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ABSTRACT: Governments often attempt to increase the confidence of financial market participants by making implicit or explicit guarantees of uncertain credibility. Confidence in these guarantees presumably alters the size of the financial sector, but observing the long-run consequences of failed guarantees is difficult in the modern era. We look to America's free-banking era and compare the consequences of a broken guarantee during the Indiana-centered Panic of 1854 to the Panic of 1857 in which guarantees were honored. Our estimates of a model of endogenous market structure indicate substantial negative long-run consequences to financial depth when panics cast doubt upon a government's ability to honor its guarantees.

JEL: D53, G21, L11, L13, N21

Keywords: banking panics, government guarantees, leverage cycles, endogenous market structure, economic history

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> *"Indiana presents the anomaly of having been a State organizing the most admirable system of banking of any State in the Union and also of having a banking system at one time so vicious that under it the banks bankrupted nearly the whole people."*
>
> –John Jay Knox, *A History of Banking in the United States* (1900)

1. Introduction

A bank run is the canonical example of a self-fulfilling prophecy. Bank liabilities are fixed in value while most assets are illiquid and fluctuate in value. If creditors lose confidence in the banking system's ability to convert assets into legal tender on command, even solvent banks may fall victim to a run. Governments understand the danger of self-fulfilling bank runs and often make guarantees in order to increase the confidence of financial market participants. The recent financial crisis has illustrated that government guarantees may not be credible when the size of the required financial sector bailout dwarfs the sovereign's ability to raise funds. The long-term consequences of a broken government guarantee, however, remain unexplored. Do sovereigns who fail to live up to the market's ex ante expectations of support quickly regain the trust of financial markets after the crisis has passed, or does lost reputation doom a sovereign's territory to a reduced steady state level of financial development?

Measuring the long-run consequences of broken promises is difficult in part because government insurance programs and implicit guarantees only fail during panics and a banking panic itself necessarily leads to changes in the equilibrium size of the financial sector. During panics banks exit from (and then perhaps enter into) the financial sector until a new steady state is achieved. Unfortunately, one cannot simply observe a sample of modern panics and compare the change in steady states across markets with and without broken guarantees. Because modern banks operate across many jurisdictions, cross-sectional analysis is confounded by international linkages and the harmonized regulatory response to modern crises. Financial integration has essentially created one global market, robbing analysts of the cross-sectional variation necessary

to identify the causal impact of broken guarantees. Furthermore, it is difficult to disentangle the long-run impact of panics on government creditability from the regulatory reforms that typically follow modern banking crises. To properly measure the effect of guarantees on market structure, one would ideally observe many similar markets that differ only in the ex post credibility of their guarantees and measure their long-run responses to a common panic. While such an ideal design does not exist with contemporary globalized banking, the variation in state guarantees during antebellum America's free banking era comes remarkably close.

During the free-banking era (1837-63), a still sparsely populated America had many geographically isolated towns that constituted localized banking markets. Furthermore, the era saw bank runs, panics, and closures occur with some regularity, but these events tended to be more localized than they are today. The existence of such markets and banking events can provide the cross-sectional variation lacking in today's global capital market. Regulation was also fragmented. Regulation was a state rather than federal power, and banks were limited to a single state. Each state adopted regulations designed to assure bank creditors that banknotes issued by banks within that state's borders would always be redeemed at par. While no state explicitly guaranteed redemption at par, the collateral and monitoring regulations amounted to an implicit guarantee that notes would be redeemed at par as long as the state's regulatory authorities fulfilled their statutory requirements *and* the size of the bank panic did not impair the state's sovereign credit. These implicit guarantees were only credible in practice, though, if the bond market was willing to hold state debt at low yields. Historical circumstances periodically called these guarantees into question and provide us with examples of broken guarantees. Finally, regulations were rarely revised in the aftermath of panics, so there is little trouble in distinguishing the impact of the panic from that of reform. The period thus had many features ideal for the study of the interaction of government guarantees and the size and structure of the financial system.

We investigate the consequences of a broken guarantee by comparing the Indiana-centered Panic of 1854 with the Panic of 1857 during which regulatory guarantees were honored. In the latter panic of 1857, many markets across the country endured bank closures, but banknote holders were made whole after banks were unwound. Despite the system working, it is possible that confidence in, and therefore demand for, banking decreased. This lack of confidence may then generate less banking in markets where closures occurred. In the earlier panic of 1854,

though, largely idiosyncratic forces revealed flaws in Indiana's collateral system which led to instances of banknotes being redeemed at less than par, despite the state's implicit guarantee. Indiana's regulatory reputation was damaged and subsequent potential bank investors may have lowered their demand for banknotes issued by Indiana banks when deciding where to allocate resources. This broken guarantee would then compound any reduced banking confidence that resulted from closures during the panic, spilling over into lower demand for banks located in Indiana markets that saw no closures but were nonetheless covered by the flawed regulatory regime.

To measure the impacts of these historical events, we make use of the isolated nature of banking markets during this period and examine what determines market structure. Our major results come from a model of banking in which banks enter where it is profitable to do so and fixed costs limit the number of entrants. Employing Abraham, Gaynor, and Vogt's (2007) extension of Bresnahan and Reiss (1990, 1991), we relate the number of banks in a market to market characteristics.[1] Specifically, we infer the determinants of latent (unobserved) banking profits by employing an ordered probit to link market characteristics and panic history with the consequent equilibrium market structure. Such models are now standard in the industrial organization literature but, for the aforementioned reasons, are difficult if not impossible to apply meaningfully to the question of panics in modern banking markets. Our formal model enables us to control for market-level variables and draw conclusions about profitability even though many components of bank profits cannot be ascertained.[2] Essentially, we recognize that the era's potential bankers wished to locate in the most profitable locations and let the observed entry and exit decisions of antebellum bankers illuminate their implied profits.

Our data come from isolated markets in Indiana and surrounding states in mid-1854 (before that year's panic) and late 1860 (three years after the '57 panic). The Indiana-centered panic in 1854 provides us with an exogenous shock to government credibility, and closures from the national panic of 1857 offer cases when panics occurred but guarantees were not in question. Our results suggest that in mid-1854 Indiana was an exceptionally banking-friendly state, in that Indiana markets had far more banks than the underlying population and other market

[1] Cohen and Mazzeo (2007) use related techniques to exploit localized conditions and consider the causes and impacts of endogenous bank-branching decisions.

[2] Measurement issues of profitability have been a recurring problem in past studies of the free banking era. See Bodenhorn (1995) for an excellent contribution and review of the literature.

characteristics would suggest. By late 1860, though, Indiana's implicit guarantee had been questioned for six years, and the state was underbanked relative to both its population and other free-banking states. The difference in banking activity between these six years is both statistically and economically significant and provides us with a stark example of the interaction between sovereign credibility and the size of the financial sector.

We explore two mechanisms to explain Indiana's decline, distinguishing them by considering how much of the Indiana impact is concentrated in the local markets that experienced actual bank closures. The first – which we call the Kindleberger hypothesis, after Charles Kindleberger's observations of French banking before the Revolution[3] – revolves around the local depression and loss of confidence that individual creditors experience as a consequence of personal losses due to bank failures. This explanation applies equally to any market that is struck by bank failure, regardless of regulatory regime. Psychology and behavioral economic models of reinforced learning emphasize the importance of personal experience in decision making.[4] If a town's bank closed during a panic, that town may be a less profitable location in steady state if its citizens are subsequently less likely to trust (and hold notes of) local banks than citizens of towns that did not suffer panics. Our second mechanism focuses on information about the state's ability to fulfill its guarantee. Unlike the first explanation, the loss of confidence in the government guarantee should affect each market within the state rather than only markets that suffered failures.

When guarantees are honored, we find little evidence that bank failures have long lasting implications for the steady state level of banking. Markets outside of Indiana that suffered bank failures in 1857 have insignificantly lower implied steady state profits in 1860. The same cannot be said for Indiana markets where a closure of a bank during the panic lowers the steady state level of banking. We attribute these results to Indiana suffering a state-wide reputational cost from its failure to fulfill its implicit guarantee during the earlier panic of 1854.

The structure of this paper is as follows. We begin with discussions of the regulation of antebellum banking and of the practice of free banking in Section 2. We then discuss the curious

[3] Kindleberger, *A Financial History of Western Europe*, 1984.

[4] Reinforced learning occurs when personal experiences are given more weight than other sources of information in the formation of expectations about risk and return (Choi et al., 2009). Osili and Paulson (2009) show that immigrants to the United States who personally experienced banking panic in their home country are less likely to trust U.S. banks. See their literature review and cites therein for an excellent summary of the empirical evidence that individuals over-extrapolate from personal risk and return experience when making banking decisions.

details of Indiana's Panic of 1854 and the national Panic of 1857 in Section 3. Section 4 details our basic model of endogenous market structure. Sections 5 and 6 outline the data with some basic analysis and then consider the model's estimates, and we conclude in Section 7.

2. State Regulation, Trust and Profits during the "Free Banking" Era

After the Second Bank of the United States' charter expired in 1836, banks were regulated entirely at the individual state level. States had previously granted banking charters on a bank-by-bank basis via acts of the legislature or discretionary approval by a state appointed regulator. Beginning with Michigan in 1837, many states adopted laws that permitted individuals who abided by general banking laws to form limited liability banks with no discretionary approval. These so called "Free-Banking" statutes allowed for free entry of banks subject to each state's regulatory requirements.

The required capital, reserves, and type of security accepted as collateral varied from state to state. Antebellum regulation was based on the desire to create safe banknotes that could be used as a transaction medium and store of value and was predicated on the belief that bank runs could be prevented if noteholders were confident that all losses in bankruptcy would be borne by equity holders. To that end, banks were required to post collateral securities backing each banknote in sufficient quantity that no monitoring of individual banks was required by noteholders.[5]

States wished to make their banknote circulations safe enough that they could serve as a medium of exchange both within and outside the state. After all, a merchant in Cincinnati or Chicago could not be expected to know the riskiness of each bank whose notes passed through his business. Regulations therefore required notes to be backed by sufficient transparent collateral that no due-diligence was necessary on the part of noteholders. Banknotes that were sufficiently collateralized became what Gorton (2010, 2012) has described as "secretless" or "information-insensitive" debt – debt with value that was known with such certainty that it was readily accepted as a medium of exchange.

[5] Ng (1988), Bodenhorn (1990), Economopolous and O'Neill (1995), and Dwyer (1996) each survey antebellum capital and entry requirements.

Contemporary commentators referred to the collateral backing note issues as the "ultimate security" but realized that, while this backing may eliminate the need to monitor individual bank assets, the need to convert these securities into specie during a panic meant that banks could be subject to what we refer to today as "wrong-way risk" – collateral that was likely to lose value in exactly the state of the world in which it was needed.

> "This 'ultimate security' is, it may be admitted, better than no security at all. The mischief is that it is *least available when most wanted*. The very causes which prevent the banks from redeeming their issues promptly, produce a fall in the value of the stocks and mortgages, on the 'ultimate security' of which their notes have been issued" - *The Bankers Magazine (Sept.1857 p.169)*

A bank that wished to circulate banknotes first had to use specie to purchase an acceptable federal or state government bond. Next, the bank deposited the bond with the state auditor who returned endorsed banknotes that could be legally circulated. The bank was required to redeem the banknotes in specie on demand, and noteholders were protected against default by the posted collateral. Should a bank fail to redeem a banknote, the noteholder could protest to the state auditor who was empowered to sell the posted collateral and redeem the note in gold. As long as the bond collateral could be sold in the open market for at least the face value of banknotes, the noteholders were assured redemption at par regardless of the value of the bank's other illiquid assets and therefore had no reason to "run" on banks at the first hint of trouble. With banknotes backed by posted collateral, potential noteholders did not have to monitor individual banks. Instead, noteholders only had to trust the bank's home state regulator to properly monitor the specie reserves and collateral value of posted bonds.

Table 1 summarizes the regulatory differences across select states in our study. The key differences were the amount, quality and diversity of collateral required to back note issues. Some states adopted remarkably careful collateral requirements that resulted in well diversified collateral pools backing their note issue. They did so in large part by granting less than full value (i.e., applying haircuts) to less than ideal collateral.

Indiana, on the other hand, used its collateral requirements to encourage banks within its borders to hold domestic state bonds as collateral. This provided Indiana's government with cheap funding but also exposed the banks in the state to the danger of undiversified portfolios.[6]

[6] The implications of collateral value on equilibrium security prices have been examined by a number of authors including Geanakaplos (2003, 2010), Brunnermeir and Pedersen (2009), and Garleanu and Pedersen (2011).

By construction, these portfolios were vulnerable to the "wrong way risk" of collateral that was likely to default in exactly the state of the world in which it was needed.

Indiana's collateral requirements were lenient with respect to haircuts and designed in such a way that they inevitably encouraged the concentration of Indiana bonds in the collateral portfolios of her free banks. Before 1851 Indiana had issued bonds with coupons of 5% and 2.5% while virtually every other state bond had coupons of 6% or more. Due to their low coupon rate, these Indiana bonds were ineligible as collateral in most states and subject to extremely large haircuts in others. Indiana's legislature perceived that the low collateral value of Indiana's existing bonds was depressing their market price and raising the state's funding costs. Indiana's free banking legislation therefore attempted to provide the state with cheap funding by accepting Indiana bonds as collateral.

> "Thus it will be perceived that this banking law was a shrewd financial measure on behalf of the State [of Indiana] to enhance their bonds, which only bore five percent interest" - *The Bankers Magazine (Sept.1857 p.165-166)*

Cross-state differences in regulation resulted in Indiana bonds having a higher collateral value to Indiana banks than to other potential holders. Indiana banks consequently purchased large quantities of Indiana bonds as note collateral for their growing circulation, and Indiana bonds became concentrated in Indiana bank collateral portfolios.

Figure 1 reports the diversification of bank portfolios in three states that published sufficiently detailed collateral reports before the panics of 1854 and 1857. Indiana banks had far more concentrated holdings than Illinois or Wisconsin. To make matters worse, Indiana 5% bonds traded close to par so the value of banknotes in circulation was roughly equivalent to the market value of posted collateral. This concentration and lack of over-collateralization would prove disastrous in the events that follow.

2.A. Trust and Profits

The issuance and lending of banknotes would seem a highly lucrative enterprise, but competitive pressure constrained bank leverage and profits. Banks could only maintain a circulation of notes by convincing noteholders that their currency was sound. Bank notes traded in major trade centers, and the price of a bank's notes served as both a public signal of its

soundness and a measure of its potential leverage and profits. Notes could obviously not trade below par in a city of redemption without creating opportunities for arbitrageurs to buy discounted notes and immediately redeem them at par. Notes could, however, trade at a discount outside of redemption cities, provided the discount was smaller than the transaction costs of returning notes to the bank for redemption.[7] If a bank's notes were trusted and traded near par in far away cities, note holders would not find it profitable to pay the transport costs of returning notes for redemption. As long as a bank was considered sound, its owners could profit from the leverage created by circulating more notes.[8]

Banks leveraged their initial capital of gold by buying an acceptable bond to post as collateral for state auditor-endorsed banknotes. If the bank's notes circulated at prices near par, the bank could use its notes to acquire more bonds and post those bonds as collateral for still more notes. Each time this process was repeated, the bank earned the coupons on the bonds posted as collateral. As long as the market trusted the bank and was willing to accept its notes near par, the owners of a bank could continue to repeat this cycle and leverage their initial investment. With each purchase of bonds, though, the number of banknotes in circulation increased, and the bank's owners risked that the price of notes would fall below the threshold at which noteholders would find it profitable to return their notes for redemption in gold. Thus the market price of the notes put a limit on a bank's leverage.[9] A bank made profits by guarding its reputation so that its notes would continue to circulate and its owners would earn the coupons on the collateral bonds backing note circulation.

Given this setting, banks could increase their profits by circulating notes far from home. A bank with notes accepted far from home had more scope for profitable leverage. Notes circulated locally were more likely to be redeemed for purely idiosyncratic reasons and required banks to hold more non-earning specie reserves than notes circulated in distant cities. By locating in states with reputations for sound banking, banks found their notes in demand in distant cities, while banks located in states with poor reputations or costly regulations found it more profitable to borrow notes from banks in sound states than to circulate their own notes. The

[7] Excellent descriptions of note circulation and redemption practices during the free banking era can be found in Rockoff (1975, 1985) and Gorton (1996).
[8] Banks could also increase leverage by accepting uncollateralized deposits on which they paid interest, but the issuance of banknotes was the lower cost option.
[9] Our data and the relevant literature suggest that the era's banks were able to achieve leverage ratios of between two and three times their capital stock.

most notorious example of the second case was Michigan, which earned a reputation for wildcat banking and a lax regulatory regime in the late 1830s. Its banks' notes faced larger discounts well into the 1850s, and many of its banks found it impossible to maintain a circulation far from home. Indiana, on the other hand, earned a reputation for sound banking during the panics of 1837 and 1841. As a result, Indiana notes traded closer to par on the East Coast before the panic of 1854, and many Indiana banks were able to maintain a profitable circulation on the East Coast.[10]

Ohio had a reputation for sound regulation as well, but the state taxed local banknote circulation and adopted unprofitable collateral and specie reserve requirements. As a result, Ohio banks found it more profitable to borrow and circulate notes from Indiana banks than to maintain their own circulation.[11] When the auditor of the State of Ohio questioned why an Ohio bank did not keep up its own circulation, he was told, "*It could if it were not for the high rates of taxation. If taxes were low, a circulation would be a profit*."[12]

A regulatory arbitrage developed in which banks that were located in states with poor reputations or costly regulations purchased bonds and loaned them to banks in low-cost, good-reputation states. These banks then re-hypothecated the bonds to their state regulator in return for banknotes which they loaned to banks in states where note issue was unprofitable. For example, from a bank examiner's report we know that on November 2nd, 1853, the Union Bank of Sandusky Ohio borrowed $50,000 of banknotes from the Steuben County Bank of Indiana and delivered $33,000 worth of Indiana state bonds and coin for collateral. The Steuben County Bank promptly re-hypothecated the collateral with the Indiana regulator to replenish its banknote supply.[13] There is good reason to believe these interstate loans were a common means of concentrating note issue in regulatory friendly states. Writing about the pre-1854 arbitrage opportunities, the 1858 *Encyclopedia of Commerce* noted that "*the oppressive tax law of Ohio*

[10] Eighty-eight Indiana banks were able to maintain a circulation in Philadelphia during the first eight months of 1854. Indiana banknotes traded at an average discount of 1.58% and a range of 1.13-1.75% between Jan. 1 and Aug. 1, 1854. At the same time, only ten Michigan banks issued notes that were accepted at a low enough discount to maintain a circulation in Philadelphia. These Michigan notes traded at an average discount of 1.82% with a range between 1-5%. Source: Gorton & Webber (http://www.minneapolisfed.org/research/economists/wewproj.cfm#discounts)

[11] Writing of Ohio banks in 1856, H.F. Baker cites a businessman's complaint to the Cincinnati city council that in six years of business he had received but four banknotes circulated by Cincinnati banks. (Huntington, p. 222, footnote 44)

[12] Reemelin (1855), *Appendix to annual report of Auditor of State: Series of reports made on the condition of the Ohio stock banks, as ascertained by Charles Reemelin, Esq*., p.14

[13] Ibid p. 117.

has driven banking capital out of the state, it was at once invested in the free banks of Indiana".[14] The 1857 *Bankers Magazine* further noted that the ease of establishing a bank in Indiana and the widespread acceptance of Indiana notes "*was enough to encourage brokers and bankers from other States to avail themselves of its facilities for supplying railroads and pork-packers with a convenient currency and receive in payment therefore their bills of exchange on New York".*[15] Banks with trustworthy notes were only too happy to lend far from home in exchange for a promise that their notes would be given a "good circulation" and "scattered" in a way that decreased the probability that the notes would find their way home and thus limit the need to hold costly specie reserves.[16] And before the panic of 1854, no banks had a better reputation than banks regulated by Indiana. As a result Indiana's free and State banks found their notes accepted across the nation, and those banks employed every means available to increase their circulation and profits.

> "Every possible avenue of circulation was surcharged – every opportunity for substitution and exchange for other notes improved - brokers were employed to scatter them on rail-roads and steamboats, until the traveling public found nothing but Indiana notes in their pockets" - *The Bankers Magazine (Sept.1857 p.170)*

In this setting, a bank panic could alter the long run leverage, profitability and equilibrium number of banks if it altered the perceived safety of the banknotes in circulation. While each note was over-collateralized by the collateral on deposit, specie reserves, and other assets, the fact that banks were leveraged ensured that the aggregate number of notes in circulation exceeded the value of gold in the economy. When a single bank failed, the regulator could sell the bond collateral and redeem all notes at par with little trouble, but, if many banks were forced to convert their bond collateral into gold at once, the equilibrium price of bonds would decline. The possibility of such an event created the risk that not all noteholders could simultaneously be made whole.[17] A state's potential for systemic risk was thus dictated by the extent to which that

[14] Homans' (1858 p. 137)
[15] *Bankers Magazine Sept.1857 p.166*
[16] See quotes from letters examined by Reemelin (1855), p. 117-118.
[17] The fire sale declines in state bond collateral during the panics of the free-banking era provide some of the best empirical examples of what Allen and Gale (2005) and Acharya and Yorulmazer (2008) call "Cash-in-the-Market" pricing.

state's regulations permitted or encouraged the concentration of note collateral in a single collateral bond.[18]

3. Bank Panics and Regulator Reputation

State-wide panics revealed information about the stability of the regulatory system, specifically the elasticity of demand for required note collateral, the excess specie held in bank vaults, the liquidity of banks' loan portfolios, and the quality of capital buffers. If these safeguards proved adequate, banks could expect their notes to circulate near par and to enjoy all the leverage and profits that implied. If, however, a panic revealed inadequacies in the regulatory regime, noteholders could respond by demanding a larger discount to hold notes issued by banks located in the territory of sovereigns whose guarantees were revealed to be lacking.

3.A. The Panics of 1837 & 1841

Indiana earned a reputation for sound banking during the panics of 1837 and 1841 when "of all the banks then possessing government deposits, the Indiana Bank was the only one that offered or paid any specie".[19] Previous to the panic of 1837, Indiana had established a system of chartered banks known as the branches of the State Bank of Indiana. Despite its name, the State Bank of Indiana system was not branches of a single bank but rather a collection of banks with independent stock holders and management. Each branch raised its own capital, made its own lending and investment decisions and retained all profits and losses outside of bankruptcy. Should one of the branches fail, however, the remaining branches were mutually liable for the losses incurred by the bankrupt branch. This mutual insurance scheme encouraged monitoring and collective action to discourage excessive risk taking.[20]

When eastern banks suspended in May 1837, the Indiana State Bank branches held approximately $1.2M specie and feared runs from both specie-short eastern bankers who held approximately $1M of bank's $2.5M notes in circulation and the Federal Government whose

[18] A number of authors have documented the importance of collateral regulation in determining the cause of free bank panics. See Rolnick and Weber (1983, 1984), Hasan and Dwyer (1994), and Jaremski (2010).
[19] Esarey (1912 p.259)
[20] Calomiris (1990) surveys pre-FDIC bank insurance systems and concludes the mutual insurance system adopted by Indiana to be one of the most effective.

deposits accounted for approximately $1.5M of the bank's $1.9M deposit liability.[21] The branches quickly dispatched a representative to Washington, D.C., with $80,000 in specie to give to the Treasury in hopes of forestalling a run. The Treasury Secretary, who suddenly found his deposits throughout the nation tied up in suspended banks, gratefully accepted the money and agreed not to run on the Indiana bank if the bank would pay out the government's specie when drawn in the regular course of business.[22]

The State Bank responded to the risk of a run on its notes in the traditional manner – by suspending convertibility of State Bank notes into specie. Due to a number of mitigating circumstances, however, the suspension enhanced rather than harmed the State Bank's reputation. The most important factor was the fact that virtually every other bank in the nation also suspended note convertibility during the panic. Additionally, the State Bank adopted a number of measures that maintained the market value of its notes until the full resumption of specie payment in 1841. First, the bank accepted its own notes at par in payment of its more than $2M in loans outstanding. Secondly, the bank convinced the local merchants that the suspension was one of choice rather than necessity, and the merchants of Indianapolis collectively agreed to accept the State Bank's notes at par in their business transactions. These two actions created sufficient demand for the State Bank's notes in Indiana to maintain a par market value in the state and discounts in New Orleans and eastern markets that were relatively small compared to other banks in the west. At a time when many Western and Southern banks were ruined, the State Bank of Indiana used its freedom from specie payments to increase its circulation and convert the privileged price its notes received in eastern exchange into large profits.[23]

The State of Indiana did not fare as well as the State Bank during the panic of 1837 and the depression that followed. Falling land values and the disappointing prospects for bond-funded public works projects forced the State into default on its bonds in 1841.[24] This default sparked a new panic as Indiana's defaulted 5% bonds were a popular collateral backing the banknote issuance of New York free banks. Although Indiana's bond default resulted in widespread bank failures in New York and another suspension of convertibility in Philadelphia,

[21] The balance sheet data and specific liabilities during the panic of 1837 are estimates of Esarey (1912 p.259-260) and *The Banker's Magazine Sep. 1857 p. 162-164.*
[22] Esarey (1912 p.259) and Lainer (1877, p.16-17)
[23] Esarey (1912 p.260)
[24] See Wallis (2003) for an excellent account of the interaction of land values, tax revenues and bond prices in Indiana.

the State Bank of Indiana was relatively unscathed. The State Bank had yet to resume specie payments from 1837 and had used the past years' profits to build a fortress balance sheet that allowed the bank to weather the panic despite the default of its home sovereign.

Taken together, the panics of 1837 and 1841 left the capital market with the impression that the banking regulations in Indiana produced the most prudent and safe banks in the nation. This confidence manifested itself in a willingness to hold Indiana banknotes in foreign markets that the State Bank branches and later Indiana's free banks translated into profits that were unavailable to banks located in less trusted regulatory environs.

3.B. Free Banks Enter Indiana

Indiana's free banking law took effect on July 1, 1852. New entrants flocked to Indiana to capture the profits from issuing notes in a state with such a sterling reputation for sound banking. The free banks notes were implicitly guaranteed by Indiana's regulators promise to maintain sufficient collateral to back all notes, but the free banks lacked the mutual liability of the State Bank branches. Despite the differences between free and State Bank governance, the government's implicit guarantee served its purpose and transformed banknotes issued by free banks and the State Bank branches into information-insensitive equivalent securities in the eyes of the market. Of the 738 unique monthly Indiana free bank banknote quotations that appeared on the Philadelphia market between October 1852 and pre-panic October 1854, 694 (94%) were identical to the discount on the State Bank notes[25] and every free bank note was quoted at the same price as State Bank notes for all 582 observations between January 1854 and the panic of 1854.[26]

3.C. The Panics of 1854 & 1857

Due to the sterling reputation and regulatory advantages they had, Indiana banks were the preferred counterparties of Ohio and Illinois banks that preferred to borrow out-of-state notes rather than maintain their own circulation. By the summer of 1854, Indiana banks stood at the center of a vast interconnected network of interbank lending in which foreign banknotes made up

[25] Free banks were quoted at a higher discount 42 times and a lower discount 2 times.
[26] Source: Authors' calculations from data provided in Weber, Warren E. Quoted Discounts on State Bank Notes in New York, Cincinnati, and Cleveland, selected dates, 1827-1858. Research Department, Federal Reserve Bank of Minneapolis. http://minneapolisfed.org/research/economists/wewproj.html

the majority of the circulating currency of Ohio and Illinois.[27] Table 2 reports the circulation per capita, circulation per dollar of capital and specie reserves per dollar of circulation for banks in select Midwestern states. Before the panic of 1854, Indiana's reputation allowed Indiana banks to hold fewer specie reserves and circulate more notes per dollar of capital than other states. That is, Indiana's funding advantage manifested itself in increased leverage and a relatively high circulation per capita among Indiana banks.

Indiana's Panic of 1854 began in Ohio when, in an attempt to increase domestic circulation and tax revenue, Ohio banking authorities enacted a law making it illegal for any resident after November 1, 1854, to possess small denomination banknotes issued by an out-of-state bank.[28] In response, Ohio banks stopped discounting out-of-state banknotes and returned their banknote inventories to Indiana for redemption in gold. The inflow of notes for redemption caused Indiana banks to exhaust their gold on hand, forcing the state regulator to sell the state bond collateral to raise specie. The simultaneous selling of so many banks' Indiana state bonds pushed the market price of Indiana collateral down to 22-25% below face value.[29] Noteholders throughout the state realized that their notes were no longer fully collateralized, and a statewide panic ensued as noteholders attempted to convert their notes into specie before the banks were inevitably forced to suspend redemption.

The panic quickly spread to Illinois, but Illinois regulations had encouraged a more diversified portfolio of collateral by applying haircuts to Illinois bonds. The Illinois collateral regulations accepted bonds with 6% coupons at a minimum of market or face value, but bonds with coupons below 6% faced 50% haircuts and bonds issued by the state of Illinois were haircut 20% regardless of coupon. In early 1854, 6% bonds traded above par, and roughly 30% of Illinois' banknote circulation was secured by Illinois or California 5% bonds with large haircuts. As a result, Illinois' regulator in May 1854 was in the enviable position of holding a diversified portfolio of collateral bonds with a market value of $1.16 for every $1 in banknotes outstanding.[30] Fear of counterparty exposure to Indiana banks and the decline of heavily used

[27] Huntington (1915) claimed banknotes from Indiana, Illinois and other states supplied Ohio's domestic currency to the exclusion of Ohio banknotes (p. 222). The Illinois Bank Commission report of May 1854 estimated that foreign banknotes accounted for 70% of the paper in circulation in Illinois.
[28] This account relies primarily on Hansen and Dwyer (1994), p. 276-7.
[29] The price of Indiana 5% bonds fell to 77.75% of par in New York (*Banker's Magazine*, Dec. 1854) and 75% of par in Boston (Martin (1871), p. 90).
[30] Authors' calculation from the market value and circulation figures reported in the Bank Commissioner's Report of May 1854.

Missouri and Virginia bonds to respectively 93% and 95% of par triggered a run that closed eight Illinois banks. These banks, however, were sufficiently over-collateralized that noteholders suffered no losses.

The panic was over by December of 1854. The majority of banks throughout the Midwest were forced to suspend redemption, but most reopened quickly after the panic had subsided. Outside of Indiana, noteholders of every failed bank received 100 cents on the dollar from the sale of note collateral. In Indiana, though, the panic exposed the critical flaw in the regulatory framework, namely the systemic and wrong-way risk that arose from encouraging collateralization in primarily Indiana state bonds. Even with these deficiencies, banknotes issued by many Indiana banks were redeemed at par by the auditor.[31] The notes of the remaining banks, however, were redeemed at 80-97 cents on the dollar. Thus, while the average redemption was quite high, the panic introduced doubt regarding the system's infallibility.

The panic of 1854 revealed information about the relative stability of each state's regulatory regime. Despite the state's promises, Indiana's regulator was unable to redeem all banknotes at par. While many banks failed in Illinois as well, the bonds and capital backing Illinois circulation proved more robust, and the state auditor was able to make noteholders whole in a timely fashion. The Indiana state attorneys concluded that the state was not obligated to make noteholders whole, and no reforms were made to limit the use of Indiana bonds as collateral or reduce the leverage of Indiana banks. The legislator did increase the haircut on bonds posted as collateral requiring the state regulator to issue only $100 in notes for every $110 of collateral posted.[32] This change did make Indiana notes safer in the event of a bankruptcy and should, all else equal, have made Indiana notes more appealing to noteholders after 1854.

The national Panic in October of 1857 provides a useful counterpoint, in that it revealed no new structural flaws in the various regulatory regimes. That panic's causes are less transparent than Indiana's panic of 1854, but, regardless of its cause, the panic of 1857 led to widespread closures across many states with Indiana again being hit especially hard.[33] Note

[31] At least fifteen failed Indiana banks were redeemed at Par. Source: Authors' calculations from various issues of *The Annual Report of the Auditor of the State of Indiana* and the *Letter from the Secretary of the Treasury May 13, 1856* House Ex Doc no.102 34th Congress 1st Session.

[32] This reform reduced the statutory maximum leverage, but, as the market-imposed limits on leverage were much lower, these statutory limits were binding neither before nor after the reform.

[33] Calomiris and Schweikart (1991) review the possible causes and consequences of this panic. Candidate causes include lower crop and land prices following the Crimean War, the sinking of the *S.S. Central America* with a loss of 30,000 pounds of gold bound for the East Coast, and the *Dred Scott* decision in March 1857 which lessened the

holders of banks that closed were uniformly paid off in full, though after several months and presumable uncertainty. If the Kindleberger thesis of first-hand uncertainty decreasing banking demand holds, we would expect to see that markets that suffered closures during the Panic of 1857 should be especially underbanked by 1860.

What were these panics' long term effects on the market structure of banking? Did note holders reward banks in those states where the regulatory regime proved robust to bank runs and failures? Did creditors raise the cost of capital to punish banks in the state of Indiana where systemic risk was revealed and not corrected? Or were noteholders uniformly scarred by bank failures and any regulatory concerns were swamped? To answer these questions, we now take advantage of the (endogenous) entry and exit decisions of banks observed in mid-1854 and late 1860 to estimate a model of bank profits across geographic space.

4. An empirical model of endogenous market structure

We employ techniques similar to those developed by Bresnahan and Reiss (1990, 1991) and Berry (1992) and extended by Abraham, Gaynor, and Vogt (2007, henceforth AGV) for examining the determinants of market structure. In particular, we employ a discrete dependent variable model relating the number of banks in a market to characteristics of that market. Although variables such as profits, prices, and costs are not observed, this approach permits the estimation of the impact of market characteristics, most notably market size, on the number of banks in a market and in turn allows the derivation of threshold conditions on bank entry. In other words, even without data on a number of economically relevant variables, one can still examine the determination of market structure through observation of actual decisions by banks. Thus, actual realizations of market structure reveal features of underlying profitability even without directly observing profits.

A bank's entry decision depends upon the profit it expects to earn following entry given the entry decisions of other potential banks in the market, the nature of post-entry competition, and both demand and cost factors. We assume that the long-run profits of a bank in a market can be expressed as a function of the number of active bank in the market and characteristics of the

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prospect of lucrative westward railroad expansion. They also note and emphasize the disproportionate impact the '57 Panic had on Indiana's banking sector.

market. In other words, the profits of bank *i* in market *k* are given by

$$\Pi_i(N_k, y_k, x_k) \quad (1)$$

in which N_k is the number of banks in the market, y_k is a scalar such as the total population of consumers describing the size of market *k*, and x_k is a vector of variables that can affect both costs and demand. This expression should be interpreted as a reduced form discounted long-run profit function reflecting the outcome of competition between the banks in market *k*. Thus, if $N_k = 1$, (1) describes the equilibrium profits of a monopolist in market k, while, if $N_k = 2$, (1) describes the per-firm equilibrium profit outcome for duopolists.

Following earlier empirical studies of entry, we view banks' equilibrium post-entry profits as unobserved random variables. As our data suggest that allowing for heterogeneous banks is unimportant, we instead impose very strong restrictions on profits for banks in a given market.[34] In particular, we assume that the equilibrium profits for bank *i* in market *k* are given by

$$\Pi_i(N_k, y_k, x_k) = \pi(N_k, y_k, x_k) + \varepsilon_k \quad (2)$$

This formulation says that equilibrium profits are composed of expected profits, $\pi(N_k, y_k, x_k)$, and a random term ε_k, in which both components depend only on the market *k*. That is, there are no observed or unobserved variables unique to bank *i* in market *k*.

These assumptions have several useful implications. Most importantly, if expected profits decline in N_k, the assumption that profits involve only market-specific factors implies that the Nash equilibrium of many standard entry games will involve banks entering a market until entry by additional banks would be unprofitable. Put differently, the equilibrium number of active banks in a market is the maximum number that the market can profitably sustain. Thus, this assumption implies simple threshold conditions on profits that characterize the equilibrium number of firms in a market. In particular, the equilibrium number of banks in market *k*, denoted N_k^*, is characterized by

$$N_k^* = 0 \; if \; \pi_k^1 + \varepsilon_k < 0$$

$$N_k^* = N \; if \; \pi_k^N + \varepsilon_k \geq 0 \; and \; \pi_k^{N+1} + \varepsilon_k < 0$$

in which $\pi_k^N = \pi(N_k = N, y_k, x_k)$. That is, there will be *N* banks in market *k* if it is profitable for each of those banks to enter given conditions in that market but unprofitable for additional banks to enter. These simple conditions contrast with those involving unobserved bank-specific

[34] Unreported regressions indicate that incumbents that were state banks (rather than free banks) or banks with higher-than-typical assets had no significantly different impact on market structure.

heterogeneity, as those conditions would need to account for different combinations of entrants and the differences in their unobserved profitability. [35] With the distributional assumption that the random component is i.i.d. normal across markets, the probabilities observing *N* banks in market k are

$$\begin{aligned} P(N_k^* = 0) &= 1 - \Phi(\pi_k^1) \\ P(N_k^* = 1) &= \Phi(\pi_k^1) - \Phi(\pi_k^2) \\ P(N_k^* = 2) &= \Phi(\pi_k^2) - \Phi(\pi_k^3) \\ P(N_k^* \geq 3) &= \Phi(\pi_k^3) \end{aligned} \tag{3}$$

in which $\Phi(\bullet)$ is the cdf of a standard normal random variable with the variance of the disturbance term normalized to one.[36]

Our restrictions on heterogeneity among banks are certainly not innocuous. They imply that all variation in outcomes across markets is attributable solely to differences in characteristics of those markets. This inference may be erroneous if heterogeneity among firms is in fact the source of variation in market outcomes. Without additional information or assumptions about the number of potential entrants, though, it is difficult to distinguish the effect of unobserved heterogeneity from market characteristics. The lack of such information in the data that we use in this study necessitates the imposition of these assumptions. The widespread ease of entry during the free-banking era, of course, also presumably makes this lack of heterogeneity less onerous.[37]

Turning to functional form assumptions, we assume that expected profits can be decomposed into variable profits and fixed costs.[38] Unlike in Bresnahan and Reiss, market size here does not play a central role in identification. We follow the endogenous market structure literature and assume the slope of profits in market size may vary with market structure. We additionally assume that fixed costs may vary over market structures because of endogenously

[35] Ciliberto and Tamer (2009) provide a solution to the problem of unobserved heterogeneity among firms in their analysis of airlines; however, their method requires knowledge of the characteristics of each potential entrant and is therefore not applicable to banking markets in an era of unit banks.

[36] It is straightforward to extend the analysis to more than three entrants, as $P(N_k^* = N) = \Phi(\pi_k^N) - \Phi(\pi_k^{N+1})$. Our data set, however, includes very few observations of markets containing more than three banks, and we therefore consider all markets with three or more banks as a single outcome. Regardless, the last probability in (3) provides a necessary condition for observing at least three banks.

[37] Manuszak (2002) likewise exploits a truly free-entry situation of minimal regulation in his analysis of late 19th century American brewing.

[38] Because they have quantity data, AGV find value in breaking variable profits into market size, per-capita quantity, and average variable profit. Without such data, we gain little from such a breakdown.

determined barriers to entry (represented as higher costs to all firms). Formally, expected profits for a bank in a market with *N* banks are

$$\pi_k^N = \frac{1}{N} v(N, y_k, x_k) - F(N, x_k) \quad (4)$$

in which $v(\bullet)$ denotes the industry's variable profits (revenues less variable costs) and $F(\bullet)$ denotes fixed costs. We follow AGV and further assume that industry variable profits and fixed costs can be approximated by exponential functions of *N* and variables affecting demand and costs. We specifically assume that

$$v(N, y_k, x_k) = \exp(y_k\lambda + x_k\delta_X + \delta_N + \varepsilon_k^v) \quad (5)$$
$$F(N, x_k) = \exp(x_k\gamma_X + \gamma_N + \varepsilon_k^F)$$

The parameters δ_N and γ_N are coefficients on dummy variables for market structure. They capture differences in industry variable profits and fixed costs between markets with one bank and markets with *N* banks. The idiosyncratic disturbances ε^v and ε^F are assumed to be normally distributed with mean zero and constant variance. As discussed in AGV, this specification makes explicit the identification troubles that arise when one tries to distinguish the impacts of variable profits and fixed costs on market structure without quantity data.[39] Like AGV, we use the log of population, *ln(Pop)*, as our measure of *y*, so our specification for industry variable profits can be rewritten as

$$v(N, y_k, x_k) = Pop_k^{\lambda} \exp(x_k\delta_X + \delta_N + \varepsilon_k^v) \quad (5a)$$

Substituting these specifications into the prior inequalities that determine market structures, we see that the N^{th} bank enters when its share of industry variable profits exceeds its fixed costs. That is,

$$\frac{1}{N}\exp(y_k\lambda + x_k\delta_X + \delta_N + \varepsilon_k^v) - \exp(x_k\gamma_X + \gamma_N + \varepsilon_k^F) > 0$$

Rearranging and taking the log of both sides yields

$$y_k\lambda + x_k\delta_X + \delta_N + \varepsilon_k^v - \ln N > x_k\gamma_X + \gamma_N + \varepsilon_k^F$$

Denote $\mu_X = \delta_X - \gamma_X$ and $\mu_N = \gamma_N - \delta_N$, and further denote $\varepsilon^{\Pi} = \varepsilon^v - \varepsilon^F$, which is distributed

[39] While the signs of our critical parameters are robust to the use of Bresnahan and Reiss's usual model that identifies variable profit margin and fixed costs from the linear functional form, parameters were imprecise unless we considered only one or the other.

$N(0, \sigma^2)$. We then see that

$$N = \begin{cases} 0 & if \quad y_k\lambda + x_k\mu_X + \varepsilon_k^{\Pi} < \mu_1 \\ 1 & if \quad \mu_1 < y_k\lambda + x_k\mu_X + \varepsilon_k^{\Pi} < \mu_2 + \ln 2 \\ 2 & if \quad \mu_2 + \ln 2 < y_k\lambda + x_k\mu_X + \varepsilon_k^{\Pi} < \mu_3 + \ln 3 \\ 3+ & if \quad \mu_3 + \ln 3 < y_k\lambda + x_k\mu_X + \varepsilon_k^{\Pi} \end{cases}$$

The normality assumption on the error term ε^{Π} yields an ordered probit (with threshold values of μ_N) that can be estimated via maximum likelihood techniques in which the dependent variable in the ordered probit is the number of banks in a market. All parameters are rescaled by σ, which we normalize to $\sigma = 1$. Note that, in this specification and unlike many applications of Bresnahan and Reiss, coefficients do not accumulate. For example, the relevant test of whether entry of the third firm affects per-firm profits will be $\mu_2 = \mu_3$ rather than $\mu_3 = 0$.

The above framework applies nicely for our pure cross-sectional analyses, but we are also interested in the change across cross-sections, that is, whether Indiana's banking parameter decreased from 1854 to 1860. To implement this test, we offer a slight extension of AGV in which we pool our two cross-sections, imposing that the primitive parameters are identical for the two years but allowing the scalars representing the distribution's variance (σ) to differ. That is, we will normalize the scalar for 1854 ($\sigma_{54}=1$) but estimate the 1860 scalar σ_{60} as a free parameter. Our explicit control for market population makes the restriction that parameters are fixed across the two cross-sections somewhat plausible; we will let the reader judge how onerous those restrictions are by comparing the estimates of the separate cross-sections to the pooled estimates.

This framework also implicitly assumes that all markets are subject to free entry, an assumption at odds with the presence of several states that required charters from the state legislature. This problem, however, is readily resolved by revising the above entry thresholds so that, for state-charter-only states, they reduce to the probit case in which the market structure possibilities are either zero banks or at least one bank (i.e., $N=0$ or $N \geq 1$). As we observe few markets with more than a single bank in states that require charters, this agglomeration leads to little information being lost.

Our emphasis in this study is to consider the impact of various market characteristics (specifically whether or not a market is in Indiana) on firm profitability, and thus our interest is primarily upon the relevant parameters μ_X. We would be remiss, however, if we did not trace the

(difficult to interpret) estimates back to their real-world implications. Estimation of the profit function provides information about the market sizes required to support entry. Specifically, the market sizes y^M and y^D at which monopoly and duopoly profits are respectively zero can be formed from the estimates of the profit function parameters. For example, the exact expressions for y^M and y^D are given by

$$\pi^M = 0 \leftrightarrow y^M = \exp\left(\frac{\mu_1 - x\mu_X}{\lambda}\right) \tag{7}$$

$$\pi^D = 0 \leftrightarrow y^D = \exp\left(\frac{\mu_1 + \mu_2 - x\mu_X}{\lambda}\right)$$

in which the parameters are replaced by maximum likelihood estimates in practice. The thresholds y^M and y^D therefore provide estimates of the sizes of markets required to support the long-run equilibrium of one and two firms.[40] How these entry thresholds differ over time and between Indiana and other free-banking states thus offers an extra check of the estimates' plausibility.

5. Data review and analysis

We begin by compiling cross-sections of markets from 1854 and 1860 located in (largely) Midwestern states. Potential markets consist of every enumerated place in the Inter-University Consortium for Political and Social Research (ICPSR) machine-readable 1850 and 1860 Censuses of the United States. A Census enumerated place consists of a city, town or village, so observations at the township level were excluded. These ICPSR data are not complete. The aggregate population of ICPSR places does not approach the aggregate population of many states (e.g., Tennessee, Arkansas, Georgia), and we consequently focus on states for which coverage appeared complete. As our eventual goal is to construct a sample of geographically isolated markets, we exclude most of the densely populated Eastern Seaboard. We also exclude Michigan because of its highly erratic banking history and long-standing reputation for wildcat banking. These restrictions leave us to consider seven states: Missouri, Iowa, Illinois, Wisconsin, Indiana, Ohio, and western Pennsylvania. In preliminary work, we allowed observations from western New York, but results indicated that idiosyncratic features of

[40] To facilitate estimation and interpretation, we demean most of our variables x. The thresholds in this case reduce to $M = \exp\left(\mu_1/\lambda\right)$, $D = \exp\left(\mu_1 + \mu_2/\lambda\right)$, and $T = \exp\left(\mu_1 + \mu_3/\lambda\right)$

New York made it too dissimilar to include.[41] We gather latitude and longitude coordinate data for the center of each of these Census observations, and we use these coordinate data to construct distances between observations' center-points. Given these restrictions, we begin with a sample of 1352 not necessarily isolated observations.

We consider Census enumerated observations in these states to be geographically isolated (and thus included in our 1860 sample) if they satisfy either of two criteria in 1860. First, we include any observation that is at least ten miles from its nearest neighboring observation. Given the speed of transportation at the time and an absence of communication options[42], ten miles seems a reasonable distance beyond which there would be substantial pressure to create a more local bank. Second, we consolidate observation-pairs that are near one another but far from any other markets. To satisfy this criterion, two observations must be within five miles of each other and at least ten miles away from the next closest observation. In these latter cases, we create a new observation that aggregates all relevant features of the two observations. We use similar conditions in constructing the 1854 sample, with the additional requirement that we see the 1850 population for that observation. Because of their relative size and easy transportation access, we also exclude St. Louis and Cincinnati even though they otherwise survive our isolation criteria.

Applying these criteria reduces our original sample of Census observations to 254 and 362 isolated observations in 1854 and 1860 respectively.[43] Maps of our 1854 and 1860 markets can be found in Figures 2 and 3. We will henceforth refer to these observations as markets. A reasonable robustness check would be to consider even more stringent requirements for isolation. Unfortunately, about half of the markets of these 362 markets from the 1860 cross-section that survive our initial ten-mile-minimum criterion have a neighboring observation within 12.5 miles. Fewer than 100 observations are at least 15 miles from the nearest observation. We therefore trade off more compelling degrees of isolation in exchange for a substantially larger sample size.

Market definition is of course only the first step in the analysis. We next determine how many banks existed in each market and link each market with population, weather history and access to railroads. Populations and demographic characteristics are taken from the 1850, 1860,

[41] We define western Pennsylvania and New York by constructing a line that connects Albany, NY, and Allentown, PA. Pennsylvania and New York Census enumerated places to the west of this line are eligible for inclusion in the sample.
[42] While Western Union would offer transcontinental telegraph service in 1861, our isolated small markets generally lacked telegraph access in 1860.
[43] Iowa had banned banks prior to its free-banking act of 1858, so we exclude it from our 1854 sample.

and 1870 Censuses[44] and include all persons.[45] Bank number and closure information come from Warren Weber's (2006) impressive census of antebellum banking available at the Federal Reserve Bank of Minneapolis.[46] We deviate from Weber only when state auditor reports indicate a bank was circulating notes before Weber's entry date or newspaper articles indicate the bank was suspended never to reopen before Weber's exit date.

Economists have long been interested in the link between weather, agricultural output and financial distress.[47] Many of our sample markets suffered drought conditions between 1854 and 1860. We control for these weather shocks with an annual rainfall index derived from tree-ring records. This weather information consists of the annual time series of the Palmer Drought Severity Index (PDSI) inferred by taking a weighted average of the nearest grid points' values from Zhang et al. (2004). After experimentation, we combine this drought information into a single variable as shown in the appendix. This measure looks back five years, ignores wetter-than-average years, places more weight on more recent events, and exhibits a convex relation with PDSI.

We include controls for access to railroads. Contemporaries complained that banks located in hard to reach locales to raise the cost of returning their note issues, and Gorton (1990) documents a link between transportation costs and banknote discounts in Philadelphia. We therefore construct a railroad dummy equal to 1 if a railroad was operating in the bank's county in the year in question.

Table 3 provides variable definitions, and Table 4 summarizes population, demographic features, bank presence, and other variables for these markets. Most notable is the number of markets that have no reported banks. In the 1854 cross-section, about 80% of markets in free-banking states (including Indiana) lack banks, while close to 95% of markets in state-charter-only states have no bank. These percentages are lower in the 1860 cross-section for all states. The number of markets with more than one bank is not large in either cross-section, and that with more than two banks is quite small. This limitation of the data guides our later caution when we estimate explicit triopoly-plus specifications in addition to the more easily justifiable duopoly-plus specifications. Populations of markets with different numbers of banks are generally

[44] The 1870 Census included population totals for the 1850, 1860, and 1870 Censuses, and we use those figures for those years.
[45] Missouri, the only slave state in our sample, thus includes both freemen and slaves in its population count.
[46] Weber's bank census is available http://www.minneapolisfed.org/research/economists/wewproj.cfm#censusstate
[47] See for instance Landon-Lane, Rockoff, and Steckel (2011) and cites therein.

intuitive. Markets with one bank have higher populations than markets with no banks, and markets with two banks have higher population than markets with one bank. The fact that average population for markets with more than two banks is less than that for markets with two banks for free-banking states in 1860 is somewhat troubling and highlights the need for caution when interpreting the estimates from the triopoly-plus specification.

Drought data indicate that the primary meteorological event of the 1850s was a western drought in 1856 that lingered into 1857 in Illinois and Missouri. About 44% of our markets qualified as being hit by drought (PDSI < -2) in 1856. As would be expected, there was a great deal of regional variation in these figures. In 1856, 70% of our Indiana markets had drought conditions, as did over 80% of our Illinois markets, 30% of our Iowa markets, and all of our Missouri markets. As only 5% of our Ohio markets and no Wisconsin or Pennsylvania markets suffered drought conditions in 1856, we expect that we have sufficient variation in the data to separate out impacts of banking regulation from the primary competing shock of drought. Because we expect drought to affect rural agriculture-centered markets most directly, we include an interaction of our drought measure and market population in the summary statistics and later empirics.

The last variables of Table 4 highlight how we will handle the Panics of 1854 and 1857. For a market to suffer a panic-closure, it must have first had at least one bank and therefore probably had exceptional banking demand. Examining panic-closures without controlling for the original level of banking will likely lead to results erroneously indicating that panic-closures increase the steady-state level of banking. We see that the Panic of 1854 caused the closure of almost half the banks that were in operation in August immediately prior to the panic. Observing the September 1857 level of banking, we can see that banking in Indiana had recovered somewhat from the 1854 panic (though far from its previous peak), but the robustness of those new banks is uncertain. Within our isolated-market sample, the closures in the Panic of 1857 disproportionately struck Indiana, as noted in Calomiris and Schweikart (1991). These closures moved the Indiana average number of banks closer to the free-banking state average. Our analysis now illuminates the extent of additional decline between that panic and the 1860 observations.

6. Estimation results

Table 5 presents the maximum likelihood estimates of the expected profit functions for the separately estimated cross-sections. To reiterate, the estimation involves a discrete dependent variable model in which the dependent variable is the number of banks in a market, and the econometric goal is to uncover features of underlying profitability. Specifically, the estimated equations related to the latent profit functions are

$$v(N, y_k, x_k) = Pop_k^{\lambda} \exp(x_k \delta_X + \delta_N + \varepsilon_k^v) \quad (6)$$
$$F(N, x_k) = \exp(x_k \gamma_X + \gamma_N + \varepsilon_k^F)$$

in which the estimated parameters are $\mu_X = \delta_X - \gamma_X$ and $\mu_N = \gamma_N - \delta_N$. We represent the cross-section-specific standard deviations of the normally distributed $\varepsilon^{\Pi} = \varepsilon^v - \varepsilon^F$ as σ_t for year t. In addition to separate estimates by cross-section, we also display estimates using the duopoly-plus and triopoly-plus specifications. Entry thresholds beneath the estimates themselves indicate the estimated number of persons required to support a market structure in a given regime.

The estimates from the 1854 cross-section are all of the expected sign, and many coefficient estimates are significant at conventional levels. Banking is clearly increasing with population, and markets in charter-only states are at a sizable disadvantage. To support at least three banks, markets must be significantly larger than triple the size needed to support a monopoly bank, but no similar conclusions can be drawn with respect to duopoly and monopoly or triopoly and duopoly. Our drought measure is negatively related to profits and its impact is decreasing with market population, consistent with expectations. Of most importance, Indiana significantly outperforms its free-banking peers in both the duopoly-plus and triopoly-plus specifications.

The implied entry thresholds are plausible, if not especially precise, and consistent with our story of Indiana being a bank-friendly state in 1854. Depending on specification, at least 4305 persons were needed to support a monopoly bank in non-Indiana free-banking states, while only 1729 were required in Indiana. Both contrast favorably to the monopoly entry threshold in charter-only states (at least 9,518 persons needed). The exponential specification of AGV ensures that other entry thresholds are proportional (e.g., Indiana's monopoly and duopoly thresholds are both 40% of those for non-Indiana free banking states).

Indiana's position reverses when we consider the estimates from the 1860 cross section. The Indiana indicator's estimated coefficient is now significantly negative in both the duopoly-

plus and triopoly-plus specifications (respective p-values of 0.015 and 0.018). Signs of other estimated coefficients are the same as from the 1854 estimation, though the impact of additional entrants on profits is now statistically significant[48] and the impacts of drought and being in a charter-only state are now insignificant. The implied entry thresholds obviously reflect these estimates. While approximately 1729 persons were needed to support a monopoly bank in Indiana in 1854, close to 6,831 are required by 1860. This implication contrasts with the non-Indiana free-banking states in which the threshold declined by at least 20% across specifications and the charter-only states in which the threshold fell dramatically (50-75% depending on specification). It seems reasonable to conclude that whatever happened to Indiana between 1854 and 1860 was not a shock with uniform impact across our sample. Furthermore, the loss of Indiana's paramount position in the regulatory arbitrage network coincided not only with a diminution of its banking sector but a reduction to a level below that of its peers that had never experienced such financial success.

Table 6 displays the results when we pool our cross-sections, restricting the parameters to be identical across years but allowing the standard deviation of the normal distribution to vary. These are strong assumptions that may generate a great deal of insight and additional precision if they are not especially onerous. While certain restrictions (e.g., the impact of state-charter-only banking being the same in 1854 and 1860) show strain, the general implications that are relevant to our paper are robust between the cross-sections and pooled regressions. We will therefore take the pooled estimates at face value.

Aside from the coefficients of the drought variables (which are still the expected sign for duopoly-plus), the key parameters are estimated precisely. Markets with greater population have more banks, charter-only states are under-banked relative to their free-banking peers, and the entry of additional banks lowers profits, both when moving from monopoly to duopoly and from duopoly to triopoly. Most importantly for our purposes, we can now explicitly reject the hypothesis that Indiana did not undergo a change between 1854 and 1860. Entry thresholds are quite similar to those implied by the separate cross-sectional estimates and confirm the magnitude of the change that Indiana banking underwent.

[48] Using the test statistics that are standard in the IO literature, we can reject with high confidence ($p=0.028$ in the duopoly-plus case and $p=0.026$ in the triopoly-plus case) that a doubling of the monopoly threshold will support a second entrant. Given the institutional details of the era's banking sector, this is presumably because of the increased competition limiting leverage and reducing interest rates on loans rather than higher fixed costs, though our estimates give us no way to test this story.

These results strongly indicate something happened to Indiana banking between mid-1854 and 1860, and Indiana's panic of 1854 is the likeliest candidate. From a policy perspective, however, the mechanism through which the panic had its impact is the critical issue. Did Indiana become a less profitable location to locate a bank because of the loss of faith in its regulatory guarantees, or did so many Indianans personally suffer loses and shun future banks that much of Indiana was unprofitable for future banking? If panics reveal no regulatory shortcomings but negatively affect long-run banking demand (*à la* Kindleberger), then there may be sizable gains to early intervention. If, however, panics make their impact by revealing regulatory flaws and not by affecting consumer demand, then early intervention without remedies for the underlying flaw are likely to fail. We now turn to an extended examination of our 1860 cross-section in which we consider the impacts of closures during the two panics.

We use the panic of 1857 to investigate the cause of Indiana's banking decline. The panic of 1857 resulted in a number of bank failures across our sample states. Unlike the panic of 1854, banknote guarantees were honored. The panic of 1857 therefore provides us with an opportunity to examine the effect of bank panics on individual markets without the confounding revelation that a state guarantee will not be honored. If the Kindleberger hypothesis is true, we should observe a decrease in implied banking profits across all markets that suffered bank failures in 1857. Furthermore, if this hypothesis is the entire story, the impact of such closures should draw away the explanatory power of the Indiana indicator. If loss of faith in government guarantees is also a culprit, though, we should still witness a decline in bank profits in Indiana markets even controlling for closures.

Table 7 displays the results of maximum likelihood estimation when we extend our model to include a market's number of prior closures.[49] As column (2) indicates that the triopoly-plus threshold is significantly greater (p=0.055) than the duopoly threshold, we employ the triopoly-plus specification going forward; results (not shown) are similar under the duopoly-plus specification. We begin our extensions by incorporating the number of banks present in a market in September 1857 (immediately prior to the October panic) and then add variables capturing bank closures from the Panic of 1857. Given the endogeneity of a market's banking level, the coefficient on the pre-panic number of banks can be most usefully interpreted as absorbing market-specific characteristics that are constant over time. We stress that, unlike our

[49] Because Iowa had no banks during the Panic of 1857, we omit its markets from this sample.

other variables and their coefficients, we make no attempt to build on this estimate; its inclusion is necessary so that the closure variables do not inadvertently capture those same market-specific and time-invariant characteristics.

Our first closure variable is the number of banks that closed in a market during the 1857 panic, and we also include an interaction of that variable with the Indiana indicator (columns (4) and (5)). The first of these specifications offers some support for the Kindleberger hypothesis, in that inferred profits are significantly decreasing in the number of closures that a market experienced in the '57 panic. While the interaction of (5) is not estimated precisely, there is little evidence that closures in Indiana had greater negative impact than closures in other states. Despite the inclusion of market-specific closure variables, the Indiana indicator is always significantly negative, as one would expect if the impact of Indiana's Panic of 1854 was a loss of confidence in the regulatory structure. We tentatively conclude that this loss of confidence in the regulatory regime is a primary reason for Indiana's lessened banking activity and that diminished demand arising from direct experience with bank closures does not fully explain the data.

We further explore the Kindleberger hypothesis in Table 8, in which we consider statewide rather than market-specific bank closures. Dropping Iowa because of its banking-ban prior to 1858, we construct cumulative statewide failure rates as the ratio of bank failures in the state in the '54 and '57 panics to the cumulative number of pre-panic banks. These failures and bank-counts are thus not limited to our sample of isolated markets. These failure rates are PA, 0.96%; OH, 5.51%; IN, 40.15%; IL, 19.75%; WI, 8.43%; and MO, 0%. If banking demand falls because potential noteholders fear losses on account of bank failures anywhere in their state, these failure rates should be negatively correlated with levels of banking.

Column (1) of Table 8 confirms that Indiana is still significantly under-banked for this smaller sample. After dropping the Indiana indicator (column (2)), we see that there is a negative but insignificant relation between failure rates and bank profits in column (3). This result, however, disappears when we introduce an interaction of the Indiana indicator and the failure rate. These estimates indicate that outside of Indiana the states with higher historical panic failure rates (e.g., Illinois and Wisconsin) are associated with higher demand for banking in 1860. Indiana, however, shows the opposite relationship. The estimates are consistent with a story in which potential banknote holders contrast the resiliency of the Illinois and Wisconsin regulatory regimes with that of Indiana and choose to allocate their money accordingly.

7. Conclusion

The panics of 1854 and 1857 present us with a near ideal setting to examine the consequences of financial and regulatory fragility. The many isolated markets and state-level regulation of the antebellum era provide cross-sectional variation in both bank failures and regulatory regime, variation that is unmatched in modern times. We apply a model of endogenous market structure in order to examine the impact of panics on the steady state level of banking.

Prior to the panic of 1854, Indiana enjoyed a reputation for sound regulation that elevated Indiana banks to a status of preferred counterparties to other banks throughout the Midwest. Indiana's banks were able to translate this trust advantage into profits by holding lower reserves and to access cheap funding by circulating more banknotes than their out-of-state competitors. New entrants flocked to Indiana. Indeed, our model of endogenous market structure implies that Indiana towns in mid-1854 could support an initial bank with less than half the population necessary in other free-banking states.

The panic of 1854, though, exposed a critical flaw in the Indiana regulatory regime. Indiana's collateral requirements encouraged the holding of domestic state debt to an extent unmatched in other states. As a result, Indiana's noteholders were exposed to wrong-way risk as the majority of collateral backing their notes declined in value at exactly the time it was most needed. The panic of 1854 resulted in suspensions and failures throughout the Midwest, but regulators in states with more diversified portfolios were able to make good on their implicit promise to convert collateral backing notes of failed banks into sufficient gold to redeem all notes at par. Indiana's regulation resulted in a collateral portfolio disproportionately backed by Indiana state bonds that could not be liquidated at a price sufficient to make noteholders whole.

There is good reason to believe that the loss of trust in Indiana's regulatory regime after the panic of 1854 was the primary cause of the decrease in its steady state level of banking. While markets outside of Indiana saw insignificantly reduced levels of banking after experiencing closures in the Panic of '57, Indiana's markets with no direct experience in panicked closures also saw reduced banking activity. This statewide effect is not explained by Indiana's high level of closures in the '54 and '57 panics. Other states with high numbers of closures but with more robust regulatory regimes saw banking activity increase appreciably after

the Panic of ’57. These results are consistent with a statewide decline in profitability rather than a decline in only markets where citizens had firsthand experience of bank failures.

Our results confirm that trust is an important trait in a well-functioning financial system. Unaddressed regulatory failure can leave long-lasting impacts on the expectations of consumers and counterparties and result in a long-lasting decline in the level of financial intermediation.

Appendix: Construction of Drought Variable

The Palmer Drought Severity Index (PDSI) "uses temperature and rainfall information to determine dryness". (NOAA website, http://www.drought.noaa.gov/palmer.html, accessed 7/5/2012). The measure is standardized to local climate and normalized to 0. Negative numbers indicate drought, with -2/-3/-4 denoting moderate/severe/extreme drought. We use the reconstructed measures of the Palmer Drought Severity Index provided by Zhang, Mann, and Cook (2004). This study employs tree-ring data over the coterminous United States to estimate PDSI measures for a system of latitude-longitude grid points back to the year 1700. Our market-appropriate PDSI measures then use market latitude-longitude coordinates to construct a weighted average of the provided gridpoints.

The above measure indicates a severe and widespread drought in 1856. The average PDSI in 1856 for our 362 markets observed in 1860 was -1.8689 (i.e., almost the moderate drought threshold of -2). The drought continued in many but not all places in 1857 (average PDSI in 1857 was -1.4291). Furthermore, roughly 44% of our 362 markets from 1860 experienced at least one drought-year of at least moderate severity between 1850 and 1859. The most recent drought year (compared to 1860) was 1857 for 11% of the markets and 1856 for 33% of the markets. All other markets experienced no drought for the time period.

Our market-level measure is constructed for 1854 and 1860. Given the cumulative effects of yearly precipitation, it looks back five years with recent years more heavily weighted than distant years. The measure also builds on the intuition that droughts are worse for agriculture than overly wet seasons (so asymmetric) and that the agricultural costs of drought are non-linear (so convex). Each market-year's drought measure is

$$\left(PDSI_{j,t-k} | PDSI_{j,t-k} < 0\right)^2$$

so that a market-year's drought measure is positive if there was any degree of drought and zero otherwise. Given a look-back of *LB* years, the weight applied to *k* years ago follows the formula

$$\omega_k = 1 - \frac{k-1}{LB}$$

So for our proposed look-back of *LB=5*, the immediately prior year is given full weight (*ω=1*) and preceding years are given weights 0.8, 0.6, 0.4, and 0.2. Our full drought measure is then

$$Dro_{jt} = \sum_{k=1}^{LB} \omega_k \left(\left(PDSI_{j,t-k} | PDSI_{j,t-k} < 0\right)^2\right)$$

While different specifications yielded much different estimates of the impact of drought on equilibrium levels of banking, our paper's core results are robust to the use of many drought measure (e.g., varying number of years looked back, linear rather than convex, symmetric rather than asymmetric, etc.).

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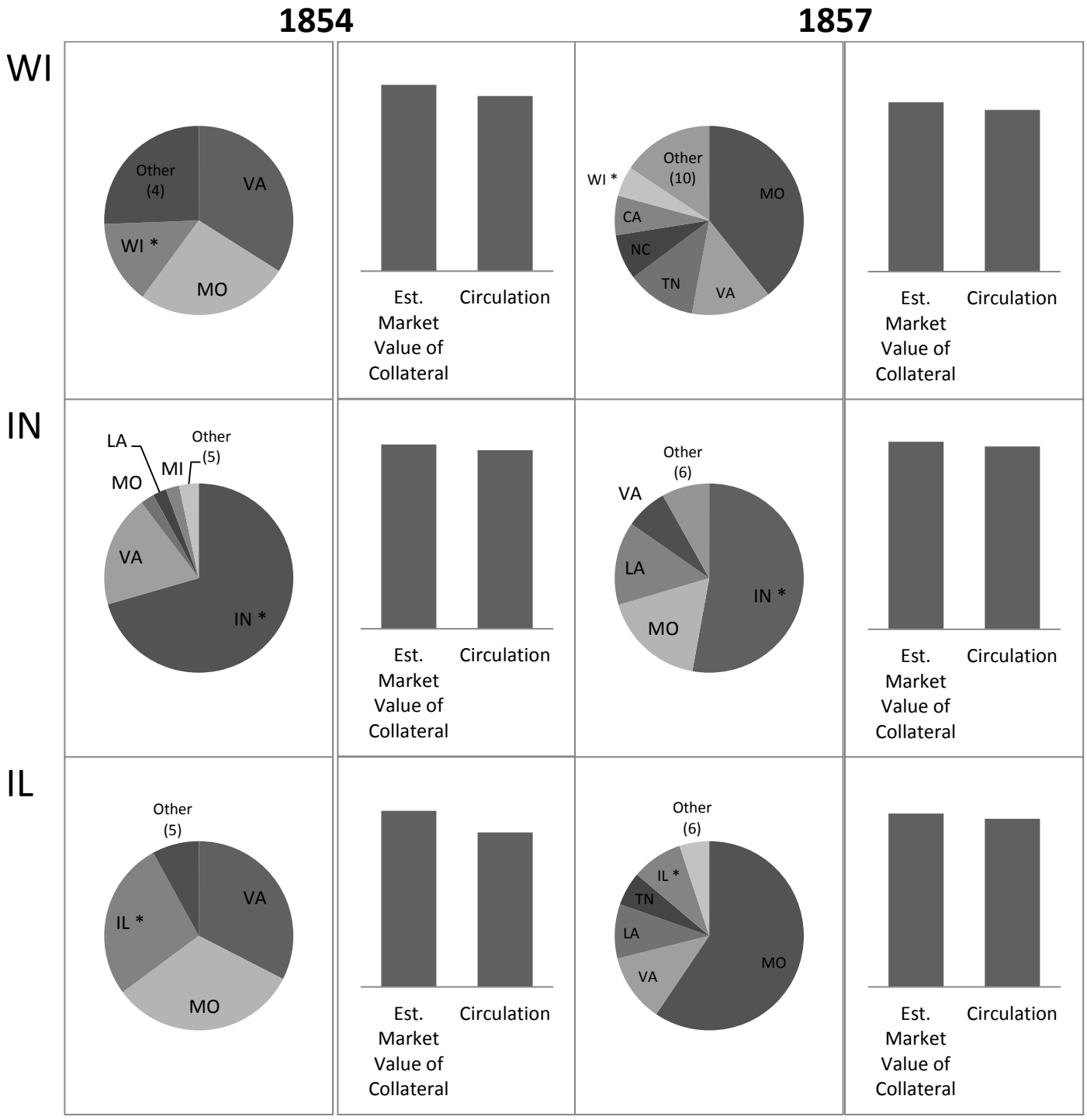
Figure 1: Collateral Portfolios Held by State Regulators



* Indicates home state bonds. Source: Author's calculations from relevant state auditor reports and New York and Boston stock market quotations.

Figure 2: 1854 Markets

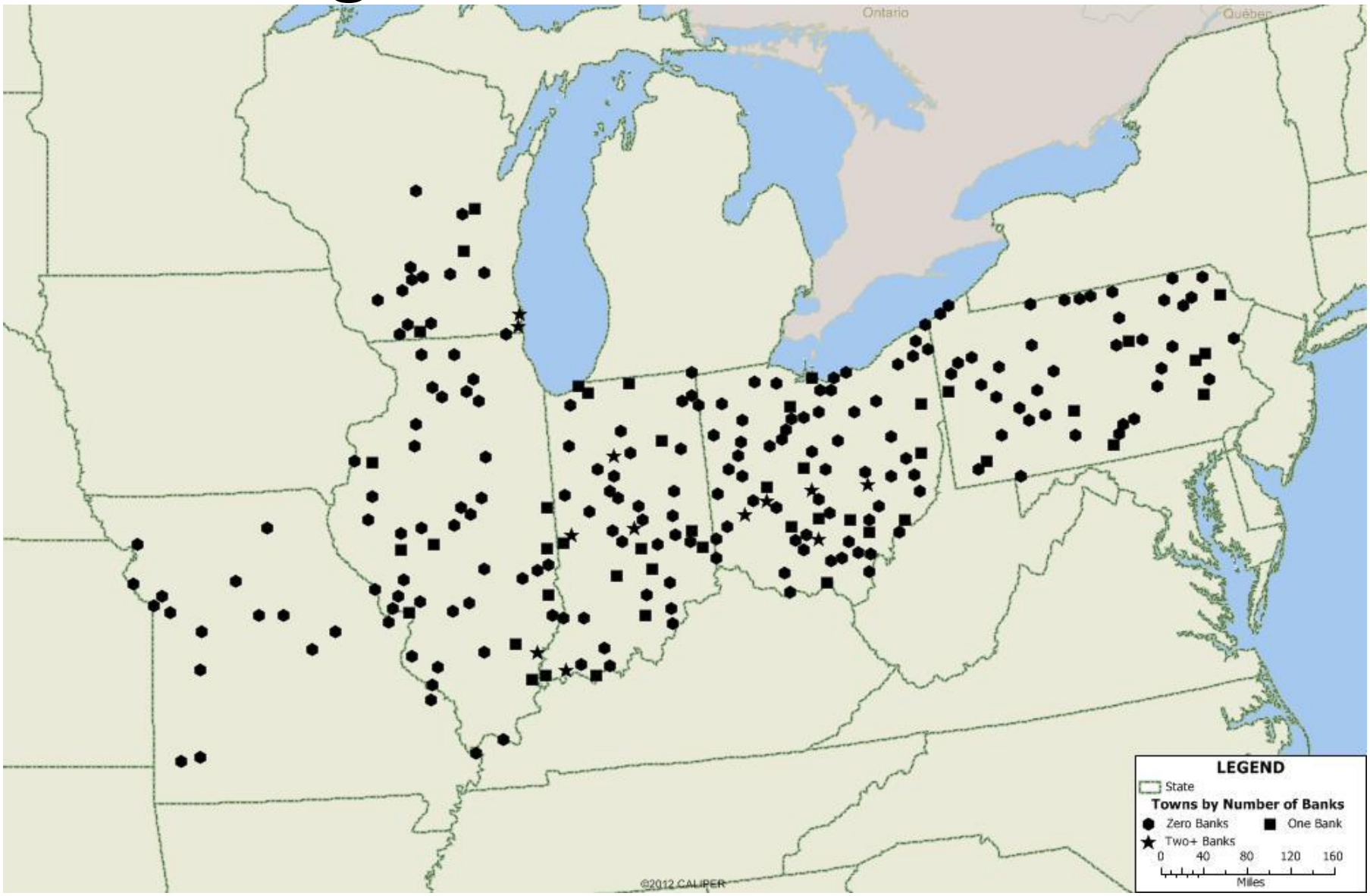


Figure 3: 1860 Markets

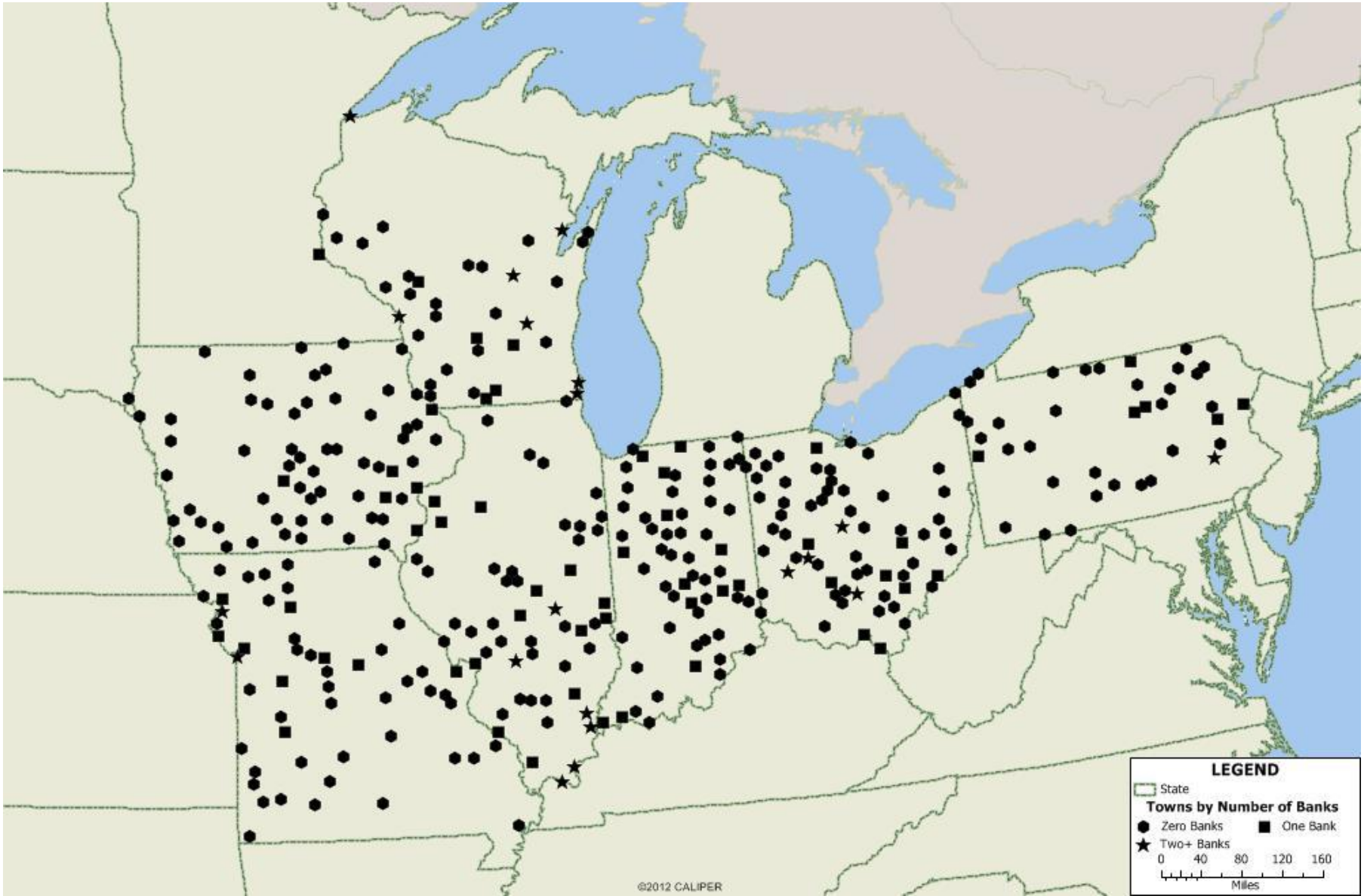


Table 1: Free Bank Regulations

	Ohio	Indiana	Illinois	Wisconsin
Capital	Min: $25,000 Max: $500,000	Min: $50,000	Min: $50,000	Min: $25,000 Max: $500,000
Required Reserves	30% (in specie + current notes)	12.5%	None	None
Note Collateral Rules	US or Ohio State Bonds marked at min of market or par value	Any current state bond marked at min of market or par. After 1855: marked at 91% of min of market or par value	US or State Bonds paying 6% marked at min of Par or Market Value. Illinois state securities marked at 80% of market value. Bonds paying less than 6% coupon marked at 50% of market value.	US or State Bonds paying 6% marked at min of market or par. Instate RR 7% bonds marked at 80% of NYSE market value

Table 2: Bank balance sheet info, by state

	Circulation	Deposits	Population	Circ per cap	Circ/Capital	Spec/Notes
Ohio						
1854	8,074,132	5,450,556	2,116,862	3.81	0.87	0.22
1856	9,153,629	6,543,420	2,188,618	4.18	0.90	0.18
1858	8,040,304	4,389,831	2,262,807	3.55	0.75	0.30
1860	8,143,611	4,046,811	2,339,511	3.48	1.11	0.21
Indiana						
1854	8,165,856	2,289,605	1,119,831	7.29	1.02	0.15
1856	4,731,705	1,852,742	1,191,952	3.97	0.70	0.22
1858	5,379,936	1,723,840	1,268,718	4.24	0.75	0.19
1860	5,755,201	1,841,051	1,350,428	4.26	0.82	0.15
Illinois						
1854	2,283,526	1,286,102	1,125,896	2.03	0.96	0.23
1856	5,534,945	1,002,399	1,294,680	4.28	0.94	0.11
1858	5,707,045	640,058	1,488,768	3.83	1.43	0.05
1860	11,010,837	807,763	1,711,951	6.43	1.71	0.02
Wisconsin						
1854	740,764	1,482,053	443,437	1.67	0.63	0.31
1856	1,702,570	3,365,562	534,342	3.19	0.58	0.32
1858	4,695,170	3,022,384	643,884	7.29	0.59	0.15
1860	4,310,175	4,083,131	775,881	5.56	0.58	0.09

Source: Statement Exhibiting the Number of Banks, with Circulation, Deposits, and Amount Due to Other Banks, By States, for the Nine Years Prior to January 1863. P.49-51 in "Report of the Comptroller of the Currency Dec 7, 1896" 54th Congress 2d Session, House Doc. No.10 Part1.

Table 3: Definition of Variables

Variable name	Definition
N	Number of state registered banks in market
IN	Binary variable indicating that market in state of Indiana
POP	Total (free and slave) population from US Census: linear interpolation for 1854, as observed for 1860
DROUGHT	Measure of cumulative drought severity, constucted from Palmer Drought Severity Index (see Appendix)
RR	Binary variable indicating that market in county with railroad line
SCO	Binary variable indicating that market in state that requires banks to have charter from state legislature
54BANKS	Number of banks in market on August 1, 1854
CLOS54	Number of market's bank closures from Panic of 1854
57BANKS	Number of banks in market on September 1, 1857
CLOS57	Number of market's bank closures from Panic of 1857
SB	Binary variable indicating that county had state bank branch (OH & IN only)

Table 4: Summary statistics

	8/1854 (254 mkts)			12/1860 (362 markets)		
	IN = 1	IN = 0		IN = 1	IN = 0	
	SCO = 0	SCO = 0	SCO = 1	SCO = 0	SCO = 0	SCO = 1
#Mkts	49	140	65	59	214	89
#Mkts|N=0	31	119	60	46	158	71
#Mkts|N=1	12	12	5	13	38	15
#Mkts|N=2	3	6	0	0	13	3
#Mkts|N>2	3	3	0	0	5	0
AvgPop	1876	1702	2072	2083	1634	1806
AvgPop|N=0	1427	1108	1650	1489	1113	1249
AvgPop|N=1	1658	2656	7141	4188	2903	2291
AvgPop|N=2	2146	7718	---	---	4075	12569
AvgPop|N>2	7125	9340	---	---	2110	---
Drought	0.56	0.39	0.49	1.78	2.53	2.78
Dro*Pop	1.13	0.65	0.90	3.83	3.51	4.18
Railroad	0.71	0.58	0.48	0.81	0.57	0.54
8/54 Banks	---	---	---	0.559	0.122	0.034
Clos54	---	---	---	0.288	0.005	0.000
9/57 Banks	---	---	---	0.373	0.196	0.034
Clos57	---	---	---	0.119	0.014	0.000

Notes: Counts MO & PA as SCO60=1, omits IA in 1854

Table 5: Separate cross sections (all states)

*Maximum likelihood estimates of ordered probit

Date	8/1854		8/1854		12/1860		12/1860	
n	254		254		362		362	
	1		2		3		4	
	b	s.e.	b	s.e.	b	s.e.	b	s.e.
μ_1/σ_t	**7.31**	2.49	**9.77**	2.09	**5.19**	1.06	**5.18**	1.04
μ_2/σ_t	0.41	0.21	0.38	0.20	**0.31**	0.13	**0.32**	0.13
μ_3/σ_t	---		**0.93**	0.33	---		**0.54**	0.20
λ^{Pop}/σ_t	**0.83**	0.34	**1.17**	0.28	**0.64**	0.15	**0.64**	0.15
$\mu^{Drought}/\sigma_t$	**-2.45**	0.94	**-1.63**	0.72	**-0.15**	0.07	**-0.14**	0.07
$\mu^{Dro*Pop}/\sigma_t$	**0.73**	0.36	0.26	0.18	0.02	0.02	0.01	0.02
μ^{IN}/σ_t	**1.01**	0.29	**1.07**	0.28	**-0.49**	0.22	**-0.47**	0.22
μ^{SCO}/σ_t	**-0.98**	0.38	**-0.93**	0.37	-0.29	0.20	-0.29	0.20
$\mu^{RR?}/\sigma_t$	-0.18	0.26	-0.17	0.26	**-0.50**	0.18	**-0.53**	0.18
/log-lik/	87.06		97.24		201.57		213.70	
p: $\mu_2=\mu_3$	---		0.06		---		0.18	
Implied entry thresholds								
y^M|IN=0, SCO=0	6555	4204	4305	1205	3267	898	3276	892
y^M|IN=0, SCO=1	21334	23160	9518	4157	5143	2085	5120	2047
y^M|IN=1	1936	536	1729	314	6991	3390	6831	3244
y^D|IN=0, SCO=0	24631	28555	10802	5132	15736	9717	15872	9655
y^D|IN=1	7274	5144	4337	1405	33669	27268	33095	26243
y^T|IN=0, SCO=0	---		24399	16591	---		42667	36340
y^T|IN=1	---		9797	5096	---		88966	91413

Notes: Only MO and PA treated as SCO=1 states in 1860; IA included only in 1860 sample

Table 6: Pooled cross sections (all states)

*Maximum likelihood estimates of ordered probit on pooled cross-sections

* 616 markets (254 in August 1854, 362 in December 1860)

	1		2	
	b	s.e.	b	s.e.
μ^M	**10.91**	1.43	**10.88**	1.40
μ^D	**0.72**	0.18	**0.68**	0.17
μ^T	---		**1.17**	0.26
λ^{Pop}	**1.36**	0.19	**1.35**	0.19
σ_{60}	**1.84**	0.22	**1.76**	0.20
μ^{Dro}	-0.19	0.12	-0.15	0.12
$\mu^{Dro*Pop}$	0.01	0.03	-0.01	0.03
μ^{IN}	**0.85**	0.24	**0.88**	0.23
μ^{IN*60}	**-1.80**	0.49	**-1.72**	0.46
μ^{SCO}	**-0.80**	0.26	**-0.77**	0.25
μ^{RR}	**-0.39**	0.20	**-0.42**	0.19
loglik	300.32		322.69	
p: $\mu^D=\mu^T$	---		0.0082	
Implied Entry Thresholds				
y^M|IN=0, SCO=0	3137	386	3106	367
y^M|IN=0, SCO=1	5674	1093	5479	1010
y^M|IN54=1	1673	240	1625	229
y^M|IN60=1	6324	2086	5800	1780
y^D|IN=0, SCO=0	8915	1986	8553	1776
y^D|IN54=1	4753	954	4476	865
y^D|IN60=1	17971	7239	15974	5956
y^T|IN=0, SCO=0	---		16656	4631
y^T|IN54=1	---		8716	2209
y^T|IN60=1	---		31108	13346

Notes: σ_{54} normalized to 1; {MO PA} as SCO60=1; IA dropped from 1854 sample

Table 7: 1860 Cross-section with '57 panic closures (n = 301) … all states (except IA)

*Maximum likelihood estimates from ordered probit, scaled by σ_{60}

	1		2		3		4		5	
	b	s.e.	b	s.e.	b	s.e.	b	s.e.	b	s.e.
μ^{M}	**5.21**	1.12	**5.20**	1.10	**3.20**	1.09	**2.69**	1.10	**2.72**	1.11
μ^{D}	**0.30**	0.13	**0.30**	0.13	**0.56**	0.17	**0.58**	0.17	**0.58**	0.17
μ^{T}	**---**		**0.57**	0.21	**0.96**	0.25	**1.00**	0.26	**1.01**	0.26
λ^{Pop}	**0.67**	0.16	**0.67**	0.15	**0.38**	0.15	**0.31**	0.15	**0.31**	0.15
μ^{Dro}	0.01	0.09	0.02	0.08	0.09	0.08	0.07	0.08	0.08	0.08
$\mu^{Dro*Pop}$	0.01	0.02	0.00	0.02	-0.02	0.02	-0.01	0.02	-0.01	0.02
$\mu^{RR?}$	**-0.63**	0.19	**-0.66**	0.19	**-0.73**	0.19	**-0.74**	0.19	**-0.74**	0.19
μ^{IN}	**-0.61**	0.22	**-0.59**	0.22	**-0.80**	0.24	**-0.69**	0.25	**-0.67**	0.25
μ^{SCO}	**-0.59**	0.22	**-0.58**	0.22	-0.36	0.22	-0.34	0.22	-0.34	0.22
$\mu^{PrePanicBanks}$	**---**		**---**		**1.02**	0.17	**1.21**	0.19	**1.21**	0.19
$\mu^{\#57Clos}$	**---**		**---**		**---**		**-0.88**	0.40	-0.71	0.71
$\mu^{\#57Clos*IN}$	**---**		**---**		**---**		**---**		-0.22	0.75
loglik	182.27		194.04		172.96		170.40		170.36	

Notes: Treats {MO, PA} as SCO=1 states, Iowa excluded (no banks in 1854 or 1857)

Table 8: 1860 Cross-section with statewide panic failure rates (n = 301)

*Maximum likelihood estimates of ordered probit by individual cross-sections

	1		2		3		4	
	b	s.e.	b	s.e.	b	s.e.	b	s.e.
μ^{M}/σ_{60}	**5.2020**	1.0958	**5.1268**	1.0884	**5.1441**	1.0927	**5.7267**	1.1299
μ^{D}/σ_{60}	**0.2996**	0.1327	**0.2642**	0.1278	**0.2768**	0.1296	**0.3247**	0.1359
μ^{T}/σ_{60}	**0.5724**	0.2083	**0.5066**	0.2005	**0.5310**	0.2035	**0.6137**	0.2128
$\lambda^{Pop}/\sigma_{60}$	**0.6709**	0.1518	**0.6390**	0.1503	**0.6499**	0.1511	**0.6995**	0.1546
μ^{Dro}/σ_{60}	0.0195	0.0842	0.0162	0.0842	0.0343	0.0851	-0.0629	0.0896
$\mu^{Dro*Pop}/\sigma_{60}$	0.0016	0.0220	0.0016	0.0219	0.0010	0.0219	0.0040	0.0222
μ^{IN}/σ_{60}	**-0.5912**	0.2199	---		---		---	
μ^{SCO}/σ_{60}	**-0.5845**	0.2150	**-0.4275**	0.2067	**-0.6376**	0.2504	0.0600	0.3171
$\mu^{StFailRate}/\sigma_{60}$	---		---		-0.9999	0.6723	**4.9185**	1.7798
$\mu^{StFailRate*IN}/\sigma_{60}$	---		---		---		**-5.0237**	1.3888
μ^{RR}/σ_{60}	**-0.6578**	0.1862	**-0.6783**	0.1847	**-0.6756**	0.1853	**-0.6249**	0.1873
/log-lik/	194.04		197.84		196.72		190.20	

Notes: Treats {MO, PA} as SCO=1 states, Iowa excluded (no banks in 1854 or 1857)

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