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Financial Development and Sectoral Output Growth in 19th century Germany

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Financial Development and Sectoral Output Growth in 19th Century Germany

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August 2010

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August 2010

Abstract: In this paper we re-evaluate the hypothesis that the development of the financial sector is an essential factor behind economic growth in 19th century Germany. We apply a structural VAR framework to a new annual data set from 1870 to 1912 that was initially recorded by Walther Hoffmann (1965). With respect to the literature, the distinguishing characteristic of our analysis is the focus on different sectors in the economy and the interpretation of the findings in the context of a two-sector growth model of Tornell and Schneider (2004). We find that all sectors are affected significantly by shocks from the banking system. Interestingly, this link is the strongest in non-tradable goods producing sectors, such as home services, agriculture and traffic. In this regard, the growth patterns in 19th century Germany are reminiscent to those in today's emerging markets.

Keywords: Economic Growth, Financial Development, Sectoral asymmetries

JEL: C22, N13, N23, 011

1 Motivation

In this paper we re-evaluate the hypothesis that bank lending was a key factor in the growth process in 19th century Germany and that it has been instrumental in financing technical progress and the industrial revolution that followed from it. We employ a new data set that was initially recorded by Walter Hoffmann (1965) that covers the sample period of 1870-1912. This data set includes - next to the standard national accounts - a sectoral disaggregation of output that allows us to trace the effect of bank lending on net domestic product, as well as on the sectoral structure underneath it. The importance of sectoral information when analysing the effects of financial deepening on growth, has been emphasized, among others, by Rajan and Zingales (1998) and Tornell and Schneider (2004).

In the empirical analysis, we use a VAR framework to trace the effect of an unexpected shock in aggregate lending on domestic product and its subsectors. From the VAR coefficients, we generate impulse response functions in two different ways. On the one hand, we use generalized impulse response functions. These can be computed without prior knowledge of the contemporaneous causal relationships among the variables. On the other hand, we use a Cholesky decomposition that was proposed by Tornell and Westermann (2005) and that, using an appropriate ordering, can be interpreted as structurally identified in the context of a theoretical two-sector growth model with credit market imperfections. As output depends on investment and credit in period *t-1*, it is assumed not to be affected by bank lending in the same period.

We find that - using both approaches - net domestic product (NDP) as well as all subsectors react significantly to a standard shock in the bank lending variable. This finding is consistent with most papers on economic history, as well as today's emerging markets. It is interesting, however, that the importance of these shocks varies substantially across sectors. In a variance decomposition of the forecast errors, we find that for the mining sector, the industrial sector and the trade sector, shocks from the banking system only play a minor role. The agricultural sector, the traffic sector and the home service sector on the other hand, are substantially more affected.

This result appears to be at odds with the hypothesis, that the industrial sector benefited the most from the development of the banking sector. It is interesting, however, that the sectoral patterns are indeed quite reminiscent of the sectoral growth patterns in today's

emerging markets. Tornell and Schneider (2004) motivate theoretically that in credit constrained economies, the non-tradables goods producing sectors are likely to benefit the most from bank lending, while the tradables sectors typically consist of large firms that have other forms of financial instruments available. In their model, later sectors can directly borrow from the (international) capital market and are largely unaffected by the domestic banking system.

The empirical results in our paper seem to confirm this later view. The industry, mining and trade sector are classical tradable goods producing sectors and in particularly the industrial sector displayed the highest export share during the late 19th and early 20th century in Germany. At least the former two also consist of mostly large firms. Traffic and home services, on the other hand, are clearly non-tradable. Although agriculture ranks among the more tradables sectors today, it is plausible that due to the lack of modern refrigerating technologies, its output was mostly non-tradable more than a century ago.

Although our findings confirm previous studies that also report a significant impact of bank lending on growth (see for instance Burhop (2006) for Germany, Levine (1997), King and Levine (1993), Rousseau and Wachtel (1998, 2000) and Schularick and Steger (2010) for other countries), they challenge the role the banking system has actually played in promoting growth. Our results indicate that rather than speeding up the structural change towards the industrial sectors, the importance of the banking system may have been to allow other sectors to keep up with its pace. In a period of rapid technological change, it seems to have allowed for a more *balanced* growth path than it otherwise could have been. Our finding could be rationalized by a recent paper of Rancière and Tornell (2010), who have developed a two sector growth model, in which the non-tradable sector that is subject to credit constraints is a bottleneck to economic growth as it is used as an input in the tradable sectors production. Relaxing the credit constraints in the non-tradable sector therefore leads to overall higher growth. Our findings also provide a rationale for the rapid increase in productivity of small agricultural firms, that is documented in van Zanden (1991).[1]

We test for the robustness of our results in several ways. First, we employ two alternative indicators of bank lending, the net contribution of banks to financing investment and total assets in the banking system. Furthermore, we use data on equity capital to show that the

[1] Van Zanden shows that the use of mechanical theshers, reapers or sowing machines was particularly high in post-1870 Germany. The development of agricultural finance in the 19th century Germany has also been documented in Blömer (1990).

non-tradables sectors did not disproportionately benefit from alternative forms of financing that are typically used by large industrial firms. When using equity capital, the industrial sector is indeed the one that is reacts to an unexpected increase in financial resources most strongly.

We conclude the paper by drawing an analogy to the empirical evidence on today's emerging markets. Tornell, Westermann and Martinez (2003) have documented in a broad cross section of middle income countries from 1980-2000 that there exists a pronounced shift toward small firms and non-tradable goods producing firms (n-sector) in periods of rapid credit expansion. It is remarkable that the patterns of 19th century Germany are reminiscent of the sectoral growth processes that are often observed in emerging markets in the past 20 to 30 years.

2 Description of the data and preliminary analysis

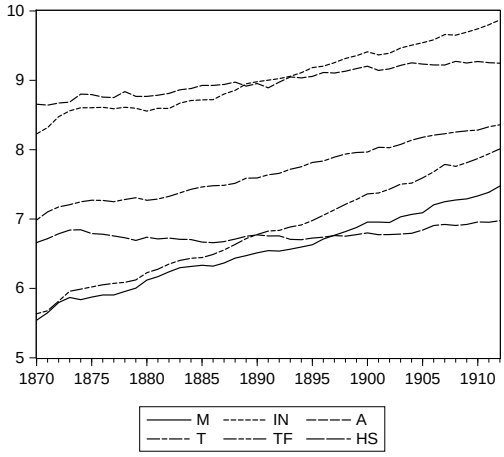
The data in our analysis are recorded from a book written by the German economic historian Walter Hoffmann (1965). This data set is particularly useful for our analysis because it includes a detailed decomposition of sectoral output.

Our main variables are the *Net Domestic Product (NDP)*[2], *Investment (I)*[3] and *Bank Lending (B)*[4]. Both, domestic product and investment are expressed in net terms and in constant 1913 prices. Our bank variable captures the contribution of banks in the financing of net investment.

On a disaggregated level we consider the following sectors: *Mining (M)*, *Industry (IN)*, *Agriculture (A)*, *Trade (T)*, *Traffic (TF)* and *Home Services (HS)*.[5] The mining sector contains value added of mining and salines, the industry sectors consists of industry and handcraft and the agriculture sector covers the value added of farming, forest and fishing. The trade sector contains the value added of trade, banks, insurances and public houses. Figure 1 shows the time paths of the sectors in logged terms. While mining and industrial production were growing very fast over our sample period there was also substantial growth in agriculture. Traffic was the fastest growing among all sectors.

[2]See Hoffmann (1965), table 5a, p.26f., converted in level data.
[3]See Hoffmann (1965), table 248, p.825f.
[4]See Hoffmann (1965), table 239, p.812f. Because the data for *Bank Lending* are only available in nominal terms, we adjusted the values with the price index for the net national product, table 148, p.598ff.
[5]See Hoffmann (1965), table 103, p.454f.

Figure 1: Graphs for Sectoral Output Growth



Note: The graphs for Mining (M), Industry (IN), Agriculture (A), Trade (T), Traffic (TF), and Home Services (HS) are displayed.

We also take an alternative measure of the banks' contribution to financing investment. Our indicator *Bank Lending 2 (B2)* includes the total assets of savings banks, cooperate credit associations, mortgage banks, banks of issue and commercial banks.[6] All data are recorded on an annual basis. The sample period covers the years 1870 to 1912.[7]

We start our empirical analysis, by testing the unit root properties of our time series. We first apply the conventional Augmented Dickey Fuller test. In table 1 that reports the results for our main variables, we can see that all of our time series are nonstationary in levels, but stationary in first differences. The optimal lag length in the test specifications were chosen by the Schwarz information criterion.

In the following sections of the paper we will estimate the causal linkages among our main variables by using a vector autoregression. In this VAR our variables enter in logged levels and we therefore need to check the cointegration properties of our data set as second preliminary exercise (see table 2).

Overall, the evidence on cointegration is mixed. Using the Engle and Granger (1987) approach, we find evidence of cointegration among all pairs of time series that later enter the VAR analysis, except home services and bank lending. We generally cannot confirm cointe-

[6] See Hoffmann(1965), tables 202, 203, 205, 206, 207, p.733ff.

[7] Note that some of the data go back to 1850. In our benchmark regressions, we did not take the full time period, however, to limit our analysis to a period with a uniform federal territory of Germany and to avoid structural breaks. We also avoid the necessary interpolation of some data points in the 1850s. The main results of the analysis are unaffected by the choice of the time window.

Table 1: Results of ADF test

Variable	Level			1st Differences		
	ADF	k	Prob.	ADF	k	Prob.
Net Domestic Product	0.252	0	0.973	-5.493***	0	0.000
Investment	-0.988	1	0.749	-12.507***	0	0.000
Bank Lending	-2.455	0	0.134	-6.950***	1	0.000
Bank Lending 2	-1.921	1	0.320	-3.941***	0	0.004
Equity Capital	0.123	4	0.963	-4.938***	3	0.000
Mining	-0.205	0	0.930	-5.679***	1	0.000
Industry	0.119	0	0.964	-4.875***	0	0.000
Agriculture	-0.953	0	0.761	-8.067***	0	0.000
Trade	0.347	0	0.978	-7.984***	0	0.000
Traffic	-0.584	0	0.864	-5.465***	0	0.000
Home Services	-1.364	1	0.591	-4.804***	0	0.000

Note: The ADF test is calculated for levels and first differences for the variables net domestic product, investment, bank lending, bank lending 2, equity capital, mining, industry, agriculture, trade, traffic and home services for the years 1870 to 1912. The lag length is selected by the Schwarz information criterion. *** (**,*) indicates significance at the 99% (95%, 90%) level.

gration with using the Johansen (1991) test, however. In particular the three variable system of net domestic product, investment and bank lending as well as some bivariate combinations do not appear cointegrated in this second approach.

Although there is only mixed evidence on cointegration we continue with the VAR specification in levels, as the time series in the first differences appear to have a much higher variance in the beginning of the sample than towards the end of the sample. The intuition of this phenomenon is that at this very early stage of development, the time series start to grow from very low levels. Thus, positive as well as the negative growth rates will have a much larger amplitude than in the later part of the sample, where they have reached a higher level. We need to keep in mind, however, a potential bias in our results if the time series are not clearly cointegrated.

Except for the bivariate combination of home services and bank lending, we can reject the null of no cointegration at least in one of the three approaches (Engle/Granger, Johansen, Trace/Max-Eigenvalue Statistic).

Table 2: Results of Cointegration Tests

Variable		Johansen Trace		Max-Eigenvalue	Engle Granger
Net Domestic Product, Investment	r=0	61.634**°°	r=0	25.360* °	-4.016**°
Bank Lending	r≤1	36.275**°°	r=1	18.934* °	
	r≤2	17.340**°°	r=2	17.340**°°	
Net Domestic Product and Bank Lending	r=0	38.974**°°	r=0	23.660**°°	-3.417**°
	r≤1	15.314**°°	r=1	15.314**°°	
Investment and Bank Lending	r=0	30.903**°°	r=0	21.465**°	-4.243**°°
	r≤1	9.438*	r=1	9.438*	
Mining and Bank Lending	r=0	36.425**°°	r=0	27.208**°°	-3.176**°
	r≤1	9.217	r=1	9.271	
Industry and Bank Lending	r=0	31.528**°°	r=0	20.425**°	-3.467**°
	r≤1	11.103* °	r=1	11.103* °	
Agriculture and Bank Lending	r=0	26.850**°	r=0	15.858*	-3.614**°°
	r≤1	10.992* °	r=1	10.992* °	
Trade and Bank Lending	r=0	48.807**°°	r=0	33.476**°°	-3.564**°
	r≤1	15.331**°°	r=1	15.331**°°	
Traffic and Bank Lending	r=0	30.750**°°	r=0	18.707* °	-3.245**°
	r≤1	12.043* °	r=1	12.043* °	
Home Services and Bank Lending	r=0	11.252	r=0	8.631	-1.567
	r≤1	2.621	r=1	2.621	

Note: Results of testing for cointegration are shown for all couples of variables, which are of interest. Concerning cointegration suggested by Johansen (1991) Trace and Maximum Eigenvalue statistics for r=0 and r=1 are shown. ** and * indicate test statistic significance at 5% and 1% level by employing critical values from Osterwald-Lenum. °° and ° state test statistic significance at 5% and 1% level taking critical values from Cheung and Lai (1993). For Engle and Granger (1987) the test statistics are given. ** and * indicate test statistic significance at 5% and 1% level. °° and ° state test statistic significance at 5% and 1% level taking critical values from MacKinnon.

3 Investment, credit and output growth - a VAR analysis

In the subsequent analysis, we take two different approaches of modelling the link between financial development and growth. One of the key issues in a VAR framework is the identification of structural shocks. In our first approach, we apply the concept of generalized impulse responses. This approach has the benefit that the impulse response functions are independent of the ordering of the variables in the VAR. Its drawback, however, is that the structural shocks are ultimately not identified. We simulate a *system shock*, where the contemporaneous reactions of the other variables are already included.

In the second approach we follow the structural identification proposed in Tornell and

Westermann (2005). In this paper, the identification is based on a theoretical two-sector growth model that also guides the analysis in the later sections of this paper. We employ a Cholesky decomposition, where output cannot contemporaneously react to domestic lending in the same period. The intuition is that output results from investment that is financed by domestic credit in the period t-1. This also applies to sectoral output. As lending, on the other hand, can react to changes in output in the same period, we have a recursive system that can be used to identify shocks from each variable, following the standard Cholesky procedure. The advantage of this approach is that a structural interpretation can be given to the impulse response functions in the context of this model. A drawback is that we need to limit the analysis to a bivariate system. In our view, neither of the two approaches may clearly be better, but jointly, they give a more complete picture of the link between financial development and growth.

Generalized impulse response functions

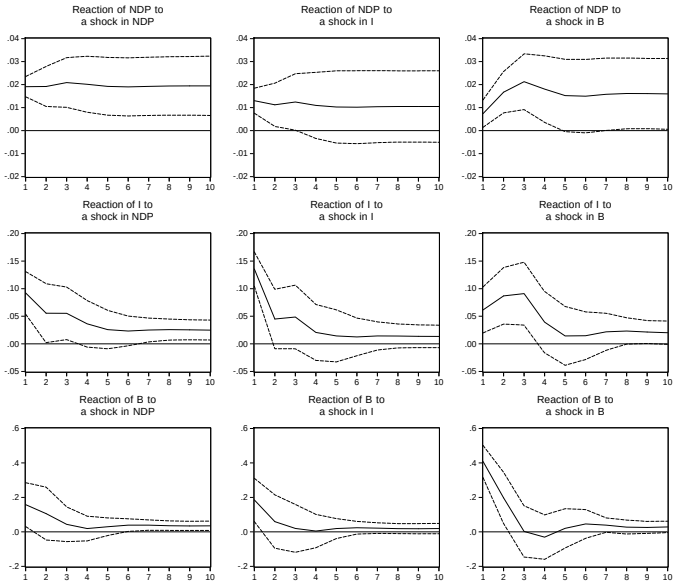
Figure 2 reports the generalized impulse responses from our first VAR that includes the variables net domestic product, investment and bank lending. In this figure, we display all impulse response functions, although our main interest is in the effect that banks have on the net domestic product. The upper right graph shows that there exists a statistically significant effect for about four years. The graph on the right in the second row shows that there is in addition another indirect effect. For a period of three to four years, an unexpected increase in bank lending increases investment. Investment, in turn, has a positive but short-lived impact on NDP, as shown in the upper graph in the middle.[8]

Although the impulse response functions have revealed a clear link between aggregate bank credit and net domestic product, they do not allow to assess the importance of these shocks in the total forecast error variance. For this purpose, we conduct a variance decomposition as a next step. Table 3 shows the variance decomposition for a forecast horizon of 5 and 10 years. We find that bank lending explains up to 24% of the forecast error variance of net domestic product and up to 30% of the forecast error variance of investment. Although this implies that other shocks seem to be more important, this is a relatively high number in a

[8]The endogenity of our two main variables of interest - output and bank lending - can be seen from the lower left graph, as NDP also has a substantial positive impact on lending. The causality therefore goes both ways.

VAR analysis.[9]

Figure 2: Impulse Responses for Net Domestic Product, Investment and Bank Lending



Note: The solid lines trace the generalized impulse responses of net domestic product (NDP), investment (I) and bank lending (B) for the years 1870 to 1912.

Table 3: Variance Decomposition for Net Domestic Product, Investment and Bank Lending

	Years	
Variance Decomposition	5	10
NDP variance due to B (in percent)	24.009	23.129
	[12.374]	[12.294]
I variance due to B (in percent)	30.006	29.281
	[12.470]	[2.541]

Note: The variance decomposition is shown for the variables net domestic product (NDP), investment (I) and bank lending (B) for the years 1870 to 1912. The values in parentheses indicate the standard deviation. The standard errors are generated by 100 Monte Carlo replications.

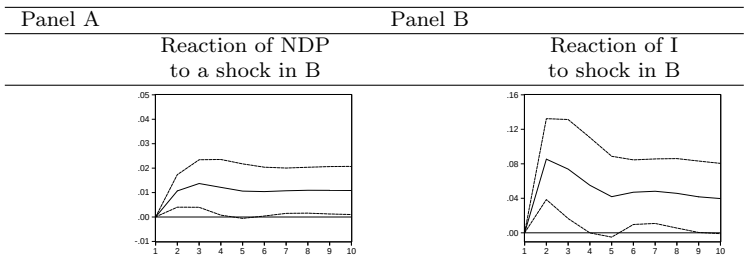
Cholesky Decompositions

In this section, we estimate the alternative approach of a Cholesky decomposition see Tornell and Westermann (2005). Panel A and Panel B of figure 3 show the results of the impulse

[9] The estimation of generalized impulse response functions is a useful approach, as it allows for a representation that needs very few assumptions about the underlying causal structure of the variables. This can be seen in the graphs for instance by the fact, that none of the impulse response functions start from zero (due to the assumptions on the recursiveness of the variables). As discussed above, a short-coming of this approach is the lack of precise identification, when the contemporaneous correlation is fairly high.

response functions, generated from two different VAR's. In this first VAR, we only include net domestic product (NDP) and bank lending, in the second one, we include NDP and investment. Panel A shows that there is a positive and significant reaction of net domestic product to an unexpected shock in bank lending. Furthermore, in Panel B, we see that there is also a significant reaction of investment to bank lending.[10] The variance decompositions, reported in table 4, show that the shock in bank lending explain 21% and 25% of the forecast error variance. Thus, the results seem to confirm the finding from the previous section that used generalized impulse response functions.

Figure 3: Impulse Responses for Net Domestic Product and Bank Lending, and Investment and Bank Lending



Note: The solid lines trace the impulse responses of net domestic product (NDP) and bank lending (B), and investment (I) and bank lending (B) respectively, for the years 1870 to 1912.

Table 4: Variance Decomposition for Net Domestic Product and Bank Lending, and Investment and Bank Lending

	Years	
Variance Decomposition	5	10
NDP variance due to B (in percent)	20.777	21.045
	[10.648]	[11.186]
I variance due to B (in percent)	25.256	25.690
	[12.860]	[13.955]

Note: The variance decomposition is shown for the variables net domestic product (NDP) and bank lending (B), and investment (I) and bank lending (B) respectively, for the years 1870 to 1912. The values in parentheses indicate the standard deviation. The standard errors are generated by 100 Monte Carlo replications.

[10] Note that these impulse response functions come from seperate regressions. In a Cholesky decomposition it is not feasible to include the three variables at the same time, as it does not exists a plausible ordering for net domestic product and investment.

4 A sectoral analysis

The findings in the previous sections largely confirmed earlier research on historical data in Germany and other countries. A key question that we would like to address in the present paper, is to understand which sectors of the economy benefited most strongly from the positive link between bank lending and growth. In the literature on today's emerging markets, pronounced sectoral asymmetries are often found, and we find it very interesting to compare how the growth process in 19th century Germany relates to the experiences of the emerging markets of the last 20 to 30 years. We therefore also investigate the sectoral differences in the responses of output to aggregate lending in this section.

In the literature on financial development in emerging markets, sectors are typically classified as small (and non-tradable) or large (and tradable). The motivation for this classification is that the former set of firms are financing investment mainly via the domestic banking system, while the later has other financial instruments available, such as issuing equity or commercial paper, or borrowing on the international capital market. It is often found that the strength of the link between financial development and output growth differs substantially between these two groups. This difference across sectors is quite pronounced in middle income countries and emerging markets, but less prevalent in industrial economies.

The data set of Hoffmann (1965) includes detailed information on the sectoral aggregate accounts of Germany and allows us to do such a decomposition. We focus on six main subsectors of NDP, the industrial sector, mining, agriculture, trade, traffic and home services.

Figure 4 shows the impulse response functions that were generated from bivariate VARs, including the respective measure of output and our bank lending variable. As in the previous section, we generate the impulse response functions from a Cholesky decomposition, where the bank lending variable is ordered at the second position in the VAR.

We find that in all sectors there is a positive reaction of output to an unexpected shock in bank lending. In all sectors, except for the trade sector, this reaction is also statistically significant at the 5% level. However, the variance decomposition in table 5 shows that the shocks coming from the banking system are of quite different importance for the various sectors of the economy. The insignificant trade sector is least affected by banks. Shocks from the banking system explain only up to 4.9% of the forecast uncertainty of the trade sector. Interestingly, shocks from the banking system also show little impact on the industry and

mining sectors, with values of 9.3% and 5.7%. This finding is interesting, as it challenges the conventional wisdom that the industrial revolution was substantially accelerated by the parallel development of the banking system. On the other hand, we find that the sectors agriculture (up to 17.9%), traffic (up to 25.5%) and home services (up to 25%) were most affected by shocks in the banking system.[11]

The structure of German exports - that was also recorded, although not on an annual basis, by Hoffmann (1965) - suggests that the industry sector was indeed the most tradable in Germany. In 1910-13, final goods had the largest share in total German exports - textiles (12.3%), metal and machinery (21%) as well as chemicals (9.9%) - followed by raw materials such as coal (5.3%) and half-manufactured goods such as iron (6.6%). Food products, such as grain (3.4%) and sugar (2.3%) had a substantially smaller share.[12] Exports as a share of production were also quite high within some sectors. The highest shares were recorded for leather products (110%), metal products (93%) and textiles (99%) in 1910-13. Overall the export share of production increases from 70% in 1875-79 to 95% in 1910-13.[13]

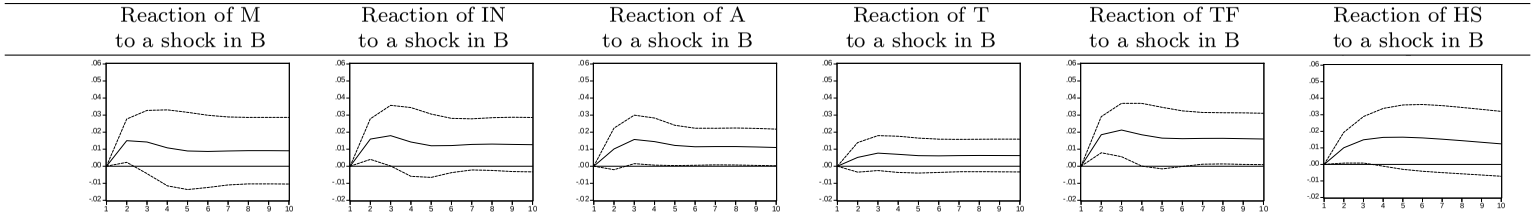
Although this evidence does not support the view that bank development was very important for technological progress that occurred in manufacturing during the industrial revolution, it is remarkable that the patterns in 19th century Germany are very similar to modern emerging markets. In emerging markets it is typically found that the non-tradables sectors are impacted the most by domestic banking system (see Tornell and Westermann (2005) and IMF (2003)). Table 5 shows that this is also the case in 19th century Germany, as both home services and traffic are clearly non-tradable. Due to the lack of modern refrigeration, the output of the agriculture sector is likely to have been largely non-tradable as well.

[11] Note that the significance level of the variance decomposition is very low in general. Our robustness tests in the following section will show, however, that the contributions of banks to the forecast error variance are also significant at conventional levels, when using the alternative banking indicator.

[12] See Hoffmann (1965), table 60, p.154.

[13] See Hoffmann (1965), table 70, p.158.

Figure 4: Impulse Responses for Sectoral Output and Bank Lending with Cholesky Decomposition



Note: The solid lines trace the impulse responses of the sectoral output of mining (M), industry (IN), agriculture (A), trade (T), traffic (TF) and home services (HS) related to bank lending (B) for the years 1870 to 1912.

Table 5: Variance Decomposition for Sectoral Output and Bank Lending

Period	M due to B	IN due to B	A due to B	T due to B	TF due to B	HS due to B
5	6.773	9.691	16.049	4.556	24.643	16.559
	[8.496]	[8.481]	[13.064]	[6.939]	[12.972]	[14.152]
10	5.730	9.343	17.969	4.916	25.386	25.095
	[9.577]	[9.213]	[14.958]	[8.264]	[15.532]	[20.331]

Note: The variance decomposition (in percent) is shown for the sectoral output of mining (M), industry (IN), agriculture (A), trade (T), traffic (TF) and home services (HS) related to bank lending (B) for the years 1870 to 1912. The values in parentheses indicate the standard deviation. The standard errors are generated by 100 Monte Carlo replications.

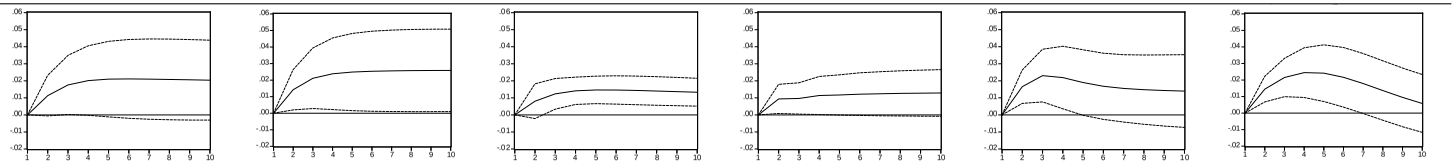
An alternative measure of bank lending

In this subsection we perform some robustness tests to our main findings that (a) banks contributed substantially to investment and growth in 19th century Germany and (b) this has been particularly important for non-tradables sectors. We start by taking an alternative measure of bank lending.

As all of our variables - net domestic product and investment are in net terms - we initially started the analysis with the net contribution of the banking system to financing investment as our main indicator of bank lending. In the present section we take the more conventional measure of total assets in the banking system as an alternative (denoted as bank lending 2 (B2) in the following tables).

The impulse response functions of the six sectors of the economy are displayed in figure 5. We see that all sectors still respond positively to a standard shock in our alternative measure of bank lending. Table 6 shows furthermore, that we find roughly similar results also for the variance decomposition. Overall the share of the forecast error variances is somewhat higher than in the previous tables. The least affected sector is still the trade sector (up to 14.3%), followed now by the traffic sector (17.5%), mining (20.7%) and the industry (23.7%). Substantially higher values are found in the agriculture sector (47.9%) and home services (48.6%). Again, the non-tradables sectors appear to have been more strongly affected by bank lending than the industry or mining sector.

Figure 5: Impulse Responses for Sectoral Output and Bank Lending 2 with Cholesky Decomposition



Note: The solid lines trace the impulse responses of the sectoral output of mining (M), industry (IN), agriculture (A), trade (T), traffic (TF) and home services (HS) related to bank lending 2 (B2) for the years 1870 to 1912.

Table 6: Variance Decomposition for Sectoral Output and Bank Lending 2

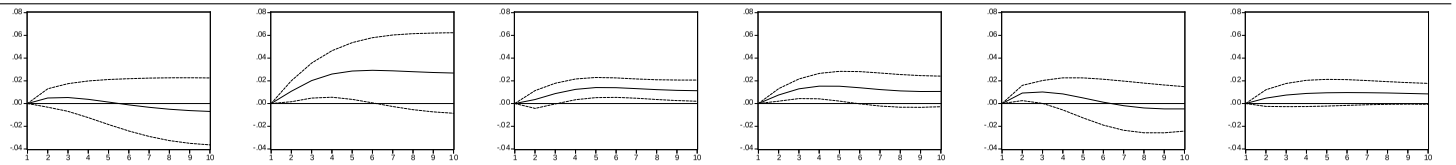
Period	M due to B2	IN due to B2	A due to B2	T due to B2	TF due to B2	HS due to B2
5	15.477	16.891	29.144	10.645	23.686	39.361
	[13.614]	[13.154]	[12.461]	[8.503]	[14.269]	[13.268]
10	20.735	23.690	47.979	14.297	17.487	48.659
	[18.654]	[19.408]	[14.049]	[11.824]	[15.230]	[14.824]

Note: The variance decomposition (in percent) is shown for the sectors mining (M), industry (IN), agriculture (A), trade (T), traffic (TF) and home services (HS) related to bank lending 2(B2) for the years 1870 to 1912. The values in parentheses indicate the standard deviation. The standard errors are generated by 100 Monte Carlo replications.

Equity Capital

Finally, we perform a plausibility test for our main hypothesis that small, non-tradables goods producing sectors were dependent on the banking system, while other sectors, in particular the industrial sector, had other sources of finance available. In the Hoffmann data set, we extracted the time series on total equity capital (denoted as Equity Capital (EC)) that was raised in the economy by listed stock market companies. When we use this indicator in our regressions - instead of bank lending -, we find that indeed the industrial sector shows the strongest reaction to an unexpected change in equity capital, that is statistically significant at the 5% level. Most other sectors (except mining) also show a significant reaction but quantitatively smaller than the industrial sector. When looking at the variance decomposition, this finding is also confirmed. After 5 years, the industrial and the trade sectors show the highest share of forecast error variance that is explained by the equity shocks with 20.5% and 23.4%, respectively. After a period of 10 years, it is again the agricultural sector that is most affected, followed by the industrial sector, the traffic and the trade sectors, although with a much smaller lead compared to the previous section. For home services the equity financing plays a much smaller role explaining only 5.2% of the variance after 5 years and 11.1% after 10 years.

Figure 6: Impulse Responses for Sectoral Output and Equity Capital with Cholesky Decomposition



Note: The solid lines trace the impulse responses of the sectoral output of mining (M), industry (IN), agriculture (A), trade (T), traffic (TF) and home services (HS) related to equity capital (EC) for the years 1870 to 1912.

Table 7: Variance Decomposition for Sectoral Output and Equity Capital

Period	M due to EC	IN due to EC	A due to EC	T due to EC	TF due to EC	HS due to EC
5	0.670	20.532	16.207	23.426	3.594	5.202
	[3.026]	[13.086]	[9.637]	[15.464]	[5.668]	[7.061]
10	0.852	24.775	26.664	20.462	22.821	11.091
	[6.767]	[20.563]	[13.019]	[17.772]	[10.779]	[10.762]

Note: The variance decomposition (in percent) is shown for the sectors mining (M), industry (IN), agriculture (A), trade (T), traffic (TF) and home services (HS) related to equity capital (EC) for the years 1870 to 1912. The values in parentheses indicate the standard deviation. The standard errors are generated by 100 Monte Carlo replications.

5 Conclusions

In this paper we attempted to evaluate the role that the banking system played in 19th century Germany by taking a sectoral perspective. We found evidence that the sectors of the economy were affected *asymmetrically* by shocks from bank lending. This evidence is robust to reasonable alternative estimation procedures and alternative indicators of bank lending. Our central finding is that not the industrial sector, but traffic, agriculture and home services benefited the most from the development of the banking sector.

We explain this new stylized fact, referring to a two sector growth model of Tornell and Schneider (2004), who show that small, non-tradables firms benefit most from lending booms in economies with contract enforceability problems. We point out that our findings are indeed reminiscent to stylized facts that have been documented on today's emerging markets. During Boom- Bust cycle episodes in the 1980's and 1990's, the non-tradable sector has often grown more strongly during the boom-phase and fallen into a more deep and sustained recession in the aftermath of banking crisis.

Several questions remain unanswered, however, that further research might be able to address. First, we found that - similar to today's emerging markets - the tradable sector is hardly affected by the domestic banks. But is this because there was already a well enough developed *international* capital market, or because this set of firms happened to be large firms, who had equity finance and other *domestic* financial instruments available? The Hoffmann data set gives some indication that capital markets were indeed quite open. German gross foreign assets increased for instance from 7172 (mill.) Mark in 1882 to 19396 (mill.) Mark in 1912. The foreign emissions of equity and commercial paper increased from 300 (mill.) Mark in 1883 to 604 (mill.) Mark in 1913 (with a peak of 1108 (mill.) Mark in 1905).[14] Also the trade account appears to have been quite open, as between 1880 and 1913 the share of exports to NDP fluctuated between 12.8% and 17.7%.[15] The openness of financial markets in the 19th century have also been documented by Bordo (2002).

Furthermore, there does not exist - to the best of our knowledge - data on historical real exchange rates from this period. So ultimately the source of the similarity in stylized facts remains unsolved. Firm level data, if available, and individual case studies would help a lot to

[14] See Hoffmann (1965), table 43, p.262. These numbers are quite high. In the peak year 1905, total domestic equity capital was 8043 (mill.) Mark and the total block of commercial paper was 2345 (mill.) Mark.

[15] See Hoffmann (1965), table 65, p.151.

strengthen the case that today's industrialized countries experienced a similar start up phase in their development process as today's emerging markets. Several such case studies and a large body of literature on the institutional development of the German banking system already exist and are surveyed for instance in Guinnane (2002). Particularly interesting from our perspective are the origins of German credit cooperatives in the 1840's and 1850's, who, next to financing small businesses and corporations, also engaged directly in purchasing agricultural inputs and the marketing of agricultural products.[16] Also, Edwards and Fischer (1994) and Edwards and Nibler (2000) documented the development of the *universal* banking system in Germany. For large firms, banks provided - next to credit - a wide range of financial instruments and maintained a close relationship with large corporations. Continuing to set together these pieces of information is a challenging, but worthwhile exercise for both, researchers in economic history and in development finance.

[16]See also Guinnane (2001).

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Appendix

Table A.1-1: Sources and Composition of the Variables

Variable	Table	Column	Page
Net Domestic Product (NDP)	5a: *Die jährlichen Wachstumsraten des Nettoinlandsprodukts und des Kapitalsocks, jeweils in Preisen von 1913, der Beschäftigten und der gesamten Faktorproduktivität (%)* The annual growth rates of the Net Domestic Product and of the capital stock, both in prices of 1913, of the employment and of the total factor productivity	1: *Nettoinlandsprodukt in Preisen von 1913* Net Domestic Product in prices of 1913	26-7
Investment (I)	249: *Die Verwendung des Nettosozialprodukts zu Marktpreisen in Preisen von 1913* The Application of the Net Domestic Product in market prices of 1913	2: *Nettoinvestitionen* Net Investment	827-8
Bank Lending (B)	239: *Die Finanzierung der einheimischen Nettoinvestitionen* The Financing of domestic Net Investment	1: *Banken und Bausparkassen* Banks and Building Association	812-3
Bank Lending 2 (B2)	Sum of:		
Saving Banks	202: *Die Finanzierung durch die Sparkassen* The Application provided by Saving Banks	3: *Bilanzsumme* Total Assets	733-4
Cooperative Credit Association	203: *Die Finanzierung durch die Kreditgenossenschaften* The Application provided by Cooperative Banks	4: *Bilanzsumme* Total Assets	736-7
Mortgage Banks	205: *Die Finanzierung durch die Hypothekenbanken* The Application provided by Mortgage Banks	4: *Bilanzsumme* Total Assets	739-40
Banks of Issue	208: *Die Finanzierungen durch die Notenbanken* The Application provided by Banks of Issue	Adjusted Total Assets	
Commercial Banks	207: *Die Finanzierung durch die Kreditbanken ohne Notenausgabe* The Application provided by Commercial Banks without Note Issue	1: *Aktienkapital* + 2: *Reserven* + 3: *Kreditoren, Depositen* + 4: *Akzepte* Capital Stock + Reserves + Payables, Debtors + Accepted Bills	748-749 454-5

Note: All variables used in this paper are listed with its corresponding abbreviations. Data are taken from Hoffmann (1965). In addition to the table and column numbers, table and column names are shown in original terms and in translation. The sample contains the years from 1870 to 1912.

Table A.1-2: Sources and Composition of the Variables

Variable	Table	Column	Page
Mining (M)	103: *Die Wertschöpfung nach Wirtschaftsbereichen in Preisen von 1913* The Added Value according to Economic Sectors in prices of 1913	2: *Bergbau und Salinen* Mining and Salines	
Industry (IN)	103: *Die Wertschöpfung nach Wirtschaftsbereichen in Preisen von 1913* The Added Value according to Economic Sectors in prices of 1913	3: *Industrie und Handwerk* Industry and Handcraft	454-5
Agriculture (A)	103: *Die Wertschöpfung nach Wirtschaftsbereichen in Preisen von 1913* The Added Value according to Economic Sectors in prices of 1913	1: *Landwirtschaft, Forsten, Fischerei* Farming, Forest and Fishing	454-5
Trade (T)	103: *Die Wertschöpfung nach Wirtschaftsbereichen in Preisen von 1913* The Added Value according to Economic Sectors in prices of of 1913	5: *Handel, Banken, Versicherungen, Gaststätten* Trade, Banks, Issurances and Public Houses	454-5
Traffic (TF)	103: *Die Wertschöpfung nach Wirtschaftsbereichen in Preisen von 1913* The Added Value according to Economic Sectors in prices of of 1913	4: *Verkehr* Traffic	454-5
Home Services (HS)	103: *Die Wertschöpfung nach Wirtschaftsbereichen in Preisen von 1913* The Added Value according to Economic Sectors in prices of 1913	6: *häusliche Dienste* Home Services	454-5
Equity Capital (EC)	220: *Das eingezahlte Kapital der Aktiengesellschaften* Paid-in capital of stock corporations	18: *Insgesamt* Total[a]	772-5

Note: All variables used in this paper are listed with its corresponding abbreviations. Data are taken from Hoffmann (1965). In addition to the table and column numbers, table and column names are shown in original terms and in translation. The sample contains the years from 1870 to 1912.

[a] Linear interpolated for the years 1972/4/5.