The Underissuance of national bank notes and the Act of June 1874

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Abstract

Until the early 1920s, National Banks issued fewer bank notes than allowed, even as this activity was considered fairly profitable. This "underissuance puzzle" has been widely debated, although no consensus has been reached yet. In this paper I employ a novel dataset between 1870 and 1878 to shed light on its causes. I find that until 1874 remote banks had less underissuance than banks close to the reserve cities, but that this situation reverted after the 1874 amendment of the Bank Act. I relate this break to a change in issuance costs, and find evidence supporting the "redemption costs hypothesis".

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1. Introduction

During the early national bank era, started by the National Bank Act of 1864, the currency arrangements of the United States were quite peculiar. Two currencies—gold and the Treasury-issued greenback—coexisted, and until 1879 there was no fixed convertibility between both. Even paper money had several types[1]. Some of these were Civil War legacies, such as fractional currency, while others were more recent creations. In this paper, I will be concerned only about one type of currency, the "National Bank note" created in concert with the National Bank System.

National bank notes are interesting because they were currency that could be issued by the banks at their own volition. The only requirements (see section 2) were that they were below a certain fraction of the banks' capital and were backed by enough collateral (in the form of U.S. bonds) and reserves (in the form of greenbacks and specie). As detailed in section 3, several authors have estimated that issuing bank notes was quite profitable for banks. Even so, they found that many banks limited their issuance to levels below their legal maximums, and thus "left money on the table" (Cagan & Schwartz, 1991). Considering that banks are thought as profit-maximizing agents, this is a puzzle.

This paper uses a novel dataset (see sections 4 and 5) to give lights on the causes of the underissuance puzzle. We discuss the two main hypotheses, that of hidden redemption costs and of hidden opportunity costs, and compare them with the null hypothesis of banks' irrationality. To do so, in section 6 we link the underissuance puzzle with the geographic distance between a bank and its closest reserve city[2], and study how this relationship changed when the Bank Act was amended in 1874. We argue that this amendment affected the redemption costs of remote banks more than that of banks close to the reserve cities, and use this change to infer the true influence of

[1] See Friedman & Schwartz, 1963 page 15 for a detailed discussion on this subject.
[2] Until 1882, the government classified sixteen of the largest cities as "reserve cities". This denomination mostly entailed having a Treasury department office, certain clearinghouse agreements, and different reserve requirements.

redemption costs. In all cases we control for a set of other variables, such as scope and scale economies, and still find strong evidence backing the redemption costs hypothesis.

2. Regulatory environment

Even though the National Bank Act was approved in 1864, it was not until 1865 that the national bank notes started to play a significant role. In that year, the Congress passed an act that taxing at a 10% rate all the notes issuances of the previously existing State banks. This heavy tax—which was in practice a ban on State bank notes—created a strong incentive for State banks to recharter as National banks. From that point National banks started to increase in number (see Table 1) and the National Bank System started to grow.

National bank notes were equivalent to other types of money issued by the government, with two differences: they could not be used to pay tariffs, nor as part of banks mandatory vault reserves. Nevertheless, the public accepted national bank notes without concern (Friedman & Schwartz page 23), so in that sense they were perfectly equivalent and could be used at par with greenbacks as a medium of payment.

The amount of notes that banks could issue was limited by the amount of capital stock that each bank held. The exact details are quite contrived (see Calomiris & Mason, 2008 page 332), but in general banks were allowed to issue notes up to 90% of their capital stock[3].

To guarantee convertibility, banks were required to back up their note issuance with deposits of U.S. government bonds held at the Treasury[4]. They were allowed to issue up to 90% of the market value

[3] Banks with capital above $500,000 faced stricter rules, which also varied through the years. Since these banks were few in number and were located mostly in central cities, we will restrict our attention to banks with capital stocks below this threshold. Finally, in 1900 all the limits regarding capital were standardized and relaxed up to a flat 100% ratio.

[4] The minimum level of bonds that banks needed to hold with the U.S. Treasury was the maximum between $30,000 and 33% of their capital stock, which was mandatory even for banks that issued no bank notes.

of bonds held deposited with the Treasury[5]. Since investing in U.S. bonds had a steep opportunity cost[6], banks avoided unnecessarily holding them as much as possible[7].

Until 1874, all country banks (i.e., banks located outside the sixteen "reserve cities") were required to hold a 15% reserve fund against both deposits and notes outstanding. Up to 60% of those reserves could be held up as deposits in reserve banks, while the rest needed to be maintained in *lawful money* (that is, greenbacks, gold, or certain Civil war-related notes such as three percent certificates[8]).

The amendment of June 20 introduced two main changes. First, all reserve requirements for bank notes were lifted and instead a 5% cash redemption fund was put in place. Each bank had to deposit in *lawful money* an amount equivalent to at least 5% of its outstanding bank notes. This fund also counted towards the reserves held against deposits, so the net reserves held by banks for issued notes was in fact zero. Second, the U.S. Treasury started redeeming[9] bank notes itself using the funds deposited by each bank, and asking them to periodically replenish the deposits as notes got redeemed at the Treasury counter.

2. Framing the underissuance puzzle

The underissuance puzzle was first studied by Bell (1912). Previously, the Comptroller of the Currency in his 1910 annual report had argued that the profits from note issuing were low. Bell disputed this claim, arguing that the formula employed by the Comptroller was incorrect. After fixing the formula, Bell found the money issuance activity to be indeed quite profitable. He lays as possible

[5] This rule also varied through time and had special provisions. Before 1882, if the market value was higher than the par value then the par value of the bond would be the binding one. From July 1882 to March 1900, the provision was changed to consider only the par value of bonds. Finally, after 1900, the limits were relaxed up to 100% of the par value of the bonds. Since our period of analysis will be below 1882, we will ignore these changes.

[6] Bank notes paid lower interest rate than what could be obtained from loan activities, as described by Bell (1912) page 49.

[7] In our sample—discussed in the next section—we find that the median bank held only 0.54% more deposits for circulation that legally required.

[8] See Friedman and Schwartz (1963, page 25) for a discussion of this and other types of currency in circulation at the time.

[9] That is, accepting national bank notes and exchanging them at par with greenbacks.

explanations the default risks of government bonds (page 51) and opportunity costs of issuing notes (page 57). As proof, he shows that New York banks—which were better able to lend to foreign money markets or to speculators—had a lower ratio of circulation to capital.

After Bell, it was not until 1963 that Friedman and Schwartz studied this subject, in their canonical book "A monetary history of the United States, 1867-1960". They pointed out that the amount of bank notes issued was too low with respect to their profitability and their maximum allowed levels. The authors suspected the existence of some overlooked costs of issuing notes, but had "no explanation for this puzzle" (page 23). Motivated by their work, Goodhart (1965) wrote in favor of Bell's explanation. He emphasized the risk that banks faced if their circulation privileges are terminated by a possible change in regulation, and showed that the costs of issuing were both high and increasing with respect to the amount issued[10].

In contrast, James (1976) criticized Goodhart's arguments of government risk and redemption costs because they failed to explain the underissuance of notes prior to 1900 and because of his estimates that the redemption costs to be low. Instead, he emphasized the opportunity cost hypothesis. He found that the issuing ratios were significantly different across regions, and that the relative profitability of lending (measured through regional interest rates) had a strong effect on note issuing (measured as the percentage excess of bonds held, a measure very similar to ours). Most remarkably, James' work was the first one that applied regression techniques to the problem. His results, ran on a cross-section time series of state and reserve city aggregates between 1888 and 1911, were highly significant and influenced the more modern literature.

Following James, Hetherington (1990) studied the effect of regulatory changes (the amendments of 1882 and 1900). He found that these amendments helped to explain the swings experienced by bank notes circulation, and also backed James' result of a significant regional difference. Champ, Wallace,

[10] Goodhart (page 520) pointed out that half of the banks' outstanding notes were redeemed every year, and that redemption was more common for notes of reserve city banks.

and Weber (1992) gave an alternative view, pointing out the term structure of interest rates as a source of risk for banks. Their main argument is that by investing in long term securities (U.S. Bonds) and funding themselves on shorter terms (through deposits), banks created a risky maturity mismatch, which reduced the incentives to purchase bonds.

Cagan and Schwartz (1991) evaluated the plausibility of the different hypothesis of the banks' underissuance. In particular, they tested the hypothesis of Goodhart, James and Champ et al., that risks, opportunity costs, or redemption costs were behind the puzzle. They argued that the evidence presented was inconclusive, and concluded that "national banks did not pursue rational profit maximization" (page 306).

Following Cagan and Schwartz critique, Champ (2007a, 2007b, 2007c) documented the debate in a series of linked works that also provided additional evidence about the existence of the puzzle. Most recently, Calomiris and Mason (2008) attempted to provide stronger evidence in favor of the rationality of banks' behavior. Regarding this work, the authors studied three cross sections of bank-level balance sheet statements (in 1880, 1890 and 1900), and found that redemption cost models cannot explain the underissuance puzzle. However, the authors found evidence in favor of the opportunity cost hypothesis, and also regarding economies of scope between the deposit-taking and the note issuing activities.

This paper is largely constructed on top of Calomiris and Mason's contribution. It studies bank-level variables for a different period (1870-1878) and in a panel-data setting instead than in cross-sections, but employs almost identical explained variables and controls. However, in contrast with Calomiris and Mason, we do find evidence in favor of the redemption cost argument, and also show that changes in the regulatory framework can affect redemption costs, in the same spirit as the work of Hetherington.

3. Sources of information

> *"Statistics so complete and accurate as those deduced from the reports of the national banks have never been made in any country under any previous system"*
>
> ANNUAL REPORT OF THE COMPTROLLER OF THE CURRENCY FOR 1875, PAGE 26

To test the hypothesis that the act of 1874 changed the note issuing behavior of national banks, we need balance sheet information for each national bank, for the years surrounding the introduction of the act. Since less than four months passed between the act enactment and the date the 1874 information was collected, we instead look for structural breaks in 1875.

In addition, to test whether the banks behavior depended on its distance to the reserve cities, I calculated the distance between each bank and its closest reserve city[11]. I obtained the geographic coordinates of each city from the U.S. Geological Survey's Geographic Names Information System, which has the advantage of containing many "historical" cities that are not found in other datasets. To estimate each distance, I employed the Vincenty inverse method which takes into account the Geodesic nature of the Earth.

I restricted the sample of interest according to three criteria. First, only the years between 1870 and 1878 are included. This is because before 1870 the system was still in its infancy, and from 1879 the US returned to the gold standard, which changed the process of money creation (see chapter 2 of Friedman and Schwartz for a detailed discussion on the subject). Second, I excluded banks with a capital stock of 500,000 or more. As Calomiris & Mason (2008) explained, above this threshold banks had different capital requirements, which complicate the analysis. Third, I restrict attention only to "country banks"—banks outside the reserve cities—as reserve city banks had very different behaviors (as shown in the next section).

[11] Leavenworth was excluded from the list of reserve cities starting in 1872.

My main sources of information are the *Reports on the condition of the national banking associations*, contained in the annual reports of the Comptroller of the Currency to the United States Congress. These reports contain balance sheet information for each national bank, obtained in early October of each year from 1867 to 1900. Due to the sheer size of the information—thousands of banks tracked through a span of decades—this dataset has remained relatively unexploited. Some authors (Friedman & Schwartz, 1963) employed aggregate information for the entire period, while others restricted themselves either to state-level information (Champ, 2007a) James, 1976). Until now, the most comprehensive use of this dataset has been Calomiris & Mason (2008), which collected bank-level information for the years 1880, 1890 and 1900.

To bypass the difficulties of constructing the dataset by hand, I applied optical character recognition techniques to extract the information. I obtained around 11,000 individual bank reports, and discarded 12,500 reports with incorrectly processed data[12].

Through the remaining of this paper I employ several variables which are defined in Table 1. The most important one is the "issue propensity", first proposed by Calomiris & Mason (2008), which measures the amount of voluntarily issued bank notes, as a percentage of the legal maximum. I employ a small variation of their definition. Instead of using "bank notes issued", which is subject to unexpected changes whenever the notes get redempted, I use "US bonds held to secure circulation", which is a better measurement of the amount of bank notes that the banks *intend* to issue (this is the same correction applied by James). However, it should be noted that the main results obtained in this paper are robust to using any of the two definitions.

The other rations described in the table proxy for complementarities of the deposit activity of banks with the note issuing activity (dep2cap), for scale economies (log_assets), for the opportunity cost of loans (loanrat), and for any unobserved geographic effects common to both banks (ip_others).

[12] Since we are dealing with balance sheet statements, we can verify if the information is correct by comparing, for each side of the balance sheet, the totals with the sum of the items, and then both totals.

Table 1 – Description of Variables Employed

Name	Description
LOG_DIST	Natural logarithm of distance to the nearest reserve city
LOG_ASSETS	Natural logarithm of assets
EARNING_ASSETS	Earning assets voluntarily held: Loans and discounts + Bonds on hand + Other stocks, bonds and mortgages
DEP2CAP	Ratio of individual deposits to capital stock
LOANRAT	Ratio of loans and discounts to earning assets voluntarily held[13]
BONDS	US bonds held to secure circulation
CAP_STOCK	Capital stock of the bank (excludes surplus funds and undivided profits)
MIN_BONDS	Legal minimum of US bonds held to secure circulation: Formula: `min(30,000; 0.33 ×` capital stock`)`
IP	Issue Propensity[14] *Voluntarily held US bonds held to secure circulation (% of maximum amount).* Formula: 100 × (BONDS - MIN_BONDS) / (BONDS - CAP_STOCK)
IPTRUNC	IP truncated between 0 and 98
IP_OTHERS	IPTRUNC of other banks in the city
TREAS2NOTES	Ratio of lawful money deposits held with the US Treasury to bank notes outstanding (as a percentage)
EXCESS_DEP	(TREAS2NOTES -5), truncated between 0 and 5
RURAL_PROXY	Dummy for cities with only 1 or 2 banks for the entire period
DUM75	Dummy variable equal to 1 from 1875 to 1878

3. Outstanding national bank notes between 1870 and 1878

Between 1870 and 1878, national bank notes circulation remained almost constant at around 300 million dollars, increasing only 2.72% during the whole period. This was in line with the evolution of the total money stock, which fluctuated between 1.4 and 1.7 billion dollars in that period (see Friedman and Schwartz page 30).

[13] This is the formula proposed by (Calomiris & Mason, 2008).

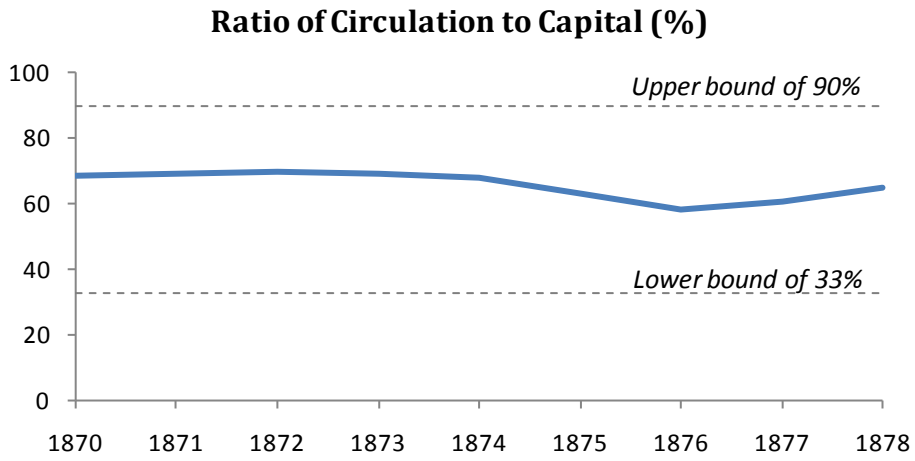
[14] This variable is very similar to the one used by (Calomiris & Mason, 2008), except that I use "bonds to secure circulation" instead of "bank notes outstanding".

Table 2 – Aggregate Statistics of National Banks

Year	Banks	Circulation	Deposits	Loans	Capital	Assets	Circ.-Capital Ratio (%)
1870	1,615	293.9	515.3	716.0	430.4	1,510.7	68.3
1871	1,767	317.4	631.4	831.6	458.3	1,730.6	69.3
1872	1,919	335.1	628.9	877.2	479.6	1,755.8	69.9
1873	1,976	340.3	640.0	944.2	491.0	1,830.6	69.3
1874	2,004	334.2	683.8	954.4	493.8	1,877.2	67.7
1875	2,087	319.1	679.4	984.7	504.8	1,882.2	63.2
1876	2,089	292.2	666.2	931.3	499.8	1,827.2	58.5
1877	2,080	291.9	630.4	891.9	479.5	1,741.1	60.9
1878	2,053	301.9	668.4	834.0	466.2	1,767.3	64.8

Source: Annual Report of the Comptroller of the Currency, 1878, page 15.
Note: Observations for each year were usually taken during the first week of October, except for 1873 where it was based on the call report of September 12.

As shown in the next chart, on aggregate, it appears that the underissuance puzzle was quite relevant during those years, as bank notes outstanding always remained below their 90% legal maximum. Therefore, we could suspect that the capital stock was not a binding constraint on the amount of notes issued.



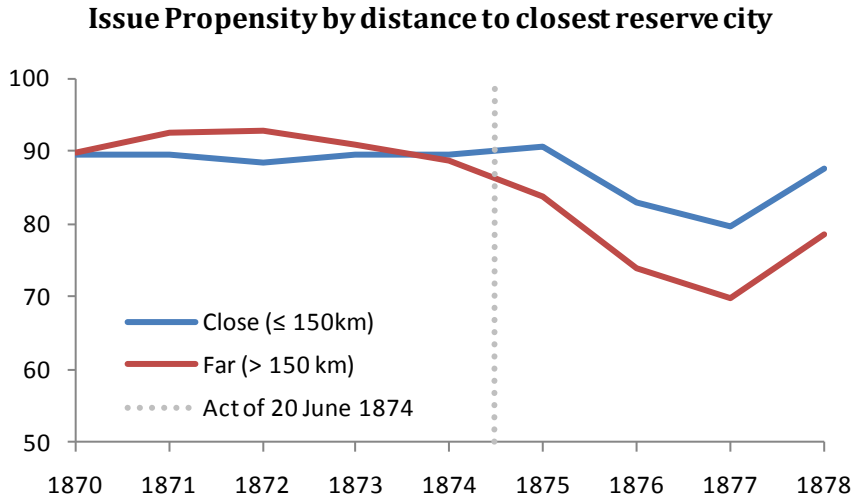
By studying individual banks, we find that this presumption is in fact false, and the capital constraint was binding for around half of the country banks and a quarter of the banks in reserve cities. Thus, trying to solve the puzzle using only aggregates will incorrectly show up that banks were not at corner solutions, while in fact this issue was true only for a fraction of them (which is the fraction of interest).

Table 3 – Percent of banks with notes issuance constrained by their capital levels

Category	1870	1871	1872	1873	1874	1875	1876	1877	1878
Country bank	50.1	54.2	58	54.3	52.8	48	51.2	43.3	48.9
Reserve bank	28.6	25	25.6	18.3	21.9	19.4	12.2	14.1	21.2

As we see in Table 3, country banks had a substantially larger issue propensity than banks in reserve cities. This fact, already acknowledged by authors such as Goodhart, motivates us to focus only on country banks, to avoid having to model the quite heterogeneous behavior followed by reserve city banks (and New York banks in particular).

Regarding country banks, the following chart gives preliminary evidence regarding the effects of distance to reserve cities. We split the sample of banks in two groups (with a threshold of 150 kilometers, very close to the average), and studied the time series of issue propensity for our sample. The results are intriguing. Until 1874, banks located far from the reserve cities had a slightly larger issue propensity, while after that year the situation reverted dramatically. Since this sudden change may be related to a few unobserved effects (such as the economic situation of rural areas), we will proceed in the next section to perform a more rigorous analysis.



4. Statistical analysis

To give an answer on whether the distance to reserve cities had an effect on the issue propensity of banks, and if that effect changed after the 1874 amendment to the National Bank Act, I ran a series of regressions of distance against the issue propensity. I controlled for time effects, scale and scope economies, rural areas, and the opportunity costs of not using the held up capital in new loans, as explained by Calomiris & Mason (2008) page 340. Again, our sample only includes bank records between 1870 and 1878, with a capital stock of less than 500,000 dollars, and located outside the reserve cities (country banks).

Since our explained variable—IPTRUNC—is truncated between 2 and 98, the correct estimation method is a Tobit regression. Even more, we can exploit the panel nature of our dataset by running a random-effects Tobit model[15]. Nevertheless, to assess the robustness of our results, we ran our regression using five different techniques: i) linear regression, ii) linear regression with the White-Huber correction for heteroskedasticity, iii) panel data random-effects regression[16], iv) Tobit regression, and v) random-effects Tobit regression. In all cases our two variables of interest maintained the same sign, although the first two models did not found that distance before 1875 was statistically significant.

[15] This also requires us to assume that the intercept of each bank comes from a random draw of a normal distribution. Since no sufficient fixed-effect estimator exist, we cannot statistically assess the validity of the random-effects assumption in a Tobit model. As a poor man's alternative, we tested this hypothesis on the panel OLS estimators and found it sensible (see the next footnote).

[16] A Hausman test shows no systematic difference in the intercepts of a random-effects OLS and a fixed-effects OLS. The reported chi-square is 146 and the P-value 0.000. Therefore, it is sensible to employ a random-effects model instead of a fixed effects one.

Table 4 – Regression results on truncated issuance propensity (IPTRUNC)

Method		OLS		Robust OLS		RE OLS		Tobit		RE Tobit	
Observations		4802		4802		4802, 1865 banks		4802		4802, 1865 banks	
R^2		0.065		0.065		0.053 (overall)		N.A.		N.A.	
Log distance (km)		0.26	*(0.60)*	0.26	*(0.58)*	1.21	*(0.04)*	2.96	*(0.09)*	5.56	*(0.01)*
Log Dist × dum75		-4.63	*(0.00)*	-4.63	*(0.00)*	-5.02	*(0.00)*	-12.81	*(0.00)*	-14.61	*(0.00)*
Log of Assets		0.53	*(0.40)*	0.53	*(0.42)*	4.92	*(0.00)*	-0.91	*(0.67)*	13.17	*(0.00)*
Deposits / Capital		0.00	*(0.91)*	0.00	*(0.91)*	0.00	*(0.47)*	0.03	*(0.02)*	0.03	*(0.04)*
Loanrat		-0.09	*(0.02)*	-0.09	*(0.01)*	0.03	*(0.40)*	-0.45	*(0.00)*	0.09	*(0.52)*
Rural proxy		0.91	*(0.19)*	0.91	*(0.20)*	3.04	*(0.00)*	3.17	*(0.20)*	10.88	*(0.00)*
Constant		89.60	*(0.00)*	89.60	*(0.00)*	14.69	*(0.24)*	180.46	*(0.00)*	-65.89	*(0.14)*
Year dummies	1871	1.17	*(0.38)*	1.17	*(0.27)*	1.16	*(0.25)*	0.02	*(1.00)*	0.52	*(0.88)*
	1872	0.89	*(0.52)*	0.89	*(0.42)*	0.49	*(0.64)*	2.03	*(0.69)*	3.22	*(0.39)*
	1873	0.48	*(0.70)*	0.48	*(0.65)*	0.10	*(0.92)*	1.90	*(0.68)*	1.75	*(0.61)*
	1874	-0.49	*(0.74)*	-0.49	*(0.70)*	-0.52	*(0.64)*	-1.75	*(0.74)*	-0.17	*(0.97)*
	1875	20.21	*(0.00)*	20.21	*(0.00)*	21.04	*(0.00)*	56.02	*(0.00)*	60.92	*(0.00)*
	1876	11.62	*(0.00)*	11.62	*(0.01)*	14.27	*(0.00)*	34.57	*(0.01)*	43.19	*(0.00)*
	1877	8.29	*(0.03)*	8.29	*(0.05)*	12.27	*(0.00)*	25.02	*(0.05)*	38.80	*(0.00)*
	1878	16.29	*(0.00)*	16.29	*(0.00)*	19.38	*(0.00)*	45.22	*(0.00)*	58.22	*(0.00)*

Note: Number in parenthesis shows the P-Value

The effect of distance on issue propensity

As we see in the table, distance appears to have a quite weak but positive effect in the years up to 1874. In particular, the random-error OLS and the two Tobit models find distance before 1874 weakly significant, while the OLS models find no effect. This means that banks far from the reserve cities have a slightly higher propensity to issue. The RE Tobit model reports a marginal effect of +0.75 of a change in log(distance), which is equivalent as saying that a bank situated at 400km from a reserve city issues 0.75% more notes than a bank situated only 150km away.

In contrast, distance after the 1874 amendment appears to have a much stronger—but negative—effect. It is statistically significant in all cases, and the random-effects Tobit model predicts that a bank 400km away from a reserve city will have an issue propensity 1.96% *lower* than a bank located 150km away.

The strength of this change is quite puzzling on a first impression. Distance not only played a significant role, but this role changed in *direction* when the Banking Act was amended. Since the literature has mostly pointed out towards either redemption costs (Goodhart 1965, Cagan & Schwartz 1991) or hidden opportunity costs (Calomiris & Mason 2008), we would expect at least one of these factors to be related to distance.

Direct transport costs of redemption are unlikely to be the cause. Bell (1912, page 45) estimated that the redemption process took between "one and two weeks", not quite enough to offset the gains of note issuance. Further, as Calomiris & Mason (page 329) stated, "transportation costs associated with note redemption were likely low". However, the Act may have changed not the costs of redemption but the *frequency* of redemptions, thus increasing the total costs involved.

As we can recall, until 1874, banks were obliged to accept notes from other banks as payment[17], but redemption (exchange of notes with legal tender) was only possible in two places: either with the bank that issued the note or with its correspondent bank in one of the reserve cities. Thus, a reserve city bank will find it difficult to redeem a note from a remotely located bank whose correspondent is in a different city. In turn, this means that notes from remote banks will probably be redeemed less often, which reduces the note issuance cost for remote banks. This idea of costly redemption is backed by Friedman and Schwartz (1963, page 22), who explained that until 1874 New York banks sold country bank notes to brokers at a discount, who in turn resold them back to the issuing banks.

In contrast, after the 1874 change in redemption procedures, "national bank notes could also be redeemed at par at the Treasury… [who] paid out lawful money from funds each national bank deposited with it for redemption purposes" (Friedman & Schwartz p.22). This means that notes from remote banks were at least as likely to be redeemed as notes from banks close to the reserve cities. However, this "was a lengthy and expensive process for both the bank redeeming the notes and the bank whose notes were being redeemed" (Goodhart, 1965 page 521). Redeeming banks lost the use

[17] National Bank Act sec. 32

of their funds while they were on transit to the treasury[18], while issuing banks had to "ship lawful money to the redemption agency in Washington to rebuild their depleted redemption fund to the required 5%..." (ibid). As we see, remote banks now face higher costs than closer banks, because city banks would tend to redeem their notes with the Treasury, instead of exchanging them directly at a lower cost for both parties.

This hypothesis can be tested by observing how much extra deposits did banks held at the Treasury, besides their mandatory 5%. If remote banks indeed had more frequent redemptions through the Treasury, we would expect them to hold larger excess reserves. As we show at the end of this part, this is indeed the case, albeit the effect is quite small.

To summarize, the puzzling effect of distance on issuing propensity can be explained by the changes in redemption regulations. Until 1874, regulation benefited remote banks, but the situation reversed with the new Act. We now turn to the interpretation of the remote variables, some of whom are quite puzzling by themselves.

The effect of control variables

Regarding the control variables, they present some interesting results. The rural proxy is statistically insignificant in most specifications, while the year dummies after 1875 are significant and suggest a strong change in bank behavior beyond the captured effect of distances. The scale effect (log of assets) shows inconclusive results, as the sign is not constant across models.

Scope economies with respect to deposit activities (measured by the ratio of deposits to capital) appear quite low, since the signs are positive in all cases but with small magnitudes and low statistical significance. This is surprising, since the deposit-taking and lending activities share their reserve allocations. It also contradicts the results found by Calomiris and Mason regarding the

[18] This idea has been convincingly contested by (Cagan & Schwartz, 1991) p.302, although it remains reasonable to assume that redeeming banks preferred to exchange the money directly with the issuing banks instead of transacting with the Treasury.

"substantial economies of scale" found (p. 353), and may signal that the savings in sharing reserves are lower than previously thought.

The loanrat variable—which proxies for opportunity costs from lending—also shows an interesting result: the Tobit model shows a negative and significant coefficient, reinforcing the Calomiris and Mason's hypothesis that unobserved opportunity costs explain the underissuance puzzle (they also used the Tobit model). However, in all the other specifications there is no statistical significance. In particular, the panel Tobit model clearly rejects any effect of the loanrat variable and even has the opposite sign.

The difference in results between the Tobit and the random-effects Tobit may be because the random-effects model is able to exploit the panel data nature of the dataset, a feature that the Calomiris and Mason work didn't have.

All in all, our results fail to support their results regarding the scope economies of deposits and the opportunity costs of loans. This may be either because the distance variable captures this effect, or because the banks behavior was different in the years between 1880 and 1900 (where their sample is contained).

Are our results robust to omitted regional effects?

One possible source of bias of our model lies in the fact that geographic factors besides distance may be at play. For instance, regions may have different predominant economic activities, different laws in place, or even different propensities to hold money. In order to test against this issue we replace the rural proxy by a new variable, the issuance propensity of the *other* banks in each city. We ran this modified regression for all banks located in cities with between 3 and 10 banks. If regional differences are what matters, then our new variable will make distance statistically insignificant.

It should be noted that since the issuance propensity of other banks in the city is also an endogenous variable, we are only running a reduced form model. Nevertheless, this reduced form model is able to correctly determine whether distance is relevant or not.

We ran the same five regressions as reported in the previous table. In all cases, the coefficient for the IP of other banks was strongly positive and significant. Below we present the results for the random-effects Tobit model (except the year dummies). We find that a 1% increase in the issuing propensity of other banks in the city will raise the expected issue propensity of the current bank by 0.11% (conditional on the fact that the issue propensity is not already in a corner solution). Both distances still have similar magnitudes, although distances before 1875 are only significant at the 10% level. Other variables are all statistically insignificant, which points out to a strong relationship between them and the local conditions of each town. This result validates our hypothesis, and it does not contradict the conclusion of Calomiris & Mason (2008) that the opportunity costs of issuing money are relevant, since the opportunity costs are probably correlated across geographical areas.

Table 5 – Effects of issuing propensity of other local banks

Method	**RE Tobit**	
Observations	1022	
Number of banks	578	
Log distance (km)	6.69	*(0.07)*
Log Dist × dum75	-16.06	*(0.00)*
Log of Assets	2.00	*(0.67)*
Deposits / Capital	0.01	*(0.55)*
Loanrat	-0.19	*(0.51)*
IP of other local banks	0.63	*(0.00)*
Constant	31.74	*(0.67)*

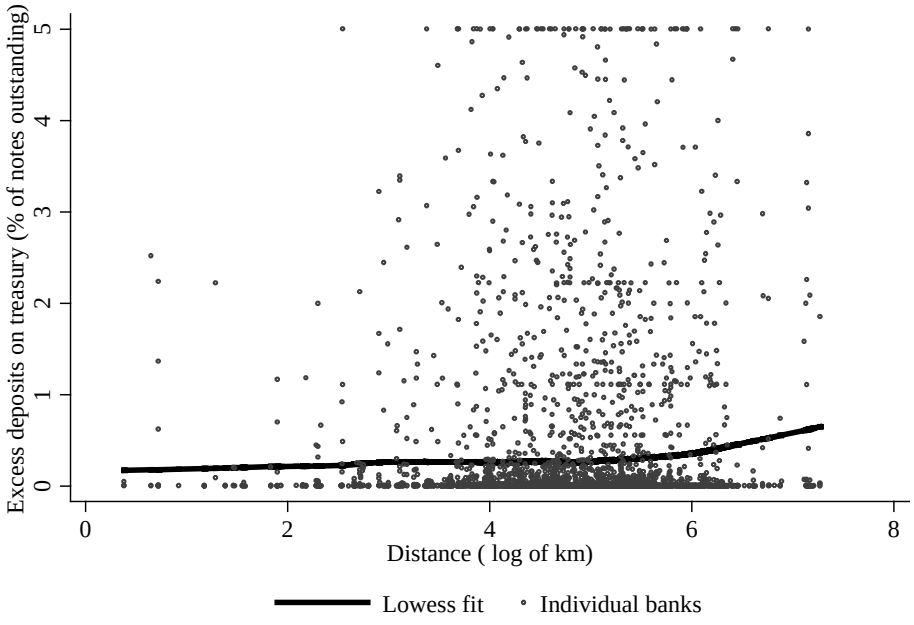
Note: Number in parenthesis shows the P-Value

Distance and excess deposits with the treasury

On average, the excess deposits held by the country banks in our sample were 0.27% of the outstanding notes or 5.4% more than the required amount. There was a clear relationship between distance and excess deposits held in the Treasury, although on first sight this relationship is obscured by the high number of banks that deposit the bare minimum.

The following graph plots excess deposits against distance, for the years 1875-1878 (after the Act was amended). It also graphs a Lowess curve, which shows the positive relationship between both variables.

Excess deposits held at the Treasury and distance to the closest reserve city



Country banks between 1875 and 1878, with capital stock of less than $500,000 (1948 obs.)

In order to provide a more rigorous test for the hypothesis that remote banks face a higher frequency of redemptions after the 1874 amendment, we run a series of regressions between the excess deposits held by banks in the US Treasury and the log distance from the closest reserve city. In all cases, the distance coefficient is positive and significant at the 5% level. The average marginal effect of an increase in distance is around 0.02%, which can be loosely interpreted as saying that a

bank 400 kilometers away will hold 7%[19] more voluntarily held deposits than a bank only 150 km away. Since 0.02% of notes issued are quite an economically insignificant estimate, we take this result as only weakly supporting the hypothesis that remote banks face more redemptions.

5. Conclusions

This paper sheds new lights about the underissuance puzzle of national bank notes. There is strong evidence that the distance of country banks to the reserve cities affects the banks' issuance behavior. Under the original reserve and redemption requirements of the 1864 National Bank Act, an increasing distance is related to higher bank issuance. After the 1874 amendment, the relationship changes and distance starts to negatively affect the amount of notes issued.

The first consequence of this result is a disproof of the Cagan and Schwartz argument of the irrationality of bankers. If bankers are truly irrational, then distance would have to be related to this irrationality, and—unbelievably—after 1874 the more remote bankers would have stopped being the more rational ones, transforming themselves into the more irrational ones, with the lowest note issuance ratios.

We find little evidence in favor of the opportunity cost hypothesis. In a panel data setting, the main variable employed by Calomiris and Mason loses significance and has the wrong sign. Nevertheless, our proxy for regional effects is strong, which may point towards other hidden opportunity costs.

We find evidence in favor of the redemption costs hypothesis. The amendment of 1874 altered the redemption procedures in a way consistent with our distance coefficients, which changed both in magnitude and sign. Furthermore, the effects of distance are robust across all models and even after controlling for rural areas, scale and scope economies, and regional effects.

Our findings can also be related to the changes in money stocks during that period, which in turn affected prices. As Friedman and Schwartz pointed (page 33), there are large discrepancies between

[19] 7% = 0.02 / 0.27

the different price indices compiled for that time. It is possible that these differences may be caused by a diverging evolution of money stocks across central and remote areas (or urban and rural areas). If this is the case, then an adjusted model of money supply could correctly account for these issues.

The biggest implication of our result is that changes in the regulatory environment should not be overlooked, as they can often have unforeseen effects on the agents behavior. In our case, the unforeseen effect of redemption costs lead to just a “puzzle”, but—as we have seen in recent years—in other situations they may have more drastic impacts.

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Appendix

List of Reserve Cities between 1870 and 1878

Albany
Baltimore
Boston
Chicago
Cincinnati
Cleveland
Detroit
Leavenworth (until 1872)
Louisville
Milwaukee
New Orleans
New York
Philadelphia
Pittsburgh
Saint Louis
San Francisco

Location of banks in the sample (4803 observations)