Wesleyan Economics Working Papers

**Other People's Money:
The Evolution of Bank Capital in the Industrialized World**

Richard S. Grossman

April 2006

Other People's Money:

The Evolution of Bank Capital in the Industrialized World

Richard S. Grossman

Department of Economics
Wesleyan University
Middletown, CT 06459
rgrossman@wesleyan.edu

and

Institute for Quantitative Social Science
Harvard University
Cambridge, MA 02138

April 2006

1. Introduction

Jeffrey G. Williamson and like-minded practitioners of the New Comparative Economic History focus on analyses of historical events, highlighting issues of contemporary importance. Because of its long-run comparative framework, the New Comparative Economic History can provide insights into current-day policy issues that research based on shorter time series and narrower geographic scope cannot. In the spirit of Williamson's work, this paper takes a long-run comparative approach to the evolution of bank capital in Europe, the US, Canada, Australia, and Japan from the nineteenth century through the Second World War.

From the enactment of the first commercial banking codes in Britain (1844) and Sweden (1846), through the establishment of the Basel (1988) and Basel II (2004) capital accords in recent years, policy makers have argued that capital promotes bank "soundness and stability."[1] Even in the absence of explicit government regulation of capital, the investing and depositing public has an interest in bank capital levels, what Berger et al (1995) refer to as "market capital requirements." The goal of this paper is both to present data on the evolution of bank capital-to-asset ratios across countries and US states, and to assess the relative importance of market capital requirements, government capital regulation, and other factors in that evolution.

Briefly, I find that capital-to-asset ratios declined consistently across countries from the mid-nineteenth century through the end of World War I. The findings from the interwar period are less clear cut. I find an important role for market capital requirements:

---

[1] Basel Committee on Banking Supervision (1988, 2004).

banking crises and other indicators of increased risk are associated with higher capital-to-asset ratios. Government policies, such as deposit insurance and other aspects of the bank safety net yield more ambiguous results, although these policies are notoriously difficult to measure accurately. Interestingly, government-mandated capital requirements do not appear to have been systematically associated with increases in capital-to-asset ratios—and may have been, if anything, associated with lower capital-to-asset ratios.

The outline of the paper is as follows. The next section discusses the importance of bank capital. Section 3 presents capital-to-asset data for a number of countries from the mid-nineteenth century through World War II; the subsequent section presents statistical analysis of those data. Section 5 attempts to explain the variation of capital-to-asset ratios by looking across US states during the period 1890-1930. Section 6 concludes.

2. Bank Capital[2]

Broadly speaking, banks--and other firms--have two sources of funds with which to conduct operations: debt and equity.[3] According to Modigliani and Miller (1958), in a world with efficient capital markets, no tax distortions, and no bankruptcy costs, firm value will be invariant to the mix of debt and equity so managers and shareholders will be indifferent to the relative levels of debt and equity financing. Since a primary business of banks is to take deposits, it would seem that banks could operate with virtually no capital: managers could simply make loans and buy securities with borrowed funds. If the returns on the loans and investments are greater than the interest paid to depositors, it would be

---

[2] This section draws heavily on Berger et al (1995).
[3] Retained earnings may also be available.

in owners' interest to finance as much of the bank's operation with borrowed money as possible: the less dispersed the ownership, the fewer shareholders with whom to share the profits. And, in fact, banks are among the most highly leveraged firms: the average debt-to-equity ratio in US agriculture today is about one; the average in manufacturing is close to two; the average in banking is over nine.[4]

Of course, exclusive reliance on debt has a downside. While dividend payments to equity holders can be postponed or cancelled without an existential threat to the firm, obligations owing from debt must be met. Since a large fraction of deposits is payable on demand, this concern is especially relevant to banks.

Bank capital, then, serves several roles. First, it provides a buffer against a shortfall in cash flow. As noted above, dividends can be suspended without catastrophic consequences, freeing up money to pay depositors and other creditors. Second, if a bank is forced to close, capital serves as a reserve of funds that can be called upon to liquidate unpaid debts. Third, higher holdings of capital can encourage banks to undertake less risk: because the capital is at risk in case of failure, banks have an incentive not to take risks that might put them out of business.[5] Fourth, because banks know more about their operations than their investors (information asymmetry), the decision to hold more capital—i.e., to subject owners to a greater loss in case of failure—can signal to depositors and investors that the bank will undertake less risk than it otherwise might. Finally, banks hold capital because government regulations force them to do so. Such

---

[4] Troy (2004).
[5] This presupposes that the incentives of bank managers shareholders are aligned (i.e., assuming no principal-agent problem). Glassman and Rhodes (1980). The incentive effect can be even more powerful when shareholder liability is not limited (Grossman 2001).

government regulation is typically justified on the grounds that it promotes soundness and stability in the banking sector: that is, for all the reasons cited above.

Although government-mandated capital requirements are common today, they were far from universal in the late nineteenth and early twentieth centuries. A number of industrial countries had no specific commercial banking regulations before the twentieth century (e.g., France, Germany, Italy, the Netherlands), consequently in some countries there were no official minimum capital requirements. Still, even in the absence of government-mandated capital requirements, for the reasons noted above, banks will hold more than token amounts of capital. Berger et al (1995) term the amount of capital that banks hold to maximize the value of their institutions "market capital requirements."

How does the "market capital requirement" evolve as a country's financial system matures? It should fall for two reasons. First, as information about financial institutions becomes more widely available, through, for example, the publication of balance sheets and as reputations become better known, depositors and shareholders will require banks, on average, to hold less capital. In other words, since banks hold capital in part to mitigate the information asymmetry, as information flows improve, less capital should be necessary. Second, since the role of capital is largely tied to reducing the likelihood of bank failure and mitigating the effects of bank failures once they happen, as the risk of bank failure declines, market capital requirements should fall.[6]

Why does the risk of failure decline with economic development? First, as money markets develop, banks are able to hold some fraction of their assets in liquid securities, rather than choosing between liquid cash and illiquid loans. This allows banks to hold lower levels of non-earning assets, boosting cash-flow, while maintaining protection

---

[6] Berger et al (1995), 402 document the decline in bank capital-to-asset ratios in the United States.

against sudden deposit withdrawals, which can lead to failure. Second, as banking

systems grow, and individual banks increase in size and geographic spread, their ability

to diversify increases and the risk of failure falls.[7] Third, as financial systems prosper the

stakes for managers, shareholders, depositors, and the public rise. These actors therefore

have a greater incentive to develop mechanisms to reduce the risk of bank failure. These

mechanisms might include the emergence of bankers' associations which, among other

things, would promote increased standardization and the development of conventional

(i.e., conservative) banking practices.[8] Such failure-reducing mechanisms might also

take the form of a bank safety net, encompassing formal government programs, such as

bank inspection, double liability,[9] deposit insurance, and lender of last resort facilities, as

well as unofficial elements, such as clearing houses.[10]

3. Data

Figure 1 presents capital-asset ratio data for twelve countries.[11] To the extent

possible, the data represent the ratio of paid-up capital to total assets for all commercial

banks within each country. Central banks, savings banks, savings and loans, and credit

cooperatives are excluded. Because state-level regulations varied widely, the US data

---

[7] Demsetz and Strahan (1997) find a link between bank holding company size and diversification, but not between bank size and risk.

[8] See Kennedy (1987) and Collins (1989) on the increasing conservatism of British bankers in the later nineteenth century. Bankers associations founded at this time included the Chartered Institute of Bankers in Scotland (1875), Chartered Institute of Bankers in Great Britain (1879), the American Bankers Association (1875), Canadian Bankers Association (1891), the German Zentralverband des deutschen Bank- und Bankiergewerbes (1901), and the Finnish Suomen Pankkiyhdistys (1914). A Bankers Library (Keizai Bunko) was established in Tokyo in 1897.

[9] In nineteenth century United States, more economically developed states were more likely to enact stability-promoting double liability than less developed states. Grossman (2005).

[10] See, for example, Cannon (1910), Gorton (1985, 1987), and Timberlake (1984) on the operations of private bank clearinghouses in the United States during nineteenth and early twentieth century banking panics.

[11] Aggregate capital-to-asset ratios come from various national annual or retrospective publications—most often produced by governments or central banks. Belgian data come from the financial press.

analyzed in this section include only national banks. The series for Japan represents the ratio of capital to total deposits, and is not used in any of the statistical calculations presented in the next section.

It should be remembered that data collection efforts by national authorities, the contemporary financial press, and secondary sources vary substantially in the completeness and accuracy of their coverage. Additionally, since the early years of each series may well include only a few banks, it is possible that sharp fluctuations may be due to the entry of new banks. In Finland, for example, the capital-to-asset ratio dropped dramatically in the second and third years of the sample, from over 40 percent in 1862 to less than 20 percent in 1864, and fell consistently thereafter until 1873-74, when it tripled, from slightly over nine percent to nearly 28 percent. This can be explained by the fact that there was only one commercial bank in Finland between 1862 and 1873: when a new bank with a substantially higher capital-to-asset ratio entered in 1874, the aggregate ratio rose substantially as well, before continuing the preexisting downward trend.

Despite its cluttered nature and the volatility of the series, the data presented in Figure 1 clearly illustrate a downward trend in capital-to-asset ratios throughout in the nineteenth and early twentieth centuries.[12] This trend slowed and, for some countries, reversed around the end of World War I. There was no discernable trend during the 1920s and 1930s: by 1937, aggregate capital-to-asset ratios were higher than in 1918 in about half the sample, and lower in about half. The downward trend accords well with the predictions of the previous section: as economies matured during the second half of the nineteenth century, aggregate capital-to-asset ratios fell. The trend breaks down right

---

[12] One could argue that this convergence in capital-to-asset ratios occurs in response to greater global competition, however, banks in many countries conducted primarily local business and were often insulated from foreign competition.

around World War I. We can speculate that the instability of the interwar period led to the end of the nineteenth century trend in capital-to-asset ratios.

Did government regulation lead to higher capital-to-asset ratios? A cursory examination of the data suggest that it did not: Figure 2 presents average capital-to-asset ratios for countries with and without capital requirements.[13] Before the end of World War I, banks in countries without specific capital requirements held <u>higher</u> capital-to-asset ratios than countries in which there were capital requirements; the averages converge during World War I and are not appreciably different during the interwar period.[14] There are at least two possible explanations for this result.

First, if government regulation was more likely to be established in countries which were perceived by market participants as having more stable banking systems, the market might not have required banks to hold as high a proportion of their assets in capital as they would in a country perceived as being more susceptible to crisis. Second, since nineteenth century banking laws typically regulated minimum capital levels, not capital ratios, and if smaller banks held higher capital-to-asset ratios than larger banks-- perhaps because the market viewed smaller banks as more susceptible to failure-- countries with particularly high capital requirements and populated with relatively large banks might well have lower capital-to-asset ratios than countries populated by smaller, but better capitalized, banks.[15] It is therefore possible that although high minimum

---

[13] Countries without capital requirements (and years for which data are available): Australia (1876-1939), Belgium (1877-1912), Denmark (1876-1918), Germany (1883-1920), Italy (1890-1920), Norway (1900-23), and the UK (1881-1939). Countries with capital requirements: Canada (1876-1939), Denmark (1919-39), Norway (1924-39), Sweden (1876-1937), and the US (1876-1939).

[14] The difference in means is significant at the ten percent level for four years around the turn of the century.

[15] The early banking codes in Sweden, Britain, and Canada each fixed minimum absolute levels of capital. In Japan and the US minimum capital requirements were determined by the population of the city within which the bank was located.

capital requirements did not lead to higher capital-to-asset ratios, they may have discouraged entry into banking, leading to a banking system characterized by fewer and larger, if less well capitalized, banks.[16] I investigate this possibility in section 5.

In order to take a closer look at the possible consequences of the imposition or alteration of capital requirements, Figures 3 and 4 present capital-to-asset ratio data for five countries which experienced such changes. Figure 3 presents data for three countries (Canada, Sweden, and the United States) which established or altered capital requirements during the nineteenth century; Figure 4 focuses on two countries (Denmark and Norway) which established capital requirements anew during the interwar period.

Sweden's first banking code was enacted in 1846, and established a minimum capital requirement of SKr 1,000,000. A decree of 1824 had permitted the establishment of banks, however, that law only provided that the bank's articles of association, including the amount of capital, had to be approved by the Crown: it did not specify a minimum capital requirement. According to Flux (1910, 37), the SKr 1,000,000 capital requirement was notable because, of the six banks that had been established under the 1824 decree, four had started with less--and one still had less--than SKr 1,000,000 in capital. Not surprisingly, the aggregate capital-to-asset ratio rose during the next two years. A subsequent law, passed in 1864, did not change the minimum capital requirement, but did shorten the period within which the capital had to be paid up. Unlike the 1846 law, this law was followed by a ten year period of rapidly declining aggregate capital-to-asset ratios.

---

[16] Yet another possibility is that in countries where parallel sets of institutions had different regulatory requirements (e.g., state and national banks in the United States, banks and savings banks, and private and chartered banks in many other countries), capital-to-asset ratios in may merely reflect the presence or absence of alternative regulatory regimes.

The Canadian experience was not very dissimilar: minimum capital requirements were established by acts in 1870 and 1871, and the banking systems' aggregate capital-to-asset ratio rose for the next five years. An 1890 law did not change the minimum capital level, but did reduce the time in which capital had to be paid up. This law was enacted during a period in which aggregate capital-to-asset ratios were declining; the trend appears to have continued unabated.

Capital requirements for national banks in the US had been established under the National Banking Acts (1863-64). Because state bank note issues were taxed out of existence at the time, the national banking system grew quickly while state-chartered banks declined in numbers and assets. The growth of deposit-taking as an alternative source of funds, combined with lower capital requirements, led to a resurgence in state banking: by 1894, state banks once again outnumbered their federally chartered counterparts. In recognition of the competition between the two systems, Congress lowered the capital requirements for banks in cities with populations below 3000 in the Gold Standard Act of 1900. This legislation coincided with a slowdown in, but not an end to, the decline in aggregate national bank capital-to-asset ratios.

Unlike the Swedish, Canadian, and US requirements, the post-World War I laws in both Denmark (1919) and Norway (1924) specified both minimum absolute levels of capital as well as minimum capital-to-liabilities ratios. The 1919 banking law in Denmark, the country's first commercial banking law, coincides with the post-World War I turnaround in capital-to-asset ratio: Denmark's aggregate the capital-to-asset ratio in 1918 was at its lowest point in the entire 1854-1939 period.[17] Norway's banking law

---

[17] The number of commercial banks continued to rise, albeit at a reduced rate, for two years following the imposition of the new law.

was enacted following two years of sharp declines in the capital-to-asset ratio and was followed by two more years of relatively slowly declining ratios before starting a decade-long increase.

Because Figures 3 and 4 show only aggregate ratios and dates of capital legislation, and omits many other variables that might affect capital-to-asset ratios, they should be interpret with extreme caution. The upturns following the enactment of the Swedish 1846 and Canadian 1870-71 laws are dramatic. Without more specific micro-data, it is impossible to say conclusively that the establishment of minimum capital requirements led to the increase in aggregate capital-to-asset ratios, although the correspondence is suggestive. The later Canadian and Swedish laws, both of which shortened the amount of time banks had to pay up capital, coincided with—and appear not to have interrupted--long-run declines in capital-to-asset ratios. The US law of 1900, enacted so national banks could remain competitive with state banks, came in the midst of a downward trend in national bank capital-to-asset ratios. As one would expect, the general trend continued after the law's enactment.

The Danish and Norwegian patterns are more difficult to interpret. Both countries endured substantial post-World War I recessions, which could have led to an increase in market capital requirements due to the increased risk of bank failure, although Norway's legislation (1924) followed a banking crisis (1922-23), while Denmark's 1919 law preceded a crisis in 1922. Hence, it is not clear whether market forces, government regulation, government regulation reacting to (or anticipating) market forces, or some other factor was responsible for the turnaround in these countries.

4. Cross-Country Estimation

In theory, each of the capital-to-asset ratios presented in Figure 1 could be analyzed individually by inspection, in the manner of Figures 3 and 4. As should be clear from the preceding section, there are enough complicating factors to make such an analysis problematic. We can approach the analysis more systematically by pooling the observations and seek empirical regularities across countries and time.

Which factors were responsible for the change in capital-to-asset ratios? The two main forces identified above are government capital requirements and market capital requirements. Of the two, the more easily recognizable is government capital requirements. Despite the difficulties in interpreting government-mandated capital requirements discussed above, they can be identified as having been enacted at a particular time.

I attempt to capture changes in government regulation with four separate dummy variables. One variable takes on the value of one in a year in which capital requirements are established or raised and zero in all other years. This is intended to capture short-term consequences of changes in capital requirements. A second dummy variable, intended to capture longer-term consequences of capital regulation takes on the value of one in the year in which capital requirements are raised and in each subsequent year. A third dummy variable takes on the value one in any year that any government regulatory requirements (not just capital requirements) are made more stringent, and zero otherwise (i.e., capturing short-term effects of greater regulatory stringency), while a fourth takes

on the value of one in the year in which regulatory requirements are made more stringent and in all subsequent years (i.e., capturing longer-term effects).[18]

Market capital requirements, reflecting increasing information and reduced risk of bank failure, are harder to measure. One way of measuring the soundness and stability of a banking system is to consider ex post banking stability. We would expect that banking crises would raise the specter of further banking instability and hence cause aggregate capital-to-asset ratios to rise. Ideally, banking instability would be measured in terms of the percentage of banks, or the percentage of assets in banks, that fail in a given year. Since these measures are not available for most countries, I use a dummy variable to indicate a banking crisis.[19]

Another factor that might strengthen banking stability and, therefore, lower capital-to-asset ratios, is the development of government and private mechanisms for lowering the likelihood—and reducing the cost—of banking failures: that is, the development of the financial safety net. Important elements of the safety net would include deposit insurance and the emergence of a lender of last resort. Additionally, government or private sector bailouts of a troubled institution, whether or not part of a systematic mechanism for promoting financial stability, could also indicate a turning point in the development of the financial safety net: once the government, central bank, or some other entity has found a way to rescue a troubled institution, the market at large

---

[18] Regulatory tightening includes both higher capital requirements as well as other measures that imposed stricter regulation on banks (e.g., more frequent or detailed reporting to regulatory authorities, greater power to regulatory authorities to intervene in bank business). I code capital and other regulatory requirements based on my reading of the secondary literature.
[19] Bordo et al (2001) present a catalogue of banking crises. My catalogue of crises is similar to theirs.

may well view such assistance as being available to other troubled banks, and therefore demand that banks hold less capital.[20]

For purposes of this paper, I take the financial safety net to include the enactment of deposit insurance, the emergence of a lender or last resort, or a government- or private-sector bailout of an individual financial institution. The financial safety net is measured in two ways: first, as a variable that takes on the value of one in the first year that a country's financial safety net becomes evident (i.e., through the enactment of deposit insurance, a lender of last resort action, or a bailout) and in all subsequent years. The theory behind this measure is that, having been used once, market participants view the financial safety net as operational—and permanent.[21] Alternatively, one could argue that markets have relatively short-term memories, and that a safety net far enough in the past will be discounted by market participants. In order to allow for that possibility, a second safety net dummy variable takes on the value of one if a country's safety net was active at any time during the past decade, and zero otherwise.

Finally, I use long-term government bond interest rate as an imperfect proxy for overall economic risk: as the risk of economic and financial disturbance declines, one would expect interest rates to decline as well.[22] Of course, long-term interest rates are driven by a number of factors, including expected inflation (and currency depreciation) and changes in the government's fiscal position, in addition to the risk of economic or

---

[20] Flannery and Rangan (2002).
[21] An obvious shortcoming of this method is that bailouts, where assistance is given to a firm on a discretionary basis, may depend crucially upon the identity of the institution to be rescued: institutions with stronger political connections may be rescued, while those less well connected may be allowed to fail. Lender of last resort assistance, by contrast, is available to any bank with good collateral.
[22] Rates on government bonds (as close to 10 year maturity as possible) are taken from *Global Financial Data.*

financial disturbance.[23] The sample includes a substantial period when countries were on the classical international gold standard: one would expect bond rates to be a better measure or pure economic risk (rather than exchange rate risk) during the years that countries adhered to the gold standard.

The results of OLS panel regressions with country fixed-effects are presented in Tables 1 and 2.[24] Results presented in Table 1 include regressions run over all available observations. For reasons noted above, results presented in Table 2 include only country-year combinations in which the country in question was on the gold standard.[25]

The results in Table 1 show highly significant estimated coefficients on the lagged dependent variable and the time trend. The estimated coefficients on the lagged dependent variable are positive and significantly less than one. The estimated coefficients on the time trend are negative, as we would expect, given the sustained decline in capital-to-asset rates. It is tempting to interpret this coefficient as reflecting a long-run trend increase in financial efficiency and information flows, although there is no evidence in the data available to suggest that financial efficiency increased at a steady rate.

The coefficients on the crisis variable are positive and statistically significant, indicating that capital-to-asset ratios rose with banking crises. Whether this effect was due to crisis–induced shedding of assets (with relatively stable capital levels), or from

---

[23] Bordo and Rockoff (1996) use long-term bond rates as an indicator of government's commitment to the gold standard.

[24] About half of the capital-to-asset ratios are non-stationary. Lagged dependent variables are included in all regressions. The presence of a lagged dependent variable in a fixed-effect panel regression can lead to bias that varies inversely with the length of the time series. Since the time series used here are relatively long, I do not resort to the GMM estimator. See Arellano and Bond (1991).

[25] Because of the turbulence in financial markets during the interwar gold standard period, I restrict the sample of observations to country-years prior to 1914 where the gold standard prevailed.

bank efforts to increase capital in aftermath of a crisis, the result that crises coincide with higher capital-to-asset ratios is as expected.[26]

Few of the other estimated coefficients are significantly different from zero. The estimated coefficients on the bond rate are positive, while those on the safety net variables are mixed, although none of the coefficients are significant at standard levels. Of the four estimated coefficients on regulatory tightening and increase in capital requirements, the short-run estimated coefficients are negative and the long-run estimated coefficients are positive, although only the long-run coefficient on regulatory tightening is significant.

The estimated coefficients on the lagged dependent variable, time trend, and crisis dummy presented in Table 2 are similar in sign and significance to the results presented in Table 1 and all are significant at standard levels. The estimated coefficients on the regulatory dummies are not significantly different from zero, although a safety net action within the past ten years has a significantly negative coefficient, as predicted.

A change from the regressions presented in Table 1 is that the sample is restricted to country-years prior to World War I in which the country adhered to the gold standard. Given that the gold standard implies a commitment to price and exchange rate stability, we would expect the bond rate to better represent economy-wide risk than in times when exchange rates were not fixed. The estimated coefficients on the bond rate again positive, however, in two out of three specifications, they are significantly different from zero. This result suggests that declines in economy-wide risk were translated into lower bank capital-to-asset ratios.

---

[26] Estimated coefficients on lagged crises are typically not significantly different from zero, suggestion that the crisis effect is short-lived.

The cross-country results presented in this section have several implications. First, capital-to-asset ratios clearly declined over time. We can speculate that this decline reflected a gradually growing efficiency and increased information flows. Second, the crisis variable is clearly important: crises led to higher capital-to-asset ratios, as predicted. The result is statistically significant and quantitatively large: if the mean capital-to-asset ratio is around 20 percent, this suggests that a banking crisis increased it on the order of 1.5 percent—about 20 times the trend rate of decline. Third, evidence from the gold standard period suggests that increased risk, as proxied for by the long-term government bond rate, led to increased capital-to-asset ratios.

Several factors which we would expect to affect both government-mandated and market capital requirements yielded more ambiguous results. First, changes in government regulation do not appear to have systematically affected aggregate capital-to-asset ratios. The coefficient on higher capital requirements and tighter overall regulation are more often negative than positive and not significantly different from zero, except in equation 2 of Table 1 when it is both positive and significant at standard levels. One possible explanation for this ambiguity is that regulatory changes were temporally close to financial crises, so that the effects of regulation are difficult to separate from the effects of crises. Another plausible explanation is that tightening regulatory requirements in general—and specifically increasing minimum capital requirements—increased barriers to entry and led to a banking system characterized by fewer, larger banks. If larger banks are viewed as being less susceptible to fail, then higher capital requirements and tighter regulations may, in fact, have led to lower market capital requirements. The net result might well be ambiguity in the observed effects of higher capital requirements.

Second, the signs and significance on the safety net are not consistent. A safety net action within the past ten years had a negative and significant effect upon capital-to-asset ratios in the pre-World War I period, however, other measures and different time horizons yield results that are not significant. The weakness of this result might be because the safety net is imprecisely measured: it is entirely plausible that the emergence of the safety net was far more gradual than the measures employed here, and hence is being picked up by the negative and significant estimated coefficient on the time trend variable.

5. Regulatory Variety: The United States

The results presented in the previous section do not find any consistent evidence of the effects of government capital requirements or the development of the financial safety net on aggregate capital-to-asset ratios. That is not to say that these factors did not play a role in the long-run decline of capital-to-asset ratios, but the cross-national evidence presented in the last section does not support such a claim.

This absence of a systematic relationship may lie, in part, with the nature of data. In the previous section, financial instability was coded as a relatively crude dichotomous variable: country-years in which banking crises occurred took on the value of one and in all other years took on the value zero. This coding leaves no role for banking instability short of a full-blown crisis to affect capital-to-asset ratios. Additionally, since regulatory changes frequently coincided with banking crises, it may be that the crisis variable, which yielded positive and significant coefficients, in fact, reflected the consequences of regulation, or crisis-induced regulation. Similarly, the regulatory variables employed in

the previous section were all dichotomous: either a capital-raising or regulatory-tightening reform took place or it did not. The measures of the financial safety net employed are also less than precise.

The importance of government versus market capital requirements can be assessed by using data on state-chartered banks in the United States from the late nineteenth and early twentieth centuries. Prior to the establishment of the National Banking system in 1863-64 the only federally chartered banks were the protocentral First (1791-1811) and Second (1816-1836) Banks of the United States. Aside from these institutions, all commercial banks in the United States operated under charters granted under state law. From the establishment of the national banking system, then, there was a "dual banking system" in the country—parallel sets of state and federally chartered and regulated banks.

In this section I use data on state-chartered banks to assess the effects of government and market capital regulation.[27] State-level data offer a number of advantages over cross-country data. First, each state set the capital requirements for the banks under its jurisdiction, and changed capital requirements relatively frequently (about 60 times) during the course of the sample period (1891-1930). By contrast, in the cross-country sample, capital requirements were established or changed only about a dozen times. Additionally, state capital requirements should be easier to compare across jurisdictions, since they are all denominated in dollars. Second, rather than relying upon dichotomous bank crisis variables, we can employ the percentage of state-chartered banks that failed, as well as the percentage of state-chartered bank assets in failed banks, in any

---

[27] Data on state and national bank balance sheets are taken from the *Annual Report* of the Comptroller of the Currency. Data on regulations are taken from state statutes.

given year as a more nuanced measure of banking instability. Third, states enacted a variety of reforms (e.g., deposit insurance, permissibility of branching, double liability), including safety net reforms, which might have had an effect on banking system risk and capital-to-asset ratios. Thus, an analysis of banking data across US states, will it will be possible to develop a richer analysis of both capital and non-capital regulation.

Regression results on state-level aggregates are presented in Table 3. The dependent variable in each regression is the aggregate capital-to-asset ratio of all state-chartered banks within the given state in a given year. As in the cross-country regressions, lagged values of the capital-to-asset ratio are positive and significant and significantly below one, while the estimated coefficients on the time trend are negative and significant. The downward trend in capital-to-asset ratios, found in the cross-country data, is also present among state banks in the US.

Two measures of state-level banking risk are included: the rate of state bank failures (the number of state bank failures divided by the total number of state banks) and the asset failure rate of state banks (assets of failed state banks divided by the total assets of state banks). The estimated coefficients on these variables are uniformly positive, and almost always statistically significant.[28] This confirms the earlier finding that banking crises led to increases in the capital-to-asset ratio.[29] Finally, two other measures of government intervention are included: the change in the minimum capital requirement—

---

[28] Equation 3, where the p-value is 10.5 percent, is an exception.
[29] Failure rates also yield positive and significant when lagged two years, although not when lagged one year.

that is, the capital requirement for banks in the smallest locations[30] and a dummy variable for every year in which a state had a deposit insurance system.

The presence of a state deposit insurance system yields negative estimated coefficients, which we would expect from a measure that strengthens the financial safety net, however, they are not significantly different from zero. The estimated coefficients on changes in the minimum capital requirement have negative signs, that is, increases in the minimum capital requirement lead to lower capital-to-asset ratios, although these coefficients are not significant at standard levels. This may suggest that higher capital requirements led to larger, less well-capitalized banks, although the results are not statistically significant.

Other variables, including the legality of branching (which might increase diversification and reduce risk), double liability (which reduced risk-taking),[31] and changes in the maximum population of cities in the smallest capital category did not yield statistically significant coefficients. The absence of any effect from any of these measures which should, and in the case of double liability did, reduce risk, is puzzling and requires further investigation.

Can we discern any other consequences of increased capital requirements? Is it possible that increased capital requirements caused smaller banks to exit and discouraged the entry of new banks? Although I do not have data on new entrants, I can use the percentage change in the number of state banks as a proxy: reduced entry and greater

---

[30] Because state banking statutes frequently specified several minimum capital requirements based on the population of the city in which the bank was located, it is impossible to come up with one number that completely summarizes that state's capital requirement. I use the minimum capital requirement estabslihed for banks in the smallest localities as an indicator of the state's capital requirements.

[31] Double liability means that shareholders of failing banks might be called upon to pay twice the amount they initially invested in the bank in the event of failure. Grossman (2001) demonstrates that, in times of relative financial calm, double liability, in fact, reduced bank risk-taking.

voluntary exit will have a negative effect upon this measure. Table 4 presents panel regressions testing the effects of changes in capital requirements upon net bank growth. The dependent variable is the percentage change in the number of state banks in a given state in a given year. Independent variables include the percentage increase in the number of national banks, the state bank failure rate, the change in the minimum capital requirement, and a time trend. The percentage increase in national banks is included to capture the effects of economic conditions: other things being equal, the forces that would lead to an increase (decrease) in the number of national banks should exert a similarly positive (negative) impact upon the number of state banks. The state bank failure rate is included since state banks were typically more volatile and had higher failure rates than national banks, hence, the change in the number of national banks may understate the effect on state banks.[32] The estimated coefficient on the change in the minimum capital requirement is negative and significant. This suggests that tighter capital regulation may have slowed the net increase of state banks, leading to fewer, larger, less well-capitalized banks. If larger banks hold smaller capital-to-asset ratios than larger banks, increasing barriers to entry in banking may lead to lower aggregate capital-to-asset ratios.

The results based on state panel data are consistent with those on cross-country data. Market capital requirements appear to be an important determinant of capital-to-asset ratios. We still cannot discern the impact of declining levels of risk on capital-to-asset ratios, beyond noting the negative and significant coefficient on the time trend. A perhaps more surprising result is the absence of any detectable effect of government

---

[32] If the state bank failure rate is omitted, the significance on the change in the minimum capital requirement remains negative, but is no longer significant.

mandated capital requirements or a government sponsored safety net upon capital-to-asset ratios: neither changes in minimum capital requirements, nor the presence of a deposit insurance system show any statistical evidence of bringing about higher capital-to-asset ratios (or slowing the decline of those ratios). Additional tests on branching and double liability (not reported) similarly yield non-significant coefficients.

Although I do not find a statistically significant effect of changes in government capital requirements upon aggregate capital-to-asset ratios, the evidence suggests that increased government capital requirements may have affected the banking system by slowing the growth of the state-chartered banking system—either by encouraging exit or discouraging entry.

6. Conclusion and Extensions

What explains the behavior of commercial bank capital-to-asset ratios during the later nineteenth and early twentieth centuries? The cross-country and cross-state analyses presented here find persuasive evidence of the role of market capital requirements. Banking instability, whether measured as a dichotomous banking crisis variable or as a bank failure rate, increased capital-to-asset ratios. Given that bank capital typically adjusts slowly, and the absence of a long-term impact of financial instability on capitalization, it appears that the crisis-induced decline in capital-to-asset ratios was brought about via asset shedding. Similarly, the decline in economic risk, as measured by government bond rates during the gold standard period, also appears to have had a negative effect on capital-to asset ratios.

Surprisingly, it is difficult to find a systematic effect of government capital regulation on bank capital-to-asset ratios. Analysis of state-level data in the US suggests that increased capital requirements did have a statistically significant impact upon banking sector growth: it may be that tightening regulatory restrictions—whether or not they involved capital requirements—led to a banking sector composed of fewer, larger, and less well capitalized banks, although direct tests of the influence of capital requirements on capital-to-asset ratios did not yield statistically significant results. Similarly, safety net variables, such as the presence of bailouts or lender of last resort (in the cross-country data) and the introduction of deposit insurance (in the US data) did not yield consistently statistically significant coefficients. The results accord with Flannery and Rangan's (2002) conclusion that market forces, rather than government regulation, may be the binding constraint on bank leverage.

A third finding is that, after controlling for other variables, there was a statistically significant downward trend in capital-to-asset ratios, both in the cross-country data and in the US data. The estimated coefficient on the trend suggests several possibilities. First, it may be that the data here do not accurately capture economy-wide risk, banking instability, or the evolution of the government safety net, and so the trend is capturing these variables. Additionally, the trend may be capturing a gradual increase in banking efficiency and increased information flows.

The results suggest an agenda for further research. First, given the ambiguous nature of the consequences of government regulation, it will be important to focus on the political debates over regulation. To what extent was more stringent regulation brought about by bankers in order to discourage entry and reduce competition? This question can

be addressed with more systematic historical research on the policy debates of the time. Second, the results highlight the need for an analysis of bank-level microdata in order to determine the effects of regulation upon entry, exit, size distribution, and intensity of competition among banks. Bank-level data can also be used to examine the effects of changes in requirements upon capital constrained banks.

More history, more data, and many, many more questions: just the prescription that Jeff Williamson would give.

Bibliography

Arellano, Manuel and Stephen Bond (1991) "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies* **58**(2), 277-297.

Basel Committee on Banking Supervision (1988), *International convergence of capital measurement and capital standards,* Basel: Basel Committee on Banking Supervision.

Basel Committee on Banking Supervision (2004), *Basel II: International Convergence of Capital Measurement and Capital Standards: a Revised Framework,* Basel: Basel Committee on Banking Supervision.

Berger, Allen N., Richard J. Herring and Giorgio Szegö (1995), "The Role of Capital in Financial Institutions," *Journal of Banking and Finance* **19**(3-4), 393-430.

Bordo, Michael, Barry Eichengreen, Daniela Klingebiel and Maria Soledad Martinez-Peria (2001), "Is the Crisis Problem Growing More Severe?," *Economic Policy* **32,** 53-82.

Bordo, Michael and Hugh Rockoff (1996), "The Gold Standard as a "Good

Housekeeping Seal of Approval"," *Journal of Economic History* **56**(2), 389-428.

Cannon, James Graham (1910), *Clearing Houses,* Washington,: Govt. Print. Off.

Collins, Michael (1989), "The Banking Crisis of 1878," *Economic History Review,*

Second Series **42**(4), 504-527.

Demsetz, Rebecca S. and Philip E. Strahan (1997), "Diversification, Size, and Risk at

Bank Holding Companies," *Journal of Money, Credit and Banking* **29**(3), 300-

313.

Flannery, Mark J. and Kasturi P. Rangan (2002), "Market forces at Work in the banking

Insustry: Evidence form the Capital Buildup of the 1990s," mimeo.

Flux, Alfred William (1910), *The Swedish Banking System,* Washington: Government

Printing Office.

Glassman, Cynthia A. and Stephen A. Rhoades (1980), "Owner vs. Manager Control

Effects on Bank Performance," *Review of Economics and Statistics* **53**(263-270.

Gorton, Gary (1985), "Clearinghouses and the Origin of Central Banking in the United

States," *Journal of Economic History* **45**(2), 277-283.

Gorton, Gary and Donald J. Mullineaux (1987), "The Joint Production of Confidence:

Endogenous Regulation and Nineteenth Century Commercial-Bank

Clearinghouses," *Journal of Money, Credit and Banking* **19**(4), 457-468.

Grossman, Richard S. (2001), "Double Liability and Bank Risk Taking," *Journal of*

Money, Credit & Banking **33**(2), 143-159.

Kennedy, William (1987), *Industrial Structure, Capital Markets, and the Origins of*

British Economic Decline, Cambridge: Cambridge University Press.

Modigliani, Franco and Merton Miller (1958), "The Cost of Capital, Corporation

    Finance, and the Theory of Inestment," *American Economic Review* **48**(3), 261-

    297.

Timberlake, Richard H. (1984), "The Central Banking Role of Clearinghouse

    Associations," *Journal of Money, Credit and Banking* **16**(1), 1-15.

Table 1: Dependent Variable is Capital to Asset ratio, entire sample

	1	2	3	4	5	6	7	8
Constant	1.069 ***	1.064 ***	1.075 ***	1.073 ***	0.622 ***	0.620 ***	0.011 ***	0.008 ***
	0.153	0.153	0.154	0.153	0.137	0.136	0.004	0.002
Capital-to-Asset Ratio (t-1)	0.816 ***	0.817 ***	0.82 ***	0.817 ***	0.857 ***	0.857 ***	0.941 ***	0.943 ***
	0.018	0.018	0.02	0.018	0.016	0.016	0.009	0.009
Year	-0.00054 ***	-0.001 ***	-0.001 ***	-0.001 ***	-0.00031 ***	-0.00031 ***		
	0.00008	0.000	0.000	0.000	0.00007	0.00007		
Tighter legislation		-0.004						
		0.005						
Capital raising legislation			-0.005					
			0.007					
Crisis				0.011 ***		0.012 ***		
				0.004		0.003		
Bond rate					0.0013 0.180	0.00099		
					0.0010	0.00098		
Safety Net (in last 10 years)								-0.0016
								0.0026
Safety net (ever)							-0.0037	
							0.0031	
Country Dummies?		Yes	Yes	Yes	Yes	Yes	No	No
N	700	700	700	700	610	610	623	623
Adjusted R-squared	0.954	0.954	0.954	0.954	0.971	0.972	0.954	0.953
D-W	1.707	1.711	1.709	1.712	1.767131	1.778	1.929	1.929
Log liklihood	1516.6	1517.0	1516.8	1519.7	1477.512	1483.127	1321.903	1321.903

Estimated with OLS
standard errors below coefficients
* = significant at the 10% level, ** = significant at the 5% level, *** significant at the 2.5% level.

Table 2: Dependent Variable is Capital to Asset ratio, pre-1914 gold standard countries

	1	2	3	4	5	6	7	8	9
Constant	1.140 ***	1.146 ***	1.155 ***	1.100 ***	1.193 ***	0.001	0.002	0.004	0.006 ***
	0.267	0.268	0.267	0.264	0.300	0.009	0.009	0.003	0.002
Capital-to-Asset Ratio (t-1)	0.84 ***	0.84 ***	0.84 ***	0.84 ***	0.83 ***	0.90 ***	0.90 ***	0.95 ***	0.95 ***
	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01
Year	-0.0006 ***	-0.0006 ***	-0.00059 ***	-0.000562 ***	-0.000615 ***				
	0.0001	0.0001	0.000139	0.000137	0.000155				
Tighter legislation		-0.0043							
		0.0052							
Capital raising legislation			-0.00983 19						
			0.007423						
Crisis				0.0126 ***			0.0130 ***	0.0147 ***	0.0155 ***
				0.0037			0.0041	0.0040	0.0040
Bond rate					0.0034	0.0063 **	0.0054 *		
					0.0029	0.0029	0.0029		
Safety Net (in last 10 years)									-0.0040
									0.0026
Safety net (ever)							0.0013		
							0.0024		
Country Dummies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
N	352	352	352	318	318	318	318	315	315
Adjusted R-squared	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
D-W	2.17	2.17	2.17	2.21	2.21	2.24	2.27	2.27	2.29
Log liklihood	926.6	926.9	927.5	831.3	831.3	823.2	828.3	812.2	812.2

Estimated with OLS
standard errors below coefficients
* = significant at the 10% level, ** = significant at the 5% level, *** significant at the 2.5% level.

<p align="center">Table 3
Panel OLS Results: State bank aggregates, US, 1891-1932 (fixed effects)</p>

	1	2	3	4	5	6
Constant	1.014 ***	0.990 ***	0.837 ***	0.902 ***	0.384 **	0.394 ***
	0.251	0.247	0.251	0.254	0.172	0.172
Capital-to-Asset Ratio (t-1)	0.837 ***	0.834 ***	0.826 ***	0.825 ***	0.901 ***	0.895 ***
	0.020	0.020	0.022	0.022	0.013	0.013
Year	-0.00052 ***	-0.00051 ***	-0.00043 ***	-0.00046 ***	-0.00020 **	-0.00020 ***
	0.00013	0.00013	0.00013	0.00013	0.00009	0.00009
State bank failure rate	0.107 ***		0.059 10.5		0.090 ***	
	0.037		0.036		0.034	
State bank asset failure rate		0.163 ***		0.155 ***		0.119 ***
		0.058		0.058		0.052
Change in minimum capital requirements			-4.07E-08	-6.39E-08		
			2.11E-07	2.12E-07		
State deposit insurance system					-0.00125	-0.00105
					0.001773	0.001713
N	546	537	443	435	546	537
Years	1891-1930	1892-1930	1891-1930	1892-1930	1891-1930	1892-1930
States included	34	34	27	27	34	34
Adjusted R-squared	0.94	0.94	0.93	0.93	0.94	0.94
Log liklihood	1577.9	1570.8	1318.0	1296.2	1561.1	1554.2
D-W	1.75	1.87	1.80	1.83	1.76	1.86

Estimated with OLS
standard errors below coefficients
* = significant at the 10% level, ** = significant at the 5% level, *** significant at the 2.5% level.

Table 4: Fixed effects Panel Regressions
Dependent Variable is percent change in the number of state banks

	1	2
Constant	8.274645 ***	7.840194 ***
	1.602296	1.677689
Year	-0.004289 ***	-0.004067 ***
	0.000838	0.000877
Percent change in number	0.334078 ***	0.423762 ***
of national banks	0.096756	0.100323
State bank failure rate	-0.747184 ***	
	0.277593	
State bank asset failure rate		-0.488058
		0.304568
Change in minimum capital requirement	-8.72E-06 ***	-8.68E-06 ***
	2.79E-06	2.80E-06
Number of cross sections	29	29
N	909	884
Years	1891-1930	1892-1930
Adjusted R-squared	0.070162	0.071961
Log-liklihood	-55.14141	-54.23945
D-W	2.300848	2.332536

Estimated with OLS
standard errors below coefficients
* = significant at the 10% level, ** = significant at the 5% level, *** significant at the 2.5% level.

Figure 1: Capital-to-Asset ratios, 1834-1939
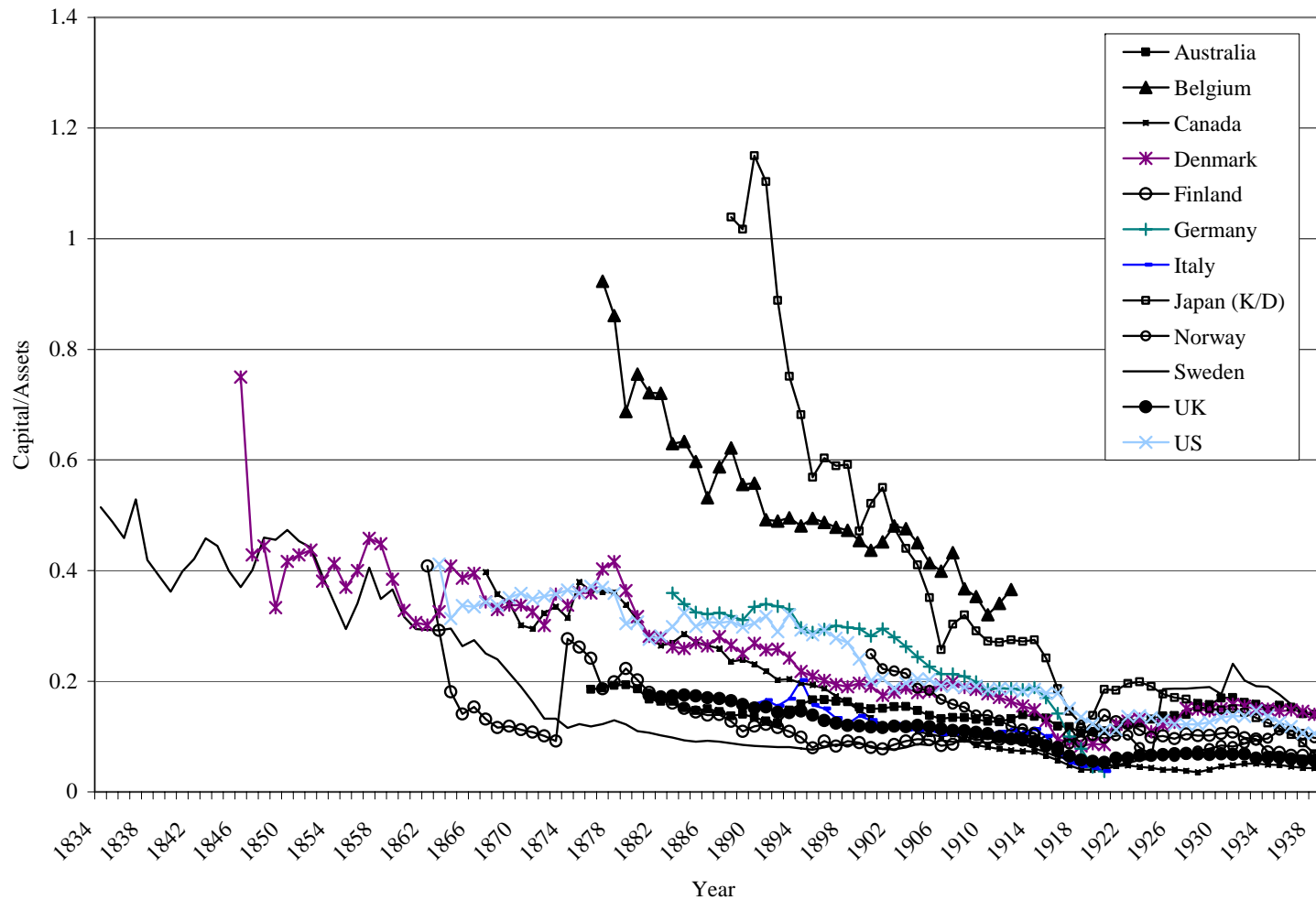
Figure 2: Capital-to-Asset Ratios, 1881-1939: Countries with and without capital requirements
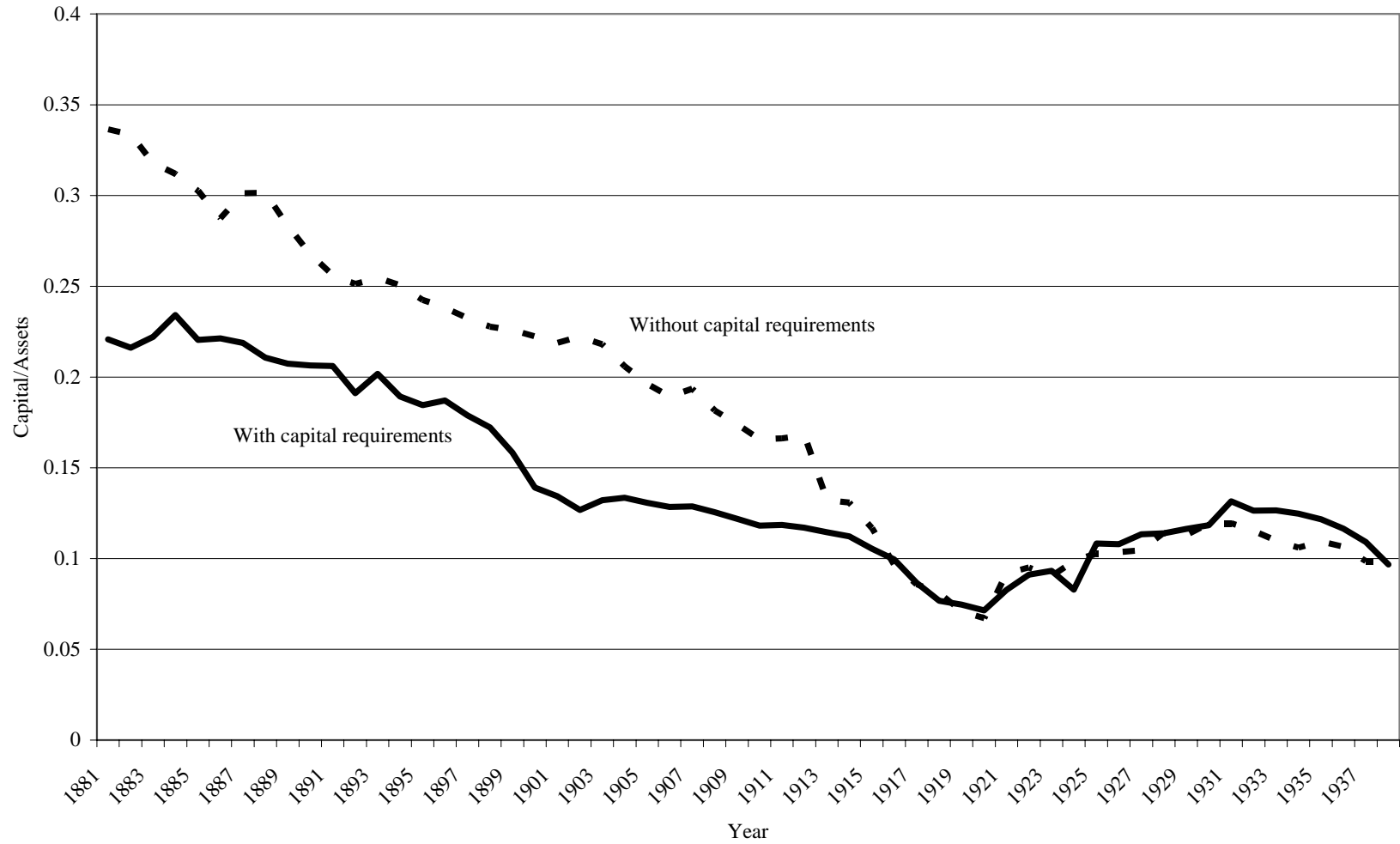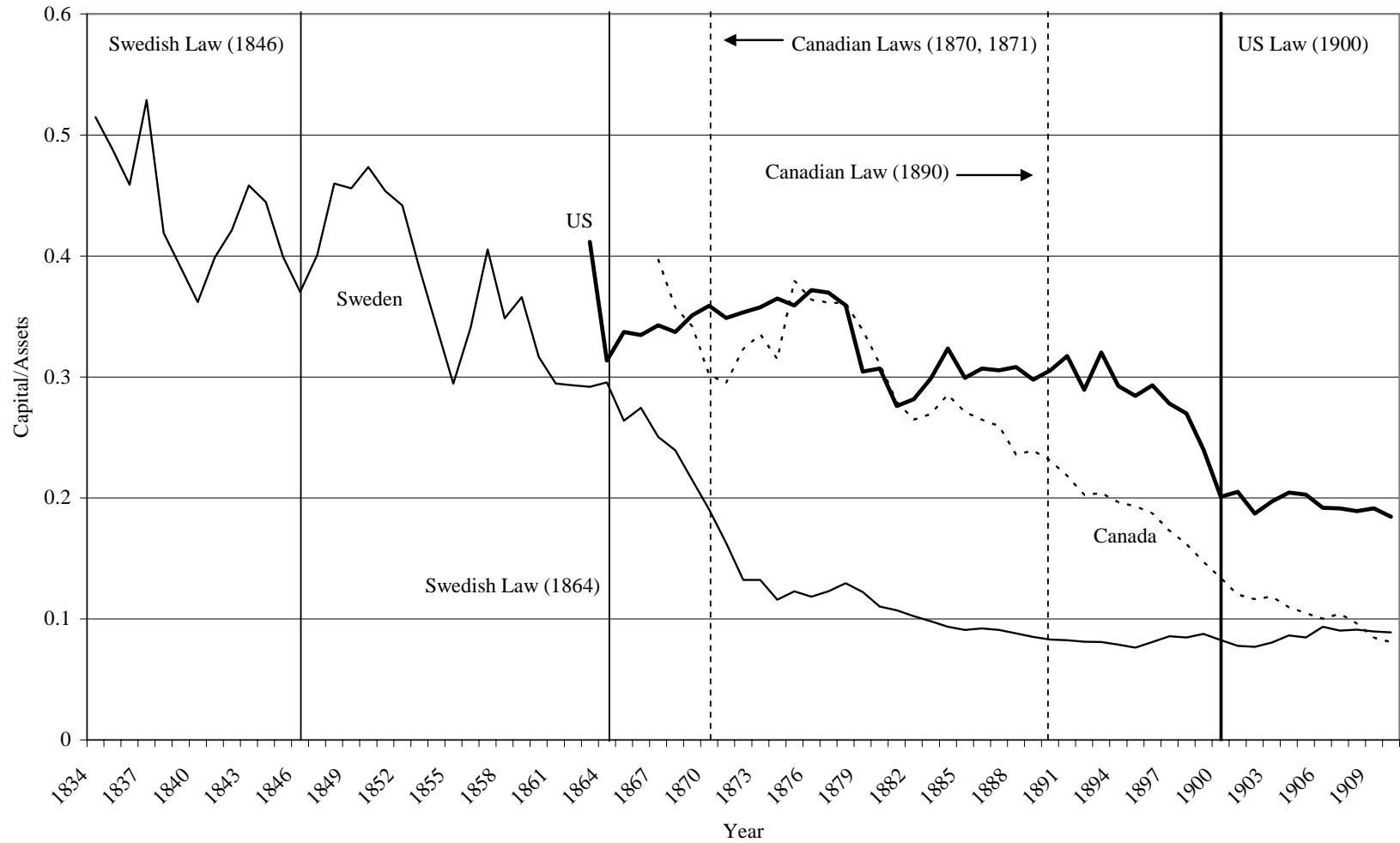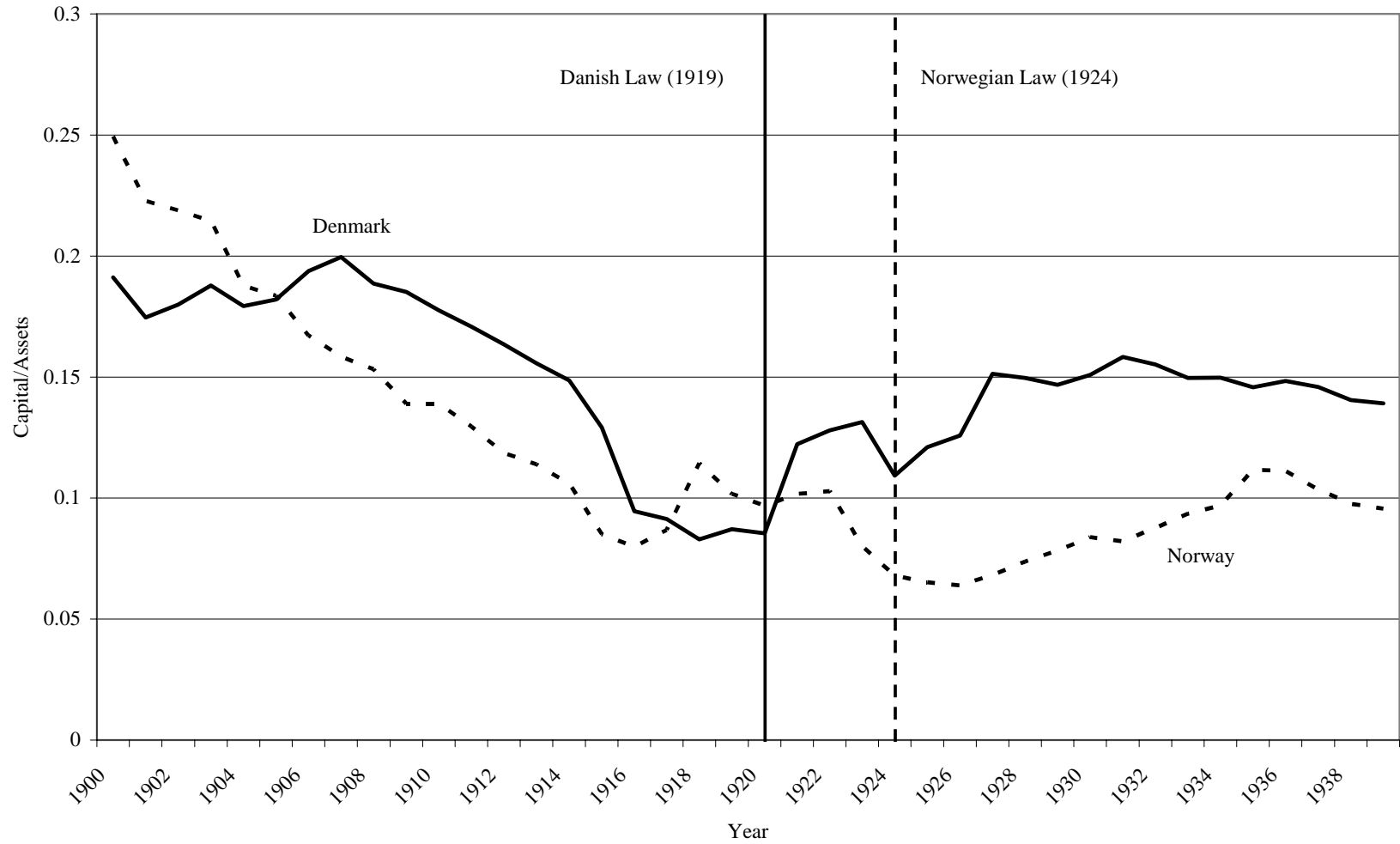
Figure 3: Capital-to-Asset ratios, 1834-1910: Canada, Sweden, and the US

Sources: See text.

34

Figure 4: Capital-to-Asset ratios, 1900-1939: Denmark and Norway