Housing Bubbles and Misallocation: Evidence from Spain*

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Abstract

During the 2000s, several developed economies experienced a housing bubble. At the same time, productivity growth started to decline. Spain is a paradigmatic example. We use unique matched firm- and bank-level data to empirically analyze the effects of the housing bubble on the allocation of capital and credit across firms. We focus on manufacturing firms (robust to consider non-financial market economy). We employ housing supply elasticity at the municipality level (based on land availability) as an instrument for house price growth. We find empirical evidence that the housing bubble increased misallocation and reduced total factor productivity (TFP). We identify two types of misallocation: (i) industry and (ii) geographical misallocation. Given the municipality, firms with a larger share of real estate assets (over total assets) increased their investment, whereas firms with less real estate assets decreased their investment (industry misallocation). This difference in investment across firms was exacerbated in municipalities with lower housing supply elasticity (geographical misallocation). We derive the same misallocation results for credit given to firms. Our interpretation is that the housing bubble generated misallocation through the change in the value of the collateral of firms, which depended on both the composition of assets and the location of the firm.

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1 Introduction

Starting in the early-2000s, several developed economies experienced a large increase in house prices followed by a sudden bust. The growing consensus is that these economies had a housing bubble. Before the onset of the global financial crisis, productivity growth started to decline in different countries[1]. The coincidence of both facts aroused a suspicion among economists and policymakers that housing bubbles could be responsible of the misallocation of factors.

In this paper, we provide a first empirical attempt to identify the effect of housing bubbles on the misallocation of capital and credit. We perform this exercise for Spain, which is a paradigmatic example. House prices increased by 114% between 2000 and 2007 before they suddenly collapsed. During this period, non-residential investment increased by 87% and debt of non-financial institutions (over GDP) almost doubled (from 64 to 124%). This investment boom, financed mostly by debt, resulted in a decline of total factor productivity (TFP) of 3.6%.[2]

An empirical challenge in investigating the effect of the housing bubble on the allocation of factors is that house price growth may be endogenous. To address this concern, we instrument house price growth at the municipality level with the housing supply elasticity. The instrument, borrowed from Basco and Lopez-Rodriguez (2017), is based on land availability and it is analogous to the one used in Glaeser et al. (2008) or Mian and Sufi (2011) for the United States. Housing bubbles cannot appear if the housing supply is infinitely elastic. Therefore, we exploit within-country differences in housing supply elasticity to identify the effect of the housing bubble.

We show that the housing bubble generated misallocation of capital and reduced TFP. We document two types of misallocation: (i) industry and (ii) geographical misallocation. Given the municipality and industry, we show that firms with a larger share of real estate assets (over total assets) invested more than firms with a lower share of real estate assets (industry misallocation). In addition, this difference in investment between firms with different composition of assets is exacerbated in municipalities with low housing supply elasticity (geographical misallocation). Then, we uncover the credit supply channel behind the misallocation on investment. Finally, we show these misallocations resulted in an increase in the variance of the capital-labor ratio and, thus, a fall in aggregate TFP.

Our paper contributes to the empirical literature on misallocation and financial frictions. Our presumption is that entrepreneurs are financially constrained. They can borrow only a fraction of their collateral (as in, for example, Kiyotaki and Moore, 1997). The only difference across entrepreneurs is the distribution of real estate assets. In this context, we assume that a housing bubble emerges. We do not take a stand on the origin of the housing bubble. It could

[1] See, for example, Fabina and Wright (2013) or Fernald (2015).

[2] We obtain TFP data from Feenstra et al. (2015). House prices come from Bank of Spain.

be, for example, a rational housing bubble driven by international capital inflows (Basco, 2014) or a behavioral-based bubble as in Case and Shiller (2003). In any event, the bubble increases the price of the house, which raises the value of the collateral of entrepreneurs with real estate assets. These entrepreneurs receive more credit, which allows them to increase their investment. Since entrepreneurs are otherwise identical, this differential effect on investment implies that the housing bubble reduces TFP. We are the first to empirically investigate this channel.

We use unique matched firm- and bank-level data from Banco de España between 2004 and 2007.[3] The firm-level dataset comes from the reported financial statements that all firms are required to yearly submit to the Commercial Registry (Registro Mercantil Central). This dataset is representative and covers around 90% of registered business in Spain. The firm-level credit data come from the loan level Central Credit Register (Central de Información de Riesgos – CIR) owned/collected by Banco de España in its role of supervisor of the Spanish banking system. By having access to these data, we can both investigate the effect of the housing bubble on investment and document the credit supply channel.

We start providing macroeconomic background and aggregate suggestive evidence consistent with the housing bubble generating misallocation of factors through the collateral channel. First, we document that the housing boom in Spain between 2000 and 2007 was very large by international standards. This increase in house prices were heterogenous across municipalities. The growth rate between 2004 and 2007 in housing supply inelastic municipalities were 14.3% higher than in housing supply elastic ones. Second, we show that this increase in house prices coincided with an aggregate non-residential investment boom financed by debt. The increase in debt were much larger than in other eurozone countries, which also received capital inflows (e.g., France and Italy). Third, we argue that Spanish firms are very dependent on banks to obtain credit and strongly rely on collateralized debt. Finally, we document that the increase in misallocation during the housing boom was heterogenous across municipalities. Our measure of misallocation is the variance of the capital-labor ratio, which is the fundamental determinant of productivity dynamics (see, e.g., Hsieh and Klenow, 2009). We find that the variance of the capital-labor ratio increased 12.4% in housing supply elastic municipalities, whereas it increased 57.5% in housing supply inelastic municipalities.

After the suggestive evidence, we formally test the effect of the housing bubble on investment. The baseline sample consists only of manufacturing firms. Our dependent variable is annual investment from 2004 to 2007. The regressions are at the firm level and we include both firm and sector*year fixed effects. The main variable of interest is the interaction between annual house price growth of the municipality and the initial share of real estate (over total assets) of the firm. We run this regression both using OLS and instrumenting house

[3] There is no house price data at municipality level before 2004. This precludes to extend our analysis before 2004, when presumably the housing bubble had already begun.

price growth with the housing supply elasticity of the municipality. Our IV coefficients imply that the house price elasticity depends on the share of real estate. A firm without real estate assets has a elasticity of -.71 and a firm with only real estate assets has a elasticity of 2.02. These elasticities imply that there are two types of misallocation. Given the municipality and industry, firms with more real estate assets invested more (industry misallocation). Then, given the share of real estate assets, firms in bubbly municipalities invested more (geographical misallocation). Quantitatively, these coefficients imply that, without the bubble, the investment of the firm with only real estate assets would have been 28.8% lower.[4] In our baseline specification we only include, in addition to the firm and sector*year fixed effects, the share of real estate assets as control variable. We expand the set of controls and include the productivity of the firm and the leverage ratio of the firm. The coefficient on the interaction term remains significant and its magnitude is very similar in all different specifications. In this set of results we only consider manufacturing firms. Our results are robust to enlarge the sample to the non-financial economy (excluding construction).

Our working assumption is that the housing bubble affected the relative investment of firms through the credit channel. The housing bubble raised the price of houses, which increased the value of the collateral of firms with a larger share of real estate assets. Thus, these firms were able to borrow more. Our dataset allows us to test this credit channel. We run the same type of specification and show that there were also both industry and geographical misallocation of credit. Our baseline IV coefficients imply that the house price elasticity for credit is zero if the firm has no real estate assets and 1.39 if the firm only has real estate assets. Thus, we obtain the same misallocation result as with investment. Following with the same example, without the bubble, the amount of loans received by the firm with only real estate assets would have been 19.9% lower. These results apply both to manufacturing and non-financial market economy firms. In addition to the effect on the intensive margin, we investigate the extensive margin. That is, whether given the share of real estate assets, firms in bubbly municipalities were more likely to receive credit. We show that this was the case for manufacturing firms. The results are less robust outside manufacturing.

Then, we provide a series of robustness checks to our results. First, one would expect that our effects were larger and better identified in small firms. The reason is that small firms are the most likely to be financially constraint and to have all activity in one location. We show that this hypothesis is correct. Second, one could ague that in small municipalities the correspondence between real estate assets (mainly, headquarters) and activity is looser than in larger municipalities. We show that our results are robust to focus only on large municipalities. Third, in our baseline specification we define investment as the change in fixed assets (as in the related literature, e.g., Gopinath et al., 2017) but one could argue

[4] To compute this number, we assume that the housing bubble is the difference between house price growth in housing supply inelastic and elastic municipalities. That is, 28.8%=2.02*14.3%.

that it is better to define investment as change in the capital-labor ratio. We show that in this case the coefficient on the interaction term is statistically significant and very similar in magnitude with respect to the baseline case. Lastly, an alternative narrative is that these differential effects across municipalities could be driven by differences in real interest rates. We compute monthly average interest rates on loans given to firms in housing supply elastic and inelastic municipalities and show that there are no significant differences between both series. Our interpretation is that low interest rates are necessary but not sufficient to generate misallocation of capital.

Finally, we provide evidence that the housing bubble had aggregate effects. We show that the housing bubble increased the dispersion of the capital-labor ratio. The coefficient in our conservative specification implies that 10% increase in house prices is associated with an increase in .74% of the variance of the capital-labor ratio. Thus, without the bubble, the variance of the capital-labor ratio would have been between 1.06%. lower. This lower variance implies, through the lens of our model, that the housing bubble can explain about the 17% of the decline in TFP in Spain. These numbers should be taken with a grain of salt because we use a model developed to illustrate the qualitative effects of the housing bubble on the misallocation of capital.

Related literature. This paper relates to different strands of the literature. Following the seminal paper of Hsieh and Klenow (2009) on misallocation, there has been a large number of empirical investigations on the reasons why the actual allocation of inputs may depart from the optimal one (see Jones, 2016). In this paper we study how housing bubbles affect the allocation of inputs. In this sense, our paper is related to Banerjee and Duflo (2014) and Midrigan and Yi Xu (2014), who analyze how financial frictions may generate misallocation of inputs. One departure from this literature is to document how the relaxation of financial frictions may exacerbate the misallocation of capital. That is, we show that, in bubbly municipalities, the increase in credit was biased toward firms with a larger share of real estate assets (over total assets), which increased the within-industry dispersion of investment. In other words, relaxation of financial conditions did not improve the allocation of inputs because this easing of financial conditions were biased towards firms with an specific type of asset (real estate)

The credit boom in Spain in the late 2000s has aroused a great interest in the academia. For example, Garcia-Santana et al. (2015) show that the economic growth in GDP was not driven by improvement in total factor productivity (TFP). A closer paper is Gopinath et al. (2017). Their goal is to analyze whether a fall in interest rate may increase misallocation of inputs. They employ Spanish firm-data level and argue that low interest rates were the cause that capital was misallocated towards firms with more net worth. A first difference is that we identify geographical misallocation of capital within Spain. We show that firms in bubbly municipalities (low housing supply elasticity) increased relatively more their investment, which was financed by debt. A second difference is that we identify the collateral channel behind the industry misallocation. Our interpretation of the decline in TFP in Spain is that the housing bubble increased the value of the collateral of entrepreneurs (real estate) and this appreciation was larger in firms with a larger share of real estate assets. Thus, one reason why low interest rates generated misallocation in Spain was through their effect on the housing bubble.

Finally, there have been other papers that have studied how house price fluctuations affect investment of firms. For example, for the United States, Chakraborty et al. (2016) show that firms that borrowed from banks active in strong housing markets invested less. Similarly, Chaney et al. (2012) shows that the collateral channel was stronger for real state owners than renters during the housing boom in the United States. Consistent with the finding of Chaney et al. (2012), we also identify a collateral channel for Spanish firms during the housing bubble. A departure from this literature is that we analyze how the housing bubble generated misallocation of capital and credit. These papers use Compustat data, which only cover public firms and introduces several biases. For example, Ali et al. (2009) show that industry concentration measures computed with Compustat are poor proxies for actual industry concentration using U.S. Census. Moreover, we expect that the easing of financial constraints affects relatively more small firms, which are underrepresented in Compustat. Thus, to have a complete picture on the effect of housing bubbles on the allocation of capital and credit we need a representative dataset. As highlighted above, our dataset is representative and covers around 90% of registered business in Spain, which allows us to assess the effect of the housing bubble on the allocation of capital in Spain.

2 Macroeconomic Background and Suggestive Evidence

Before describing the most salient empirical predictions, we provide suggestive evidence on the relevance of the macroeconomic shock and the collateral channel driving the misallocation of capital and credit in Spain.

The boom-bust cycle in house prices in Spain in the late 2000s was a large macroeconomic event by international standards. As an example, Figure 1a reports the evolution of (nominal) house prices in Spain and in the United States. Notice that the extraordinary US housing boom resulted in an average house price growth of 70%. In contrast, in Spain, house prices rose well-above 110%. The Spanish housing boom suddenly stop in 2008 when house prices collapsed. This impressive increase in house prices was heterogeneous across municipalities and correlated with geographical conditions. To give empirical content to geographical conditions, we borrow the housing supply elasticity measure, based on land availability, built in Basco and Lopez-Rodriguez (2017). This measure is similar to the housing supply elasticity developed by Saiz (2010) for the U.S.[5] We document that the average house price growth per square meter during the housing boom (2004-2007) was 14.3% higher in housing supply inelastic municipalities than in elastic ones. Inelastic municipalities are defined as being below the 25th percentile in the housing supply distribution, whereas elastic municipalities are defined as those above the 75th percentile in the distribution.

The huge increase in house prices coincided with a boom in non-residential investment. This rise in investment is not comparable with other developed countries. Figure 1b reports the evolution of non-residential investment for Spain, Italy, Germany and the United States. The non-residential investment raised 87% between 2000 and 2007 in Spain. To put this number into perspective, in Italy and Germany, with the same monetary policy, the increase was just 31% and 27%, respectively. In the United States, the increase was 34%. In 2008, investment levels started to converge and in 2012 the differences had ended. In addition, the investment boom-bust cycle was also heterogenous across municipalities and correlated with housing supply elasticity. Figure 1c reports the evolution of capital stock in housing supply inelastic and elastic municipalities between 2000 and 2012. Notice that capital stock increased by 40% in housing supply inelastic municipalities between 2000-07, whereas it increased by just 20% in housing supply elastic municipalities. In 2012, the differences had returned to 2000 levels. This evidence hints to an effect of the housing bubble on investment.

The Spanish investment boom was financed by debt. As documented in Figure 1d, non-financial firms raised its leverage from 64% in 2000 up to 124% in 2007, well-above other eurozone countries (like France or Italy) that also received capital inflows during the 2000s. Our working hypothesis is that the housing bubble, through the collateral channel, were the cause of the increase in both non-residential investment and debt. The collateral channel is more likely to be large in Spain than in, for example, the United States. One particularity of the Spanish economy is that firms are very dependent on banks to obtain credit.

The boom in non-residential investment financed by debt coincided with an increase in misallocation of capital. Figure 2 provides suggestive evidence that the housing bubble exacerbated the misallocation of capital. It reports the evolution of misallocation for average (blue line), elastic (red line) and inelastic (green line) municipalities between 2000 and 2012. Our measure of misallocation is the variance of the capital-labor ratio, which is the fundamental determinant of productivity dynamics (Hsieh and Klenow, 2009). The variance of the capital-labor ratio (of non-financial firms) in the average municipality increased by 26.9% between 2000 and 2007, which points to rising misallocation of capital in Spain. This empirical fact has also been documented by Gopinath et al. (2017) for the manufacturing firms. However, this aggregate figure hides the differential increase across municipalities. Indeed, note that the lines for elastic and inelastic municipalities grow apart during the housing bubble and start to converge after the bubble burst. Quantitatively, the increase in the variance of the

[5] See Section 5 for further details.

capital-labor ratio was more than four times larger in housing supply inelastic municipalities (57.5%) than in elastic ones (12.4%).

The evidence presented in this section paints a picture consistent with the view that the housing bubble exacerbated the misallocation of capital in Spain. In addition, it hints to the collateral channel as the mechanism through which the rise in house prices translated into an increase in both non-residential investment and debt. This collateral channel is likely to be significant in Spain because Spanish firms, bank-dependent, rely on collateralized loans to obtain funds. To formally test these hypotheses, we need matched firm and bank-level data and a representative sample of the economy. As we explain in Section 4, our Spanish dataset is representative and, thus, we will be able to empirically investigate the effects of the housing bubble on the misallocation of capital and credit.

3 Housing Bubbles and Misallocation

In this section we describe the most salient empirical predictions on the effects of the housing bubble. Consistent with our empirical strategy, we want to capture two types of misallocation: (*i*) geographical misallocation and (*ii*) industry misallocation. In the geographical misallocation, we want to compare the same firm in different municipalities. In the industry misallocation, we want to compare two firms in the same industry and municipality. To capture the collateral channel and illustrate these two types of misallocation, we consider a static partial equilibrium model with borrowing constraints.

We assume that there is a continuum of entrepreneurs, with mass M, indexed by i. Entrepreneurs are endowed with real estate assets h^i and non-real estate assets η^i. None of these assets is used in production but can be collateralized. We assume that financial markets are not perfect. Borrowers could avoid repayment by paying a fraction θ of the value of their assets. This financial friction implies that entrepreneurs face the following borrowing constraint, $Rd_i \leq \theta \left[ps_h^i H + \eta^i\right]$, where R is the interest rate, d_i is the amount borrowed by firm i, p is house price and $s_h^i = \frac{h^i}{H}$ is the share of real estate owned by firm i.[6] The price that more directly affects the value of real estate is the commercial price. Unfortunately, there does not exist an index of commercial prices at the municipality level. Thus, we assume that the correlation between house price and commercial prices growth is very high at the municipality level, as it is the case at the aggregate level. A similar assumption is also made in Chaney et al. (2012). Entrepreneurs have access to a production technology, $f(k) = k^\alpha$. We assume that $f'(k) > R$, which guarantees that the borrowing constraint is binding. Therefore, since $k = d$, the investment of firm i is $k_i = \theta \left[ps_h^i H + \eta^i\right]/R$.

In our empirical section, we compare municipalities with different housing supply elasticity.

[6] This borrowing constraint is the same as in Monacelli (2009). It is also similar to Kiyotaki and Moore (1997) with the difference that they consider the limiting case in which θ=1.

Thus, we assume that the supply of housing is given by $H^S = h(p, \varepsilon) = p^\varepsilon$, where ε is the supply-elasticity of housing. We denote by σ the fundamental demand for houses.

Finally, we assume that the only difference between entrepreneurs is the composition of their assets. For simplicity, *low-i* firms are assumed to have only real estate assets and *high-i* firms only have non-real estate assets. In particular,

$$s_h^i = \begin{cases} \frac{1}{\kappa} \text{ if } i < \kappa \\ 0 \text{ if } i > \kappa \end{cases}$$
$$\eta_t^i = \begin{cases} 0 \text{ if } i < \kappa \\ \eta \text{ if } i > \kappa \end{cases}$$

The next assumption implies that, in the absence of bubbles, the value of the endowment is the same for all firms.

Assumption 1 *(symmetry condition)* $\eta = \frac{1}{\kappa}\sigma^{\frac{1+\varepsilon}{\varepsilon}}$

Following with the suggestive evidence described above, we assume that a housing bubble emerges in Spain. We do not take a stand on the origin of the bubble.[7] Instead, we just assume that the demand for houses were $\sigma + B(\varepsilon)$, where $B'(\varepsilon) < 0$. This assumption implies that the size of the bubble is decreasing with the housing supply elasticity (see Glaeser et al., 2008 or Basco, 2016, for a theoretical justification). Our main counterfactual exercise is a Spain without a housing bubble. However, as long as the growth in house prices is higher than in other types of assets, there will be a misallocation of capital driven by the collateral channel.

We are now ready to describe the empirical predictions on the effects of the housing bubble.

Prediction 1 *Given the municipality, if there is a housing bubble, investment increases relatively more in firms with real estate assets (industry misallocation). This difference in investment between firms is larger in municipalities with low housing supply elasticity (geographical misallocation).*

The relative investment of firms with housing ($i < \kappa$) in the bubbly equilibrium is[8]

[7] A possible interpretation of the recent Spanish experience is that international capital inflows created a shortage of assets, which brought about a rational housing bubble (see Basco, 2014, for a theoretical model on this mechanism). Note for example that the current account deficit increased from 3.88% of GDP in 2003 to 9.65% in 2007, when it started to decline. An alternative interpretation is that unrealistic expectations on future house price increases were responsible for the housing bubble (see Case and Shiller, 2003, for a discussion of this channel in the United States).There exist other narratives. For example, Laibson and Mollerstrom (2009) argue that behavioral housing bubbles also explain capital inflows. Arce and López-Salido (2011) show, in a closed economy, how financial frictions can be conducive to the emergence of rational housing bubbles.

[8] It is straightforward, given assumption 1, that $\Phi(B, \varepsilon) > 1$. Moreover, $\frac{\partial \Phi(B,\varepsilon)}{\partial \varepsilon} < 0$ because both $\frac{1+\varepsilon}{\varepsilon}$ and B decrease with ε.

$$\frac{k^{\text{with houses}}}{k^{\text{without houses}}} = \frac{\frac{1}{\kappa}\left[\sigma + B(\varepsilon)\right]^{\frac{1+\varepsilon}{\varepsilon}}}{\eta} \equiv \Phi(B, \varepsilon) > 1.$$

The intuition for this result is that the housing bubble raises the value of the collateral of the firms who own houses. This effect is exacerbated when ε is small because the increase in house prices is decreasing with the housing supply elasticity. Note that in the absence of bubbles the two types of firms would invest the same amount.

Prediction 2 *Given the municipality, if there is a housing bubble, firms with real estate assets receive more credit than firms without real estate assets (industry misallocation). This difference in credit growth is larger in municipalities with low housing supply elasticity (geographical misallocation). In addition, if there is rationing, we should observe the same effect in the access to credit (extensive margin).*

These predictions are a corollary of the previous one. In the model, investment is equivalent to credit ($D = K$). Thus, firms with housing invest more because they can also borrow more. There is no credit rationing in the model. However, if we assumed that the likelihood of receiving credit depends on the value of the collateral, we would find that firms with houses are more likely to receive credit. Moreover, these effects are larger, the lower is the housing supply elasticity.

Prediction 3 *With a housing bubble, the dispersion in k is larger. Moreover, this effect is larger, the lower is the housing supply elasticity.*

Given the equilibrium investment of firms, the standard deviation of capital is

$$st.d(k)^{Bubbles} = (\Phi - 1)\frac{\left[(M-\kappa)M\kappa\right]^{\frac{1}{2}}}{\Phi\kappa + M - \kappa} \tag{1}$$

The first thing to notice is that without a housing bubble, $\Phi = 1$, the standard deviation of capital is zero. In addition, if all firms had housing ($\kappa = M$) or no firm had housing ($\kappa = 0$), the standard deviation would also be zero. When there is a bubble, $\Phi > 1$, the standard deviation is positive. In addition, the increase is larger, the lower is housing supply elasticity.[9]

This prediction implies that the allocation of capital is less efficient when there is a housing bubble. The reason is that firms with more housing can invest more than other firms. The next prediction relates this misallocation of capital to lower TFP.

[9] This is the case because $\frac{\partial st.d(k)^{Bubbles}}{\partial \varepsilon} < 0$ given $\frac{\partial \Phi}{\partial \varepsilon} < 0$.

Prediction 4: *The TFP is lower with housing bubbles. Moreover, the TFP is lower in municipalities with low housing supply elasticity.*

In order to compute a measure of TFP, remember that $f(k) = k^{\alpha}$. Given that we have two types of firms, it follows that aggregate output is $Y = [k_1^{\alpha}]^{\frac{\kappa}{M}} [k_2^{\alpha}]^{\frac{M-\kappa}{M}}$,where 1(2) stands for firms with low(high) i index.

$$TFP^{Bubble} = \left[\frac{\Phi\kappa}{\Phi\kappa + M - \kappa}\right]^{\alpha\frac{\kappa}{M}} \left(\frac{M-\kappa}{\Phi\kappa + M - \kappa}\right)^{\alpha\frac{M-\kappa}{M}} \tag{2}$$

It is straightforward to see that TFP^{Bubble} has an inverse-U shape with maximum at $\Phi = 1$. When there is no bubble, $\Phi = 1$. Thus, $TFP^{Bubble} < TFP^{Without\ Bubble}$. Note also that if all firms were identical, TFP would be independent of Φ. Lastly, remember that the lower is the housing supply elasticity, the higher is Φ.

Finally, note that, as in, e.g., Hsieh and Klenow (2009), the variance of the capital-labor ratio is a sufficient statistic for TFP. In order to obtain closed form solutions, we assume that $M = 1$ and $\kappa = 1/2$. In that case, by plugging equation 1 into equation 2, we find that

$$TFP = \left[\frac{1 - var(k)}{4}\right]^{\frac{\alpha}{2}} \tag{3}$$

This equation means that the higher is the variance of capital, the lower is the level of TFP. In our case, in the absence of the housing bubble, the variance of capital would be zero. Similarly, as we discussed in Prediction 3, the variance of capital is higher, the larger is the housing bubble (or the lower is the housing supply elasticity).

Discussion of the Model: Housing vs Asset Price Bubbles Since we want to empirically analyze the effect of the housing bubble on the misallocation of capital, we assumed that the bubble appeared in housing. Needless to say, the predictions of the model would be different if the bubble were not attached to houses. For example, if the bubble, instead of being used to purchase houses, were shared equally among all entrepreneurs, it would not create misallocation of credit.[10] In other words, the housing bubble creates misallocation because it artificially raises the value of the collateral of entrepreneurs with real estate assets, who receive relatively more credit and, thus, invest more.

[10] See, for example, Basco (2016) for a discussion on the differential effect of housing and asset price bubbles.

4 Data

In this section, we describe the data that we are going to use in section 5. We test the empirical predictions of the model using a rich firm-level dataset with exhaustive information on administrative credit records and financial statements of Spanish firms. This micro dataset is complemented with (aggregated local) data on both residential housing prices and housing supply elasticity at municipality level. These local datasets are matched with the firm-level dataset according to the geographic location reported by business in their financial statements.

4.1 Firm Data

The empirical strategy to identify the misallocation mechanism crucially relies on having exhaustive firm-level information on business' activity in terms of both flows and stocks matched with their credit records with the banking system. The firm-level dataset has an administrative nature because comes from the reported financial statements that all firms are required to yearly submit by law to the Commercial Registry (Registro Mercantil Central). Banco de España has processed, digitalized and statistically treated this raw data resulting in an exhaustive dataset covering around 90% of registered business in Spain from 2000-2013. This dataset is representative of the non-financial productive sector of the economy given that it replicates the firm-size distribution of firms in terms of both sales and employment, and also the dynamics of production and full-time employment according to official census statistics provided by the National Institute of Statistics of Spain and Spanish Tax Agency.[11]

The resulting firm-level dataset has a panel structure from 2000 to 2013 and includes the following information for each firm: business name, fiscal identifier, zipcode location, sector of activity (4-digit CNAE-2009 code), number of employees and the complete information contained in their financial statements composed by the Balance Sheet and the Profit & Loss Account. The main variables used in our empirical analysis included in the reported financial statements are: (i) the annual net operating revenue; (ii) material expenditures, i.e. the cost of all raw materials and services purchased by the firm in the production process; (iii) labor expenditures, which accounts for the total wage bill of a firm, excluding social security contributions; (iv) total assets; (v) stock of capital; (vi) value-added; and (vii) accounting profit. Table A1 presents summary statistics on these variables for the firms included in our analysis.

The firm-level credit data come from the loan level Central Credit Register (Central de Información de Riesgos – CIR) owned/collected by Banco de España in its role of supervisor of the Spanish banking system. This credit register contains detailed monthly information on

[11] See Almunia, Lopez-Rodriguez and Moral-Benito (2017) for a detailed description on the construction and representativeness of this firm-level dataset.

granted credit and drawn down credit from all new and outstanding loans over 6000 euros to non-financial firms granted by all banks operating in Spain since 1984.[12] We process the information recorded in outstanding loans' data in order to obtain aggregate measures of average drawable and drawn down credit at the firm-year level from 2000 to 2013. We also create these firm-level measures of credit by type of lender separating the sample in loans granted by either commercial or savings banks. Besides of information on granted loans, CIR also compiles since 2002 monthly requests lodged by banks to obtain information on outstanding loans of potential borrowers when the latter give their consent. Lenders receive monthly information on the default status and outstanding debts with all banks of their current borrowers, thus these requests reveal information on borrowers' applications to banks without outstanding debt. We match firm-year level data on loans granted by banks and the set of loan applications in order to infer both loans' denial rates and the new loans granted by banks to nonconcurrent borrowers.

In order to analyze the credit channel of the misallocation mechanism, we merge firm-level data contained in the financial statements database with the yearly aggregated firm-level information on loan applications and credit exposures from the Central Credit Register. The matching process is feasible given the common fiscal identification number associated to each firm that is available in both datasets. Table A2 presents summary statistics on credit and loan applications for the firms included in the analysis.

4.2 Housing Supply Elasticity

In order to capture the real estate market dynamics, we use housing price indexes at municipality level considering that these local indexes capture valuations of real estate assets hold by firms located in a given town. Price indexes are built using the census micro-data on real estate transactions provided by the Spanish Ownership Registry (Registro de la Propiedad) to the Banco de España since 2004. This dataset contains daily frequency information on the market value of transacted real estate assets, size of the assets measured in square meters and the geographic location of each transaction (i.e. local registers that report transactions can be associated to municipality identifiers). We calculate the market value price per square meter for each transaction and then aggregate those prices for all transactions made in a town during a natural year to create yearly average prices per square meter from 2004 to 2012 in towns with more than 1000 inhabitants.[13] We also calculate the same average price indexes for towns that exceed 5000 inhabitants in 2004 to undertake the sensitivity analysis discussed

[12] The significantly low reporting threshold implies that virtually all firms with outstanding bank debt are included in the CIR database. See, for instance, Jiménez et al. (2012) for a detailed discussion on the CIR database.

[13] We exclude tiny towns to avoid small yearly sample sizes that present high volatility and thus could introduce biases in our estimates. This exclusion does not affect the aggregate results because these towns represent less than 5% of population being rural areas without a significant share of economic activity.

in section 5.3. These indices were first used in Basco and Lopez-Rodriguez (2017).

According to our empirical predictions, the dynamics of housing prices affects firms' investment and credit decisions but housing prices are endogenous to these decisions. To address the endogeneity problem, in our empirical strategy we instrument housing price growth with a measure of the housing supply elasticity in the geographic area of analysis, in line with the empirical strategy followed by Mian and Sufi (2011). Indeed, we use a measure of housing supply elasticity for Spanish towns created in Basco and Lopez-Rodriguez (2017), which follow the insights provided by Glaeser et al. (2008) and adapting the elasticity measure created by Saiz (2010) for metropolitan areas in the US. This measure aims to capture the housing supply geographic fundamentals that should explain the evolution of housing prices in the long-run. In particular, Saiz (2008) proposes a geographic measure of land availability that cleans undevelopable land (e.g. water areas, mountains) from total surface, and then correct/adjust it by land's slope to measure potential land for urban development. Using census data on land categories at municipal level registered by the Spanish Cadastre (Catastro), Basco and Lopez-Rodriguez (2017) calculate the ratio of potential plot surface over the built urban surface in a year previous to the housing boom. Within potential plot surface, they consider undevelopable total land once excluded protected non-urban areas (e.g. rivers or natural parks), plot classified as of rural use and public goods land (e.g. local surface occupied/covered by transport and utilities infrastructure). They measure this variable as of 1996/1997 to avoid feedback effects of booming prices on the availability of undevelopable urban land during the housing bubble. They select 1996/1997 given that it precedes the housing prices-credit boom of 2000. The constructed measure is a good proxy of the (physical) relative capacity to build new real estate assets in a municipality as showed by its predictive power on differential housing prices' dynamics during the housing boom (see Table A1 in the Appendix) .

5 Empirical Evidence

This section reports the main empirical results of the paper. First, we document the two types of misallocation of capital. Then, we uncover the mechanism behind this misallocation of capital. Lastly, we run a series of robustness checks to these results.

5.1 Housing Bubble and Investment

In this section we test the first prediction of the model. According to our model, the housing bubble allowed firms with a larger initial share of real estate assets to invest more than firms with a lower share of real estate assets. In order to test this prediction, we start with the next simple panel regression,

$$\Delta K_{f,t+1} = \beta_0 + \beta_1 * \Delta HP_{c,t+1} + \beta_2 * \Delta HP_{c.t+1} * \text{share Real Estate}_{f,t} + \delta_f + \delta_{st} + \epsilon_{cf}, \quad (4)$$

where $\Delta K_{f,t+1}$ is the log-difference in the capital stock between $t+1$ and t of firm f, $\Delta HP_{c,t+1}$ is log-difference in house prices between $t+1$ and t, share Real Estate$_{f,t}$ is the ratio of real estate assets on total assets in t, δ_f are firm fixed effects and δ_{st} are sector*year fixed effects. Prediction 1 of the model implies that $\beta_1 < 0$ and $\beta_2 > 0$.

Column 1 of Table 1a reports this regression with standard errors clustered at municipality*year level for the manufacturing sector. Consistent with the prediction of the model, the coefficient on house prices is negative and the interaction is positive. The house price elasticity, $\widehat{\beta}_1 + \widehat{\beta}_2 *$share Real Estate, is -.065 when the firm has no real estate assets and it is .103 when the firm only has real estate assets. These elasticities inform us on both the industry and geographical misallocation. Given the municipality, firms with a larger share of real estate assets invest more than firms with a lower share of real estate assets (industry misallocation). In addition, given a positive share of housing, firms in bubbly municipalities (low housing supply elasticity) invest relatively more (geographical misallocation). In the absence of the bubble, identical firms should invest the same independently on their location. Firm in bubbly municipalities can invest more because the housing bubble raises the value of their collateral (above the fundamental value).

A possible concern in the above regression is that the increase in house prices may be endogenous. In order to address this concern, we use housing supply elasticity of the municipality as an instrument for house price growth. This instrument, based on land availability, was constructed in Basco and Lopez-Salido (2017). A similar instrument has been used in Mian and Sufi (2011) and Chaney et al. (2012) for the U.S. housing market. The intuition behind this instrument is that if there is an aggregate demand shock (low interest rate), the effect on house prices depends on the availability of houses in the municipality. That is, given the decline in interest rate, house prices should increase more in municipalities where the supply of housing is less elastic. To prove the validity of the instrument, we run the following regression,

$$\Delta HP_{c,t} = \gamma_0 + \gamma_1 * HSE_c \Delta R_t + \delta_c + \delta_t + u_c,$$

where HSE_c is the housing supply elasticity in municipality c, δ_c is municipality fixed effect and δ_t is year fixed effects. Our hypothesis is that $\gamma_1 < 0$. The lower is the housing supply elasticity, the larger will be the effect of (common) interest rate on house price growth.

Table A1 reports the coefficients of running this regression. Columns 1 and 2 use the measure of housing supply elasticity in year 1997 and columns 3 and 4 the measure of housing supply elasticity in year 1996. Notice that both measures of housing supply elasticity are from before the housing bubble. In the odd columns we only include time fixed effects and in the even columns we also add municipality fixed effects. Note that the coefficients are, as expected, negative and very similar in all specifications. We choose the measure of housing supply elasticity in 1997 to maximize the coverage of our sample. The results are robust to use the measure of housing supply elasticity in 1996.

Thus, to take into account the endogeneity concern, we run equation (4) with the housing supply elasticity as in instrument for house price growth. Column 2 of Table 1a reports the coefficients. Note that the interaction term remains positive and statistically significant and the coefficient on house prices is negative. These coefficients imply that the house price elasticity is -.71 if the firm has no real estate assets and 2.02 if the firm has only real estate assets. These elasticities imply that there is both industry and geographical misallocation. In a given municipality, the response to a change in house prices depends on the share of real estate assets (industry misallocation) of the firm. In other words, the housing bubble increases the dispersion in investment across firms. Then, for a given share of real estate assets, the change in investment will depend on the location of the firm (geographical misallocation). Note that the increase in the dispersion of investment is higher in municipalities with low housing supply elasticity (high house price growth). Quantitatively, these coefficients imply that without the bubble the investment of the firm with only real estate assets would have been 28.8% lower. On the other side, the investment of the firm without real estate assets would have been 10.1% higher.

One possible concern with these results is that, even though we are controlling for firm fixed effects, some firms become more productivity during the period and this may be distorting our results. In order to address this concern, column 3 of Table 1a includes the productivity of the firm. We take the firm level productivity computed in Antràs et al. (2017), see the paper for more details. The coefficient on the interaction term remains negative, statistical significant and its magnitude is very similar. The coefficient on the productivity of the firm is positive but only significant at 10 percent.

A similar concern is that the leverage of the firm may change over time and it may affect the investment decisions of the firm. Column 4 of Table 1a adds leverage to the controls in column 3. Note that the coefficient on the interaction term is very similar to the coefficient on column 2. In addition, neither the coefficient on productivity nor leverage turns out to be significant.

In Table 1a we restricted the sample to manufacturing because most of the related literature focusses on manufacturing and this allows us to compare our results to this literature. For example, Chaney et al. (2012) finds that the house price elasticity on investment is .18% for the average firm in the U.S. In our case, if we take the average manufacturing firm in Spain (share of real estate equal to .33), the elasticity implied by the coefficients on column 2 of Table 1a is .19%.

Finally, in Table 1b we report the same specifications as the ones in Table 1a for the non-financial market economy (excluding construction). We exclude construction because we are interested in the misallocation within-sectors and construction would distort our results. Note that the coefficients on this table are very similar to Table 1a. Thus, our findings on misallocation of capital are robust to all the real economy.

5.2 Credit Channel: Housing Bubble and Credit Supply

In the previous section we have shown that the housing bubble generated misallocation of capital in Spain. In this section we provide evidence on the mechanism behind this misallocation of capital. According to our model, firms are financially constrained and their borrowing is linked to the value of their collateral. In other words, we should observe the same effects on credit than on investment.

In order to test this prediction, we run regressions of the following type,

$$\Delta Credit_{f,t+1} = \beta_0 + \beta_1 * \Delta HP_{c,+1t} + \beta_2 * \Delta HP_{c.t+1} * \text{share Real Estate}_{f,t} + \delta_f + \delta_{st} + \epsilon_{cf}, \quad (5)$$

where $\Delta Credit_{f,t+1}$ is the log-difference in credit of firm f between $t+1$ and t. Note that this is the same specification as equation 4. The only difference is the dependent variable. Prediction 2 in Section 3 implies that $\beta_2 > 0$.

Table 2a reports the coefficients of running equation 5 for manufacturing firms. Column 1 reports the OLS coefficients. Consistent with Prediction 2, the coefficient on the interaction term is positive and statistically significant. Therefore, we observe again the industry and geographical misallocation. Given the municipality and industry, firms with a larger share of real estate assets received more credit. Similarly, given the firm and industry, a firm located in a bubbly municipality (high house prices growth) was granted more credit than if it were located in a non-bubbly municipality (low house prices growth).

Columns 2 to 4 report the coefficients of using housing supply elasticity as an instrument for house price growth. Column 2 reports the coefficient of the baseline specification (without additional controls). The coefficient on the interaction term is positive and statistically significant. The coefficient implies that the house price elasticity is zero if the firm has no real estate assets and the house price elasticity is 1.39 if the firm has only real estate assets. This elasticity implies that there is both industry and geographical elasticity. Quantitatively, these coefficients imply that without the bubble, the firm with only real estate assets would have received 19.9% less credit.

In column 3 we control for the productivity (TFP) of the firm. The coefficient on the interaction term is slightly higher and statistically significant. In this specification, the coefficient on house prices growth is negative but it is significant only at 10%. In this case, the house price elasticity is -.59 if the firm has no real estate assets and 1.12 if the firm has only real estate assets. Thus, these coefficients are consistent with the misallocation of credit.

Finally, we add, in addition to the productivity, the leverage of the firm. Column 3 reports the coefficients of running this regression. The coefficient on the interaction term is positive and statistically significant and the magnitude is very similar to the baseline specification (column 2). Therefore, our finding on the industry and geographical misallocation of credit is robust to the inclusion of these variables. The coefficient on the productivity of the firm is positive. It implies that more productive firms received more credit. Lastly, the coefficient on the leverage of firm is negative. As expected, firms with a higher leverage level received less credit.

These results on the misallocation of credit are robust to include firms outside the manufacturing sector. Table 2b reports the coefficients of running the same regressions as Table 2a for all firms in the non-financial market economy (excluding construction). Note that the coefficient on the interaction term is positive and statistically significant in all specifications. Thus, we conclude from this exercise that the misallocation of capital documented in Table 1 can be explained by the misallocation of credit. In other words, the credit channel was the mechanism behind the misallocation of capital.

In Table 2 we investigated the effect of the housing bubble on the intensive margin of credit. The effect on the intensive margin is the most direct evidence on the collateral channel affecting the investment of firm. However, our database allows us to analyze also the effect of the housing bubble on the extensive margin of credit. We provide two measures of the extensive margins. Our first measure is $New\ loans_{f,t+1}$. This variable is defined as the number of new loan applications granted to firm f in year $t+1$. Table 3a reports the coefficient of running all four different specifications with this dependent variable for manufacturing firms. Note that the coefficient of the interaction term is positive and statistically significant in all columns (except the OLS specification, column 1). Quantitatively, the house price elasticity implied by our preferred specification (column 2) is .735*share real estate.

Our second measure of extensive margin is $Accept_{f,t+1}$. This dummy variable takes value 1 if at least 1 bank granted one loan application to firm f in year $t+1$ and 0 if the firm has the same number of credit providers-banks. This definition is more stringent and it implies that the firm stated a new loan relationship at time $t+1$. Table 3ab reports the coefficients of running the same specifications as above with this dependent variable. The coefficient on the interaction term is positive and statistically significant in all specifications (except the OLS specification). This coefficient implies that if a firm has a larger share of real estate assets, the likelihood of starting a new loan relationship increases (industry misallocation). In addition, given the share of real estate assets, if the firm is located in a bubbly municipality (low housing supply elasticity) the increase is larger.

Tables 3b and 3b-b report the coefficients of running the same extensive margin regressions for all non-financial market economy firms (excluding construction). The coefficient on the interaction term is positive in all specifications but it is not always significant. For example, in our preferred specification (column 2), the coefficient is significant at 5% in Table 3b and at

10% in Table 3b-b. Thus, even though the picture is more nuanced, the results are consistent with a misallocation of credit also at the extensive margin.

To conclude, the evidence presented in this section is consistent with the view that the misallocation of capital was driven by the misallocation of credit. The existence of both industry and geographical misallocation of credit implies that (i) firms with a larger share of real estate assets increased their credit and (ii) this increase was larger in bubbly municipalities (low housing supply elasticity).

5.3 Robustness

In this section we conduct a series of robustness checks of our main empirical results.

Size of the Firm In the theoretical framework discussed in Section 3, we assumed that all firms were financially constrained. If firm were not financially constrained, an increase in the value of their collateral would not affect their access to credit and investment. In other words, the effect of the housing bubble should be larger in more financially constrained firms. Large firms are more likely to have access to other sources of credit and, thus, be less affected by the collateral channel. In addition, large firms are more likely to have their real estate assets (mostly, headquarters) and their activity in different locations. For both reasons, we expect that the effect of the housing bubble will be larger and better identified among small firms. Table 4 reports the effects of the housing bubble on the misallocation of capital and credit by the size of the firm. Columns 1(4), 2(5) and 3(6) constraint the sample to small, medium and large firms, respectively. Columns 1 to 3 (4 to 6) consider the misallocation of capital(credit). Table 4a considers manufacturing firms and Table 4b all non-financial market economy firms (excluding construction). The pattern is similar in both tables and consistent with our hypothesis. The effects are larger and better identified in columns 1 and 4.

Large Municipalities One concern with our results is that some small municipalities may be driving our results. Similarly, the location of headquarters may be in a small municipality and their activity in a closeby municipality. In order to address these concerns, we constraint the sample to large municipalities (more than 5000 inhabitants). Table 5 reports the coefficients of running the same baseline specifications as Table 1 for large municipalities. Table 5a considers manufacturing firms and Table 5b non-financial market economy firms (excluding construction). In all specifications, the coefficient of interest is positive and statistically significant. The coefficients in this sample of municipalities is very similar to our baseline sample of municipalities with more than 1000 inhabitants. For example, the coefficient in our preferred specification (column 2) is 2.793 in Table 5a and it was 2.724 in Table 1a. Therefore, the industry and geographical misallocation of capital is robust to only considering large municipalities.

Investment as Change in K/L In our baseline specification we have defined investment as change in capital stock. This is the definition of investment in the related literature on the effect of the collateral channel (e.g., Chaney et al., 2012) and the analysis of misallocation of capital (e.g., Gopinath et al., 2017). However, since a main driver of TFP is the variance of the capital-labor ratio, we run our baseline regression with the change in the capital-labor ration instead of the capital stock. Table 6 reports the coefficients of running this regression. The coefficient on the interaction term is positive and statistically significant in all specifications. This results holds both in both the sample of manufacturing firms (Table 6a) and all non-financial market economy (excluding construction) firms (Table 6b). Moreover, the coefficients imply that the house price elasticity for the capital-labor ratio is very similar to the elasticity for the capital stock. For example, the house price elasticity given the coefficients in our preferred specification (column 2 Table 6a) is -.616 + 2.223*share of real estate, which is very similar to the house price elasticity implied by our baseline specification -.707+2.724*share of real estate (column 2 of Table 1a).

Current Share of Real Estate Assets In all our regressions we have considered the initial share of real estate assets as our independent variable. This choice is consistent with the typical borrowing constraint in which the lender anticipates the future value of the collateral of the borrower, as described in Section 3. However, if the lender asks, for example, the borrower to make a downpayment (e.g., Arce and Lopez-Salido, 2011, or Basco, 2016), the relevant share of real estate assets would be the current one. In the Appendix, Table A2 reports the coefficients of our baseline regression with the current share of real estate assets, instead of the lag. The coefficient on the interaction term is positive and statistically significant in all regressions. These results holds both for manufacturing firms (Table A2a) and non-financial market economy (excluding construction) firms (Table A1b). The house price elasticity in our preferred specification (column 2 in Table A2a) is -1.594+3.695*share real estate. Note that the misallocation implied by this specification is larger than in the baseline specification. Therefore, the results in Table 1a should be seen as a lower bound on the effects of the housing bubble on the allocation of capital.

Alternative narrative: The Role of Savings Banks A popular story in Spain is that political-oriented savings banks created the housing bubble. This political economy narrative has also been embraced in academic circles (see, for example, Santos, 2014). According to this narrative, the mismanagement of savings banks explains the build up and bust of the housing bubble. Therefore, one could argue that what we are finding is not that the housing bubble allowed firms with more housing to invest more. Instead, our results could be driven by savings banks that wanted to expand and lend more during the housing boom. In order to address this concern, Table 7 reports the effect of the housing bubble on the intensive margin of credit for commercial and savings banks. Columns 1 and 2 constraint the sample to commercial banks and columns 3 and 4 to savings banks. The coefficient of the interaction term is positive and statistically significant in all specifications. These results imply that the misallocation of credit was present among both commercial and savings banks. However, if we compare the coefficients in column 1 and 3 (our preferred specification), we see that the misallocation of credit driven by savings banks is larger than by commercial banks. Thus, the housing bubble generated both industry and geographical misallocation of credit and these misallocations seem to be exacerbated in savings banks.

Alternative narrative (II): Low Interest Rates One of the established explanations of the misallocation of capital in Spain is that low interest rates allowed firms to overinvest (see, for example, Gopinath et al., 2017). In order to address this concern, we compute monthly average market interest rates of loans given to corporations in different municipalities. To homogenize the series, we focus on loans with more than five years of maturity, which tend to be collateralized. Figure 3 reports the evolution of monthly interest rates between 2004 and 2012. The blue (red) line is the monthly interest rate in housing supply inelastic (elastic) municipalities. Notice that the two lines are almost identical throughout the period. Thus, the documented differential behavior of investment between these two groups of municipalities cannot be explained by differences in interest rates. Our interpretation is that low interest rates are correlated with misallocation in Spain because they coincided with a housing bubble, which raised the value of the collateral of firms with a large share of real estate assets. That is, if low interest rates would have increased the value of all types of assets, we would not have observed an increase in misallocation of capital and credit. In other words, low interest rates may be necessary (as long as they are associated to the housing bubble) but they are not sufficient to explain the misallocation of capital in Spain.

6 Aggregate effects

In this section we provide suggestive evidence on the aggregate effect of the housing bubble on the misallocation of capital and the decline in TFP.

In Section 5, we provided evidence of geographical misallocation of capital and credit. Given a share of real estate assets, firms in municipalities with low housing supply elasticity (high house price growth) received more credit and invested more than firms in municipalities with high housing supply elasticity (low house price growth). This firm level evidence (for example, the house price elasticity implied by the coefficients in Table 6) already inform us on the effect of the housing bubble on the variance of the capital-labor ratio. In this section we go one step further and directly test Prediction 3. In order to test this prediction, we run the following baseline regression,

$$Var(K/L)_{c,s,t} = \beta_0 + \beta_1 * HP_{c,t} + \delta_t + \epsilon_{cf}, \quad (6)$$

where $Var(K/L)_{c,s,t}$ is the variance in the capital-labor ratio in municipality c, industry s and time t, δ_t is a set of year fixed effects. The prediction of the model is $\beta_1 > 0$.

Table 8 reports the coefficient of running equation 6 with different sets of fixed effects. In column 1 we only consider year fixed effects. In column 2 we include both year and municipality fixed effects. In column 3 we include sector*year fixed effects. Finally, in column 4 we include municipality and sector*year effects. Table 8a considers manufacturing sectors and Table 8b includes all non-financial manufacturing sectors (excluding construction). The sign of house prices is always positive and statistically significant. The significance is higher when considering all sectors (Table 8b). The magnitude of the effect depends on the set of fixed effects and it decreases when municipality fixed effects are included. For example, when considering manufacturing, the coefficient on house prices ranges from .356 (column 1) to .074 (column 2).

As discussed in Section 2, there is a one-to-one mapping between variance of capital-labor ratio and TFP. To provide an estimate of the contribution of the housing bubble on the decline of TFP in Spain, we perform the following counterfactual exercise. First, we use equation 3 to compute value of TFP and variance of capital-labor ratio that match the actual increase in the variance of capital-labor ratio and the decline of TFP between 2004 and 2007. The variance of the capital-labor ratio increased by 7% for the average municipality and, according to Feenstra et al. (2015), TFP in the manufacturing sector declined by .81%. Second, we use the coefficients of Table 8a to construct the counterfactual world without the bubble. Without the bubble, house prices growth would have been 14.28% lower, which is the difference between housing supply inelastic and elastic municipalities.

The smallest coefficient in Table 8a implies that, without the bubble, the variance of the capital-labor would have been, in 2007, 1% lower than the actual one. This lower variance implies that the decline in TFP would have been .67% instead of .81%. In other words, the housing bubble can explain the 17% of the total decline in TFP.

We want to emphasize that this is a back-of-the-envelope exercise and, thus, these numbers should be taken with a grain of salt. A precise quantification of the effect of the housing bubble is outside the scope of the paper. An important challenge is that we do not know the actual size of the bubble. We made the conservative assumption that the size of the bubble is the difference between municipalities in the 25th and the 75th percentile of housing supply elasticity distribution. However, one may argue that the housing bubble was present, in different size according to their housing supply elasticity, throughout Spain. Moreover, our model was developed to illustrate the qualitative effects of the housing bubble, which make it ill suited to perform quantitative exercises.

7 Concluding Remarks

Spain experienced a large housing bubble in the late 2000s. Even though bubbles are often associated with misallocation of resources, there has not been any empirical investigation of the effects of a housing bubble on the allocation of capital and credit. In this paper we fill this gap by using matched firm- and bank-level data for Spain.

Our main contribution is to document that housing bubbles generate both (i) industry and (ii) geographical misallocation of capital. Given the municipality, a firm with a larger share of real estate assets invested more than an otherwise identical firm (industry misallocation). In addition, given the share of real estate assets, firms located in bubbly municipalities (high house price growth) invested more (geographical misallocation). We used housing supply elasticity as an instrument for house price growth of the municipality. In all regression we included both firm and sector*year fixed effects. We also controlled, for example, for productivity and leverage of the firm. These results hold for both manufacturing firm and non-financial market economy firms (excluding construction).

Then, we uncovered the mechanism behind this misallocation of capital. According to our theoretical framework, firms with more real estate assets were able to invest more because the housing bubble raised the value of their collateral relatively more. We documented this collateral channel and find the same industry and geographical misallocation for intensive and extensive credit. That is, firms with a larger share of real estate assets received more credit and were more likely to receive credit than firms with a lower share of real estate assets (industry misallocation). The difference was higher in bubbly municipalities (geographical misallocation). We included the same fixed effects and controls as in our regressions for capital.

The firm level regressions already imply that the housing bubble increased the variance of the capital-labor ratio and, according to our model, to lower TFP. In order to provide an estimate of the aggregate effect of the housing bubble on TFP, we first used municipality level data to show that house prices are correlated with variance of capital-labor ratio. Then, we used the smallest coefficient of this regression as a lower bound of the effect of the housing bubble on the variance of the capital-labor ratio. According to our model, this coefficient implies that the housing bubble explains the 17% of the decline of TFP in Spain between 2004 and 2007.

To conclude, asset price bubbles are often attached to houses (Kindleberger and Aliber, 2011). Even though Maggiori et al. (2016) concluded that recent housing booms in London were not a rational bubble, we do not have a good understanding of why house prices are prone to this boom-bust behavior. In a related paper, Basco and Lopez-Rodriguez (2017) analyze the origins of the residential mortgage debt boom in Spain and hint to a possible feedback between financial regulation, housing bubbles and mortgage debt. In future work, we plan to further work on this idea to investigate the origin of housing bubbles.

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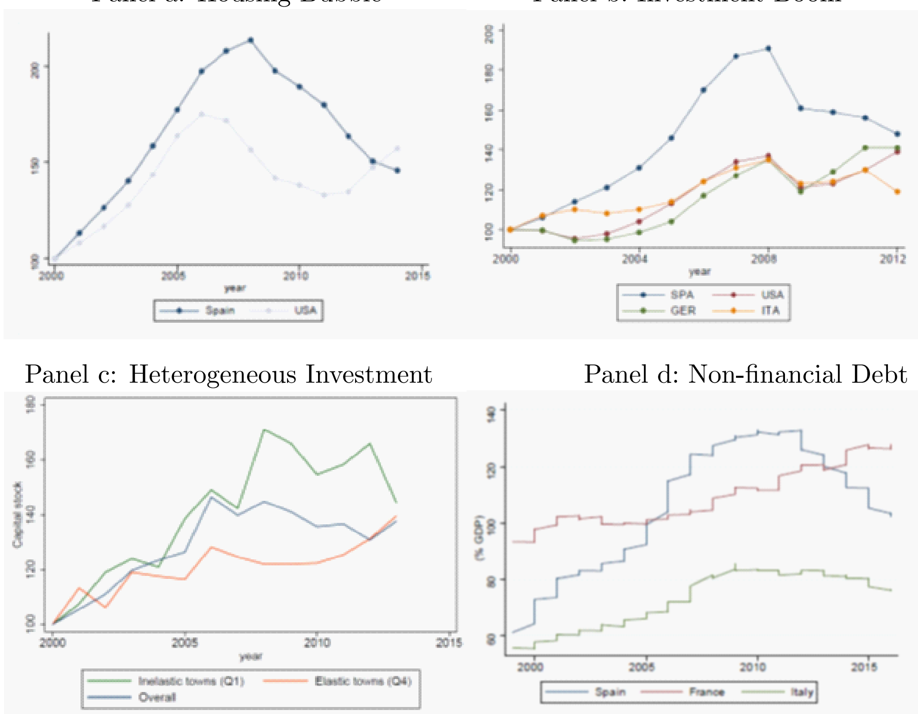
9 Figures and Tables

Figure 1: House Prices and Misallocation: Suggestive Evidence

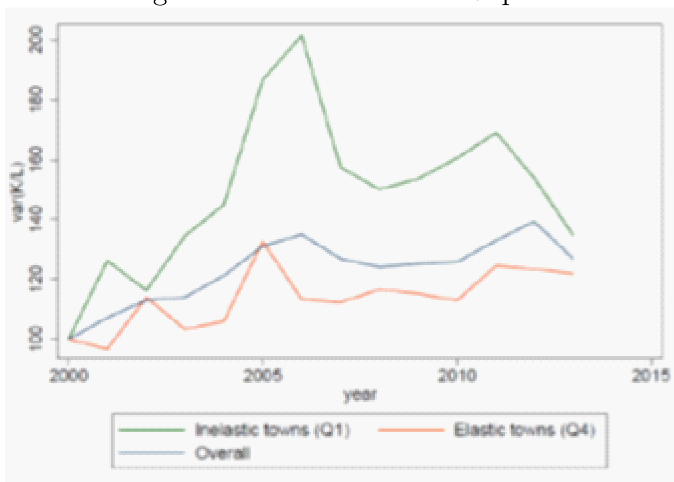
Panel a: Housing Bubble | Panel b: Investment Boom

Panel c: Heterogeneous Investment | Panel d: Non-financial Debt



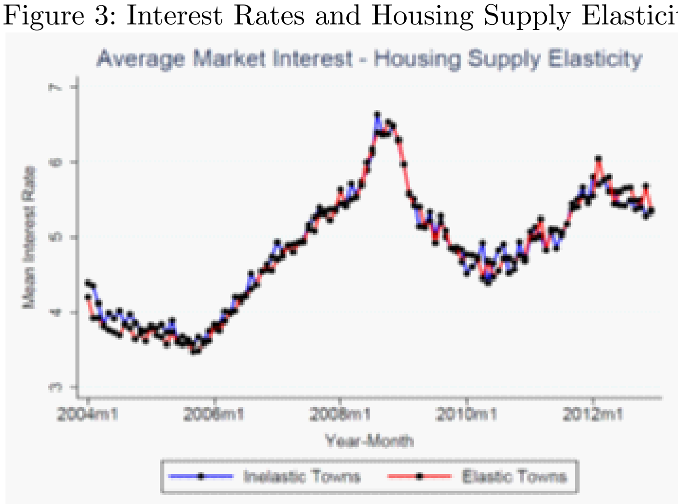
Notes: Panel a, house price index in Spain computed as median across CCAA (yearly data) from the Bank of Spain. For the United States, Cass-Shiller national home price index. Both in nominal terms. Panel b, non-residential investment is defined as (1-share of dwelling)*GFCF in US dollars, normalized at 100 in 2000. Data from OECD databases. Panel c, investment for housing supply inelastic (green) and elastic (yellow) municipalities. Data from Bank of Spain. Panel d, non-finacial debt (% GDP) data from Bank of Spain.

Figure 2: Misallocation of Capital



Notes: variance of the capital-labor ratio for housing supply inelastic (green), elastic (yellow) and average (blue) municipalities. Data from Bank of Spain.

Figure 3: Interest Rates and Housing Supply Elasticity



Notes: average monthly market interest rate in housing supply inelastic (blue) and elastic (red) municipalities. Data from Bank of Spain.

Table 1a: Housing Bubbles and Investment

Manufacturing

	(1)OLS	(2)IV	(3)IV	(4)IV
		$Dep.Var.:$	$\Delta K_{f,t+1}$	
ΔHouse Prices$_{c,t+1}$	-.065***	-.707**	-1.075***	-.964***
	(.024)	(.295)	(.340)	(.344)
Share Real Estate$_{f,t}\Delta$House Prices$_{c,t+1}$	.168***	2.724***	3.070***	2.812***
	(.054)	(.272)	(.329)	(.332)
Share Real Estate$_{f,t}$	-2.178***	-2.374***	-2.442***	-2.382***
	(.054)	(.065)	(.072)	(.078)
TFP$_{f,t}$			.023*	.019
			(.014)	(.014)
Leverage$_{f,t}$				-.001
				(.008)
Firm FE	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y
F-statistic	538.68***	470.24***	305.01***	219.75***
No. Observations	185354	164512	112708	97363

Notes: Dependent variable is annual investment by the firm between 2004 and 2007. Column 1 reports the coefficients of the OLS regression. Columns 2 to 4 report the coefficients of the 2SLS. In the first stage, house price growth is instrumentalized by housing supply elasticity. We include only manufacturing firms. Clustered standard errors at municipality-year level in parenthesis. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table 1b: Housing Bubbles and Investment

Non-financial market economy (excluding construction)

	(1)OLS	(2)IV	(3)IV	(4)IV
		$Dep.Var.:$	$\Delta K_{f,t+1}$	
ΔHouse Prices$_{c,t+1}$	-.066***	-.915***	-.991***	-.752***
	(.016)	(.278)	(.275)	(.250)
Share Real Estate$_{f,t}\Delta$House Prices$_{c,t+1}$	.171***	2.347***	2.783***	2.404***
	(.038)	(.195)	(.228)	(.222)
Share Real Estate$_{f,t}$	-2.275***	-2.436***	-2.556***	-2.464***
	(.054)	(.062)	(.063)	(.062)
TFP$_{f,t}$			.021**	.023**
			(.009)	(.009)
Leverage$_{f,t}$				.001
				(.005)
Firm FE	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y
F-statistic	667.17***	528.70***	569.57***	480.59***
No. Observations	719698	656009	398491	322940

Notes: Dependent variable is annual investment by the firm between 2004 and 2007. Column 1 reports the coefficients of the OLS regression. Columns 2 to 4 report the coefficients of the 2SLS. In the first stage, house price growth is instrumentalized by housing supply elasticity. Clustered standard errors at municipality-year level in parenthesis. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table 2a: Housing Bubbles and Credit

Manufacturing

	(1)OLS	(2)IV	(3)IV	(4)IV
		$Dep.Var.:$	$\Delta Credit_{f,t+1}$	
ΔHouse Prices$_{c,t+1}$	-.039**	-.496	-.591*	-.446
	(.016)	(.349)	(.353)	(.317)
Share Real Estate$_{f,t}\Delta$House Prices$_{c,t+1}$	.098**	1.393***	1.714***	1.318***
	(.044)	(.231)	(.268)	(.228)
Share Real Estate$_{f,t}$	-.353***	-.452***	-.500***	.259***
	(.028)	(.038)	(.045)	(.038)
TFP$_{f,t}$			-.011	.027**
			(.014)	(.011)
Leverage$_{f,t}$				-.789***
				(.013)
Firm FE	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y
F-statistic	53.30***	50.96***	32.00***	721.81***
No. Observations	163725	144660	103225	102038

Notes: Dependent variable is annual change of loans received by the firm between 2004 and 2007. Clustered standard errors at municipality-year level in parenthesis. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table 2b: Housing Bubbles and Credit

Non-financial market economy (excluding construction)

	(1)OLS	(2)IV	(3)IV	(4)IV
		$Dep.Var.:$	$\Delta Credit_{f,t+1}$	
ΔHouse Prices$_{c,t+1}$	-.026***	-.413*	-.401	-.422**
	(.010)	(.246)	(.246)	(.214)
Share Real Estate$_{f,t}\Delta$House Prices$_{c,t+1}$	.069***	.820***	1.221***	1.268***
	(.024)	(.133)	(.158)	(.145)
Share Real Estate$_{f,t}$	-.350***	-.405***	-.513***	.214***
	(.015)	(.020)	(.026)	(.023)
TFP$_{f,t}$			.002	.025***
			(.007)	(.006)
Leverage$_{f,t}$				-.771***
				(.017)
Firm FE	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y
F-statistic	180.65***	167.48***	104.06***	447.58***
No. Observations	581465	527944	342263	337035

Notes: Dependent variable is annual change of loans received by the firm between 2004 and 2007. Clustered standard errors at municipality-year level in parenthesis. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table 3a: Housing Bubbles and Credit-Extensive Manufacturing

	(1)OLS	(2)IV	(3)IV	(4)IV
		$Dep.Var.:$	$New\ loans_{f,t+1}$	
ΔHouse Prices$_{c,t+1}$	-.007	-.515	-.313	-.321
	(.015)	(.383)	(.484)	(.484)
Share Real Estate$_{f,t}\Delta$House Prices$_{c,t+1}$	.056	.735***	.856***	.889***
	(.034)	(.223)	(.291)	(.303)
Share Real Estate$_{f,t}$	-.073***	-.128***	-.180***	-.064
	(.019)	(.031)	(.039)	(.041)
TFP$_{f,t}$			-.018*	-.011
			(.011)	(.011)
Leverage$_{f,t}$				-.118***
				(.006)
Firm FE	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y
F-statistic	5.74***	5.89***	5.84***	78.76***
No. Observations	169770	150069	105767	102038

Notes: Dependent variable is annual change of loans received by the firm between 2004 and 2007. We run 2SLS. In the first stage, house price growth is instrumentalized by housing supply elasticity. Clustered standard errors at municipality-year level in parenthesis. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table 3b: Housing Bubbles and Credit-Extensive

Non-financial market economy (excluding construction)

	(1)OLS	(2)IV	(3)IV	(4)IV
		$Dep.Var.:$	$New\ loans_{f,t+1}$	
ΔHouse Prices$_{c,t+1}$	-.002	-.519**	-.287	-.299
	(.008)	(.253)	(.291)	(.294)
Share Real Estate$_{f,t}\Delta$House Prices$_{c,t+1}$	.005	.241**	.205	.220*
	(.017)	(.101)	(.125)	(.129)
Share Real Estate$_{f,t}$	-.075***	-.094***	-.125***	-.004
	(.008)	(.124)	(.016)	(.017)
TFP$_{f,t}$			.009**	.012***
			(.004)	(.005)
Leverage$_{f,t}$				-.115***
				(.005)
Firm FE	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y
F-statistic	28.67***	25.89***	22.80***	121.37***
No. Observations	613156	557084	354185	337035

Notes: Dependent variable is annual change of loans received by the firm between 2004 and 2007. We run 2SLS. In the first stage, house price growth is instrumentalized by housing supply elasticity. Clustered standard errors at municipality-year level in parenthesis. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table 3a-b: Housing Bubbles and Credit-Extensive Manufacturing

	(1)OLS	(2)IV	(3)IV	(4)IV
		$Dep.Var.:$	$Accept_{f,t+1}$	
ΔHouse $\text{Prices}_{c,t+1}$	-.014	-.403	-.226	-.207
	(.011)	(.289)	(.301)	(.302)
Share Real $\text{Estate}_{f,t}\Delta$House $\text{Prices}_{c,t+1}$	.042	.400***	.480**	.521***
	(.026)	(.152)	(.189)	(.196)
Share Real $\text{Estate}_{f,t}$	-.075***	-.102***	-.127***	-.028
	(.014)	(.023)	(.028)	(.029)
$\text{TFP}_{f,t}$			-.016**	-.011
			(.007)	(.008)
$\text{Leverage}_{f,t}$				-.096***
				(.004)
Firm FE	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y
F-statistic	9.59***	7.03***	6.28***	101.19***
No. Observations	169770	150069	105767	102038

Notes: Dependent variable is annual change of loans received by the firm between 2004 and 2007. We run 2SLS. In the first stage, house price growth is instrumentalized by housing supply elasticity. Clustered standard errors at municipality-year level in parenthesis. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table 3b-b: Housing Bubbles and Credit-Extensive
Non-financial market economy (excluding construction)

	(1)OLS	(2)IV	(3)IV	(4)IV
		$Dep.Var.:$	$Accept_{f,t+1}$	
ΔHouse Prices$_{c,t+1}$	-.006	-.396**	-.283	-.276
	(.006)	(.188)	(.199)	(.196)
Share Real Estate$_{f,t}\Delta$House Prices$_{c,t+1}$	.005	.149*	.094	.121
	(.013)	(.079)	(.092)	(.094)
Share Real Estate$_{f,t}$	-.074***	-.085***	-.109***	-.006
	(.006)	(.010)	(.012)	(.013)
TFP$_{f,t}$			.006*	.007**
			(.003)	(.003)
Leverage$_{f,t}$				-.096***
				(.004)
Firm FE	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y
F-statistic	46.99***	41.53***	31.47***	124.17***
No. Observations	613156	557084	354185	337035

Notes: Dependent variable is annual change of loans received by the firm between 2004 and 2007. We run 2SLS. In the first stage, house price growth is instrumentalized by housing supply elasticity. Clustered standard errors at municipality-year level in parenthesis. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table 4a: Robustness: Size of firm

Manufacturing

	(1)$Small$	(2)Med	(3)$Large$	(4)$Small$	(5)Med	(6)$Large$
	$Dep.Var.:$	$\Delta K_{f,t+1}$		$Dep.Var.:$	$\Delta Credit$	
ΔHouse Prices$_{c,t+1}$	-.710**	-3.790	-3.770	-.346	-.660	1.642
	(.362)	(2.428)	(5.563)	(.336)	(.906)	(3.920)
Share Real Estate$_{f,t}\Delta$HP$_{c,t+1}$	2.816***	4.013	-9.878	1.389***	1.02	4.087
	(.339)	(2.502)	(19.232)	(.237)	(1.04)	(8.777)
Share Real Estate$_{f,t}$	-2.281***	-4.015***	-4.974**	.250***	.351	.158
	(.077)	(.557)	(2.402)	(.039)	(.216)	(.987)
TFP$_{f,t}$	.040***	-.284*	-.386	.030***	-.041	.339
	(.015)	(.160)	(.507)	(.011)	(.060)	(.278)
Leverage$_{f,t}$	-.001	-.035	.032	-.786***	-.856***	-.699***
	(.008)	(.043)	(.089)	(.013)	(.050)	(.061)
Firm FE	Y	Y	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y	Y	Y
F-statistic	214.67***	12.89***	3.19***	705.16***	64.63***	27.18***
No. Observations	87242	5381	1760	90711	5961	1892

Notes: Dependent variable in columns 1 to 3 is annual investment by the firm between 2004 and 2007. Small, medium and large firms are firms with less than 50, between 50 and 200 and more than 200 employeees, respectively. Clustered standard errors at municipality-year level in parenthesis. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table 4b: Robustness: Size of firm

Non-financial market economy (excluding construction)

	(1)*Small*	(2)*Med.*	(3)*Large*	(4)*Small*	(5)*Med*	(6)*Large*
	Dep.Var. :	$\Delta K_{f,t+1}$		*Dep.Var.* :	$\Delta Credit$	
ΔHouse Prices$_{c,t+1}$	-.643**	-3.938	-2.198	-.333	-.648	-8.118
	(.255)	(2.612)	(15.610)	(.214)	(1.012)	(36.264)
Share Real Estate$_{f,t}\Delta$HP$_{c,t+1}$	2.420***	2.960*	2.285	1.298***	.916	2.307
	(.227)	(1.641)	(3.045)	(.152)	(.909)	(6.666)
Share Real Estate$_{f,t}$	-2.417***	-3.436	-5.821***	.208***	.347**	.443
	(.057)	(.381)	(1.339)	(.023)	(.149)	(.956)
TFP$_{f,t}$	.034***	-.042	-.365	.025***	-.065	.049
	(.009)	(.083)	(.264)	(.006)	(.037)	(.221)
Leverage$_{f,t}$	-.001	-.022	.067	-.770***	-.843***	-.780***
	(.005)	(.026)	(.058)	(.016)	(.040)	(.089)
Firm FE	Y	Y	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y	Y	Y
F-statistic	538.57***	20.57***	5.34***	519.73***	94.85***	24.23***
No. Observations	299491	11321	3496	310548	12583	3761

Notes: Dependent variable in columns 1 to 3 is annual investment by the firm between 2004 and 2007.Small, medium and large firms are firms with less than 50, between 50 and 200 and more than 200 employeees, respectively. Clustered standard errors at municipality-year level in parenthesis. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table 5a: Robustness: Large Municipalities

Manufacturing

	(1)OLS	(2)IV	(3)IV	(4)IV
		$Dep.Var.:$	$\Delta K_{f,t+1}$	
ΔHouse Prices$_{c,t+1}$	-.089**	-.510	-1.141*	-.936*
	(.035)	(.594)	(.617)	(.516)
Share Real Estate$_{f,t}\Delta$House Prices$_{c,t+1}$	.240***	2.793***	3.101***	2.923***
	(.084)	(.299)	(.357)	(.357)
Share Real Estate$_{f,t}$	-2.181***	-2.382***	-2.459***	-2.402***
	(.060)	(.071)	(.078)	(.084)
TFP$_{f,t}$			.025*	.020
			(.015)	(.015)
Leverage$_{f,t}$				-.0006
				(.009)
Firm FE	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y
F-statistic	444.57***	395.79***	261.73***	187.92***
No. Observations	163929	147829	100998	87120

Notes: Dependent variable is annual investment by the firm between 2004 and 2007. Column 1 reports the coefficients of the OLS regression. Columns 2 to 6 report the coefficients of the 2SLS. In the first stage, house price growth is instrumentalized by housing supply elasticity. Columns 4 and 5 constraints the sample to manufacturing firms. Clustered standard errors at municipality-year level in parenthesis. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table 5b: Robustness: Large Municipalities

Non-financial market economy (excluding construction)

	(1)OLS	(2)IV	(3)IV	(4)IV
		$Dep.Var.:$	$\Delta K_{f,t+1}$	
ΔHouse Prices$_{c,t+1}$	-.099***	-1.143**	-1.214**	-.890**
	(.021)	(.502)	(.541)	(.429)
Share Real Estate$_{f,t}\Delta$House Prices$_{c,t+1}$	.275***	2.454***	2.907***	2.547***
	(.057)	(.214)	(.254)	(.248)
Share Real Estate$_{f,t}$	-2.299***	-2.460***	-2.582***	-2.496***
	(.059)	(.067)	(.068)	(.067)
TFP$_{f,t}$			.021**	.022**
			(.009)	(.009)
Leverage$_{f,t}$				.001
				(.005)
Firm FE	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y
F-statistic	585.47***	465.97***	515.84***	445.58***
No. Observations	665407	611570	370188	299075

Notes: Dependent variable is annual investment by the firm between 2004 and 2007. Column 1 reports the coefficients of the OLS regression. Columns 2 to 6 report the coefficients of the 2SLS. In the first stage, house price growth is instrumentalized by housing supply elasticity. Columns 4 and 5 constraints the sample to manufacturing firms.Clustered standard errors at municipality-year level in parenthesis. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table 6a: Robustness- Investment as Change K/L

Manufacturing

	(1)OLS	(2)IV	(3)IV	(4)IV
		$Dep.Var.:$	$\Delta(K_{f.t+1}/L_{f,t+1})$	
ΔHouse Prices$_{c,t+1}$	-.071***	-.616*	-1.052***	-.940***
	(.025)	(.361)	(.362)	(.364)
Share Real Estate$_{f,t}\Delta$House Prices$_{c,t+1}$	.210***	2.223***	3.067***	2.882***
	(.063)	(.293)	(.343)	(.350)
Share Real Estate$_{f,t}$	-2.383***	-2.536***	-2.323***	-2.302***
	(.057)	(.068)	(.076)	(.081)
TFP$_{f,t}$			.839***	.823***
			(.027)	(.027)
Leverage$_{f,t}$				.017**
				(.008)
Firm FE	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y
F-statistic	582.69***	509.16***	384.02***	329.24***
No. Observations	175251	155182	111922	96832

Notes: Dependent variable is annual investment by the firm between 2004 and 2007. Column 1 reports the coefficients of the OLS regression. Columns 2 to 6 report the coefficients of the 2SLS. In the first stage, house price growth is instrumentalized by housing supply elasticity. Columns 4 and 5 constraints the sample to manufacturing firms. Clustered standard errors at municipality-year level in parenthesis. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table 6b: Robustness- Investment as Change K/L

Non-financial market economy (excluding construction)

	(1)OLS	(2)IV	(3)IV	(4)IV
		$Dep.Var.:$	$\Delta(K_{f.t+1}/L_{f,t+1})$	
ΔHouse Prices$_{c,t+1}$	-.058***	-1.239***	-.943***	-.647**
	(.017)	(.431)	(.291)	(.281)
Share Real Estate$_{f,t}\Delta$House Prices$_{c,t+1}$	.159***	2.139***	2.881***	2.474***
	(.041)	(.240)	(.247)	(.246)
Share Real Estate$_{f,t}$	-2.421***	-2.573***	-2.458***	2.373***
	(.057)	(.068)	(.062)	(.061)
TFP$_{f,t}$			.781***	.749***
			(.028)	(.027)
Leverage$_{f,t}$				.013***
				(.005)
Firm FE	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y
F-statistic	679.28***	555.75***	400.25***	404.58***
No. Observations	658014	598424	394912	320652

Notes: Dependent variable is annual investment by the firm between 2004 and 2007. Column 1 reports the coefficients of the OLS regression. Columns 2 to 6 report the coefficients of the 2SLS. In the first stage, house price growth is instrumentalized by housing supply elasticity. Columns 4 and 5 constraints the sample to manufacturing firms. Clustered standard errors at municipality level. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table 7: Robustness- Commercial vs. Savings Banks
Non-financial market economy (excluding construction)

	(1)*Commercial*	(2)*Commercial*	(3)*Savings*	(4)*Savings*
		$Dep.Var.:$	$\Delta Credit_{t+1}$	
ΔHouse Prices$_{c,t+1}$	.022	-.404	-.849**	-.382
	(.371)	(.281)	(.391)	(.412)
Share Real Estate$_{f,t}\Delta$House Prices$_{c,t+1}$	.649***	1.136***	1.219***	1.838***
	(.188)	(.176)	(.232)	(.287)
Share Real Estate$_{f,t}$	-.324***	.217***	-.482***	.222***
	(.025)	(.028)	(.037)	(.044)
TFP$_{f,t}$		.016**		.041***
		(.007)		(.010)
Leverage$_{f,t}$		-.761***		-.756***
		(.018)		(.015)
Firm FE	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y
F-statistic	63.87***	360.83***	65.27***	516.30***
No. Observations	306649	204814	140728	83423

Notes: Dependent variable is annual change of loans received by the firm between 2004 and 2007. We run 2SLS. In the first stage, house price growth is instrumentalized by housing supply elasticity. Columns 4 and 5 constraints the sample to manufacturing firms. Clustered standard errors at municipality-year level in parenthesis. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table 8a: Misallocation at the municipality level

Manufacturing

	(1)OLS	(2)OLS	(3)OLS	(4)OLS
		$Dep.Var.:$	$Var(k/l)_{c,s,t}$	
House Prices$_{c,t}$	.356***	.074**	.381***	.086*
	(.062)	(.013)	(.062)	(.051)
Municipality FE	N	Y	N	Y
Sector*Year FE	N	N	Y	Y
Year FE	Y	Y	N	N
F-statistic	32.68***	5.12**	37.27***	3.01*
No. Observations	38218	37493	38218	37494

Notes: Dependent variable is variance of capital labor ratio in municipality c, sector s and year t (in logs). Clustered standard errors at municipality-year-sector level, municipality-year and sector level. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table 8b: Misallocation at the municipality level
Non-financial market economy (excluding construction)

	(1)OLS	(2)OLS	(3)OLS	(4)OLS
		$Dep.Var.:$	$Var(k/l)_{c,s,t}$	
House Prices$_{c,t}$	.347***	.171***	.389***	.176**
	(.041)	(.039)	(.030)	(.039)
Municipality FE	N	Y	N	Y
Sector*Year FE	N	N	Y	Y
Year FE	Y	Y	N	N
F-statistic	70.08***	18.62***	165.58***	20.64***
No. Observations	83186	82420	83186	82421

Notes: Dependent variable is variance of capital labor ratio in municipality c, sector s and year t. Clustered standard errors at municipality-year-sector level. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

10 Appendix

Table A1: First Stage Regression

	(1)$HSE97$	(2)$HSE97$	(3)$HSE96$	(4)$HSE96$
		$Dep.Var.:$	ΔHouse Prices$_{c,t}$	
HSE$_c$*ΔR_t	-.007***	-.007***	-.008***	-.008***
	(.002)	(.002)	(.002)	(.002)
Year FE	Y	Y	Y	Y
Municipality FE	N	Y	N	Y
F-statistic	17.88***	11.48***	19.74***	12.85***
No. Observations	14374	15207	14317	15180

Notes: Dependent variable is annual change of house prices between 2004 and 2007. Clustered standard errors at municipality level. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table A2a: Robustness-Current Share Real Estate Assets

Manufacturing

	(1)OLS	(2)IV	(3)IV	(4)IV
		$Dep.Var.:$	$\Delta K_{f,t+1}$	
ΔHouse Prices$_{c,t+1}$	-.088***	-1.594***	-1.350***	-1.093***
	(.024)	(.363)	(.401)	(.373)
Share Real Estate$_{f,t+1}\Delta$House Prices$_{c,t+1}$	.270***	3.695***	3.382***	2.882***
	(.057)	(.325)	(.350)	(.341)
Share Real Estate$_{f,t+1}$	2.06***	1.683***	1.808***	1.774***
	(.054)	(.065)	(.069)	(.070)
TFP$_{f,t}$			.112***	.109***
			(.015)	(.016)
Leverage$_{f,t}$				-.069***
				(.008)
Firm FE	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y
F-statistic	506.88***	384.25***	289.98***	213.57***
No. Observations	185369	164509	112546	97219

Notes: Dependent variable is annual investment by the firm between 2004 and 2007. Column 1 reports the coefficients of the OLS regression. Columns 2 to 6 report the coefficients of the 2SLS. In the first stage, house price growth is instrumentalized by housing supply elasticity. Columns 5 and 6 constraints the sample to manufacturing firms. Clustered standard errors at municipality level. *, **,*** denote significant at 10, 5 and 1 percent, respectively.

Table A2b: Robustness-Current Share Real Estate Assets

Non-financial market economy (excluding construction)

	(1)OLS	(2)IV	(3)IV	(4)IV
		$Dep.Var.:$	$\Delta K_{f,t+1}$	
ΔHouse Prices$_{c,t+1}$	-.112***	-1.574**	-1.266***	-.976***
	(.017)	(.347)	(.293)	(.271)
Share Real Estate$_{f,t+1}\Delta$House Prices$_{c,t+1}$	.319***	3.818***	3.611***	3.091***
	(.044)	(.278)	(.267)	(.245)
Share Real Estate$_{f,t+1}$	2.06***	1.733***	1.879***	1.796***
	(.055)	(.056)	(.057)	(.055)
TFP$_{f,t}$			.097***	.099***
			(.009)	(.010)
Leverage$_{f,t}$				-.075***
				(.004)
Firm FE	Y	Y	Y	Y
Sector*Year FE	Y	Y	Y	Y
F-statistic	513.46***	371.94***	361.32***	379.95***
No. Observations	720646	656827	398075	322510

Notes: Dependent variable is annual investment by the firm between 2004 and 2007. Column 1 reports the coefficients of the OLS regression. Columns 2 to 6 report the coefficients of the 2SLS. In the first stage, house price growth is instrumentalized by housing supply elasticity. Columns 5 and 6 constraints the sample to manufacturing firms. Clustered standard errors at municipality level. *, **,*** denote significant at 10, 5 and 1 percent, respectively.