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# STEAM ENGINES OF CREDIT: THE ROLE OF BANKS IN SWITZERLAND'S ECONOMIC DEVELOPMENT, 1850-1913

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*From the mid-nineteenth century to the beginning of World War One, the Swiss economy grew to be among the most advanced in the world. Economists however have not yet completely determined the reasons for Switzerland's economic success. One source of this success may have been the Swiss banking system. This article explores the link between Swiss banks and Swiss economic development using historical analysis and time series econometric techniques. The evidence suggests that Switzerland's banks contributed to Swiss economic success and that Switzerland's universal banks in particular contributed to the country's industrial development.*

## **Introduction**

The importance of financial markets and associated institutions in fostering economic growth and development has been a source of contention among economists for decades. Some economists argue that financial systems play an active role in determining growth while others contend that the financial sector merely passively follows the rest of the economy<sup>1</sup> This article contributes to this debate by examining the importance of Switzerland's banking system in Swiss economic

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<sup>1</sup> See for example Thorsten Beck, Ross Levine and Norman Loayza (2000), Philip Arestis, Panicos Demetriades and Kul Luintel (2001), Dimitris Christopoulos and Efthymios Tsionas (2004), Peter Rousseau and Dadanee Vuthipadorn (2005), Beck, Luc Laeven, and Stelios Michalopoulos (2015), and Jakob Madsen and James Ang (2016) for supportive evidence of finance promoting economic growth, and Jordan Shan and Alan Morris (2002) and Shan (2005) for evidence to the contrary.

## Steam Engines of Credit in Switzerland

development from the mid-nineteenth century to the start of World War One.

In addition to studying “finance-led growth” in Switzerland generally, this article also examines a more specific question concerning the role that large universal banks play in industrial development. Several authors assert that the combination of commercial and investment banking in universal banking systems promotes the development of large industrial firms. Other researchers refute this claim suggesting that the benefits of universal banks have been overstated. A body of empirical work explores the relationship between universal banks and industry. The results of these studies, which have mostly focused on universal banking in Germany, are contradictory and inconclusive. This article examines the nexus between Switzerland’s universal banks and Swiss industry to provide additional evidence concerning the potential benefits of universal banking.

The decision to study Switzerland is prompted not only because it provides a new country for the study of financial systems and economic growth, but also because Switzerland’s economic development has been understudied. Of all European countries, Switzerland has received the disproportionately smallest amount of attention from economic historians.<sup>2</sup> This neglect is puzzling considering that Switzerland achieved very high levels of economic development during the latter half of the nineteenth century and by World War One trailed only Britain in per-capita income in Europe. Furthermore, Switzerland achieved this prosperity despite having a severe lack of natural resources, begging the question of what were the sources of Switzerland’s success. This article assesses the possibility that Switzerland’s banking system was an important source of Swiss economic development.

We use several types of analysis for this study. First, we present historical information documenting the relationship between banks and

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<sup>2</sup> Rondo Cameron notes this inattention: “It is ironic that Switzerland, the wealthiest country in Europe, has the least satisfactory literature in English on its economic history” (1997, 423). Richard Sylla and Gianni Toniolo’s edited book, *Patterns of European Industrialization: The Nineteenth Century*, for example, devotes five lines out of 276 pages to Switzerland. Interestingly, the first sentence of these lines reads, “Switzerland merits more study” (Sylla, 1991, 55).

enterprises. Cross-country comparative statistics are then used to illustrate a possible link between Switzerland's financial system and economic development. To further examine the possibility that the Swiss banking system induced economic development, we also use Vector Error Correction Model (VECM) time series analysis to test for a causal relationship between banks and growth. As a whole, our evidence is suggestive that the Swiss banking system helped foster economic development and industrialization in Switzerland between 1850 and 1913.

The remainder of the article proceeds as follows. The next section of the paper presents a short introduction into banking theory and surveys the empirical evidence concerning the role of financial intermediaries in economic development while the following section details the economic history literature examining the role of universal banks during industrialization. A brief narrative and literature review concerning the relationship between Swiss banks and economic development is then presented, followed by cross-country comparative statistics of financial systems and economic performance. The next section provides empirical tests of the relationship between banks and development. The article ends with a brief conclusion.

### **Financial Intermediation and Economic Development**

Economists' views on the importance of financial intermediation for economic performance have been, and continue to be, widely varied.<sup>3</sup> Joseph Schumpeter (1911) contended that services provided by financial intermediaries were crucial in promoting technological innovation and economic development. However, with the rise of Keynesian economics following the Great Depression, research focused mostly on the passive role intermediaries play in determining the money supply. Most notably, Joan Robinson (1952) argued the financial sector merely follows economic growth. Although John Gurley and Edward Shaw (1955) stressed an active role for intermediaries in affecting economic performance through the provision of credit, their work failed to shift

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<sup>3</sup> For those new to this literature, the following provide excellent overviews: Levine (2005), Ang (2008), Arestis, Georgios Chortareas, and Georgios Magkonis (2015), and Petra Valickova, Tomas Havranek, and Roman Horvath (2015).

mainstream macroeconomics away from its concentration on money. Furthermore, Gurley and Shaw's hypothesis was soon to be overshadowed by the seminal work of Franco Modigliani and Merton Miller.

Modigliani and Miller (1958) presented a framework in which the financial sector was irrelevant in making real economic decisions. Moreover, their work provided researchers with a rigorous justification for abstracting from the complications induced by financial considerations. Neoclassical investment theorists in particular used the Modigliani-Miller Theorem as a rationale for ignoring financial markets in models of firm investment. Under their assumption of perfect capital markets, the marginal cost of funds for investment financed by internal sources (such as retained earnings) is the same as the marginal cost of investment funds financed by external sources (such as bank loans). Hence, firms invest in every project having a positive expected net present value regardless of how the investment is to be financed. Under such conditions there is little role for intermediaries to play in fostering the investment that leads to economic growth; in fact, in the absence of capital market imperfections, there are no reasons for financial intermediaries even to exist.

However, if capital markets are not perfect, financial intermediaries may arise and subsequently influence economic performance and growth. As Levine (2005) points out, financial markets can perform a number of functions that help reduce the effects of information asymmetries, enforcement, and transaction costs, and thus may be growth enhancing. These functions include: (i) reducing transaction costs and facilitating the management of risk, (ii) mobilizing and pooling savings, facilitating the matching of borrowers and lenders, (iii) producing information *ex ante* about possible investments, (iv) monitoring investments and exerting corporate governance, and (v) easing the exchange of goods and services.

Despite the generally prevailing opinion that finance followed economic development, beginning in the late 1960s, there was a renewed interest in examining the empirical relationship between the financial sector and economic development. In two books edited by Rondo Cameron (1967, 1972) the contributors generally found that banking systems played a positive role in the early industrialization of most of the

countries examined.<sup>4</sup> In another early study, Raymond Goldsmith (1969) examined very limited long-run historical data for 35 countries and finds a correlation between economic and financial development. Ronald McKinnon (1973) examined Germany and several developing nations following World War Two and found the evidence strongly suggests that better functioning financial systems support faster economic growth.<sup>5</sup>

Over the past few decades, the general empirical research on financial development and economic growth has been focused on two main approaches—those that use cross-country/panel studies and those that employ time-series techniques. Led by significant contributions from Levine and coauthors, including Robert King and Levine (1993a, 1993b), Levine and Sara Zervos (1998), and Beck, Levine, and Loayza (2000), as well as more recent papers such as Beck, Laeven, and Michalopoulos (2015), Arestis, Chortareas, and Magkonis (2015), and Madsen and Ang (2016) the evidence emerging from cross-country and panel studies generally points to a positive contribution of financial development to economic growth.<sup>6</sup>

Several time-series studies, however, find a wide range of results, calling into question this near-consensus. Demetriades and Khaled Hussein (1996), Rousseau and Paul Wachtel (1998), Luintel and Mosahid Khan (1999), Rati Ram (1999), Zhenhui Xu (2000), Arestis, Demetriades and Luintel (2001), Rousseau and Vuthipadadorn (2005), Shan and Morris (2002), Shan (2005), and Rumi Masih and Suhair Khan (2011) show a range of results in terms of causality, signs, and significance of the finance-growth relationship. These conflicting results have raised the important issue of heterogeneity in the finance-growth relationship, a

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<sup>4</sup> Switzerland was not studied.

<sup>5</sup> The references in the text are generally quantitative in nature; for readers interested in a more qualitative history of financial conditions in Europe, Charles Kindleberger's classic 1993 manuscript is recommended.

<sup>6</sup> Iftekhar Hasan, Horvath, and Jan Mares (Forthcoming) is an excellent recent paper which uses Bayesian model averaging to test the robustness of common financial development measures with growth, while Arestis, Chortareas, and Magkonis (2015), and Valickova, Havranek, and Horvath (2015) are recent meta-analysis articles which also examine the stability of the finance-growth relationship seen in many of the existing studies. Interested readers are encouraged to consult these works.

particular problem on the cross-country and panel side of this literature, and which has signaled the usefulness of looking at long time-series data for one country at a time. In sum, the time-series literature has led many researchers to reconsider the strength and direction of the finance-growth relationship, with research continuing on this basic question today.<sup>7</sup>

### **Universal Banking**

This section narrows the previous discussion to consider the influence of a particular type of intermediary called universal banks. Also known as “mixed banks” (or *Grossbanken*, literally meaning “large banks” in German), universal banks combine commercial and investment banking and may offer an entire range of financial services. They can issue loans, underwrite securities, and carry out securities transactions on behalf of others. They may also own equity interests in firms and vote the shares of companies they own. Furthermore, universal banks may sometimes even elect their own employees as members of the boards of directors on those companies.<sup>8</sup>

The early literature on universal banks focused on the great size of these banks as the key to their capacity to finance the large enterprises associated with industrialization in the late nineteenth century. More recent literature, while accepting that size did matter, has focused mostly on the ability of universal banking systems to reduce information asymmetries between banks and firms. The reduction of asymmetries occurs because universal banks can own equity interests in firms and may place agents on firms’ boards of directors. If a bank owns equity in a firm the problem of asymmetric information between the firm and its lenders is diminished (and perhaps even completely eliminated) because now the owners and the lenders overlap. Additionally, having banks place agents on firms’ boards of directors is a way for firms to credibly relay information about themselves and their expected future profitability to the

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<sup>7</sup> Further, the research on the finance-growth relationship has extended to how the effect of financial development on growth can differ depending on range of variables (institutions, inflation, level of development, etc). Examples of this work include Felix Rioja and Neven Valev (2004a, 2004b), Rousseau and Hakan Yilmazkudy (2009), and Ryan Compton and Daniel Giedeman (2011).

<sup>8</sup> See George Benston (1994) for a review of universal banking.

banks. The agents will be able to monitor the firms and their investment decisions/possibilities and report their findings back to the banks, reducing information asymmetries between the two. These relationships should promote investment by lowering the cost of external financing as a consequence of reduced risk premiums firms need to pay on borrowed funds. Additional benefits of universal banking may include a reduction in bank expenditures, as banks are able to spread fixed costs over more transactions and the promotion of bank portfolio diversification. Both of these effects should result in reduced costs of funds obtained from banks (Charles Calomiris and Carlos Ramirez 1996).<sup>9</sup> In a somewhat related paper, Marco Da Rin and Thomas Hellman (2002) develop a theoretical model demonstrating that banks can serve as a catalyst for industrialization if they are sufficiently large to finance a critical mass of firms and they have enough market power to profit from the coordination of economic activities.

Not all of the literature, however, imputes benefits to universal banking. The traditional popular criticism of universal banks is that they create conflicts of interests such that commercial banks deliberately mislead the public into investing into low quality securities. The notion of universal banks creating a similar type of “money trust” in the United States led to the passage of the Glass-Steagall Act of 1933 that separated commercial from investment banking. Some studies suggest that these concerns were unwarranted (see, for example, Randall Kroszner and Raghuram Rajan 1994). John Boyd, Chun Chang and Bruce Smith (1998), however, present theoretical work that suggests universal banks, rather than reducing problems resulting from information asymmetries, might actually exacerbate moral hazard problems between banks and deposit insurers. Under the conditions Boyd et al. describe, a bank’s position as firm equity holders increases its ability to extract surpluses. A third

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<sup>9</sup> Calomiris (1995) also focuses on the benefits of long-term relationships between firms and universal banks. If credible exclusive long-term relationships can be established, “banks can spread the costs of monitoring over many periods, this reduces the initial costs of borrowing and allows firms to pay less for credit during their early years when investment needs are high and cash flow is low” (Calomiris, 1995, 265). The ability of banks to enforce exclusive relationships is questionable, however, and these benefits may not have been great.

## Steam Engines of Credit in Switzerland

criticism of universal banking is that it may result in a misallocation of resources in an economy by over-funding heavy industry at the expense of other enterprises.

Although universal banking developed in several countries during the late nineteenth century, the attention of most empirical studies has focused on the role universal banks played in the German economy. Jacob Riesser (1911) offered early praise for these banks. Alexander Gerschenkron (1962) popularized the idea that universal banks played a crucial role in Germany's industrialization. As a late-developing "backward" economy, Germany's industrialization required great capital investment and universal banks provided the means to this investment. Richard Tilly (1989, 1992, and 1998) also assigns a positive role to the universal banks in industrial development. Although Tilly focuses mostly on Germany, he also mentions Austria-Hungary and Italy as two additional economies in which large mixed-banking promoted industrialization (1998, 14-15). Calomiris (1995) compares the American and German banking systems and concludes the German universal banking system was superior because of its greater ability to finance industrialization. Marco Becht and Ramirez (2003) find that German joint-stock banks reduced liquidity constraints for firms in the early twentieth century, while Carsten Burhop (2006) finds that joint-stock banks positively influenced capital formation during Germany's industrialization.

The view that the German mixed-banking system benefited the German economy is not, however, universally accepted. Hugh Neuberger and Houston Stokes' (1974) controversial findings suggest that the credit allocation policy of the universal banks was inhibiting rather than stimulating for the German economy. They conclude that the banks misallocated funds away from light industry and agriculture into heavy industry. Further, the view that universal banks benefited industrialization at all has also been questioned. Jeremy Edwards and Sheilagh Ogilvie (1996) review empirical evidence and find that it would be difficult to assign a central role in industrialization to the German universal banks because, they argue, the available evidence does not support the view that universal banks made large contributions to the finance of investment by German industrial joint-stock companies. Caroline Fohlin (1998) attacks the hypothesis that German universal banking alleviated firm-level finance

constraints. She finds little evidence that firms affiliated with a universal bank experienced a lessening of investment sensitivity to liquidity for the period 1903-1913. Frank Westermann and Katharina Diekmann (2011) find that it was not the industrial sector of the German economy which benefited most from turn of the century banking development, but rather the agriculture, transportation, and services sectors. The mixed evidence concerning the impact of universal banking suggests the need for more research on the topic. Switzerland provides an opportunity to study universal banking in an as yet unexplored setting.<sup>10</sup>

### **Swiss Banks and Economic Development**

As mentioned in the introduction, during the decades preceding World War One Switzerland grew to become one of the world's most industrialized countries. However, the reasons for the Swiss economy's success are not generally known. Switzerland's high degree of industrialization arose despite its lack of natural resources. Over 25 percent of its land is uncultivable, and although endowed with timber and waterpower, it has few other natural resources. Sidney Pollard (1990, 27) describes the difficulties facing the Swiss as they industrialized:

Switzerland and Belgium are often treated together, as two small countries which led the industrialization of the continent ... Yet most of the favourable pre-conditions enumerated for Belgium were missing. Switzerland has virtually no coal, iron or other mineral deposits. It is landlocked, it has the highest mountains in Europe blocking access to neighbours in all directions except the North, and the neighbours, additionally mostly maintained high tariffs against Swiss imports. Until 1848 there was no Government, properly

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<sup>10</sup> Tilly's (1998) historical perspective on universal banking stresses the importance of a central bank in maintaining economic stability within a universal banking system. Switzerland did not establish a central bank until 1907, but as Manfred Neldner (1998, 303) notes, financial crisis did not generally occur "primarily due to the willingness of the Bank of France to act as a lender of last resort also for Switzerland." Carmen Reinhart and Kenneth Rogoff (2008), however, do identify two periods of banking crisis during the period under study. The first of these (in 1870-71) actually resulted from the reliance on the Bank of France.

## Steam Engines of Credit in Switzerland

speaking: each canton governed itself and levied excise duties on the products of the other Swiss cantons on the same basis as foreign wares.

So how did the Swiss achieve their industrial success? Bruno Fritzsche claims it was the result of a highly educated workforce: “In comparison with the rest of Europe, the degree of literacy was remarkably high; there can hardly be any doubt that human capital was the mainstay and the most important stimulating factor of the economic growth” (1996, 137-138).<sup>11</sup> Other explanations unique to Switzerland include its traditional neutrality or, somewhat counter-intuitively, its lack of a legal patent system (Eric Schiff 1971). Thomas David and Andre Mach (2006) argue that good political institutions (including political stability and the management of conflict resolution) and cooperation between public and private interests fostered Swiss economic growth. Beatrice Weder and Rolf Weder (2009) highlight high levels of economic competition and political contestability as key factors. Another potential catalyst for Switzerland’s economic development was its financial system, particularly its famed banks. This study examines the relationship between Switzerland’s banking sector and its industrial development to determine the role it played in Swiss economic growth.

The tradition of Swiss banking dates back to the fourteenth century when merchant bankers and moneylenders financed trade at fairs in Geneva. Private merchant banking grew and by the eighteenth century several strong banking houses existed. These private bankers mostly catered to an international clientele and had few links with the domestic economy. The first banks that mostly assisted the domestic economy were savings banks (“Sparkassen”). These banks began to appear early in the nineteenth century and primarily served peasants, small craftsman and traders. In the 1830s another type of banking arose as individual cantons began opening publicly-owned banks to encourage regional economic development. These “Cantonal Banks” provided funds for local

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<sup>11</sup> Roman Studer (2008), however, presents evidence that, at least in terms of real wages, Switzerland lagged behind many other European nations until after World War One.

infrastructure investment and mortgage capital for farmers, tradesmen, and other small enterprises. While cantonal banks did grow to become a large part of the Swiss financial system, their focus was more on fostering local government objectives and the provision of mortgages rather than profit-seeking. As such, they generally avoided risk-taking and hence did not provide funding to larger manufacturing or industrial ventures.<sup>12</sup> Operating somewhat similarly to the cantonal banks were the “Mortgage Banks” that first began operating in Switzerland in the mid-nineteenth century. As their name suggests, these banks focused on providing loans secured by land and property.

For most of the early part of the nineteenth century these banks were sufficient to meet the needs of the Swiss economy, in which firms generally self-financed their investments using retained earnings. This situation began to change in the 1850s as technological advances created an increasing demand for capital investment in transport and industry. The huge amounts of capital required to build railroads and large-scale factories forced enterprises to seek financing from external sources. The existing system of Swiss banks, however, was unable to meet the needs of these new borrowers. Bauer and Blackman (1998, 129) describe the changing situation in Switzerland as follows:

The interesting development in mid-century Switzerland was the transition from a capital surplus country to a nation of capital shortage ... The combination of domestic economic expansion, fostered by the new economic and political relationships among the cantons and between the cantons and the federal government, and the necessity for the building of capital intensive railroads and

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<sup>12</sup> Hans Bauer and Warren Blackman (1998, 138) go so far as to write: “In terms of developing production or manufacturing industry, the cantonal banks were not at all interested because, in the political philosophy of the day, there was no accommodation for this particular aspect of economic development.” Joseph Jung (2000, 28) also suggests that fostering industrial development was not among the cantonal banks’ primary objectives: “The cantonal banks’ main aim, as state-run discounting and issuing organizations, was to encourage regional economic activity, to alleviate the marked shortage of funds in commercial banking business and to represent cantonal interests vigorously to the federal government.”

## Steam Engines of Credit in Switzerland

industry proved to be too much of a strain on existing supplies of financial capital. It was this pressure of capital shortage which led to the establishment and growth of the Grossbanken for which the country is now so well known. It was these banks which were particularly suited to the import of foreign capital through the media of the Swiss stock exchanges. At the same time these banks were, in the tradition of the *Credit Mobilier*, engaged in the development of domestic industry.

The Swiss Grossbanken came into being in the second half of the nineteenth century and operated similarly to the German Grossbanken. The first of these major banks, Swiss Credit Bank (*Credit Suisse*), was founded in 1856 by Alfred Escher in Zurich.<sup>13</sup> In 1862 the Bank in Winterthur was incorporated; it later merged with the Toggenburger Bank to become the Union Bank of Switzerland in 1912. Also founded in 1862 was the Commercial Bank of Basle (*Basler Handelsbank*). In 1863 and 1869, respectively, the Federal Bank and the Popular Bank (*Schweizerische Volksbank*) were founded in Berne. Finally, in 1872 the Basler Bank Corporation (*Basler Bankverein*) was incorporated which then became the Swiss Bank Corporation (*Schweizerischer Bankverein*) in 1898.<sup>14</sup>

These largest Swiss commercial banks operated similarly to Germany's large banks. They were "universal" in every sense, providing a wide range of services to their industrial clients. There was also a widespread use of interlocking-directorates between the Swiss Grossbanken and large industrial firms. Although outside the period examined in this article, Youssef Cassis and Jakob Tanner (1992, 301) find that in 1933 the Grossbanken exercised an influence on 469 corporations

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<sup>13</sup> Technically, it could be argued that the first Grossbank was the *Banque Generale Suisse de Credit International Foncier et Mobililier* which opened in 1853 in Geneva (and went into liquidation in 1869). This bank focused much of its attention on international endeavors and was likely established in Switzerland primarily to avoid French laws. As such, we prefer to consider *Credit Suisse* as the first true Swiss Grossbank. See Cameron (1961) for more information about *Banque Generale Suisse*.

<sup>14</sup> See Youssef Cassis (1994, 1016) and Cassis and Jakob Tanner (1992, 295), for more complete discussions of the formation of the Grossbanken.

(3 percent of the total) which had a combined capital of 2.86 billion francs (33 percent of the total). Figure 1 shows the rise in importance of the Grossbanken over the period under study.

As noted in the introduction, the existing economic history literature concerning the relationship between Swiss banking and Swiss economic development is sparse. Though most authors agree that the Swiss banks positively affected development, the empirical evidence supporting these claims is not abundant. Cassis (1997, 169) writes:

... in the present state of research, [the Grossbanken's] contribution to industrial development cannot be properly assessed. The large Swiss banks were universal banks, and in this capacity offered a wide range of services to their industrial customers. It is usually admitted that the Kontokorrent credit was particularly well suited for the needs of trade and industry, but it is more difficult to establish to what extent these bank accounts, designed for running expenditures and incomes, were used by industrial companies to finance investment.

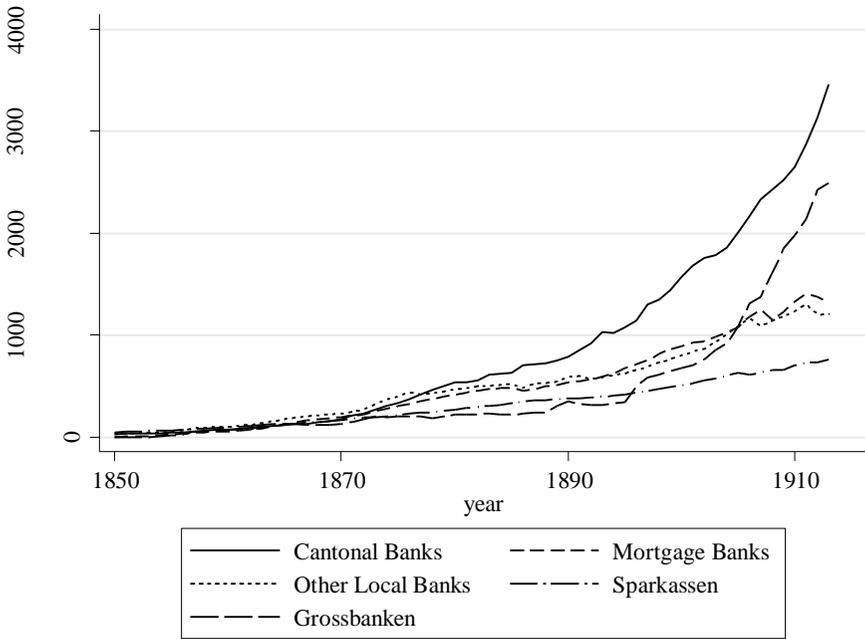
That a connection between Swiss banks and industry did exist was noted in 1912 by Heinrich Schmidt, professor at the St. Gallen business school. He wrote, "The development of Swiss industry owes a great deal to the commercial banks. Without their help, they could have achieved neither the rate of growth of the last twenty years nor their current expansion, and large corporations would not have been able to emerge."<sup>15</sup>

Bauer and Blackman (1998, 137) concur: "Without pause we can now say that the economic development and prosperity of modern Switzerland rests upon the welfare of one of its greatest industries, the Grossbanken." Cassis and Tanner (1992, 298) also suggest that the banking business contributed relatively highly to Swiss national income, but they caution that the contribution of the financial sector is difficult to estimate because of a lack of statistics relating to financial matters.

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<sup>15</sup> As quoted in Cassis and Tanner (1992, 300).

## Steam Engines of Credit in Switzerland



*Source:* Heiner Ritzmann-Blickenstorfer (1996), Table: O.8. Kantonalkassen, Bodenkreditbanken, andere Lokalkassen, Sparkassen und Grossbanken: Anzahl und Bilanzsumme 1800-1965.

**Figure 1**

Total Bank Assets by Type of Bank, 1850-1913

Although few statistical tests have been conducted to examine the connection between Switzerland's banks and industry, business historians have documented examples of banks promoting the development of significant economic enterprises. The first of these, chronologically as well as in importance, was the banks' financing of railroads. The Swiss Credit Bank was founded for the express purpose of financing the St. Gotthard Pass railway tunnel through the Alps, a particularly important project which kept Switzerland at the crossroads of Europe by connecting the rail systems of France, Germany and Italy. The Swiss had been in danger of being bypassed by French rail connections to Italy, but the development of Switzerland's rail system secured its position as a hub of European trade. The opening of the Suez Canal in 1869 made the Swiss

railroads and Alpine tunnels very important strategically and economically as trade between Asia and Europe became funneled through Switzerland. Furthermore, because Switzerland is landlocked, its place at the center of the European railway system provided the Swiss with the access to foreign markets they needed for their industrial growth. Switzerland's banks provided essential financing for the development of the Swiss railway system, described as the greatest achievement of the Swiss banking system in the nineteenth century (Bauer and Blackman, 1998, 152). The consequences of railway financing extended to the entire Swiss economy as railroads provided an impetus for the growth of the rest of the economy. As Jung (2000, 44) writes, "In 1850, Switzerland stood at a crossroads. If it did not join up with the international railway network it was threatened with isolation. An inadequate transportation infrastructure would have serious consequences for Swiss business, science and academia."

In the mid-1880s, as the need for new railways subsided, Switzerland's banks shifted their attentions to other industries. Although most commonly banks provided working capital to industrial firms through *Kontokorrent* (current) accounts, they also granted loans and mortgages to businesses. In addition to directly supplying financing to firms, banks also provided their clients with other services related to financing. They helped convert private firms into joint-stock companies, underwrote issues of stocks and bonds, and secured admission for businesses on the stock exchange. Additionally, banks placed their own personnel on firms' boards of directors to monitor and advise firms. The banking sector's use of various combinations of these services allowed banks to play an active role in the development of the economy. Jung (2000, 26), for example, argues that the large Swiss banks "were in the front line when it came to driving forward the second phase of industrialization in Switzerland: the development of infrastructure and big industry."

An example of the connection between Swiss banks and firms is given by the relationship of the chemical firm *Bindschedler und Busch* and the Swiss Bank Corporation. In 1873, the Swiss Bank Corporation provided *Bindschedler und Busch* with an initial credit of 50,000 Swiss francs. Later, the bank provided the chemical firm with a 5 percent mortgage of 1.75 million francs to build a new factory. In 1884, the firm considered selling the factory, but then in collaboration with the Bank Corporation, it

## Steam Engines of Credit in Switzerland

was decided to incorporate the firm into a joint-stock company with a capital of 2.5 million francs. The chairman of the Bank Corporation became the chairman of the board of directors of the new company (*Gesellschaft für Chemische Industrie in Basel*), and two other members of the Bank Corporation's committee joined the new corporation's board of directors. The company's shares were introduced on the Basel stock exchange in mid-1885. This example is typical of the relationship between universal banks and industrial firms during this time.<sup>16</sup>

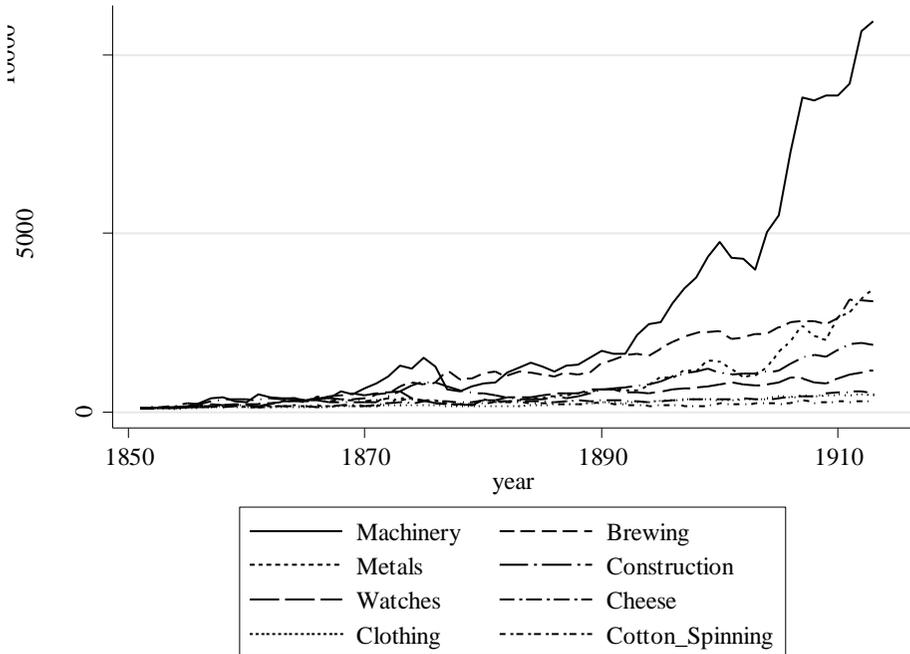
Existing historical information demonstrates that banks were involved in the growth of the Swiss economy during the decades prior to World War One. Particular emphasis must be placed on the role of Switzerland's large universal banks in promoting large-scale industrialization including the development of Switzerland's railway system. These large banks were the embodiment of Gerschenkron's (1968, 137) notion that banks could be comparable to "steam engines" in their economic effect. The universal banks became involved both domestically and abroad in financing activities in the chemical and pharmaceutical industries; mechanical engineering and metalworking firms; food industries; the electrical industry; and varied other enterprises in fields such as iron and steel, aluminum, and textiles (Bauer and Blackman 1998).

Rajan and Luigi Zingales (1998) argue that, in general, such industries are ones for which external financing is relatively more important compared to other industries. Although Rajan and Zingales study a much later period (the United States in the 1980s), for scale and technical reasons, the relative importance of external financing across the industries they examine is likely to be similar for the period we examine. Figures 2 and 3 show production across select industries in Switzerland during the period we study and demonstrates that growth was disproportionately exhibited by the industries most likely to be in need of external financing.

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<sup>16</sup> The example is taken from Bauer's (1972) *Swiss Bank Corporation 1872-1972*, a volume published by the bank to commemorate the occasion of its Centenary. As this example demonstrates, stock markets were active in Switzerland at this time. Unfortunately, data limitations prevent us from deeply examining the relationship between stock markets and Switzerland's industrialization and growth. Anecdotal evidence does suggest though that, consistent with Levine and Zervos (1998), markets performed growth-enhancing services that were complementary to bank services.

The historical evidence presented above indicates that Switzerland's banking sector provided the financial inputs necessary for the development of an advanced economy. The next two sections of the article examine quantitative evidence of the relationship between Swiss banks and Swiss economic progress.



Source: Ritzmann-Blickenstorfer (1996), Table: K.16a.  
 Bruttoproduktionswert des Zweiten Sektors nach Branchen 1851-1913.

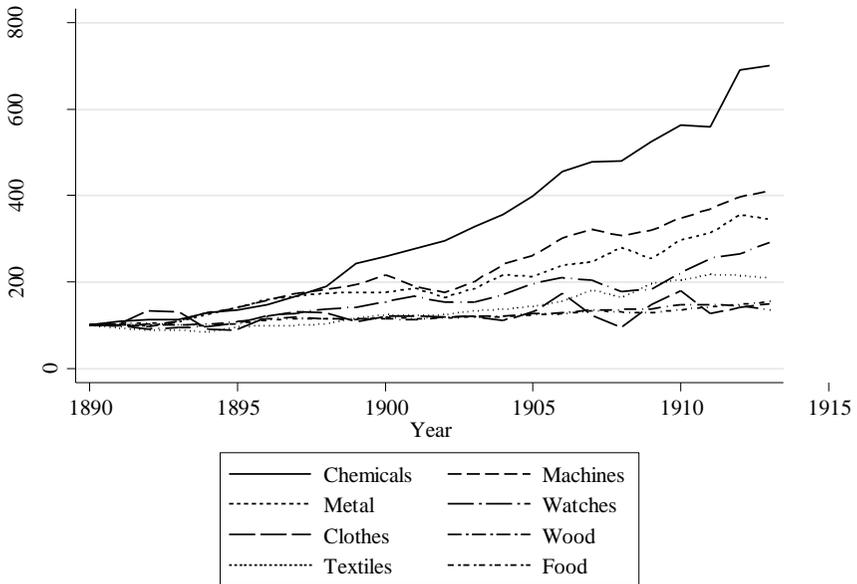
**Figure 2**

Index of Value Added by Industry in the Secondary Sector, 1851-1913

**Cross-Country Comparisons**

In what follows we compare Switzerland's economy and financial system with those of other nations for the period prior to World War One and suggest a relationship between Switzerland's economic achievement and the development of its financial system.

## Steam Engines of Credit in Switzerland



*Source:* Ritzmann-Blickenstorfer (1996), Table: Q.17c. Index of Industrial Production by Branches (2. Sector) 1890-1960

**Figure 3**

Index of Industrial Production, Selected Secondary Sector Industries,  
1890-1913

From the mid-nineteenth century to World War One, Switzerland's economy grew to become among the most advanced in the world. As Table 1 shows, although it started out significantly below similar western-European nations, by the dawn of World War One, it was second only to the United Kingdom in per-capita GDP. Again, it should be noted that these high income levels were obtained in the absence of most of the basic raw materials traditionally associated with economic performance during this period.

Considering Switzerland's very limited supply of important natural resources, Table 2 is perhaps even more illustrative of the achievements of the Swiss economy. Although GNP and industrial output are certainly related, per-capita GNP does not solely indicate the level of an economy's sophistication in terms of industrialization. Table 2 presents estimates of

**Table 1**  
Per-Capita GDP for Selected European Countries 1850-1910

	1850	1860	1870	1880	1890	1900	1910
Austria	1,650	1,778	1,863	2,079	2,443	2,882	3,290
Belgium	1,847	2,293	2,692	3,065	3,428	3,731	4,064
Denmark	1,767	1,741	2,003	2,181	2,523	3,017	3,705
France	1,597	1,892	1,876	2,120	2,376	2,876	2,965
Germany	1,428	1,639	1,839	1,991	2,428	2,985	3,348
Italy	1,350	1,425	1,499	1,581	1,667	1,785	2,332
Netherlands	2,371	2,377	2,757	3,046	3,323	3,424	3,789
<b>Switzerland</b>	<b>1,488</b>	<b>1,745</b>	<b>2,102</b>	<b>2,450</b>	<b>3,182</b>	<b>3,833</b>	<b>4,331</b>
United Kingdom	2,330	2,830	3,190	3,477	4,009	4,492	4,611
Average	1,759	1,969	2,202	2,443	2,820	3,225	3,604

*Source:* Angus Maddison (2010).

*Note:* Figures are in 1990 International Geary–Khamis dollars.

**Table 2**  
Index of Per-Capita Levels of Industrialization, 1880 and 1913

	1880	1913
Austria-Hungary	15	32
Belgium	43	88
Denmark	12	33
France	28	59
Germany	25	85
Great Britain	87	115
Italy	12	26
Russia	10	20
Sweden	24	67
<b>Switzerland</b>	<b>39</b>	<b>87</b>

*Source:* Tilly (1998).

*Note:* Great Britain in 1900=100

## Steam Engines of Credit in Switzerland

per-capita levels of industrialization for several European countries. Although the data are limited, they clearly show Switzerland's place among the world's top industrial economies and again demonstrate strong growth during the period.

Recall that the reasons for Switzerland's high level of economic development are not precisely known. One possible determinant of the high Swiss income levels may be Switzerland's financial system. From the middle of the nineteenth century to World War One, Switzerland had by far the deepest financial system in the world. Table 3 shows commercial and central bank assets as a percentage of GNP for various countries prior to 1913. In 1860 only Britain's banking system was larger in relative terms, and by 1880 Switzerland was well beyond Britain, indicating that Switzerland had a well-established banking system in place to promote economic growth and development. Table 4 presents estimates of the financial depth (the ratio of the assets of all financial institutions to GNP) for various economies during the same period. Again, by 1880 Switzerland had surpassed all other countries in this traditional measure of financial development.

Universal banks are particularly interesting components of the financial systems of several European countries. These large banks have been credited with promoting economic growth and industrialization in several nations prior to World War One. Table 5 provides a measure of the relative importance of universal banks in the economies of six European countries. It shows the percentage of all financial assets held by the large commercial banks in each economy. Using this measure, the importance of Switzerland's universal banks increased more than the universal banks of any other country from 1880 to 1913, and by 1913 they trailed only Belgium in terms of proportional importance in the financial sector.

A further illustration of the relative importance of the large banks in each country is given by Table 6 which shows the assets of the large commercial banks as a percentage of GNP. By the start of World War One, Switzerland's universal banks held assets equal to almost two-thirds of Swiss GNP. Not only is this figure comparable with Belgium, it is

**Table 3**  
Commercial Bank and Central Bank Assets as a Percentage of GNP for  
Selected Countries 1860-1913

	1860	1880	1900	1913
Belgium		49.7	55.3	63.9
Denmark		33.3	41.9	58.0
France	8.6	23.1	32.6	41.4
Germany	26.3	25.9	36.6	45.3
Great Britain	37.3	58.3	50.7	49.4
Italy		20.6	28.0	51.2
Netherlands		24.2	24.3	36.9
Norway		48.9	65.6	79.2
Japan		12.0	62.3	61.3
Sweden	29.4	48.0	74.5	87.2
<b>Switzerland</b>	<b>30.1</b>	<b>95.7</b>	<b>102.4</b>	<b>180.1</b>
United States	17.8	29.1	53.5	58.4

*Source:* Sandberg (1978) based upon data from Goldsmith (1969).

*Note:* 1860: Swedish data are for 1861; 1913: US data are for 1912.

**Table 4**  
All Financial Institution Assets as a Percentage of GNP for Selected  
Countries 1860-1913

	1860	1880	1900	1913
Belgium		71.0	94.0	110.0
Denmark		95.0	147.0	184.0
France	19.0	50.0	96.0	104.0
Germany	40.0	73.0	114.0	158.0
Great Britain	57.0	95.0	93.0	103.0
Italy		36.0	61.0	97.0
Netherlands		32.0	45.0	80.0
Norway		107.0	136.0	166.0
Japan		13.0	82.0	97.0
Sweden	60.0	89.0	123.0	136.0
<b>Switzerland</b>	<b>56.0</b>	<b>153.0</b>	<b>184.0</b>	<b>287.0</b>
United States	28.0	49.0	86.0	91.0

*Source:* As Table 3; Fohlin (2011) presents similar figures.

*Note:* As Table 3.

**Table 5**

Share of Assets of Large Commercial Banks in Total Assets of Financial Institutions

	1880	1913
Austria-Hungary		0.20
Belgium	0.62	0.57
France	0.16	0.17
Germany	0.22	0.11
Italy	0.35	0.10
<b>Switzerland</b>	<b>0.14</b>	<b>0.23</b>

*Source:* Tilly (1998).

*Note:* Cassis (1994) estimates the figure for Switzerland in 1913 as 0.27.

almost four times greater than the proportional amount of assets held by the heralded universal banks of Germany.<sup>17</sup>

The statistics presented in this section do not prove that Switzerland's banks were responsible for its economic success, but suggest that the banks played a significant role in the Swiss economy. The banking sector was relatively more important in Switzerland's economy than in any other country, and its universal banks held a larger proportion of assets relative to GNP than did the universal banks of other countries. The size and sophistication of the Swiss banking sector suggests that banks may have compensated for Switzerland's lack of natural resources to contribute to Switzerland's high levels of GNP and industrialization. The next section will investigate this possibility empirically.

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<sup>17</sup> Which may partially answer Sylla's question, "Were the Swiss, in banking, more German than the Germans?" (1991, 55). The disproportionate size of the Swiss banking sector provokes the question to what extent did Switzerland's banks benefit from Swiss neutrality, tax considerations, and laws on banking secrecy? The answer for the period under study is not that much. Robert Vogler (2006) shows that banking secrecy was not unique to Switzerland during the period we study. Christophe Farquet (2012) implies that Switzerland's status as a tax haven arose in association with World War One and Benedicte Vibe Christensen (1986) suggests that it was not until the twentieth century that Switzerland became a safe haven for foreign funds. Finally, Swiss banks, though disproportionately large for the country's size, were still small by international standards.

**Table 6**

Share of Assets of Large Commercial Banks in GNP

	1880	1913
Belgium	0.44	0.63
France	0.08	0.18
Germany	0.16	0.17
Italy	0.13	0.10
<b>Switzerland</b>	<b>0.21</b>	<b>0.66</b>

Source: Sandberg (1978); Tilly (1998); and our own calculations.

Note: Using estimates from Cassis (1994) the figure for Switzerland in 1913 is 0.77.

### Data and Time Series Approach

#### Data

The data used for the time series analysis in this study are taken from the *Historical Statistics of Switzerland* for the period of 1850-1913, and include measures of total output, two industrial production measures, population, consumer price index, money base, total banking assets, and universal (Grossbanken) banking assets.

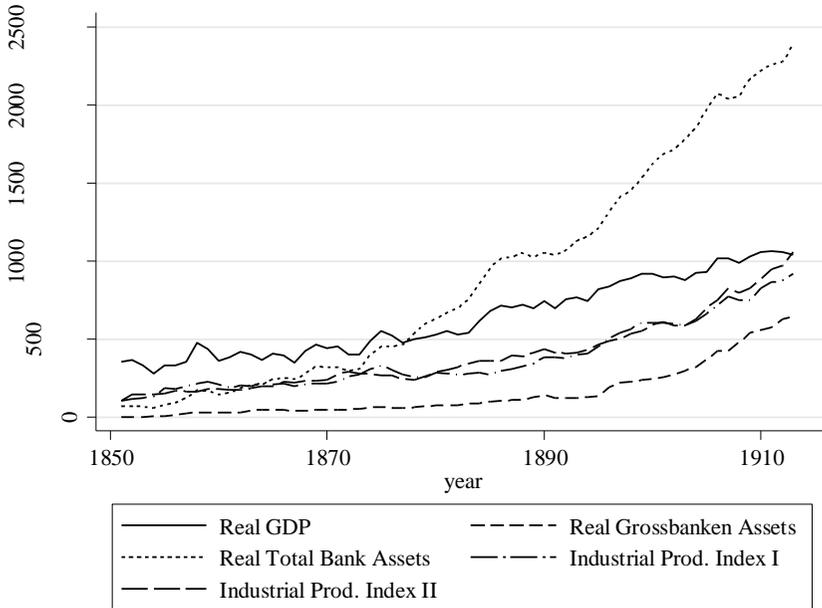
The empirical methodology employed in this article follows an approach commonly used in the time-series finance and growth literature. Rousseau and Vuthipadorn (2005) use a similar approach.<sup>18</sup> More specifically, we consider several measures of economic activity. The first measure we construct is real GDP per capita (*GDP*), which is a standard variable of interest in the finance and growth literature. However, given that we are also interested in industrialization we also consider two industrial production indices (*IP1*, *IP2*). As well, we consider two financial measures. One is real total bank assets per capita (*Total Bank*) and, given our interest in universal banking, real universal bank assets per capita (*Grossbanken*). Lastly, we also include real money base per capita (*MB*) as a control variable due to the fact that currency can serve as an important store of value and facilitate the financial system in capital accumulation (Rousseau and Vuthipadorn, 2005, 90).

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<sup>18</sup> Readers interested in the use of time series econometrics in economic history applications are directed to David Greasley and Les Oxley (2010).

## Steam Engines of Credit in Switzerland

Our approach then is a trivariate set-up where each model includes a measure of economic activity, banking development, and money base as a control. In order to determine whether a VAR or VECM model is appropriate for this analysis, the order of integration of the variables is considered. To provide a sense of the series used in the analysis over time, a plot of our series of interest is provided in Figure 4.



Source: Ritzmann-Blickenstorfer (1996).

Note: Industrial Production Index I and Industrial Production Index II are indices and therefore not measured in Swiss francs.

**Figure 4**

GDP, Industrial Production, and Banking Measures: 1850-1913

### *Unit Root and Cointegration Tests*

Two unit root tests are employed to determine the stationarity of our series, the Augmented Dickey Fuller (ADF) test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. These two tests are complementary: the null and alternative hypothesis of the KPSS test is the opposite of the

null and alternative hypothesis of the ADF test. The results are shown in Table 7.

**Table 7**  
Unit Root Test Statistics

Variable	ADF Statistic		KPSS Statistic	
	Level	First	Level	First
	Difference		Difference	
GDP	-2.367	-6.441***	0.120*	-
IP 1	-2.154	-7.182***	0.220**	-
IP 2	-1.776	-6.912***	0.175**	-
M0	-1.046	-7.782***	0.163**	-
Total Bank	-2.093	-6.871***	0.263***	-
Grossbanken	-1.082	-6.636***	0.129*	-

*Notes:* All variables are logged and with the exception of the industrial production indices, are real and per capita. Null for ADF is non-stationarity, null for KPSS is stationarity. Inclusion of intercept and trends in unit root tests based on individual series plots. \*, \*\*, \*\*\* indicates 10%, 5%, 1% statistical significance levels.

First consider the ADF test results. The Akaike Information Criterion was used to determine the number of lags to include within the test, and the inclusion of a constant and time trend was determined based on the trending nature of each series considered.<sup>19</sup> The null of the ADF test is that the series is non-stationary, while the alternate hypothesis is stationarity. In the case of each series we see from Table 7 that we are unable to reject the null of nonstationarity in levels, while in differences we are able to

<sup>19</sup> More specifically, in the levels when a series exhibited a trend, we included a constant and a trend in the test (and in differences included only a constant). When no trend was present in the series, we included only a constant in the test of the levels (and no constant or trend in the differences).

reject the null of nonstationarity at conventional levels. This evidence suggests all our series are  $I(1)$  and thus integrated of order 1.

The KPSS test has a null of stationarity and alternate hypothesis of non-stationarity. The test uses a Bartlett kernel with the bandwidth determined based on Whitney Newey and Kenneth West (1994), and again the inclusion of a constant and time trend is determined based on the trending nature of each series considered. Table 7 indicates that we are able to reject the null of stationarity in each of our series in levels, and that the series contain a unit root.

Based on the results of the two unit root tests, there is supportive evidence that our variables are  $I(1)$ , and so we apply the Soren Johansen (1991) test to determine whether the variables of interest in our model are cointegrated, and, if so, the number of cointegrating vectors.

Table 8 details the test statistics from our Johansen tests for the possible combinations of economic activity, money base, and banking with which we are concerned. We are interested in testing whether stable long run relationships exist between these combinations of variables (economic activity measure, bank measure, money base). More specifically we are interested in determining if there is a long run stable relationship between real GDP per capita, real money base per capita, and real total banking assets per capita (this result would be comparable to other results in the general finance and growth literature). Given the focus of this article on the role of universal banking, we also are interested in testing for a long run relationship between real GDP per capita, real money base per capita, and real universal banking assets per capita. Lastly, in order to investigate empirically the role that universal banking played in promoting industrial expansion in Switzerland, we further want to examine if there exists a long-run stable relationship between our respective industrial production index ( $IP1$ ,  $IP2$ ), real money base per capita, and real universal bank assets per capita.

The findings presented in Table 8 demonstrate that in each of our three variable systems there is evidence of at most one cointegrating vector, as we see the null of no cointegration is generally rejected by the eigenvalue and trace statistics, while the null of at most one cointegrating vector is

**Table 8**

## Johansen Test Statistics and Cointegrating Vector

Variables	Maximum Eigenvalue			Trace			Cointegrating Vector
	$r=0$	$r\leq 1$	$r\leq 2$	$r=0$	$r\leq 1$	$r\leq 2$	
Y, MB, -Total bank	33.70 ***	4.82	0.87	39.41 ***	5.70	0.87	[1 -0.277 -0.420]
Y, MB, -Grossbanken	19.26 *	3.26	0.00	22.52	3.26	0.00	[1 -0.552 -0.301]
IP1, MB, -Grossbanken	23.43 **	2.48	0.71	26.64	3.21	0.72	[1 0.101 -0.534]
IP2, MB, -Grossbanken	23.31 **	3.53	0.06	28.90 *	3.59	0.06	[1 -0.282 -0.494]

*Notes:* All variables are logged and with the exception of the industrial production indices, are real and per capita. Lag lengths are determined based on AIC criterion. The column labeled  $r=0$  tests the null of no cointegration, while the columns  $r\leq 1$  and  $r\leq 2$  tests the null of at most one or two cointegrating vectors respectively. \*, \*\*, \*\*\* indicates rejection of the null at 10%, 5%, 1% statistical significance levels.

not rejected by these statistics.<sup>20</sup> These findings suggest that in each case there is a stable long-run (cointegrating) relationship between the variables

<sup>20</sup> We should note in the case of the real GDP, money base, and Grossbanken, the Eigenvalue of 22.52 is not statistically significant; this finding calls into question the existence of the cointegrating relationship that was indicated by the trace statistic. We therefore consider the result for both a case of cointegration (using a VECM) as well as possibly no cointegration using the Hiro Toda and Taku Yamamoto (1995) approach which is valid when there is uncertainty over the order of integration or cointegration. In the case of industrial production index 1, money base, and Grossbanken, we note the Eigenvalue of 26.64 has a p-value of 0.11 and so, given the result of the trace statistic, we are comfortable that cointegration does exist between these three variables.

in each of our systems. The final column in Table 8 details the estimated cointegrating vector.<sup>21</sup>

*VECM Results*

The evidence of cointegration in our three-variable systems suggests there is a long run relationship between these variables; however it does not indicate which of the variables adjust to disturbances to this long-run equilibrium. For instance, while we know from the first cointegrating vector in Table 8 that real GDP per capita, real money base per capita and real total bank assets per capita share a long run relationship, we still do not know which variables respond to a disturbance to this equilibrium. To understand this we need to include our cointegrating vector within a VECM framework. Our general three-variable VECM therefore takes the following form:

$$\Delta x_{1,t} = \mu_1 + \sum_{i=1}^{k-1} \alpha_{1,i} \Delta x_{1,t-i} + \sum_{i=1}^{k-1} \beta_{1,i} \Delta x_{2,t-i} + \sum_{i=1}^{k-1} \delta_{1,i} \Delta x_{3,t-i} + \gamma_1(ax_{1,t-1} + bx_{2,t-1} + cx_{3,t-1}) \quad (1a)$$

$$\Delta x_{2,t} = \mu_2 + \sum_{i=1}^{k-1} \alpha_{2,i} \Delta x_{1,t-i} + \sum_{i=1}^{k-1} \beta_{2,i} \Delta x_{2,t-i} + \sum_{i=1}^{k-1} \delta_{2,i} \Delta x_{3,t-i} + \gamma_2(ax_{1,t-1} + bx_{2,t-1} + cx_{3,t-1}) \quad (1b)$$

$$\Delta x_{3,t} = \mu_3 + \sum_{i=1}^{k-1} \alpha_{3,i} \Delta x_{1,t-i} + \sum_{i=1}^{k-1} \beta_{3,i} \Delta x_{2,t-i} + \sum_{i=1}^{k-1} \delta_{3,i} \Delta x_{3,t-i} + \gamma_3(ax_{1,t-1} + bx_{2,t-1} + cx_{3,t-1}) \quad (1c)$$

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<sup>21</sup> For those unfamiliar with cointegration, recall that when the variables in the vector are cointegrated they share a common stochastic trend and thus the error term of the linear combination of these variables is stationary. Thus if  $x_{1t} = \lambda_1 + \lambda_2 x_{2t} + \lambda_3 x_{3t} + \varepsilon_t$ , this means  $\varepsilon_t = x_{1t} - \lambda_1 - \lambda_2 x_{2t} - \lambda_3 x_{3t}$  is stationary. For interpretation purposes consider the first row of results in Table 8 and the cointegrating vector in particular [1 -0.277 -0.420]. The 1 represents the loading of our real GDP per capita variable and is a normalization (which is evident in  $\varepsilon_t = x_{1t} - \lambda_1 - \lambda_2 x_{2t} - \lambda_3 x_{3t}$  by construction). -0.277 is our  $-\lambda_2$  for our MB variable and -0.420 is our  $-\lambda_3$  for our real total banking variable. Hence the coefficient of interest in the cointegrating vector is -0.420 which indicates that there is a positive relationship (given that it represents  $-\lambda_3$ ) between real total banking assets per capita and real GDP per capita. With respect to the economic size of this variable, we note that both our GDP measure and bank measure are in logs and so the 0.420 coefficient would be interpreted as a one percentage point increase in our bank measure being associated with a 0.42 percentage point increase in our GDP measure.

where  $x_1$  is an economic activity measure (*GDP*, *IPI*, or *IP2*),  $x_2$  is our money measure (*MB*), and  $x_3$  is a bank measure (*Total Bank* or *Grossbanken*), and the final term in brackets is our cointegrating vector lagged one period. While Table 8 establishes the existence of a long run relationship in each system due to the presence of cointegration, the error correction coefficients will capture the extent to which a given variable within that system adjusts to a temporary deviation from the estimated long-run cointegrating relationship. So for instance, a negative loading on the banking measure in our cointegrating relationship, coupled with a negative (and statistically significant) loading on the error correction coefficient in the GDP equation (equation 1a above) implies that real GDP per capita rises in response to an increase in our real banking measure. Further, an insignificant error correction coefficient for the banking equation (equation 1c above) would suggest that banking does not adjust to shocks in the long run equilibrium relationship (due to say an increase in economic activity). In sum then this finding would be interpreted as unidirectional causality from banking to economic growth.

This outcome is in fact what we see in our first system in Table 9, which has real GDP per capita, real money base per capita, and real total bank assets per capita in the system. Our cointegrating vector shows that real total banking assets per capita has a positive long run relationship with real GDP per capita. The error correction coefficient for the real GDP per capita equation is negative and statistically significant indicating that output will respond to disequilibrium in the cointegrating relationship (brought about by, say, an increase in real total banking assets per capita). Thus an increase in total banking will see a subsequent increase in real GDP per capita in order to restore the cointegrating equilibrium. Importantly, the error correction coefficient in the total bank equation is statistically insignificant, indicating that our bank measure does not respond to disequilibrium in the cointegrating relationship. Taken together this is evidence of a one-way causal relationship from total banking to real GDP per capita, or more informally, that our banking measure causes growth, but that growth does not cause our banking measure to increase.

**Table 9**

VECM Results (Cointegrating Vector, Error Correction Terms, R<sup>2</sup>)

Cointegrating Vector	Equation	Error Correction Coefficient	R <sup>2</sup>
[1 -0.277 -0.420]	GDP	-0.185 [1.99]	0.45
	MB	-0.136 [1.72]	0.53
	Total Bank	0.062 [0.74]	0.57
[1 -0.552 -0.301]	GDP	-0.205 [1.35]	0.37
	MB	-0.007 [0.06]	0.46
	Grossbanken	0.689 [2.32]	0.35
[1 0.101 -0.534]	IP1	-0.197 [2.67]	0.25
	MB	0.101 [1.24]	0.39
	Grossbanken	0.445 [2.59]	0.37
1 -0.282 -0.494]	IP2	-0.169 [2.63]	0.20
	MB	0.158 [1.93]	0.49
	Grossbanken	0.660 [3.90]	0.43

*Notes:* VECM column details the cointegrating vector. Equation indicates the dependent variable for the given VECM equation and the error correction coefficient (with t-statistic in square brackets) corresponds accordingly as does the R<sup>2</sup>. All variables of the VECM are in logs. Lag length for the VECM was determined based on using the AIC criterion to determine the number of lags (*k*) for the VAR in levels, and using *k-1* lags for the VECM.

Turning to our next set of results, which considers our universal banking measure, we see that given the cointegrating vector, universal banking shares a positive relationship with real GDP per capita. However, the error correction coefficients (negative and insignificant for the GDP equation and positive and significant for the Grossbanken equation) indicate that real universal bank assets per capita responds to disequilibrium in the cointegrating relationship. The error correction results coupled with the cointegrating vector are therefore evidence of real GDP per capita Granger causing our universal bank measure.<sup>22</sup>

<sup>22</sup> This direction of causality is sensitive to the length of sample used. While causality is found to run from GDP to Grossbanken using the full sample, moving

While the results of our two bank measures on growth are important and relevant for the general literature on finance and growth, our story centers around the role that the universal banks played in promoting the industrial development of Switzerland. Therefore we also want to consider this relationship. In Table 9 we consider two alternative industrial production indices (*IPI* and *IP2*). Both cases yield very similar results in that our universal banking measure is positively related to both industrial production measures, and that our error correction coefficients indicate that industrial production (however measured) responds to disequilibrium in the cointegrating equilibrium, as does our universal banking measure. This is evidence of a bi-causal relationship between universal banking and industrial production.

### **Conclusion**

In this study we used a combination of historical information, cross-country comparative statistics, and time-series analysis to investigate what role the Swiss banking system played in the country's impressive economic development between 1850 and 1913. Taken as a whole, the evidence supports the hypothesis that Switzerland's banking system contributed to its economic development in this period.

Further, there is also supportive evidence that Switzerland's universal banks helped foster the growth of industry, and based on the bi-causal statistical results, may have benefited from industrial development (i.e.

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the sample up 3 years causes that causality to switch direction. There is also the question of the extent of cointegration given the Eigenvalue statistic found in Table 8 for this model. To account for this we also employed the Toda and Yamamoto (1995) approach which is robust to the integration and cointegration properties of the data. Using this approach we find evidence of one-way causality from Grossbanken to our GDP measure. While the issue of cointegration was not relevant for our other models, we also estimated the other three models using the Toda and Yamamoto approach and find bi-directional causality between total banks and GDP, one-way causality from Grossbanken to our first industrial production measure, and bidirectional causality between Grossbanken and our second industrial production measure. These results all lend support to our VECM evidence and general hypothesis that Swiss banks were important for growth and industrial development in Switzerland over this period. They can be obtained by contacting the corresponding author.

## Steam Engines of Credit in Switzerland

universal banking development led to industry expansion, which in turn fed further universal banking development).

Our findings contribute to the time-series literature on finance and growth as well as the economic history on the role of financial development in early development and growth. The findings also suggest the need for further work on the effectiveness of Switzerland's universal banks, and the financial system more broadly in promoting industrial development and growth.

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