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Abstract

After the bursting of real estate bubbles in 1991, Japanese banks continued lending to the construction and real estate sectors to conceal problem loans. We revisit Japan's experience and propose a new mechanism via which banks' loan-evergreening policy for these troubled sectors undermines allocative efficiency. Namely, banks' support for the construction and real estate sectors encourages labor hoarding in unviable construction projects. Since construction projects predominantly use low-skilled workers, banks' loan-evergreening policy may depress other low-skilled industries. Based on the industry-level data in each of Japan's 47 prefectures from 1992-1996, we document empirical facts consistent with this hypothesis. On average, low-skilled industries experienced disproportionately slower output and employment growth and more sluggish growth in the number of new establishments in prefectures where the share of bank loans to local construction/real estate sectors increased more after construction boom ended.

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1. Introduction

Japan's real estate and construction sectors borrowed heavily from banks in the late 1980s when commercial real estate development was booming. These two sectors faced financial difficulties when real estate bubbles burst in 1991. A distinguishing feature of Japan's experience, however, is that, even after construction boom ended, Japanese banks continued directing loans to these troubled sectors in order to hide the extent of non-performing loans and avoid immediate losses being added to their balance sheets. The extensive practice of loan-evergreening, or so called “zombie lending”, in the construction and real estate sectors has been widely documented (Sasaki 2000; Tsuru 2001; Sekine et al. 2003; Watanabe 2010; Hoshi, 2000, 2001; Hosono and Sakuragawa 2004). The literature shows two channels via which such zombie lending affected the allocative efficiency of the Japanese economy. First and foremost, loans could have been allocated to more productive firms, thereby reducing dispersion in the rate of return on capital (Peek and Rosengren 2005, Ueda and Khaliun 2020). Second, new firms were reluctant to enter a declining industry that was increasingly populated with unproductive firms which continued to receive subsidized loans from banks (Hoshi 2006, Caballero et al. 2008).

In this paper, we revisit Japan’s experience to explore an additional mechanism via which banks’ financial support for the troubled construction and real estate sectors distorts the efficiency of resource allocation and reduces the growth of other industries after the bursting of real estate property booms. The unwillingness of banks to cut off funding for these sectors protects construction jobs during economic downturns, and yet given that construction projects predominantly employ low-skilled workers, it effectively reduces the availability of low-skilled

workers to other industries. As a result, to the extent that labor mobility is geographically limited, loan-evergreening in the construction and real estate sectors is likely to limit the availability of low-skilled workers and reduce the growth opportunity of other low-skilled industries. Consistent with this hypothesis, we show that low-skilled industries exhibited relatively slower output and employment growth as well as slower growth in the number of new establishments in prefectures where the share of bank loans to the local construction and real estate sectors increased more after construction booms ended.

To be specific, we put together an industry-level data set on output and employment as well as the number of establishments in each of Japan's 47 prefectures between 1992 and 1996. Our industry-prefecture-year multilevel data set is well-suited for examining the disparate economic effects of loan-evergreening in the local construction and real estate sectors on other industries because it gives us useful information about the spatial dimensions of employment and production. Banks' loan-evergreening policy for the construction and real estate sectors is likely to help local construction projects avoid laying off many workers. However, when workers are tied up in local construction projects, other local industries which competed for these, largely low-skilled, workers may have difficulty finding workers and, as a result, experience a disproportionately slower growth, given workers are not perfectly mobile across regions. As we show later, the extent to which loans to the construction and real estate industries increased after 1991 varies substantially across prefectures. We exploit this cross-prefecture variation in order to capture the differential impacts of banks' financial support for the construction and real estate sectors on the growth of other low-skilled industries.

To preview the results, we first document that, in the post commercial real estate bubble period, cross-prefecture correlation between changes in the share of construction workers and changes in the share of bank loans to the construction and real estate industries is positive and highly significant. Hence, the results are consistent with the widely held narrative that loan-evergreening for these sectors helped protect construction jobs in Japan. We then show that other low-skilled industries exhibited slower output and employment growth in prefectures where the share of bank loans to the construction and real estate sectors increased more, as compared to high-skilled industries in the same prefecture. Further, these prefectures are characterized by slower growth in the number of new establishments in low-skilled industries. Altogether, banks' continuing financial support for the troubled construction and real estate sectors saved construction jobs, while harming the growth of other low-skilled industries which competed for non-college educated workers with local construction projects.

We perform two robustness checks to examine whether the central results are driven by unobservable shocks that differentially affect low-skilled industries in prefectures where banks engaged in loan-evergreening more extensively. First, we directly control for total factor productivity growth to address a concern that technological progress might have been biased against low-skilled industries, particularly in locations where banks continued lending to the construction and real estate industries. We show that both employment and output are strongly and positively correlated with total factor productivity growth as expected, and yet, the central results are highly robust even after we control for total factor productivity growth. Second, low-skilled industries may be more vulnerable to declines in local economic conditions than high-skilled industries. We address this concern by interacting the share of non-college

educated workers with local commercial land price growth to account for differential exposure of low-skilled industries to local economic shocks more directly. We find that the central results are highly robust even after we control for heterogeneous effects of local economic shocks on industries with different labor compositions.

1.1. Related Literature

Our paper is related to a series of papers that examine the efficiency cost of zombie lending. The seminal work of Caballero et al. (2008) shows that inefficient, but heavily subsidized, zombie firms stifled the growth of more productive non-zombie firms in the same industry. Moreover, they show that zombie firms crowded the market and lowered the entry rate of new firms. As a result, industries with more zombie firms, such as construction and real estate industries, generally experienced a lower productivity growth.[1] Caballero et al. (2008) have spawned subsequent works on zombie lending in Japan. For example, Kwon et al. (2015) and Fukao and Kwon (2006) use the plant-level data from manufacturing sector in Japan to quantify the economic cost associated with inefficient resource allocation arising from banks' financial support for zombie firms. Imai (2016) shows that investment is insensitive to marginal q for zombie firms among small and medium-sized firms in Japan, which is indicative of inefficiency in capital expenditure decision.[2] Our paper complements these papers by

[1] See also Ahearne and Shinada (2005) for a related work.

[2] Some papers show contrarian results which suggest that what look like zombie lending might be economically efficient, especially given on temporary basis. For example, Ogura et al. (2019) show that banks provide subsidized loans to poorly performing but influential firms in a local economy. Without such loans, the failure of influential firms affects sales of interconnected firms in a network. Banks internalize this negative externality with the provision of subsidized loans to firms whose failure damages the network of connected firms. Fukuda and Nakamura (2011) and Goto and Wilbur (2019) also show that many zombie firms in Japan became profitable again shortly after the economy recovered.

examining an alternative but complementary labor-hoarding mechanism in which loan-evergreening in the construction and real estate sectors limited the growth prospects of other local industries that employ a similar type of workers.

More recently, a series of papers note similarities between Japan's experience with zombie lending and that of European countries in the aftermath of the debt crisis in Europe. These papers follow the methodological framework of Caballero et al. (2008) to examine the impact of zombie firms on productivity growth and firm dynamics in Europe (Banerjee and Hofmann 2018, 2020, Blattner et al. 2018, Schivardi et al. 2017, Acharya et al. 2020, Acharya et al. 2021, McGowan et al. 2017, Tracey 2021, Schmidt et al. 2020).[3] They largely examine the efficiency effects of subsidized loans on both zombie and non-zombie firms *within the same industry*. Our paper contributes to this literature by documenting a new fact that loan-evergreening for the troubled sectors distorts the allocation of workers *across industries* in local economies and that it harms the growth of other healthy industries which employ the same types of workers as in the troubled industries.

The rest of the paper is structured as follows. Section 2 describes the data. Section 3 outlines the empirical methodology. Section 4 presents our regression results and robustness checks, and Section 5 concludes.

2. Data

[3] Notwithstanding the experience of zombie firms in Japan and Europe, Jordà et al. (2020) find that historically, corporate debt boom (and its subsequent bust) does not typically affect the long-run economic growth path except when debt-restructuring is not properly incentivized.

To measure the extent to which banks continued directing loans to the local construction and real estate sectors, we calculate the share of bank loans to construction and real estate industries in each prefecture. We retrieve the data on bank loans for construction and real estate industries as well as total loans in each prefecture from the chapter "Loans and Discounts Outstanding of Banking Accounts of All Banks, by Major Industry and Fund Utilization" in the *Prefecture Economics Statistics Periodic* published annually by the Bank of Japan (Bank of Japan 1996).

Table 1 shows cross-prefecture variations in terms of how the share of loans to the construction and real estate sectors changed in different prefectures from 1991-1996, which we exploit later in our econometric analyses. Columns (1) and (2) show the share of loans to construction and real estate industries in 1991 and 1996, respectively. Column (3) calculates changes in the share of loans to these industries from 1991-1996 (i.e., column (2) minus column (1)). A striking feature is that the share of loans to these distressed industries actually *rose* for more than a half of the prefectures, despite that the bursting of commercial real estate property markets rendered a large proportion of these loans non-performing.

However, there is a considerable amount of cross-prefecture heterogeneity. For example, while Iwate, Tokyo, and Toyama saw an average of 2.5 percentage points increase in the share of bank loans to the construction and real estate industries, Chiba and Kyoto experienced a decline of similar magnitude at the same time. In addition, one might conjecture that loan-evergreening for the construction and real estate sectors must have been prevalent mostly in the metropolitan areas (e.g., Tokyo and Osaka) since they experienced the largest burst in the real estate bubble, yet we see from the data that the share of loans to these

sectors increased just as much in numerous rural and remote prefectures (e.g., Iwate and Yamagata). [4] Interestingly, we also see a large fall in the share of loans to the construction and real estate industries in Kyoto whose commercial real estate properties fell in value just as precipitously as in Tokyo and Osaka in the early 1990s.

To measure the inter-industry allocation of labor and industry-level output in each prefecture, we use the data on value-added and employment by year-prefecture-industry from the Regional-level Japan Industrial Productivity (R-JIP) Database 2017. The R-JIP 2017 database covers 23 industries.[5] The data on value-added are expressed in million Yen based on the constant price level in the base year of 2000. The employment data are expressed in terms of the number of workers. According to Kuttner and Posen (2001), employment in construction sector remained persistently high in the aggregate data even after the end of construction booms, a pattern suggestive of labor hoarding in construction projects.[6] Our prefecture-level data offer additional cross-sectional variation to shed further lights on the widely held narrative

[4] It might be surprising to see such a large increase in the share of bank lending to the construction and real estate sectors in some of the rural prefectures where commercial property markets were much more stable than large cities during this period. However, banks in rural areas faced more intense social pressure to help struggling firms (and their employees). Hoshi (2006) shows that zombie firms were more likely to be found outside the six largest cities (Tokyo, Yokohama, Nagoya, Kyoto, Osaka, and Kobe), which is also consistent with the narrative that rural banks tend to base lending decisions in response to social (and perhaps political) pressure.

[5] These industries are: (1) Agriculture, forestry, and fisheries (2) Mining (3) Food and beverages (4) Textile mill products (5) Pulp and paper (6) Chemicals products (7) Petroleum and coal products (8) Ceramics, stone and clay (9) Basic metal (10) Processed metals (11) General machinery (12) Electrical machinery (13) Transport equipment (14) Precision instruments (15) Other manufacturing (16) Construction (17) Electricity, gas and water utilities (18) Wholesale and retail trade (19) Finance and insurance (20) Real estate (21) Transport and communications (22) Non-government other services (23) Government other services. In order to match the industries in the R-JIP 2017 database to the industries in the Survey of Employment Structure described in the next section, we combine (6) Chemical products and (7) Petroleum and coal products to be one industry under the name "Chemicals - Petroleum and coal products." In other words, there are in total 22 industries in our econometric analyses that use the data from the R-JIP 2017 database.

[6] Kuttner and Posen (2001) show that while the overall unemployment rate gradually increased after 1991, the share of employment in construction sector was strikingly stable at 10% during the 1990s. Construction-related jobs started to decline only after 1997 (Genda and Rebick 2000).

that banks' loan-evergreening policy protected construction jobs in Japan. We calculate changes in the share of bank loans to the construction and real estate industries and also changes in the share of construction employment out of total workers in 47 prefectures from 1992-1996 to explore whether prefectures with more loan-evergreening in the troubled sectors tended to see more workers retained in the construction sector. We indeed find a positive correlation between these two variables (Figure 1), suggesting that loan-evergreening helped the construction sector avoid laying off many workers.

The Survey of Employment Structure, published by the Statistics Bureau of Japan and made available online in e-Stat, reports statistics about the education-level of workers by industry every five years (Ministry of Internal Affairs and Communications 1997). While the survey was conducted in both 1992 and 1997, we use the 1997 Survey of Employment Structure, because the industry classification system corresponds better with the R-JIP 2017 database than the 1992 version.[7] We follow Table A1 of the Appendix to aggregate the number of non-college educated workers and the workers aged 15 or above from 52 industries in the Survey of Employment Structure up to 22 industries based on the industry classification in the R-JIP 2017 database in order to merge the two databases by industry. We then calculate the share of non-college educated workers (15 years or older) for each of those 22 industries.[8] Figure 2 visualizes the share of non-college educated workers by industry. The share of non-college educated workers working in the construction industry is labelled in red on the bar plot.

[7] We compare the share of non-college educated workers between the 1992 survey and the 1997 survey for those industries whose classifications did not undergo any changes. We verify that the share of non-college educated workers did not vary significantly between the two survey data sets (i.e., the correlation coefficient is 0.865).
[8] The *1997 Survey of Employment Structure* also provides information about the gender composition in each industry. The central results are qualitatively similar when we disaggregate the share of non-college educated workers by gender.

It confirms that the construction industry predominantly employs low-skilled workers as nearly 90 percent of construction workers do not have college degrees. Further, given that construction industry was the third-largest industry in Japan at that time, it is reasonable to characterize it as one of the most important recruiters of low-skilled workers.

3. Econometric Methods

The primary focus of our paper is to measure the relative performance of low-skilled industries in relation to the extent of loan-evergreening to the construction and real estate sectors in local economies after the bursting of real estate bubbles. When banks engage in loan-evergreening in the construction and real estate sectors, it saves construction jobs, despite their poor economic prospects. Nonetheless, the hoarding of low-skilled workers in construction projects is likely to have had disproportionately larger negative effects on other low-skilled industries. To preliminarily test this mechanism, we implement a two-step approach. We first calculate, for each industry, a measure of how sensitively employment responds to an increase in the share of loans to the local construction and real estate sectors. We then examine whether the estimated responsiveness is more negative for industries which employ more unskilled workers. To be more specific, we use the annual panel data from 47 prefecture between 1992 and 1996 and estimate a regression model for each industry *j*, separately:

$$ln(Employment)_{ijt} = \delta_{ij} + \theta_j \times Loan\text{-}evergreening_{it-1} + \varepsilon_{ijt} \quad \textbf{(1)}$$

where *i*, *j*, and *t* represent prefecture, industry, and year. $Loan\text{-}evergreening_{it\text{-}1}$ is the share of bank loans to the construction and real estate industries in prefecture *i* in lagged year *t-1*. The industry-specific impact of loan-evergreening, denoted by θ_j, is the key parameter which captures the extent to which industry *j*'s employment declines in response to an increase in the share of loans to the construction and real estate sectors. Prefecture fixed effects δ_{ij} are included in all regressions so that θ_j is estimated based only on within-prefecture variation in the share of bank loans to the construction and real estate sectors.

When banks engage in local loan-evergreening to the construction and real estate sectors, thereby protecting construction jobs, we expect other low-skilled industries to be affected more negatively as compared to high-skilled industries. Hence, we conjecture that θ_j is negatively correlated with the share of non-college educated workers across industries. After we estimate Equation (1) for each industry, we produce a scatter plot of all estimates of θ_j against the share of low-skilled workers in Figure 3. This scatter plot conveys the central message in our paper: the adverse economic impact of loan-evergreening to the construction and real estate industries on employment in other industries is larger for industries that employ more low-skilled workers. That is, while banks' financial assistance for the construction and real estate industries might have left high-skilled industries largely unaffected, it stifled the growth of low-skilled industries which competed for non-college educated workers.

To implement more formal econometric test, we pool all 20 industries in 47 prefectures from 1992-1996. We then use this industry-prefecture-year multi-level data set to estimate the following fixed effect regression models and examine whether the impact of loan-evergreening

in the construction and real estate sectors on employment in other industries is systematically larger when the share of non-college educated workers is higher:

$$
\begin{aligned}
&ln(Employment)_{ijt} \\
&\quad = \delta_{ij} + \phi_t + \alpha_1 Loan\text{-}evergreening_{i,t-1} \\
&\quad + \alpha_2 (Loan\text{-}evergreening_{i,t-1}) \\
&\quad \times (non\text{-}college\ share_j) + \varepsilon_{ijt}
\end{aligned}
\qquad \textbf{(2)}
$$

where the dependent variable *ln(Employment)*$_{ijt}$ is defined as the natural log values of employment in prefecture *i*, industry *j*, and year *t*. Additionally, we use the natural logs of value-added as an alternative dependent variable to measure production. $Loan\text{-}evergreening_{i,t-1}$ is the share of banks loans to the construction and real estate industries in prefecture *i* and lagged year $(t-1)$. The variable *non-college share*$_j$ is defined as the share of non-college educated workers out of total workers aged 15 or above working in industry *j*. δ_{ij} represent prefecture-industry fixed effects, which capture unobserved, time-invariant factors specific to a particular industry in each prefecture. ϕ_t represent year fixed effects, which control for time-varying common shocks that affect all industries in the entire economy. Again, with prefecture fixed effects δ_{ij}, the relevant source of variation is within-prefecture variation in the share of bank loans to the construction and real estate sectors. In some specifications, we instead include prefecture-year fixed effects, ϕ_{it}, to further control for time-varying local economic shocks, in which case, $Loan\text{-}evergreening_{i,t-1}$ drops out from the regression equations since it is perfectly collinear with ϕ_{it}. The error terms ε_{ijt} capture the industry-prefecture- year idiosyncratic shocks that are not explained in the models. We cluster

standard errors at the prefecture level to account for correlation within prefectures (Bertrand et al. 2004).

The coefficient of interest in Equation (2) is α_2. This coefficient on the interaction of the share of loans to the construction and real estate sectors with the share of low-skilled workers measures the relative effects of an increase in loan-evergreening in the construction and real estate sectors on the performance of other industries. Intuitively, as banks continue lending to these troubled sectors and help save construction jobs, other industries, especially the unskilled ones, might have difficulties in employing those workers to expand production. As a result, loan-evergreening in the construction and real estate sectors is likely to have disproportionately larger negative effects on low-skilled industries. Therefore, we expect α_2 to be negative.

4. Results

4.1. Baseline results

We report the baseline results in Table 2. Column (1) shows that the coefficient on the interaction of the share of loans to the construction and real estate sectors with the share of low-skilled workers is negative for employment. This econometric result mirrors Figure 3, confirming that the adverse impacts of banks' loan-evergreening policy for these troubled sectors on the performance of other industries varies systematically with the extent to which other industries use low-skilled workers without college degrees. Column (2) adds prefecture-year fixed effects to address a concern that the results might be driven by time-varying shocks that affect prefectures differently (the share of loans to the construction and real estate sectors drops out because it is perfectly collinear with prefecture-year fixed effects). Notice that the coefficient estimates on the key interaction term in columns (1) and (2) are nearly identical (-

7.4) with slightly different standard errors. The results are, thus, consistent with the idea that loan-evergreening policy to support these troubled sectors facilitated the hoarding of low-skilled workers in local construction projects away from other industries that predominantly employ similar types of workers.

Columns (3) and (4) show the results for output. Once again, the coefficients on the interaction of the share of loans to the construction and real estate sectors with the share of low-skilled workers are negative and statistically significant. The results suggest that banks' sustained support for these troubled sectors reduced output more in other low-skilled industries than high-skilled ones. The results are also quantitatively important. For example, difference in the share of non-college educated workers between agriculture, forestry, and fisheries industry, on the one hand, and chemical, petroleum, and coal products industry, on the other, is 0.37 (= 0.98 − 0.61). Given that the coefficient on the interaction term is −15, if the share of loans to the construction and real estate sectors increases by 0.01, then, relative to the chemical, petroleum, and coal products industry, output of the agriculture, forestry, and fisheries industry is likely to fall by 5.6% (15×0.37×0.01). Note again that adding prefecture-year effects does not alter the central results (column 4).

4.2. Robustness check

In this subsection, we examine how robust our central results are when we control for other potentially relevant industry-specific characteristics in order to address a concern that the policy of loan-evergreening in the construction and real estate sectors (or other unobservable shocks) might have affected low skilled industries more negatively through some

alternative mechanisms. The results of robustness checks for industry output are shown in Table 3 with column (1) re-producing the basic results. In column (2), we first add the Total Factor Productivity (TFP) growth to control for unobservable productivity shocks that affect each local industry to address a concern that low-skilled industries might have faced slower technological progress, especially in prefectures where banks engaged in extensive loan-evergreening.[9] The results show that output growth is linked positively with TFP growth, as expected. If low-skilled industries experienced negative productivity shocks at the same time when zombie lending increased with the bursting of real estate bubbles, then we expect the coefficient estimate on the key interaction term to decline in magnitude and lose statistical significance. But as shown in column (2), it remains negative, statistically significant, and with little change in magnitudes after we additionally include TFP growth as a control variable.

In column (3), we examine whether the coefficient estimates on the interaction term are robust after controlling for the heterogeneity in the response of each industry to local economic conditions. One might be concerned that prefectures which experienced larger negative economic shocks might have seen more loan-evergreening in the troubled sectors. If low-skilled industries were affected more severely by these negative economic shocks, then low-skilled industries would perform more poorly, not because of banks' support for the troubled construction and real estate sectors, but because of low-skilled industries' exposure to negative shocks. We use the annual percentage change in commercial land price index to capture changes in local economic conditions at the prefecture level. The interaction of

[9] We draw the data on year-prefecture-industry varying TFP growth rate in the 1992–1996 period from the R-JIP 2017 database.

commercial land price index with the share of workers without college education, thus, controls for heterogeneous effects of local economic shocks on industries with different labor compositions. Note that the coefficient estimates on the interaction of the share of loans to the construction and real estate sector and the share of low-skilled workers remain negative and statistically significant (column 3).

Column 4 controls for all of these potential confounding factors at the same time. It shows that the central results are still robust. Moreover, we run the same set of robustness checks for employment (Table 4). Again, the results do not change sensitively to the inclusion of these additional control variables, which consolidates the central takeaway of our paper that the labor composition, proxied by the share of non-college educated workers employed, is an important determining factor for the impacts of loan-evergreening in the construction and real estate sectors on the performance of other industries.

4.3. Firm formation

In this sub-section, we additionally examine the differential impacts of loan-evergreening in the construction and real estate sectors on firm formation in other low-skilled industries based on the data on the number of establishments from the Establishment and Enterprise Survey.[10] Even though the survey was conducted only in two years, 1991 and 1996, it covers 81 industries in 47 prefectures, capturing richer variation across industries in terms of the share of low-skilled workers as compared to the R-JIP 2017 database with 23 industries. In

[10] The database is published by the Statistics Bureau of Japan and made available online to the public in e-Stat (Ministry of Internal Affairs and Communications 1996).

addition, the Establishment and Enterprise Survey divides firms into sub-group by the year of establishment. We make use of this information to define new firms and old firms. For the 1996 survey data, we define the new firms as the those established after 1991 and the old firms as those established in 1991 or earlier. Similarly, for the 1991 survey data, we define the new firms as those established after 1986 and the old firms as those established in 1986 or earlier. We utilize the data on the age composition of firms to examine the differential impacts of zombie lending on the entry of new firms and exit of old firms among different industries. The data of employment by industry and education level are mapped from 52 industries in 1997 Survey of Employment Structure to 81 industries based on the 1996 Establishment and Enterprise Survey, according to the industry conversion presented in Table A2 of the Appendix.

Utilizing the information on the number of firms by age, industry, and prefecture, we estimate the following fixed effect regression:

$$ln(Firm)_{ijt} = \delta_{ij} + \phi_{it} + \beta_2 Loan\text{-}evergreening_{it} \times non\text{-}college\ share_j + \varepsilon_{ijt} \quad (3)$$

where *i* indexes for 47 prefectures, *j* indexes for 81 industries, and *t* indexes for 2 years (either 1991 or 1996). The dependent variable $\ln(\text{Firm})_{ijt}$ is defined as the natural log values of the numbers of all firms, new firms, and old firms in prefecture *i*, industry *j*, and year *t*. We note that some industries do not have any establishments in some prefectures. Taking natural log on those zero values in the number of firms results in missing values (as ln(0) is undefined). We allow these data points to drop out and run the regressions with an unbalanced panel. To make

sure that the results are not driven by those cells with zero values, in alternative specifications, we first add one to numbers of all firms, new firms, and old firms respectively before taking the log transformation in alternative specifications. We report the results of both specifications.

The definition of the variable $Loan\text{-}evergreening_{it}$ is also slightly different from that in Equation (2). To be specific, for year 1991 ($t = 1991$), the variable $Loan\text{-}evergreening_{it}$ is defined as the average share of bank loans to the construction and real estate industries in the 1987–1991 period; for year 1996 (t = 1996), this variable is defined as the average share of bank loans to the construction and real estate industries in the 1992–1996 period so that our results are not influenced by year-by-year fluctuations in loan-evergreening.[11] Again, δ_{ij} represent prefecture-industry fixed effects. ϕ_{it} represent prefecture-year fixed effects in year 1991 or 1996.[12] We also control for the interactions of commercial land price index with the share of non-college educated workers so that our results are not driven by differential exposure of industries to local economic shocks. ε_{ijt} capture error terms. Standard errors are clustered at prefecture-level to address correlated errors within each prefecture (Bertrand et al. 2004).

As in Equation (2), the main coefficient of interest in Equation (3) is the coefficient, β_2, on the interaction of the share of loans to the construction and real estate sectors with the share of low-skilled worker. We expect β_2 to be negative for the number of establishments: when banks direct more loans to the troubled construction and real estate sectors, low-skilled industries are likely to suffer more because of a decline in availability of low-skilled workers

[11] The variable non-college share$_j$ is defined as the share of non-college educated workers based on 81 industries in the *1991 Establishment and Enterprise Survey*.

[12] Recall that the share of loans to the construction and real estate sectors drops out because it is perfectly collinear with prefecture-year fixed effects. The results are similar with year-fixed effects, which we do not report to conserve space.

who are being hoarded away by local construction projects. Furthermore, if β_2 for new firms is more negative than that for old firms, then it means that in a low-skilled industry, loan-evergreening in the construction and real estate sectors discourages the entry of new firms to a greater extent than it pushes the exit of old and less efficient firms.

Coefficients α_2 in Equation (2) and β_2 in Equation (3) both estimate the differential impact of loan-evergreening in the troubled construction and real estate sectors on the performance of other industries through the availability of low-skilled workers. However, estimating Equation (3) based on a separate data set on the number of establishments is a critical check on the credibility to the central results. Moreover, the estimate of β_2 in Equation (3) sheds some important light on the mechanism behind the differential impacts of loan-evergreening on low-skilled industries. While a negative estimate of α_2 from Equation (2) suggests that low-skilled industries experienced a relatively larger decline in output when banks direct more loans to the construction and real estate sectors, we do not know whether such a decline in output is driven by the negative impacts of loan-evergreening on the existing firms' production or firm formation. The estimate β_2 from Equation (3) answers this question.

The results are reported in Table 5. As in Table 3, our coefficients of interest are estimates on the interaction of the share of loans to the construction and real estate sectors with the share of low-skilled workers. Columns (1) and (2) show negative coefficients on the interaction terms, indicating that when banks engage more in loan-evergreening in the construction and real estate sectors, it disproportionately reduces the number of establishments in low-skilled industries. However, the results are not statistically significant. When we examine the number of new firms, the negative coefficients on the interaction terms

in columns (3)–(4) turn out to be statistically significant. That is, firms' entry declined more in low-skilled industries in prefectures where banks direct more loans to the construction and real estate sectors. At the same time, the negative coefficients on the interaction terms in columns (5)–(6) suggest that the rate of old firms' exit also increasesd somewhat in low-skilled industries when the construction and real estate sectors receive more bank loans. Nonetheless, these negative coefficients for the number of old firms are much smaller, compared to those for new firms, suggesting that in a low-skilled industry, loan-evergreening in the construction and real estate sectors discourages the entry of new firms more than it encourages old firms to leave the market compared to other high-skilled industries.

5. Concluding Remarks

Banks kept lending to the construction and real estate sectors in Japan even after commercial real estate booms abruptly ended in 1991. Such loan-evergreening in the troubled sectors still appears to be prevalent in other countries today. Moreover, policymakers are now concerned about the unintended consequence of preferential treatments to distressed firms, such as loosening screening for the loan application and even the recent COVID temporary relief bills (Boddin et al. 2020, Laeven et al. 2020, Hoshi et al. 2023, Honda et al. 2023). Those policies help save jobs, but at what cost?

In this paper, we present the spatial evidence of the differential impacts of loan-evergreening via the local labor market channel. Theoretically, if banks cut off funds for the construction and real estate sectors after real estate bubbles burst, construction projects that are deemed to be unviable would be quickly terminated, resulting in an immediate loss of

construction-related jobs. Since construction projects predominantly employ non-college educated workers, we expect other low-skilled industries to poach newly unemployed workers, thereby increasing employment of low-skilled workers elsewhere. Banks' loan-evergreening policy shuts down this natural, inter-industry re-allocation process.

Our empirical results, based on Japan's experience, are consistent with this mechanism: other low-skilled industries experienced a disproportionately slower employment and output growth in prefectures where banks continued lending more to the construction and real estate sectors. In addition, utilizing data of firms and establishments by age among different industries and prefectures, we show that low-skilled industries experienced a relatively slower new firm entry in these prefectures. Taken together, our results offer some cautionary tales: support for distressed sectors for job protection may disproportionately hurt the performance of other sectors that rely on a similar type of workers. In the case of Japan, while bank loans to the construction and real estate sectors may have temporarily protected those low-skilled workers in the construction industry from being laid off, from the allocative efficiency's perspective, it might have been an economically costly way to achieve such an objective because of its negative impacts on the other low-skilled industries.

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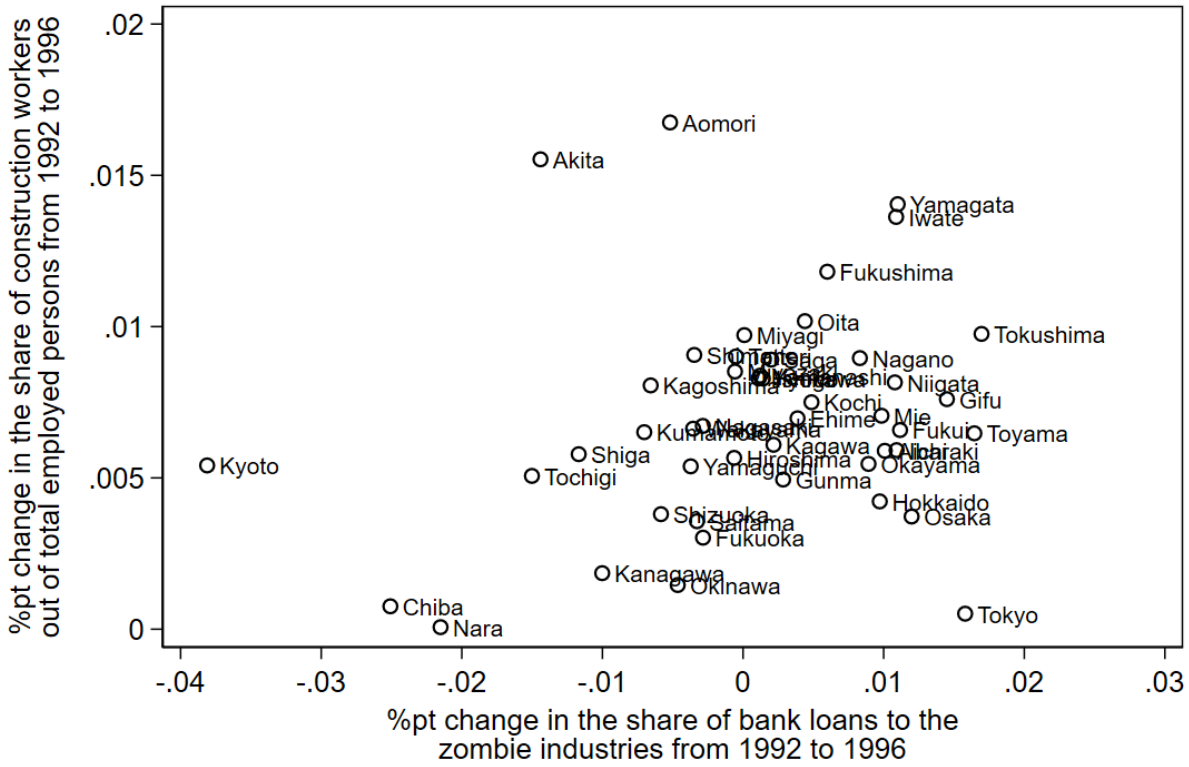
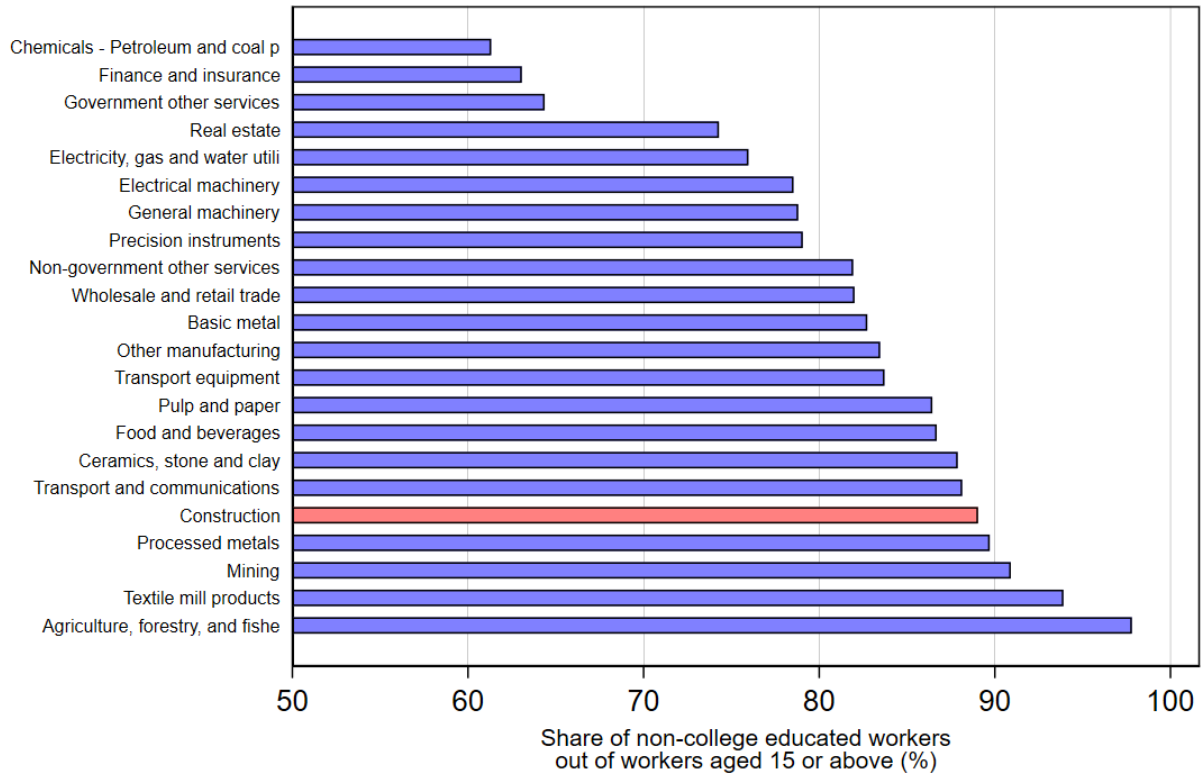
Figure 1: Relationship between changes in the share of construction employment and changes in the share of bank loans to the construction and real estate industries



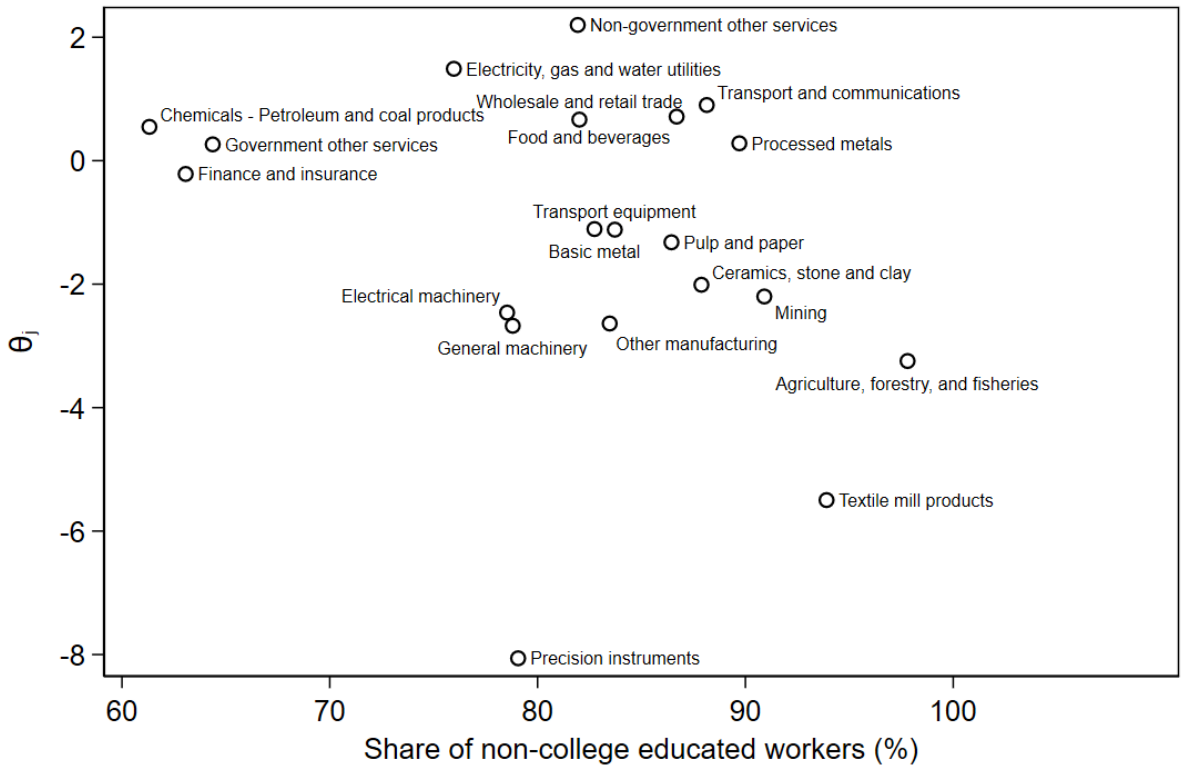
This figure shows that an increase in bank loans to the construction and real estate industries was beneficial to the growth of construction employment in the 1992–1996 period. The data of the construction employment and the number of employed persons are both retrieved from the R-JIP 2017 database. The bank loans data are retrieved from the chapter “Loans and Discounts Outstanding of Banking Accounts of All Banks, by Major Industry, and Fund Utilization” in the Prefecture Economics Statistics Periodic published by the Bank of Japan annually.

Figure 2: Share of non-college educated workers by industry



This figure visualizes the share of non-college educated workers employed in each industry, which is defined as the 1 - (total number college educated workers aged 15 or above)/(total number of workers aged 15 or above). The data are retrieved from the 1997 Survey of Employment Structure.

Figure 3: Differential impacts of zombie lending on employment in relation to the share of non-college educated workers



This figure shows that employment in industries hiring relatively more non-college educated workers was more negatively affected by loan-evergreening to the construction and real estate industries. We first estimate the industry-specific impacts of loan-evergreening (θ_j) on employment for each industry *j*, where the estimate θ_j represents the average percentage change in employment in response to one percentage point increase in the share of bank loans to the construction and real estate industries in a given prefecture. To be specific, for each industry *j*, we compute the estimate θ_j through a fixed-effect regression model (equation 1):

$$ln(Employment)_{ijt} = \delta_{ij} + \theta_j \times loan\ evergreening_{\ it-1} + \varepsilon_{ijt}$$

where *t* indexes for year, *i* indexes for prefecture, and *j* indexes for industry. *Loan-evergreening*$_{it-1}$ is the lagged share of bank loans to the construction and real estate industries. Prefecture fixed effects δ_{ij} are included in all regressions so that θ_j is estimated based only on the within-prefecture variation in the share of bank loans to the construction and real estate sectors.

Table 1: Share of bank loans to the construction and real estate industries by prefecture

	(1)	(2)	(3)
Prefecture	Share of bank loans to the construction and real estate industries in 1991	Share of bank loans to the construction and real estate industries in 1996	Changes in share of bank loans to the construction and real estate industries from 1991-1996
Hokkaido	16.74	18.58	1.84
Aomori	14.79	14.21	-0.57
Iwate	15.54	18.13	2.59
Miyagi	17.33	17.49	0.16
Akita	17.42	16.91	-0.51
Yamagata	14.14	15.54	1.40
Fukushima	17.22	18.66	1.43
Ibaraki	21.21	23.07	1.86
Tochigi	18.18	16.76	-1.42
Gunma	14.65	15.86	1.21
Saitama	21.48	20.66	-0.82
Chiba	25.21	22.95	-2.26
Tokyo	15.10	17.95	2.85
Kanagawa	21.30	20.57	-0.74
Niigata	15.98	18.23	2.25
Toyama	13.53	16.03	2.50
Ishikawa	16.69	17.18	0.49
Fukui	16.76	18.52	1.76
Yamanashi	17.32	18.37	1.05
Nagano	16.33	18.46	2.14
Gifu	14.54	16.82	2.28
Shizuoka	13.50	13.45	-0.05
Aichi	11.97	13.64	1.67
Mie	15.62	16.67	1.05
Shiga	24.16	23.45	-0.71
Kyoto	17.53	13.81	-3.71
Osaka	18.66	20.80	2.14
Hyogo	19.18	20.97	1.78
Nara	21.27	20.82	-0.45
Wakayama	19.90	20.26	0.36
Tottori	16.22	15.90	-0.33
Shimane	17.35	17.82	0.48
Okayama	16.65	17.52	0.87
Hiroshima	17.31	16.96	-0.35
Yamaguchi	18.58	18.45	-0.12
Tokushima	15.42	17.37	1.95
Kagawa	15.04	15.44	0.41
Ehime	13.38	13.85	0.47
Kochi	17.29	17.99	0.69
Fukuoka	19.63	19.12	-0.51
Saga	15.87	17.08	1.21
Nagasaki	15.59	15.37	-0.22
Kumamoto	14.94	14.82	-0.12
Oita	16.74	17.59	0.85
Miyazaki	16.69	16.10	-0.59
Kagoshima	14.41	14.03	-0.38
Okinawa	23.76	23.16	-0.61

Columns (1) and (2) show the share of bank loans to the construction and real estate industries in 1991 and 1996, respectively, by prefectures. The data on bank loans are retrieved from the chapter “Loans and Discounts Outstanding of Banking Accounts of All Banks, by Major Industry, and Fund Utilization” from the Prefecture Economics Statistics Periodic published by the Bank of Japan annually. Column (3) shows changes in the share of loans to the construction and real estate industries from 1991-1996.

Table 2: Baseline results

	ln(Employment)		ln(Value-Added)	
	(1)	(2)	(3)	(4)
Share of loans to the construction/real estate sectors	5.839***		12.28***	
	(1.748)		(3.596)	
Share of loans to the construction/real estate sectors × non-college share	-7.409***	-7.409***	-15.01***	-15.01***
	(2.191)	(2.190)	(4.640)	(4.637)
Observations	4,700	4,700	4,700	4,700
R-squared	0.999	0.999	0.997	0.997
Number of years	5	5	5	5
Number of prefectures	47	47	47	47
Number of industries	20	20	20	20
Year FE	✓		✓	
Prefecture × industry FE	✓	✓	✓	✓
Prefecture × year FE		✓		✓

This table shows that industries employing relatively more non-college educated workers experienced disproportionately slower employment and output growth in prefectures where the share of bank loans to the construction and real estate industries increased more from 1992–1996. The key independent variable is interaction between the share of bank loans to construction and real estate industries and the share of non-college educated workers. The share of loans to the construction and real estate sectors is lagged one year to avoid endogeneity issues. Standard errors (in parentheses) are clustered at prefecture-level to address serial correlation.

*** Significance at 1% level ** Significance at 5% level * Significance at 10% level

Table 3: Robustness checks (industry output)

Dependent variable: natural log of value-added				
	(1)	(2)	(3)	(4)
Share of loans to the construction/real estate sectors × non-college share	-15.01***	-15.52***	-11.80**	-12.05**
	(4.637)	(4.723)	(4.893)	(5.101)
TFP growth rates (%)		0.368***		0.368***
		(0.0293)		(0.0294)
%Δ in land price index × non-college share			0.0351**	0.0379**
			(0.0170)	(0.0183)
Observations	4,700	4,700	4,700	4,230
R-squared	0.997	0.997	0.997	0.997
Number of years	5	5	5	5
Number of prefectures	47	47	47	47
Number of industries	20	20	20	20
Prefecture × industry FE	✓	✓	✓	✓
Prefecture × year FE	✓	✓	✓	✓

This table shows that the estimated coefficients on the interaction of the share of loans to the construction and real estate sector with the share of non-college educated workers are robust to additional control variables. The dependent variable is the natural log of real value-added retrieved from the R-JIP 2017 database. The variable non-college share is defined as the share of non-college educated workers. The data on TFP growth are retrieved from the R-JIP 2017 database. Prefecture-level growth (%Δ) in land price index is calculated from the commercial land price index retrieved from the Land Information Center (2021). Standard errors (in parentheses) are clustered at prefecture-level to address serial correlation.

*** Significance at 1% level ** Significance at 5% level * Significance at 10% level

Table 4: Robustness checks (industry employment)

Dependent variable: natural log of employment				
	(1)	(2)	(3)	(4)
Share of loans to the construction/real estate sectors × non-college share	-7.409***	-7.274***	-6.149***	-6.081***
	(2.190)	(2.121)	(2.202)	(2.126)
TFP growth rates (%)		-0.0990***		-0.0988***
		(0.0335)		(0.0335)
%Δ in land price index × non-college share			0.0138	0.0130
			(0.00847)	(0.00802)
Observations	4,700	4,700	4,700	4,700
R-squared	0.999	0.999	0.999	0.999
Number of years	5	5	5	5
Number of prefectures	47	47	47	47
Number of industries	20	20	20	20
Prefecture × industry FE	✓	✓	✓	✓
Prefecture × year FE	✓	✓	✓	✓

This table shows that the estimated coefficients on the interaction of the share of loans to the construction and real estate sector with the share of non-college educated workers are robust to additional control variables. The dependent variable is the natural log of employment retrieved from the R-JIP 2017 database. The variable non-college share is defined as the share of non-college educated workers. The data on TFP growth are retrieved from the R-JIP 2017 database. Prefecture-level growth (%Δ) in land price index is calculated from the commercial land price index retrieved from the Land Information Center (2021). Standard errors (in parentheses) are clustered at prefecture-level to address serial correlation.

*** Significance at 1% level ** Significance at 5% level * Significance at 10% level

Table 5: Results on firm formation

	(1) ln(Firm)	(2) ln(1+Firm)	(3) ln(New Firm)	(4) ln(1+New Firm)	(5) ln(Old Firm)	(6) ln(1+Old Firm)
Share of loans to the construction/real estate sectors × non-college share	-2.072	-1.778	-12.59**	-9.927*	-2.190*	-1.311
	(1.727)	(1.717)	(6.053)	(5.157)	(1.286)	(1.289)
%Δ in land price index × non-college share	0.00603**	0.00649***	0.0143***	0.0107**	0.00462**	0.00498***
	(0.00236)	(0.00205)	(0.00426)	(0.00505)	(0.00172)	(0.00156)
Observations	6,650	7,050	6,128	7,050	6,632	7,050
R-squared	0.995	0.996	0.974	0.981	0.994	0.995
Number of years	2	2	2	2	2	2
Number of prefectures	47	47	47	47	47	47
Number of industries	75	75	75	75	75	75
Prefecture × industry FE	✓	✓	✓	✓	✓	✓
Prefecture × year FE	✓	✓	✓	✓	✓	✓

This table shows that industries employing relatively more non-college educated workers experienced disproportionately slower growth in the number of establsihments in prefectures where the share of bank loans to the construction and real estate industries increased more from 1992–1996.. The key independent variable is interaction between the share of bank loans to construction and real estate industries and the share of non-college educated workers. Growth (%Δ) in land price index is calculated by taking the average of the growth rates in prefecture-level commercial land price index over 1987-1991 and 1992-1996 respectively. The data on commerical land price index is retrieved from the Land Information Center (2021). Standard errors (in parentheses) are clustered at prefecture-level to address serial correlation.

*** Significance at 1% level ** Significance at 5% level * Significance at 10% level