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House prices, collateral, and self-employment ☆

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ABSTRACT

We show the importance of the collateral lending channel for small business employment over the past decade. Small businesses in areas with greater increases in house prices experienced stronger growth in employment than large firms in the same areas and industries. To identify the role of the collateral lending channel separately from aggregate changes in demand, we show that this effect is more pronounced in industries that need little start-up capital and in which housing collateral is more important. This increase is also present in manufacturing industries, particularly those that ship goods over long distances. In aggregate, the collateral lending channel explains 15–25% of employment variation.

1. Introduction

The boom-and-bust cycle of house prices over the past decade has featured prominently in explanations of the low unemployment during the surge in house prices and the high unemployment that followed the real estate bust. The debate has focused on two primary explanations for the observed employment dynamics. One view is that consumers' use of their houses as "ATMs" drove demand and created employment during the surge in prices, so employment suffered when aggregate demand dropped because of household deleveraging and falling house prices (see, e.g., Mian and Sufi, 2014; New York Times, 2011). The other view is that the increase in house prices and the rise in labor demand in the construction industry masked structural mismatches in the workforce caused by job losses in the manufacturing sector (see Kocherlakota, 2010; Charles, Hurst, and Notowidigdo, 2012).

Our paper finds 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 employment in small businesses. Seminal papers by

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Bernanke and Gertler (1989) and Kiyotaki and Moore (1997) and research since theirs suggest 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 alleviated more easily when collateral values are high and firms, therefore, can have higher leverage (Rampini and Viswanathan, 2010) and that these problems are especially acute for small, more opaque firms (Kashyap, Stein, and Wilcox, 1993; and Gertler and Gilchrist, 1994). Yet it has been difficult to cleanly identify the causal direction of the collateral effect empirically. The challenge is that, on the one hand, increased collateral values facilitate lending but that, on the other hand, higher collateral values can be the result of improvements in economic conditions (e.g., Iacoviello, 2005).

This paper is the first to look directly at shocks to home values and consider the impact these shocks have on employment in small firms relative to large firms. 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). This measure uses exogenous geographic and regulatory constraints to housing supply to differentiate areas where an increase in housing demand translates into higher house prices and more collateral value (areas where it is hard to build—that is, in which the elasticity of the housing supply is low) or into higher volume of houses built (areas with high elasticity). By relying on exogenous restrictions on the expansion of housing volumes, we can identify the effect of high collateral values on employment in small businesses. This identification strategy is similar to Chaney, Sraer, and Thesmar (2012), who look at corporate investment decisions, and Mian and Sufi (2011), who examine increases in consumption from household leverage.

We show that, during the housing price boom of 2002–2007, 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 were employed in establishments with fewer than ten employees compared with 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 home prices on job creation decreases monotonically with firm size. This asymmetric effect on small versus large holds only for instrumented house prices, which suggests that the noninstrumented part of the variation (the one that captures endogenous demand) chiefly impacts employment at larger firms. This asymmetry points to the interpretation of the collateral lending channel as an important driver of employment creation particularly for small firms, as large firms have access to other forms of financing and should be less affected by the collateral channel. In fact, if large firms are also affected by the increase in real estate values, our estimates could understate the effect of the collateral channel on total employment. In further support of the collateral lending channel, we show that areas with higher house price growth are those with HELOC (home equity line of credit) financing and cash out refinancing, which makes this capital available for people to also start new businesses.

Although the result above supports the importance of the collateral channel for small business creation, two alternative hypotheses must be ruled out as explaining our results. The first hypothesis is that increases in housing prices can drive local demand for goods (Campbell and Cocco, 2007) and, consequently, employment at non-tradable industries (Mian and Sufi, 2014). To the extent that small firms could be more sensitive to changes in demand (Kashyap and Stein, 1994), the asymmetry in the results could reflect increased consumer demand instead of use of the collateral lending channel. The second alternative hypothesis results from our use of housing and zoning restrictions for obtaining identification, because we rely on cross-sectional differences between high- and low-elasticity areas. These areas could also vary in other characteristics, such as the level of economic vitality. For example, not only could areas with low housing elasticity see higher home prices when demand for housing picks up—and therefore increased available collateral—but they could also be the areas where more investment opportunities become available.

We devise a number of tests to 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 home prices saw stronger employment growth in smaller establishments than areas with stagnant prices.[1]

Second, narrowing in on the importance of collateral for business financing, we look at variation across industries in the amount of start-up capital needed to create a new firm. The minimal feasible scale of businesses differs across industries, and the availability of collateral matters more or less depending on that minimal scale. For example, some businesses, such as home health care services, can be started with small amounts of capital that could reasonably be financed through appreciation in home values. In contrast, many sectors within manufacturing, for example, require large amounts of capital and fixed investments. The capital needs in these areas 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 into industries with above and below median needs for start-up capital, we find that the effect of house price increases 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 plays an important role in shaping employment dynamics. Borrowing against housing wealth allows people in areas with more rapid home price appreciation to start small businesses and drives the increase in employment at these small firms.

Third, we confirm that our results are not driven by the non-tradable or construction sectors. If the relation between increasing housing price and job creation in small firms were purely constrained to the non-tradable or construction sectors, one would be concerned that the results are driven

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

not by changes in the collateral lending channel but by differences in local demand. However, our results are almost unchanged when we eliminate these sectors from the analysis, and they also hold for the manufacturing sector where products are easily tradable. The difference in employment creation between large and small firms is also particularly strong for industries in which firms report shipping goods across long distances. Our results are thus distinguished from the work of Mian and Sufi (2014), which shows 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.

Last, we rule out that our results are driven by generally loosening credit standards in areas with rapid house price growth. The growth of small businesses could be caused not 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 calculation similar to that in Mian and Sufi (2014), we compute the approximate contribution of the collateral lending channel to changes in overall employment in the precrisis period, 2002–2007. Using this approach, we find that the collateral channel accounts for 10–25% of the increase in employment in these years (depending on the specific assumptions about the reference group that best isolates the collateral effect), and the demand channel explains about 40% over the same period, and the two effects are mutually nonoverlapping. Interestingly, we do not find a statistically significant effect of the demand channel over the period 2002–2007. This is in stark contrast to the postcrisis period, when the drop in demand of overleveraged counties shows up very strongly in the data (as in Mian and Sufi, 2014). Although the point estimate for the effect of the demand channel is positive, the effect is noisily estimated in the period 2002–2007, so we cannot reject that there is no effect from increased demand driven by higher house prices before the crisis. 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 increase in house prices was stronger in the period before the crisis. This suggests that small firms that were created in low-elasticity areas during the time of increasing collateral values were more resilient than larger ones in those areas and did not immediately disappear when the crisis struck. This shows an interesting asymmetry in the mechanism behind the collateral lending channel. Although it is a powerful channel in facilitating the creation of new small establishments, a contraction in the amount of available collateral does not lead to a disproportionate amount of destruction of employment in those small establishments. We are, however, cautious in interpreting our results for the period post-2007. First, given the nature of our data, we cannot disentangle whether the relative persistence of jobs in small businesses is due to the survival of existing small businesses or a change in the entrance of newly started firms. Second, although the elasticity measure has a natural interpretation for positive housing demand shocks, we lack a good instrument for the house price drop. In fact, an increase in housing demand can translate into either higher house prices (inelastic areas) or an expansion of housing volume (elastic areas). However, on the downside, a drop in housing demand does not lead to the destruction of housing stock, and thus prices simply drop in both inelastic and elastic areas. So, instead of instrumenting for the price drop in the crisis period, we compare areas with large appreciation in the precrisis period (low elasticity) with those that had smaller house price increases, that is, the timing of the housing price changes remains 2002–2007, as in the rest of the analysis. Once the crisis hit, areas that experienced larger house price increases in the precrisis period were more leveraged (Mian and Sufi, 2011, 2014), so it should be harder for households to access collateral in these areas in the crisis.

Our study builds on literature that shows that credit constraints at the household level matter for the creation of new businesses (Evans and Jovanovic, 1989; Holtz-Eakin, Joulfaian, and Rosen, 1994; Gentry and Hubbard, 2005; Cagetti and De Nardi, 2006), although some authors have argued that this relation is present only at the very top of 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 start-ups (see Fan and White, 2003; Fairlie and Krashinsky, 2012; Fort, Haltiwanger, Jarmin, and Miranda, 2013; Corradin and Popov, 2013; Kleiner, 2013; Schmalz, Sraer, and Thesmar, 2013, for France; and Black, De Meza, and Jeffreys, 1996; Kleiner, 2013, for the United Kingdom). Previous work has also found that bank credit is an important source of financing for small businesses (Petersen and Rajan, 1994; Fracassi, Garmaise, Kogan, and Natividad, 2013; Robb and Robinson, 2013) and that entrepreneurs often have to provide personal guarantees when they obtain financing (Berger and Udell, 1998). More recently, Greenstone, Mas, and Nguyen (2014) use the sharp reduction in credit supply following the 2008 crisis, and the heterogeneity of this effect among banks, to show that a decrease in the origination of small business loans leads to a decrease in county employment and business formation during the period 2007–2009.

The rest of the paper proceeds as follows: Section 2 describes our data and 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 US Bureau of the Census. The CBP data contain employment data by county, industry, and establishment size (measured in number of employees) between 1998 and 2010 as of March of the

reported year. We use the data at the four-digit North 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 employee number allows us to differentially estimate the effect of housing price growth in the net creation of establishments of different sizes.[2]

We use five establishment categories in our regressions that the Census Bureau commonly uses: establishments of one to four employees, five to nine, 10–19, 20–49, and 50 or more. The CPB provides all but the final category. For establishments with 50 or more employees, the CBP has multiple categories, but if we were to use each one individually, it would add noise to our estimation because such large businesses become rare at the county level and even scarcer at the county and industry levels, which we need for some of the specifications. 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 100–249 employees, we multiply the number of establishments by 174.5), and then we add them all up at the country and industry levels.

The housing prices used in the regressions come from the Federal Housing Finance Agency (FHFA) House Price Index (HPI) data at the Metropolitan Statistical Area (MSA) level. The FHFA HPI is a weighted, repeat-sales index, and it measures average price changes in repeat sales or refinancings on the same properties. This information includes repeat mortgage transactions on single-family properties whose mortgages have been purchased or securitized by Fannie Mae (Federal National Mortgage Association) or Freddie Mac (Federal Home Loan Mortgage Corporation) 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. To identify the causal 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 areas where land is easily available are classified as high elasticity. Low-elasticity areas correlate strongly with steeper house price growth in the years 2002–2007. This measure is available for 269 MSAs that we match to 776 counties using the correspondence between MSAs and counties for the year 1999 as provided by the Census Bureau.[3] Although employment growth and our other controls are available for a much larger sample of counties, our regressions focus on the subset of counties for which we have the housing supply elasticity measure.

An important measure for our analysis is the amount of capital needed to start a firm, because these investment requirements affect how much a given industry depends on the housing collateral channel. 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 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 offers such business characteristics as firm size, employer-paid benefits, minority- and women-ownership, access to capital, and firm age. We focus here on the "Amount of start-up or acquisition capital" for each firm, and we group the answers to this question at the two-digit NAICS industry level (the finest level available in the data) for firms established in 2007. The classification is virtually identical whether we use all years in the data or focus on firms with one to four employees only. The median amount of capital needed to start a business in the data is $215,000. 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 $132,000, and the average amount needed for industries above the median is $260,000 (detailed amounts by two-digit NAICS sector are in Online Appendix Table A5).

Our classification of non-tradable, tradable, and construction industries at the four-digit NAICS level is obtained from Online Appendix Table A2 of Mian and Sufi (2014).[4] Non-tradable codes are included largely in sectors 44 and 45 (Retail Trade), as well as under 72 (Accommodation and Food Services). Construction industries include most codes under the Construction two-digit NAICS sector (23) and 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 (2014) (i.e., those not in construction or in "other industries").

To address further the concern that the results could be driven by local demand, we construct a measure of the average distance that firms in an industry ship their goods similar to

[2] The data include only the number of establishments in each county, industry, and year by category of employment size (one to four employees, five to nine, 10–19, etc.), not the total employment for each establishment category. As such to construct the employment in each bin, we multiply the number of establishments by the middle point of each category. For example, to calculate the total employment of one-to-four-employee establishments in a given industry, county, and year, we multiply the number of establishments by 2.5.

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

[4] The current version of the Online Appendix can be found at http://faculty.chicagobooth.edu/amir.sufi/data-and-appendices/unemployment_miansufi_EMTRAR2_APPENDIX.pdf.

that used in Duranton, Morrow, and Turner (2013). These data are available from the 2007 Census Commodity Flow Survey, which reports the distance traveled by shipments of a sample of establishments in each three-digit NAICS manufacturing industry.[5] The unit of observation in the census data is at the state and industry levels, 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 how often each industry appears in each decile, are shown in Online Appendix Table A4.

We also use data on county-level births and deaths of establishments for each two-digit NAICS industry between 2002 and 2010 from the Census Statistics of US Businesses (SUSB). Data on births and deaths of establishments are provided under the Employment Change section of SUSB, and it does not include a breakdown by establishment size at the county and industry levels, so we cannot use it as our main data set. However, given that most establishment births are of a very small scale (Haltiwanger, Jarmin, and Miranda, 2013), we view the regressions performed on this data set 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) and the census nonemployer statistics. From the BEA we use non-farm proprietorship employment at the county level between 2002 and 2007 to estimate the growth of sole proprietorships in this period. From the census we obtain the number of establishments for the period 2002–2007 at the two-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 equivalents, and these data are 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 are 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 data set 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).[6] We also compute net flows as inflows minus outflows, and we scale all figures by the number of nonmovers in the county. The data are 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 years 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, and, therefore, better control for changes in investment opportunities in those counties.[7]

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 cover a total of 775 counties with non-missing total employment data. We split the sample into counties above and below the median of the housing supply elasticity measure and show *t*-statistics (with standard errors clustered by MSA) for the difference in means between the two groups. Counties with low supply elasticity are larger but have similar unemployment rates in 2002 as those with high supply elasticity. The characteristics in 2002 from the census are broadly similar for the two groups, with the one exception being the percentage of college-educated people (somewhat higher in low-elasticity areas). Average household income is also higher in those counties, but the difference is economically small (about 10% of the mean). As expected, counties with a low elasticity of housing supply experienced much stronger growth in house prices than did counties with a high elasticity of supply (a crude version of the first stage in our regressions) and similarly experienced a much larger increase in average debt-to-income ratio (consistent with Mian and Sufi, 2014).

Panel B of Table 1 shows how employment is distributed across the different establishment-size categories. The biggest firm category, 50 employees or more, accounts for 51.7% of employment in 2002, and the smallest category, one to four employees, accounts for 8.9%. Growth

[5] The year 2007 is the first in which the data are reported at the three-digit NAICS level (previous years had only commodity identifiers, not industry data).

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

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

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). The last column shows the *t*-statistic for the difference in means of the two groups, adjusted for clustering at the Metropolitan Statistical Area level. *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. *Percent College Educated* is the percentage of the population with a college degree, *Percent Employed* is the percentage of the labor force that is employed, *Workforce as a Percentage of Population* is the share of the population in the workforce, and *Percent of Homes Owner-occupied* is the percentage of homes that are owner-occupied (i.e., not rental properties). *Average Household Income* is the total income in a county divided by the number of households as of 2002, and *Growth in Income* is the percentage change in income in a county between 2002 and 2007. *Change in DTI* is the percentage change in debt-to-income ratio in 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 2007 at the MSA level from the Federal Housing Finance Agency. 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: Regional characteristics, high and low elasticity counties

	All Counties	High elasticity	Low elasticity	*T*-Statistic, difference
Total employment (2002)	113,918	69,057	157,523	4.2
	45,454	*33,228*	*63,286*	
	(238,831)	(129,569)	(304,041)	
Unemployment rate (2002, percent)	5.4	5.3	5.4	−1.4
	5.3	*5.2*	*5.4*	
	(1.5)	(1.5)	(1.4)	
Percent college educated (2000 Census)	22.2	20.2	24.1	2.3
	20.5	*18.7*	*22.5*	
	(9.4)	(8.3)	(10.1)	
Percent employed (2000 Census)	55.5	55.9	55.2	0.4
	55.9	*56.2*	*55.5*	
	(6.1)	(5.8)	(6.5)	
Workforce as a percentage of population (2000 Census)	0.8	0.8	0.8	-0.6
	0.8	*0.8*	*0.8*	
	(0.0)	(0.0)	(0.0)	
Percent of homes owner-occupied (2000 Census)	71.2	71.8	70.6	0.7
	72.5	*72.5*	*72.5*	
	(9.7)	(8.8)	(10.4)	
Average household income (2002, thousands of dollars)	40.4	37.9	42.8	2.9
	37.7	*36.0*	*40.9*	
	(12.7)	(11.2)	(13.6)	
Growth in income (02–07, percent)	27.6	27.2	28.0	1.1
	23.9	*23.0*	*24.5*	
	(21.2)	(24.2)	(17.7)	
Change in debt-to-income (02–07, percent)	37.4	30.4	44.2	2.5
	34.5	*29.4*	*42.4*	
	(21.5)	(18.3)	(22.2)	
Growth in house prices (02–07, percent)	33.8	23.5	43.6	3.0
	26.8	*19.4*	*40.9*	
	(21.1)	(14.3)	(21.9)	
Number of counties	775	382	393	

Panel B: Sector employment by establishment size

	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	6,213	5,566	7,350	11,012	39,921
Growth (02–07)	10.9	11.1	13.4	14.2	25.0
Percentage of total	12.1	10.8	12.8	16.6	47.7
Employment in firms > P50 of start-up capital					
Total	2,888	3,556	5,468	10,453	33,018
Growth (02–07)	6.6	4.3	13.0	9.4	9.3
Percentage of total	5.8	7.4	11.7	20.5	54.6

in employment is stronger among larger companies in the period 2002–2007, especially among the industries that we classify as having low start-up capital needs.

2.3. Empirical model

We 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 home prices on the net creation of establishments in different size categories.[8] Our identification relies on the idea that improved availability of collateral in the form of higher house prices can positively affect the creation of small businesses, whereas availability of collateral in the form of home equity is likely to have no effect on the creation of larger establishments because 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, including changes in household income in the area and improvements in investment opportunities. To overcome this difficulty, we instrument for the changes in house prices during our period of interest (2002–2007) using the elasticity of housing supply by MSA (see Saiz, 2010). Our identification relies on the assumption that the elasticity of the housing supply affects employment creation at establishments of different sizes only through its effect on house prices. The exclusion restriction is 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, e.g., Mian and Sufi, 2011, 2014; Charles, Hurst, and Notowidigdo, 2012; Robb and Robinson, 2013). Davidoff (2013) argues that the supply elasticity measure does not capture the severity of the boom-and-bust cycle of the 2000s. In our setting we are concerned only with price increases between 2002 and 2007, and the supply elasticity measure developed by Saiz is a strong predictor of the increase in prices (i.e., there is no weak instruments problem). We also include specifications that include county fixed effects that should further mitigate concerns about the cross-sectional elasticity measure.

We rely on two basic regression specifications for our analysis. The first specification aggregates data up to the level at which our instrument varies, that is, 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. We thus 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

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

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 housing prices at the county level for the same time period where we instrument for the growth in house prices using the housing supply elasticity of Saiz (2010). 1_i 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's 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 (2014).

The second specification disaggregates observations to the county, year, establishment size, and four-digit NAICS level, yielding a much larger number of observations than the specification above (because each county now appears multiple times for each industry). When using these 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 four-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

$$\Delta^{02-07}Employment_{ijz} = \alpha + \beta_1 \Delta HP_j^{02-07} + \beta_2 1_i + \beta_3 1_i \Delta HP_j^{02-07} + \gamma X_j + 1_z + \varepsilon_{i,j} \quad (2)$$

in which 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 home prices caused increased demand, which then prompted the growth in new businesses. This type of demand story (as opposed to the collateral lending channel) comes in two versions. The first is that rising house prices lead to an increase in demand because households feel richer or have access to home equity. This channel is proposed in Mian and Sufi (2014) to explain

[8] As we discuss in the data section, our data do 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 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.

the drop in employment during the Great Recession of 2007–2009. A second version of the demand hypothesis is that increasing house prices could benefit certain industries more than others and that these industries happen to be composed of smaller establishments on average (i.e., a composition effect).

We address these alternative demand hypotheses in several 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 four-digit NAICS industry. This addresses the composition effect described above. Second, a pure local demand story should affect establishments of all sizes similarly, whereas the credit collateral channel is relevant mainly for small businesses. However, the possibility still exists that smaller firms are more sensitive to local demand shocks than large firms. To see if this effect could explain our results, we exclude the most obvious candidate industries that could 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 (2014). We repeat our tests only for manufacturing firms, those that should be least affected by local demand shocks.

As a robustness check to our results we also implement the approach in Chaney, Sraer, and Thesmar (2012) by constructing the product of the nationwide conventional mortgage rate (obtained from the Federal Reserve data website) with the local elasticity of housing supply measure. This provides time-varying shocks to the demand for housing. When mortgage rates drop more, the shock to demand for housing should be larger, consistent with Adelino, Schoar, and Severino (2012). This shock then translates into higher prices in areas with a low elasticity of housing supply than in places where it is easy to build. This specification uses a panel of yearly observations at the county level and includes county fixed effects, unlike the previous two specifications. We run two-stage least squares regressions of the form

$$\Delta Employment_{ijt} = \alpha + \beta_1 \Delta HP_{jt} + \beta_2 1_{it} + \beta_3 1_{it} \Delta HP_{jt} + \gamma_1 1_j + \gamma_2 1_t + \varepsilon_{ijt} \quad (3)$$

The instrument for house prices is the product of mortgage rates and housing elasticity, not just the elasticity measure as before. We include county fixed effects (1_j), which absorbs all county-level controls included in the previous two specifications, as well as year fixed effects.[9]

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, because it provides individuals with easier access to start-up capital. As a result, we should see a sharper increase in self-employment and employment in small businesses in areas that had steeper housing 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. We run two-stage least squares regressions of the growth in employment between 2002 and 2007 on five establishment size categories and their interaction with house price growth in the same period. The instrument for house price growth 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 1 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%). The F statistic on this regression is 14.5 (above the conventional threshold of 10 for evaluating weak instruments). This reflects that MSAs with a higher elasticity of supply experienced significantly lower housing price growth between 2002 and 2007, in line with previous literature. We run a regression of employment change between 2002 and 2007 on the change in house prices during the same period (Column 2). In this regression, we do not instrument the change in house prices to show the raw correlation between house prices and employment. The effect is positive and economically large. A 1 standard deviation increase in house prices is associated with an increase in total employment of 3.95% over this period, for an average growth in employment of 10.6%. In the simple weighted least squares regression, no distinction emerges between the effect of home 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.).

Column 3 of Table 2 presents the results when we repeat the same regression but instrument the change in house prices with the Saiz measure for the elasticity of housing supply. A positive but not significant causal relation exists between county-level employment change and house price growth on average, in contrast to the results in Column 2. However, when we look at the differential effect of instrumented housing price changes, the increase in home prices has a significant and large positive effect on the small establishments but no significant effect on employment growth for big establishments (50 or more employees). The coefficient on the interaction term between house price growth and the one to four employees size category shows that a 1% increase in house prices translates into a 0.19% increase in employment at these establishments relative to the largest ones. This translates into an increase in employment of 5.3% for a 1 standard deviation change in house prices, for an average change in employment at the smallest establishments of 9.4% (the effects of a 1 standard deviation change in house prices for each size category are shown in Online Appendix Table A3). Furthermore, the effect of collateral is decreasing monotonically with firm size. For firms with more than ten employees, the effect is indistinguishable from

[9] We do not rely on the panel specifications for most tests because mortgage rates did not experience large drops in the period we analyze. We effectively have one large shock to demand for housing in the period 2002–2007, and the first two specifications capture this fact more clearly.

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 5 "All Industries" shows the results for the whole sample of firms: first the weighted least squares results, then the IV at a county level, the IV results at a county and industry level, and then the IV results using yearly observations and the interaction of the elasticity measure with the conventional mortgage rates as the instrument. Columns 6–11 show the coefficients split by the start-up capital amount (above and below the median) also at the county, at the county and industry level, and at the county level with yearly observations. 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. 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.

	First stage	All industries **(WLS)**	All industries **(IV)**			Start-up capital **< P50 (IV)**			Start-up capital **> P50 (IV)**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**
Housing Supply Elasticity	−0.09***										
	(0.02)										
Growth in House Prices		0.19***	0.05	−0.06	0.02	−0.01	−0.04	−0.11***	0.06	−0.07	0.10**
		(0.04)	(0.06)	(0.10)	(0.03)	(0.07)	(0.13)	(0.04)	(0.07)	(0.10)	(0.04)
Growth in House Prices∗1 − 4 Employees		0.03	0.20***	0.26**	0.16***	0.33***	0.32**	0.31***	0.14**	0.18**	0.10*
		(0.03)	(0.05)	(0.09)	(0.05)	(0.07)	(0.12)	(0.06)	(0.06)	(0.09)	(0.06)
Growth in House Prices∗5 − 9 Employees		−0.02	0.08**	0.17	0.00	0.19***	0.14	0.17***	0.04	0.19**	−0.10*
		(0.03)	(0.04)	(0.10)	(0.04)	(0.05)	(0.15)	(0.05)	(0.06)	(0.08)	(0.05)
Growth in House Prices∗10 − 19 Employees		−0.02	0.01	0.06	−0.05	0.14***	0.02	0.10*	−0.07	0.09	−0.12**
		(0.02)	(0.04)	(0.09)	(0.04)	(0.05)	(0.12)	(0.05)	(0.06)	(0.09)	(0.05)
Growth in house prices∗20 − 49 Employees		0.01	0.00	0.07	−0.07**	0.13***	0.10	0.06	−0.07	0.02	−0.14***
		(0.02)	(0.04)	(0.07)	(0.03)	(0.05)	(0.10)	(0.05)	(0.05)	(0.08)	(0.04)
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	–
County Fixed Effects	–	–	–	–	Y	–	–	Y	–	–	Y
Number of Observations	731	3,653	3,653	373,576	21,962	3,653	196,027	21,954	3,651	177,549	21,949
R^2	0.30	0.27	0.22	0.30	0.02	0.21	0.39	0.00	0.14	0.10	0.03

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, as the amount of collateral that is provided by real estate appreciation is not enough to start a larger firm. Also, these results suggest that the causal impact of house prices on employment growth in the period 2002–2007 did not work through increased demand, because 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 change in house prices 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 could reflect a composition effect, not the collateral channel, as we suggest. Although a number of factors would need to line up in a very specific way, we cannot rule this concern out on face value with the specifications in Table 2. To eliminate the alternative hypothesis about industry composition, we use our more disaggregated data, which provide information at the county, four 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 with greater increases in home prices. 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. As before, we find that impact of house price changes (instrumented with the Saiz measure) is stronger for establishments with one to four employees when compared with the bigger firm categories. We again find that the effect is monotonically decreasing and not statistically significant beyond firms with ten or more employees. To be more specific about which industries show the strongest effects from the collateral channel, in Online Table A9 we show the three-digit NAICS industries that are not construction, manufacturing, non-tradable, finance, insurance, or real estate, as well as the employment share in each size bin. The sample includes a variety of services and wholesale activities, with significant cross-sectional variation in the proportion of employees in the very small establishment-size categories (from 26.3% of employment in establishments with one to four -employees in the case of "NAICS 425—Wholesale Electronic Markets and Agents and Brokers" to 0% in this category for "NAICS 622—Hospitals").

We test whether our estimated employment effects are stronger in industries that have lower start-up capital needs. We expect this to be the case, given that the median amount of home debt at its peak in 2006 for all US households was approximately $117,000 (Mian and Sufi, 2011) 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 $309,000 and that most families obtain an 80% loan-to-value (LTV) loan. Even accounting for the fact that most entrepreneurs are over age 35 and that almost half are over 45 (Robb and Robinson, 2013), and so we expect them to have built home equity relative to the initial 80% LTV, financing a large amount of capital using home equity as collateral is not plausible. Brown, Stein, and Zafar (2013) show that the average amount of home equity lines of credit in the boom period is $2,623, with a standard deviation of $13,672. This implies that even homeowners who are 2 standard deviations above the mean have less than $30,000 in home equity loans. The paper also shows that the fourth quartile of homeowners in high house-price appreciation areas has about $8,500 in HELOC. These numbers suggest the range of funds that can be obtained from homes as collateral for starting a business.

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 SBO PUMS 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 6–11 of Table 2. The effect of collateral on employment growth in small establishments is stronger for industries in which 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 $132,000). In fact, for this subset of industries, the effect is statistically significantly different from that of the largest group even for establishments with up to 49 employees, that is, 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 statistically significant only 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 start-up capital needs that can reasonably be financed through loans on home equity. The assumption underlying these tests is that the contribution of housing as collateral is more likely to matter at the margin for firms that require low amounts of capital than for firms that require substantial amounts of capital. In fact, for firms that require large amounts of capital, we expect entrepreneurs to seek out additional sources of capital, and housing collateral is unlikely to be as important for the decision to start a firm.

As we discuss in Section 2.3, as a robustness test we implement the approach in Chaney, Sraer, and Thesmar (2012) and construct time-varying shocks to the demand for housing by multiplying the nationwide conventional mortgage rate with the local elasticity of housing supply. This version of the instrumented regression is shown in Columns 5, 8, and 11 of Table 2. These specifications use yearly observations on county-level employment for each establishment size and include county fixed effects to account for time-invariant differences across regions. The results are consistent with the two previous specifications, with the same monotonically decreasing effect of house prices on employment at establishments of increasing size.

3.1.1. *Effect after removing non-tradable industries*

In this subsection, we show that our results are not driven by certain industries, in particular construction and non-tradable firms. If the increase in house prices led to increased demand for construction services or local services (e.g., local retail or restaurants), it could have resulted in an increase in new firms in these industries (e.g., more remodeling and new housing construction, more dry cleaners). This would be a consequence of increased demand, not an effect of the collateral channel. We rerun our main specifications excluding all industries linked to the construction and non-tradable sectors as classified by Mian and Sufi (2014), as well as Finance, Insurance, and Real Estate firms (NAICS 52 and 53). We report these results in Table 3.

The direction and magnitude of the effects are virtually unchanged when we remove these sectors from the regressions. If the effect we measure were driven largely by a local demand shock (instead of the collateral channel), we would expect the coefficient to be significantly affected when we remove from the sample the sectors that are most sensitive to local demand (Columns 1–3 of Table 3).

In the last two columns of Table 3, we limit the regressions to the manufacturing sector. These industries are the least likely to be affected by local demand. At the same time, however, they typically require significant

start-up capital, which makes it harder to find the effect of the collateral channel using our experiment. Still, we find that small firms created more employment relative to large firms in 2002–2007 in areas where housing prices rose more (Columns 4 and 5 of Table 3). The effect is similar in magnitude for establishments of one to four employees, five to nine, and ten to 19, but it is statistically significant only at conventional levels for the smallest size category. We know that, on average, firms in the manufacturing sector lost jobs during this period, and the coefficient on the largest firms suggests that they lost more jobs in places where house prices rose more (coefficient is −0.16). When we combine this effect with the coefficient on the small firms, this implies that access to collateral allowed the smallest firms to preserve employment. Meanwhile, the largest firms were losing jobs during this period. This confirms that a simple demand-side story is not driving our results and confirms the importance of the collateral channel for the creation of smaller establishments in the period 2002–2007.

In Table 4, we perform an additional test for manufacturing industries. In this test, we split industries based on the average distance of shipments in each three-digit NAICS industry and state. This addresses further the concern that local demand shocks could be driving the results for manufacturing firms. Table 4 shows that the result for manufacturing in Table 3 is driven by firms in industries and states that ship goods across large distances. The median reported distance in the sample is six hundred miles, so firms that report shipping goods more than six hundred miles are unlikely to make decisions as a function of local demand shocks (details on the distances shipped by firms in each industry and state are in Online Appendix Table A6).

One possible concern with the test using distances is that small firms in a given sector could be very different from large firms, so the small firms in those industries could depend more on local demand. Although we do not have shipment data by firm, in Online Appendix Table A7 we consider the relation between the reported distance shipped in a given state and industry cell and the share of small businesses in that cell. We use the same distance measure from before and separately compute the share of employment in establishments that have 50 or more employees for each state and three-digit NAICS manufacturing industry. Then, for each industry, we compute the average (over all states) of the distance shipped, as well as the average share of employees in firms that have 50 or more employees. Finally, for each state and industry observation, we compute the deviation from the industry mean for both measures and classify observations into deciles based on these deviations.[10] The table shows that no visible relation exists between the distance shipped and the share of employees at large firms versus small firms. In particular, considerable heterogeneity is evident across industries in the fraction of small firms and the distance shipped. This should mitigate the concern that a strong positive relation between firm size and distance shipped could explain the results in Table 4.

Our measure of growth of establishments by size category does not allow us to observe the creation and destruction of establishments directly, so in a separate set of regressions shown in online Table A8 we use the Statistics of US Businesses from the census to look at births and deaths of establishments at the two-digit NAICS industry level. The disadvantage of this data set is that it does not include the breakdown of establishments by employment size. Given that an overwhelming percentage of new businesses are very small (Haltiwanger, Jarmin, and Miranda, 2013; Robb and Robinson, 2013), 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 and that the result holds when we consider the net creation of establishments (i.e., births minus deaths). The coefficient is unchanged when we include two-digit NAICS fixed effects (the finest industry category available in this data set at a county level).

3.1.2. *Magnitude of the collateral effect relative to previous work*

One way to give a rough estimate of the importance of the collateral lending channel is to compare the magnitude of the employment gains that can be attributed to this channel with those that can be assigned to the demand channel shown in Mian and Sufi (2014). 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 industries are most likely to be affected by a drop in local demand due to overleveraged 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.

We perform essentially the same calculations for the period 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 2002–2007. That regression is shown in Column 3 of Table 5. If we aggregate in the same way as described above (where the baseline employment is now as of 2002), we obtain an increase in employment in the non-tradable sector of 451.8,000 jobs, which, given a share of employment in this sector of 18.4% in 2002, translates into a predicted total job gain due to increased aggregate demand of 2.452 million jobs. This is about 40% of the jobs created in the private sector in the 660 counties used for the calculation. The confidence interval for this estimation is very large and includes zero, which opens the possibility that the aggregate demand effect for the period before the crisis could be small. This is in sharp

[10] So, state-industry observations that are in the first decile of the distance are those that ship goods at short distances relative to the industry average. Similarly, those in the first decile of the share of employment at large firms are state-industry observations that have few employees in large firms relative to the industry average.

[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.

Table 3
Employment growth and house prices: excluding construction, non-tradable, and finance 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, four-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 four-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 also excludes finance, insurance, and real estate-related industries (NAICS codes 52 and 53), Column 4 includes only manufacturing industries (NAICS 31–33), and Column 5 has manufacturing industries that are classified as tradable in Mian and Sufi (2014). 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.

	Drop construction	Drop const. and non-trad.	Drop const., non-Trad. and F.I.R.E.	Manufacturing	Manufacturing (tradable)
Growth in House Prices	−0.09	−0.12	−0.14	−0.17	−0.16
	(0.10)	(0.10)	(0.10)	(0.11)	(0.12)
Growth in House Prices∗ 1–4 Employees	0.27***	0.32***	0.35***	0.13*	0.15*
	(0.09)	(0.09)	(0.10)	(0.07)	(0.09)
Growth in House Prices∗5–9 Employees	0.19*	0.21*	0.24**	0.12	0.10
	(0.10)	(0.11)	(0.11)	(0.08)	(0.09)
Growth in House Prices∗10–19 Employees	0.08	0.12	0.12	0.11	0.16
	(0.09)	(0.09)	(0.09)	(0.11)	(0.11)
Growth in House Prices∗20–49 Employees	0.08	0.12*	0.11*	0.01	−0.05
	(0.06)	(0.06)	(0.06)	(0.12)	(0.09)
Log of the Population	−0.04***	−0.04***	−0.04***	−0.02**	−0.02*
	(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)
Percent Employed (2000 Census)	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	−0.88***	−0.84***	−0.84***	−0.64**	−0.66**
	(0.22)	(0.23)	(0.24)	(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)	(0.00)	(0.00)
China Import Share in County (2005)	−0.11	−0.23	−0.28	−0.88*	−1.24**
	(0.34)	(0.36)	(0.36)	(0.50)	(0.56)
Controls	Y	Y	Y	Y	Y
4-Digit Industry Fixed Effects	Y	Y	Y	Y	Y
Number of Observations	325,349	264,901	242,510	55,345	44,649
R^2	0.29	0.30	0.31	0.02	0.02
Growth HP ∗1–4 E.=Growth HP∗5–9 E.	0.04**	0.02**	0.02**	0.95	0.48
Growth HP∗1–4 E.=Growth HP∗10–19 E.	0.00***	0.00***	0.00***	0.85	0.91
Growth HP∗1–4 E.=Growth HP∗ 20–49 E.	0.00***	0.00***	0.00***	0.33	0.10*

contrast to the estimates obtained by Mian and Sufi (2014) for the years after the crisis, when the same regression yields very strong effects for the drop in demand on non-tradable employment.

We now turn to the calculation of the magnitude of the collateral channel over the same period. We rely on the differential impact of house prices on employment creation at small firms relative to firms with 50 or more employees, and we focus on the specifications in which 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 10th percentile county), and then we aggregate to all counties. When we do that, we obtain an estimated total job gain in firms with fewer than 50 employees relative to those with 50 or more employees of 1.698 million jobs in all counties, or 27.8% of jobs created between 2002 and 2007. If we restrict our attention to the specification in which the demand explanation for our results is the least plausible, that is, the manufacturing sector and, in particular, firms in industries and states where the shipment distance is largest (Column 2 of Table 4), the same computation would yield an estimate of 676,000 jobs, or about 11% of jobs created in this period and subset of counties. Section A1 of the Online Appendix

Table 4
Breakdown of manufacturing industries by 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, four-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 four-digit NAICS fixed effects. The table splits industries and states based on the median of the shipment distance distribution (about 600 miles). 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 three-digit NAICS and state of origin level. 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 Dist. shipped < P50	**Manufacturing Dist. shipped > P50**
Growth in House Prices	−0.11	−0.29**
	(0.17)	(0.14)
Growth in House Prices∗1–4 Employees	0.07	0.21**
	(0.14)	(0.09)
Growth in House Prices∗5–9 Employees	0.11	0.20**
	(0.17)	(0.09)
Growth in House Prices∗10–19 Employees	−0.03	0.24**
	(0.17)	(0.11)
Growth in House Prices∗20–49 Employees	0.06	0.04
	(0.30)	(0.12)
Log of the Population	−0.02	−0.02*
	(0.02)	(0.01)
Percent College Educated	0.00	0.00
	(0.00)	(0.00)
Percent Employed (2000 Census)	0.00	0.00
	(0.00)	(0.00)
Workforce as a Percentage of Population	−0.42	−0.58*
	(0.36)	(0.32)
Percent of Homes Owner-occupied	0.00	0.00**
	(0.00)	(0.00)
China Import Share in County (2005)	−0.29	−1.21**
	(0.45)	(0.58)
Controls	Y	Y
4-Digit Industry Fixed Effects	Y	Y
Number of Observations	27,599	27,294
R^2	0.02	0.02
Growth HP∗1–4 E. = Growth HP∗5–9 E.	0.82	0.90
Growth HP∗1–4 E. = Growth HP∗ 10–19 E.	0.59	0.77
Growth HP ∗1–4 E. = Growth HP∗20–49 E.	0.96	0.13

describes the calculation we perform in more detail. We view this exercise as a useful 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 be important.

The magnitude we estimate above is likely to be a lower bound for the total importance of collateral for job creation for two reasons. First, our data do 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), Chakraborty, Goldstein, and MacKinlay (2013), and Cvijanovic (2013).

As an additional comparison to previous work, Charles, Hurst, and Notowidigdo (2013) suggest that the slowdown of manufacturing in the United States contributed about 2.1% to the increase of nonemployment in the United States. At the same time, the (temporary) boost in employment from the expansion of the construction sector reduced nonemployment by 0.9%. This means that the countervailing, positive effect of construction employment explains why the rise in nonemployment due to manufacturing between 2000 and 2007 was relatively moderate at 1.2%. The magnitude of this effect is, almost by construction, smaller than the effect of the collateral effect, because it applies only to non-college-educated men, whereas the collateral effect potentially affects all sectors in the economy, as well as a broad spectrum of education levels.

3.2. 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 housing price growth on net creation of proprietorships relative to all the establishment categories listed in the previous tables using the Saiz measure to instrument for exogenous movements in housing price changes. The first column of Table 6 uses employment data on sole proprietorships from the BEA, and the last three columns rely on census data on nonemployer establishments (which includes information on the two-digit NAICS sector in which the establishment operates). The coefficient on housing 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 one-to-four-employee category. In Column 2, we use census data 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 needed to start a business in a given industry. We find that the effect of home 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. However, the difference between

Table 5
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 (2014). 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
R^2	0.30	0.24	0.18	0.10	0.30	0.21

the coefficients in the two specifications (below and above median capital needs) is not statistically significant.

3.3. Crisis period (2007–2009)

One question that remains regarding the business establishments created as a consequence of the increasing value of collateral during the rise in house prices is whether these establishments were then eliminated after the housing bubble burst. In this subsection, we try to distinguish whether these newly created businesses were particularly fragile and were disproportionately affected by the crisis or whether they behaved like the rest of the firms in the economy.

Our data do not allow us to track individual establishments, so we cannot know whether the specific firms created in the period 2002–2007 survived the crisis. We can, however, test whether small establishments in general were more or less likely to downsize or disappear in the crisis, that is, 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 precrisis period [which are also the most leveraged counties, as shown in Mian and Sufi (2014)]. The results in Table 7 show that employment loss was similar across large and small establishments during the crisis period or, if anything, was a little worse at large firms (in the specifications without industry fixed effects) in counties where house prices increased by more. This suggests that, as a group, small firms were no more likely to destroy jobs as a consequence of the increased leverage accumulated during the precrisis period. This is consistent with the findings of Mian and Sufi (2014) regarding non-tradable industries for this period.

3.4. Migration

An additional consideration is the effect of house price changes on the net migration of people in and out of each county. We measure net migration as the difference between inflows and outflows of individuals at the county level. Table 8 shows county-level regressions of county-to-county net migration, as well also inflows and outflows separately, on house prices changes instrumented with the Saiz measure and the same county-level controls as the previous tables. The results on migration show no significant effect of the (instrumented) change in house prices on net migration. This masks stronger results when we break down the results by inflows and outflows. Counties that experience higher growth in house prices had larger outflows that were offset in part by somewhat bigger inflows of people at the same time. This alleviates the concern that low-elasticity counties experience high growth in demand due to large in-migration. If anything, the results seem to suggest the opposite. We cannot observe who is entering and who is migrating out of each county, so we cannot address the more detailed question of whether entrepreneurs were moving in as other individuals were moving out, but the aggregate trends suggest stronger outflows than inflows in the high-appreciation areas.

3.5. Credit conditions and elasticity of housing supply

3.5.1. Denial rates

One possible concern with the instrument we use is that the behavior of lenders in high- and low-elasticity areas during the precrisis period could have been different. Specifically, if it became easier to obtain credit in low-elasticity areas relative to high-elasticity areas during our sample

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 are obtained from the Bureau of Economic Analysis in Column 1 and from the census in Columns 2–4. 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
R^2	0.48	0.38	0.31	0.28

period for reasons unrelated to collateral availability, and if this drove the creation of new businesses, then the exclusion restriction for our instrument would be violated. One mechanism for such an effect could be that banks might become more lax on all their credit decisions because of the improvement of the quality of their mortgage portfolio due to higher house prices. Although the evidence points to commercial lending having become more difficult in places where house prices boomed (Chakraborty, Goldstein, and MacKinlay, 2013), making it unlikely that small business credit provision became easier because of stronger mortgage portfolios, we wish 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 that credit could have become more lax 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.[12] Using the yearly estimates, we compute the proportional change in denial rates between 2002 and 2007. We focus on loans used for purchasing homes because they are less sensitive to the issue of relationship lending or private lender information about the borrowers, or both, and therefore should better reflect the loosening of credit conditions.

Panel A of Table 9 shows that credit conditions tightened, not 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% in counties with low elasticity of housing supply, and they go down in high-elasticity areas by 1%, that is, credit loosened in those areas. The difference between the two types of counties is statistically significant at the 1% level. In addition, total volume of applications decreases by 1% in low-elasticity areas in comparison to the 10% increase in 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. Consistent with the summary statistics of Panel A, lower elasticity is associated with higher denial rates of loan applications, and these results are robust to different specification and controls.

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

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 five 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, show the results for the whole sample of firms (first the weighted least squares results and then the IV), and Columns 3–6 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)
Workforce as a Percentage of 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^2	0.12	0.09	0.07	0.03	0.13	0.14

Although the regressions condition on the applicant pool (thus the denial rate could mask riskier borrowers applying for loans), we control for debt-to-income in these regressions to account for changes in applicant types.

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.

3.5.2. *Credit amount—residential and commercial and industrial*

To confirm that the effect we estimate runs through the collateral channel, we focus on the two types of loans that are most often used to extract equity from a home to start a business, namely mortgages used for refinancing and home equity lines of credit. [13] Data on all refinancing mortgages originated in the United States come from the Home Mortgage Disclosure Act, and data on securitized HELOCs come from Blackbox Logic, a mortgage-level data set that covers securitized mortgages in the United States. We aggregate the loan-level observations at the MSA and compute the growth between 2002 and 2007 in each of these two types of loans.

Table 10 shows that both refinancings and HELOCs respond strongly to house price appreciation in an MSA in this period. In the first panel of Table 10, strong responses are found from both categories: the growth in total amount of loans for refinancing between 2002 and 2007 increases by 1.6% for each percentage point increase in house prices in an MSA. The total amount of (securitized) HELOCs grows by 1.7% for each percentage point increase in house prices.

A related question is whether banks increased commercial and industrial (C&I) lending during this period. To investigate this, we use data from Call Reports and assign all loans of a given bank to an MSA if more than 75% of a bank's deposits are in that MSA. The results are shown in Panel B of Table A10 in the Online Appendix. We find point estimates that are close to zero for all three loan amounts we consider (below 250,000, between 250,000 and 1 million, and above 1 million) for both the count of loans made and the amount of loans outstanding. This suggests that the increased use in housing collateral over our period does not go hand in hand with more C&I lending. In Table A11 of the Online Appendix we repeat this analysis on C&I loans using the bank-level approach of

[13] HMDA does not distinguish regular refinancing activity from cash-out refinances. To the best of our knowledge, no data exist on all HELOCs originated in the United States, only securitized HELOCs and those on banks' balance sheets.

Table 8
Total employment, unemployment, and migration.

The table shows two-stage least squares regressions at a county level of the 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. 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 nonmigrants (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.

	Net migration	Inflows	Outflows
Growth in House Prices	−0.16	0.19	0.34**
	(0.12)	(0.12)	(0.17)
Log of the Population	0.00	−0.07***	−0.07***
	(0.01)	(0.01)	(0.01)
Percent College Educated	0.00	0.01***	0.00***
	(0.00)	(0.00)	(0.00)
Percent Employed (2000 Census)	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
Workforce as a Percentage of Population	−0.01	−0.63*	−0.62**
	(0.19)	(0.34)	(0.26)
Percent of Homes Owner-occupied	0.00**	0.00***	−0.01***
	(0.00)	(0.00)	(0.00)
China Import Share in County (2005)	0.19	−1.08***	−1.27***
	(0.29)	(0.28)	(0.44)
Number of Observations	731	731	731
R^2		0.41	0.18

Table 9
Denial rates.

The table shows the relation 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 are 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, and 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

Table 9 (*continued*)

Panel B

		Denial rates			Volume	
		(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
R^2	0.30	0.58	0.55	0.09	0.42	0.26

Table 10
House price growth and origination of refinancing mortgages and HELOCs.

The table shows two-stage least squares regressions of growth between 2002 and 2007 in the amount of mortgages used for refinancing and growth in cash-out home equity lines of credit (HELOCs) on house price growth instrumented with the elasticity of housing supply. Each observation is at the MSA level. Data on mortgages for refinancing come from the Home Mortgage Disclosure Act (HMDA) data sets made available by the Federal Financial Institutions Examination Council. Data on securitized cash-out HELOCs come from Blackbox Logic. Individual loan-level observations in each data set are aggregated at the MSA level using census tract identifiers (HMDA) and zip codes (Blackbox). 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. 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 the MSA 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.

	Refinance (HMDA)	Cash-Out HELOC (Blackbox)
Growth in House Prices	1.603***	1.723***
	(0.227)	(0.595)
Controls	Y	Y
Number of Observations	260	215
R^2	0.69	0.2

Chakraborty, Goldstein, and MacKinlay (2013). Again, we do not find a significant positive reaction of C&I lending to house price growth. For a more detailed description of the data and methodology, please refer to the Online Appendix table. Overall, these results support the hypotheses that the increase in small business employment documented here was financed by loans against residential real estate (refinancing or HELOCs) and that banks may have even reduced C&I lending in favor of such loans.

4. Conclusion

Overall, the evidence we present identifies the causal effect of rising house prices in the creation of new small firms. Increased access 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 to starting a new business or self-employment. Our study is in line with recent survey evidence from the Federal Bank of New York that shows that access to capital is the top growth challenge for small firms in 2013; the most cited reason for not receiving credit is insufficient collateral; and the most used form of collateral for small businesses is personal real estate [in line also with the findings of Kleiner (2013)].[14] This implies that the effect we uncover is a collateral effect and not the result of changing household risk aversion due to increased wealth [as suggested by Kihlstrom and Laffont (1979)].

We show that the effect of house prices is concentrated in small firms only and has 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 in which 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.

Our results on the collateral effect on the upside (2002–2007) and after the crisis hit, paired with the results on the effect of demand on job creation, suggest an interesting asymmetry of these effects. Collateral was particularly important in explaining job creation when more collateral became available, but we observe no significant destruction when collateral became scarce. This is consistent with a bright side of bubbles [as suggested in Caballero, Farhi, and Hammour (2006), although the effect we emphasize is different]. In contrast, a drop in demand is a strong predictor of employment loss, but a similar shock on the upside (at least in the recent experience) does not seem as powerful in predicting where jobs would be created.

[14] The May 2013 Small Business Credit Survey is available at http://www.newyorkfed.org/smallbusiness/2013/.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.jfineco.2015.03.005.

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