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DID RAILROADS MAKE ANTEBELLUM U.S. BANKS MORE SOUND? LINKING RAIL LOCATIONS WITH BANK BALANCE SHEETS AND SURVIVAL RATES

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1. Introduction

Before the Civil War and passage of the National Banking Acts, banks in the United States were governed, if at all, by state laws. These laws varied across states and over time, but for the most part shared the common characteristic that bank note issues were not statutorily limited. Prior to the Bank War with President Jackson that ended the federally-chartered Second Bank of the United States in 1836, the Second Bank could and did indirectly limit money creation by individual banks through its policy of returning notes to the cashiers of over-issuing banks for redemption in gold and silver coins. While this device alone was insufficient to ensure universally sound banking practices, conditions worsened after the Bank's demise. Indeed, the term "wildcat banking" is often used to describe the operation of some U.S. banks over the period that followed and until the passage of the National Banking Acts in 1863 and 1864 reformed and reshaped the banking system. The very idea of wildcat banking is premised on the notion that such banks would tend to locate away from population centers ("where the wildcats throve" (Quinn and Samad 1991) quoting from (Luckett 1980)) so they could issue notes that would circulate in more populated areas yet be difficult to redeem because of the issuing bank's remoteness. By the time such notes would appear for redemption at a wildcat bank, so the legend goes, the bankers themselves would have disappeared.

While there are colorful stories of such instances in antebellum history, accounts of this form of wildcatting are surely overstated (Rockoff 1974; Rolnick and Weber 1983). Even so, the frontier was still quite vast in the period from 1837 to 1860, and in this sense many (or most) banks outside of the eastern cities and a few population centers elsewhere might be considered remote, and thus possibly tempted to take advantage of this remoteness to act in ways that compromised the positions of their liability holders. This type of "quasi-wildcatting" (for want of a better term) would have suffered a serious setback as improved means of transportation and communications, especially the railroads, made their way across the nation's interior, connecting communities and their banks with faster communications, more direct oversight, and better trade opportunities. We believe that railroads made it increasingly difficult for bankers to seek private gain through excessive risk taking and muster evidence in this essay to support that claim.

The decades before the Civil War witnessed the transformation of the United States economy from an outpost of the European Atlantic economy perched on the eastern seaboard to a rapidly growing, dynamic domestic economy and continental power. Improvements in transportation seem to have been at the heart of this transformation, and made it possible for large segments of the population to live at ever-increasing distances from natural waterways. Improvements in finance over the period also provided a means of payment that lubricated increasingly impersonal trade. To the extent that the railroads drew new banks closer to the centers of economic activity and allowed existing banks to participate in the growth opportunities afforded by efficient connections to major population centers, they provided incentives for banks to serve their communities while pursuing private gains. And it is this sense that railroads may have helped to align the interests of bankers with their liability holders, providing bankers with a reason to submit to monitoring and to persist as ongoing businesses rather than seek after one-time profits.

The links between transportation improvement and banking were, in some cases, quite explicit and direct as when the state of Illinois passed "an act to increase the capital stock of certain banks, and to provide means to pay the interest on a loan authorized by an act entitled 'an act to establish and maintain a general system of internal improvements'" (1837; quoted in Callender 1902). Indiana and Tennessee passed similar laws. However, as we will show, the positive interaction between transportation improvements and banking was more general and pervasive even when state legislatures did not intervene directly. Specifically, in this paper we examine the relationship between the internal improvements, particularly the railroad, and the operation and success of banks.

How, then, did railroads affect the operation of banks? Hitherto, answers to this question have been limited to the suggestion that proximity to transportation routes limited opportunities to engage in irresponsible and private rent-seeking (see, for example, Bullock 1900; Dwyer 1996; Economopoulos 1988). We, on the other hand, show in a series of probability models that proximity to a railroad, was associated with lower failure rates and better balance sheet management, a finding more wide-reaching than the few documented cases of traditional "wildcatting."

Others have shown that the coming of the railroad was associated with a wide variety of changes associated with economic growth and economic development, ranging from increases in urbanization, rising land values and agricultural productivity and the expansion of the factory system in manufacturing to increased investments in education (Atack et al. 2010; Atack, Haines, and Margo 2011; Atack and Margo 2011; Atack, Margo, and Perlman 2012). Each separately and collectively should have increased the attractiveness of the area to banks. Moreover, elsewhere, we have shown that nearly half of the new Midwest banks after 1840 opened within a few years of a railroad's arrival in their county (Atack, Jaremski, and Rousseau 2013). Here, we describe a mechanism through which railroads not only affected finance on the extensive margin, but led to efficiency changes that enhanced the intensity of financial intermediation. And of course, it is the interaction of the intensity of intermediation along with its quantity that seems most important for long-run growth (Rousseau and Wachtel 1998, 2011).

Our paper is organized as follows. In Section 2 we offer some background on the nature of antebellum banking. Section 3 describes our data which makes extensive use of geographic information systems (GIS) technology for transportation and bank locations. Section 4 contains estimates from a series of multivariate proportional hazard models which indicate that proximity to transportation related to bank failure rates and stronger bank balance sheets. Section 5 concludes.

2. Antebellum Bank Failures

The key to understanding the operation of antebellum banks is to recognize their reliance on bank notes rather than deposits as the dominant means of financing their operations. Indeed, unlike today, deposits during the period were not demandable or subject to check writing, nor were they a high priority debt. Therefore, to obtain liquidity and make investments, states gave banks the right to issue notes. These notes functioned as a medium of exchange in the marketplace but were also dollar-denominated liabilities that promised to pay the equivalent in specie when demanded by the noteholder at the bank of issue, thus also serving as a store of value. Due to the importance of bank notes in the payments system, states generally mandated that each note be fully backed by some type of collateral assets. Moreover, the state representative would close and liquidate the bank to redeem any outstanding notes if so much as a single request for note redemption went unmet.

Prior to 1837, each potential bank petitioned for a unique charter from its state legislature, and approval thereof depended as much on political influence as on need.[1] The requirements imposed by these charters varied according to the whims of the legislature, but most states allowed almost any assets to be used as collateral for a bank's notes and even allowed the bank to hold that collateral on site.[2]

Beginning in 1837 and gaining momentum in the early 1850s, a series of "free banking" laws in some states replaced the need for legislative approval of each individual bank by establishing instead a well-defined set of capital, reserve, and note requirements.[3] Reserve requirements varied by state but the new laws generally specified that free banks had to purchase specific types of assets, often state or federal debt, as collateral for each note.[4] Moreover, the collateral was to be held by the state representative and only relinquished when the bank returned an equal amount in notes.

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[1] For convenience, we define "charter banks" to be any institution established by direct order of a state legislature. This distinction is necessary because charter banks continued to operate even after free bank laws were passed.

[2] Most banks notes described the type of assets used as collateral somewhere on the note.

[3] Three states adopted free banking in the late 1830s. One other, Alabama, would do so in the (very late) 1840s. Eleven states, however, passed free banking laws between 1850 and 1853 with two others (Iowa and Minnesota) passing laws in 1858. However, because some states passed laws, repealed them and then re-passed them (for example, Michigan and Ohio), the situation is not easily described. See Rockoff (1975); also Rolnick and Weber (1983).

[4] Other assets were occasionally allowed to back notes, such as real estate in Michigan and slaves in Georgia.

Despite this backing requirement, the assets of closed banks were not always sufficient to cover their note circulations due to adverse market fluctuations in the price of the collateral assets. In such cases, bank notes were redeemed at cents on the dollar, as would be the usual case in bankruptcy actions. Rockoff (1974) and Rolnick and Weber (1983) show that some of the losses were minimal (most Indiana banks, for example, redeemed at 95 cents on the dollar), but in other cases losses were nearly total (e.g., Minnesota "railroad" banks repaid less than 35 cents of each dollar issued).

Following Rolnick and Weber (1984), we consider "failed banks" as those institutions which did not redeem their notes at full value, whereas "closed banks" simply ceased banking operations but repaid their notes at par. Based on this distinction, 30 percent of the 861 free banks failed. In comparison, only 19 percent of the 1,828 charter banks failed, even though charter banks could back their notes with almost any type of asset.

Based upon his examination of bank balance sheets over time, Jaremski (2013) reaches two conclusions. First, the highly-specific backing requirements for note issues prescribed in the various free banking laws seem to be the underlying cause of the free banking system's high failure rate relative to the charter banking system. Moreover, this statistical relationship was not the result of general declines in bond prices. Rather, banks were sensitive only to the prices of those bonds that were eligible for note backing. Second, solvent free banks seem to have diversified their assets away from bonds and their liabilities away from note circulation, and these actions seem to have at least partially shielded those banks from bond price declines.

From both theoretical and empirical standpoints, however, other factors might also play an important role in the success or failure of financial intermediaries, especially those related to the community and the environs that these banks served. Here, we examine the effects of transportation and communications improvements on bank operations and survival. Hitherto, such an analysis was nearly impossible due to a lack of comprehensive data on bank locations relative to means of transportation and communication but recent advances in the development of historical geographic information systems databases have now removed this impediment.

As Table 1 shows, the distance from the nearest railroad is positively correlated with the probability of failure for both charter and free banks—that is to say, the further away that a bank was from a railroad, the more likely it was that the bank would fail. This is consistent with a central role for market forces in bank survival. Only 7.2% of charter banks within 10 miles of a railroad failed compared to 35% of those not located close to a rail.[5] The results are even more pronounced for free banks, with only 16.5% of free banks on a railroad within 10 miles of a railroad failing compared with 60% of those not on a rail. Moreover, canals did not have the same stabilizing effect. The probability of failure is roughly the same for charter banks on and off a canal, whereas free banks on a canal were about 25 percentage points less likely to fail.

There are several possible explanations for why proximity to a railroad might have affected the probability of bank failure for both free and charter banks. First, railroads brought population and increased economic activity to an area (Atack et al. 2010; Atack, Haines, and Margo 2011). A railroad would thus increase a bank's access to liquidity and lower its loan default rate. Second, the ability of noteholders and regulators to reach the bank more quickly and cheaply may have encouraged banks to hold less risky portfolios and adjust their operations to reflect the new degree of oversight as it increased acceptability of the bank's notes. Certainly,

[5] This is not to imply that those banks at a greater distance that failed should be considered "wildcat banks." Our choice of 10 miles is arbitrary but it represents a distance that someone might plausibly cover on foot to tend to important business and which could easily and routinely be covered on horseback.

statements by contemporaries suggested that “wildcat banks” tended to form in wilderness areas where they could issue notes which they never intended to redeem. While such accounts have surely overstated the case, banks that wanted to take greater risks and avoid firsthand oversight by regulators should have been less likely to locate along a transportation route.

3. Data

Beginning with the two antebellum bank databases assembled by Warren Weber (Weber 2008; Weber 2005), we have constructed a dataset that provides financial and biographical information for almost every bank in operation in the United States between 1830 and 1862. Weber’s data ends in 1860, but Jaremski (2010) extends the bank census to the outbreak of the Civil War using annual editions of the *Merchants and Bankers’ Almanac* (Anonymous s.d.). These provide a comprehensive list of U.S. banks each year. This extension of Weber’s data is important for two reasons. First, over 120 banks failed in 1861 and 1862, and excluding these failures halves the failure rate of free banks, making them appear much more stable. Second, because our empirical model examines failure over the subsequent years, the non-extended database would either have to assume that all banks operating in 1860 survived or would have to drop all 1860 observations. Either choice would bias the results. We also make a few adjustments to Weber’s data based upon these directory listings and other contemporaneous information.[6]

The final database contains yearly observations for 2,056 of the approximately 2,475 antebellum banks that operated sometime between 1830 and 1862. The missing banks generally

[6] In particular, the changes involved merging banks that “closed” in one year with those that “opened” almost immediately after with the same name. We believe that these reflect charter renewals or mergers so that the “new” bank was not necessarily an entering bank. We also remove the few banks with undefined start and end dates from the sample.

closed before they published a balance sheet and their absence slightly biases our sample towards more stable (possibly non-fraudulent) banks.

The transportation data come from three different GIS databases covering the antebellum period developed by Atack from a variety of contemporary and retrospective sources including historic digitized maps, modern topographical maps produced by the U.S. Geological Survey, reports by various government agencies, compilations from travel guides, and the like (Atack 2013). These databases provide information on the location and dating of canals, rivers that were being navigated by steamboats at the time, and railroads. The canal mapping was initially based upon those produced by Poor (1970) and by Goodrich (1961) for 1860 but modified with respect to exact locations based upon USGS topographical maps and histories of the various canals.[7] Those histories also provide dating as to when specific sections of each canal were first opened (and closed) to traffic. For our mapping of navigable rivers, we defined navigability in terms of the river's use by steamboats, ignoring earlier (and concomitant) use by other craft such as rafts, canoes, and bateaux since, of all the various craft plying trade on the rivers, only steamboats provided speedy and reliable service both upstream as well as down (Haites, Mak, and Walton 1975; Hunter 1949). The dating and location of such traffic is based upon sources such as Hunter's history of western river steamboating (Hunter 1949), contemporary gazetteers (Rowell Geo. P. & Co. 1873), newspaper accounts, and reports from the U.S. Army Corp of Engineers who eventually assumed responsibility for maintaining and promoting navigation of the nation's rivers (U. S. Congress. House. et al. 1871). Additionally, we also generated coastlines for the

[7] For histories of individual canals, see especially Whitford's history of the Erie (Whitford 1906). Briefer discussions of the construction and operation of other canals have been produced by various historical societies. Many of these are available on-line, for example, http://www.indcanal.org/ regarding canals in Indiana and http://www.middlesexcanal.org/ or http://www.winchestermass.org/canal.html on the Middlesex Canal.

Great Lakes, the Atlantic and the Gulf of Mexico from the NHGIS shapefiles.[8]

Whereas the river and canal GIS databases provide annual information on the extent of navigation, our railroad databases only provide snapshots at 5-year intervals because of the difficulty of assembling a reliable annual series. Moreover, as of the time of writing, the location of rail lines is much less precise than that of rivers and canals. Today, we have precise location data based upon satellite imagery and thus know exactly where railroads are now. Historically, however, the railroad network was much more extensive and much of the old roadbed has been recycled and reused (for example, by highways). For example, according to *Historical Statistics,* miles of main track essentially plateaus between 1916 and 1930 at around 260,000 but declines to under 183,000 miles by 1980 (a decline of about 30%) and there are substantially fewer miles today (Carter et al. 2006, Series Df932). Track has also been realigned and straightened due to improvements in civil engineering and the advent of higher speed trains on some routes, thereby altering their original locations.[9]

Atack's mappings of historical railroads are, instead, based on small scale, state-level maps of the rail system in 1911 by Matthews Northrup Co. for the "New Century Atlas" (Whitney and Smith 1911). Where railroad lines are still in operation, these 1911 maps prove to

[8] This proved to be much more complicated and difficult than this simple description suggests because of the extremely high resolution of the TIGER files that underlie the NHGIS shapefiles and the complexity of coastal features that include not only bays, headlands, inlets and estuaries but also small islands.

[9] It is possible to recover some of this historic information through a careful visual study of the modern topographical maps that informed Atack's historical mapping, as many of the modern USGS topographical maps bear legends such as "old railroad grade" where railroads that no longer exist once located in close proximity according to historical mappings. Such labeling on the USGS maps, however, is inconsistent and generally only visible at scales larger than 1:63,360 (one inch to one mile); indeed the optimum scale for many such features is 1:24,000 or larger.

be very accurately and carefully drawn, especially taking into account the limitations created by their small scale. These maps were geo-referenced against NHGIS state boundary shapefiles using the ArcGIS 10 software, and the rail lines shown were then traced into their own shapefiles, thus defining the location and extent of railroads in 1911. Mappings for earlier years were then created by working backwards in time, selecting what was considered the most accurate mapping of the rail system in a particular year and deleting lines from the later mapping that did not appear on the earlier mapping. Many of the maps were produced by publishers of popular, well-respected and frequently updated travel guides such as Colton and Rand McNally. For this paper, the map for year t was based upon the map for year $(t+5)$ working backwards from Atack's (2013) 1860 mapping of the rail system.[10]

Using these GIS databases, we are able to measure the distance between each bank and its nearest railroad, canal, steam navigable river, ocean, and Great Lake every five years starting in 1830 using the ArcGIS Toolbox function, "Near", in Analysis/Proximity for use in our panel.

Our analysis includes a number of controls. In particular, we add a bond price index to control for the value of a bank's collateral from Jaremski (2010) which assigns the average value of the bonds allowed by the state's free banking law. While most states allowed any state or federal bonds paying full interest as collateral for their note obligations, some--Alabama, New Jersey, New York, and Ohio--allowed their banks to use only specific state bonds. The bond price index in those states not subject to a specific bond constraint consists of the average of the 14 available state bonds. The index in Alabama and New Jersey only contains the U.S. Treasury

[10] The "base" map for the 1860 mapping (subject to the procedures detailed in the text) was by J. H. Colton (Colton 1860). An annual railroad mapping cannot be produced using maps but rather must be done from newspaper and other contemporary accounts in the manner of Paxson's work for the Midwest (Paxson 1914). This, however, would be a massive undertaking especially if it were to embrace the entire nineteenth and early twentieth centuries.

bonds, while Ohio banks were limited to holding only that state's bonds.[11] The situation in New York was more complex. Prior to the 1842 change in its free banking law, the index for New York banks is the average of the 14 state bonds but the index contains only New York state bonds afterwards. All prices are quoted relative to face value.

4. Empirical Analysis

We apply the multivariate proportional-hazard model with time varying covariates proposed by Cox (1972; Cox and Oakes 1984). This approach models the probability of failure of bank *i* given survival to the period *t* as:

$$\lambda(t, X_i, \beta, \lambda_0) = \lim_{h \to 0} \frac{P(t \leq T < t + h \mid T \geq t)}{h} = \lambda_0 exp(X_i(t)\beta) \qquad (1)$$

where *T* is the failure date, λ_0 is the baseline hazard function common to all banks, and the exponential function captures the effects of the explanatory variables, X_i. Cox's method estimates the equation using a semi-parametric "partial likelihood" approach that requires the specification of the scale function but not the baseline hazard. The model takes account of a bank's specific entry and exit dates even though we might only observe the bank at a few specific moments. In this way, the model examines the lifespan of each bank and the point at which it failed, identifying the βs from variation across starting and failure dates.[12]

Because our railroad data are only observed at five-year intervals, each observation covers a 5-year period and the βs coefficients should be interpreted as the variables' effect on the probability of failure over the *following* 5 years.

[11] States that did not pass a free banking law are assumed to have no bond constraint.

[12] The model treats banks which were solvent at the end of 1862 or which closed during the period as censored observations.

Like a panel probit or logit model, the hazard function treats each period that a bank was open (*t*) as a unique observation linked to the individual bank. This method gains efficiency over other binary choice models by explicitly taking into account survival through that period. A drawback of the model is that one needs to make additional assumptions regarding the initial hazard function to calculate the marginal effect of each variable. Rather than make assumptions regarding those fundamental conditions, we instead report the raw coefficients. These provide information on the direction and relative size of an explanatory variable's effect on the probability of failure but not its marginal effect.

We measure the impact of transportation using a series of dummy variables that indicate whether a particular transportation method (i.e., railroad, canal, ocean, river, or Great Lakes coastline) was within 10 miles of the bank.[13] Our choice of other explanatory variables is motivated by modern bank regulatory practice that was implemented in 1979 under the Uniform Financial Institutions Rating System (Federal Deposit Insurance Corporation 1997) and the information available on each bank from the nineteenth century contemporary record. Without information on a bank's management quality or its income, we are unable to estimate the full set of CAMELS measures that modern regulators use in assessing a bank's soundness but we follow Jaremski (2010) and construct as many as possible.[14] Specifically,

- The average value of the state's allowable fraction of par or market value on bonds used as collateral measures the bank's "Sensitivity to market risk";
- *log(Assets)* measures size differences among banks;

[13] As we will show in later sections, the results are not sensitive to other reasonable cutoffs.

[14] The CAMELS ratings are a modern measure of a bank's quality. Each letter stands for a factor in rating: C for Capital adequacy, A for Asset quality, M for Management quality, E for Earnings, L for Liquidity, and S for Sensitivity to market risk.

- *Capital* (defined as the ratio of Capital to Total Assets) measures "Capital adequacy";
- *Specie* (defined as Specie divided by Total Assets) is an index of bank "Liquidity", measuring the bank's capacity to meet bank runs in specie;
- *Deposits* (defined as the ratio of Deposits to Total Assets) measure the bank's liability diversity;
- *Loans* (defined as the ratio of Loans and Discounts to Total Assets) and *Bonds* (defined as the ratio of state and U.S. government assets on the bank's balance sheet to Total Assets) measure asset diversity;[15]
- *Circulation* (defined as the ratio of Circulation to Total Assets) measures the level of potential future redemptions.

Moreover, we include fixed effects for states to account for heterogeneity across them such as regulation enforcement, and for years to account for financial panics and specie suspensions.[16]

4.1. The Effects of Proximity to Railroads on Bank Failure Rates

The first column in Table 2 presents estimates of the specification in Eqn. 1 with only the transportation variables, free bank dummy, and state fixed effects included. The second column then adds the bank's balance sheet variables and average bond price to the specification. As access to transportation could have altered bank composition, the first column provides the full effect of transportation on bank stability, whereas to measure the full effect of transportation in

[15] Unlike modern studies where government debt is generally considered safe, *Loans* can also be thought of as a crude measure of "Asset quality" due to their high return and short maturity compared to bonds during the period.

[16] Given the small number of banks in most counties, any county-fixed effects would degrade the model into a bank-fixed effect and limit us from comparing stable banks that did not fail to those that did.

the second column we must know something about how balance sheets changed in response to transportation.

The results show a tendency for free banks to be generally less stable than chartered banks over the five-year intervals that we examine. However, once we control for the bond prices and the balance sheet variables, the positive coefficient loses its statistical significance.

Regardless of the other variables, railroads are the only transportation type that has a negative impact on bank failure. Moreover, that effect is statistically significant. While the coefficients do not represent marginal effects, the underlying hazard ratios indicate the effect of having a railroad nearby was quite large. This effect becomes smaller when we add balance sheet variables to the specification but remains statistically and economically significant. The decline is likely due to two factors: proximity to a railroad could have altered the composition of a bank's assets and successful state building projects such as railroads often caused positive fluctuations in bond prices.

Several of the other variables also have a statistically significant effect on bank failure. The value of bond collateral is negatively and significantly related to the probability of failure. Larger banks with more reserves, loans, and deposits and fewer bank notes were less likely to fail. These results are in line with Jaremski (2010) despite our inclusion of the transportation variables.

4.2. The Effect of Proximity to Railroads on Bank Failure Controlling for Urbanization

While railroads seem to be associated with bank stability, this raises the obvious question of *how* they might have affected banks. The most obvious answer is that the railroads brought about greater urbanization (Atack et al. 2010), and thus more deposits and more scrutiny with them. To test this hypothesis, we link the individual banks to county-level census data assembled by Haines (2010), which updates the original ICPSR database (1979). Before merging, we account for changes in county boundaries over our sample period by aggregating individual counties where necessary to create "super-counties" with consistent geographic borders.[17]

The boundaries of our consistent geographic areas are shown in Figure 1. The aggregated areas are shaded and outlined with heavier boundaries while those counties whose boundaries did not change are clear. The grey lines within the shaded areas show the 1860 counties boundaries within that area; the thinner lines show the 1840 county boundaries that are aggregated into these "super-counties."

We limited this linkage procedure to the period from 1840 onwards because extending it back to 1830 would necessitate the combination of nearly all Midwest and Southern counties into "super-counties." Moreover, since the few banks existing in 1830 and 1835 were almost solely in Northeast counties that did not change borders, it was more efficient to exclude those few counties that changed boundaries in this period and then pick them back up in 1840.[18] This procedure in combination with the exclusion of banks in those areas that defied consistent

[17] While we could restrict our analysis to counties that had constant boundaries over the time period, such an approach leaves out large swathes of the nation. Instead, we adopt the GIS-based procedure used by Atack, Jaremski, and Rousseau (2013) but broadened to encompass the entire settled area of the United States. This identifies constant geographic areas for which we can also obtain consistent economic and demographic information over time. We start by eliminating boundaries that extended beyond those of the modern states before 1840. After selecting out counties that did not change their boundaries, we combine the remaining non-GIS identical counties within a state into contiguous areas made up of variable numbers of individual counties in each year. This procedure for managing boundary changes is quite different from that used by Hornbeck (2010, see especially the "border fix" files at https://www.dropbox.com/s/1cygkeoo4p89vrw/BWreplication_BorderFixes.rar) who essentially redistributes population and economic production proportionately among counties based upon their loss or gain of territory from adjacent counties.

[18] Results are similar if we eliminate observations from 1830 and 1835. We also note that the hazard specifically accounts for bank age; therefore, even if we do not observe a bank early in its operation, the hazard will not mistakenly consider it a new bank.

aggregation in 1840 (mostly in Iowa and Northern Wisconsin) drops 49 of the 1,897 banks from the sample.

Since population data are only available from the decennial censuses, we assume that population and urbanization grew at constant rates between successive censuses. We thus add the log of population and the fraction of population living in an urban area to the hazard model.[19] Because our aggregation process excludes some banks, we first report results for the reduced sample using just the free banking dummy and the transportation variables (Table 3). The reduced sample slightly alters the results but, even then, only when the additional variables are included in the regression. Specifically, close proximity to a steam navigable river or one of the Great Lakes is now negatively correlated with bank stability. This change is likely due to the exclusion of the large number of Wisconsin free banks (located either on the Mississippi River and its tributaries or on the Great Lakes) that failed during the early 1860s. Moreover, the ratio of capital to assets is now a significant determinant of bank failure, but the actual p-value of the estimate is not much different from those in Table 2. This change thus could be the result of the reduced number of observations rather than a different fundamental relationship.

Regardless of which variables we include in the hazard functions, railroads are the only transportation method that is positively correlated with bank stability. The introduction of the balance sheet variables slightly decreases the effect of railroads, as does the inclusion of population and urbanization data, but the railroad coefficient remains statistically and

[19] While we would like to include measures of manufacturing and agriculture, these are not included in the Census until after 1830. See Wright (1900).

economically significant.[20] To the extent that railroads were exogenous to bank activity, they thus made banks less likely to fail through changes in balance sheet variables and urbanization as well as through other effects.[21]

The remaining columns show that urbanization tends to reduce the probability of failure, but this is not statistically significant when we include the balance sheet variables, probably because the size of the bank was dependent on the size of its customer base. While the inclusion of the census variables lowers the effect of railroads, it actually increases the effect of being on a navigable river and the Atlantic Coast. The lower positive coefficients on these variables when we do not control for urbanization thus might be due to the tendency for most urban areas before 1830 tended to be located along water routes such as rivers and ports. Once the stabilizing effect of urbanization is removed, water transportation relates to a higher probability of failure.

4.3 Controls for Endogeneity of Railroad Entry

To interpret the coefficient on railroads as causal, the timing and route taken by them

[20] The decline is likely driven by two factors. The inclusion of the variables controls for initial conditions that might have attracted a railroad and then controls for the effect of railroads on those variables.

[21] Some banks were clearly endogenous to internal improvements in general and railroads in particular. Witness, for example, the 1837 Illinois law "to increase the capital stock of certain banks, and to provide means to pay the interest on a loan authorized by an act entitled 'an act to establish and maintain a general system of internal improvements'" (1837; quoted in Callender 1902). Even more directly, some banks and railroads were chartered jointly, such as the Erie and Kalamazoo Railroad Bank and the Detroit and St. Joseph Railroad Bank in Michigan, and the Benton and Manchester Railroad and Banking Co. in Mississippi. Some joint ventures did not even call themselves "banks" as in the case of the "Mississippi and Alabama Railroad Co." Close associations between banks and railroads can also be found in the Northeast, as with the "Railroad Bank" of Providence and the "Railroad Bank" in Boston (data from Weber 2005). To the extent that bank officers held wealth and influence in the local community, it is likely that they also acted as "boosters." As such, they would have been actively solicited as investors in any local railroad promotion. We discuss these and other endogeneity issues in Sec. 4.3 below.

must be exogenous, and there are reasons why the route chosen by railroads (especially in the Northeast) would not have been related to the stability of banking. While we cannot fully control for this type of endogeneity, we can control for two other possible sources. First, railroads were attracted to populated areas and sources of economic activity just as banks were. Many of these attractions are also captured by the other transportation media and by the county population variables, but other economically meaningful metrics such as output data are not really available before 1840.[22]

In Table 4, we shorten the sample period to control for the logarithm of manufacturing capital (1840-1860) and agricultural capital per person (1850-1860). Regardless of the inclusion of these variables, however, the coefficient on the railroad variable remains negative and statistically significant. It also should be noted that the stabilizing effect of railroads seems to grow over time as the coefficient is larger for the 1840s and 1850s than for the longer period. This is likely due to the spread of banks and rails into the undeveloped Midwest and the emergence of a more interconnected transportation system.

Second, it is possible that only stable banks entered after a railroad because only relatively conservative, conventional banks could survive in the more transparent, connected environment. The results in the previous tables thus could partially be due to this reverse causation rather a structural break in the way existing banks operated. This type of behavior does not detract from the story. In fact, it might even be the more important aspect of railroads' effects on bank survival and performance given the charges of wildcat banking; however, it is important to examine whether railroads had an effect both on existing banks and on the decisions of

[22] There was a census of manufactures in 1820 but virtually nothing is recorded for the Midwest or southern states despite the fact that we know there were flour milling everywhere and quite sophisticated machine shops and foundries in Cincinnati and Louisville. Moreover, the county level tabulations are seriously flawed (See United States. Census Office. 1990).

potential new bankers. In Table 5, we present two additional types of specifications: (1) eliminating observations for banks that entered after a railroad was in operation in the local area, and (2) removing banks present before and after a railroad came within 10 miles. In all cases, the coefficient on the railroad dummy is negative and significant, showing that railroads seem to have stabilized both existing banks and new banks. Comparing the two sets of coefficients, the largest (and seemingly more consistent) effect seems to come from banks that were present before a railroad entered.

4.4. Sensitivity to Different Mileage Cutoffs

The previous models measure the effect of transportation using a cutoff distance of 10 miles. This choice reflects our view that it was a distance that contemporaries could routinely cover by horseback or wagon and could be traversed on foot with more effort. However, to show the results are not sensitive to the cutoff, we re-estimate the specifications containing the balance sheet variables in Table 3 using a variety of cutoffs. Specifically, we looked at every even cutoff from 4 miles through 20 miles, and report the coefficients and standard error bands on the railroad dummy both with and without the county variables in Figure 2. The figure shows that banks within 14 miles of a railroad are significantly less likely to fail without accounting for the county variables, and banks between 6 and 10 miles of a railroad are significantly less likely to fail when controlling for them. Outside of these ranges, railroads have no statistically significant effect on bank failure. It is worth noting the railroad coefficient was largest for a cutoff of 6 miles, meaning our use of the 10-mile cutoff slightly biases the results downward.

4.5. The Effects of Proximity to Railroads on Charter and Free Banks

While the inclusion of railroads did not eliminate the higher failure rate of free banks relative to charter banks, railroads still could have affected free banks differently from charter banks. We therefore, re-estimate the equations separately for free and charter banks. As before, we estimate the regressions with and without the balance sheet variables and with and without the county population variables.

In Table 6, we see that railroads had a negative and statistically significant effect on the failure of both types without any control variables, but only remains significant for free banks in the full specifications. The other transportation variables are generally not statistically significant across the bank types as a result of the different locations of transportation methods and bank types. A bank located on the Great Lakes would be less likely to fail if was a free bank but more likely to fail if it was a charter bank. A free bank that was on the Atlantic Ocean or a navigable river was also more likely to fail.

Many of the balance sheet variables affected the two banks similarly, but the statistical significance varies for several of the variables. Across both bank types, large banks with large specie reserves in urban areas were significantly more likely to succeed. However, free bank stability was also related to high bond prices and large loan portfolios, whereas charter bank stability was also related to large deposits.

The insignificant effect of railroads for charter banks seems to go against a general effect of railroad on stability. The result, however, seems to be due to those charter banks that entered after railroads were established. If we remove these banks from the sample (Table 7), we find that the negative coefficient on railroads reasserts itself and is statistically significant.

4.5. The Effects of Proximity to Railroads on Bank Balance Sheets

In the previous sections, we have seen that the introduction of the balance sheet variables reduced the size of the railroad coefficient. This raises the question of whether banks altered the composition of their assets in response to railroads or whether the sudden rise of railroads was simply correlated with the fluctuations in bond prices. We test this possible explanation using the following model:

$$Y_{i,t} = a + \beta_1 Ln(Age)_{i,t} + \beta_2 Free_{i,t} + \beta_3 X_{i,t} + t_t + u_i + e_{i,t} \qquad (2)$$

where the $Y_{i,t}$ consists of balance sheet variables discussed above, $Ln(Age)_{i,t}$ is the logarithm of a bank's age, $Free_{i,t}$ is a free bank dummy, t_t is a time fixed effect, and u_i is either a bank fixed or a state fixed effect. We also separately regress the logarithm of each individual item to capture their extensive changes.

The results in Table 8 show that the arrival of a railroad generally made banks larger, consistent with the findings of others regarding the economic impact of railroads on urbanization and various kinds of economic activity (Atack et al. 2010; Atack, Haines, and Margo 2011; Callender 1902). The railroad dummy coefficient is generally statistically significant for assets, deposits, loans, bonds, and reserves. However, these results do not always hold up in the presence of bank fixed effects probably because most banks after 1840 entered around the same time as a railroad and thus the coefficient is identified on the few banks that were present before (Atack, Jaremski, and Rousseau 2013). When looking at the balance sheet ratios in Table 9, we find that railroads might have decreased the amount of bonds, specie, deposits, and circulation relative to assets, but increased the number of loans. It is worth pointing out that the ratio of loans to assets and specie to assets are the only variables that were statistically significant when including the bank fixed effects.

Putting these results in the context of bank failure, railroads seem to lowered bank failure rates by encouraging them to operate more safely through increased bank loans as well as lowered bonds and circulations, yet also relate to lower holdings of reserves. Of course, the latter could simply reflect a greater sense of confidence in banks among the public when located near a railroad, and this allowed them to reduce primary and secondary reserves because of the repeat trades in which they engaged.

5. Conclusion

The decades before the Civil War witnessed the transformation of the United States economy into a rapidly growing, dynamic domestic economy and continental power. The nation's bourgeoning financial system was one of the factors at the heart of this transformation. However, it was not a smooth development. The financial system was subject to periodic panics and crises, and as a result, nearly a third of all banks created before 1862 closed with their noteholders sustaining losses. Some important changes taking place contemporaneously in the economy, however, may have mitigated these losses. By linking detailed bank and transportation data, we show that the arrival of railroads may have helped stabilize the system despite the association of financial crises with investment cycles and the speculative internal improvements that of came with them.

The data indicate the railroads were positively correlated with bank stability even after controlling for local economic activity and population, whereas other means of transportation were either uncorrelated or negatively correlated with bank stability. The effect is apparent not only for banks existing before the railroads went through, but also for new banks that opened up after the rails. Moreover, the arrival of a railroad seems to have encouraged banks to hold safer portfolios consisting of fewer bonds and banknotes and more loans. These changes would well have driven local investment in the local economy, which implies that railroads could have had important indirect effects on local economic growth through the longevity of banks and the stability of longer-term finance. These effects reach beyond the traditional arguments about agglomeration of economic activity usually associated with the arrival of the railroad.

Bibliography

An Act to increase the capital stock of certain banks...establish and maintain a general system of internal improvements. Tenth General Assembly, March 4, 1837.

Anonymous. s.d. *The Merchants and Bankers' almanac*. New York: J. S. Homans.

Atack, Jeremy. 2013. "On the Use of Geographic Information Systems in Economic History: The American Transportation Revolution Revisited." *Journal of Economic History* no. 73 (2):313-38.

Atack, Jeremy; Fred Bateman; Michael Haines, and Robert A Margo. 2010. "Did Railroads Induce or Follow Economic Growth? Urbanization and Population Growth in the American Midwest, 1850-1860." *Social Science History* no. 34 (2):171-97.

Atack, Jeremy; Michael Haines, and Robert A Margo. 2011. "Railroads and the Rise of the Factory: Evidence for the United States, 1850-1870." In *Economic Evolution and Revolutions in Historical Time*, edited by Paul Rhode, Joshua Rosenbloom and David Weiman. Palo Alto: Stanford University Press.

Atack, Jeremy; Matthew Jaremski, and Peter L. Rousseau. 2013. American Banking and the Transportation Revolution

Before the Civil War. Nashville TN and Hamilton, NY: Vanderbilt University and Colgate University.

Atack, Jeremy; Robert A Margo, and Elizabeth Perlman. 2012. The impact of railroads on school enrollment in nineteenth century America. Boston: Boston University.

Atack, Jeremy and Robert A. Margo. 2011. "The Impact of Access to Rail Transportation on Agricultural Improvement: The American Midwest as a Test Case, 1850-1860." *Journal of Transportation and Land Use* no. 4 (2).

Bullock, Charles Jesse. 1900. *Essays on the monetary history of the United States*, *The citizen's library of economics, politics, and sociology*. New York, London,: Macmillan and Co.

Callender, G. S. 1902. "The Early Transportation and Banking Enterprises of the States in Relation to the Growth of Corporations." *The Quarterly Journal of Economics* no. 17 (1):111-162.

Carter, Susan B.; Scott Sigmund Gartner; Michael R. Haines; Alan L. Olmstead; Richard Sutch; Gavin Wright, and Louis P. Cain. 2006. *Historical Statistics of the United States Millennial Edition Online*. New York: Cambridge University Press.

Colton, J. H. 1860. Colton's new railroad & county map of the United States and the Canadas &c. New York: Joseph Hutchins Colton.

Cox, D. R. 1972. "Regression Models and Life-Tables." *Journal of the Royal Statistical Society. Series B (Methodological)* no. 34 (2):187-220. doi: 10.2307/2985181.

Cox, D. R. and David Oakes. 1984. *Analysis of survival data*, *Monographs on statistics and applied probability*. London ; New York: Chapman and Hall.

Dwyer, Gerald. 1996. "Wildcat Banking, Banking Panics and Free Banking in the United States." *Federal Reserve Bank of Atlanta Economic Review* no. 81:1-20.

Economopoulos, Andrew J. 1988. "Illinois Free Banking Experience." *Journal of Money, Credit and Banking* no. 20 (2):249-264.

Federal Deposit Insurance Corporation, . *FDIC Law, Regulations, Related Acts*. 62 Fed. Reg. 752, January 6, 1997, effective January 1, 1997, September 16, 2013 1997 [cited 11/25/2013. Available from http://www.fdic.gov/regulations/laws/rules/5000-900.html.

Goodrich, Carter, ed. 1961. *Canals and American economic development*. New York,: Columbia University Press.

Haines, Michael R and Inter-university Consortium for Political and Social Research. 2010. *Historical, Demographic, Economic, and Social Data: The United States, 1790-2002*: Inter-university Consortium for Political and Social Research (ICPSR) [distributor].

Haites, Erik F.; James Mak, and Gary M. Walton. 1975. *Western river transportation : the era of early internal development, 1810-1860*, *The Johns Hopkins University studies in historical and political science*. Baltimore: The Johns Hopkins University Press.

Hunter, Louis C. 1949. *Steamboats on the Western rivers; an economic and technological history*, *Studies in economic history*. Cambridge,: Harvard University Press.

Inter-university Consortium for Political and Social Research. 1979. *Historical, Demographic, Economic, And Social Data: The United States, 1790-1970*.

Jaremski, Matthew. 2010. "Free Bank Failures: Risky Bonds versus Undiversified Portfolios." *Journal of Money, Credit and Banking* no. 42 (8):1565-1587. doi: 10.1111/j.1538-4616.2010.00354.x.

Jaremski, Matthew. 2013. "State Banks and the National Banking Acts: Measuring the Response to Increased Financial Regulation, 1860–1870." *Journal of Money, Credit and Banking* no. 45 (2-3):379-399. doi: 10.1111/jmcb.12006.

Luckett, Dudley G. 1980. *Money and banking*. 2d ed. New York: McGraw-Hill.

Paxson, Frederic L. 1914. "The Railroads of the "Old Northwest" before the Civil Wat." *Transactions of the Wisconsin Academy of Sciences, Arts, and Letters* no. 17 (Part 1):247-274.

Poor, Henry Varnum. 1970. *History of the railroads and canals of the United States of America*, *Library of early American business & industry, 34*. New York,: A. M. Kelley.

Quinn, Stephen F and A Samad. 1991. "Wildcat Banking in Illinois: A Look into Our Financial History." *Illinois Business Review* no. 48 (4):16-17.

Rockoff, Hugh. 1974. "The Free Banking Era: A Reexamination." *Journal of Money, Credit, and Banking* no. 6:141-67.

Rockoff, Hugh. 1975. *The free banking era : a re-examination*, *Dissertations in American economic history*. New York: Arno Press.

Rolnick, Arthur J. and Warren Weber. 1984. "The Causes of Free Bank Failures: A Detailed Examination." *Journal of Monetary Economics* no. 14:269-91.

Rolnick, Arthur J. and Warren E. Weber. 1983. "New Evidence on the Free Banking Era." *The American Economic Review* no. 73 (5):1080-1091.

Rousseau, Peter L. and Paul Wachtel. 1998. "Financial Intermediation and Economic Performance: Historical Evidence from Five Industrialized Countries." *Journal of Money, Credit, and Banking* no. 30:657-78.

Rousseau, Peter L. and Paul Wachtel. 2011. "What is Happening to the Impact of Financial Deepening on Economic Growth." *Economic Inquiry* no. 49 (1):276-88.

Rowell Geo. P. & Co. 1873. *Geo. P. Rowell & co's gazetteer, containing a statement of the industries, characteristics, population and location of all towns in the United States and British America, in which newspapers are published*. New York,: G.P. Rowell & co.

U. S. Congress. House.; U. S. Army. Corps of Engineers; U. S. War Department, and U. S. War Department. Engineer Department. 1871. Engineer's report of certain rivers and harbors. Letter from the Secretary of War, transmitting reports of the Chief Engineer upon the improvement of certain rivers and harbors. February 21, 1871. -- Referred to the Committee on Commerce and ordered to be printed.

United States. Census Office. 1990. *Digest of accounts of manufacturing establishments in the United States and of their manufactures : made under direction of the Secretary of State, in pursuance of a resolution of Congress, of 30th March, 1822*. Edited by Publishing Norman Ross, *Norman Ross Publishing series ; v. 6*. New York, N.Y.: Norman Ross Publ.

Weber, Warren. 2008. Balance sheets for U.S. Antebellum State Banks. edited by Minneapolis Federal Reserve.

Weber, Warren E. 2005. Census of State Banks. edited by Minneapolis Federal Reserve Bank.

Whitford, Noble E. 1906. *History of the Canal System of the State of New York, Together with Brief Histories of the Canals of the United States and Canada . Supplement to the Annual Report of the Engineer and Surveyor of the State of New York*. Vol. Two. Albany: Brandow Printing Co.

Whitney, William Dwight and Benjamin E. Smith. 1911. *The Century dictionary and cyclopedia, with a new atlas of the world*. Rev. and enl. ed. 12 vols. New York,: The Century co.

Wright, Carroll D. 1900. *History and Growth of the United States Census*. Washington DC: GPO.

Table 1: Correlation of Transportation and Bank Outcomes

	Number of Banks	% Fail	% Close
Charter Banks			
On Rail	1015	7.2%	11.0%
Not on Rail	209	34.9%	39.7%
On Canal	706	10.6%	12.8%
Not on Canal	518	12.9%	18.3%
Free Banks			
On Rail	516	16.5%	20.9%
Not on Rail	157	59.2%	21.0%
On Canal	394	11.8%	25.8%
Not on Canal	279	36.8%	17.5%

Notes: Banks are denoted as being on a rail or canal if they are within 10 miles from it at any point in their development. Changing this distance over plausible daily walking or horseback travel distances, say 5-20 miles, does not alter the basic conclusion.

Table 2: Determinants of Bank Failure (1830-1860)

	All Banks	
Free Bank Dummy	0.785***	0.113
	[0.298]	[0.339]
Within 10 Miles of Railroad	-0.686***	-0.260**
	[0.120]	[0.122]
Within 10 Miles of Canal	0.088	0.221
	[0.154]	[0.152]
Within 10 Miles of River	0.028	0.153
	[0.118]	[0.116]
Within 10 Miles of Great Lakes	0.035	0.292
	[0.216]	[0.198]
Within 10 Miles of Atlantic Coast	-0.214	0.220
	[0.229]	[0.245]
Bond Value		-0.023***
		[0.008]
Bonds/Assets		-0.459
		[0.614]
Circulation/Assets		2.524***
		[0.815]
ln(Assets)		-0.331***
		[0.076]
Capital/Assets		1.196
		[0.782]
Specie/Assets		-9.058***
		[2.176]
Loans/Assets		-0.750**
		[0.380]
Deposits/Assets		-2.794**
		[1.126]
Observations	5,636	5,636
Pseudo R-squared	0.140	0.173

Notes: The model is a proportional-hazard partial likelihood model. The dependent variable is the whether the bank failed during the five-year period The model treats each five year period a bank was open as a unique observation but links them under the individual bank. Fixed effects for state and each 5-year period have been added to all specifications. Robust standard errors are listed below the coefficients in brackets. * denotes significance at 10%; ** at 5% level and *** at 1% level.

Table 3: Determinants of Bank Failure (1830-1860)

	All Banks			
Free Bank Dummy	0.729**	0.662**	-0.148	-0.158
	[0.295]	[0.295]	[0.339]	[0.340]
Within 10 Miles of Railroad	-0.598***	-0.354***	-0.279**	-0.227*
	[0.130]	[0.137]	[0.128]	[0.137]
Within 10 Miles of Canal	0.050	0.287*	0.187	0.243
	[0.155]	[0.160]	[0.155]	[0.160]
Within 10 Miles of River	0.057	0.220	0.246*	0.289**
	[0.130]	[0.135]	[0.128]	[0.128]
Within 10 Miles of Great Lakes	0.198	0.535**	0.614***	0.731***
	[0.245]	[0.244]	[0.217]	[0.224]
Within 10 Miles of Atlantic Coast	-0.221	0.231	0.234	0.337
	[0.228]	[0.277]	[0.246]	[0.261]
Ln(Population)		-0.039		0.047
		[0.068]		[0.072]
Fraction Urban		-1.673***		-0.629
		[0.460]		[0.465]
Bond Value			-0.022***	-0.021***
			[0.008]	[0.008]
Bonds/Assets			-0.398	-0.281
			[0.657]	[0.667]
Circulation/Assets			2.704***	2.517***
			[0.872]	[0.888]
ln(Assets)			-0.358***	-0.334***
			[0.080]	[0.082]
Capital/Assets			1.720**	1.671**
			[0.836]	[0.831]
Specie/Assets			-10.426***	-10.144***
			[2.429]	[2.472]
Loans/Assets			-1.038**	-1.081**
			[0.436]	[0.438]
Deposits/Assets			-2.705**	-2.704**
			[1.242]	[1.245]
Observations	5,539	5,539	5,539	5,539
Pseudo R-squared	0.140	0.145	0.178	0.178

Notes: The model is a proportional-hazard partial likelihood model. The dependent variable is the whether the bank failed during the five-year period The model treats each five year period a bank was open as a unique observation but links them under the individual bank. Fixed effects for state and each 5-year period have been added to all specifications. Robust standard errors are listed below the coefficients in brackets. * denotes significance at 10%; ** at 5% level and *** at 1% level.

Table 4: Tests of the Effect of Railroads on Bank Failure Including Additional County Controls

	Additional County-Level Controls							
	1840-1860				1850-1860			
Free Bank Dummy	0.621**	0.529*	-0.239	-0.251	-0.444	-0.614	-1.755***	-1.826***
	[0.298]	[0.298]	[0.338]	[0.339]	[0.554]	[0.601]	[0.650]	[0.669]
Within 10 Miles of Railroad	-0.646***	-0.369***	-0.321**	-0.268*	-0.789***	-0.437**	-0.390**	-0.406**
	[0.132]	[0.140]	[0.130]	[0.139]	[0.149]	[0.180]	[0.163]	[0.198]
Within 10 Miles of Canal	0.029	0.285*	0.131	0.187	-0.262	0.031	-0.023	0.082
	[0.158]	[0.162]	[0.156]	[0.161]	[0.235]	[0.235]	[0.239]	[0.248]
Within 10 Miles of River	0.073	0.232*	0.282**	0.318**	0.127	0.279*	0.216	0.300*
	[0.131]	[0.138]	[0.129]	[0.131]	[0.161]	[0.162]	[0.159]	[0.157]
Within 10 Miles of Great Lakes	0.243	0.561**	0.655***	0.739***	-0.926*	-0.181	-0.384	0.130
	[0.240]	[0.239]	[0.211]	[0.221]	[0.501]	[0.491]	[0.535]	[0.534]
Within 10 Miles of Atlantic Coast	-0.350	0.050	0.095	0.164	-0.436	0.097	0.174	0.301
	[0.246]	[0.301]	[0.262]	[0.277]	[0.376]	[0.444]	[0.388]	[0.419]
Ln(Population)		-0.009		0.063		0.036		0.126
		[0.069]		[0.075]		[0.087]		[0.097]
Fraction Urban		-1.312**		-0.387		-3.034***		-1.624**
		[0.523]		[0.527]		[0.721]		[0.673]
Ln(Mfg. Capital P.C.)		-0.225**		-0.100		-0.010		0.146
		[0.104]		[0.105]		[0.115]		[0.122]
Ln(Farm Capital P.C.)						-0.127		0.224
						[0.226]		[0.259]
Bond Value			-0.030***	-0.030***			0.011	0.011
			[0.008]	[0.008]			[0.020]	[0.020]
Bonds/Assets			-0.671	-0.620			-0.196	0.297
			[0.677]	[0.690]			[1.065]	[1.069]
Circulation/Assets			3.031***	2.811***			2.509**	2.286**
			[0.914]	[0.934]			[1.137]	[1.147]
ln(Assets)			-0.358***	-0.337***			-0.713***	-0.662***
			[0.080]	[0.082]			[0.124]	[0.128]
Capital/Assets			1.839**	1.785**			1.187	1.169
			[0.886]	[0.880]			[1.153]	[1.169]
Specie/Assets			-10.099***	-9.736***			-15.128***	-14.991***
			[2.505]	[2.551]			[4.216]	[4.338]
Loans/Assets			-1.030**	-1.076**			-0.421	-0.507
			[0.441]	[0.442]			[0.614]	[0.622]
Deposits/Assets			-2.894**	-2.926**			-2.345	-2.326
			[1.318]	[1.320]			[1.489]	[1.513]
Observations	4,639	4,639	4,639	4,639	3,317	3,317	3,317	3,317
Pseudo R-squared	0.120	0.126	0.163	0.164	0.170	0.181	0.215	0.219

Notes: The model is a proportional-hazard partial likelihood model. The dependent variable is the whether the bank failed during the five-year period The model treats each five year period a bank was open as a unique observation but links them under the individual bank. Fixed effects for state and 5-year period have been added to all specifications. Robust standard errors are listed below the coefficients in brackets. * denotes significance at 10%; ** at 5% level and *** at 1% level.

Table 5: Additional Tests of the Effect of Railroads on Bank Failure (1830-1860)

	Dropping Banks that Entered After Railroad				Dropping Banks Present When Railroads Entered			
Free Bank Dummy	1.103***	1.121***	0.368	0.390	0.872**	0.786**	-0.381	-0.421
	[0.412]	[0.412]	[0.565]	[0.563]	[0.364]	[0.369]	[0.364]	[0.368]
Within 10 Miles	-1.258***	-1.131***	-0.868***	-0.881***	-0.805***	-0.538***	-0.445***	-0.388**
of Railroad	[0.293]	[0.302]	[0.280]	[0.300]	[0.141]	[0.153]	[0.145]	[0.157]
Within 10 Miles	0.276	0.314	0.356	0.345	-0.013	0.197	0.161	0.208
of Canal	[0.231]	[0.231]	[0.223]	[0.227]	[0.175]	[0.174]	[0.181]	[0.179]
Within 10 Miles	-0.158	-0.093	-0.015	-0.007	0.014	0.143	0.180	0.223
of River	[0.162]	[0.167]	[0.165]	[0.166]	[0.139]	[0.147]	[0.135]	[0.137]
Within 10 Miles of	0.544	0.578	0.537	0.572	0.136	0.439*	0.455**	0.586**
Great Lakes	[0.423]	[0.437]	[0.405]	[0.414]	[0.241]	[0.249]	[0.217]	[0.228]
Within 10 Miles of	-0.114	0.066	0.203	0.230	-0.340	0.180	0.090	0.242
Atlantic Coast	[0.357]	[0.389]	[0.356]	[0.370]	[0.291]	[0.347]	[0.307]	[0.327]
Ln(Population)		0.029		0.069		-0.050		0.057
		[0.091]		[0.100]		[0.073]		[0.077]
Fraction Urban		-0.975		0.051		-1.644***		-0.718
		[0.729]		[0.776]		[0.547]		[0.518]
Bond Value			-0.001	-0.001			-0.034***	-0.033***
			[0.009]	[0.009]			[0.009]	[0.009]
Bonds/Assets			-0.443	-0.415			-0.556	-0.394
			[0.907]	[0.914]			[0.683]	[0.696]
Circulation/Assets			0.752	0.842			2.913***	2.674***
			[1.370]	[1.411]			[0.880]	[0.895]
ln(Assets)			-0.420***	-0.420***			-0.431***	-0.413***
			[0.125]	[0.131]			[0.080]	[0.081]
Capital/Assets			0.877	0.884			1.813**	1.746**
			[1.242]	[1.252]			[0.818]	[0.814]
Specie/Assets			-3.610	-3.754			-9.376***	-9.159***
			[3.255]	[3.265]			[2.592]	[2.656]
Loans/Assets			-0.417	-0.404			-1.442***	-1.483***
			[0.599]	[0.607]			[0.475]	[0.481]
Deposits/Assets			-5.477***	-5.484***			-1.905	-1.937
			[2.086]	[2.057]			[1.201]	[1.211]
Observations	3,161	3,161	3,161	3,161	2,981	2,981	2,981	2,981
Pseudo R-squared	0.218	0.219	0.238	0.238	0.139	0.143	0.178	0.179

Notes: The model is a proportional-hazard partial likelihood model. The dependent variable is the whether the bank failed during the five-year period The model treats each five year period a bank was open as a unique observation but links them under the individual bank. Fixed effects for state and 5-year period have been added to all specifications. Robust standard errors are listed below the coefficients in brackets. * denotes significance at 10%; ** at 5% level and *** at 1% level.

Table 6: Determinants of Free and Charter Bank Failure (1830-1860)

	Free Banks				Charter Banks			
Within 10 Miles of Railroad	-0.810***	-0.611***	-0.475***	-0.604***	-0.416**	-0.198	-0.205	-0.154
	[0.159]	[0.175]	[0.178]	[0.201]	[0.200]	[0.213]	[0.195]	[0.204]
Within 10 Miles of Canal	-0.027	0.153	0.073	0.048	0.108	0.301	0.230	0.280
	[0.247]	[0.258]	[0.265]	[0.279]	[0.225]	[0.226]	[0.216]	[0.220]
Within 10 Miles of River	0.079	0.152	0.186	0.228	0.034	0.290	0.343	0.401*
	[0.169]	[0.177]	[0.164]	[0.170]	[0.220]	[0.234]	[0.240]	[0.243]
Within 10 Miles of Great Lakes	-0.034	0.337	0.572**	0.635**	0.874**	0.988***	0.913***	0.954***
	[0.293]	[0.304]	[0.279]	[0.301]	[0.374]	[0.367]	[0.334]	[0.339]
Within 10 Miles of Atlantic Coast	0.556	1.506***	1.202**	1.269***	-0.341	-0.018	0.115	0.177
	[0.534]	[0.553]	[0.498]	[0.476]	[0.241]	[0.281]	[0.263]	[0.274]
Ln(Population)		0.019		0.202*		-0.030		-0.001
		[0.094]		[0.117]		[0.101]		[0.103]
Fraction Urban		-1.718***		-0.049		-1.562***		-0.525
		[0.653]		[0.625]		[0.595]		[0.628]
Bond Value			-1.612***	-1.600***			0.009	0.009
			[0.016]	[0.016]			[0.007]	[0.007]
Bonds/Assets			0.247	0.443			-0.911	-0.823
			[1.208]	[1.154]			[2.606]	[2.513]
Circulation/Assets			2.510	2.698			2.036	1.883
			[1.699]	[1.648]			[1.276]	[1.307]
ln(Assets)			-0.775***	-0.839***			-0.293**	-0.272**
			[0.141]	[0.151]			[0.125]	[0.129]
Capital/Assets			2.565	2.522			0.654	0.648
			[1.647]	[1.581]			[1.187]	[1.180]
Specie/Assets			-24.844***	-26.430***			-6.204*	-6.085*
			[5.148]	[5.226]			[3.185]	[3.205]
Loans/Assets			-1.245*	-1.129*			-0.761	-0.820
			[0.689]	[0.680]			[0.591]	[0.597]
Deposits/Assets			-0.330	-0.194			-5.265***	-5.101**
			[1.936]	[1.874]			[2.022]	[2.038]
Observations	1,057	1,057	1,057	1,057	4,482	4,482	4,482	4,482
Pseudo R-squared	0.193	0.197	0.242	0.244	0.128	0.133	0.155	0.155

Notes: The model is a proportional-hazard partial likelihood model. The dependent variable is the whether the bank failed during the five-year period The model treats each five year period a bank was open as a unique observation but links them under the individual bank. Fixed effects for state and 5-year period have been added to all specifications. Robust standard errors are listed in brackets. * denotes significance at 10%; ** at 5% level and *** at 1% level.

Table 7: Additional Tests of the Effect of Railroads on Charter Bank Failure (1830-1860)

	Only Charter Banks That Existed Before a Rail Entered			
Within 10 Miles of Railroad	-1.233***	-1.102***	-0.825***	-0.822***
	[0.296]	[0.309]	[0.291]	[0.307]
Within 10 Miles of Canal	0.105	0.203	0.167	0.173
	[0.284]	[0.296]	[0.280]	[0.295]
Within 10 Miles of River	-0.142	0.027	0.108	0.110
	[0.265]	[0.288]	[0.281]	[0.303]
Within 10 Miles of Great Lakes	0.750*	0.821*	0.805*	0.790
	[0.439]	[0.466]	[0.478]	[0.513]
Within 10 Miles of Atlantic Coast	-0.118	0.042	0.287	0.276
	[0.356]	[0.386]	[0.362]	[0.374]
Ln(Population)		-0.013		-0.023
		[0.129]		[0.136]
Fraction Urban		-1.011		-0.001
		[0.807]		[0.868]
Bond Value			0.019**	0.019**
			[0.009]	[0.009]
Bonds/Assets			-0.245	-0.226
			[1.806]	[1.812]
Circulation/Assets			0.664	0.645
			[1.515]	[1.535]
ln(Assets)			-0.309*	-0.313
			[0.183]	[0.193]
Capital/Assets			-0.198	-0.199
			[1.354]	[1.351]
Specie/Assets			-3.881	-3.865
			[3.562]	[3.586]
Loans/Assets			-0.717	-0.721
			[0.747]	[0.750]
Deposits/Assets			-7.817***	-7.823***
			[2.635]	[2.609]
Observations	2945	2945	2945	2945
Pseudo R-squared	0.191	0.192	0.219	0.219

Notes: The model is a proportional-hazard partial likelihood model. The dependent variable is the whether the bank failed during the five-year period The model treats each five year period a bank was open as a unique observation but links them under the individual bank. Fixed effects for state and each 5-year period have been added to all specifications. Robust standard errors are listed below the coefficients in brackets. * denotes significance at 10%; ** at 5% level and *** at 1% level.

Table 8: Effect of Transportation on Level of Bank Balance Sheets - Five Year Periods (1830-1860)

	Ln(Assets)		Ln(Capital)		Ln(Deposits)		Ln(Circulation)		Ln(Loans)		Ln(Bonds)		Ln(Specie)	
Ln(Bank Age)	0.027***	0.019***	0.028***	0.016***	0.046***	0.066***	0.016***	0.007***	0.034***	0.043***	-0.013***	-0.015**	0.032***	0.024***
	[0.002]	[0.001]	[0.002]	[0.001]	[0.004]	[0.006]	[0.003]	[0.002]	[0.004]	[0.005]	[0.005]	[0.006]	[0.004]	[0.006]
Free Bank	-0.325***		-0.326***		-0.185		-0.461***		-0.730***		-1.232***		-1.120***	
Dummy	[0.076]		[0.083]		[0.255]		[0.095]		[0.262]		[0.188]		[0.147]	
Within 10 Miles	0.028*	0.004	0.014	-0.009	0.513***	0.185**	-0.001	0.027	0.248***	0.148**	0.378***	0.028	0.393***	0.267**
of Railroad	[0.015]	[0.019]	[0.016]	[0.019]	[0.069]	[0.079]	[0.029]	[0.037]	[0.048]	[0.058]	[0.098]	[0.154]	[0.079]	[0.114]
Within 10 Miles	0.252***	0.026	0.212***	-0.088*	0.949***	1.053*	0.052	-0.232**	0.231**	-0.283*	0.145*	0.074	0.578***	0.401
of Canal	[0.030]	[0.058]	[0.035]	[0.049]	[0.163]	[0.559]	[0.045]	[0.114]	[0.091]	[0.171]	[0.080]	[0.356]	[0.090]	[0.337]
Within 10 Miles	0.249***		0.295***		0.364***		-0.002		0.348***		-0.171*		0.183*	
of River	[0.039]		[0.044]		[0.134]		[0.054]		[0.123]		[0.099]		[0.107]	
Within 10 Miles	0.045		0.027		0.220		-0.195***		0.060		0.073		-0.076	
of Great Lakes	[0.068]		[0.093]		[0.275]		[0.067]		[0.239]		[0.186]		[0.163]	
Within 10 Miles	0.565***		0.579***		1.024***		0.082		0.647***		0.162*		1.002***	
of Atl. Coast	[0.044]		[0.048]		[0.121]		[0.062]		[0.088]		[0.083]		[0.100]	
Fixed Effect	State	Bank	State	Bank	State	Bank	State	Bank	State	Bank	State	Bank	State	Bank
Observations	5,636	5,636	5,636	5,636	5,636	5,636	5,636	5,636	5,636	5,636	5,636	5,636	5,636	5,636
R-squared	0.305	0.312	0.1934	0.206	0.1742	0.179	0.0926	0.096	0.0955	0.128	0.097	0.108	0.0484	0.050

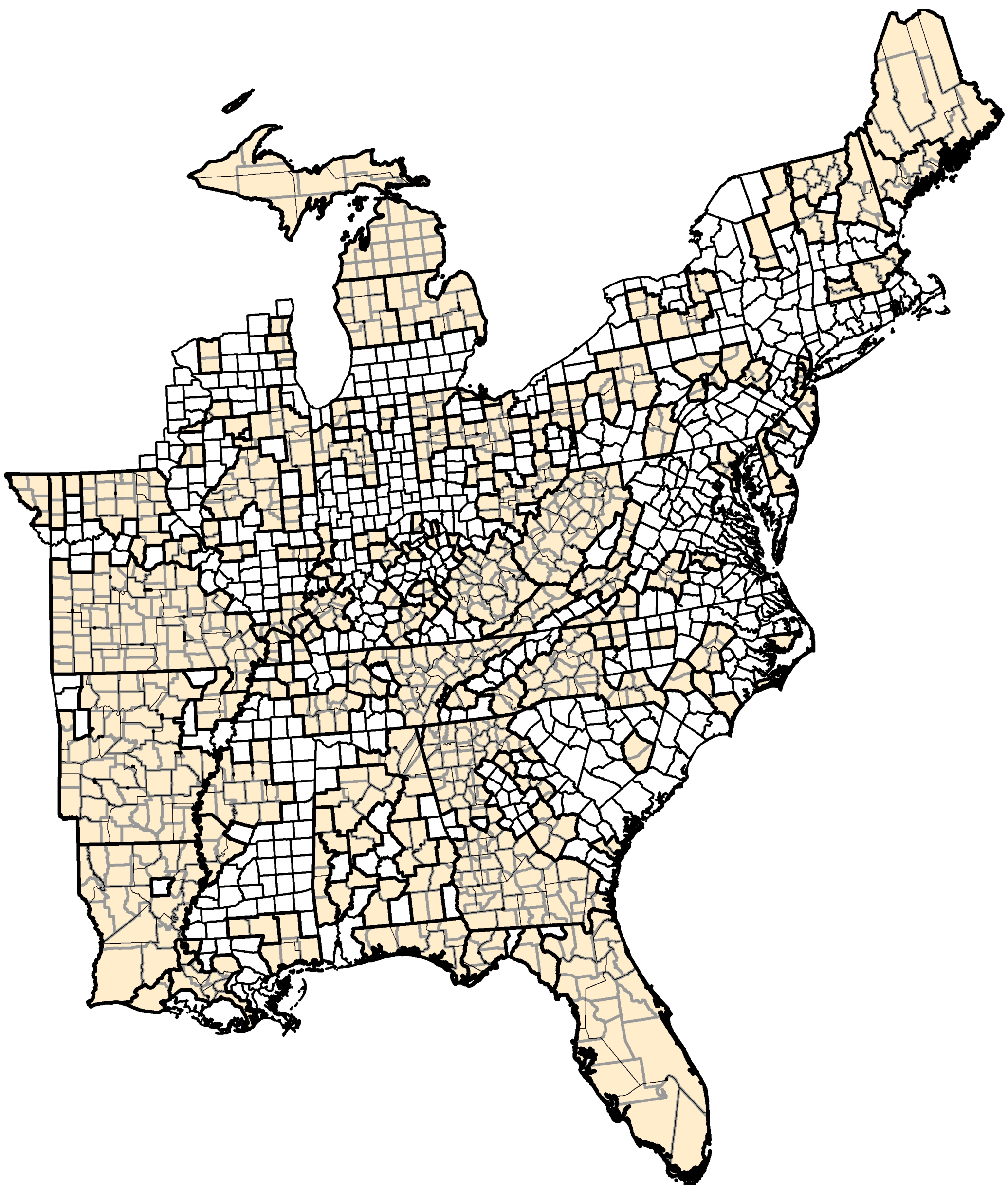
Notes: Table presents the results of an OLS regression. The dependent variable is described in the column heading. Each observation is a bank-half decade. Dollar values are deflated to 1860 using Officer (2008). Fixed effects for each 5-year period have been added to all specifications. Robust standard errors are listed below the coefficients in brackets. * denotes significance at 10%; ** at 5% level and *** at 1% level.

Table 9: Effect of Transportation on Ratio of Bank Balance Sheets - Five Year Periods (1830-1860)

	Capital/Assets		Deposits/Assets		Circulation/Assets		Loans/Assets		Bonds/Assets		Specie/Assets	
Ln(Bank Age)	0.001	-0.002***	0.001***	0.003***	-0.003***	-0.003***	0.001***	0.003***	-0.001***	-0.001	-0.001	-0.001**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Free Bank	0.041***		0.026		-0.040***		-0.170***		0.038***		-0.022***	
Dummy	[0.010]		[0.016]		[0.012]		[0.015]		[0.010]		[0.003]	
Within 10 Miles	-0.006	-0.008	-0.002	-0.012***	-0.016***	0.005	0.018***	0.014*	-0.003**	-0.001	-0.004***	-0.006***
of Railroad	[0.004]	[0.006]	[0.003]	[0.004]	[0.004]	[0.005]	[0.005]	[0.008]	[0.001]	[0.001]	[0.001]	[0.002]
Within 10 Miles	0.005	-0.047**	0.037***	0.036*	-0.061***	-0.025	0.027***	0.030	0.002	0.008	0.007***	0.018***
of Canal	[0.006]	[0.021]	[0.008]	[0.019]	[0.006]	[0.016]	[0.007]	[0.026]	[0.004]	[0.009]	[0.002]	[0.007]
Within 10 Miles	0.013**		0.025***		-0.052***		0.040***		-0.005		0.001	
of River	[0.006]		[0.008]		[0.007]		[0.008]		[0.007]		[0.002]	
Within 10 Miles	-0.008		0.028*		-0.064***		0.040**		-0.030**		0.002	
of Great Lakes	[0.011]		[0.015]		[0.013]		[0.016]		[0.013]		[0.004]	
Within 10 Miles	0.001		0.083***		-0.094***		0.005		0.002		0.015***	
of Atl. Coast	[0.006]		[0.008]		[0.007]		[0.008]		[0.003]		[0.002]	
Fixed Effect	State	Bank	State	Bank	State	Bank	State	Bank	State	Bank	State	Bank
Observations	5,636	5,636	5,636	5,636	5,636	5,636	5,636	5,636	5,636	5,636	5,636	5,636
R-squared	0.2183	0.223	0.1649	0.167	0.1926	0.202	0.0701	0.071	0.0135	0.014	0.0193	0.022

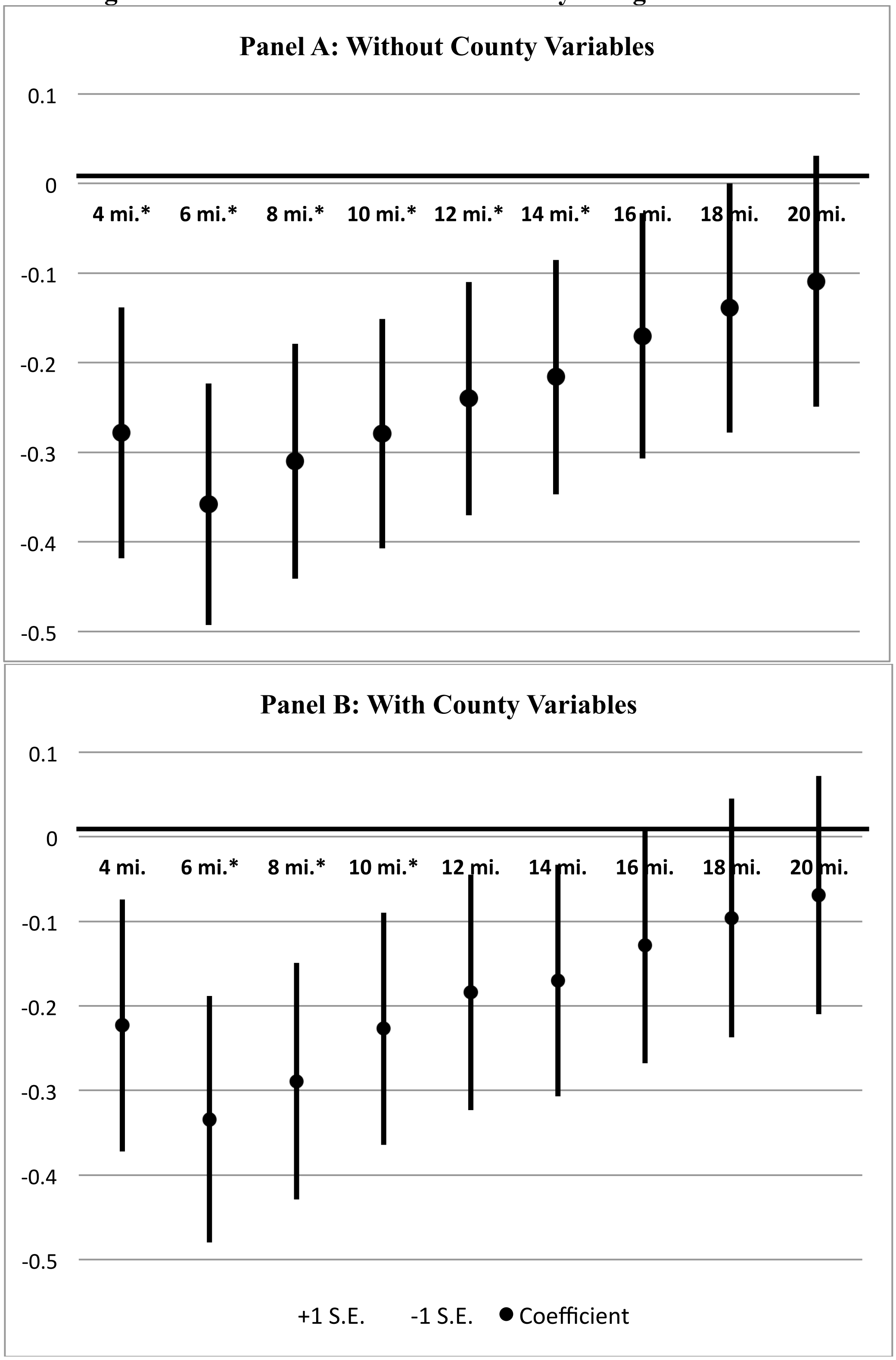
Notes: Table presents the results of an OLS regression. The dependent variable is described in the column heading. Each observation is a bank-half decade. Dollar values are deflated to 1860 using Officer (2008). Fixed effects for each 5-year period have been added to all specifications. Robust standard errors are listed below the coefficients in brackets. * denotes significance at 10%; ** at 5% level and *** at 1% level.

Figure 1: County Aggregation Map



Notes: Figure displays the county aggregation process. Shaded counties are aggregated, whereas non-shaded counties did not change their borders.

Figure 2: Coefficient on Railroad Dummy Using Other Cutoffs



Notes: Figures present the coefficient on the railroad dummy for various mileage cutoffs. Each coefficient comes from an equation similar to those in columns (3) and (4) of Table 3. The stared mileage cutoffs denote coefficients that are statistically significant at the 10% level or greater.