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# Banks, Credit Supply, and the Life Cycle of Firms: Theory and Evidence from Late Nineteenth Century Japan

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How does local credit supply affect economic dynamism? Using an exogenous bond shock in historical Japan and new genealogical firm-level data, we empirically examine the effects of credit availability on firm life cycles. Our main result shows that, consistent with our theoretical model, the lifespan of firms decreases with bank capital. Capital-abundant regions have more firm destruction. For manufacturing, we document that these regions have both increased firm creation and destruction. These results suggest that samurai bonds were conducive to the emergence of banking, which eased firms' financial constraints and led to more economic dynamism.

Keywords: credit supply, banks, liquidity constraints, firm dynamics, entrepreneurship
JEL codes: E51, N15, O16

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## *I. Introduction*

The recent financial crises in most developed economies underscored the importance of credit booms. At the macro level, there exists a consensus that credit booms are associated with economic expansions (e.g., Levine, 2005) and that the recessions following them tend to be deeper and longer than normal recessions (e.g., Schularick and Taylor, 2012 or Jordà et al, 2013). At the micro level the effects of credit booms are less clear. Some empirical evidence shows that the credit booms in Spain and other euro-area countries in the 2000s had heterogenous effects on investment of existing firms (e.g., Gopinath et al., 2017 or Basco et al., 2020). However, there is no evidence on whether new firms that are created during a credit boom differ from those in other credit conditions.[1]

One observable difference from the effect of credit booms is in the life cycle of firms. Firm dynamics, measured in terms of entry and exit, are an important determinant of economic growth. This Schumpeterian "creative destruction" has been shown to be affected by changes in financial access, regulation, firm organization, and international trade.[2] In particular, there is a large quantitative macro literature emphasizing the effects of financial constraints on entrepreneurship at the micro level.[3] Largely absent in this scholarship are the micro-level effects of credit booms in a developing economy, particularly from a historical perspective,

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[1] For example, Amazon and Pets.Com were both created during the dot-com bubble (1996-2000). The former is now one of the most valuable companies in the world and has contributed to increase aggregate productivity, while the latter did not survive past its first year; see Abelson (2000).

[2] Per Schumpeter, creative destruction refers to the "process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one" (1942, pp. 82-83). As applied to firms, it can describe intra-industry churn as well as reallocation of resources within firms over their life cycle. See Caves (1998) for a survey of empirical studies on firm dynamics, with Dunne et al (1988) and Foster et al (2008) as prominent examples. Relatedly, Decker et al. (2014) underlines the diminishing share of young firms and entrepreneurship to explain the decline of economic dynamism in the United States.

[3] See Buera et al (2015) for a review of recent studies.

due to limited data.[4] This is unfortunate given that the aforementioned factors may be exacerbated in a financially immature economy undergoing structural change. At the same time, historical contexts may provide a cleaner economic framework that makes disentangling the relative influence of these factors possible.

Late nineteenth century Japan offers a unique setting to analyze the effect of a credit supply shock on the life cycle of firms.[5] We use a quasi-natural experiment setting to proxy for the changes in credit supply and a novel firm-level dataset to estimate economic dynamism. During this period, Japan transitioned from an internally fragmented, internationally isolated economy to an increasingly industrialized and globally integrated one. In 1876, the new central government under the Meiji regime (1868-1912) unilaterally converted annual hereditary stipends to former samurai into public bonds worth 174 million yen, the equivalent of nearly a third of Japanese national income and six times the government's total spending that year. This bond issuance was also exceptional in that it improved the government's fiscal position, more than trebled the amount of public bonds by value, and was actively resisted by the samurai recipients (Basco and Tang, 2020).[6] Moreover, bond value per capita at the time of issuance

[4] A notable exception is Gregg and Nafziger (2018), which uses the universe of Russian incorporation data in the late nineteenth and early twentieth centuries to analyze firm dynamics.

[5] An important question not addressed by our analysis is whether credit booms are driven by an increase in the supply or demand of credit, which itself is subject to debate. For example, Mian and Sufi (2009) argue that the mortgage boom in the United States in the mid 2000s was supply driven and emphasize the expansion of mortgage credit in subprime (riskier) areas, where income growth did not increase. More recently, Adelino et al. (2018) offer a more nuanced view arguing that both credit supply and demand were driving the mortgage credit boom. For our analysis, we interpret the change in credit as supply driven while acknowledging that alternative demand-side explanations may also be valid.

[6] The 1876 policy resulted in samurai losing their hereditary payments and receiving an asset (bond), whose value was lower than the present value of the stream of promised future payments (hereditary stipends). The 1877 Seinan war (aka, Satsuma rebellion) was led by samurai opposed to the compulsory commutation (Flath, 2014, page 33).

was unrelated to pre-1876 regional product per capita, further suggesting exogeneity in subsequent economic outcomes from this credit shock.[7]

We use this bond issuance as a discrete change in available financial capital available to entrepreneurs, with bond holders (i.e., samurai) acting as providers and banks as intermediaries.[8] Theoretically, this change in the composition of the stream of endowments should lead to an increase in savings (i.e., permanent income hypothesis), which in turn could be channeled towards the banking sector. For Japan, this was the case as the government revised the National Banking Act in 1876 to allow chartered national banks to use these bonds along with specie as paid in capital. As a result, the number and scale of banks rose dramatically in the three years following the bond issue (Goldsmith 1983, page 25). In particular, chartered national banks increased from 6 to 153 between the years 1876 and 1879 and were established throughout the country. Bonds issued to samurai represented nearly 60 percent of these banks' capital as late as 1884, when redemption of bonds had already begun, as shown in Table 1.[9]

To derive testable predictions, we consider a simple model of banks, savers, and entrepreneurs, which we then adapt to the context of a developing economy like late nineteenth century Japan. Banks act as intermediaries between households, who supply capital, and entrepreneurs, who demand it. Entrepreneurs differ in investment risk and endowment while banks do not know the individual risk of entrepreneurs and offer a loan contract. In this type of environment, there will be adverse selection where only the riskiest entrepreneurs accept the loan. In an economy developing a formal financial system like Japan, there are two regimes.

[7] See discussion in Section III.

[8] It is also possible for samurai to directly invest in firms without using financial intermediation, but in the absence of systematic financial data for firms during this period, how intensively this channel was used is unclear. See the next section for further discussion.

[9] The correlation between National Banks capital per capita and samurai bonds per capita is 0.72 at less than 1 percent statistical significance.

In the first, we assume that aggregate savings are low and there is no credit market, so entrepreneurs can only fund their projects with their own internal financing. In the second regime, aggregate savings are high, which reduce the cost of banks to obtain funds, and there exists a credit market that allows riskier and financially constrained firms to obtain funds as well.

Our empirical predictions rely on two features of the model. First, firms obtaining funds in the credit market are, on average, riskier. Second, an increase in savings makes the existence of a credit market more likely. The first result obtains from standard models of credit rationing with adverse selection (e.g., Mankiw, 1986). The second result holds if the cost to obtain funds by banks is inversely related to savings demand by households. This model generates three salient empirical predictions: (i) the lifespan of firms decreases with bank capital, (ii) firm destruction increases with bank capital, and (iii) firm creation increases with bank capital.

To test our model, we use a recently developed firm level dataset based on Japanese corporate genealogies (Tang, 2011 and 2014; Onji and Tang, 2017) and an instrumental variable approach. Although qualitative in nature and thus limiting the analysis to extensive measures of firm activity, the sample of firms in the data spans all prefectures in the country and sectors in the years immediately preceding and following the 1876 bond issuance. To our knowledge, no other firm level data with the same geographic and industrial coverage exist for Japan over the same period. The genealogical structure provides the specific year of entry and exit for each firm, from which we can estimate the impact of differential credit supply by region, instrumented by per capita bond value in 1876, on firm lifespan, creation, and destruction.[10] Our identification comes from the exogenous nature of the bond issuance and the variation

[10] We use per capita bond value as an instrument for both per capita national bank capital and per capita total bank capital. These IV estimates are also directly compared to both OLS and Poisson estimates directly using both banking series as well as that of samurai bonds.

across prefectures in per capita bond values. We also include covariates to account for prefectural differences in income, urbanization, and population.

Our findings are largely consistent with the empirical predictions of our model. First, the lifespan of new firms is inversely related to per capita bank capital. Second, firm exit increases in prefectures with a larger increase in per capita bank capital. We fail to observe, however, a statistically significant relationship between firm entry and bank capital availability. At the sectoral level, however, all three predictions of the model hold for manufacturing. The improved fit is consistent with differential external financing constraints among sectors, with manufacturing firms face a higher financial constraint (i.e., larger initial fixed cost of project investment to available credit) compared to other sectors and the economy at large (Rajan and Zingales, 1998). Likewise, our results using firms in the service sector, which may have lower funding threshold, show a poorer fit with our predictions. Our results are also robust to using samurai bonds as an instrument for either banking series as well as directly in the empirical specifications.

Our main contribution is to show that differences in credit supply affect the life cycle of firms. We argue that the involuntary samurai bond conversion increased aggregate savings, which translated into an increase in bank deposits and, thus, bank capital. In the presence of credit rationing and adverse selection, firms receiving bank loans had on average riskier projects and, thus, shorter lifespans. This theoretical prediction is corroborated by our empirical evidence of entrepreneurial activity in late nineteenth century Japan, where firms in areas with a larger supply of credit were also those experiencing more exits and shorter lives.

## *II. Related Literature*

There is a large and increasing empirical literature on the effects of credit supply, most of which focuses on long-run aggregate outcomes (Levine, 2005). Our approach relates more closely to recent studies that use historical data to examine the short- and medium-run effects of fluctuations in credit supply.[11] However, instead of aggregate measures, our study uses firm-level data, which allow us to analyze how firm dynamics are affected by credit supply and to provide a more comprehensive view of the effects. Our quasi-natural experiment approach also allows us to better identify the credit supply shock, which may be endogenous in other contexts. This identification has been previously used in Basco and Tang (2020), who examine the long-run effect of the samurai bond conversion on economic growth.

Our work is also informed by the literature on financial intermediation and how credit is channeled to firms through banks. In our model and empirical analysis, we focus on the intermediary role that banks play between firms and households. While banks may also serve other functions, our interest in the paper is to highlight the importance of banking on resource allocation and economic development (c.f., Gerschenkron, 1962 and Greenwood and Jovanovic, 1990). The assumption of households not investing directly into firms (e.g., through equity markets) would also be reasonable for Japan in this period given its nascent stock exchanges in Tokyo and Osaka, both established in 1878, high barriers to equity finance, and relative paucity of corporations (Morikawa, 1992, pp. 93-94, Goldsmith, 1983, p. 61).[12] Indeed, Allen and Gale (1995) emphasize the difference between bank-oriented economies like Japan, with households holding mostly safe assets, versus equity market-oriented economies like the United States.

Furthermore, there are a number of studies that examine the effect of credit supply on the quality or risk of the loans granted by banks. In a recent work, Jimenez et al (2020) argue that the Spanish housing boom in mid 2000s was akin to a credit supply shock. Banks obtained

[11] See Jordà et al. (2013), Jordà et al. (2017), Kaminsky and Schmukler (2008), Loayza and Ranciere (2006), Mendoza and Terrones (2012), and Schularick and Taylor (2012).

[12] This extra-banking investment channel is tested with our pseudo-IV specifications in the results section.

liquidity via securitization of real-estate assets. More importantly, Spanish banks took more risk by relaxing borrowing standards. Similar results have found for the recent mortgage debt boom in the United States (Demyanyk and Van Hemert, 2011, and Key et al, 2010). While we do not have direct evidence on which firms obtained bank loans after the credit supply shock, our findings on the life-span and firm destruction are consistent with this literature and lend support to our interpretation. Our contribution to this strand of the literature is to investigate the effect of the credit supply shock on the life cycle of firms.

A third area of related scholarship is understanding how firm dynamics affect economic growth in the line of Schumpeter (1942). Recent contributions include Dunne et al (1988), who provided the first statistics on firm creation and destruction across industries in the United States, while Foster et al (2008) underscore the importance of firm entry in aggregate productivity growth in the United States. These studies, however, use much more detailed firm data and observe firms in a developed economy context, neither of which applies to our historical study. A closer fit would be studies on how credit constraints can act as barriers to firm creation and growth, as shown by Aghion et al (2007), Banerjee and Duflo (2014), Banerjee et al (2019), Barrot (2016), and Beck and Demirguc-Kunt (2006)[13]. Our paper follows this empirical approach, but also utilizes a quasi-natural experimental setting that allows us to

[13] See also Buera et al (2015) for a review of the quantitative macro literature on the effect of financial frictions on entrepreneurship. We depart from this literature by having a more macro approach and exploit within-country variation in samurai bonds to assess the effect of credit supply on firm lifespan, creation, and destruction.

study a change in credit availability in a developing economy.[14] To this we add evidence on firm destruction and lifespan, which is absent in most of this literature.[15]

Finally, we contribute to the economic history and development literatures that relate the banking sector with economic activity. There is extensive scholarship examining the collapse of the banking sector in the United States during the Great Depression (e.g., Bernanke, 1983; Richardson, 2007; and Richardson and Van Horn, 2009). The findings suggest that through bank failures, credit availability decreased and exacerbated the decline in output. Our study shows similar, but obverse, patterns when credit expanded. We also provide micro-level evidence that the financial revolution experienced in Japan and leading to its industrialization may have had its origins in the government's policy to expand credit through banking (Rousseau, 1999, and Tang, 2013). Our analysis underscores the role of public bonds in increasing bank lending capacity as was true in early twentieth century China (Ma, 2019). It also complements modern studies in Thailand and India that find increased credit accelerated the growth and sales of firms, relaxed the constraint for high productivity households who may not have had credit access otherwise, and raised total entrepreneurial activity (Banerjee and Duflo, 2014, Banerjee et al, 2015, Banerjee et al, 2019, and Paulson and Townsend, 2004). We further discuss this mechanism in the context of firms in our theoretical model following the historical overview.

[14] Kaboski and Townsend (2012) similarly use a governmental microfinance program in modern Thailand to find that increased household credit provided increased financial intermediation, which in turn raised borrowing, investment, and wages in the short run. Our approach abstracts from the household and measures extensive firm activity for a longer period of time.

[15] An exception is Barrot (2016) which studies a reform in trade credit regulation (2006) in the French trucking industry. One main difference with our analysis is that we have data on all sectors and our credit supply shock represented a large increase in bank capital in the country.

## *III. Historical Background*

Late nineteenth century Japan was a country in transition, moving from an agrarian, semi-autarkic economy to an industrial and internationally integrated one over the course of a few decades. Institutional reforms undertaken by the new central government included the adoption of a modern banking system and commercial code, which complemented the establishment of a central bank and equity exchanges as well as public bond offerings (Lockwood, 1954). By many accounts, Japan had a successful financial revolution that underpinned its economic growth, becoming the first non-western country to industrialize and an economic leader in the region (Rousseau 1999, Tang 2013). Figure 1 shows how firms in modern sectors like textile and machine manufacturing grew rapidly in number and size relative to firms in primary production or services, and this was facilitated in part by their newly found access to investment capital, formal financial intermediation, and an integrated domestic market.

[Figure 1 here]

Immediately preceding the country's modern financial development was the central government's 1876 policy that converted the hereditary stipends of former samurai into interest bearing government bonds (Tomita, 2005; Basco and Tang, 2020). Along with two earlier, smaller bond issues, these "samurai bonds" were collectively valued at 210 million yen, or half of Japan's national income and six times total government revenue in that year.[16] This policy

[16] The two earlier bond issues, in 1873 and 1874, were voluntary conversions of samurai stipends and worth 36 million yen in current terms. Bonds varied in their payable interest rates depending on the former rank of the recipient samurai and his hereditary or life income. The highest ranked samurai received the largest payments in bonds but at the lowest interest rate, while the lowest ranked samurai the opposite. The conversion of annual incomes into lump sum bonds was not a one-for-one change in the government's liabilities, however, as higher ranked samurai took a loss of up to 75 percent of the present discounted value of their previously non-securitizable incomes (Flath, 2014, p. 33).

was enacted to reduce annual government outlays on liabilities carried over from the previous Tokugawa shogunate regime, to provide samurai with a financial security that could be sold or invested, and to increase the amount of capital available to the country's nascent banking sector (Tomita, 2005).[17]

To facilitate the latter, the government also revised its National Banking Act in the same year to explicitly allow these bonds to be used by banks as capital for currency and loan issue through reserve lending (Yamamura, 1967, and Harootunian, 1960). As shown in Table 1, former samurai owned the majority of the national banks' stock by using their bonds as collateral, and banks bought additional bonds themselves as investments.[18] These national banks, which were privately owned but received charters from the central government, preceded the expansion of private and quasi-banks that followed in the 1880s as part of the government's fiscal retrenchment and monetary consolidation under the auspices of a central bank established in 1882.[19] Despite the government capping the issuance of banknotes for each prefecture to a national limit of ¥34 million as a measure to counter inflation, total financial assets in the economy still increased nine-fold between 1875 and 1885 to ¥273 million.[20] Of this amount, national banks had a dominant share with 41.4 percent of the total compared to ordinary private banks, quasi-banks, or other financial institutions (Goldsmith, 1983, p. 218).

[17] All bonds issued in 1876 had a maturity term of twenty-five years starting in 1882 but could be sold starting in 1878 (Goldsmith, 1983, pp. 22-24). The government retired a large proportion of these bonds in the early 1880s.

[18] The 58.5 percent ownership share in 1884 is a decrease from the 75 percent share in 1882; however, prefectural disaggregation is not available for the latter figure (Harootunian, 1960, p. 440).

[19] The national banking system was initially based on the American model in use at the time, which was considered compatible for Japan given the economy was similarly decentralized, unlike those in Europe (Shizume, 2018).

[20] National banks were allowed to issue banknotes based on the amount of capital that they held (which included the samurai bonds). To centralize control over the money supply and make banknotes convertible into specie, the Bank of Japan took over this responsibility and no additional charters to national banks were granted (Shizume, 2018). There was subsequently a consolidation of national banks as their charters expired, with regular private banks increasingly dominant in the financial system starting in the 1880s (Yamamura, 1967).

This was equivalent to 14.1 percent of gross national product, compared to the 1.2 percent just ten years prior.

[Table 1 here]

The average per capita bond value by prefecture is 5.68 yen across bonds with different payable interest rates. As shown in the table, the top three prefectures receiving bonds in per capita terms were Tokyo (¥40.42), Ishikawa (¥17.64), and Kochi (¥16.63) while the bottom three prefectures were Yamanashi (¥0.14), Tochigi (¥1.06), and Osaka (¥1.16).[21] Figure 2 shows the distribution of these per capita bond values along with the per capita income levels in 1874. The substantial geographic and economic development variation in regions at the time of the bond issue provides identification in assessing the relative impact of credit availability on subsequent firm activity. It is also indicative of the exogeneity of the commutation policy given pre-existing conditions, which has been confirmed by earlier empirical analysis (Basco and Tang, 2020).

[Figure 2 here]

An important consideration is whether the samurai bonds were exclusively channeled into banks, which is the channel utilized in our theoretical model. While it was possible for samurai to sell their bonds and use the funds to directly invest into firms, thus circumventing the financial intermediation of banks, there is no documented evidence that this occurred systematically (Goldsmith, 1983, pp. 23-24). Rather, anecdotal studies indicate that samurai were less entrepreneurial than the farming or merchant classes and preferred bureaucratic or military employment, which corresponded to their higher education levels and historic

[21] At the time of the samurai stipend commutation, there were eight (out of 47) prefectures that did not exist formally as they were part of other prefectures: Fukui, Kagawa, Miyazaki, Nara, Saga, Tokushima, Tottori, and Toyama. These are given the same per capita bond values as their former larger entities, which included the populations of these later administrative units. Another prefecture, Okinawa, was not formally incorporated into Japan until 1879, and thus did not receive any bonds at the time of the commutation.

occupations (Kinmouth, 1981, pp. 35 and 79). Government policies to induce samurai to pursue land reclamation or colonial expansion attracted approximately 30,000 samurai and their families by the late 1880s out of two million samurai that lived in country at the time (Harootunian, 1960, pp. 437-439). Separate government loans to former samurai for the specific purposes of starting businesses totaled ¥5.3 million, or less than one fifth of the value of samurai ownership in national banks (*ibid*, p. 443). What is unknown is the share of funds invested into these enterprises that was derived from these loans versus the original commutation bonds, and the relative magnitudes suggest an emphasis on the latter per our model. To test for the extra-banking channel that the bonds may have utilized, we use a pseudo-IV specification as described in the section on empirical strategy.

## *IV. A Simple Model of Banks, Firms and Credit Rationing*

We consider a banking economy with adverse selection and credit rationing. There exists a large corporate finance literature examining the interaction between banks and credit rationing; see, for example, the seminal paper of Stiglitz and Weiss (1981) or the standard formulations in Freixas and Rochet (2008). Our simple model is a general equilibrium version of the model in Mankiw (1986), where we introduce households to endogenize the cost of banks of obtaining funds. This modification allows us to investigate how a shift in the endowment of households towards the present increases savings and, thus, bank capital through deposits. We start by solving the model (Sections IVa and IVb), and then we discuss how the findings can be applied to the introduction of samurai bonds in nineteenth century Japan and derive testable predictions (Section IVc).

*IVa. Environment*

In our economy there are three agents: (i) a bank, (ii) households, and (iii) entrepreneurs. The interaction between agents is summarized in Figure 3. We assume a two-period economy where in each period households have some endowment. In the first period, households choose to consume part of this endowment and invest the remainder as bank deposits. Entrepreneurs will invest in the first period and produce the consumption good in the second. Bank capital allocated to each firm is determined in equilibrium, and banks then transfer the savings from households, via deposits, to entrepreneurs as loans (Freixas and Rochet, 2008).

[Figure 3 here]

We assume that households can only lend to entrepreneurs through banks, which act as intermediaries. That is, there is no equity market. This assumption is consistent with underdeveloped financial systems as banks reduce the costs of acquiring and evaluating firm information that would be unaffordable to individual households (Levine, 2005).[22] Additional considerations favoring intermediation include diversification of household savings in otherwise indivisible large entrepreneurial investments as well as improved intertemporal risk sharing.

***Households*** There exists a representative household that makes consumption and savings decisions. In the first period, they receive some endowment ($\omega_1$), which they can either consume, save by making a deposit in the bank ($D^h$), or both. In the second period, they

[22] This assumption also aligns with the historical experience of Japan, which had two stock exchanges established in 1878 in Tokyo and Osaka but these were mainly for large scale enterprises like railways and cotton spinning factories. These firms were few in number for our period of analysis and represent 7 percent of our sample (28 spinning, 3 railways).

consume their endowment ($\omega_2$)[23] plus any returns from their deposits ($R_d D^h$). We take the price of the good in the first period as the numeraire. For simplicity, we assume, without loss of generality, the standard log-utility with an exogenous discount factor, $\rho < 1$.[24] Therefore, the problem of household is as follows:

$$Max\ U(c_1, c_2) = \ln(c_1) + \rho \ln(c_2) \qquad (PH)$$

$$\text{subject to} \quad \omega_1 = D^h + c_1$$

$$pc_2 = R_d D^h + \omega_2$$

***Entrepreneurs*** There exists a continuum of entrepreneurs between 0 and 1, indexed by *n*. Each one has access to an investment project, with unit cost, to produce the homogenous consumption good in period 2. The project is characterized by two parameters $(X_n, \theta_n)$. $X_n$ is the expected revenue of the project and $\theta_n$ is the probability of success.[25]

We assume that there are two groups of entrepreneurs. A fraction $1 - \mu$ of is endowed with 1 unit of capital, whereas the remaining entrepreneurs have no endowment and require a bank loan to fund their investment. This assumption allows for firms to exist before the emergence of banks.

[23] In a more general model, if we assumed that labor is used to produce the good, the endowment in the second period would be the wage. In our environment, this can be thought of as home production or the original stipends that samurai received.

[24] For our argument, we need that, as a response to a change in the endowment tilted towards the present, households will increase savings. To obtain this result, we do not need to assume log-utility but only that households are risk-averse and thus will smooth their consumption. Since this saving decision is not critical to obtain testable predictions from our model, we use log-utility for ease of exposition.

[25] Expected revenue, $X_n$, obtains from the price of the consumption good and the production function. For example, this could be written as $X_n = p\theta_n y_n$ and the production function as $y_n = f_n(I = 1)$, since firms invest one unit. We choose not to unbundle expected revenues for ease of exposition.

We assume that $X_n = X > 0$ is constant for all firms. We also assume that for financially constrained firms, $\theta_n \sim U[0,1]$, whereas for financially unconstrained firms the average probability of success is $(1 + a)/2$ with *a>0*. That is, we assume that all firms have the same expected return but investment risk is heterogenous across firms. In addition, we assume that financially unconstrained firms on average have a lower failure rate than constrained ones. This assumption could be rationalized as a moral hazard story, where unconstrained firms exert more effort since they use their own resources and bear all the investment risk. In other words, the debt contract implies that if the financially constrained firm fails, which happens with probability 1- $\theta_n$, the firm does not repay the loan.[26] A similar argument of having "skin-in-the-game" is used to emphasize the importance of collateral (e.g., Kiyotaki and Moore, 1997). Per Mankiw (1986), we assume a uniform probability distribution and constant expected returns to obtain a closed form solution.

The financially constrained entrepreneur $n$ solves the following problem,

$$Max\ \pi^n = X_n l_n - \theta_n R_b l_n \qquad \textit{(PF)}$$

subject to $l_n = \{1,0\}$

This entrepreneur $n$ accepts the loan from the bank if $X_n = X > \theta_n R_b$. Note that only the riskiest entrepreneurs (i.e., those with lower $\theta_n$) accept the contract. That is, if there is rationing, the safest financially constrained entrepreneurs will be unfunded and unconstrained firms invest their endowment since $X > 0$.[27] If firms make profits, they purchase the consumption good alongside households.

[26] Per the literature, we take the use of debt contracts as given. However, in the context of costly state verification models, they have been shown to be optimal to other forms of financial contracts; see Townsend (1979) or Williamson (1987).

[27] In principle, financially unconstrained firms could also make a deposit in the bank with their endowment. However, they will decide not to do it because in equilibrium the returns on their investment are larger than the return to deposits (Section 2.2).

***Banks*** The representative bank acts as an intermediary between firms needing funds and households providing savings. We assume that the bank does not know the risk of each firm asking for a loan but it knows the distribution of risk in the economy. This assumption implies that the bank offers the same debt contract to all firms demanding a loan. Therefore, the problem of the bank is:

$$Max\ \pi^B = \beta R_b L_b - R_d D^b \qquad \textit{(PB)}$$

$$\text{Subject to } L_b = D^b$$

where $\beta$ is the average probability of success among firms taking the loan, $R_b$ is the gross return of the loan, $R_d$ is the gross return of the deposits, $L_b$ are the total loans that the bank makes, and $D^b$ are total deposits. The constraint implies that there will be no idle resources in the economy. The bank uses all deposits to make loans. Note that bank participation requires $\beta R_b = R_d$. This equation implies that expected revenues of the bank are equal to the expected cost of raising funds. In other words, since banks act only as intermediaries, the expected return of the banks is the same as the returns to savings of households.

### *IVb. Solving the Equilibrium*

***Definition*** *A general competitive equilibrium is a set of interest rates* $(R_b, R_d)$*, allocations* $(D^h, D^b, l_n, L_b, c_1, c_2)$*, number of firms receiving loans* $(L_N)$*, and total number of active firms* $(N)$ *such that: (i) households, firms and bank solve problems PH, PF and PB, respectively, and (ii) all markets clear. There are three market clearing conditions: (i) goods market (S=I), (ii) deposit market* $(D^h = D^b)$*, and (iii) credit market* $(L_b = L_N)$.

**Assumption A1 (Existence of Credit Market)**

To obtain an equilibrium in the credit market, we assume that X>$2R_d$. This assumption is more likely to be satisfied when the average return of the investment projects of entrepreneurs is high and/or when the return to deposits is low. An analogous assumption is discussed in Mankiw (1986).[28]

We start by solving the credit market problem, which is at the core of this paper.[29] Two equations determine the return on loans, $R_b$, as a function of the exogenous expected revenue of the project $X$ and the endogenous return on deposits:

$$\beta R_b = R_d \qquad (1)$$

$$\beta(R_b) = E[\theta | X > \theta_n R_b] \qquad (2)$$

Equation (1) is the participation constraint of the bank as discussed above. Equation (2) acknowledges that the average probability of success of the firms taking the loan depends on the debt contract. In addition, from the financially constrained firm's decision problem, the bank knows that the riskiest entrepreneurs, low $\theta_n$, will be the ones accepting the loan.

Assumption A1 implies that the unique equilibrium is $R_b = 2R_d$.[30] Given this equilibrium, we obtain the fraction of constrained firms that have access to funds. All constrained firms with $\theta_n < \bar{\theta} = X/2R_d$ accept the debt contract. Given A1, $\bar{\theta} > 1$, and, thus, all firms obtain funds. This is a special case given our uniform distribution and simplifying

[28] The return to deposits, $R_d$, is endogenous and it will depend in equilibrium on $\omega_1, \omega_2$, and $\mu$. Thus, we could write assumption A1 in terms of these parameters. However, for ease of exposition, we prefer to state the assumption in terms of $R_d$.

[29] Since we have three markets in this economy, by Walras Law we focus on the deposit and credit markets to solve for a general equilibrium.

[30] Notice that equation (2) implies that $\beta$ equals to ½ if X>$R_b$ and it is equal to X/2$R_b$ otherwise. Assumption A1 implies that case 1 applies. Then, just plug $\beta$ into equation (1) to obtain the result. If assumption A1 is violated, the two equations do not intersect, and, thus, the only equilibrium is no trade (credit collapses as discussed in Mankiw, 1986).

assumptions. In general, there will be rationing, $\bar{\theta} < 1$, and only the riskiest projects will be funded. In any event, in our case the total loans used by the bank to fund firms is $L_b = L_N = \mu$.

To solve for the deposit market equilibrium, we must have $D^b$ equal to $D^h$. We know that the deposits of the bank ($D^b$) equals loans ($D^b = L_N$), which we have just derived. Thus, we only need to find the demand for savings ($D^h$). From the household problem, it follows that $c_1 = \frac{1}{1+\rho}\left(\omega_1 + \frac{\omega_2}{R_d}\right)$. Thus, $D^h = f(\omega_1, \omega_2, R_d) = \frac{1}{1+\rho}\left(\rho\omega_1 - \frac{\omega_2}{R_d}\right)$. Note that $f_{\omega_1} > 0$, $f_{\omega_2} < 0$, and $f_{R_d} > 0$. That is, savings are increasing with both the endowment in first period and the return to savings, and they decline with future endowment. Given that $D^b(R_d)$ is constant and $D^h(R_d)$ is increasing with $R_d$, there will be a unique equilibrium given by:

$$D^b(R_d) = D^h(R_d), \text{ where } D^b(R_d) = \mu.$$

$$D^h(R_d) = f(\omega_1, \omega_2, R_d)$$

**Result 1:** The equilibrium deposit interest rate $R_d(\omega_1, \omega_2, \mu)$ is decreasing with the ratio between current and future endowments ($\omega_1/\omega_2$),

*Proof. In equilibrium* $R_d\,(\omega_1, \omega_2, \mu) = \frac{\omega_2}{\rho\omega_1 - (1+\rho)\mu}$.[31] Note that this expression increases with $\omega_2$ and decreases with $\omega_1$, and thus decreases with $\frac{\omega_1}{\omega_2}$.

Result 1 implies that when there is a change in endowment shifted towards the present, the deposit interest rate declines. The reason is that to smooth consumption, households decide to increase savings since they will be poorer in the future than expected. This increase in savings translates into a decline in the deposit interest rate since investment is unaffected. We

[31] In principle, this expression could be lower than one. We assume that parameters are such that this is not the case.

apply this standard result from intertemporal trade models to the historical context of samurai bonds in the next section.[32]

*IVc. Application: Late nineteenth century Japan*

In this section we explain how our model can be used to understand the effect of the bond conversion of samurai stipends and to derive the empirical predictions that we will take to the data in the next section.

**Two Cases**

Case 1 (No Banking Economy): Pre-Samurai Bond Issue, $X<2R_d$

Case 2 (Banking Economy): Post-Samurai Bond Issue, $X>2R_d$

In the absence of samurai bonds, prefectures did not generate enough savings, and as implied by Case 1 assumption A1 is violated. Thus, there is no banking activity. We assume that, due to the introduction of samurai bonds, their endowment stream shifted toward the present. As shown in Result 1, a shift in endowment toward the present makes assumption A1 more likely to be satisfied. Therefore, Case 2 implies that after the introduction of samurai bonds, assumption A1 is satisfied and there is a credit market.

These assumptions on the shift in endowment are consistent with the historical evidence. Samurai were given a bond, redeemable after 5 and up to 30 years, in exchange for their hereditary annual stipends. In addition, the value of the bond was on average lower than the net present real value of the stipends they replaced (Flath, 2014). These two conditions are enough to rationalize, according to the model, an increase in savings demand. Moreover, samurai were encouraged to use these bonds to fund banks as indicated by the revision to the

[32] For more information, see, for example, the treatment in Obstfeld and Rogoff (1996).

National Banking Act in 1876 (Tomita, 2005). This allowed these bonds to be used as paid in capital for national banks. While samurai could use the bonds to self-finance and become an entrepreneur themselves, it is unclear how many did so and once the bonds are sold, the identity of the holder no longer is relevant. What is clear is that all prefectures that received samurai bonds had some invested into the national banks that were established thereafter, with capital ownership shares ranging from 6 to 94 percent. Banking activity was also negligible before the issuance of samurai bonds, and both the extensive and intensive development of the modern financial system took place following this reform (Shizume and Tsurumi, 2016 and Tang, 2014). We choose to focus on the banking channel because this can be precisely tested with empirical data across regions during this period, whereas direct investment into enterprises with these bonds is not documented. Thus, in this paper, we assume that samurai bonds increased the demand for deposits, which enabled banks to act as intermediaries to fund entrepreneurs.

Based on the two regimes describes above, we now discuss two results comparing how the number of firms, their probability of failure, and average firm destruction change under the regimes preceding and following the issuance of samurai bonds.

**Result 2:** In the Pre-Samurai Bond regime (Case 1),

(1) The number of firms is $N^{Pre} = 1 - \mu$;

(2) The average probability of failure of individual firms is $\frac{1-a}{2}$; and

(3) Average firm destruction in the region is $\frac{1-a}{2}(1 - \mu)$.

This result follows from the definition of pre-samurai bond regime. Given case 1, there is no credit market because there are no enough household savings in the economy (i.e., $R_d$ is too high). Thus, only financially unconstrained firms are able to fund their investment projects. It then follows that the average success rate of these firms is $\frac{1+a}{2}$.

**Result 3**: With Post-Samurai Bond regime (Case 2),

(1) The number of firms is larger $N^{Samurai} = (1-\mu) + \mu * min\{\bar{\theta}, 1\} = 1 > (1-\mu)$=$N^{Pre}$;

(2) The average probability of failure of the newly created firms is larger than the old ones, $(1-\beta) = \frac{1}{2} > \frac{1-a}{2}$; and

(3) Average firm destruction in the region is higher, $(1-\beta)N^{Samurai}$>$\frac{1-a}{2}N^{Pre}$.

In this regime, we are in the environment discussed in Section 2.2 (i.e., Assumption A1 applies). There exists a credit capital market and financially constrained firms receive funds. The proof of the first part of Result 3 follows from the fact that there is a fraction 1-$\mu$ of financially unconstrained firms and a mass of $min\{\bar{\theta}, 1\}$ of the constrained firms obtains funds from banks. Since $\bar{\theta} > 1$, it implies that all firms obtain funds. The second statement was proved in Section 2.2. (i.e., given Assumption A1, $1-\beta = \frac{1}{2}$). Finally, the third statement combines the two previous results. This statement in turn leads to the following empirical predictions.

**Empirical Predictions**

(1) The lifespan of firms decreases with bank capital.

(2) Average firm destruction increases with bank capital.

(3) Average firm creation increases with bank capital.

Empirical prediction 1 follows directly from Result 3.2. Firms created with bank capital are, on average, more likely to fail. Theoretically, the reason is that there is adverse selection in the firms that get bank capital. Empirical prediction 2 follows directly from Result 3.3. With bank capital, there are more firms in the region and these firms are, on average, more likely to exit. Empirical prediction 3 follows from Result 3.1.

**Heterogenous Effects**

In our model, we assume that all firms belong to the same industry. It is immediate to see that the empirical predictions would be exacerbated in industries with a larger share of financially constrained firms. For example, let us assume that there are two industries: manufacturing and retail, with $\mu = \mu^{manuf} + \mu^{retail}$ and $\mu^{manuf} > 0 = \mu^{retail}$. In this extreme example, all the effects of bank capital would concentrate in the manufacturing sector (i.e., the one with more financially constrained firms); see, for example, Rajan and Zingales (1998). The effect of bank capital is exacerbated in the industries more dependent on external finance (larger $\mu$). The assumption $\mu^{manuf} > \mu^{retail}$ seems to apply to late nineteenth century Japan. Manufacturing firms needed some large initial investment, whereas retail firms were typically self-employed workers selling their products. In any event, we will assume $\mu^{manuf} > \mu^{retail}$ and explore whether effect of bank capital was heterogenous across sectors in our empirical analysis.

## *V. Empirical Approach and Data Sources*

### *Va. Empirical Strategy*

Following the empirical predictions derived above, the main variable of interest is bank capital per capita. Bank capital was heterogenous across prefectures in Japan, which allows us to examine the effect of variation in bank capital on the life cycle of firms. A concern with directly using bank capital per capita in a given prefecture is endogeneity as it may be correlated with the demand of credit in that particular prefecture. To identify the credit supply channel, we consider an instrument variable approach. We instrument bank capital per capita with the value of samurai bonds per capita in that prefecture, which was the exogenous shock described in the theoretical model from the previous section. The exclusion restriction is satisfied as the bond issuance occurred before the development of the banking system in Japan, so there is no simultaneity concern. Both banking series are shown in Table I along with reported the total ownership share of samurai of national banks. Even though we have only direct evidence of samurai owning national banks, the effect of samurai bonds should be widespread and affect all banking system and we report estimates for both series.

As a robustness check, we use samurai bonds per capita directly in our regression instead of bank capital, which can be interpreted as a pseudo-IV specification. The main advantages of this strategy are that our sample size increases since banking data are available only after 1880; and the specification can be interpreted as an event study (i.e., a pre- and post-treatment comparison) since the value of samurai bonds was zero before they were issued. Before the stipend commutation, the four national banks that existed totaled ¥5 million in assets nominal terms, of which ¥3 million were in the form of government securities (Goldsmith, 1983, Table 2-2). This contrasts with the ¥102 million in the 151 banks that existed in 1880, with ¥44 million in government securities that now included the samurai bonds. Thus, while comparatively negligible, bank capital was not zero nor homogenous across prefectures. If the results of the pseudo-IV specification substantially differ from the IV strategy, we may conclude that the banking channel was not the main channel through which samurai bonds affected the economy.

We test each of the three predictions from the theoretical model. Our main empirical prediction is on lifespan, which can be tested using individual firm-level data. Our OLS regression model is as follows,

$$LifeSpan_{it} = \beta * B_{it} + \gamma X_i + \delta_j + \delta_t + \varepsilon_{it}, \quad (3)$$

where $LifeSpan_{it}$ is the number of years that a firm created in prefecture *i* in year *t* survives, $B_{it}$ is the per capita value of bank capital in prefecture *i* in year t, $X_i$ are prefecture level control variables, $\delta_j$ are sector fixed effects, and $\delta_t$ are year fixed effects. Control variables for initial conditions include income, population, and urbanization of the prefecture in 1874. Sector fixed effects control for potential idiosyncratic differences between four major sectors.[33] Year fixed effects control for aggregate shocks taking place in Japan during these years.

The sample coverage is firms born between 1880 and 1890, since banking data prior to this date do not exist. That said, the year marking firm exit is not constrained to this time range. The empirical prediction is $\beta < 0$, meaning we expect the lifespan of firms decreases with credit supply. In other words, prefectures with higher per capita samurai bond value generated more bank capital, which was allocated to on average riskier firms due to adverse selection. Separately, to account for potential endogeneity in bank capital, we instrument $B_{it}$ with samurai bond value per capita, $S_{it}$, in the above specification, equation (3) and report both the first stage F-statistic and coefficient on samurai bond value.

Our pseudo-IV specification takes the following functional form,

$$LifeSpan_{it} = \beta * S_{it} + \gamma X_i + +\delta_j + \delta_t + \varepsilon_{it}, \quad (4)$$

Note that the only difference with equation (3) is that we test the overall effect of samurai bonds. If samurai bonds had an effect beyond the banking channel, we could observe a different $\beta$. In this case, our sample period ranges from 1870 to 1890 since the value of samurai bonds

[33] Sectors include primary, manufacturing, finance, and services (retail, transport, and other services).

was zero before their issuance.[34] Thus, $S_{it}$ takes the value of zero before the bond conversion in 1876 and equals $S_{i1876}$ thereafter. We transform the per capita bond values with the inverse hyperbolic sine function instead of logs to retain zeroes before the bond conversion. The empirical prediction is the same as above, $\beta < 0$.

To test the firm entry and exit predictions (Predictions 2 and 3 in Section III), we use analogous regression specifications. One main difference in these specifications is that the unit of analysis is the prefecture instead of individual firms. In addition, given the sparsity of events (creation/destruction) in our sample and to conserve degrees of freedom, we use five-year periods instead of years and include the latter as fixed effects. Periodization follows the historical evidence on economic cycles in Japan: (i) pre-samurai bond conversion (1870-75), (ii) economic boom after the samurai bond (1876-80), (iii) the Matsukata deflation (1881-85), and (iv) the recovery period (1886-90).[35]

The analogous version of equation (3) is the following,

$$N_{ipj} = \beta * B_{ip} + +\gamma X_i + +\delta_j + \delta_p + \varepsilon_{it}, \quad (5)$$

where $N_{ipj}$ is the average yearly per capita number of firm entries or exits in prefecture *i* in period *p* and sector *j*. Since both firm entry and exit or measured as count events, instead of the OLS model for lifespan, we use Poisson maximum likelihood for estimation. We also use the same control variables as above except for the substitution of period ($\delta_p$) for year fixed effects. The empirical prediction for both firm creation and firm destruction is $\beta > 0$. That is, in prefectures abundant with samurai bonds, more entrepreneurs received funds from banks but these firms were on average riskier due to adverse selection. In other words, an increase in

[34] This is imprecisely measured since there were bonds issued in 1873 and 1874 totaling ¥36 million, or 17 percent of the ¥210 million for all samurai bonds. Unfortunately, we do not have prefectural disaggregation for the bonds issued before 1876, only the total amount by prefecture.

[35] See, for example, the gross national income estimates in Japan Statistical Association, 1987, Table 13-3.

bank capital is associated with more firm creation and destruction. Furthermore, we also report the estimates using our IV with samurai bond per capita, $S_{ip}$, and pseudo-IV approaches, the latter following the form:

$$N_{ipj} = \beta * S_{ip} + +\gamma X_i + +\delta_j + \delta_p + \varepsilon_{it}, \qquad (6)$$

The empirical predictions are also the same as above: for both firm creation and destruction, $\beta > 0$.

To add precision to our results, we separately estimate equations (2) to (6) for the two main sectors of manufacturing and services (which also includes retail and transport).[36] As discussed at the end of the previous section, we expect that the effects of bank capital being amplified in the manufacturing sector given its greater dependence on external finance. That is for lifespan, $\beta^{mfg} < \beta^{serv}$, and for both firm creation and destruction, $\beta^{mfg} > \beta^{serv}$.

### *Vb Data Sources and Measurement*

Our firm data come from corporate genealogies that provide some of the oldest existing evidence of firm establishment in Japan. Collected by Japanese business historians from 1,089 corporations listed in the Tokyo Stock Exchange in 1984, the genealogies contain over 14,000 unique entries of firm establishment (Yagura and Ikushima, 1986). The qualitative nature of these sources notwithstanding, there is information on the dates of firm appearance, industry classification, ownership type and change, and geographical location.[37] Structured as firm level observations, these data provide a systematic way to examine firm dynamics at the extensive

[36] There are too few primary sector firms to generate statistically meaningful estimates. See Table 4 for summary statistics of our dataset.

[37] We refer to each entry as a firm, although the definition of the business enterprise (e.g., sole proprietorship, partnership, and corporation) was not formalized until the promulgation of the 1893 Commercial Code; see Onji and Tang (2016) for more information.

margin, such as the number of new establishments in a given year, the dates of their death or reorganization, and thus the longevity of individual firms.

Given that firms listed in genealogies are subject to survivorship bias, there may be selection by industry and viability. However, this issue is partially mitigated by our research design since we compare only outcomes for firms within our sample, all of which are affected by this potential bias. An additional point is that the genealogies include both direct line parent firms that survive as well as any unsuccessful firm whose assets were transferred to a surviving line firm (as well as their ancestor firms). Moreover, the firm observations used in this analysis, from the year 1870 to 1890, have the least mechanical selection of survivorship since the number of firms increases over this period whereas for the genealogies as whole the number decreases over time. Earlier scholarship has also indicated that the sample of firms in the genealogies is generally reliable in representativeness and regional distribution, with a Pearson's correlation coefficient of 0.97 at the 1 percent level of statistical significance for non-financial corporations in the dataset and with national aggregates when the latter area available.[38] More importantly, we use these genealogical data since the 1876 commutation of samurai stipends into government bonds precedes the availability of official firm data starting in 1893. These firm observations also allow us to examine gross flows of entry and exit, unlike studies that rely on periodic censuses.

Finally, a novel feature of our dataset is that it includes all firms by ownership type, including sole proprietorships, partnerships, and corporations for a developing economy. Unlike other studies that focus on the behavior of corporations (Gregg and Nafziger 2019), which have better documentation, our analysis does not select on firm size and thus can show

[38] See Onji and Tang (2017) for a more detailed discussion of the dataset. These data have been used to analyze the adoption of foreign technology in Japan (Tang, 2011), the impact of tax reform on incorporation (Onji and Tang, 2017), and the extensive growth of financial intermediation and modern industries (Tang, 2013).

how informal enterprises without financial records may also respond to changes in the economic environment including shocks to credit supply and institutional reform. This is particularly salient in a developing economy context as credit availability is more constrained, which disproportionately affects younger, smaller, and less efficient enterprises (Aghion et al., 2007). These smaller firms are more likely to exit but are also responsible for a significant share of job growth and economic dynamism (Brown et al., 2015).

[Table 2 here]

Our analysis focuses on the sample of 440 firms that were established between 1870 and 1890 in 42 prefectures across the country; their summary statistics on entry, exit, and lifespan are shown in Table 2.[39] We can further disaggregate our sample across four major sectors: primary (18), manufacturing (145), finance (224), and other services (53). We exclude firms that were established before 1870 and those in Okinawa and Hokkaido, which were colonial territories prior to the bond issuance. We do include firms located in prefectures that were not autonomous prior to the 1876 bond issuance, using the per capita bond value for the older, composite-level prefecture as shown in Table 1.

To clarify the definitions of entry and exit, we consider firm entry as the first appearance of a firm in a corporate genealogy (Onji and Tang, 2017); if there are multiple references to the same firm across different genealogies, the earliest record is used. A firm that merged with another is not considered a different firm if the name remains the same, even if the ownership type or location changes. A firm that changes name without any merger or acquisition activity is still considered the same firm. For firms emerging from merger activity and with a name change, the oldest firm participating in the merger is considered the ancestor

[39] The five excluded prefectures are Hokkaido, Kagawa, Miyazaki, Nara, and Okinawa. Both Hokkaido and Okinawa were not considered part of Japan proper until after the late 1870s, postdating the historic distribution of samurai, and the remaining prefectures do not have firms recorded in the genealogies during this period.

firm and continues that firm's record and birthdate. Firm exit is when a firm is merged into another firm or undergoes liquidation, with its assets transferred to another firm. Consequently, firm lifespans are measured as the difference between exit and entry years.[40] A stylized example of a firm genealogy is in Figure 4.

[Figure 4 here]

As shown in Table 2, the number of new firm establishments in our full period of analysis (1870-1890) conforms with our priors about credit access. Both entry and exit increase significantly after the 1876 bond issuance, but the largest relative change occurs for entry in the five years after the bond issue while for exit it occurs during the macroeconomic contraction in the first half of the 1880s. Lifespan is also lower for firms created in the 1870s, which includes the years immediately following the bond issue, and there is more heterogeneity in age by sector than in the years before 1876 and after 1880.

Our financial data comprise three separate series: national bank capital, total bank capital, and samurai bond value. Both bank capital series are annual (1880-1890) and were compiled from all prefectures by the Cabinet Bureau of Statistics (Japan Statistical Association, 1962). The 1876 data on samurai bonds by prefecture were recorded by the Japanese Ministry of Finance (1904). All three series are in nominal yen.

Since the bond value per capita variable is time invariant, we are unable to include prefecture dummies. Thus, we control for other observable differences with initial prefecture-level income data (Fukao et al, 2015), demographic measures of population, and a proxy of urbanization (i.e., population density by habitable land gradient) (Japan Statistical Association, 1962). These variables also partly address the issue of exogeneity of bond distribution across regions. In principle, it may be the case that prefectures receiving a greater credit supply shock

[40] See Onji and Tang (2017, data appendix) for a more detailed description of the corporate genealogies used in this analysis.

were ex ante different in their levels of economic activity and market access. Earlier studies (Tang, 2016; Basco and Tang, 2020) indicate that initial income levels were not associated with either the placement of the railway stations or the per capita value received in bonds. This endogeneity concern was also discussed in Section III, where we showed the geographical distribution of bond per capita in 1876 and prefectural output per capita in 1874 (Figure 2).

## *VI. Empirical Results*

### *VIa. Effect of Bank capital on Lifespan*

We start with the most salient empirical prediction of the model. Our model predicts that the lifespan of firms decreases with bank capital. Table 3 reports the coefficients of equation (3) using the total bank capital and national bank capital series. The top panel shows the estimates using the OLS regression model while the bottom panel the analogous 2SLS specification. Our dependent variable is the lifespan of a firm that is created in a given year and prefecture between the years 1880 and 1890. All specifications include year and sector fixed effects, and robust standard errors are clustered by prefecture.

[Table 3 here]

As a first pass, we report in Columns 1 and 3 the baseline coefficient on banking without adding the prefectural control variables for each bank capital series, respectively. We find that, consistent with the prediction of the model, the coefficient of bank capital is negative and statistically significant in both capital series. The difference between the two bank capital series is that while the impact of the samurai bond issuance should theoretically affect the entire banking sector, our estimates for national banking are more precise since we have only direct estimates of samurai ownership in these banks. Moreover, national banks were created as response to the bond issuance and largely preceded the emergence of other banks in the country. Including the prefectural control variables in Columns 2 and 4 does not change the sign and both coefficients remain statistically significant. Our interpretation of this finding is that firms in prefectures with increased bank capital are shorter lived.

Given possible endogeneity between bank capital and prefectural demand, we use the samurai bond values from 1876 as an instrument for both bank capital series, shown in the bottom panel. As expected, the IV coefficients are larger than their OLS analogues in absolute value, which may be correcting the downward bias from the OLS specification. Adding in our prefectural control variables in Columns 2 and 4, the coefficient on bank capital remains negative and statistically significant. For both of these IV specifications, bank capital increases in statistical significance compared to their OLS equivalents and the F-statistic of joint significance increases with the added control variables. Our test for weak instruments also indicates that samurai bond value is a highly relevant instrument for the bank capital series.[41] Quantitatively, according to our preferred specification (bottom panel, column 2), a 10 percent increase in total bank capital per capita decreases the number of years of the firm by 32.1 percent.

Since sectors may vary in their external finance dependence, we report in Table 4 the coefficients from running equation (3) for manufacturing and services separately. Columns 1 and 2 report the results for all bank capital per capita and columns 3 and 4 report the results when using National Banks capital per capita. All specifications include year fixed effects. For ease of exposition, we only report the regressions when including all control variables for both the OLS and IV specifications.

[Table 4 here]

In the top panel, the coefficients for regressing manufacturing firm lifespan on bank capital are negative and statistically significant when using both measures of bank capital. Quantitatively, a 10 percent increase in total bank capital per capita decrease the number of

[41] Based on benchmark F-statistic thresholds in Stock and Yogo (2001).

years of the firm by 7.4 percent. In contrast, the results for service firm lifespans in the bottom panel show that the coefficients on bank capital are not statistically different from zero. The fact that the effect of bank capital is exacerbated in the manufacturing sector is consistent with bank capital easing financial conditions of financially constrained firms (Rajan and Zingales, 1998).

### *VIb. Effect of Bank capital on Firm Exit*

Our model predicts that bank capital abundant prefectures should experience increased firm exit, and Table 5 reports the results from running equation (5). The dependent variable is the number of firms exiting in a given prefecture, sector, and period. All specifications include sector and period fixed effects, and robust standard errors are clustered at the prefecture level. The top panel reports the results when using a Poisson regression model for both banking series while the bottom panel uses a generalized method of moments (GMM) IV Poisson model to account for possible endogeneity.[42]

Consistent with our theoretical predictions, the coefficient on bank capital is positive and significant in specifications for both bank capital series and both regression models. Unlike in the lifespan regressions, adding prefectural control variables reduces the bank capital coefficients but does not affect statistical significance. Even more interesting is that the added control variables are generally not statistically significant, which suggests that bank capital availability is the main determinant of firm exit. In particular, the results from the IV model indicates that the emergence of samurai bonds had, through the banking channel, increased firm destruction. Quantitatively, according to our preferred specification (bottom panel,

[42] Estimates from our Poisson regression specifications are also robust to using the negative binomial distribution (not reported).

column 2), a 10 percent increase in total bank capital translates into an increase of firm exit of 7 percent.

[Table 5 here]

Table 6 reports the effect of bank capital on firm exit for the manufacturing sector. We cannot report the results for services because of small sample size. All specifications include period fixed effects and all prefectural control variables. Similar to the results for firm exit in all sectors, the coefficient of bank capital is positive and significant across both bank capital and model specifications. Quantitatively, a 10 percent increase in total bank capital (Column 2) translates into an increase in firm exit of 5.5 percent. We cannot compare the results of manufacturing with services; however, our empirical results for manufacturing firms is consistent with the predictions from our theoretical model.

[Table 6 here]

*VIc. Effect of Bank capital on Firm Entry*

Our third measure of firm dynamics is on firm entry, and Table 7 reports the coefficients from running equation (5) that regresses the number of new firms established in a prefecture for each sector and period on bank capital and other variables. As with the firm exit estimates, specifications include sector and period fixed effects and the standard errors are clustered at the prefecture level.

[Table 7 here]

The bank capital coefficient, as predicted by the model, is positive in all specifications. This suggests that firm entry is positively associated with bank capital availability. Coupled with the results from firm exit, additional bank capital increases firm dynamism in both creation and destruction. However, in the full specification with all prefectural control variables in the IV specification is no longer statistically significant for either bank capital series. As we mentioned, our measure of bank capital may be capturing some positive demand shock that is conducive to firm creation, which is removed in the IV specification. According to these results, samurai bonds may not be enough to generate a generalized increase in firm creation across all sectors. This result is consistent with previous research (Basco and Tang, 2020) that fails to document effects from the bond issuance on aggregate output.

Nevertheless, the sector-specific estimates shown in Table 8 provide some nuance and explanation to the economy-wide results. In the top panel for manufacturing firms, the coefficient on both bank capital series is positive and statistically significant across both Poisson and IV Poisson specifications. In contrast, the bottom panel for service firms shows a negative and statistically significant coefficient in the IV Poisson specifications. This decomposition of the economy by sector indicates that entry behavior was highly heterogenous and masked in the aggregate. Quantitatively, according to our preferred specification for manufacturing (column 2), a 10 percent increase in total bank capital increases firm entry by 1.6 percent. The equivalent for a service sector firm is -3 percent, although the service sector results may be sensitive to the small sample size. That said, the results are consistent with the predictions from our theoretical model, where the effects of bank capital availability are amplified in sectors with greater external financial dependence (e.g., manufacturing vis-a-vis services).

[Table 8 here]

*VId. Effect of Samurai Bonds*

Our results thus far have used bank capital as the main channel affecting firm dynamics. The advantage to this approach, whether directly or instrumented with samurai bond values, is that bank capital maps clearly with our theoretical model. At the same time, relying on bank capital data has some limitations and may not fully capture all channels of finance available to firms. To address these points, we provide a complementary exercise where instead of used as an instrument, we regress firm outcomes directly on samurai bond values. This allows us to increase the sample size of firms used in the analysis, to identify a pre-period where neither bank finance or samurai bonds was readily provided to firms, and to check if firms accessed funds outside formal bank intermediation. In other words, we can set up an event study analysis and compare the magnitudes of coefficients on samurai bond values versus those on bank capital. Table 9 reports these estimates from running the lifespan regression model (equation 4) and the firm entry/exit model (equation 6) for all sectors, manufacturing, and services using firm data between 1870 and 1890. All specifications have the same fixed effects and prefectural control variables as in the previous analogous tables and robust standard errors clustered by prefecture.

[Table 9 here]

In the top panel for firm lifespan, the coefficient on samurai bond value is negative and statistically significant for firms across all sectors (Column 1) and in manufacturing (Column 2). The lifespan of service sector firms does not appear to be affected by samurai bonds. The quantitative effects of these regressions are very similar to the analogous IV regressions (Tables 3 and 4), which suggest that most of the effect of samurai bonds was through the banking channel.

The middle and bottom panels report the effects of samurai bond value on firm exit and entry, respectively. The results are also very similar to those on bank capital as reported in the earlier corresponding tables (Tables 5 to 8). As predicted, samurai bonds had a positive and significant effect on firm exit across all and individual sectors. However, the positive effect of samurai bonds on firm entry only takes place in the manufacturing sector while the opposite is true for service sector firms. Again, while the sample of service sector firms has increased with the extension of the period of analysis, the size may still be relatively small for reliability.

Those for all sectors and manufacturing in particular are larger and the results are consistent with our interpretation of samurai bonds as a positive credit supply shock that had differential effects depending on external financial dependence. Finally, the similarity in magnitudes between the bank capital specifications and those in this table also suggest that the samurai bonds were largely channeled into banking.

## *VII. Discussions and Concluding Remarks*

Japan experienced an unexpected positive credit supply shock when the government replaced the hereditary stipends of samurai for government bonds in 1876. Samurai, who also lost all their other privileges, had many incentives to use this money relatively quickly to invest in existing firms, to create new firms, or to fund the nascent banking industry. In this paper, we examined the effect of samurai bonds on life cycle of firms through the banking system.

To derive empirical predictions, we adapted the credit rationing model of Mankiw (1986) to nineteenth century Japan. Our model relied on two intermediate assumptions. First, the change in the stream of endowments of samurai increased demand deposits (savings). Second, firms obtaining funds from the credit market are, on average, riskier. Given these, we show that the issuance of samurai bonds was conducive to the creation of a credit market. This credit market enabled riskier financial constrained entrepreneurs to obtain funds and establish firms. From this model, we derived three empirical predictions. First, the life expectancy of firms decreases with bank capital. Second, bank capital abundant prefectures have more firm exits. Lasty, bank capital abundant prefectures have more firm entry.

We tested these predictions using a recently developed firm level dataset based on Japanese corporate genealogies. To identify exogenous differences in the availability of credit supply, we instrumented bank capital with samurai bonds. Our empirical findings are broadly consistent with all predictions of the model. The lifespan of firms decreases with bank capital and this effect is exacerbated in the manufacturing sector. We also find that prefectures abundant with bank capital have increased firm exit. The results for firm entry are only significant for the manufacturing sector, which suggest that samurai bonds were not enough to generate an aggregate increase in firm entry. Our findings are robust to two separate measures of bank capital as well as using samurai bond values directly as a pseudo-IV. Taken together, our results indicate that banking was the main channel through which samurai bonds affected the economy.

Our results also underscore the important, but subtle impact of the 1876 samurai bond issuance, namely that it appears to have facilitated Japan's financial development. Channeled through the banking system that was adapted to utilize it, this credit injection increased firm dynamism by helping to fund some firms, which were relatively more fragile and shorter-lived, especially in the manufacturing sector. An interpretation of our results is that this large credit supply shock marked an inflection point for Japan's modernization by increasing aggregate savings to develop a financial system and generate entrepreneurial activity. Whether this would have been possible without other reforms taking place in the country, such as the early land reform for fiscal taxation, the adoption of a modern commercial code for incorporation, and the creation of personal and corporate income taxes, is outside the scope of this paper but likely relevant (e.g., Kramer, 1953, Onji and Tang, 2017). Similarly, the importance of state capacity to pursue and implement both fiscal and monetary policies may explain differences between the historical experiences of Japan and China or modern-day developing countries (e.g., Ma and Rubin, 2019). That said, the credit supply shock early in Japan's modernization, large even by today's standards, may itself be instructive for other economies seeking a similar inflection point.

REFERENCES

Abelson, Reed (2000). "Pets.com, Sock Puppet's Home, Will Close," *New York Times*, 8 November. URL: https://www.nytimes.com/2000/11/08/business/technology-petscom-sock-puppet-s-home-will-close.html . Accessed 24 April 2020.

Adelino, Manuel, Antoinette Schoar and Felipe Severino (2018). "The Role of Housing and Mortgage Markets in Financial Crisis", *Annual Review of Financial Economics* 10(1): 25-41.

Aghion, Philippe, Thibault Fally, and Stefano Scarpetta (2007). "Credit constraints as a barrier to the entry and post-entry growth of firms," *Economic Policy* 22(52): 731-779.

Allen, F. and D. Gale (1995). "A welfare comparison of intermediaries in Germany and the U.S," *European Economic Review*, 39 (2): 179–209.

Banerjee, Abhijit, Emily Breza, Robert Townsend, and Diego Vera-Cossio (2019). "Access to credit and productivity," *Inter-American Development Bank Discussion Paper*, No. IDB-DP-655.

Banerjee, Abhijit and Esther Duflo (2014). "Do Firms Want to Borrow More? Testing Credit Constraints Using a Directed Lending Program," *Review of Economic Studies* 81: 572-607.

Banerjee, Abhijit, Esther Duflo, Rachel Glennerster, and Cynthia Kinnan (2015). "The Miracle of Microfinance? Evidence from a Randomized Evaluation," *American Economic Journal: Applied Economics* 7(1): 22-53.

Barrot, Jean-Noe (2016). "Trade Credit and Industry Dynamics: Evidence from Trucking Firms," *Journal of Finance* 71(5): 1975-2016.

Basco, Sergi, David Lopez-Rodriguez, and Enrique Moral-Benito (2020). "Housing Bubbles and Misallocation: Evidence from Spain," mimeo, Banco de España.

Basco, Sergi and John P. Tang (2020). "The samurai bond: credit supply, market access and structural transformation in pre-war Japan," *Journal of Economic History* 80(2): 457-500.

Beck, Thorsten and Asli Demirguc-Kunt (2006). “Small and medium-size enterprises: Access to finance as a growth constraint,” *Journal of Banking and Finance* 30: 2931–2943.

Bernanke, Ben (1983). “Non-Monetary Effects of the Financial Crisis in the Propagation of the Great Depression,” *American Economic Review* 73(3): 257-276.

Brown, J. David, John S. Earle, and Yana Morgulis (2017). "Job creation, small versus large versus young, and the SBA," in John Haltiwanger, Erik Hurst, Javier Miranda, and Antoinette Schoar (eds.), *Measuring Entrepreneurial Businesses: Current Knowledge and Challenges*. Chicago: University of Chicago Press.

Buera Francisco J., Joseph P. Kaboski and Yongseok Shin, (2015). "Entrepreneurship and Financial Frictions: A Macro-development Perspective," *Annual Review of Economics* 7(1): 409-436.

Caves, Richard (1998). "Industrial organization and new findings on the turnover and mobility of firms," *Journal of Economic Literature* 36: 1947-1982.

Decker, Ryan, John Haltiwanger, Ron Jarmin and Javier Miranda (2014). “The Role of Entrpeneurship in the US Job Creation and Economic Dynamism,” *Journal of Economic Perspectives* 28(3): 3-24.

Demyanyk, Yuliya, and Otto Van Hemert (2011). “Understanding the Subprime Mortgage Crisis,” *Review of Financial Studies* 24(6): 1848-1880.

Dunne, Timothy, Mark Roberts, and Larry Samuelson (1988). "Patterns of firm entry and exit in US manufacturing industries," *RAND Journal of Economics* 19(4): 495-515.

Flath, David (2014). *The Japanese Economy*, third edition. Oxford: Oxford University Press.

Foster, Lucia, John Haltiwanger, and Chad Syverson (2008). "Reallocation, firm turnover, and efficiency: selection on productivity or profitability?" *American Economic Review* 98(1): 394-425.

Freixas, X. and J.C. Rochet (2008). *Microeconomics of Banking*. Cambridge: MIT Press.

Fukao, Kyoji, Jean-Pascal Bassino, Tatsuji Makino, Ralph Papryzycki, Tokihiko Settsu, Masanori Takashima, and Joji Tokui (2015). *Regional Inequality and Industrial Structure in Japan: 1874-2008*. Tokyo: Maruzen Publishing Company.

Gerschenkron, Alexander (1962). *Economic Backwardness in Historical Perspective.* Cambridge: Harvard University Press.

Goldsmith, Raymond (1983). *The Financial Development of Japan, 1868-1977*. New Haven: Yale University Press.

Gopinath, Gita, Sebnem Kalemli-Ozcan, Loukas Karabarbounis, and Carolina Villegas-Sanchez (2017). "Capital Allocation and Productivity in South Europe," *Quarterly Journal of Economics* 132(4): 1915-1967.

Gregg, Amanda and Steven Nafziger (2018). "The births, lives, and deaths of corporations in late imperial Russia," mimeograph.

Greenwood, J., and B. Jovanovic (1990). "Financial development, growth and the distribution of income," *Journal of Political Economy* 98(5): 1076–1107.

Harootunian, Harry (1960). "The economic rehabilitation of the samurai in the early Meiji period," *Journal of Asian Studies* 19(4): 433-444.

Japan Statistical Association (1962). *Nihon Teikoku Tokei Nenkan* [Statistical Yearbook of the Japanese Empire]. Tokyo: Tokyo Ripurinto Shuppansha.

--- (1987). *Nihon Choki Tokei Soran* [Historical Statistics of Japan]. Tokyo: Nihon Tokei Kyokai.

Japanese Ministry of Finance (1904). *Meiji Zaiseishi* [The Financial History of the Meiji Period], volume 8, 1971 reprint. Tokyo: Yoshikawa Kokubunka.

Jiménez, Gabriel, Atif Mian, José-Luis Peydró, and Jesús Saurina (2020). "The Real Effects of the Bank Lending Channel," *Journal of Monetary Economics*, 115(C): 162-179.

Jordà, Òscar, Schularick, Moritz, and Taylor, Alan M. (2013). “When Credit Bites Back,” *Journal of Money, Credit and Banking* 45(2): 3-28.

Jordà, Òscar, Richter, Björn, Schularick, Moritz, and Taylor, Alan M. (2017). “Bank Capital Redux: Solvency, Liquidity, and Crisis,” *NBER Working Paper Series,* No. 23287.

Kaboski, Joseph P. and Robert M. Townsend (2012). "The impact of credit on village economies," *American Economic Journal: Applied Economics* 4(2): 98-133, April.

Kaminsky, G.L. and S. L. Schmukler (2008). "Short-Run Pain, Long-Run Gain: Financial Liberalization and Stock Market Cycles," *Review of Finance* 12(2): 253–292.

Keys, Benjamin J., Tanmoy Mukherjee, Amit Seru, and Vikrant Vig (2010). “Did Securitisation Lead to Lax Screening? Evidence from Subprime Loans 2001-2006,” *Quarterly Journal of Economics* 125(1): 307-362.

Kinmouth, Earl (1981). *The Self-Made Man in Meiji Japanese Thought: From Samurai to Salary Man*. Berkeley: University of California Press.

Kiyotaki, N. and J. Moore (1997). “Credit cycles,” *Journal of Political Economy* 105: 211-248.

Kramer, Irving (1953). "Land reform and industrial development in Meiji Japan," *Land Economics* 29(4): 314-322.

Lockwood, William (1954). *The Economic Development of Japan, Growth and Structural Change 1868-1938*. Princeton: Princeton University Press.

Levine, Ross (2005). "Finance and Growth: Theory and Evidence," in Philippe Aghion & Steven Durlauf (eds.), *Handbook of Economic Growth*, first edition, volume 1, chapter 12, pages 865-934. Amsterdam: Elsevier.

Loayza, Norman V. and Romain Ranciere (2006). "Financial Development, Financial Fragility, and Growth," *Journal of Money, Credit and Banking* 38(4): 1051-1076.

Ma, Debin (2019). "Financial revolution in Republican China during 1900-37: a survey and a new interpretation," *Australian Economic History Review* 59(3): 242-262.

Ma, Debin and Jared Rubin (2019). "The paradox of power: principal-agent problems and administrative capacity in imperial China (and other absolutist regimes)," *Journal of Comparative Economics* 47(2): 277-294.

Mankiw, Greg (1986). “The allocation of credit and financial collapse,” *Quarterly Journal of Economics* 101(3): 455–470.

Mendoza, Enrique G.  and Marco E. Terrones (2012). "An Anatomy of Credit Booms and their Demise," *NBER Working Paper Series,* No.18379.

Mian, Atif and Amir Sufi (2009). “The Consequences of Mortgage Credit Expansion: Evidence from the U.S. Mortgage Default Crisis. *The Quarterly Journal of Economics* 124(4): 1449-1496.

Morikawa, Hidemasa (1992). *Zaibatsu: The Rise and Fall of Family Enterprise Groups in Japan*. Tokyo: University of Tokyo Press.

Obstfeld, Maurice and Kenneth Rogoff (1996). *Foundations of International Macroeconomics*. Cambridge: MIT Press.

Onji, Kazuki and John P. Tang (2017). "Taxes and the choice of organizational form in late nineteenth century Japan," *Journal of Economic History* 77(2): 440-472.

Paulson, Anna and Robert Townsend (2004). "Entrepreneurship and financial constraints in Thailand," *Journal of Corporate Finance* 10(2): 229-262.

Rajan, Raghuram and Luigi Zingales (1998). "Financial dependence and growth," *American Economic Review* 88(1998): 559-586.

Richardson, Gary (2007) "Categories and causes of bank distress during the Great Depression, 1929-1933: The illiquidity versus insolvency debate revisited, " *Explorations in Economic History* 44(4): 588-607.

Richardson, Gary and Patrick Van Horn (2009). “Intensified Regulatory Scrutiny and Bank Distress in New York City during the Great Depression,” *Journal of Economic History* 69(2): 446-465.

Rousseau, Peter (1999). "Finance, investment, and growth in Meiji-era Japan," *Japan and the World Economy* 11: 185-198.

Schumpeter, Joseph (1942). *Capitalism, Socialism and Democracy*. London: Routledge.

Schularick, Moritz, and Taylor, Alan M. (2012). “Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870–2008,” *American Economic Review* 102(2): 1029–1061.

Shizume, Masato (2018). "A history of the Bank of Japan, 1882-2016," in Edvinsson, Rodney, Tor Jacobson, and Daniel Waldenstrom, eds., *Sveriges Riksbank and the History of Central Banking*. Cambridge: Cambridge University Press.

Shizume, Masato and Masayoshi Tsurumi (2016). "Modernizing the financial system in Japan during the 19th century: national banks in Japan in the context of free banking." *WINPEC Working Paper Series,* No, E1607. Tokyo: Waseda Institute of Political Economy.

Stiglitz, Joseph E. and Andrew Weiss (1981). “Credit rationing in markets with imperfect information.” *American Economic Review* 71(3): 393-410.

Stock, James and Motohiro Yogo (2001). "Testing for weak instruments in linear IV regression." *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg*. Available at SSRN: https://ssrn.com/abstract=1734933.

Tang, John P. (2011). "Technological leadership and late development: evidence from Meiji Japan, 1868-1912," *Economic History Review* 64(S1): 99-116.

--- (2013). "Financial intermediation and late development in Meiji Japan, 1868-1912," *Financial History Review* 20(2): 111-135.

--- (2014). “Railroad expansion and industrialization: evidence from Meiji Japan,” *Journal of Economic History* 74(3): 863-886.

Tomita, Toshiki (2005). "Government bonds in the Meiji restoration period." *NRI Papers,* No. 87. Tokyo: Nomura Research Institute.

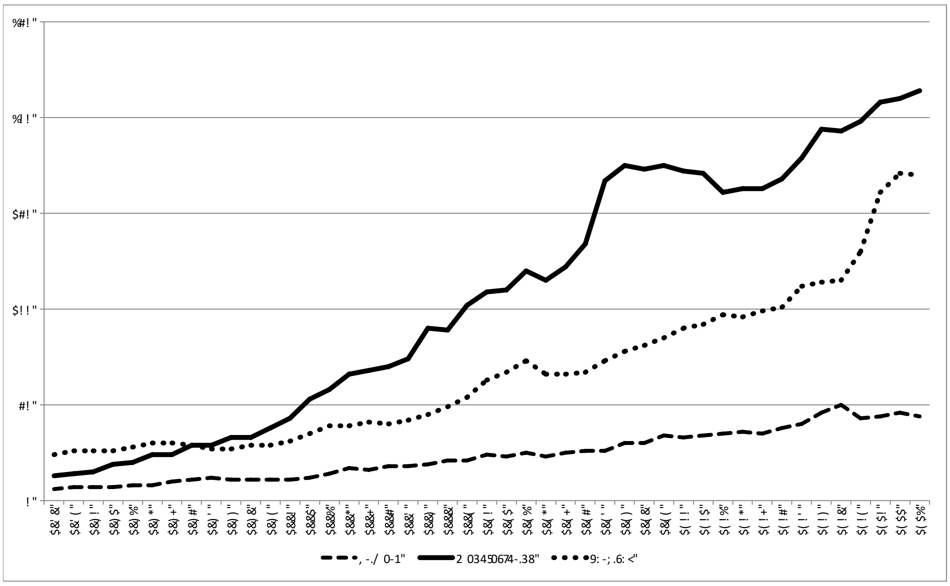
Townsend, R. (1979). “Optimal contracts and competitive markets with costly state verification,” *Journal of Economic Theory* 21: 265–293.

Yagura, Shintaro and Yoshiro Ikushima (1986). *Shuyo Kigyo no Keifuzu* [Genealogical charts of Japanese major corporations]. Tokyo: Yushodo Publishing.

Yamamura, Kozo (1967). "The role of the samurai int he development of modern banking in Japan," *Journal of Economic History,* 27(2): 198-220.

Williamson, S. D. (1987). “Costly monitoring, loan contracts, and equilibrium credit rationing,” *Quarterly Journal of Economics* 102(1): 135–145.

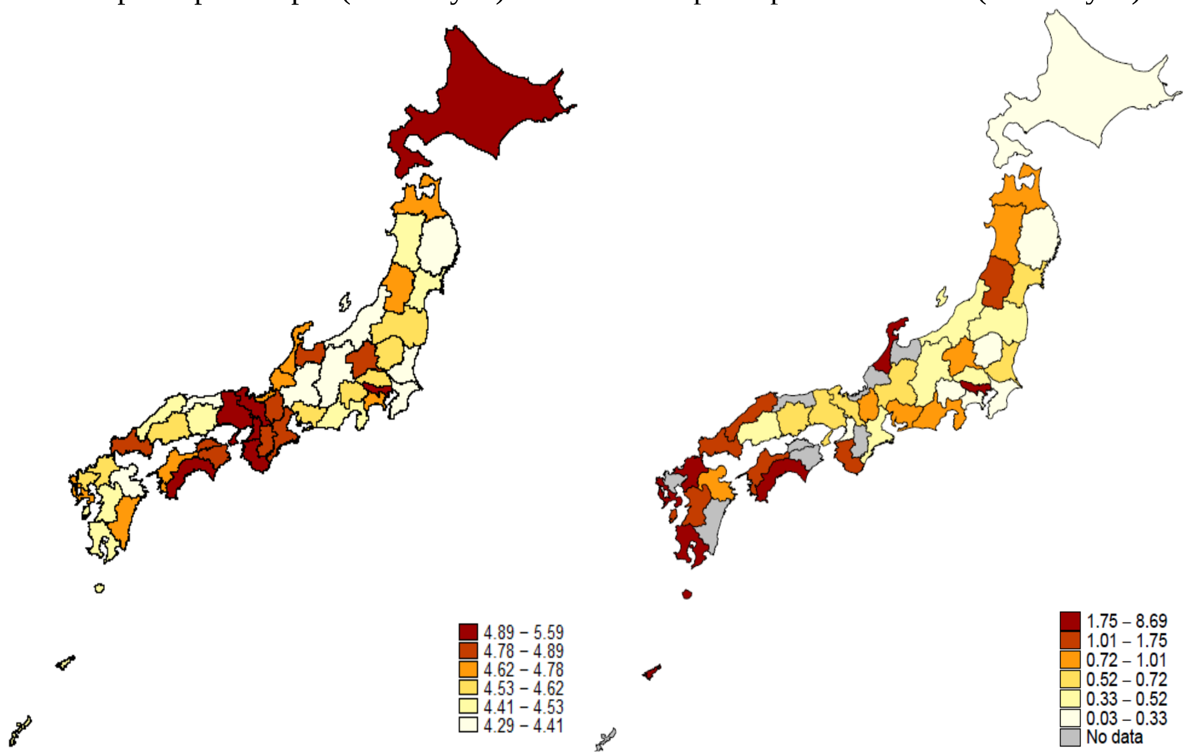
FIGURE 1—NUMBER OF FIRM STARTUPS BY MAJOR INDUSTRY, 1868-1912



Source: Tang (2013), p. 118.

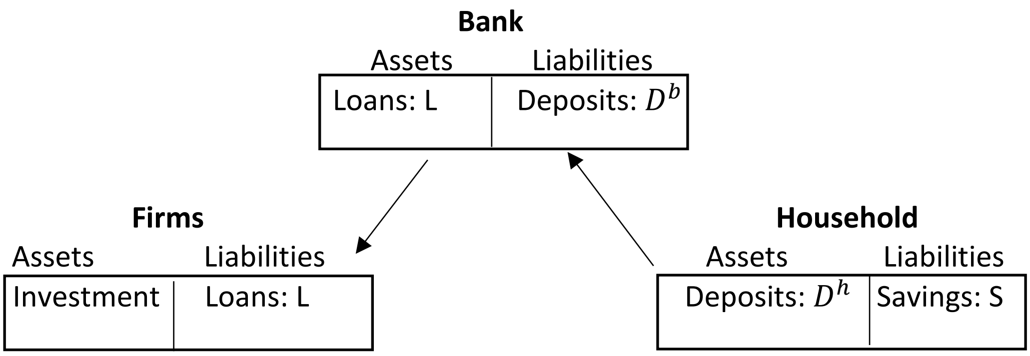
FIGURE 2—PREFECTURAL VARIATION IN OUTPUT AND BOND VALUES

1874 per capita output (current yen) | 1876 per capita bond value (current yen)



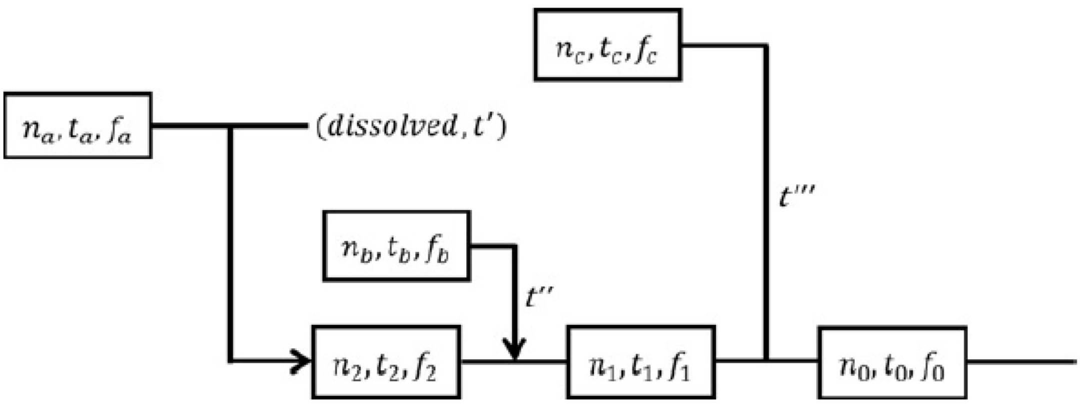

Source: Fukao et al (2015), Japanese Ministry of Finance (1904).

FIGURE 3—SUMMARY OF THE BANKING ECONOMY




Note: This figure represents the economic and financial decision of households, firms and banks. Note that banks act as intermediates between households and firms. The allocation of banks loans to firms will be driven by the wealth and investment projects of entrepreneurs.

FIGURE 4—STYLIZED EXAMPLE OF A FIRM GENEALOGY




Source: Onji and Tang (2016). Firm names are distinguished by n, changes in firm lifecycle are indicated by time t, and organizational type by f. Firm entry is based on first appearance in a genealogy while exit is by a change in n or f. Longevity is measured as the change in t between entry and exit. See text for details.

TABLE 1—FINANCIAL ASSETS DISTRIBUTION BY PREFECTURE

| | Samurai Bond Value (1876) | | National Bank Capital (1884) | | All Bank Capital (1884) |
|---|---|---|---|---|---|
| | Total | Per Capita | Total | Samurai Share | Total |
| **Japan[a]** | **173,844,631** | **5.68** | **52,536,000** | **58.5%** | **85,203,000** |
| Tokyo | 39,846,950 | 40.42 | 28,046,000 | 73.2 | 32,029,000 |
| Kagoshima | 13,146,225 | 15.62 | 530,000 | 90.8 | 597,000 |
| Ishikawa | 12,545,215 | 17.64 | 190,000 | 63.9 | 190,000 |
| Toyama | | 17.64[b] | 300,000 | 21.1 | 1,044,000 |
| Kochi | 9,110,350 | 16.63 | 650,000 | 64.0 | 650,000 |
| Tokushima | | 16.63[b] | 260,000 | 76.3 | 896,000 |
| Fukuoka | 8,741,465 | 8.14 | 640,000 | 72.2 | 1,144,000 |
| Nagasaki | 8,016,580 | 11.57 | 370,000 | 35.7 | 805,000 |
| Saga | | 11.57[b] | 390,000 | 94.1 | 1,185,000 |
| Yamaguchi | 6,518,215 | 7.52 | 680,000 | 89.9 | 680,000 |
| Aichi | 5,945,745 | 4.71 | 670,000 | 40.0 | 1,583,000 |
| Kumamoto | 5,885,420 | 5.93 | 265,000 | 96.9 | 365,000 |
| Shimane | 5,092,970 | 8.14 | 80,000 | 70.6 | 159,000 |
| Tottori | | 8.14[b] | 200,000 | 86.9 | 224,000 |
| Ehime | 4,807,515 | 5.90 | 440,000 | 53.3 | 976,000 |
| Shizuoka | 3,839,715 | 4.43 | 750,000 | 17.7 | 4,411,000 |
| Hyogo | 3,737,980 | 2.74 | 790,000 | 37.1 | 1,250,000 |
| Yamagata | 3,351,640 | 5.00 | 590,000 | 37.5 | 764,000 |
| Oita | 2,978,155 | 4.11 | 340,000 | 73.1 | 924,000 |
| Okayama | 2,975,130 | 3.25 | 380,000 | 81.5 | 1,069,000 |
| Wakayama | 2,834,755 | 4.84 | 200,000 | 74.1 | 317,000 |
| Akita | 2,732,040 | 4.42 | 100,000 | 31.6 | 100,000 |
| Shiga | 2,531,845 | 4.22 | 500,000 | 17.7 | 710,000 |
| Gunma | 2,426,385 | 4.05 | 570,000 | 47.4 | 1,393,000 |
| Niigata | 2,401,415 | 1.57 | 1,300,000 | 15.8 | 4,538,000 |
| Kyoto | 2,398,805 | 2.62 | 400,000 | 38.4 | 730,000 |
| Nagano | 2,385,160 | 2.40 | 760,000 | 34.9 | 3,546,000 |
| Hiroshima | 2,173,650 | 1.73 | 440,000 | 50.5 | 440,000 |
| Ibaraki | 2,138,681 | 3.01 | 420,000 | 76.4 | 836,000 |
| Gifu | 2,072,720 | 2.69 | 760,000 | 30.6 | 1,340,000 |
| Mie | 1,836,640 | 2.27 | 350,000 | 65.8 | 350,000 |
| Chiba | 1,745,290 | 1.39 | 215,000 | 73.7 | 490,000 |
| Aomori | 1,671,155 | 3.41 | 300,000 | 78.4 | 481,000 |
| Saitama | 1,321,790 | 1.91 | 200,000 | 25.8 | 1,659,000 |
| Miyagi | 1,278,800 | 2.58 | 250,000 | 42.4 | 282,000 |
| Fukushima | 1,192,720 | 1.75 | 930,000 | 20.4 | 1,606,000 |
| Osaka | 1,187,045 | 1.16 | 2,590,000 | 12.7 | 4,232,000 |
| Kanagawa | 1,012,315 | 1.44 | 3,100,000 | 27.0 | 5,224,000 |
| Iwate | 945,795 | 1.30 | 150,000 | 64.9 | 170,000 |
| Tochigi | 697,035 | 1.06 | 300,000 | 27.3 | 614,000 |
| Hokkaido | 236,300 | 1.56 | 330,000 | 40.7 | 430,000 |
| Yamanashi | 54,445 | 0.14 | 250,000 | 5.8 | 2,317,000 |
| Okinawa | 0 | 0.00 | 0 | 0.0 | 100,000 |

*Source:* Ministry of Finance (1904), Japan Statistical Association (1962), and authors' calculation. All values except where noted are in nominal yen. [a]Includes 5 percent bonds valued at 30,575 yen distributed to the imperial household, which are not prefecture specific. [b]Okinawa, Saga, Tokushima, Tottori, and Toyama prefectures were unincorporated or part of other prefectures at the time of the stipend commutation.

TABLE 2—FIRM SUMMARY STATISTICS

| | Total | Primary | Manufacturing | Finance | Services |
|---|---|---|---|---|---|
| Firm entry (N) | 440 | 18 | 145 | 224 | 54 |
| 1870-75 | 43 | 4 | 20 | 10 | 9 |
| 1876-80 | 142 | 1 | 20 | 114 | 7 |
| 1881-85 | 122 | 7 | 38 | 64 | 13 |
| 1886-90 | 133 | 6 | 67 | 36 | 24 |
| | | | | | |
| Firm exit (N) | 84 | 0 | 46 | 31 | 7 |
| 1870-75 | 6 | 0 | 2 | 2 | 2 |
| 1876-80 | 12 | 0 | 6 | 4 | 2 |
| 1881-85 | 25 | 0 | 9 | 13 | 3 |
| 1886-90 | 41 | 0 | 29 | 12 | 0 |
| | | | | | |
| Lifespan (year) | 20.8 (15.7) | 31.2 (15.5) | 17.3 (16.5) | 21.8 (14.0) | 23.2 (18.0) |
| 1870-75 | 19.3 (16.6) | 33.8 (8.1) | 17.9 (16.7) | 13.3 (11.2) | 22.7 (21.1) |
| 1876-80 | 19.5 (11.5) | 51.0 (-) | 21.0 (19.2) | 18.3 (8.4) | 29.4 (16.3) |
| 1881-85 | 23.3 (18.2) | 30.9 (18.4) | 17.2 (17.7) | 25.1 (17.1) | 28.4 (22.1) |
| 1886-90 | 20.5 (16.7) | 26.7 (16.3) | 15.9 (15.0) | 29.3 (18.0) | 18.7 (14.5) |

*Source:* authors' calculations. Entry is defined as first appearance in a corporate genealogy; exit is a break in the lineage through a change in ownership, organizational form, liquidation, merger, or name; and lifespan is the difference between entry and exit years. Standard deviation in parentheses. See text for more details.

TABLE 3 —LIFESPAN BY BANKING CAPITAL, ALL SECTORS

| DV: Firm lifespan | All bank capital | | National bank capital | |
|---|---|---|---|---|
| | | *OLS* | | |
| Bank capital p.c. | -1.306** | -1.748* | -0.993* | -1.633** |
| | (0.626) | (0.987) | (0.552) | (0.760) |
| Prefectural income p.c. | | 28.972* | | 29.826** |
| | | (14.666) | | (13.797) |
| Population | | 9.741** | | 10.035** |
| | | (4.422) | | (4.494) |
| Urbanization | | 2.049 | | 2.142 |
| | | (1.463) | | (1.446) |
| R-squared | 0.121 | 0.164 | 0.118 | 0.163 |
| F-statistic | 4.35 | 3.78 | 3.20 | 4.83 |
| Observations | 270 | 270 | 270 | 270 |
| | | *IV* | | |
| Bank capital p.c. | -2.472** | -3.367*** | -2.223** | -2.988*** |
| | (1.162) | (1.096) | (1.039) | (0.951) |
| Prefectural income p.c. | | 45.627*** | | 45.482*** |
| | | (12.669) | | (12.726) |
| Population | | 8.496* | | 9.163* |
| | | (4.657) | | (4.652) |
| Urbanization | | 1.472 | | 1.699 |
| | | (1.391) | | (1.370) |
| F-statistic | 4.52 | 6.24 | 4.58 | 6.12 |
| Observations | 270 | 270 | 270 | 270 |
| Samurai bond value p.c. | 0.927*** | 0.724*** | 1.031*** | 0.815*** |
| | (0.206) | (0.084) | (0.222) | (0.086) |
| First-stage F-statistic | 20.13 | 53.41 | 21.50 | 59.47 |
| Cragg-Donald Weak Instrument test | 349.16 | 321.56 | 451.18 | 494.74 |

Significance: ***1 percent, **5 percent, *10 percent. Robust standard errors clustered by prefectures in parentheses. Bank capital and samurai bond values are in nominal yen. We use an inverse hyperbolic sine transformation because the value of bonds per capita was zero before 1876. All specifications include year and sector fixed effects .

TABLE 4 —LIFESPAN BY BANKING CAPITAL AND SECTOR

| DV: Firm lifespan | All bank capital | | National bank capital | |
|---|---|---|---|---|
| | OLS | IV | OLS | IV |
| | | *Manufacturing* | | |
| Bank capital p.c. | -1.751* | -1.798** | -1.706** | -1.602** |
| | (0.959) | (0.846) | (0.820) | (0.745) |
| Prefectural income p.c. | 43.842*** | 44.313*** | 45.248*** | 44.082*** |
| | (11.967) | (11.513) | (12.080) | (11.711) |
| Population | 4.144 | 4.089 | 3.977 | 4.115 |
| | (7.566) | (7.497) | (7.490) | (7.426) |
| Urbanization | 2.369* | 2.350* | 2.427* | 2.469** |
| | (1.252) | (1.221) | (1.179) | (1.173) |
| R-squared | 0.152 | | 0.153 | |
| F-statistic | 6.05 | 6.69 | 6.51 | 6.84 |
| Observations | 111 | 111 | 111 | 111 |
| Samurai bond value p.c. | | 0.741*** | | 0.835*** |
| | | (0.066) | | (0.072) |
| First-stage F-statistic | | 175.85 | | 138.80 |
| Cragg-Donald Weak Instrument test | | 212.75 | | 278.62 |
| | | *Services* | | |
| Bank capital p.c. | -0.773 | 0.709 | -0.163 | 0.650 |
| | (1.752) | (2.458) | (1.841) | (2.250) |
| Prefectural income p.c. | -50.681 | -64.521 | -56.367 | -64.001 |
| | (37.391) | (39.127) | (39.830) | (38.084) |
| Population | 32.284** | 33.630*** | 32.840** | 33.570*** |
| | (13.955) | (13.363) | (14.058) | (13.331) |
| Urbanization | -0.773 | 0.118 | --0.415 | 0.118 |
| | (3.079) | (3.366) | (3.254) | (3.359) |
| R-squared | 0.395 | | 0.293 | |
| F-statistic | 3.10 | 1.86 | 2.52 | 1.86 |
| Observations | 40 | 40 | 40 | 40 |
| Samurai bond value p.c. | | 0.752*** | | 0.821*** |
| | | (0.141) | | (0.141) |
| First-stage F-statistic | | 30.56 | | 28.89 |
| Cragg-Donald Weak Instrument test | | 28.33 | | 32.16 |

Significance: ***1 percent, **5 percent, *10 percent. Robust standard errors clustered by prefectures in parentheses. Bank capital and samurai bond values are in nominal yen. We use an inverse hyperbolic sine transformation because the value of bonds per capita was zero before 1876. All specifications include year fixed effects.

TABLE 5 —FIRM EXIT BY BANKING CAPITAL, ALL SECTORS

| DV: Number of exits | All bank capital | | National bank capital | |
|---|---|---|---|---|
| | *Poisson* | | | |
| Bank capital p.c. | 0.841*** | 0.621*** | 0.741*** | 0.484*** |
| | (0.163) | (0.162) | (0.070) | (0.131) |
| Prefectural income p.c. | | 4.932 | | 5.866* |
| | | (3.442) | | (3.187) |
| Population | | -0.012 | | -0.068 |
| | | (0.664) | | (0.705) |
| Urbanization | | -0.096 | | -0.067 |
| | | (0.173) | | (0.705) |
| Pseudo R-squared | 0.263 | 0.263 | 0.238 | 0.248 |
| Wald statistic | 5929.90 | 6996.50 | 7030.17 | 6511.26 |
| Observations | 270 | 270 | 270 | 270 |
| | *IV Poisson* | | | |
| Bank capital p.c. | 0.897*** | 0.697*** | 0.783*** | 0.620*** |
| | (0.107) | (0.135) | (0.099) | (0.130) |
| Prefectural income p.c. | | 3.911 | | 3.706 |
| | | (2.671) | | (3.020) |
| Population | | 0.004 | | -0.058 |
| | | (0.661) | | (0.720) |
| Urbanization | | -0.074 | | -0.131 |
| | | (0.176) | | (0.176) |
| Observations | 270 | 270 | 270 | 270 |
| Samurai bond value p.c. | 0.472*** | 0.273*** | 0.641*** | 0.358*** |
| | (0.148) | (0.058) | (0.165) | (0.058) |
| First-stage Wald statistic | 270.32 | 588.89 | 535.57 | 776.87 |

Significance: ***1 percent, **5 percent, *10 percent. Robust standard errors clustered by prefectures in parentheses. Bank capital and samurai bond values are in nominal yen. We use an inverse hyperbolic sine transformation because the value of bonds per capita was zero before 1876. All specifications include sector and period fixed effects.

TABLE 6 —FIRM EXIT BY BANKING CAPITAL, MANUFACTURING

| DV: Number of exits | All bank capital | | National bank capital | |
|---|---|---|---|---|
| | Poisson | IV Poisson | Poisson | IV Poisson |
| Bank capital p.c. | 0.500*** | 0.546*** | 0.432*** | 0.484*** |
| | (0.131) | (0.086) | (0.104) | (0.081) |
| Prefectural income p.c. | 10.087*** | 9.544*** | 9.980*** | 9.248*** |
| | (2.301) | (1.889) | (2.380) | (1.928) |
| Population | 0.473 | 0.493 | 0.439 | 0.460 |
| | (0.831) | (0.829) | (0.903) | (0.901) |
| Urbanization | -0.046 | -0.026 | -0.102 | -0.084 |
| | (0.205) | (0.197) | (0.203) | (0.199) |
| Pseudo R-squared | 0.338 | | 0.333 | |
| Wald statistic | 161.98 | | 185.60 | |
| Observations | 66 | 66 | 66 | 66 |
| Samurai bond value p.c. | | 0.283*** | | 0.382*** |
| | | (0.087) | | (0.065) |
| First-stage Wald statistic | | 278.88 | | 370.61 |

Significance: ***1 percent, **5 percent, *10 percent. Robust standard errors clustered by prefectures in parentheses. Bank capital and samurai bond values are in nominal yen. We use an inverse hyperbolic sine transformation because the value of bonds per capita was zero before 1876. All specifications include period effects.

TABLE 7 —FIRM ENTRY BY BANKING CAPITAL, ALL SECTORS

| DV: Number of entries | All bank capital | | National bank capital | |
|---|---|---|---|---|
| | | *Poisson* | | |
| Bank capital p.c. | 0.502*** | 0.278** | 0.472*** | 0.219** |
| | (0.036) | (0.111) | (0.031) | (0.096) |
| Prefectural income p.c. | | 5.411** | | 5.932*** |
| | | (2.296) | | (2.168) |
| Population | | -0.017 | | -0.039 |
| | | (0.268) | | (0.286) |
| Urbanization | | -0.096* | | -0.117** |
| | | (0.054) | | (0.286) |
| Pseudo R-squared | 0.112 | 0.126 | 0.105 | 0.121 |
| Wald statistic | 560.68 | 1003.53 | 930.32 | 1295.54 |
| Observations | 270 | 270 | 270 | 270 |
| | | *IV Poisson* | | |
| Bank capital p.c. | 0.353** | 0.062 | 0.319* | 0.057 |
| | (0.206) | (0.082) | (0.167) | (0.076) |
| Prefectural income p.c. | | 7.948*** | | 7.969*** |
| | | (1.056) | | (1.059) |
| Population | | -0.043 | | -0.047 |
| | | (0.272) | | (0.276) |
| Urbanization | | -0.145*** | | -0.148*** |
| | | (0.055) | | (0.054) |
| Observations | 270 | 270 | 270 | 270 |
| Samurai bond value p.c. | 0.472*** | 0.273*** | 0.641*** | 0.358*** |
| | (0.148) | (0.058) | (0.165) | (0.058) |
| First-stage Wald statistic | 270.32 | 588.89 | 535.57 | 776.87 |

Significance: ***1 percent, **5 percent, *10 percent. Robust standard errors clustered by prefectures in parentheses. Bank capital and samurai bond values are in nominal yen. We use an inverse hyperbolic sine transformation because the value of bonds per capita was zero before 1876. All specifications include sector and period fixed effects

TABLE 8 —FIRM ENTRY BY BANKING CAPITAL AND SECTOR

| | All bank capital | | National bank capital | |
|---|---|---|---|---|
| DV: Number of entries | Poisson | IV Poisson | Poisson | IV Poisson |
| | | *Manufacturing* | | |
| Bank capital p.c. | 0.212*** | 0.155*** | 0.218*** | 0.138*** |
| | (0.061) | (0.033) | (0.059) | (0.032) |
| Prefectural income p.c. | 11.907*** | 12.513*** | 11.495*** | 12.482*** |
| | (1.314) | (0.963) | (1.526) | (0.953) |
| Population | 0.266 | 0.246 | 0.259 | 0.235 |
| | (0.467) | (0.456) | (0.482) | (0.471) |
| Urbanization | -0.158** | -0.179*** | -0.169*** | -0.194*** |
| | (0.061) | (0.059) | (0.058) | (0.270) |
| Pseudo R-squared | 0.309 | | 0.311 | |
| Wald statistic | 349.87 | | 375.32 | |
| Observations | 66 | 66 | 66 | 66 |
| Samurai bond value p.c. | | 0.283*** | | 0.382*** |
| | | (0.087) | | (0.065) |
| First-stage Wald statistic | | 278.88 | | 370.61 |
| | | *Services* | | |
| Bank capital p.c. | 0.033 | -0.298** | 0.005 | -0.266** |
| | (0.188) | (0.133) | (0.174) | (0.111) |
| Prefectural income p.c. | 10.778*** | 14.262*** | 11.089** | 13.984*** |
| | (3.125) | (1.336) | (2.986) | (1.229) |
| Population | -0.358 | -0.430 | -0.374 | -0.442 |
| | (0.341) | (0.403) | (0.345) | (0.383) |
| Urbanization | -0.206 | -0.395*** | -0.222* | -0.373*** |
| | (0.135) | (0.102) | (0.131) | (0.090) |
| Pseudo R-squared | 0.207 | | 0.207 | |
| Wald statistic | 177.92 | | 175.60 | |
| Observations | 32 | 32 | 32 | 32 |
| Samurai bond value p.c. | | 0.217** | | 0.285*** |
| | | (0.094) | | (0.098) |
| First-stage Wald statistic | | 158.55 | | 343.45 |

Significance: ***1 percent, **5 percent, *10 percent. Robust standard errors clustered by prefectures in parentheses. Bank capital and samurai bond values are in nominal yen. We use an inverse hyperbolic sine transformation because the value of bonds per capita was zero before 1876. All specifications include period effects.

TABLE 9 —FIRM DYNAMICS BY SAMURAI BOND VALUE

| DV: Firm lifespan | All sectors | Manufacturing | Services |
|---|---|---|---|
| Samurai bond value p.c. | -3.017*** | -2.289*** | 0.683 |
| | (0.532) | (0.479) | (1.883) |
| Prefectural income p.c. | 22.499*** | 29.317** | -59.513* |
| | (6.857) | (11.531) | (29.507) |
| Population | 6.089** | -0.492 | 34.795** |
| | (2.583) | (5.738) | (12.216) |
| Urbanization | 1.684* | 2.993** | 0.856 |
| | (0.954) | (1.191) | (3.478) |
| R-squared | 0.167 | 0.206 | 0.324 |
| F-statistic | 12.57 | 16.18 | 2.59 |
| Observations | 440 | 144 | 50 |
| DV: Number of exits | | | |
| Samurai bond value p.c. | 0.510*** | 0.400*** | 1.015** |
| | (0.084) | (0.073) | (0.406) |
| Prefectural income p.c. | 8.623*** | 13.870*** | 11.421*** |
| | (0.837) | (1.112) | (1.711) |
| Population | -0.091 | 0.240 | -0.157 |
| | (0.269) | (0.462) | (0.440) |
| Urbanization | -0.138** | -0.168 | -0.227 |
| | (0.063) | (0.073) | (0.108) |
| Pseudo R-squared | 0.383 | 0.438 | 0.072 |
| Wald statistic | 1191.91 | 392.54 | 3568.97 |
| Observations | 372 | 88 | 33 |
| DV: Number of entries | | | |
| Samurai bond value p.c. | 0.029 | 0.116*** | -0.226*** |
| | (0.050) | (0.038) | (0.060) |
| Prefectural income p.c. | 9.006*** | 14.064*** | 12.266*** |
| | (1.048) | (1.135) | (1.735) |
| Population | -0.099 | 0.227 | -0.205 |
| | (0.260) | (0.451) | (0.432) |
| Urbanization | -0.143** | -0.181*** | -0.347*** |
| | (0.063) | (0.066) | (0.091) |
| Pseudo R-squared | 0.155 | 0.312 | 0.239 |
| Wald statistic | 1071.05 | 320.39 | 291.59 |
| Observations | 372 | 88 | 44 |

Significance: ***1 percent, **5 percent, *10 percent. Robust standard errors clustered by prefectures in parentheses. Samurai bond values are in nominal yen. We use an inverse hyperbolic sine transformation because the value of bonds per capita was zero before 1876. All specifications include period effects and the first column also includes sector fixed effects.