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ABSTRACT

This paper documents the role of the collateral lending channel to facilitate small business starts and self-employment in the period before the financial crisis of 2008. We document that between 2002 and 2007 areas with a bigger run up in house prices experienced a strong increase in employment in small businesses compared to employment in large firms in the same industries. This increase in small business employment was particularly pronounced in (1) industries that need little startup capital and can thus more easily be financed out of increases in housing as collateral; (2) manufacturing industries where goods are shipped over long distances, which rules out that local demand is driving the expansion. We show that this effect is separate from an aggregate demand channel that relies on home equity based borrowing leading to increased demand and employment creation.

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1. Introduction

The recession that followed the financial crisis of 2008 was marked by high and very persistent unemployment rates, which has drawn renewed interest to understanding the forces that affect labor market dynamics over the business cycle. The ensuing debate has focused on two primary explanations for the persistent unemployment. On the one side are researchers who argue that the recession was propagated by a dramatic decline in consumer demand, which was exacerbated by significant deleveraging at the household level and resulted in increased firm closures and unemployment.[2] See, for example, Romer (2011) or Mian and Sufi (2011a).

On the other side are proponents of the idea that structural mismatches in the skill composition of parts of the work force explain the persistent unemployment, see for example Kocherlakota (2010). Similarly, Charles, Hurst and Notowidigdo (2012) argue that these structural problems in the labor market were already present pre-2008, but were masked by the increase in house prices and the ensuing rise in labor demand in the construction industry. Others, most prominently Mulligan (2011), put forward that structural factors in labor market institutions, such as counter cyclical unemployment insurance, reduce the incentives of unemployed workers to reenter the labor market.

Our paper documents an alternative channel that has received much less attention but significantly affects the dynamics of employment creation over the business cycle: The impact of the collateral lending channel, especially mortgage lending, on self-employment and small business starts. Going back at least to the seminal papers by Bernanke and Gertler (1989) or Kiyotaki and Moore (1997) a number of theories have suggested that improvements in collateral values ease credit constraints for borrowers and can have multiplier effects on economic growth. This collateral lending channel builds on the idea that information asymmetries between banks and firms can be more easily alleviated when collateral values are high and therefore firms can have higher leverage (Rampini and Viswanathan, 2010) and that these problems are especially acute for small, more opaque, firms (Gertler and Gilchrist, 1994 or Kashyap, Stein and Wilcox, 1993). However, empirically it has been very difficult to cleanly identify the causal direction of the collateral effect. The challenge is that increased collateral values facilitate lending but in the reverse direction higher collateral values can also be the result of improvements in economic conditions (e.g., Iacovello, 2005).

[2] On average, households reduced their debt to income ratios by more than 20% following the house price bust.

In this paper we take a different approach and look directly at shocks to the value of collateral, in particular the value of homes. In order to identify the causal effect of higher house prices we instrument for the growth in prices between 2002 and 2007 using the elasticity measure developed by Saiz (2010), which uses exogenous geographical and regulatory constraints to housing supply. The measure therefore differentiates areas where an increase in housing demand either translates into higher house prices and collateral value (low elasticity areas) or into higher volume of houses built (high elasticity). By relying on exogenous restrictions on the expansion of housing volumes, we separate out the effect of high collateral values on the creation of small businesses. This identification strategy is similar to the study by Chaney, Sraer and Thesmar (2012), which looks at corporate investment decisions or Mian and Sufi (2011b) who look at increases in consumption from household leverage.

We show that leading up to the recession of 2008, areas with rising house prices (and increased leverage) experienced a significantly bigger increase in small business starts and a rise in the number of people who are employed in establishments with fewer than 10 employees compared to areas that did not see an increase in house prices. The same increase in employment cannot be found for large establishments in these same areas. In fact, the effect of house prices on job creation monotonically decreases with the size of the firms. This asymmetric effect on small versus large only holds for instrumented house prices, which suggests that the non-instrumented part of the variation (which is the one that captures endogenous demand) mostly impacts employment at larger firms. This asymmetry points to the interpretation of the collateral lending channel as an important driver of employment creation in small firms, since large firms have access to other forms of financing and thus should not be affected by this type of collateral channel.

While the result above supports the importance of the collateral channel for small business creation, there are two alternative hypotheses that must be ruled out as explaining our results. First, increasing house prices can drive local demand for goods (Campbell and Cocco, 2007) and, consequently, employment at non-tradable industries (Mian and Sufi, 2011a). To the extent that small firms may be more sensitive to changes in demand (Kashyap and Stein, 1994), the asymmetry in the results could reflect this increased demand rather than the collateral channel. The second alternative hypothesis comes from the fact that, by using housing and zoning restrictions for obtaining identification, we rely on cross sectional differences between high and low elasticity areas. This means that these areas could also vary along other dimensions, such as the level of economic vitality. For example, areas

with low elasticity might not only see high house prices when demand for housing picks up, i.e. more available collateral, but they might also be the ones where more investment opportunities become available.

We devise a number of additional tests to meaningfully differentiate the impact of the collateral lending channel from these alternative hypotheses. First, we verify that the results are not driven by changing industry composition: Even within industries, areas with increasing house prices saw stronger employment growth in smaller establishments. [3]

Second, and to further narrow in on the importance of collateral for business financing, we look at the variation across industries in the start-up capital that is needed to set up a new firm. The idea is that there are differences in the minimal feasible scale of businesses across industries and thus the availability of collateral should matter more depending on that minimal scale. For example, some businesses like home healthcare services can be started with small amounts of capital that could reasonably be financed through house price appreciation. In contrast, many sectors within manufacturing, for example, require large amounts of capital and fixed investments, and we do not expect the housing channel to be as effective since the capital needs are too high to be financed via individual loans against property. This strategy is similar to the approach used in Hurst and Lusardi (2004).

Our results follow exactly the predicted pattern: when we repeat our regressions disaggregated by industries above and below the median needs in terms of start-up capital we find that the effect of house price growth on the creation of employment in small establishments is especially strong among industries with lower capital needs. These results confirm that the collateral lending channel played an important role in shaping employment dynamics. Borrowing against housing wealth allowed people in the areas with quicker house price appreciation to start small businesses and potentially alleviate the impact of job losses in the period leading up to 2008.

Third, we confirm that the results in our study are not driven by the non-tradable or the construction sectors. As pointed out above, if the relationship between house price increases and job creation in small firms was purely constrained to the non-tradable or construction sectors, one would be concerned that the results are not driven by changes in the collateral lending channel but by differences in local demand. However, our results hold for the manufacturing sector where

[3] A similar relationship exists when we include proprietorships and unincorporated businesses in the regressions.

products are easily tradable, and more strongly so for manufacturing firms with low external financing needs. The difference in employment creation between large and small firms is also particularly strong for industries where firms report shipping goods across long distances. This distinguishes these results from the work of Mian and Sufi (2011a), who show that areas where house prices increased most also exhibited an increase in unemployment in non-tradable industries due to deleveraging and lower demand in the aftermath of 2008. Any change in output in the low elasticity areas must therefore be driven by changes on the input (production) side. This is the collateral lending channel.

Finally, we also rule out that the results are driven by generally loosening credit standards in areas with quick house price growth. The concern would be that the growth of small businesses is not caused by better access to collateral but rather by easier access to other forms of credit because of banks' improved balance sheet position. We show that this is not the case. If anything, banks became increasingly more selective in credit approval in low elasticity areas leading up to 2007.

Using a similar calculation as Mian and Sufi (2011a) we calculate the approximate contribution of the collateral lending channel to changes in overall employment in the pre-crisis period. Using this approach the collateral channel can account for 10-25% of the increase in pre-crisis employment (depending on the assumptions we make about the reference group that best isolates the collateral effect), while the demand channel explains about 40% over the same time period. The two effects are mutually non-overlapping by construction. It is important to point out that these numbers provide rough approximations of the relative magnitudes of these two channels, but they ignore any general equilibrium effects in aggregation.

When we consider the period after the financial crisis when house prices started to decline (2007-2009) we find that small firms experienced weaker employment declines than large firms in areas where the run-up in house prices was stronger in the period before the crisis. This means that smaller firms were more resilient than larger ones in those areas, suggesting that the firms created in the pre-period may have been good projects, in the sense that they did not immediately disappear with the advent of the crisis. However, to answer the question of whether these firms were, indeed, the ones that survived in the post crisis, we need more detailed (firm-level) data that would allow us to track individual firms over time.

Our study builds on a large micro literature that shows that credit constraints at the household level matter for the creation of new businesses (Evans and Jovanovic, 1989, Holtz-Eakin et al, 1994, Gentry and Hubbard, 2004, or Cagetti and De Nardi, 2006), although some authors have argued that this relationship is only present at the very top of the wealth distribution (Hurst and Lusardi, 2004). At the same time, housing wealth in particular has been shown to be an important factor in the funding of business startups (Fan and White, 2003, Fairlie and Krashinsky, 2012 and Black, de Meza and Jeffreys, 1996 for the UK). Previous work has also found that bank credit is an important source of financing for small businesses (Petersen and Rajan, 1994; Robb and Robinson, 2012), and that entrepreneurs often have to provide personal guarantees when they obtain financing (Berger and Udell, 1998).

The rest of the paper proceeds as follows: Section 2 describes the data used in the paper, as well as the empirical methodology. Section 3 discusses the results and Section 4 concludes.

2. Data and Empirical Methodology

2.1 Data Description

We obtain employment growth from the County Business Patterns (CBP) data set published by the U.S. Census Bureau. The CBP contains employment data by county, industry and establishment size (measured in number of employees) between 1998 until 2010 as of March of the reported year. We use the data at the 4-digit National American Industry Classification System (NAICS) level, broken down by county and establishment size to construct our main dependent variable of interest, the employment growth by establishment size between 2002 and 2007. The breakdown of establishments by the number of employees allows us to differentially estimate the effect of house price growth in the net creation of establishments of different sizes.[4]

We use five establishment categories in our regressions that are commonly used by the Census Bureau – establishments of 1 to 4 employees, 5 to 9 employees, 10 to 19 employees, 20 to 49 and

[4] The data only includes the number of establishments in each county, industry and year by category of employment size (1-4 employees, 5-9, 10-19, etc.), not the total employment for each establishment category. As such, in order to construct the employment in each bin we multiply the number of establishments by the middle point of each category. For example, in order to get the total employment of 1-4 employee establishments in a given industry, county and year, we multiply the number of establishments by 2.5.

more than 50 employees. All these categories are given by the CPB except for the last one, where we aggregate all establishments of more than 50 employees. The CBP has multiple categories above 50 employees, but using each one individually would only add noise to our estimation, as they become rare at the county level, and even more so at the county and industry level, which we need for some of the specifications discussed below. In order to create the category of establishments with more than 50 employees we take the number of establishments in each category above 50 and multiply those by the midpoint of the category (for example, for the category of 100 to 249 employees we multiply the number of establishments by 174.5), and then we add all of them up.

The house prices used in the regressions come from the Federal Housing Finance Agency (FHFA) House Price Index (HPI) data at a Metropolitan Statistical Area (MSA) level. The FHFA house price index is a weighted, repeat-sales index and it measures average price changes in repeat sales or refinancings on the same properties. This information is obtained by reviewing repeat mortgage transactions on single-family properties whose mortgages have been purchased or securitized by Fannie Mae or Freddie Mac since January 1975. We use data on the MSA-level index between 2002 and 2007.

The use of MSA level house prices is consistent with our identification strategy. In order to identify the casual effect of house prices on small business creation we instrument house price growth between 2002 and 2007 with the measure of housing supply elasticity of Saiz (2010), which varies at the MSA level. The measure of the supply elasticity is constructed using geographical and local regulatory constraints to new construction. Areas where it is difficult to add new housing (due to geographic or regulatory restrictions) are classified as low elasticity and vice versa for areas where land is easily available. Low elasticity areas correlate strongly with steeper house price growth in the period of 2002 to 2007. This measure is available for 269 metropolitan statistical areas that we match to a total of 776 counties using the correspondence between MSAs and counties for the year 1999 provided by the Census Bureau.[5] Although employment growth and our other controls are available for a much larger sample of counties, all our regressions focus on the subset of counties for which we have the housing supply elasticity measure.

[5] This correspondence is available at http://www.census.gov/population/estimates/metro-city/a99mfips.txt and also http://www.census.gov/population/estimates/metro-city/a99nfips.txt for the New England Metropolitan Component Areas used by Saiz (2010).

An important measure for our analysis is the amount of capital needed to start a firm, since these investment requirements might affect how much a given industry depends on the housing collateral channel. In order to construct this variable we use the Survey of Business Owners (SBO) Public Use Microdata Sample (PUMS). The SBO PUMS was created using responses from the 2007 SBO and provides access to survey data at a more detailed level than that of the previously published SBO results. The SBO PUMS is designed to study entrepreneurial activity by surveying a random sample of businesses selected from a list of all firms operating during 2007 with receipts of $1,000 or more provided by the IRS. The survey provides business characteristics such as firm size, employer-paid benefits, minority- and women-ownership, access to capital and firm age. For the purposes of this paper we focus on the "Amount of start-up or acquisition capital" for each firm and we group the answers to this question at the 2-digit NAICS industry level (the finest level available in the data) for firms established in 2007. The classification is virtually identical if we use all years in the data or if we focus on 1-4 employee firms only. The median amount of capital needed to start a business in the data is 215 thousand dollars. We follow Hurst and Lusardi (2004) and split industries above and below the median to measure the differential effect of the collateral channel on business creation for industries in the two groups. The average amount of capital needed by firms below the median is 132 thousand dollars, whereas the average amount needed for industries above the median is 260 thousand dollars.

Our classification of "non-tradable", "tradable" and "construction" industries at the 4-digict NAICS level is obtained from Table 2 of the Appendix to Mian and Sufi (2011a).[6] Non-tradable codes are mostly included in the 44 and 45 sectors (Retail Trade), as well as under 72 (Accommodation and food services). Construction industries include most codes under the Construction 2-digit NAICS sector (23), as well as some subsectors in manufacturing, retail trade and services that are directly connected to construction (e.g., 3273 – Cement and Concrete Products Manufacturing). Manufacturing industries include all 31-33 subsectors (Manufacturing), and in some specifications we restrict the sample to manufacturing industries that are also classified as "tradable" in Mian and Sufi (2011a) (i.e. those not in construction or in "other industries").

As we mention above, the measure for the amount of capital used to start a business is only available at the 2-digit NAICS level. In order to obtain a measure at a more detailed level that also captures

[6] The current version of the online appendix can be found here: http://faculty.chicagobooth.edu/amir.sufi/data-and-appendices/unemployment_miansufi_EMTRAR2_APPENDIX.pdf

the external financing requirements of firms, we use the external finance dependence measure developed by Rajan and Zingales (1998). To construct this measure, we obtain capital expenditures and operating cash flow for all firms on Compustat for the years between 2002 and 2007 and compute the difference between capital expenditures (capx variable) and operating cash flow (oancf variable), and we scale that difference by the capital expenditures. We then average over all years and over all firms in each 4-digit NAICS industry for which there are 3 or more firms in each year-industry cell.

In order to address the concern that the results might be driven by local demand, we construct a measure of the average distance that firms in an industry ship their goods. This data is available from the 2007 Census Commodity Flow Survey and it reports the distance traveled by shipments of a sample of establishments in each 3-digit NAICS manufacturing industry.[7] The unit of observation in the Census data is at the state and industry level, so we construct a dollar-weighted average distance of shipments also for each state and industry individually. Summary Statistics of the average distance shipped, as well as the frequency with which each industry appears in each decile, are shown in Table A5.

We also use data on county-level births and deaths of establishments for each 2-digit NAICS industry between 2002 and 2010 from the Census Statistics of US Businesses (SUSB). Data on births and deaths of establishments is provided under the "Employment Change" section of SUSB and it does not include a breakdown by establishment size at the county and industry level, which is why we cannot use it as our main dataset. However, given that most establishment births are of a very small scale (Haltiwanger, Jarmin and Miranda, 2011), we view the regressions performed on this dataset as an important test of the mechanism in our main results. We compute the cumulative number of births and deaths between 2002 and 2007 for each county and industry as our dependent variable of interest and scale this number by the total number of establishments as of 2002 in the same county-industry cell.

The net creation of sole proprietorships at a county level is obtained from two sources. We use both the yearly local area personal income and employment data from the Bureau of Economic Analysis (BEA), as well as the Census nonemployer statistics. From the BEA we use Non-Farm Proprietorship employment at a county level between 2002 and 2007 to estimate the growth of sole

[7] The year 2007 is the first year in which the data is reported at the 3-digit NAICS level (previous years included only commodity identifiers rather than industry data).

proprietorships in this period. From the Census we obtain the number of establishments for the period of 2002 to 2007 at the 2-digit NAICS level. We use both sources of data in the regressions to ensure the robustness of our results.

Unemployment and unemployment rate at the county level are obtained using the Bureau of Labor Statistics Local Area estimates. Local Area Unemployment Statistics (LAUS) are available for approximately 7,300 areas that range from Census regions and divisions to counties and county equivalent and this data is available between 1976 and 2012. We match the county equivalent data to the CBP data using Federal Information Processing Standard (FIPS) county unique identifiers.

The migrations data is extracted from the IRS county to county migration data series. The migration estimates are based on year-to-year address changes reported on individual income tax returns filed with the IRS. The dataset presents migration patterns by county for the entire United States and is split by inflows – the number of new residents who moved to a county and where they migrated from – and outflows – the number of residents leaving a county and where they went.[8] We also compute net flows as inflows minus outflows and we scale all figures by the number of non-movers in the county. The data is available from 1991 through 2009 filling years.

To better identify the effect of house prices on self-employment we include a set of controls that capture some of the cross-sectional differences across counties. We use county level information from the Census Bureau Summary Files for 2000 on: the number of households in a county; the natural logarithm of county-level population; the percentage of college educated individuals defined as the number of people over 25 with a bachelor degree or higher as a proportion of the total population over 25 years old; the percentage of employed people, defined as the employed population over the total population 16 years old or older; the share of the population in the workforce, defined as the total population in the civilian labor force over 16 year old divided by the total population 16 years old or older; the percentage of owner occupied houses; and a measure of exposure of each county to imports from china[9], and therefore, better control for changes in investment opportunities in those counties

[8] The data used to produce migration data products come from individual income tax returns filed prior to late September of each calendar year and represent between 95 and 98 percent of total annual filings.

[9] We construct the measure of competition from imports from China by multiplying the fraction of employment in each county and in each industry by the share of imported goods from China as a fraction of total domestic shipments in the industry in the United States. The variation is virtually the same if we instead use the growth in the weight of imports for

2.2. Summary Statistics

Panel A of Table 1 provides descriptive statistics for our data set: The first row shows total employment in 2002 for all counties in our sample, as well as the employment growth between 2002 and 2007 estimated from the CBP data. Our data includes a total of 775 counties with non-missing total employment data. Employment in all counties in our data grew by an average of 10.6 percent during the sample period, with the unemployment rate dropping by 0.9 percentage points. We also split the sample into counties above and below the median of the housing supply elasticity measure. We see that counties with low supply elasticity are larger but have similar unemployment rates as those with high supply elasticity. The growth in total employment is somewhat lower in counties with high supply elasticity, and we discuss this fact in more detail when we discuss the regressions involving total employment and unemployment at the county level. As expected, counties with low elasticity of housing supply experienced much stronger growth in house prices than did counties with high elasticity of supply, and similarly experienced a much larger increase in average debt-to-income ratio (consistent with Mian and Sufi, 2011a).

Panel B of Table 1 shows how employment is distributed across the different employment-size categories. The biggest firm category, 50 employees or more, accounts for 51.7% of the total employment in 2002, whereas the smallest category, 1-4 employees, accounts for 8.9% of the total employed population. Growth in employment is stronger among larger companies in the 2002-2007 period, and especially so among the industries that we classify as having low start-up capital needs.

2.3. Empirical Model

This paper aims to test whether increases in real estate prices affect the growth in employment by facilitating the creation of small businesses (collateral channel). To differentiate the collateral channel from a pure (expansionary) demand shock, we look at the differential effect of house prices on the net creation of establishments in different size categories.[10] Our identification relies on the idea that

each industry as a fraction of US domestic shipments between 1998 and 2005. The import data at the industry level is obtained from Peter K. Schott' website: http://faculty.som.yale.edu/peterschott/sub_international.htm

[10] As we discuss in the data section, our data does not include changes in employment within establishments (i.e. along the intensive margin), so our measure of changes in employment relies on multiplying the number of establishments in

improved availability of collateral in the form of higher house prices can positively affect the creation of small businesses, while it is likely to have no effect on the creation of larger establishments since these firms cannot be started with capital that can be extracted from a house.

We measure the availability of collateral to small business entrepreneurs by the growth in house prices in the area where the establishment is located. However, it is challenging to establish a causal link from the availability of collateral to the creation of small businesses, since there are many omitted variables that could simultaneously affect both the value of real estate collateral and the demand faced by small businesses, for example changes in household income in the area or improvements in investment opportunities. In order to overcome this difficulty, we instrument for the changes in house prices during the period of interest for our study (2002-2007) using the elasticity of housing supply at the metropolitan statistical area, which was developed by Saiz (2010). Our identification relies on the assumption that the elasticity of housing supply only impacts employment creation at establishments of different sizes through its effect on house prices. The exclusion restriction will be violated if housing supply elasticity is correlated with employment or business creation for reasons other than house price growth. Similar approaches have been used extensively in the recent literature – see, for example, Mian and Sufi (2011a, 2011b), Charles, Hurst and Notowidigdo (2012); Robb and Robinson (2012).

We rely on two basic regression specifications for our analysis. The first specification aggregates data up to the level at which our instrument varies, i.e. at the county-year-establishment size– level. Each individual observation is the change between 2002 and 2007 of employees in a given county, year and establishment size. Therefore we add up the number of employees in all industries in each establishment category and take the growth in total number of employees as the dependent variable. We then run two-stage least squares regressions of the type:

$$\Delta^{02-07} Employment_{ij} = \alpha + \beta_1 \Delta HP_j^{02-07} + \beta_2 1_i + \beta_3 1_i \Delta HP_j^{02-07} + \gamma X_j + \varepsilon_{ij}$$

We index counties by *j* and establishment size categories by *i*. $\Delta^{02-07} Employment_{i,j}$ is the change in employment for establishment size category *i* in county *j* between 2002 and 2007. Similarly, ΔHP_j^{02-07} is the growth in house prices at the county level for the same time period where, as we discuss above, we instrument for the growth in house prices using the housing supply elasticity of

each size category by the midpoint of the number of employees in each bin. It is thus equivalent to interpret our results in terms of number of employees or number of establishments.

Saiz (2010). 1_{Cat} is a set of dummy variables for each of the four included establishment categories (we omit the largest category of more than 50 employees). We then also include the product of the establishment size dummies and the growth in house prices, and β_3 is the coefficient of interest in our regressions. In particular, the test we are interested in is whether the coefficient for the smallest establishments is larger (and positive) than those of the larger categories, which would confirm that house prices had a stronger impact on the creation of small establishments. X_j is a set of county level controls that include the size of the county, the percentage of the population with a bachelor degree or higher, the percentage of the population that is employed, the percentage of the population in the labor force, the percentage of owner occupied houses, and the county share of china imports. Standard errors in this specification are heteroskedasticity robust and clustered at the MSA level (given that the variation in the instrument we use is at this level as well) and all regressions are weighted by the number of households in a county as of 2000 as in Mian and Sufi (2011a).

The second specification disaggregates observations to the county, year, establishment size and 4-digit NAICS level, yielding a much larger number of observations than the specification above (as each county now appears multiple times for each industry). When using this disaggregated data we can include industry fixed effects in the regression, which allows us to control even further for common shocks (namely nationwide demand shocks) to each 4-digit industry. The coefficients in this case represent the differential impact that house prices have on establishments of different sizes within each industry. The specification becomes:

$$\Delta^{02-07} Employment_{ijz} = \alpha + \beta_1 \Delta HP_j^{02-07} + \beta_2 1_i + \beta_3 1_i \Delta HP_j^{02-07} + \gamma X_j + 1_z + \varepsilon_{i,j}$$

Where z indexes the industries and 1_z is a set of indicator variables for each industry.

The breakdown at the industry level allows us to address an important alternative hypothesis to the mechanism we identify, namely that higher house prices caused increased demand which then prompted the growth in new businesses. This type of demand story (as opposed to the collateral channel) comes in two versions: On the one hand one could argue that rising house prices lead to an increase in demand since households feel richer or have access to home equity. This channel is proposed in Mian and Sufi (2011a) to explain the drop in employment during the Great Recession of 2007-2009. A second version of the demand hypothesis is that increasing house prices may

benefit certain industries more than others and that these industries happen to be made up of smaller establishments on average (i.e., a "composition" effect).

We address these alternative demand hypotheses in a few different ways. First, by holding constant industry fixed effects we identify how employment in the smallest establishments reacts differently from that of large establishments within each 4-digit NAICS industry. This addresses the composition effect described above. Second, as we have argued before, a pure local demand story should affect establishments of all sizes similarly while the credit collateral channel is relevant mainly for small business. There is, however, still the possibility that smaller firms are more sensitive to local demand shocks than large firms. In order to see if this effect could explain our results we exclude the most obvious candidate industries that might directly benefit from local demand shocks due to higher house prices, namely those linked to construction and firms in the non-tradable sector as classified in Mian and Sufi (2011a) and we also repeat our tests only for manufacturing firms, those that should be least affected by local demand shocks.

3. Empirical Results

3.1. House Prices and Employment at Small Establishments

Our central hypothesis is that the availability of more valuable collateral (in our case through increased real estate prices) in the period before the financial crisis has an effect on the creation of small firms or on self-employment, since it provided individuals with easier access to startup capital. As a result we should see a sharper increase in self-employment and employment in small businesses in areas that had steeper house price appreciation. We also expect this effect to be concentrated in firms in the smaller size categories, since large firms cannot finance themselves using home equity. This hypothesis is tested in Table 2, where we run two-stage least squares regressions of the growth in employment between 2002 and 2007 on 5 different establishment size categories, and their interaction with house price growth in the same period. The instrument for house price growth, as we discuss above, is the Saiz (2010) measure of housing supply elasticity. In the first column of Table 2 we show the first stage regression of house price growth on the Saiz measure of housing

supply elasticity to confirm the validity of the instrument. The coefficient of -0.09 means that a one standard deviation increase in elasticity of housing supply is associated with an 11.7 percentage point lower growth in prices (for an average house price growth of 33.9 percent). The F statistic on this regression is 14.5 (above the conventional threshold of 10 for evaluating weak instruments). This reflects that metropolitan statistical areas with higher elasticity of supply experienced significantly lower house price growth between 2002 and 2007, in line with previous literature. In column (2) we run a regression of employment change between 2002 and 2007 on the change in house prices during the same time period. In this regression we do not instrument the change in house prices in order to show the raw correlation between house prices and employment. The effect is positive and economically large. A one standard deviation increase in house prices is associated with an increase in total employment of 3.95 percent over this period, for an average growth in employment of 10.6 percent. In the simple weighted least squares regression we see no distinction between the effect of house prices on small and large establishments. This result highlights the need for an instrument for our dependent variable of interest given the numerous factors that are likely to drive both employment creation and house prices (income growth, investment opportunities, etc.).

In column (3) of Table 2 we repeat the same regression but instrument the change in house prices with the Saiz measure for the elasticity of housing supply. We see that there is a positive but not significant causal relationship between county level employment change and house price growth on average, in contrast to the results in the previous column. However, when we look at the differential effect of instrumented house price changes, the increase in house prices has a significant and large positive effect on the small establishments but no significant effect on employment growth for big establishments (more than 50 employees). In fact, the coefficient on the interaction term between house price growth and the 1-4 employee size category shows that a 1 percentage point increase in house prices translates into a 0.19 percentage point increase in employment at these establishments relative to the largest ones. This translates into an increase in employment of 5.3 percentage points for a one standard deviation change in house prices, for an average change in employment at the smallest establishments of 9.4 percent (the effects of a one standard deviation change in house prices for each size category are shown in the appendix Table A3). Furthermore, the effect of collateral is monotonically decreasing with the size of the firm. For firms with more than 10 employees the effect is indistinguishable from that of the very largest firms. This is consistent with the collateral channel of house price appreciation being an important mechanism for small firm

creation, since the amount of collateral that is provided by real estate appreciation is not be enough to start a larger firm. Also, these results suggest that the causal impact of house prices on employment growth during 2002 to 2007 did not work through increased demand, since in that case firms of all sizes (including the very large) should have been affected.

One concern with the above specification could be that the house prices change in areas with low Saiz housing elasticity induces a local demand shock that especially affects certain industries. If those industries are also, on average, disproportionately made up of smaller establishments, the result above might reflect a composition effect, rather than the collateral channel as we suggest. While it would need a number of factors to line up in a very specific way, we cannot rule it out on face value with the specifications in Table 2. In order to eliminate the alternative hypothesis about industry composition, we now use our more disaggregated data, which provides data at the county, 4-digit NAICS and establishment size level. This allows us to hold industry fixed effects constant and test whether, conditional on an industry, the growth of small establishments is significantly stronger than that of large establishments in counties where house prices grew more. Intuitively, this specification asks whether within an industry the fraction of employment generated by small firms grows more quickly than that of large firms. This way we can confirm that the results are not a consequence of changing industry composition. The results for this specification are shown in column 4 of Table 2. Parallel to before, we find that impact of house price changes (instrumented with the Saiz measure) is stronger for establishments with 1-4 employees when compared to the bigger firm categories. We again find that the effect is monotonically decreasing and not statistically significant beyond firms with 10 employees.

In order to confirm that the effect we estimated runs through the collateral channel, we test whether our estimated effect is stronger in industries that have lower start-up capital needs. We expect this to be the case given that the median total amount of home debt at its peak in 2006 for all US households was approximately 117 thousand dollars (Mian and Sufi, 2011b) and that only a fraction of this amount would be available for use in starting a business. Also, Adelino, Schoar and Severino (2012) show that the average value of a single family home during this period is approximately 309 thousand dollars and that most families obtain an 80 percent LTV loan. Even accounting for the fact that most entrepreneurs are over 35 years old, and that almost half are over 45 (Robb and Robinson, 2012), and so we expect them to have built home equity relative to the initial 80 percent LTV, it is not plausible to finance a very large amount of capital using home equity as collateral.

We split our sample of industries at the median amount of capital needed to start a firm to explore this source of variation. As we describe in Section 2, we obtain this information from the Census Survey of Business Owner Public Microdata Survey by selecting the sample of new firms in each industry and averaging the amount of capital needed to start those firms.

We show the results split by the amount of start-up capital needed in each industry in columns 5 through 8 of Table 2. The results show that the effect of collateral on employment growth in small establishments is stronger for industries where the amount of capital needed to start a firm is lower (the average amount of start-up capital for industries below the median is approximately 132 thousand dollars). In fact, for this subset of industries the effect is statistically significantly different from that of the largest group even for establishments up to 49 employees, i.e. the causal effect of house prices extends to establishments other than the very smallest. When we include industry fixed effects only the coefficient on the smallest establishments is statistically different from zero. For the group of industries that require more start-up capital the effect of house prices on employment is smaller and only statistically significant for the very smallest group both with and without fixed effects. These results confirm that job creation at small businesses in response to house prices changes is strongest in industries with low startup capital needs that can reasonably be financed through loans on home equity.

In addition, we also document that our results are not driven by certain industries, in particular not by construction or non-tradable industries. One might be concerned that the increase in house prices led to an increase in demand for construction services or for local services (e.g. local retail or restaurants) and thus new firms got started in these industries because that (e.g. more remodeling and new housing construction, more dry-cleaners, etc.). This would be a consequence of increased demand rather than an effect through the collateral channel. We re-run our main specifications excluding all industries linked to either construction or the non-tradable industries as classified by Mian and Sufi (2011a) and the direction and magnitude of the effects are virtually unchanged. We also run our regressions only for the manufacturing sector given that these are the industries that should be least affected by local demand. We report these results in Table 3. This confirms that a simple demand side story is not driving our results and thus confirms the importance of the collateral channel for the creation of smaller establishments in the period between 2002 and 2007.

In Table 4 we perform two additional tests only for the sample of manufacturing industries. In these tests we split industries based on their needs for external finance, as well as the average distance of shipments in each 3-digit NAICS industry. Similarly to when we consider the amount of start-up capital needed in an industry, we expect the collateral effect to matter more in industries that have low external financing needs, as those are much more likely to be met by using housing as collateral. The advantage of this measure is that it is at a 4-digit NAICS industry level, which allows us to split manufacturing industries into those that are above and those that are below the median dependence on external finance using Compustat. The first two columns of Table 4 confirm that our result is driven only by industries that have below median needs of external finance. When we consider the distance at which industries ship their goods, the last 4 columns of Table 4 show that our result is driven exclusively by industries that typically ship goods across large distances. This further mitigates the concern that our results reflect local demand and instead points to the collateral channel we emphasize.

3.1.1. Magnitude of the Collateral Effect Relative to Previous Work

One way to give a rough estimate of the importance of the collateral channel is to compare the magnitude of the employment gains that can be attributed to this channel to those that can be assigned to the demand channel shown in Mian and Sufi (2011a). To do so, we follow the same calculation used in that paper to aggregate the effect across all counties. The authors compute the effect of debt-to-income (DTI) ratios as of the beginning of the crisis on the employment change between 2007 and 2009 in non-tradable industries.[11] These are the industries that are most likely to be affected by a drop in local demand due to over-levered households. They aggregate this effect by computing the predicted change in employment in non-tradable industries and then extrapolating this effect to the rest of the economy.[12]

[11] Using county-level debt-to-income ratio or the run-up in house prices between 2002 and 2007 as the independent variable (as we do in this paper) yields virtually the same results, as counties with high debt-to-income by the end of this period are also the ones that experienced large increases in home values.

[12] This is done in four steps. First, the authors compute the county-level predicted change in employment in non-tradable industries by multiplying the regression coefficient by the independent variable in each county (in this case the DTI) and subtracting the predicted change in the 10th percentile county (to avoid being affected by outliers at the bottom of the distribution).[12] Second, they multiply the predicted county-level change by the non-tradable employment in the county as of the beginning of the period to obtain a predicted change in employment in terms of numbers of workers for each county. Third, the authors sum up the predicted changes across all counties, to obtain an economy-wide predicted change in the non-tradable sector (in their case, a total of 769 thousand jobs). Fourth and finally, they

We perform essentially the same calculations for the period of 2002-2007 to establish a benchmark employment effect that can be attributed to the demand channel. We start by obtaining the effect of a change in house prices on employment in the non-tradable industries at a county level for the 2002-2007 period. That regression is shown in Table A6 in column 3. If we aggregate in the same way as described above (where now the baseline employment is as of 2002) we obtain an increase in employment in the non-tradable sector of 451.8 thousand jobs which, given a share of employment in this sector of 18.4% as of 2002, translates into a predicted total job gain due to increased aggregate demand of 2.452 million jobs. This is about 40 percent of the jobs created in the private sector in the 660 counties used for the calculation.

We now turn to the calculation of the magnitude of the collateral channel over the same time period. Here we rely on the differential impact of house prices on employment creation at small firms *relative* to firms with more than 50 employees and we focus on the specifications where we exclude non-tradable industries and construction. (Table 3, column 2). We again first compute predicted county-level employment gains for these industries (relative to the 10^{th} percentile county) and then we aggregate to all counties. When we do that, we obtain an estimated total job gain in firms with less than 50 employees relative to those with more than 50 employees of 1.698 million jobs in all counties, or 27.8 percent of jobs created between 2002 and 2007 in this period. If we restrict our attention to the specification where the demand explanation for our results is the least plausible, i.e. the manufacturing sector and, in particular, firms in industries and states where the shipment distance is largest (column 6 of Table 4), the same computation would yield an estimate of 676 thousand jobs, or about 11 percent of the total of jobs created in this period and subset of counties.

The magnitude we estimate above is a lower bound for the total importance of collateral for job creation for a couple of reasons. First, our data does not allow us to track firms over time, so if a firm grows to become very large we do not attribute the employment creation of that firm to our effect (it would be in the 50+ category that we use as our baseline). Second, we are focusing on the importance of this channel for very small firms. This ignores the role that collateral value plays for larger firms, as pointed out in Chaney, Sraer and Thesmar (2012) and Cvijanovic (2012).

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divide this number by the share of total employment in the economy represented by the non-tradable sector (19.6%), which then yields a total predicted loss in employment due to the aggregate demand shock of approximately 6 million jobs.

Finally, we should point out that this exercise is useful as a comparison to previous work and not as a proper calibration of the importance of the collateral effect for the whole economy. In extending the effect that we observe for a subset of firms and industries in individual counties to the whole economy, we ignore general equilibrium effects that could potentially be important.

3.2. Births and Deaths of Establishments

Our measure of growth of establishments by size category does not allow us to directly observe the creation and destruction of establishments, as all we can measure is the change in the number of establishments in each category as of March of each year. In a separate set of regressions shown in Table 5 we use the Statistics of US Businesses from the Census to look at births and deaths of establishments at the 2-digit NAICS industry level. The disadvantage of this dataset is that it does not include the breakdown of establishments by their employment size, but it does help us to check that our result holds when we consider births of all establishments. Given that an overwhelming percentage of new businesses are very small businesses (Haltiwanger, Jarmin and Miranda, 2011; Robb and Robinson, 2012), this robustness test directly speaks to the validity of our main results.

We find that births of establishments are very strongly affected by increasing house prices instrumented with the elasticity of housing supply. The result holds when we consider the net creation of establishments (i.e. births minus deaths) and the coefficient is unchanged when we include 2 digit NAICS fixed effects (which is the finest industry category available in this dataset at a county level). A one standard deviation increase in house prices is associated with a nine percentage point increase in the number of births of establishments (between 2002 and 2007) as a percentage of the number of establishments as of 2002 (or about ten percent of the average cumulative number of births of establishments as a percentage of total 2002 establishments). The effect is stronger for industries with below median capital needs, although that difference disappears when we include NAICS fixed effects.

3.3. Sole Proprietorships

We now expand our analysis to include the creation of businesses without employees, also called sole proprietorships or nonemployer businesses. Table 6 shows the effect of house price growth on net creation of proprietorships relative to all the establishment categories that we have in the

previous tables using the Saiz measure to instrument for exogenous movements in house price changes. The first column in this table uses employment data on sole proprietorships from the Bureau of Economic Analysis, while the last three columns rely on data on nonemployer establishments from the Census (which includes information on the 2 digit NAICS sector in which the establishment operates). The coefficient on house price growth in Column (1) interacted with the sole proprietorship category is significantly different from that on the largest establishments and close in magnitude to that on the 1-4 employee category. In Column (2) we use data from the Census and find a smaller coefficient on the sole proprietorships and we cannot distinguish that coefficient from the others in the regression.

In the last two columns we again split the sample by the amount of capital that is needed to start a business in a given industry as discussed above. We find that the effect of house prices on the net creation of sole proprietorships is stronger in industries with low start-up capital needs, which is in line with our findings for the other size categories. We should note, however, that the difference between the coefficients in the two specifications (below and above median capital needs) is not statistically significant.

3.4. Crisis Period (2007-2009)

One question that remains regarding the establishments that were created as a consequence of the increasing value of collateral during the run-up in house prices is whether these establishments were then eliminated once the housing bubble burst. The question is whether these were particularly fragile firms that were disproportionately affected by the crisis or whether, on the other hand, they were not of different quality relative to the rest of the firms in the economy.

Given the data we currently have we cannot give a definite answer to this question. The problem is that we are not able to track individual establishments, which means we cannot know if the specific firms that were created in the 2002-2007 period survived the crisis or not. We can, however, test whether small establishments in general were more or less likely to downsize or disappear in the crisis. Put differently, we can assess whether employment loss was stronger at larger or smaller firms during the crisis in counties where the increase in house prices had been stronger in the pre-period

(which are also the most levered counties as shown in Mian and Sufi, 2011a). We run those regressions in Table 7.

The results show that employment loss was similar across large and small establishments or, if anything, it seems to have been worse at large firms (in the specifications without industry fixed effects) in counties where house prices went up more. This suggests that, at least as a group, small firms were no more likely to destroy jobs as a consequence of the increased leverage accumulated during the pre-crisis period. This is consistent with the findings of Mian and Sufi (2011a) regarding the non-tradable industries for this period.

In Appendix Table A5 we also show that the effect of house price growth in the period before the crisis is similar for proprietorships as it is for 1-4 employee establishments, which suggests that the result is not being driven solely by firms shrinking and transferring across the bins in our analysis (for example, 10-19 employee establishments becoming smaller and appearing as 5-9 employee establishments). Given that proprietorships are a different form of business entity altogether, it is very unlikely that 1-4 employee firms are falling into the proprietorship category during this period.

3.5. Total Employment and Migration

We finally want to consider the effect of house price changes on total employment as measured in the County Business Pattern (CBP). Columns (1) and (2) of Table 8 show county level regressions of change in Total Employment on house prices changes instrumented with the Saiz measure. Column (2) includes a number of county level controls such as population size, average educational attainment, and unemployment rate in the pre-period. We find that house price growth had no causal effect on total employment: the coefficient on house price changes is close to zero and insignificant in either of the specifications. In contrast, when we repeat the same regression set up using the level of unemployment as the dependent variable in Columns (3) and (4) of Table 7, we find a significant and negative relationship both with and without controls. Finally, in Columns (5) and (6) we show that house price changes also had a negative impact on the unemployment *rate*:, consistent with the results of Charles, Hurst and Notowidigdo (2012). How can the negative effect on unemployment be reconciled with no changes in total employment? Our results suggest that the decrease in unemployment captures the transition of some agents in the labor force from being job

seekers to a self-employment status. However, these people are not observed in the total employment measure, since the CBP data does not include non-employee firms (sole proprietorships).

Finally we also look at the net migration of people in and out of the county. We measure net migration as the difference between inflows and outflows at the county level. We repeat the same regression set up in Column (7) and (8) to estimate the effect of house appreciation on county to county migration and find that higher house prices caused a net out-migration from the counties with high house price appreciation. In unreported regressions we confirm that this was produced by larger outflows than inflows into those counties. This evidence is consistent with the idea that house prices affected the composition of households in each county and, therefore, indirectly affected the labor market dynamics.

3.6. Credit Conditions and Elasticity of Housing Supply

One possible concern with the instrument we use is that the behavior of lenders in high and low elasticity areas during our time frame was different. Specifically, if it became easier to obtain credit in low elasticity areas relative to high elasticity areas during our sample period for reasons unrelated to collateral availability, and if this drove the creation of new businesses, this would violate the exclusion restriction for our instrument. One mechanism for such an effect would be that banks might become laxer on all their credit decisions because of the improvement on the quality of their mortgage portfolio due to higher house prices. While it is not obvious why this should necessarily affect small business credit provision, we want to address this concern directly.

To test whether such an effect is plausible, we use data on denial rates of mortgage applications from HMDA. The underlying assumption is that the cross-sectional variation on the looseness of credit conditions should be positively correlated with the same variation for mortgage credit, especially given that the reason why credit might have become laxer is the fact that house prices increased.

We consider the number of applications that are denied by financial institutions as a proportion of the total loan applications in a county and in a year.[13] Using the yearly estimates we compute the proportional change in denial rates between 2002 and 2007. We focus on loans used for purchasing homes as they are less sensitive to the issue of relationship lending and/or private lender information about the borrower, and therefore should better reflect the loosening of credit conditions.

Panel A of Table 9 shows that credit conditions tightened rather than loosened in low elasticity areas (those below median elasticity in the sample) when we use this measure of credit supply. Denial rates increased by about 2 percentage points in counties with low elasticity of housing supply, whereas they go down in high elasticity areas by one percentage points, i.e. credit loosened in those areas. The difference between the two types of counties is statistically significant at the one percent level. Additionally, total volume of applications decreases by one percent in low elasticity areas in comparison to the 10 percent increase in the high elasticity areas.

We formally test these differences in a regression framework using a continuous elasticity measure as our independent variable. Panel B of Table 9 shows the results of those regressions. Consistent with the summary statistics of Panel A, we find that lower elasticity if associated with higher denial rates of loan applications and these results are robust to different specification and controls.

Overall, this result allows us to rule out the concern that our instrument is picking up changes in the way that lenders granted credit instead of access to credit through an increase in collateral values.

4. Conclusion

Overall, the evidence we present in this paper identifies the causal effect house prices in the creation of new small firms. These results show that access to collateral allowed individuals to start small businesses or to become self-employed. We conjecture that without access to this collateral in the form of real estate assets, many individuals would not have made the transition from unemployment to starting a new business or self-employment.

[13] Volume of applications is calculated as the sum of all loans that are originated plus applications that are approved but not accepted, applications denied by the financial institution and loans purchased by the financial institution itself.

We show that the effect of house prices is concentrated in small firms only and had no causal effect on employment at large firms. Importantly, our results also hold when we exclude industries that are most likely to be affected by local demand shocks and when we restrict our attention to manufacturing industries. The effect of house prices is also stronger in industries where the amount of capital needed to start a new firm is lower, consistent with the hypothesis that housing serves as collateral but is not sufficient to fund large capital needs.

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Table 1. Summary Statistics

Panel A reports summary statistics for all counties in the sample in Column 1, and Columns 2 and 3 show the summary statistics for counties above and below the median elasticity of housing supply in the sample. For each variable we show the pooled average, median (italicized) and standard deviation (in parenthesis). *Total Employment* refers to the total number of employees in a county in thousands across all establishment sizes and industries using the County Business Patterns data as of 2002. *Unemployment Rate* is shown in percentage and comes from the Bureau of Labor Statistics Local Area statistics in 2002. *Number of Households*, in thousands, comes from the Census Bureau in 2000. *Growth of Total Employment* is the percentage change of *Total Employment* between 2002 and 2007. *Growth in DTI* is the percentage change in debt to income ratio between 2002 and 2007 and *Growth in Income* is the percentage change in income in a county during the same period. The debt to income ratio is estimated using county level household debt data from the New York Fed-Equifax and income is computed using IRS county-level information. *Growth in House Prices* is the percentage change in house prices between 2002 and 2007at the MSA level from the Federal Housing Finance Agency. Finally, *Change in Unemployment Rate*, is the change in the rate between 2002 and 2007. Panel B shows the Total Employment in 2002 in thousands, Employment Growth between 2002 and 2007 in percentage points, and the percentage of Total Employment for each establishment size for all firms, as well as split by the start-up amount of capital needed to start a firm.

Panel A

	All Counties	High Elasticity	Low Elasticity
Total Employment (2002)	113,918	69,057	157,523
	45,454	*33,228*	*63,286*
	(238,831)	(129,569)	(304,041)
Unemployment Rate (2002, percent)	5.4	5.3	5.4
	5.3	*5.2*	*5.4*
	(1.5)	(1.5)	(1.4)
Number of Households (2000, thousands)	100.2	59.3	139.8
	46.2	*34.2*	*66.4*
	(188.1)	(92.6)	(241.4)
Growth in Total Employment (02-07, percent)	10.6	10.2	11.0
	8.2	*7.5*	*8.9*
	(15.8)	(16.9)	(14.5)
Growth in DTI (02-07, percent)	51.8	36.6	66.3
	42.6	*34.9*	*58.3*
	(36.4)	(23.0)	(40.7)
Growth in Income (02-07, percent)	27.6	27.2	28.0
	23.9	*23.0*	*24.5*
	(21.1)	(24.2)	(17.6)
Growth in House Prices (02-07, percent)	33.9	23.5	43.7
	26.8	*19.4*	*40.9*
	(21.1)	(14.3)	(21.9)
Change in Unemployment Rate (02-07, percent)	-85.2	-65.9	-103.7
	-80.0	*-50.0*	*-100.0*
	(96.2)	(92.1)	(96.5)
Number of Counties	775	382	393

Panel B

	1-4 Employees	5-9 Employees	10-19 Employees	20-49 Employees	50+ Employees
Employment in All Sectors					
Total	9,101	9,122	12,819	21,466	72,939
Growth (02-07)	9.4	8.0	12.5	10.6	13.3
Percentage of Total	8.9	9.0	12.1	18.3	51.7
Employment in Firms <P50 of Start-Up Capital					
Total	6,235	5,580	7,365	11,033	39,964
Growth (02-07)	10.8	11.0	13.4	14.0	24.6
Percentage of Total	12.1	10.8	12.8	16.6	47.7
Employment in Firms >P50 of Start-Up Capital					
Total	2,866	3,542	5,454	10,433	32,975
Growth (02-07)	6.9	4.4	13.1	9.6	9.3
Percentage of Total	5.8	7.4	11.7	20.5	54.6

Table 2. Employment Growth, Firm Size and House Price Appreciation

The table shows two-stage least squares regressions of employment growth on house price growth instrumented with the elasticity of housing supply, indicator variables for each establishment size (not shown in the table) and interactions of house price growth with the size of establishments. All regressions are weighted by the number of households in a county as of 2000. Employment growth is the percentage change in employment between 2002 and 2007 estimated using County Business Patterns (CBP) data. Growth in House prices is the percentage change between 2002 and 2007, and each interaction is with a dummy indicator for the size of the establishment. Column 1 shows the first stage regression of the change in house prices between 2002 and 2007 on the Saiz elasticity measure. Columns 2 through 4 "All Industries" shows the results for the whole sample of firms, first the weighted least squares results, then the IV at a county level and, finally, the IV results at a county and industry level. Columns 4 through 8 show the coefficients split by the start-up capital amount (above and below the median) also at the county and at the county and industry levels. The omitted category refers to establishments with 50 or more employees. All regressions control for the natural logarithm of population, the percentage of the population with a college degree, the percentage of the labor force that is employed, the share of the population in the workforce, and the percentage of homes that are owner-occupied. Columns 4, 6 and 8 include 4-digit NAICS fixed effects. Controls are at a county level for the year 2000 and are obtained using Census Bureau Data Summary Files. Standard errors are in parenthesis and are clustered by MSA. *, **, *** indicate statistical significance at 10, 5, and 1% levels, respectively.

		All Industries						
	First Stage	(WLS)	All Industries (IV)		Start-up Capital < P50 (IV)		Start-up Capital > P50 (IV)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Housing Supply Elasticity	-0.09***							
	(0.02)							
Growth in House Prices		0.19***	0.05	-0.06	-0.01	-0.04	0.06	-0.07
		(0.04)	(0.06)	(0.10)	(0.07)	(0.13)	(0.07)	(0.10)
Growth in House Prices * 1-4 Employees		0.03	0.20***	0.26**	0.33***	0.32**	0.14**	0.18**
		(0.03)	(0.05)	(0.09)	(0.07)	(0.12)	(0.06)	(0.09)
Growth in House Prices * 5-9 Employees		-0.02	0.08**	0.17	0.19***	0.14	0.04	0.19**
		(0.03)	(0.04)	(0.10)	(0.05)	(0.15)	(0.06)	(0.08)
Growth in House Prices * 10-19 Employees		-0.02	0.01	0.06	0.14***	0.02	-0.07	0.09
		(0.02)	(0.04)	(0.09)	(0.05)	(0.12)	(0.06)	(0.09)
Growth in House Prices * 20-49 Employees		0.01	0.00	0.07	0.13***	0.10	-0.07	0.02
		(0.02)	(0.04)	(0.07)	(0.05)	(0.10)	(0.05)	(0.08)
Log of the Population	0.00	-0.02***	-0.02***	-0.04***	-0.03***	-0.05***	-0.02***	-0.04***
	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Percent College Educated	0.00	0.00**	0.00**	0.00	0.00	0.00	0.00**	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Percent Employed (2000 Census)	-0.01***	0.00	0.00	0.00	0.00	0.00	0.00**	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Workforce as a Percentage of Population	-0.69	-1.09***	-1.11***	-0.86***	-1.16***	-1.00***	-1.08***	-0.72***
	(0.63)	(0.19)	(0.19)	(0.22)	(0.20)	(0.25)	(0.20)	(0.21)
Percent of Homes Owner-occupied	0.00	0.00**	0.00**	0.00	0.00**	0.00	0.00	0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
China Import Share in County (2005)	0.10	0.09	0.12	-0.08	0.33	0.08	-0.01	-0.19
	(0.91)	(0.23)	(0.23)	(0.32)	(0.26)	(0.38)	(0.22)	(0.30)
4-Digit Industry Fixed Effects	-	-	-	Y	-	Y	-	Y
Number of Observations	731	3,653	3,653	373,576	3,653	196,027	3,651	177,549
R2	0.30	0.27	0.22	0.30	0.21	0.39	0.14	0.10

Table 3. Employment Growth and House Prices: Excluding Non-Tradable Industries and Considering Manufacturing Only

The table shows two-stage least squares regressions of employment growth on house price growth instrumented with the elasticity of housing supply, indicator variables for each establishment size (not shown in the table) and interactions of house price growth with the size of establishments. Each observation is at a county, 4-digit NAICS industry, and establishment size level. All regressions are weighted by the number of households in a county as of 2000. House Price Growth is instrumented using the Saiz (2010) measure of elasticity of housing supply at an MSA level. Employment growth is the percentage change in employment between 2002 and 2007 estimated using County Business Patterns (CBP) data. Growth in House prices is the percentage change between 2002 and 2007, and each interaction is with a dummy indicator for the size of the establishment. All regressions include 4-digit industry fixed effects. Column 1 shows the results when we exclude construction industries, column 2 excludes both construction and non-tradable industries, column 3 includes only manufacturing industries (NAICS 31-33) and column 4 has manufacturing industries that are classified as "tradable" in Mian and Sufi (2011a). All regressions control for the natural logarithm of population, the percentage of the population with a college degree, the percentage of the labor force that is employed, the share of the population in the workforce, and the percentage of homes that are owner-occupied. All controls are at a county level for the year 2000 and are obtained using Census Bureau Data Summary Files. Standard errors are in parenthesis and are clustered by MSA. *, **, *** denote statistical significance at the 10, 5, and 1% levels, respectively.

	All except Const.	**All except Const. and Non-Trad.**	**All Manufacturing**	**Manufacturing (Tradable)**
Growth in House Prices	-0.09	-0.12	-0.17	-0.16
	(0.10)	(0.10)	(0.11)	(0.12)
Growth in House Prices * 1-4 Employees	0.27***	0.32***	0.13*	0.15*
	(0.09)	(0.09)	(0.07)	(0.09)
Growth in House Prices * 5-9 Employees	0.19*	0.21*	0.12	0.10
	(0.10)	(0.11)	(0.08)	(0.09)
Growth in House Prices * 10-19 Employees	0.08	0.12	0.11	0.16
	(0.09)	(0.09)	(0.11)	(0.11)
Growth in House Prices * 20-49 Employees	0.08	0.12*	0.01	-0.05
	(0.06)	(0.06)	(0.12)	(0.09)
Log of the Population	-0.04***	-0.04***	-0.02**	-0.02*
	(0.01)	(0.01)	(0.01)	(0.01)
Percent College Educated	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Percent Employed (2000 Census)	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Workforce as a Percentage of Population	-0.88***	-0.84***	-0.64**	-0.66**
	(0.22)	(0.23)	(0.29)	(0.30)
Percent of Homes Owner-occupied	0.00	0.00	0.00*	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
China Import Share in County (2005)	-0.11	-0.23	-0.88*	-1.24**
	(0.34)	(0.36)	(0.50)	(0.56)
Controls	Y	Y	Y	Y
4-Digit Industry Fixed Effects	Y	Y	Y	Y
Number of Observations	325,349	264,901	55,345	44,649
R2	0.29	0.30	0.02	0.02
Growth HP * 1-4 E. = Growth HP * 5-9 E.	0.04**	0.02**	0.95	0.48
Growth HP * 1-4 E. = Growth HP * 10-19 E.	0.00***	0.00***	0.85	0.91
Growth HP * 1-4 E. = Growth HP * 20-49 E.	0.00***	0.00***	0.33	0.10*

Table 4. Breakdown of Manufacturing Industries by External Finance Dependence and Distance Shipped

The table shows two-stage least squares regressions of employment growth on house price growth instrumented with the elasticity of housing supply, indicator variables for each establishment size (not shown in the table) and interactions of house price growth with the size of establishments. Each observation is at a county, 4-digit NAICS industry, and establishment size level. All regressions are weighted by the number of households in a county as of 2000. House Price Growth is instrumented using the Saiz (2010) measure of elasticity of housing supply at an MSA level. Employment growth is the percentage change in employment between 2002 and 2007 estimated using County Business Patterns (CBP) data for manufacturing industries (NAICS codes 31-33). Growth in House prices is the percentage change between 2002 and 2007, and each interaction is with a dummy indicator for the size of the establishment. All regressions include 4-digit NAICS fixed effects. Columns 1 and 2 split manufacturing industries into Low and High Dependence on External Finance as defined in Rajan and Zingales (1998) and Becker (2007). This measure is given by the average difference (for each 4-digit NAICS industry) between each firm's capital expenditures and its operating cash flow, scaled by capital expenditures. Data for distance shipped is from the Census Commodity Flow Survey for 2007 and represents a dollar-weighted average of shipment distance calculated at the 3-digit NAICS and state of origin level. The third and fourth columns split industries and states based on the 30th percentile of the shipment distance distribution, whereas the last two columns split the sample at the median distance (about 600 miles). All regressions control for the natural logarithm of population, the percentage of the population with a college degree, the percentage of the labor force that is employed, the share of the population in the workforce, and the percentage of homes that are owner-occupied. All controls are at a county level for the year 2000 and are obtained using Census Bureau Data Summary Files. Standard errors are in parenthesis and are clustered by MSA. *, **, *** denote statistical significance at the 10, 5, and 1% levels, respectively.

	Manufacturing, Low Dep. Ext. Fin.	**Manufacturing, High Dep. Ext. Fin.**	**Manufacturing, Short Distance Shipped <P30**	**Manufacturing, Long Distance Shipped >P30**	**Manufacturing, Short Distance Shipped <P50**	**Manufacturing, Long Distance Shipped >P50**
Growth in House Prices	-0.24**	-0.09	0.25	-0.26**	-0.11	-0.29**
	(0.12)	(0.13)	(0.26)	(0.11)	(0.17)	(0.14)
Growth in House Prices * 1-4 Employees	0.22*	0.04	-0.30	0.22***	0.07	0.21**
	(0.13)	(0.13)	(0.28)	(0.08)	(0.14)	(0.09)
Growth in House Prices * 5-9 Employees	0.25**	0.01	-0.10	0.18**	0.11	0.20**
	(0.13)	(0.11)	(0.26)	(0.08)	(0.17)	(0.09)
Growth in House Prices * 10-19 Employees	0.10	0.05	-0.28	0.19**	-0.03	0.24**
	(0.12)	(0.14)	(0.32)	(0.10)	(0.17)	(0.11)
Growth in House Prices * 20-49 Employees	0.22	-0.15	-0.23	0.07	0.06	0.04
	(0.22)	(0.11)	(0.28)	(0.12)	(0.30)	(0.12)
Log of the Population	-0.03*	-0.03*	-0.01	-0.03**	-0.02	-0.02*
	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Percent College Educated	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Percent Employed (2000 Census)	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Workforce as a Percentage of Population	-0.57	-0.58*	-0.49	-0.58*	-0.42	-0.58*
	(0.40)	(0.31)	(0.52)	(0.34)	(0.36)	(0.32)
Percent of Homes Owner-occupied	0.00	0.00	0.00	0.00*	0.00	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
China Import Share in County (2005)	-0.59	-1.07*	-1.79**	-0.61	-0.29	-1.21**
	(0.51)	(0.57)	(0.77)	(0.53)	(0.45)	(0.58)
Controls	Y	Y	Y	Y	Y	Y
4-Digit Industry Fixed Effects	Y	Y	Y	Y	Y	Y
Number of Observations	19,027	34,675	11,362	43,531	27,599	27,294
R2	0.02	0.02	0.03	0.02	0.02	0.02

Table 5. House Price Growth and Creation of Establishments

The table shows two-stage least squares regressions of establishment births and deaths on house price growth instrumented with the elasticity of housing supply. Each observation is at a county level for the regressions without sector fixed effects (odd numbered columns) and at a county and 2-digit NAICS industry level whenever we include fixed effects (even numbered columns). All regressions are weighted by the number of households in a county as of 2000. House Price Growth is instrumented using the Saiz (2010) measure of elasticity of housing supply at an MSA level. Births and deaths of establishments come from the Census Statistics of US Businesses and are summed between 2002 and 2007 and scaled by the number of establishments in a county as of 2002. Growth in House prices is the percentage change between 2002 and 2007, and each interaction is with a dummy indicator for the size of the establishment. Columns 1 and 2 shows the results for births of establishments, columns 3 and 4 show results for disappearance of establishments and columns 5 and 6 use the net creation of establishments as the dependent variable. The final four columns split the sample by the amount of capital necessary for starting a business and show results for establishment births. All regressions control for the natural logarithm of population, the percentage of the population with a college degree, the percentage of the labor force that is employed, the share of the population in the workforce, and the percentage of homes that are owner-occupied. All controls are at a county level for the year 2000 and are obtained using Census Bureau Data Summary Files. Standard errors are in parenthesis and are clustered by MSA. *, **, *** denote statistical significance at the 10, 5, and 1% levels, respectively.

	Births of Est.		**Deaths of Est.**		**Net Creation of Est.**		**Births, Capital < P50**		**Births, Capital > P50**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Growth in House Prices	0.46***	0.46***	0.31***	0.28***	0.16**	0.18***	0.57***	0.43***	0.32***	0.50***
	(0.12)	(0.12)	(0.07)	(0.08)	(0.06)	(0.06)	(0.13)	(0.14)	(0.11)	(0.13)
Log of the Population	-0.01	-0.01	0.00	0.01	-0.01*	-0.02***	-0.01	-0.01	0.00	-0.01
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)
Percent College Educated	0.01*	0.00	0.00*	0.00	0.00*	0.00	0.00	0.00	0.01**	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Percent Employed (2000 Census)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Workforce as a Percentage of Population	-2.34***	-1.78**	-1.06**	-0.65	-1.28***	-1.13***	-2.43***	-2.17**	-2.17***	-1.35*
	(0.67)	(0.79)	(0.40)	(0.49)	(0.29)	(0.33)	(0.71)	(0.88)	(0.63)	(0.77)
Percent of Homes Owner-occupied	0.00*	0.00*	0.00	0.00	0.00**	0.00**	0.00*	0.01**	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
China Import Share in County (2005)	-0.62	-0.45	-0.46	-0.60	-0.16	0.16	-0.58	-0.24	-0.69	-0.68
	(0.57)	(0.67)	(0.35)	(0.40)	(0.29)	(0.35)	(0.64)	(0.61)	(0.49)	(0.85)
2-Digit NAICS Fixed Effects	-	Y	-	Y	-	Y	-	Y	-	Y
Number of Observations	731	13,482	731	13,482	731	13,482	731	7,167	731	6,315
R2	0.29	0.20	0.21	0.22	0.31	0.16	0.29	0.20	0.27	0.20

Table 6. Proprietorships and House Price Appreciation

The table shows two-stage least squares regressions at a county level of employment growth on house price growth, indicator variables for each establishment size (not shown in the table) and interactions of house price growth with the size of establishments. Proprietorships are establishments with zero employees. Each observation is at a county and establishment size level. All regressions are weighted by the number of households in a county as of 2000. House Price Growth is instrumented using the Saiz (2010) measure of elasticity of housing supply at an MSA level. Employment growth is the percentage change in employment between 2002 and 2007 estimated using County Business Patterns (CBP) data except in the case of proprietorships. The data on growth in proprietorships is obtained from the Bureau of Economic Analysis in the first column and from the Census in columns 2 through 4. All regressions control for the natural logarithm of population, the percentage of the population with a college degree, the percentage of the labor force that is employed, the share of the population in the workforce, and the percentage of homes that are owner-occupied. All controls are at a county level for the year 2000 and are obtained using Census Bureau Data Summary Files. Standard errors are in parenthesis and are clustered by MSA. *, **, *** denote statistical significance at the 10, 5, and 1% levels, respectively.

	BEA Data	**Census Data**	**Start-up Capital < P50 (Census)**	**Start-up Capital > P50 (Census)**
Growth in House Prices	0.02	0.03	-0.04	0.05
	(0.06)	(0.06)	(0.07)	(0.07)
Growth in House Prices * Proprietorships	0.14**	0.06	0.12*	0.08
	(0.07)	(0.06)	(0.06)	(0.08)
Growth in House Prices * 1-4 Employees	0.20***	0.20***	0.33***	0.14**
	(0.05)	(0.05)	(0.07)	(0.06)
Growth in House Prices * 5-9 Employees	0.08**	0.08**	0.19***	0.04
	(0.04)	(0.04)	(0.05)	(0.06)
Growth in House Prices * 10-19 Employees	0.01	0.01	0.14***	-0.07
	(0.04)	(0.04)	(0.05)	(0.06)
Growth in House Prices * 20-49 Employees	0.00	0.00	0.13***	-0.07
	(0.04)	(0.04)	(0.05)	(0.05)
Log of the Population	-0.02**	-0.02**	-0.02***	-0.02***
	(0.01)	(0.01)	(0.01)	(0.01)
Percent College Educated	0.00**	0.00**	0.00	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)
Percent Employed (2000 Census)	0.00**	0.00**	0.00	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)
Workforce as a Percentage of Population	-1.02***	-1.16***	-1.21***	-1.13***
	(0.19)	(0.20)	(0.21)	(0.21)
Percent of Homes Owner-occupied	0.00**	0.00**	0.00**	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
China Import Share in County (2005)	0.02	0.03	0.18	-0.02
	(0.22)	(0.23)	(0.24)	(0.23)
Number of Observations	4,381	4,384	4,384	4,382
R2	0.48	0.38	0.31	0.28

Table 7. Employment Growth, Firm Size and House Price Appreciation, Crisis Period (2007-2009)

The table shows two-stage least squares regressions of employment growth between 2007 and 2009 on house price growth for the previous 5 years (2002-2007), indicator variables for each establishment size (not shown in the table) and interactions of house price growth with the size of establishments. All regressions are weighted by the number of households in a county as of 2000. House Price Growth is instrumented using the Saiz (2010) measure of elasticity of housing supply at an MSA level. Employment growth is the percentage change in employment between 2007 and 2009 estimated using County Business Patterns (CBP) data. Growth in House prices is the percentage change between 2002 and 2007, and each interaction is with a dummy indicator for the size of the establishment. Columns 1 and 2, All Industries, shows the results for the whole sample of firms (first the weighted least squares results and then the IV), columns 3 through 6 show the coefficients split by the start-up capital amount. The omitted category refers to firms with 50 or more employees. The first column for each sample of industries is aggregated at the county and establishment size level, whereas the second column is at the county, establishment size and industry level, and includes industry fixed effects. All regressions control for the natural logarithm of population, the percentage of the population with a college degree, the percentage of the labor force that is employed, the share of the population in the workforce, and the percentage of homes that are owner-occupied. All controls are at a county level for the year 2000 and are obtained using Census Bureau Data Summary Files. Standard errors are in parenthesis and are clustered by MSA. *, **, *** denote statistical significance at the 10, 5, and 1% levels, respectively.

	All Industries		**Start-up Capital < P50**		**Start-up Capital > P50**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Growth in House Prices	-0.11***	-0.13**	-0.12***	-0.09	-0.13***	-0.17
	(0.03)	(0.06)	(0.03)	(0.06)	(0.04)	(0.10)
Growth in House Prices * 1-4 Employees	0.10***	0.08	0.11***	0.03	0.12***	0.14
	(0.03)	(0.05)	(0.03)	(0.07)	(0.04)	(0.11)
Growth in House Prices * 5-9 Employees	0.04*	0.06	0.05*	0.08	0.08	0.05
	(0.03)	(0.06)	(0.03)	(0.06)	(0.05)	(0.10)
Growth in House Prices * 10-19 Employees	0.06**	0.03	0.07**	0.04	0.09**	0.02
	(0.03)	(0.06)	(0.03)	(0.07)	(0.04)	(0.11)
Growth in House Prices * 20-49 Employees	0.02	0.12**	0.00	0.09	0.07	0.17
	(0.02)	(0.06)	(0.03)	(0.06)	(0.05)	(0.10)
Log of the Population	0.00**	0.00	0.00*	-0.01***	-0.01***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Percent College Educated	0.00***	0.00**	0.00***	0.00***	0.00***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Percent Employed (2000 Census)	0.00***	0.00	0.00***	0.00	0.00***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Percent of Potential Worker Population	-0.25***	-0.34***	-0.25***	-0.42***	-0.25***	-0.25*
	(0.06)	(0.07)	(0.07)	(0.07)	(0.06)	(0.13)
Percent of Homes Owner-occupied	0.00***	0.00***	0.00***	0.00***	0.00***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Industry FE	N	Y	N	Y	N	Y
Number of Observations	3,664	368,694	3,661	197,432	3,663	171,262
R-Squared	0.12	0.09	0.07	0.03	0.13	0.14

Table 8. Total Employment, Unemployment and Migration

The table shows two-stage least squares regressions at a county level of the total growth in employment, unemployment, the change in the unemployment rate and net migration on house price growth between 2002 and 2007. All regressions are weighted by the number of households in a county as of 2000. House Price Growth is instrumented using the Saiz (2010) measure of elasticity of housing supply at an MSA level. Total Employment is estimated using County Business Pattern data on the number and size of establishments. Unemployment and Unemployment Rate are obtained using Bureau of Labor Statistics Local Area estimates. Net Migration, Inflows and Outflows are obtained from the IRS county-to-county migration data series. Net Migration is calculated by county using inflows of taxpayers minus outflow of taxpayers in a year as a proportion of non-migrants (i.e. people that filed in the same county in t-1 and t). For each dependent variable the first column shows the results for the regressions without controls, and the second column shows the coefficients controlling for log of population, the percentage of the population with a college degree, the percentage of the labor force that is employed, the share of the population in the workforce, and the percentage of homes that are owner-occupied. All controls are at a county level for the year 2000 and are obtained using Census Bureau Data Summary Files. Standard errors are in parenthesis and are clustered by MSA. *, **, *** denote statistical significance at the 10, 5, and 1% levels, respectively.

	Total Employment	**Unemp.**	**Unemp. Rate**	**Net Migration**	**Inflows**	**Outflows**
Growth in House Prices	0.09	-0.20	-1.29**	-0.16	0.19	0.34**
	(0.06)	(0.14)	(0.66)	(0.12)	(0.12)	(0.17)
Log of the Population	-0.02***	-0.01	0.03	0.00	-0.07***	-0.07***
	(0.01)	(0.02)	(0.10)	(0.01)	(0.01)	(0.01)
Percent College Educated	0.00**	-0.01***	-0.03***	0.00	0.01***	0.00***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
Percent Employed (2000 Census)	0.00	0.00	0.04**	0.00	0.00	0.00
	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)
Workforce as a Percentage of Populatior	-1.15***	-0.13	3.94	-0.01	-0.63*	-0.62**
	(0.23)	(0.52)	(2.67)	(0.19)	(0.34)	(0.26)
Percent of Homes Owner-occupied	0.00**	0.00***	0.03***	0.00**	0.00***	-0.01***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
China Import Share in County (2005)	-0.23	-0.60	-4.76	0.19	-1.08***	-1.27***
	(0.28)	(0.64)	(3.65)	(0.29)	(0.28)	(0.44)
Number of Observations	731	721	721	731	731	731
R2	0.24	0.26	0.33		0.41	0.18

Table 9. Denial Rates

This Table shows the relationship between mortgage denial rates and mortgage volume at a county level and the elasticity of housing supply. Total application volume is calculated as the sum of all loans that are originated plus applications that are approved but not accepted, applications denied by the financial institution and loans purchased by the financial institution itself in each county and year, all scaled by the total number of households in a county as of 2000. Denial rates are computed as the proportion of applications denied by the financial institution over total volume in each county and year. All the data is extracted from HMDA LAR records. Panel A shows the average denial rates and average volume in 2002 and 2007, as well as the change in these variables during this period for counties above and below the median elasticity of housing supply in the sample. Panel B shows OLS regressions of the change in denial rate the change in total volume of applications on housing supply elasticity as a continuous variable and controls (debt to income level and changes, the natural logarithm of the population, the percentage of the population with a college degree, the percentage of the labor force that is employed, the share of the population in the workforce, the percentage of homes that are owner-occupied). All regressions are weighted by the number of households as of 2000. *, **, *** denote statistical significance at the 10, 5, and 1% levels, respectively.

Panel A

	Low Elasticity	High Elasticity	Difference
Denial Rate (2002)	0.12	0.14	
Change in Denial Rate (02-07)	0.02	-0.01	0.03***
	(0.06)	(0.05)	
Volume (2002)	9,454	3,811	
Volume per Household (2002)	0.07	0.06	
Change in Volume (02-07)	-0.01	0.10	.-0.11***
	(0.27)	(0.22)	
Number of Counties	394	382	

Panel B

	Denial Rates				Volume	
Elasticity	-0.03***	-0.01***	-0.01***	0.07**	-0.01	0.02
	(0.00)	(0.00)	(0.00)	(0.03)	(0.02)	(0.02)
Debt to Income (2002)		0.11***	-0.01		-0.57***	-0.13
		(0.02)	(0.04)		(0.11)	(0.21)
Changre in Debt to Income (02-07)		0.02*	0.06***		-0.26***	-0.29**
		(0.01)	(0.01)		(0.05)	(0.10)
Log of the Population		0.02***	0.02***		-0.05**	-0.08**
		(0.00)	(0.00)		(0.02)	(0.03)
Percent College Educated		0.00***	0.00***		0.01**	0.00
		(0.00)	(0.00)		(0.00)	(0.00)
Percent Employed (2000 Census)		0.00	0.00***		-0.01**	0.00
		(0.00)	(0.00)		(0.00)	(0.00)
Workforce as a Percentage of Population		-0.15*	-0.08		-1.05**	-1.10*
		(0.08)	(0.10)		(0.44)	(0.61)
Percent of Homes Owner-occupied		0.00*	0.00		-0.01***	-0.01***
		(0.00)	(0.00)		(0.00)	(0.00)
China Import Share in County (2005)		-0.39***	-0.49***		-0.12	0.47
		(0.11)	(0.11)		(0.66)	(0.90)
DTI data		NY Fed / IRS	HMDA		NY Fed / IRS	HMDA
Number of Observations	776	763	774	776	763	774
R2	0.30	0.58	0.55	0.09	0.42	0.26

Appendix Tables

Table A1. Employment Growth, Firm Size and House Price Appreciation: Individual Industries by Firm Size

The table shows two-stage least squares regressions at a county level of employment growth on house price growth split by size of establishment. All regressions are weighted by the number of households in a county as of 2000. House Price Growth is instrumented using the Saiz (2010) measure of elasticity of housing supply at an MSA level. Employment growth is the percentage change in employment between 2002 and 2007 estimated using County Business Patterns (CBP) data. Growth in House prices is the percentage change between 2002 and 2007, and each interaction is a dummy indicator for the size of the establishment. All regressions include 4-digit industry fixed effect and control for log of population, the percentage of the population with a college degree, the percentage of the labor force that is employed, the share of the population in the workforce and the percentage of homes that are owner-occupied. We drop the top and bottom one percentile of the change in employment in each county, industry and establishment category. Standard errors are in parenthesis and are clustered by MSA. *, **, *** denote statistical significance at the 10, 5, and 1% levels, respectively.

	1-4 Employees	**5-9 Employees**	**10-19 Employees**	**20-49 Employees**	**50+ Employees**
Growth in House Prices	0.13***	0.11**	0.05	-0.02	0.03
	(0.05)	(0.05)	(0.05)	(0.08)	(0.12)
Log of the Population	-0.03***	-0.06***	-0.06***	-0.04***	-0.06***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Percent College Educated	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Percent Employed (2000 Census)	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Percent of Potential Worker Population	-0.75***	-1.16***	-0.83***	-0.58*	-0.99**
	(0.20)	(0.18)	(0.21)	(0.31)	(0.44)
Percent of Homes Owner-occupied	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
4-Digit Industry Fixed Effects	Y	Y	Y	Y	Y
Number of Observations	110,069	80,915	71,947	61,427	50,381
R-Squared	0.34	0.37	0.37	0.34	0.27

Table A2. Robustness Test: Difference between High and Low Start-Up capital

The table shows two-stage least squares regressions at a county level of employment growth on house price growth split by size of establishment and interacted with a High Startup Capital indicator (indicator itself not shown). High Startup Capital is defined as 4-digit industries for which the amount of capital to start the firm is higher than the median for all industries. All regressions are weighted by the number of households in a county as of 2000. House Price Growth is instrumented using the Saiz (2010) measure of elasticity of housing supply at an MSA level. Employment growth is the percentage change in employment between 2002 and 2007 estimated using County Business Patterns (CBP) data. Growth in House prices is the percentage change between 2002 and 2007, and each interaction is a dummy indicator for the size of the establishment. All regressions include 4-digit industry fixed effect and control for log of population, the percentage of the population with a college degree, the percentage of the labor force that is employed, the share of the population in the workforce, and the percentage of homes that are owner-occupied. We drop the top and bottom one percentile of the change in employment in each county, industry and establishment category. Standard errors are in parenthesis and are clustered by MSA. *, **, *** denote statistical significance at the 10, 5, and 1% levels, respectively.

	1-4 Employees	**5-9 Employees**	**10-19 Employees**	**20-49 Employees**	**50+ Employees**
Growth in House Prices	0.23***	0.11*	0.03	0.03	0.01
	(0.06)	(0.06)	(0.06)	(0.09)	(0.13)
Growth in House Prices * High Startup Capital	-0.21***	0.00	0.05	-0.11	0.03
	(0.05)	(0.06)	(0.06)	(0.07)	(0.09)
Log of the Population	-0.03***	-0.06***	-0.06***	-0.04***	-0.06***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Percent College Educated	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Percent Employed (2000 Census)	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Percent of Potential Worker Population	-0.75***	-1.16***	-0.82***	-0.59*	-0.99**
	(0.20)	(0.18)	(0.21)	(0.31)	(0.44)
Percent of Homes Owner-occupied	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
4-Digit Industry Fixed Effects	Y	Y	Y	Y	Y
Number of Observations	110,069	80,915	71,947	61,427	50,381
R-Squared	0.34	0.37	0.37	0.34	0.27

Table A3. Effect of 1-σ change

	1-4 Employees	5-9 Employees	10-19 Employees	20-49 Employees	50+ Employees
Employment in All Sectors					
Effect of 1σ change in HP	5.2	2.7	1.3	1.1	1.1
Growth (02-07)	9.4	8.0	12.5	10.6	13.3
Employment as of 2002	9,101	9,122	12,819	21,466	72,939
Employment in Firms <P50 of Start-Up Capital					
Effect of 1σ change in HP	6.8	3.9	2.9	2.7	-0.1
Growth (02-07)	10.8	11.0	13.4	14.0	24.6
Employment as of 2002	6,235	5,580	7,365	11,033	39,964
Employment in Firms >P50 of Start-Up Capital					
Effect of 1σ change in HP	4.2	2.1	0.0	-0.2	1.4
Growth (02-07)	6.9	4.4	13.1	9.6	9.3
Employment as of 2002	2,866	3,542	5,454	10,433	32,975

Table A4. Dollar-Weighted Average Distance Shipped in Manufacturing (Miles)

This Table shows the dollar-weighted distance of shipments for 3-digit NAICS manufacturing industries. Data is obtained from the 2007 Commodity Flow Survey. The first column of Panel A shows the weighted average distance for each industry and state, and the second column aggregates the distances shipped at the 3-digit NAICS level. Panel B shows the frequency with which each industry appears in each state x industry decile.

Panel A: Summary Statistics

	Industry x State	*Industry*
Average	630.2	651.7
Std. Dev.	368.4	218.3
Percentiles:		
1%	25.0	168.9
25%	378.1	559.3
50%	600.8	620.4
75%	817.7	831.7
99%	1,789.2	1,021.3
Number of Observations	950	21

Panel B: Deciles of NAICS and State dollar-weighted average distance measure

	Industry-State Deciles									
NAICS	1	2	3	4	5	6	7	8	9	10
311	1	2	7	10	13	2	6	4	4	1
312	15	16	8	3			2	1	2	
313	2	1	4	4	3	6	5		8	3
314	3	2	8	2	3	4	4	4	6	7
315	1	1	2	1	3		4	5	3	4
316	1		2			3	2	2	3	11
321	8	12	13	4	4	3		2	3	1
322	2	3	7	9	6	8	6	3	3	1
323	5	11	5	13	5	2	6	1	1	1
324	27	10	4		2	1				1
325		1	1	2	11	9	8	4	6	7
326	1	1	3	7	8	12	8	8	2	
327	16	20	12	3						
331		2	4	9	8	7	2	5	5	4
332	3	2	3	11	10	7	7	2	6	
333	1	1			1	7	7	12	10	9
334		3	1	1	5	5	5	10	3	15
335	2	1		2		5	5	6	15	10
336	2	4	1	3	6	6	2	10	4	9
337	5	2	8	11	6	3	7	3	2	1
339			2		1	5	9	13	9	10

Table A5. Proprietorships and House Price Appreciation, Post-Crisis (2007-2009)

The table shows two-stage least squares regressions at a county level of employment growth on house price growth, indicator variables for each establishment size (not shown in the table) and interactions of house price growth with the size of establishments. Proprietorships are establishments with zero employees. Each observation is at a county and establishment size level. All regressions are weighted by the number of households in a county as of 2000. House Price Growth is instrumented using the Saiz (2010) measure of elasticity of housing supply at an MSA level. Employment growth is the percentage change in employment between 2007 and 2009 estimated using County Business Patterns (CBP) data except in the case of proprietorships. The data on growth in proprietorships is obtained from the Bureau of Economic Analysis in the first column and from the Census in columns 2 through 4. All regressions control for the natural logarithm of population, the percentage of the population with a college degree, the percentage of the labor force that is employed, the share of the population in the workforce, and the percentage of homes that are owner-occupied. All controls are at a county level for the year 2000 and are obtained using Census Bureau Data Summary Files. Standard errors are in parenthesis and are clustered by MSA. *, **, *** denote statistical significance at the 10, 5, and 1% levels, respectively.

	BEA Data	**Census Data**	**Start-up Capital < P50 (Census)**	**Start-up Capital > P50 (Census)**
Growth in House Prices	-0.12***	-0.13***	-0.14***	-0.14***
	(0.04)	(0.03)	(0.04)	(0.05)
Growth in House Prices * Proprietorships	0.10*	0.10**	0.12**	0.11**
	(0.06)	(0.05)	(0.05)	(0.05)
Growth in House Prices * 1-4 Employees	0.10***	0.10***	0.11***	0.13***
	(0.03)	(0.03)	(0.04)	(0.05)
Growth in House Prices * 5-9 Employees	0.05	0.05	0.05*	0.09
	(0.03)	(0.03)	(0.03)	(0.05)
Growth in House Prices * 10-19 Employees	0.06*	0.06*	0.07**	0.09**
	(0.03)	(0.03)	(0.03)	(0.04)
Growth in House Prices * 20-49 Employees	0.02	0.02	0.00	0.07
	(0.03)	(0.03)	(0.03)	(0.05)
Log of the Population	0.00**	0.00	0.00	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)
Percent College Educated	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Percent Employed (2000 Census)	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Workforce as a Percentage of Population	-0.31***	-0.29***	-0.29***	-0.27***
	(0.06)	(0.06)	(0.07)	(0.07)
Percent of Homes Owner-occupied	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
China Import Share in County (2005)	0.06	0.05	0.11	0.04
	(0.07)	(0.07)	(0.08)	(0.08)
Number of Observations	4,382	4,385	4,382	4,384
R2	0.33	0.12	0.13	0.19

Table A6. Employment and House Price Appreciation across Industry Types

The table shows two-stage least squares regressions at a county level of employment growth on house price growth between 2002 and 2007. Each observation is at a county level. All regressions are weighted by the number of households in a county as of 2000. House Price Growth is instrumented using the Saiz (2010) measure of elasticity of housing supply at an MSA level. Employment growth is the percentage change in employment between 2002 and 2007 estimated using County Business Patterns (CBP) data. Industry type definitions follow Mian and Sufi (2011a). All regressions control for the natural logarithm of population, the percentage of the population with a college degree, the percentage of the labor force that is employed, the share of the population in the workforce, and the percentage of homes that are owner-occupied. All controls are at a county level for the year 2000 and are obtained using Census Bureau Data Summary Files. Standard errors are in parenthesis and are clustered by MSA. *, **, *** denote statistical significance at the 10, 5, and 1% levels, respectively.

	First Stage	**All Industries**	**Non-Tradable**	**Tradable**	**Construction**	**Others**
Housing Supply Elasticity	-0.09***					
	(0.02)					
Growth in House Prices		0.09	0.10	-0.01	0.32***	0.06
		(0.06)	(0.07)	(0.11)	(0.08)	(0.06)
Log of the Population	0.00	-0.02**	-0.01	-0.02**	-0.02*	-0.03
	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Percent College Educated	0.00	0.00*	0.00**	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Percent Employed (2000 Census)	-0.01***	0.00	0.00*	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Workforce as a Percentage of Population	-0.69	-1.15***	-1.13***	-0.82	-0.83**	-1.35
	(0.63)	(0.23)	(0.28)	(0.51)	(0.37)	(0.24)
Percent of Homes Owner-occupied	0.00	0.00**	0.00	0.00**	0.00**	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
China Import Share in County (2005)	0.10	-0.23	0.42	-1.94***	-0.52	0.42
	(0.91)	(0.28)	(0.32)	(0.47)	(0.42)	(0.32)
Number of Observations	731	731	731	730	731	731
R2	0.30	0.24	0.18	0.10	0.30	0.21