic of lombard credit outstanding of the *Preussische Bank/Reichsbank*. From 1860 to 1875, these statistics are taken from Schauer (1912). From 1876 to 1882, these statistics are taken from Kaiserlichen Statistischen Amt (1883). Second, since lombard credit flow statistics for the other banking groups (private note banks of issue & joint-stock credit banks) are not available, we take the end of the year stock statistics of outstanding lombard credit of these banking groups and multiply these amounts by the abovementioned ratio of flows to stocks of the *Preussische Bank/Reichsbank* under the assumption that this ratio is similar among the abovementioned banking groups.[5] The result is the amount of lombard credit provided by the banking system in a given year. The complete data series is shown in table 1 on page 16.

[4] Also assumed in Eistert & Ringel (1971) and which is based on observations by Prion (1907).

[5] End of the year lombard credit stock statistics for private note banks of issue are taken from Spiethoff (1955) and for joint-stock credit banks are taken from Burhop (2002).

3 Current account credit flows (1860 – 1882)

In order to estimate the amount of current account credit provided by the banking system in a given year, we follow the same statistical methodology described in Eistert (1970, pp. 87 et seqq.) and Eistert & Ringel (1971, pp. 142 et seqq.), respectively. Since the central bank sector (i.e. *Preussische Bank/Reichsbank*) did not provide current account credit to the real economy in this period, the estimation only focuses on private note banks of issue and joint-stock credit banks. The estimation is based on the balance sheet entry current account credit which in the case of Burhop (2002) includes banker's acceptances as well. Thus, we have to substract banker's acceptances from this statistic in order to arrive at the pure current account credit statistic and to avoid double-counting with respect to bills of exchange credit. Data on banker's acceptances from 1883 to 1913 can be found in Bundesbank (1976). We use these data and the data on stocks of bills of exchange credit from Burhop (2002) in order to linearly interpolate the missing data on banker's acceptances from 1860 to 1882.[6] Next, we divide the flow statistics of current account credit of a sample of banks by their respective year-end stocks of current account credit in order to arrive at the ratio of flows to stocks for a given year.[7] In order to calculate this ratio for a given year, we have used balance sheet data and annual income statement statistics from the following sample of banks:

- *Disconto-Gesellschaft* (1860 – 1882)[8]
- *Dresdner Bank* (1873 – 1882)[9]
- *Deutsche Bank* (1870 – 1882)[10]
- *Norddeutsche Bank* (1860 – 1882)[11]

We assume these individual banks to be of a reasonable sample size as even the stock of current account credit of the *Disconto-Gesellschaft* alone on average accounted for 6.5% of all current account credit stocks of all joint-stock credit banks in the period from 1860 to 1882. Nonetheless, as the abovementioned sample of joint-stock credit banks

[6] Both times series are highly correlated with an R^2 of 97.8%. We estimate a coefficent of 0.7504 (no constant included) for the period from 1883 to 1913.

[7] This ratio has no specific technical meaning. It is just a pragmatic estimation approach utilised by Eistert & Ringel (1971). They call this ratio *Maßzahl*.

[8] Retreived from: `http://www.bankgeschichte.de/de/content/2448.html`

[9] Annual balance sheet and income statements *by Dresdner Bank* received from Commerzbank AG Historisches Archiv.

[10] Retreived from: `http://www.bankgeschichte.de/de/content/2164.html`

[11] Retreived from: `http://www.bankgeschichte.de/de/content/2449.html`

represents the big banks (so-called *Berliner Großbanken*), the ratio of flows to stocks could be overestimated as this ratio is significantly larger for big banks than for small banks (so-called *Provinzbanken*) as mentioned in Eistert (1970). Therefore, we calculate an index of this ratio of the big banks with 1898 as base year (100) and backward estimate the ratio for all joint-stock credit banks utilising the data from (Eistert 1970, p. 98) as basis for our estimation. Then, we multiply the abovementioned ratio with the stock of current account credit adjusted for banker's acceptances (cf. above). The result is the amount of current account credit provided by the banking system in a given year. The complete data series is shown in table 1 on page 16.

4 Securities credit flows (1860 – 1882)

Our period of investigation (1860 – 1882) is also a time period that experienced a rapid development of German capital markets, particularly around the 1870s and the so-called *Gründerzeit*.[12] Notwithstanding, financial flows via security issuance have had a rather insignificant size in comparison to other forms of financing. Moreover, with respect to credit creation and income formation of the banking system, credit creation takes place mostly in order to bridge the time between underwriting and sale of the securities to the bank/banking consortium and the actual issuance of the securities in the market place. Thus, in case of security issuance, banking institutions function as true intermediaries and the majority of credit creation has no permanent impact on macroeconomic income formation. The amount of credit creation which becomes permanently income-effective confines itself to the amount of securities that the respective banking institutions buy for their own accounts.[13] Securities which are being purchased by other capital market participants throughout the issuance do not constitute an increase in the amount of aggregate financing according to Eistert (1970). In the same way, banks that purchase securities in the secondary market do not increase the amount of aggregate financing since these funds are not received by the issuer. Moreover, the degree of income-effectiveness is relatively small according to Eistert (1970) and these types of purchases are considered to be speculative as well. Issuances of foreign companies have to be excluded as well since it is assumed that the proceeds from these issuances are not used domestically. Furthermore, securities from financial companies have to be excluded since these securities are not used to finance income effective expenditures. Financial companies rather use these funds in order to extend credit. Furthermore, conversions have to be excluded as well since they

[12] Cf. Baltzer (2007) and Weigt & Burhop (2006).
[13] Cf. Eistert (1970, pp. 99 et seqq.)

do not increase the aggregate amount of financing either. Stocks of securities on banks balance sheets are not suitable for an adequate analysis since it is not clear whether these securities have been acquired via issuances (primary market) or directly at the exchange (secondary market). Thus, the only way to acquire adequate statistics for security flows is to survey alternative statistics of stock and bond issuances. An excellent overview of the different types of security statistics is given by Kleiner (1914). Probably the best statistic in terms of quality and data methodology on securities issuances is the one by Deutsche Oekonomist (1883).[14] It is called an 'approval statistic' (*Zulassungsstatistik*) which aggregates the *approved* amount of issuances on particular exchanges. In contrast, the so-called 'issuance statistic' (*Ausgabestatistik*) records the actual issuances of securities that have been injected into the market. According to Eistert (1970), the difference between the approval statistic for a particular security and the corresponding issuance statistic in a given year, represents the amount of securities that banks purchase for their own accounts (i.e. securities credit). The only caveat is that the issuance statistic is derived from the proceeds of stamp duty on security issuances which was introduced in 1881. Thus, earlier estimations of security issuances are not possible. Nonetheless, as we have mentioned above, the amount of securities credit creation is miniscule compared to other types of financing which is why we just employ the total amount of non-financial securities issued for a given year in our statistical analysis. We adhere to the statistical methodology of the Deutsche Oekonomist (1883) (i.e. 'approval statistic') since it is considered to be the best securities statistic and original statistical material on approvals is widely available. We mainly use the individual approvals published in Saling's Börsen-Jahrbuch (1874-1883) and complement these statistics with information from Zeitschrift für Kapital und Rente (1864-1872). Individual securities are aggregated at nominal face value for a given year and conversions are excluded. The complete data series is shown in table 1 on page 16.

5 Other Data

Apart from statistics on financial flows in Germany, we will use statistics on non-agricultural output/income (Y), non-agricultural capital stock (K) and non-agricultural labour force (L) as well. For reasons explained in detail in chapter 3, we will use 'nominal' instead of 'real' (i.e. inflation-adjusted) time series. Although the national accounts data by Hoffmann et al. (1965) are the most-widely used data set so far, they have been

[14] Every security issuance statistic has its advantages and disadvantages. For a detailed assessment of the statistical material cf. Kleiner (1914).

subject to serious critique.[15] One of the main points of concern center around Hoffmann's estimation of the capital stock. Hoffmann has based his estimation of the capital stock on capital tax (*Gewerbekapitalsteuer*) on the Grand Duchy of Baden. Hoffmann's data have been criticised for not accounting for changes in tax legislation in Baden (Schremmer 1987). Moreover, the data have been criticised on the grounds that the industrial structure of Baden might not have been representative for the German Empire as a whole (Burhop & Wolff 2005). Despite all the shortcomings of the data, for the sake of better comparability with the study by Neuburger & Stokes (1974), we have decided to utilise Hoffmann's data set in this analysis as well. The data on non-agricultural income is taken from Hoffmann et al. (1965, pp. 506 et seqq.).[16] Data on non-agricultural capital and labour are taken from Hoffmann et al. (1965, pp. 255 et seqq.) (table 40, column 7 minus column 1) and Hoffmann et al. (1965, pp. 204 et seqq.) (table 20, column 9 minus column 1), respectively.[17]

Similar to Neuburger & Stokes (1974), we will correct the capital stock figure in order to account for changes in capacity utilisation. In this context, we assume that the rate of unemployment of labour was the same as the unemployment of capital. Statistics on unemployment among industrial workers were taken from Kuczynski (1945). The missing unemployment rate data from 1860 to 1886 had to be estimated on the basis of industrial wage growth assuming an exponential Phillips Curve.[18] Data on industrial wage growth are taken from Kuczynski (1954).

We have also adjusted the non-agricultural labour force time series in order to take into account the declining work-hours over time. Historical data on average weekly work-hours are depcited in Meinert (1958). On the basis of these data, we have estimated a linear time trend for the period from 1860 to 1913 which has a slope coefficient of -0.4722. In other words, average weekly work-hours declined by -0.4722% p.a. on average during this period.

The abovementioned data are shown in table 2 on page 17.

[15] Cf. Burhop & Wolff (2005) for an excellent discussion of the data.

[16] Table 122, column 16 minus column 3.

[17] The data gaps in the non-agricultural labour figure from 1858 until 1875 have been linearly interpolated.

[18] Cf. Phillips (1958). We have estimated the following relationship: $unemployment\ rate = 0.0299e^{-24{,}08 wage\ growth}$.

Part III

Methodology

With respect to the original paper on financial flows in pre-1913 Germany by Neuburger & Stokes (1974), several remarks are in order.

First, Neuburger & Stokes (1974) have used 'deflated' dependent and independent variables in their analysis, i.e. variables adjusted for the effects of inflation. However, as Uebele & Ritschl (2009) have pointed out, the utilisation of deflated time series in a regression might induce spurious correlation between dependent and independent variables. We avoid this issue by deploying nominal variables, i.e. unadjusted time series.[19]

Second, Neuburger & Stokes (1974) have used non-stationary time series in their analysis, in particular non-agricultural output, capital and labour. Although the utilisation of log-transformed variables in levels is usual within a Cobb-Douglas production function framework, the utilisation of time series with unit root in regressions likely induces spurious correlation and serially correlated errors (Granger & Newbold (1974)). This is why we use 1^{st} differences in our analysis instead of log-transformed variables in levels.

Third, Neuburger & Stokes (1974) have used Generalized Least Squares (GLS) as they have identified a low Durbin-Watson test statistic in the estimation via Ordinary Least Squares (OLS). The problem with GLS is that even though serial correlation causes no bias in the estimates of the coefficients, the GLS estimates are usually different from the OLS ones. Furthermore, in small sample sizes, GLS could induce bias in the coefficient estimates if the estimates of the serial correlation parameters are biased as well. In fact, the sample size in Neuburger & Stokes (1974) is relatively small with only 31 annual observations (from 1883 to 1913) and up to 6 regressor variables. This is why we have increased the sample size to 54 annual observations (from 1860 to 1913).

Fourth, Neuburger & Stokes (1974) use a stepwise forward selection of regressor variables. As Castle et al. (2011) have pointed out, stepwise forward selection is highly-dependent on the order of inclusion so that the procedure could 'miss' relevant variables with negative dependencies. That is the reason why we prefer a General-to-Specific/General-to-Simple (Gets) approach, i.e. a multi-path backwards elimination regression that starts from a general model that not only includes current account credit flows but also the remaining types of financial flows as well that comprise the total flow of credit provided by the

[19] Although it is a widely accepted procedure to use deflated variables (cf. most famously 'real money balances' in the production function in Fischer (1974)), the so-called 'Quantity Equation' ($MV=PY$) was originally stated in nominal terms. (See e.g. Werner (2005, pp. 114 et seqq.) for a discussion and overview.)

banking system.
Fifth, current account credit as a ratio of total credit enters as a 'shift parameter' in Neuburger & Stokes (1974) in order to measure the so-called *credit constant* effect of current account credit on non-agricultural output. However, we will use a different specification of money in the production function framework similar to the specification in Stokes (2013). Lastly, despite scientific efforts to explain the motives and causes for the development of different factors of production such as in proto-industrial models, we rather try to analyse credit as a separate factor of production in a simple production function framework. We also abstract from institutional and technological change in our analysis.[20] Our approach rather tries to build a synthesis of a (disaggregated) "Quantity Equation" framework embedded in a simple production function.

More specifically, consider the following simple production function with money (M) as production factor as well as non-agricultural income/output(Y), non-agricultural labour(L), non-agricultural capital stock (K), and factor productivity(A):

$$Y = Ae^{\lambda t}L^{\alpha}K^{\beta}M^{\gamma}\epsilon \tag{1}$$

For reasons explained above, we will estimate the model in log-differences:

$$\Delta ln(Y) = \Delta ln(A) + \lambda t + \alpha \Delta ln(L) + \beta \Delta ln(K) + \gamma \Delta ln(M) + \Delta ln(\epsilon) \tag{2}$$

Moreover, we will augment the model by equating money with credit (C) in terms of the definition by Werner (1997) and because of the fact that the original data by Eistert (1970) and our extended data set are credit (flow) data as well. Thus, for notational purposes we write:

$$\Delta ln(Y_t) = A + \lambda t + \alpha \Delta ln(L_t) + \beta \Delta ln(K_t) + \sum_{n=1}^{N} \gamma_n \Delta ln(C_{nt-\tau}) + \epsilon_t \tag{3}$$

The attentional reader might have noticed that credit (C) enters with a time lag as well as we hypothesize that changes in credit flows influence non-agricultural income with a lag. We will include credit both as coincident and lagging variables.[21] Furthermore, with regard to the classical Quantity Equation, we implicitly assume the velocity

[20] Cf. Pfister (1998) on the proto-industrial model.
[21] A similar assumption is made by Neuburger & Stokes (1974).

of money/credit to be constant with respect to nominal non-agricultural income.[22] Moreover, it is important to mention that in contrast to the simple monetary model by Polak (1957), we have not included changes in net foreign assets/reserves in our equation so that changes in the overall money supply *via* changes in net exports and external capital flows are not accounted for. Thus, from a monetary perspective, the above representation rather resembles a closed-economy framework than an open-economy framework. We intend to study this particular aspect in forthcoming research projects.

Part IV
Empirical Analysis

Given the abovementioned model, we will use the `getsm` function of the gets-package developed by Sucarrat et al. (2018) in order 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 in the GUM as well. A significance level of 99% is chosen. All time series are log-differenced by one period (YoY) in order to ensure stationarity. After having logdifferenced the data, no time series exhibits a significant unit root using the Augmented Dickey-Fuller Test (ADF).

The `getsm` algorithm terminates after an iteration of 7 paths and arrives at the following parsimonious model (t-stats in parentheses and p-values in square brackets):

$$\Delta ln(\widehat{Y}_t) = \underset{(3.35)}{0.074}\Delta ln(BC_t) + \underset{(3.65)}{0.076}\Delta ln(BC_{t-1}) + \underset{(4.32)}{0.035}\Delta ln(CA_{t-1}) + \underset{(11.83)}{1.527}\Delta ln(L_t)$$

$$R^2 : 0.74 \quad AR_1 : \underset{[0.34]}{0.91} \quad ARCH_1 : \underset{[0.45]}{0.58} \quad JB : \underset{[0.10]}{4.60} \quad T : 52 \tag{4}$$

Y: Non-agricultural income, **BC:** Bills of exchange credit, **CA:** Current account credit, **L:** Non-agricultural labour

The parsimonious model passes various specification tests: The Ljung & Box (1978) test for serial correlation in the standardised residuals (AR_1) as well as the Ljung & Box

[22] The classical Quantity Equation states that money (M) times its velocity (V) is linearly linked to nominal income (PY) assuming the velocity of money to be constant ($MV = PY$).

(1978) test for serial correlation in the squared standardised residuals ($ARCH_1$) indicate no serial correlation. Additionally, the parsimonious model exhibits homoskedasticity as implied by the Jarque & Bera (1980) test (JB).

It is interesting to note that the change in non-agriculatural capital stock has been eliminated in the parsimonious model. The results suggest that the relative statistical role compared to financial capital (i.e. bills of exchange credit & current account credit) in explaining non-agricultural income growth is rather insignificant. The constant term has been eliminated as well suggesting that there was no neutral technological change in the economy during our sample period.[23] In contrast, non-agricultural labour force growth is the most significant variable in our model. These results suggests that non-agricultural labour has been the most important factor of production throughout German industrialisation (from 1860 to 1913). They also suggest that capital mobilisation or rather *factor mobilisation* via financial capital should be considered a productive factor as well.

Moreover, it is important to note that both lombard credit and securities credit have dropped out in the specific model. This result provides evidence for the disaggregated credit methodology by Werner (1997) for the following reasons:

The majority of bills of exchange (ca. 90%) is used to finance productive expenditures. For instance, Reichsbank (1912) multiplies the proceeds from the bills of exchange stamp duty with 0.9 in order to account for speculative bills as well.[24] Thus, the vast majority of bills of exchange credit is used productively.

With respect to current account credit, there is evidence that approximately half is used speculatively and the other half is used productively. For instance, Eistert (1970) just takes 50% of the original current account credit flows in order to account for speculative credit as well. Deutsche Oekonomist (1914) also estimates that approximately half of all current account credit is used to speculate with securities. In this regard, it is highly likely that the results by Neuburger & Stokes (1974) are due to the fact that the percentage of current account credit for speculative purposes increased in the latter part of the 19^{th} and the early 20^{th} century (i.e. in their sample from 1883 to 1913). Hence, although we did not find statistical evidence for a negative effect of current account credit on non-agricultural income in the larger sample, we would not completely reject the main hypothesis by Neuburger & Stokes (1974), given the fact that current account credit is partially considered to be speculative as well.

[23] As a reminder, the non-agricultural labour statistic has been adjusted to take into account the declining work-hours per year which might include the statistical effect of technological change via higher labour efficiency as well.

[24] In other words, approximately only 10% are considered to be speculative/unproductive.

In contrast, the majority of lombard credit is used speculatively. According to Weber (1915), lombard credit and especially *report* credit is one of the most important vehicles to finance speculation. Eistert (1970) even excludes lombard credit by joint-stock credit banks and private note banks of issue completely on account of the fact that the vast majority is loaned against bills of exchange and securities, whereas lombard credit on the basis of goods does not play a large role.[25] Even with respect to the central bank sector, the majority of lombard credit is loaned against bills of exchange and securities as well. On the basis of data by Schauer (1912), from 1860 to 1913, on average, only 11.5% of lombard credit by the central bank was collateralised by goods.[26] Our results support these findings as well.

As far as securities credit is concerned, the Gets algorithm has not detected any significant role of security flows with respect to non-agricultural income. We have several explanations for this.

First, Eistert (1970) has made clear that only security issuances that are purchased by banks in the primary market for their own accounts, constitute a national income-effective expenditure. Securities that are bought by banks in the secondary market or securities that are bought by other non-bank entities are not considered to have a major impact on income formation, and purchases by banks in this way are even considered to be speculative.[27]

Second, since we could not analyse security issuances that banks bought for their own accounts given the reasons outlined in chapter 2, the sole new issuance of securities does not constitute an increase in the aggregate supply of money - they constitute a transfer of funds that have been in existence before from investors to the issuer.

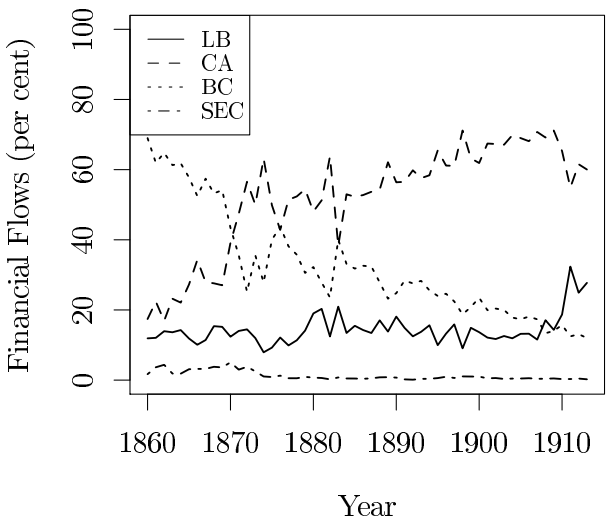
Third, financing via capital markets has rather played a minor role in Germany for non-financial private corporations during the period from 1860 to 1913 compared to other forms of financing. Non-financial private bond and equity issuances (excluding conversions) reached its highest share among all types of financial flows in 1870 with 5.1% but averaged only 1.3% from 1860 to 1913. Other types of financing such as bills of exchange credit and current account credit were historically way more important in terms of relative size, e.g. the share of bills of exchange credit flows averaged 32.1% and

[25] Cf. Eistert (1970, p. 85)

[26] The rest was collateralised by securities, bills of exchange and commodities, primarily gold. The percentage of lombard credit collateralised by goods has decreased dramatically over time from 39.6% in 1860 to 12.3% in 1913. We are well aware of the fact, that the central bank sector utilises lombard credit mainly in order to influence financial conditions in money markets and not primarily to finance real economic activity. We simply adhere to the methodology by Eistert (1970) who uses these data for other banking sectors as well.

[27] Eistert (1970, p. 99)

Figure 1: Evolution of relative German financial flows



LB: Lombard credit, **CA:** Current account credit, **BC:** Bills of exchange credit, **SEC:** Securities credit

the share of current account credit flows averaged 52.2% in the same period. This is amongst others evidence that Germany has primarily been a 'bank-based' economy in the period from 1860 to 1913. The evolution of relative German financial flows is shown in Figure 1.

Part V
Conclusion

The vast majority of studies on the German finance-induced growth model have used stock statistics of finance in their analysis. A notable exception so far has been the study by Neuburger & Stokes (1974) who have analysed the influence of current account credit flows originally estimated by Eistert (1970) by joint-stock credit banks on German non-agricultural output in the period from 1883 to 1913. Neuburger & Stokes (1974) findings imply that current account credit by joint-stock credit banks inhibited German non-agricultural output growth and that the allocation of current account credit has led to misallocations of capital.

In order to shed more light on this issue, we have enlarged the original data set by Eistert (1970) to include the period from 1860 to 1882 as well. To our knowledge, we have compiled the first dataset on German financial flows spanning from 1860 to 1913. Moreover, our academic contribution is that we have extended the analysis of Neuburger & Stokes (1974) in terms of sample size, types of credit and types of banking sectors.

Contrary to Neuburger & Stokes (1974), we have a found a significantly positive influence of current account credit flows on German non-agricultural output growth in the period from 1860 to 1913 by utilising the General-to-Specific (Gets) approach presented in Sucarrat & Escribano (2012). Besides, we have found that bills of exchange credit flows as well as labour force growth have also been significant factors of production with respect to German non-agricultural output. These findings generally suggest that capital mobilisation or rather *factor mobilisation* via financial capital should be considered a productive factor as well.

The results of this study also lend further support to the theory of disaggregated credit formalised by Werner (1997) which is amongst others advocated by Eistert & Ringel (1971) as well.

Moreover, it is important to mention that in contrast to the simple monetary model by Polak (1957), we have not included changes in net foreign assets/reserves in our model so that changes in the overall money supply *via* changes in net exports and external capital flows are not accounted for. Thus, from a monetary perspective, our model estimation rather resembles a closed-economy framework than an open-economy framework. This particular aspect could be a topic of future research projects. Other potential areas of research could be more precise estimations of our credit flow statistics based on individual banks ledgers and the estimation of securities credit flows pre-1883.

Appendix A

Table 1: Financial Flows in Germany (1860 – 1913, mn Mark)

Year	Lombard Credit	Current Account Credit	Bills of Exchange Credit	Non-Financial Private Bond Issuance	Non-Financial Private Equity Issuance	Federal & Local Gov't Bond Issuance	Memorandum: Securities Credit
1860	280	409	1620	22	18	5	
1861	341	633	1753	94	10	10	
1862	434	526	2017	106	29	9	
1863	501	853	2252	38	31	15	
1864	522	808	2260	29	39	5	
1865	529	1216	2575	78	61	0	
1866	442	1502	2301	124	16	121	
1867	506	1237	2542	60	81	200	
1868	831	1492	2877	131	74	106	
1869	889	1583	3170	195	17	66	
1870	943	2984	3305	198	188	22	
1871	1820	6156	4622	161	226	14	
1872	3457	13505	6008	247	664	26	
1873	2310	9638	6854	291	187	26	
1874	1586	12642	5575	191	18	118	
1875	1223	6588	5286	85	31	85	
1876	1431	5049	5161	140	10	80	
1877	1244	6471	4800	56	12	104	
1878	1400	6453	4406	59	6	148	
1879	2135	8236	4626	103	37	119	
1880	2836	7173	4808	64	42	63	
1881	3710	9359	5083	57	54	93	
1882	2600	13318	4922	14	34	164	
1883	3095	5656	5918	46	67	102	329
1884	2512	9905	6191	54	34	94	637
1885	2976	10042	6108	43	45	142	337
1886	2749	10157	6278	17	54	182	474
1887	2819	11271	6796	36	71	222	441
1888	3655	11651	5981	30	140	701	238
1889	4263	19134	7153	24	236	246	574
1890	5484	17081	7506	63	155	502	773
1891	4104	15575	7813	29	30	600	1143
1892	3481	16685	7697	17	18	426	1200
1893	3669	15333	7533	71	24	483	589
1894	4873	18204	7979	56	62	321	745
1895	3628	23868	8747	46	164	137	605
1896	4951	22870	9211	90	271	161	255
1897	6844	26314	9659	67	197	168	141
1898	4144	32525	8562	157	325	270	104
1899	9408	39883	13149	123	522	698	641
1900	8384	37971	14399	266	347	439	887
1901	7751	43129	12742	204	119	848	528
1902	7428	42681	12928	173	204	778	468
1903	8702	46438	13843	67	161	554	448
1904	9575	56111	14310	118	238	586	701
1905	12555	65667	16520	126	309	688	373
1906	14109	72641	19322	192	393	984	924
1907	14161	86663	21237	172	285	982	931
1908	25431	102970	19888	321	279	1805	690
1909	21235	105439	20807	275	435	1460	883
1910	26840	93702	22559	136	289	859	212
1911	66484	112770	25617	314	320	543	755
1912	47965	118468	25230	397	457	998	1553
1913	58919	127590	25506	211	287	1207	1384

Table 2: Miscellaneous Data, 1860–1913

Year	Non-Agricultural NNP (mn Mark)	Corrected Non-Agricultural Capital (mn Mark)	Corrected Non-Agricultural Labour (mn persons)	Industrial Unemployment Rate (%)
1860	4555	22763	7.53	1.9%
1861	4688	23019	7.68	1.2%
1862	4781	23282	7.70	3.0%
1863	4913	23767	7.72	3.0%
1864	5003	24812	7.74	1.9%
1865	5088	24738	7.76	3.0%
1866	5327	26281	7.78	0.8%
1867	5566	25902	7.80	3.0%
1868	5911	27729	8.04	1.3%
1869	6197	29626	8.28	0.9%
1870	6600	32042	8.53	1.4%
1871	7187	37026	8.75	1.0%
1872	8026	45017	8.91	0.2%
1873	8957	50775	9.06	0.2%
1874	9231	48117	9.22	3.0%
1875	9369	46383	9.37	4.0%
1876	9406	38319	9.60	16.7%
1877	8896	39926	9.68	10.3%
1878	8902	41520	9.71	3.0%
1879	9040	38206	9.94	7.9%
1880	9319	42084	10.03	2.1%
1881	9533	41423	10.09	3.0%
1882	9896	45000	10.24	1.5%
1883	10209	45691	10.43	2.2%
1884	10503	46856	10.68	3.0%
1885	10812	49509	10.83	1.6%
1886	11209	50736	11.18	3.0%
1887	11880	56088	11.49	0.2%
1888	12784	58971	11.90	3.8%
1889	13732	65868	12.39	0.2%
1890	14466	69172	12.75	2.3%
1891	14729	65732	12.87	3.9%
1892	14862	62498	12.98	6.3%
1893	15111	64930	13.02	2.8%
1894	15327	65698	13.24	3.1%
1895	15947	69401	13.55	2.8%
1896	17019	78128	14.05	0.6%
1897	18063	84672	14.49	1.2%
1898	19150	93624	14.93	0.4%
1899	20583	106803	15.30	1.2%
1900	21916	117992	15.72	2.0%
1901	21424	106082	15.72	6.7%
1902	21767	109723	15.85	2.9%
1903	22990	115495	16.28	2.7%
1904	24235	122669	16.76	2.1%
1905	25725	132643	17.21	1.6%
1906	27416	147410	17.76	1.2%
1907	29805	158719	18.18	1.6%
1908	29397	151476	18.17	2.9%
1909	29914	154256	18.33	2.8%
1910	31815	164906	18.79	1.9%
1911	33909	174520	19.32	1.9%
1912	36154	189630	19.79	2.0%
1913	37536	196822	20.17	2.9%

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