# House Prices, Collateral and Self-Employment[1]

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**Abstract**

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

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## 1. Introduction

The house price boom and bust cycle over the last decade has featured prominently in explaining the low unemployment during the run-up in house prices and the high unemployment that followed the bust. The debate has focused on two primary explanations for the observed employment dynamics. One view is that the use of "houses as ATMs" drove consumer demand and created employment during the run-up in prices, and that employment suffered when aggregate demand dropped due to household deleveraging and falling house prices. See, for example, Mian and Sufi (2011a) or Romer (2011). Another view is that structural mismatches in the workforce (due to job losses in manufacturing) were masked by the increase in house prices and the rise in labor demand in the construction industry (Charles, Hurst and Notowidigdo, 2012; Kocherlakota, 2010).

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

Our paper is the first to look directly at shocks to the value of homes and consider the impact these shocks have on employment in small firms relative to large firms. In order to identify the causal effect of higher house prices we instrument for the growth in prices between 2002 and 2007 using the elasticity measure developed by Saiz (2010), which uses exogenous geographic and regulatory constraints to housing supply. The measure differentiates areas where an increase in housing demand translates into higher house prices and collateral value (areas where it is hard to build, i.e.

elasticity of housing supply is low) or into higher volume of houses built (high elasticity areas). 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 the study by Chaney, Sraer and Thesmar (2012), which looks at corporate investment decisions, or Mian and Sufi (2011b) who look at increases in consumption from household leverage.

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

While the result above supports the importance of the collateral channel for small business creation, there are two alternative hypotheses that must be ruled out as explaining our results. First, increasing house prices can drive local demand for goods (Campbell and Cocco, 2007) and, consequently, employment at non-tradable industries (Mian and Sufi, 2011a). To the extent that small firms may be more sensitive to changes in demand (Kashyap and Stein, 1994), the asymmetry in the results could reflect this increased demand rather than the collateral channel. The second alternative hypothesis comes from the fact that, by using housing and zoning restrictions for obtaining identification, we rely on cross sectional differences between high and low elasticity areas. This means that these areas could also vary along other dimensions, such as the level of economic vitality. For example, areas with low elasticity might not only see high house prices when demand for housing picks up, i.e. more available collateral, but they might also be the ones where more investment opportunities become available.

We devise a number of additional tests to meaningfully differentiate the impact of the collateral lending channel from these alternative hypotheses. First, we verify that the results are not driven by

changing industry composition: Even within industries, areas with increasing house prices saw stronger employment growth in smaller establishments. [2]

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

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

Third, we confirm that the results in our study are not driven by the non-tradable or the construction sectors. As pointed out above, if the relationship between house price increases and job creation in small firms was purely constrained to the non-tradable or construction sectors, one would be concerned that the results are not driven by changes in the collateral lending channel but by differences in local demand. However, our results are almost unchanged when we eliminate these sectors from the analysis, and they also hold for the manufacturing sector where products are easily tradable, and more strongly so for manufacturing firms with low external financing needs. The difference in employment creation between large and small firms is also particularly strong for industries where firms report shipping goods across long distances. This distinguishes these results from the work of Mian and Sufi (2011a), who show that areas where house prices increased most

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

also exhibited an increase in unemployment in non-tradable industries due to deleveraging and lower demand in the aftermath of 2008. Any change in output in the low elasticity areas must therefore be driven by changes on the input (production) side. This is the collateral lending channel.

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

Using a similar calculation as Mian and Sufi (2011a) we calculate the approximate contribution of the collateral lending channel to changes in overall employment in the pre-crisis period. Using this approach, the collateral channel can account for 10-25% of the increase in pre-crisis employment (depending on the assumptions we make about the reference group that best isolates the collateral effect), while the demand channel explains about 40% over the same time period. The two effects are mutually non-overlapping. 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.

Given the nature of our data and the experiment we consider we cannot appropriately estimate the effect of the collateral channel in the period after 2008. There are two reasons for this limitation. First, and most importantly, while the elasticity measure has a natural interpretation for positive housing demand shocks, it is not a meaningful source of variation in downturns. This asymmetry arises from the fact that an increase in housing demand translates either into higher house prices (inelastic areas) or an expansion of housing volume (elastic areas). However, this analogy does not hold on the downside, since a drop in housing demand does not lead to the destruction of housing stock and thus in both areas prices just go down. Second, the level of aggregation of our data does not allow us to track individual firms over time and thus we cannot see whether there is a differential effect for firms that were started during the house price run up or before this period.

Our study builds on a large micro literature that shows that credit constraints at the household level matter for the creation of new businesses (Evans and Jovanovic, 1989, Holtz-Eakin et al, 1994, Gentry and Hubbard, 2004, or Cagetti and De Nardi, 2006), although some authors have argued that this relationship is only present at the very top of the wealth distribution (Hurst and Lusardi, 2004).

At the same time, housing wealth in particular has been shown to be an important factor in the funding of business startups (Fan and White, 2003, Fairlie and Krashinsky, 2012, Fort, Haltiwanger, Jarmin and Miranda, 2012, Kleiner, 2013, Corradin and Popov, 2013, Schmalz, Sraer and Thesmar, 2013 for France and Black, de Meza and Jeffreys, 1996 and Kleiner, 2013 for the UK). Previous work has also found that bank credit is an important source of financing for small businesses (Petersen and Rajan, 1994; Robb and Robinson, 2012; Fracassi, Garmaise, Kogan and Natividad, 2013), and that entrepreneurs often have to provide personal guarantees when they obtain financing (Berger and Udell, 1998). More recently Greenstone and Mars (2012) 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 2007-2009 period.

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

## 2. Data and Empirical Methodology

### 2.1 Data Description

We obtain employment growth from the County Business Patterns (CBP) data set published by the U.S. Census Bureau. The CBP contains employment data by county, industry and establishment size (measured in number of employees) between 1998 until 2010 as of March of the reported year. We use the data at the 4-digit National American Industry Classification System (NAICS) level, broken down by county and establishment size to construct our main dependent variable of interest, the employment growth by establishment size between 2002 and 2007. The breakdown of establishments by the number of employees allows us to differentially estimate the effect of house price growth in the net creation of establishments of different sizes.[3]

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

We use five establishment categories in our regressions that are commonly used by the Census Bureau – establishments of 1 to 4 employees, 5 to 9 employees, 10 to 19 employees, 20 to 49 and more than 50 employees. All these categories are given by the CPB except for the last one, where we aggregate all establishments of more than 50 employees. The CBP has multiple categories above 50 employees, but using each one individually would only add noise to our estimation, as they become rare at the county level, and even more so at the county and industry level, which we need for some of the specifications discussed below. In order to create the category of establishments with more than 50 employees we take the number of establishments in each category above 50 and multiply those by the midpoint of the category (for example, for the category of 100 to 249 employees we multiply the number of establishments by 174.5), and then we add all of them up.

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

The use of MSA level house prices is consistent with our identification strategy. In order to identify the casual effect of house prices on small business creation we instrument house price growth between 2002 and 2007 with the measure of housing supply elasticity of Saiz (2010), which varies at the MSA level. The measure of the supply elasticity is constructed using geographical and local regulatory constraints to new construction. Areas where it is difficult to add new housing (due to geographic or regulatory restrictions) are classified as low elasticity and vice versa for areas where land is easily available. Low elasticity areas correlate strongly with steeper house price growth in the period of 2002 to 2007. This measure is available for 269 metropolitan statistical areas that we match to a total of 776 counties using the correspondence between MSAs and counties for the year 1999 provided by the Census Bureau.[4] Although employment growth and our other controls are available for a much larger sample of counties, all our regressions focus on the subset of counties for which we have the housing supply elasticity measure.

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

An important measure for our analysis is the amount of capital needed to start a firm, since these investment requirements might affect how much a given industry depends on the housing collateral channel. In order to construct this variable we use the Survey of Business Owners (SBO) Public Use Microdata Sample (PUMS). The SBO PUMS was created using responses from the 2007 SBO and provides access to survey data at a more detailed level than that of the previously published SBO results. The SBO PUMS is designed to study entrepreneurial activity by surveying a random sample of businesses selected from a list of all firms operating during 2007 with receipts of $1,000 or more provided by the IRS. The survey provides business characteristics such as firm size, employer-paid benefits, minority- and women-ownership, access to capital and firm age. For the purposes of this paper we focus on the "Amount of start-up or acquisition capital" for each firm and we group the answers to this question at the 2-digit NAICS industry level (the finest level available in the data) for firms established in 2007. The classification is virtually identical if we use all years in the data or if we focus on 1-4 employee firms only. The median amount of capital needed to start a business in the data is 215 thousand dollars. We follow Hurst and Lusardi (2004) and split industries above and below the median to measure the differential effect of the collateral channel on business creation for industries in the two groups. The average amount of capital needed by firms below the median is 132 thousand dollars, whereas the average amount needed for industries above the median is 260 thousand dollars (detailed amounts by 2-digit NAICS sector are in Appendix Table A6).

Our classification of "non-tradable", "tradable" and "construction" industries at the 4-digict NAICS level is obtained from Table 2 of the Appendix to Mian and Sufi (2011a).[5] Non-tradable codes are mostly included in the 44 and 45 sectors (Retail Trade), as well as under 72 (Accommodation and food services). Construction industries include most codes under the Construction 2-digit NAICS sector (23), as well as some subsectors in manufacturing, retail trade and services that are directly connected to construction (e.g., 3273 – Cement and Concrete Products Manufacturing). Manufacturing industries include all 31-33 subsectors (Manufacturing), and in some specifications we restrict the sample to manufacturing industries that are also classified as "tradable" in Mian and Sufi (2011a) (i.e. those not in construction or in "other industries").

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

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

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

In order to further address the concern that the results might be driven by local demand, we construct a measure of the average distance that firms in an industry ship their goods similar to what is used in Duranton, Morrow and Turner (2013). This data is available from the 2007 Census Commodity Flow Survey and it reports the distance traveled by shipments of a sample of establishments in each 3-digit NAICS manufacturing industry.[6] The unit of observation in the Census data is at the state and industry level, so we construct a dollar-weighted average distance of shipments also for each state and industry individually. Summary Statistics of the average distance shipped, as well as the frequency with which each industry appears in each decile, are shown in Table A5.

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

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

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

Proprietorship employment at a 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 of 2002 to 2007 at the 2-digit NAICS level. We use both sources of data in the regressions to ensure the robustness of our results.

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

The migrations data is extracted from the IRS county to county migration data series. The migration estimates are based on year-to-year address changes reported on individual income tax returns filed with the IRS. The dataset presents migration patterns by county for the entire United States and is split by inflows – the number of new residents who moved to a county and where they migrated from – and outflows – the number of residents leaving a county and where they went.[7] We also compute net flows as inflows minus outflows and we scale all figures by the number of non-movers in the county. The data is available from 1991 through 2009 filling years.

To better identify the effect of house prices on self-employment we include a set of controls that capture some of the cross-sectional differences across counties. We use county level information from the Census Bureau Summary Files for 2000 on: the number of households in a county; the natural logarithm of county-level population; the percentage of college educated individuals defined as the number of people over 25 with a bachelor degree or higher as a proportion of the total population over 25 years old; the percentage of employed people, defined as the employed population over the total population 16 years old or older; the share of the population in the workforce, defined as the total population in the civilian labor force over 16 year old divided by the total population 16 years old or older; the percentage of owner occupied houses; and a measure of exposure of each county to imports from china[8], and therefore, better control for changes in investment opportunities in those counties

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

[8] 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

### 2.2. Summary Statistics

Panel A of Table 1 provides descriptive statistics for our data set: The first row shows total employment in 2002 for all counties in our sample, as well as the employment growth between 2002 and 2007 estimated from the CBP data. Our data includes a total of 775 counties with non-missing total employment data. 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. We see that counties with low supply elasticity are larger but have similar unemployment rates as of 2002 as those with high supply elasticity. The characteristics as of 2002 from the census are broadly similar for the two groups, with the one exception being the percentage of college educated people (that is somewhat higher in low elasticity areas). Average household income is also higher in those counties, but the difference is economically small (about 10 percent of the mean). As expected, counties with low elasticity of housing supply experienced much stronger growth in house prices than did counties with 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, 2011a).

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

### 2.3. Empirical Model

This paper aims to test whether increases in real estate prices affect the growth in employment by facilitating the creation of small businesses (collateral channel). To differentiate the collateral channel from a pure (expansionary) demand shock, we look at the differential effect of house prices on the

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

net creation of establishments in different size categories.[9] 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, while it is likely to have no effect on the creation of larger establishments since these firms cannot be started with capital that can be extracted from a house.

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

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

establishment category and take the growth in total number of employees as the dependent variable. We then run two-stage least squares regressions of the type:

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

We index counties by *j* and establishment size categories by *i*. $\Delta^{02-07} Employment_{i,j}$ is the change in employment for establishment size category *i* in county *j* between 2002 and 2007. Similarly, $\Delta HP_j^{02-07}$ is the growth in house prices at the county level for the same time period where, as we discuss above, we instrument for the growth in house prices using the housing supply elasticity of 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 $\beta_3$ is the coefficient of interest in our regressions. In particular, the test we are interested in is whether the coefficient for the smallest establishments is larger (and positive) than those of the larger categories, which would confirm that house prices had a stronger impact on the creation of small establishments. $X_j$ is a set of county level controls that include the size of the county, the percentage of the population with a bachelor degree or higher, the percentage of the population that is employed, the percentage of the population in the labor force, the percentage of owner occupied houses, and the county share of china imports. Standard errors in this specification are heteroskedasticity robust and clustered at the MSA level (given that the variation in the instrument we use is at this level as well) and all regressions are weighted by the number of households in a county as of 2000 as in Mian and Sufi (2011a).

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

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

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

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

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

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 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. As before, we run two-stage least squares regressions of the form:

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

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.[10]

## 3. Empirical Results

### 3.1. House Prices and Employment at Small Establishments

Our central hypothesis is that the availability of more valuable collateral (in our case through increased real estate prices) in the period before the financial crisis has an effect on the creation of small firms or on self-employment, since it provided individuals with easier access to startup capital. As a result we should see a sharper increase in self-employment and employment in small businesses in areas that had steeper house price appreciation. We also expect this effect to be concentrated in firms in the smaller size categories, since large firms cannot finance themselves using home equity. This hypothesis is tested in Table 2, where we run two-stage least squares regressions of the growth in employment between 2002 and 2007 on 5 different establishment size categories, and their interaction with house price growth in the same period. The instrument for house price growth, as we discuss above, is the Saiz (2010) measure of housing supply elasticity. In the first column of Table 2 we show the first stage regression of house price growth on the Saiz measure of housing supply elasticity to confirm the validity of the instrument. The coefficient of -0.09 means that a one standard deviation increase in elasticity of housing supply is associated with an 11.7 percentage point lower growth in prices (for an average house price growth of 33.9 percent). The F statistic on this regression is 14.5 (above the conventional threshold of 10 for evaluating weak instruments). This reflects that metropolitan statistical areas with higher elasticity of supply experienced significantly lower house price growth between 2002 and 2007, in line with previous literature. In column (2) we

[10] 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.

run a regression of employment change between 2002 and 2007 on the change in house prices during the same time period. In this regression we do not instrument the change in house prices in order to show the raw correlation between house prices and employment. The effect is positive and economically large. A one standard deviation increase in house prices is associated with an increase in total employment of 3.95 percent over this period, for an average growth in employment of 10.6 percent. In the simple weighted least squares regression we see no distinction between the effect of house prices on small and large establishments. This result highlights the need for an instrument for our dependent variable of interest given the numerous factors that are likely to drive both employment creation and house prices (income growth, investment opportunities, etc.).

In column (3) of Table 2 we repeat the same regression but instrument the change in house prices with the Saiz measure for the elasticity of housing supply. We see that there is a positive but not significant causal relationship between county level employment change and house price growth on average, in contrast to the results in the previous column. However, when we look at the differential effect of instrumented house price changes, the increase in house prices has a significant and large positive effect on the small establishments but no significant effect on employment growth for big establishments (more than 50 employees). The coefficient on the interaction term between house price growth and the 1-4 employee size category shows that a 1 percentage point increase in house prices translates into a 0.19 percentage point increase in employment at these establishments relative to the largest ones. This translates into an increase in employment of 5.3 percentage points for a one standard deviation change in house prices, for an average change in employment at the smallest establishments of 9.4 percent (the effects of a one standard deviation change in house prices for each size category are shown in the appendix Table A3). Furthermore, the effect of collateral is monotonically decreasing with the size of the firm. For firms with more than 10 employees the effect is indistinguishable from that of the very largest firms. This is consistent with the collateral channel of house price appreciation being an important mechanism for small firm creation, since the amount of collateral that is provided by real estate appreciation is not be enough to start a larger firm. Also, these results suggest that the causal impact of house prices on employment growth during 2002 to 2007 did not work through increased demand, since in that case firms of all sizes (including the very large) should have been affected.

One concern with the above specification could be that the house prices change in areas with low Saiz housing elasticity induces a local demand shock that especially affects certain industries. If those

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

The third version of the instrumented regression is shown in column (5) of Table 2, where we use yearly observations on county level employment and construct a time-varying instrument by taking the product of the average conventional mortgage rate in the US and the Saiz elasticity measure. We then add county and year fixed effects to the regressions, and run the specification described in Section 2.3 above. The results are very consistent with the two previous specifications, with the same monotonically decreasing effect of house prices on employment at establishments of increasing size. We run the robustness specifications with the time varying instrument and county fixed effects to account for time invariant differences across regions that could be correlated with elasticity and new business starts. The fact that the results are consistent our main specification alleviates these concerns.

In order to confirm that the effect we estimated runs through the collateral channel, we test whether our estimated effect is stronger in industries that have lower start-up capital needs. We expect this to be the case given that the median total amount of home debt at its peak in 2006 for all US households was approximately 117 thousand dollars (Mian and Sufi, 2011b) and that only a fraction of this amount would be available for use in starting a business. Also, Adelino, Schoar and Severino (2012) show that the average value of a single family home during this period is approximately 309

thousand dollars and that most families obtain an 80 percent LTV loan. Even accounting for the fact that most entrepreneurs are over 35 years old, and that almost half are over 45 (Robb and Robinson, 2012), and so we expect them to have built home equity relative to the initial 80 percent LTV, it is not plausible to finance a very large amount of capital using home equity as collateral. Brown, Stein and Zafar (2013) show that the average amount of home equity lines of credit (HELOC) in the boom period is 2,623 dollars, with a standard deviation of 13,672 dollars. This implies that even homeowners who are two standard deviations above the mean have less than 30 thousand dollars in home equity loans. The paper also shows that the fourth quartile of homeowners in high house price appreciation areas has about 8,500 dollars in HELOC. These numbers are suggestive of the magnitude of funds that can be obtained from homes as collateral for he purpose of 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 Census Survey of Business Owner Public Microdata Survey by selecting the sample of new firms in each industry and averaging the amount of capital needed to start those firms.

We show the results split by the amount of start-up capital needed in each industry in columns 6 through 11 of Table 2. The results show that the effect of collateral on employment growth in small establishments is stronger for industries where the amount of capital needed to start a firm is lower (the average amount of start-up capital for industries below the median is approximately 132 thousand dollars). In fact, for this subset of industries the effect is statistically significantly different from that of the largest group even for establishments up to 49 employees, i.e. the causal effect of house prices extends to establishments other than the very smallest. When we include industry fixed effects only the coefficient on the smallest establishments is statistically different from zero. For the group of industries that require more start-up capital the effect of house prices on employment is smaller and only statistically significant for the very smallest group both with and without fixed effects. These results confirm that job creation at small businesses in response to house prices changes is strongest in industries with low startup capital needs that can reasonably be financed through loans on home equity. Notice that 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 a lot of capital. In fact, for firms that require large

amounts of capital we expect entrepreneurs to have to find additional sources of capital, and housing collateral is unlikely to be as important for the decision to start a firm.

### 3.1.1. Effect After Removing Non-Tradable Industries

In this subsection we document that our results are not driven by certain industries, in particular not by construction or non-tradable industries. One might be concerned that the increase in house prices led to an increase in demand for construction services or for local services (e.g. local retail or restaurants) and thus new firms got started in these industries because of that (e.g. more remodeling and new housing construction, more dry-cleaners, etc.). This would be a consequence of increased demand rather than an effect through the collateral channel. We re-run our main specifications excluding all industries linked to either construction or the non-tradable industries as classified by Mian and Sufi (2011a), as well as Finance, Insurance and Real Estate firms (NAICS 52 and 53). We report these results in Table 3.

The first takeaway from Table 3 is that the direction and magnitude of the effects are virtually unchanged when we remove these sectors from the regressions. If the effect we measure was mostly driven 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 through 3 of Table 3).

In the last two columns of Table 3 we limit the regressions to the manufacturing sector. The reason for doing this is that these industries are the least likely to be affected by local demand. At the same time, however, they typically require significant amounts of 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 the period of 2002 to 2007 in places where house prices went up more (columns 4 and 5 of Table 3). The effect is similar in magnitude for establishments of 1 to 4 employees, 5 to 9 and 10 to 19, but it is only statistically significant 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 went up 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, whereas 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 between 2002 and 2007.

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

The next test in Table 4 splits the sample of county-industries by the distance at which firms in each 3-digit NAICS manufacturing industry and state ship their goods. This helps further address the concern that local demand shocks might be driving the results for manufacturing firms. The last two columns of Table 4 show that the result for manufacturing shown 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 600 miles, so firms that report shipping goods over more than 600 miles are unlikely to make decisions as a function of local demand shocks (detail on the distances shipped by firms in each industry and state are in Appendix Table A7).

One possible concern with the test using distances is that small firms in a given sector may be very different from large firms, so it is possible that the small firms in those industries might depend more on local demand. While we do not have shipment data by firm, in Table A8 we consider the relationship 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 more than 50 employees for each state and 3-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 more than 50 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.[11] The takeaway from this table is that there is no visible relationship between the distance shipped and the share of employees at large firms versus small firms. In particular, there is a lot of heterogeneity across industries in the fraction of small firms and the distance shipped. This should mitigate the concern that a strong positive relationship between firm size and distance shipped might explain the results in the last two columns of Table 4.

### 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 channel is to compare the magnitude of the employment gains that can be attributed to this channel to those that can be assigned to the demand channel shown in Mian and Sufi (2011a). To do so, we follow the same calculation used in that paper to aggregate the effect across all counties. The authors compute the effect of debt-to-income (DTI) ratios as of the beginning of the crisis on the employment change between 2007 and 2009 in non-tradable industries.[12] These are the industries that are most likely to be affected by a drop in local demand due to over-levered households. They aggregate this effect by computing the predicted change in employment in non-tradable industries and then extrapolating this effect to the rest of the economy.[13]

We perform essentially the same calculations for the period of 2002-2007 to establish a benchmark employment effect that can be attributed to the demand channel. We start by obtaining the effect of a change in house prices on employment in the non-tradable industries at a county level for the 2002-2007 period. That regression is shown in Table A5 in column 3. If we aggregate in the same way as described above (where now the baseline employment is as of 2002) we obtain an increase in

[11] 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.

[12] 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.

[13] This is done in four steps. First, the authors compute the county-level predicted change in employment in non-tradable industries by multiplying the regression coefficient by the independent variable in each county (in this case the DTI) and subtracting the predicted change in the 10$^{th}$ percentile county (to avoid being affected by outliers at the bottom of the distribution).[13] Second, they multiply the predicted county-level change by the non-tradable employment in the county as of the beginning of the period to obtain a predicted change in employment in terms of numbers of workers for each county. Third, the authors sum up the predicted changes across all counties, to obtain an economy-wide predicted change in the non-tradable sector (in their case, a total of 769 thousand jobs). Fourth and finally, they divide this number by the share of total employment in the economy represented by the non-tradable sector (19.6%), which then yields a total predicted loss in employment due to the aggregate demand shock of approximately 6 million jobs.

employment in the non-tradable sector of 451.8 thousand jobs which, given a share of employment in this sector of 18.4% as of 2002, translates into a predicted total job gain due to increased aggregate demand of 2.452 million jobs. This is about 40 percent of the jobs created in the private sector in the 660 counties used for the calculation.

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

The magnitude we estimate above is a lower bound for the total importance of collateral for job creation for a couple of reasons. First, our data does not allow us to track firms over time, so if a firm grows to become very large we do not attribute the employment creation of that firm to our effect (it would be in the 50+ category that we use as our baseline). Second, we are focusing on the importance of this channel for very small firms. This ignores the role that collateral value plays for larger firms, as pointed out in Chaney, Sraer and Thesmar (2012), Cvijanovic (2013) and Chakraborty, Goldstein and MacKinlay (2013).

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

### 3.2. Births and Deaths of Establishments

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

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

### 3.3. Sole Proprietorships

We now expand our analysis to include the creation of businesses without employees, also called sole proprietorships or nonemployer businesses. Table 6 shows the effect of house price growth on net creation of proprietorships relative to all the establishment categories that we have in the previous tables using the Saiz measure to instrument for exogenous movements in house price changes. The first column in this table uses employment data on sole proprietorships from the Bureau of Economic Analysis, while the last three columns rely on data on nonemployer establishments from the Census (which includes information on the 2 digit NAICS sector in which the establishment operates). The coefficient on house price growth in Column (1) interacted with the sole proprietorship category is significantly different from that on the largest establishments and close in magnitude to that on the 1-4 employee category. In Column (2) we use data from the

Census and find a smaller coefficient on the sole proprietorships and we cannot distinguish that coefficient from the others in the regression.

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

### 3.4. Total Employment and Migration

We finally want to consider the effect of house price changes on total employment as measured in the County Business Pattern (CBP). Columns (1) and (2) of Table 7 show county level regressions of change in Total Employment on house prices changes instrumented with the Saiz measure. Column (2) includes a number of county level controls such as population size, average educational attainment, and unemployment rate in the pre-period. We find that house price growth had no causal effect on total employment: the coefficient on house price changes is close to zero and insignificant in either of the specifications. In contrast, when we repeat the same regression set up using the level of unemployment as the dependent variable in Columns (3) and (4) of Table 7, we find a significant and negative relationship both with and without controls. Finally, in Columns (5) and (6) we show that house price changes also had a negative impact on the unemployment *rate*:, consistent with the results of Charles, Hurst and Notowidigdo (2012). How can the negative effect on unemployment be reconciled with no changes in total employment? Our results suggest that the decrease in unemployment captures the transition of some agents in the labor force from being job seekers to a self-employment status. However, these people are not observed in the total employment measure, since the CBP data does not include non-employee firms (sole proprietorships).

Finally we also look at the net migration of people in and out of the county. We measure net migration as the difference between inflows and outflows at the county level. We repeat the same regression set up in Column (7) and (8) to estimate the effect of house appreciation on county to

county migration and find that higher house prices caused a net out-migration from the counties with high house price appreciation. In unreported regressions we confirm that this was produced by larger outflows than inflows into those counties. This evidence is consistent with the idea that house prices affected the composition of households in each county and, therefore, indirectly affected the labor market dynamics.

### 3.5. Credit Conditions and Elasticity of Housing Supply

One possible concern with the instrument we use is that the behavior of lenders in high and low elasticity areas during our time frame was different. Specifically, if it became easier to obtain credit in low elasticity areas relative to high elasticity areas during our sample period for reasons unrelated to collateral availability, and if this drove the creation of new businesses, this would violate the exclusion restriction for our instrument. One mechanism for such an effect would be that banks might become laxer on all their credit decisions because of the improvement on the quality of their mortgage portfolio due to higher house prices. While the existing evidence points to commercial lending having become more difficult in places where house prices boomed (Chakraborty, Goldstein and MacKinlay, 2013), and so it is unlikely that small business credit provision became easier because of stronger mortgage portfolios, we want to address this concern directly.

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

We consider the number of applications that are denied by financial institutions as a proportion of the total loan applications in a county and in a year.[14] Using the yearly estimates we compute the proportional change in denial rates between 2002 and 2007. We focus on loans used for purchasing homes as they are less sensitive to the issue of relationship lending and/or private lender

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

information about the borrower, and therefore should better reflect the loosening of credit conditions.

Panel A of Table 8 shows that credit conditions tightened rather than loosened in low elasticity areas (those below median elasticity in the sample) when we use this measure of credit supply. Denial rates increased by about 2 percentage points in counties with low elasticity of housing supply, whereas they go down in high elasticity areas by one percentage points, i.e. credit loosened in those areas. The difference between the two types of counties is statistically significant at the one percent level. Additionally, total volume of applications decreases by one percent in low elasticity areas in comparison to the 10 percent increase in the high elasticity areas.

We formally test these differences in a regression framework using a continuous elasticity measure as our independent variable. Panel B of Table 8 shows the results of those regressions. Consistent with the summary statistics of Panel A, we find that lower elasticity if associated with higher denial rates of loan applications and these results are robust to different specification and controls. While the regressions condition on the applicant pool (and so the denial rate could mask riskier borrowers applying for loans), we control for the 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.

## 4. Conclusion

Overall, the evidence we present in this paper identifies the causal effect house prices in the creation of new small firms. These results show that access to collateral allowed individuals to start small businesses or to become self-employed. We conjecture that without access to this collateral in the form of real estate assets, many individuals would not have made the transition to starting a new business or self-employment. Our study is in line with recent survey evidence from the NY Fed[15] that shows that: (i) access to capital is the top growth challenge for small firms in 2013; (ii) the most cited reason for not receiving credit is insufficient collateral; and (iii) that the most used form of collateral for small businesses is personal real estate (in line also with the findings of Kleiner, 2013).

[15] Small Business Credit Survey, May 2013, Federal Reserve Bank of New York, available at http://www.newyorkfed.org/smallbusiness/2013/

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

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## Table 1. Summary Statistics

Panel A reports summary statistics for all counties in the sample in Column 1, and Columns 2 and 3 show the summary statistics for counties above and below the median elasticity of housing supply in the sample. For each variable we show the pooled average, median (italicized) and standard deviation (in parenthesis). The last column shows the t-statistic for the difference in means of the two groups, adjusted for clustering at the Metropolital 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 2007at 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*

| | 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*

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

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

The table shows two-stage least squares regressions of employment growth on house price growth instrumented with the elasticity of housing supply, indicator variables for each establishment size (not shown in the table) and interactions of house price growth with the size of establishments. All regressions are weighted by the number of households in a county as of 2000. Employment growth is the percentage change in employment between 2002 and 2007 estimated using County Business Patterns (CBP) data. Growth in House prices is the percentage change between 2002 and 2007, and each interaction is with a dummy indicator for the size of the establishment. Column 1 shows the first stage regression of the change in house prices between 2002 and 2007 on the Saiz elasticity measure. Columns 2 through 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 through 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.

| | | All Industries | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | First Stage | (WLS) | All Industries (IV) | | | Start-up Capital < P50 (IV) | | | Start-up Capital > P50 (IV) | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (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 |
| R2 | 0.30 | 0.27 | 0.22 | 0.30 | 0.02 | 0.21 | 0.39 | 0.00 | 0.14 | 0.10 | 0.03 |

## 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, 4-digit NAICS industry, and establishment size level. All regressions are weighted by the number of households in a county as of 2000. House Price Growth is instrumented using the Saiz (2010) measure of elasticity of housing supply at an MSA level. Employment growth is the percentage change in employment between 2002 and 2007 estimated using County Business Patterns (CBP) data. Growth in House prices is the percentage change between 2002 and 2007, and each interaction is with a dummy indicator for the size of the establishment. All regressions include 4-digit industry fixed effects. Column 1 shows the results when we exclude construction industries, column 2 excludes both construction and non-tradable industries, column 3 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 (2011a). All regressions control for the natural logarithm of population, the percentage of the population with a college degree, the percentage of the labor force that is employed, the share of the population in the workforce, and the percentage of homes that are owner-occupied. All controls are at a county level for the year 2000 and are obtained using Census Bureau Data Summary Files. Standard errors are in parenthesis and are clustered by MSA. *, **, *** denote statistical significance at the 10, 5, and 1% levels, respectively.

| | **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 |
| R2 | 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* |

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

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

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

## Table 5. House Price Growth and Creation of Establishments

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

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

## Table 6. Proprietorships and House Price Appreciation

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

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

## Table 7. Total Employment, Unemployment and Migration

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

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

## Table 8. Denial Rates

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

*Panel A*

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

*Panel B*

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

## Appendix Tables – Online Appendix

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

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

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

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

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

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

**Table A3. Effect of one standard deviation change in the independent variable**

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

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

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

*Panel A: Summary Statistics*

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

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

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

## Table A5. Employment and House Price Appreciation across Industry Types

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

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

## Table A6. Detail on Average Start-Up Amount by 2-digit NAICS Sector

The table shows the average start-up amount by 2-digit NAICS sector used in Tables 2 and 3 in the paper. Data is from the Survey of Business Owners (SBO) Public Use Microdata Sample (PUMS) using responses to the question about "Amount of start-up or acquisition capital" for each firm with employees in the 2007 survey year.

| Industry | NAICS2 | Average Start-Up Amount (USD) | Above/Below Median |
|---|---|---|---|
| Agriculture, Forestry, Fishing and Hunting | 11 | 146,033 | 0 |
| Mining, Quarrying, and Oil and Gas Extraction | 21 | 673,609 | 1 |
| Utilities | 22 | 601,149 | 1 |
| Construction | 23 | 78,372 | 0 |
| Manufacturing | 31 | 363,166 | 1 |
| Wholesale Trade | 42 | 188,085 | 0 |
| Retail Trade | 44 | 216,302 | 1 |
| Transportation and Warehousing | 48 | 131,893 | 0 |
| Information | 51 | 236,126 | 1 |
| Finance and Insurance | 52 | 203,799 | 0 |
| Real Estate and Rental and Leasing | 53 | 220,691 | 1 |
| Professional, Scientific, and Technical Services | 54 | 87,879 | 0 |
| Management of Companies and Enterprises | 55 | 488,681 | 1 |
| Admin. and Supp. and Waste Mgmt and Remediation Svcs | 56 | 91,278 | 0 |
| Educational Services | 61 | 156,893 | 0 |
| Health Care and Social Assistance | 62 | 214,889 | 0 |
| Arts, Entertainment, and Recreation | 71 | 218,061 | 1 |
| Accommodation and Food Services | 72 | 273,186 | 1 |
| Other Services (except Public Administration) | 81 | 161,995 | 0 |

## Table A7. Detail on Distance Shipped by Industry and State (Manufacturing)

The table shows the frequency with which each 3-digict NAICS manufacturing industry is present in each industry-state decile in terms of value-weighted distance shipped. Data is from the 2007 Census Commodity Flow Survey and it reports the distance traveled by shipments of a sample of establishments in each 3-digit NAICS manufacturing industry in each state.

| | | Industry-State Deciles | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NAICS | Description | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 311 | Food Manuf. | 1 | 2 | 7 | 10 | 13 | 2 | 6 | 4 | 4 | 1 |
| 312 | Beverage & Tobacco Product Manuf. | 15 | 16 | 8 | 3 | | | 2 | 1 | 2 | |
| 313 | Textile Mills | 2 | 1 | 4 | 4 | 3 | 6 | 5 | | 8 | 3 |
| 314 | Textile Product Mills | 3 | 2 | 8 | 2 | 3 | 4 | 4 | 4 | 6 | 7 |
| 315 | Apparel Manuf. | 1 | 1 | 2 | 1 | 3 | | 4 | 5 | 3 | 4 |
| 316 | Leather & Allied Product Manuf. | 1 | | 2 | | | 3 | 2 | 2 | 3 | 11 |
| 321 | Wood Product Manuf. | 8 | 12 | 13 | 4 | 4 | 3 | | 2 | 3 | 1 |
| 322 | Paper Manuf. | 2 | 3 | 7 | 9 | 6 | 8 | 6 | 3 | 3 | 1 |
| 323 | Printing & Related Support Activities | 5 | 11 | 5 | 13 | 5 | 2 | 6 | 1 | 1 | 1 |
| 324 | Petroleum & Coal Products Manuf. | 27 | 10 | 4 | | 2 | 1 | | | | 1 |
| 325 | Chemical Manuf. | | 1 | 1 | 2 | 11 | 9 | 8 | 4 | 6 | 7 |
| 326 | Plastics & Rubber Products Manuf. | 1 | 1 | 3 | 7 | 8 | 12 | 8 | 8 | 2 | |
| 327 | Nonmetallic Mineral Product Manuf. | 16 | 20 | 12 | 3 | | | | | | |
| 331 | Primary Metal Manuf. | | 2 | 4 | 9 | 8 | 7 | 2 | 5 | 5 | 4 |
| 332 | Fabricated Metal Product Manuf. | 3 | 2 | 3 | 11 | 10 | 7 | 7 | 2 | 6 | |
| 333 | Machinery Manuf. | 1 | 1 | | | 1 | 7 | 7 | 12 | 10 | 9 |
| 334 | Computer & Electronic Product Manuf. | | 3 | 1 | 1 | 5 | 5 | 5 | 10 | 3 | 15 |
| 335 | Electrical Eq., App., & Component Manuf. | 2 | 1 | | 2 | | 5 | 5 | 6 | 15 | 10 |
| 336 | Transportation Equipment Manuf. | 2 | 4 | 1 | 3 | 6 | 6 | 2 | 10 | 4 | 9 |
| 337 | Furniture & Related Product Manuf. | 5 | 2 | 8 | 11 | 6 | 3 | 7 | 3 | 2 | 1 |
| 339 | Miscellaneous Manuf. | | | 2 | | 1 | 5 | 9 | 13 | 9 | 10 |

## Table A8. Distance shipped and share of employees at large establishments

This table uses the distance measure at the state and 3-digit NAICS manufacturing industry from the 2007 Census Commodity Flow Survey, and also the share of employment in establishments that have more than 50 employees for each state and 3-digit NAICS manufacturing industry. For each industry, we compute the average distance shipped, as well as the average share of employees in firms that have more than 50 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.

| Industry-Demeaned Fraction of Employees in >50 | Industry-Demeaned Distance Deciles | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Employee Establishments (2002), Deciles | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| **1** | 10 | 7 | 6 | 3 | 2 | 3 | 2 | 5 | 9 | 10 |
| **2** | 15 | 12 | 6 | 3 | 5 | 10 | 5 | 13 | 12 | 16 |
| **3** | 11 | 9 | 5 | 10 | 12 | 10 | 6 | 9 | 12 | 11 |
| **4** | 5 | 7 | 13 | 11 | 10 | 12 | 11 | 13 | 8 | 9 |
| **5** | 8 | 10 | 10 | 11 | 10 | 13 | 17 | 5 | 8 | 7 |
| **6** | 5 | 9 | 9 | 9 | 14 | 7 | 17 | 15 | 8 | 6 |
| **7** | 9 | 15 | 12 | 17 | 6 | 9 | 12 | 4 | 6 | 7 |
| **8** | 6 | 9 | 12 | 14 | 14 | 7 | 5 | 15 | 7 | 10 |
| **9** | 8 | 9 | 11 | 10 | 10 | 12 | 11 | 8 | 9 | 5 |
| **10** | 16 | 5 | 9 | 4 | 9 | 10 | 6 | 6 | 13 | 11 |