# When the Going Gets Tough, the Rich Get Going: The Effects of Local Labor Demand Shocks on Migration *

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**Abstract**

This paper explores the role of house prices and wealth in mediating the relationship between worker mobility and adjustments to local labor demand shocks within the United States. Using a shift share measure of labor demand growth, I find that renters move out of declining areas at a higher rate than homeowners. The results also uncover spatial heterogeneity: homeowners in Metropolitan Statistical Areas (MSAs) where prices respond sharply to labor demand out-migrate 1.3 percentage points *less* than renters, while homeowners and renters in MSAs where house prices are non-reactive out-migrate at similar rates. This points towards "negative equity lock-in" being an important friction in a household's ability to react to local labor market conditions.

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# 1 Introduction

A consistent finding in the economic literature on geographic mobility is that there are differential trends in mobility across various groups (Bound and Holzer, 2000). Geographic mobility is important because it is often the channel through which households are able to respond to local labor market shocks. For instance, Blanchard and Katz (1992) make the case that most of the response inside states to labor demand shocks is through labor mobility rather than through job migration or job creation. They also document that the impact of these shocks fully dissipate only a decade from when they are felt. Bound and Holzer (2000) find that in fact, these rates of mobility are different for different groups of the population: blacks are less mobile than whites, and the effects of demand shifts on wages are most keenly felt by less experienced, less educated, and black workers. Given the long run decline in interstate migration explored in Kaplan and Schulhofer-Wohl (2017), it is important to study the mechanisms that might prevent people from responding to labor market shocks through mobility.

In theory, a (negative) shock to a local labor market induces workers to move out to a better job, which reduces local population and leads to a decline in housing demand. This causes house prices to fall, which implies that local labor demand shocks have an effect on the rent or user cost of both renters and homeowners. In other words, the wage decline due to the shock is somewhat compensated for by a rent decline – this is the "real wage effect" that is talked about in Moretti (2013). However, homeowners also face a second effect due to the fact that their housing wealth declines as well – I call this the "wealth effect" of local labor market shocks. Essentially, owners have to suffer capital losses in addition to decreases in real wage in the wake of a negative demand shock, which might affect their ability to adjust to local labor demand shocks.

In this paper, I quantify the extent of these wealth effects across the United States, investigating where and how these are important barriers to worker relocation after a labor market shock. First, I examine whether there are differences in the way homeowners react to labor market shocks compared to renters using a differences-in-differences strategy. By comparing owners to renters, I hope to "difference out" the real wage effect of local labor market shocks. Assuming that ownership is randomly assigned conditional on observables, the difference between owners and renters can be attributed to the "wealth effect".

It is important to note that I consider the migration decisions of households across Metropolitan Statistical Areas (MSAs) in the United States. I focus on these moves because they represent plausible channels for moves in response to labor market outcomes. For instance, a household is likely to move across MSAs to take a job, but might prefer to move within an MSA to keep a job but upgrade or downgrade on housing. The objective of the paper is focussed on the first effect, making across MSA moves a natural choice.

The data comes from the 2007-2017 biennial waves of the Panel Study of Income Dynamics (PSID). The survey follow families across time and contains data on homeownership, income, wealth portfolio, and demographics. Further, the restricted access version of the data also allows me to observe the location of the households over time. I merge the PSID data with a plausibly exogenous local employment shift-share shock that interacts employment shares in an area with national level growth rates (in the spirit of Bartik (1991)) based on the location of the individual. This local labor demand shock is constructed using data from the American Community Survey (ACS) available through the Integrated Public Use Micro Samples (IPUMS) webpage. The ACS identifies the MSA of the respondents only from 2005 onwards, which restricts my analysis to the years between 2007 and 2017.

I find that when considering all MSAs for which data is available, there are no significant differences between renters and owners. However, this masks substantial spatial heterogeneity. Specifically, I divide my sample into two groups and compare owners to renters within areas that have an inelastic housing supply (where price declines due to out-migration are likely to be large, leading to larger declines in wealth) and within areas with an elastic housing supply. The results indicate that in inelastic areas, homeowners move about 1.3 percentage points *less* than renters for a one standard deviation negative local labor demand shock. In elastic areas, the reactions of homeowners and renters are statistically indistinguishable. These results suggest that wealth effects matter, but the extent to which they do is not equal across areas within the United States.

Why are homeowners less reactive to local labor shocks in areas where price declines are higher? Since the part of the wealth of homeowners is, by definition, tied up in their home, larger price declines also lead to larger wealth declines for homeowners. The second part of the paper uncovers heterogeneous effects of the local labor shock based on the wealth holdings of a homeowner in inelastic MSAs. I find that when comparing homeowners to each other in these areas, those in the bottom quartile of the wealth distribution are the ones who are least responsive to the labor demand shock in terms of out-migration. The responsiveness of homeowners increases over the middle two quartiles, with owners in the third quartile of the wealth distribution moving 1.5 percentage points more than those in the first quartile. There is then a drop off in responsiveness for those in the top quartile of the wealth distribution. These results are consistent with there being fixed costs to mobility which the household must finance through their wealth holdings.

I also perform similar exercises using just the part of wealth that is tied up in housing, i.e. home equity, and the part that isn't (wealth holdings without equity). In both cases, the results go in the same direction, but the increase in responsiveness across quartiles is not significant. I take this as suggestive evidence that homeowners can use either part of their wealth to pay for the fixed costs to moving, meaning that looking at one part of wealth in isolation might not be enough to find evidence of mobility constraints.

Further, this heterogeneity is absent amongst homeowners who live in MSAs with a more elastic supply of housing, where house prices do not move around as much. This is consistent with the earlier results, since homeowners in these areas react similarly to renters for the same local labor demand shock.

Taken together, these findings illuminate the importance of housing wealth in mediating adjustments to local labor demand shocks, and speak to two strands of literature.

First, the mechanism of labor market shocks leading to house price declines has been studied extensively in the literature in the context of spatial equilibrium. Rosen (1979) and Roback (1982) analyze the optimal choice of location when areas differ by amenities, which in turn people have differing preferences over. Briefly, these papers show that places with low wages often have a high level of amenities to compensate, and vice versa. Spatial equilibrium models have been the foundation of many subsequent papers that also look at differences in wages and amenities across areas in order to get at inequality in real wages across the United States (Topel (1986), Moretti (2013), Diamond (2016), Notowidigdo (2011), Zabek (2017)).

For instance, Topel (1986) develops a dynamic spatial equilibrium model of local labor markets, and finds that wages are most flexible among groups that are least geographically mobile, while Notowidigdo (2011) finds that low-skill workers are less mobile because they are exposed to fewer adverse shocks, not because of mobility costs.

However, this literature has largely treated decreases in house prices that follow labor demand shocks as decreases in rent, while house price declines also mean that the wealth of homeowners decreases. My findings indicate that the fact that some of the people living in an area own their residence is quantitatively relevant in determining how they react to labor market shocks, and depends on how much house prices change in that area.

Second, the role of housing wealth in the migration decisions of individuals has been addressed in the literature on negative equity and housing "lock-in", which postulates that owners with negative equity might be unable to move for a variety of reasons: Oswald (1996) conjectures that this is due to homes being illiquid assets that are hard to sell, Engelhardt (2003) investigates whether nominal loss aversion might play a role, Andersson and Mayock (2014) investigate if default would induce underwater owners to move even more, and Demyanyk et al. (2017) consider downpayment constraints and fixed costs to moving. In general, these papers do not find evidence that negative equity makes households less mobile and if anything, households with negative equity are found to move slightly more than households that have lower leverage. However, few papers look directly at individual level wealth data to investigate how owners might react to a labor market shock.

I find that the relationship between housing wealth and mobility is hard to discern because homeowners can use either housing or non-housing wealth to finance the costs to moving. In other words, homeowners might be able to use non-housing wealth to "make up" for declines in housing wealth. This suggests that it is important to consider the total wealth holdings of a household when looking at mobility decisions instead of focusing purely on housing wealth. To the best of my knowledge, this is the first paper to study how a combination of non-housing and housing wealth can be used by owners to mitigate the negative effects of a labor demand shock that leads to house price declines.

The paper proceeds as follows: Section 2 describes the data sources, Section 3 presents some national level trends on across-MSA mobility that motivate the analysis in the paper, and section 4 talks about the empirical strategy used in the paper. Section 5 discusses the results, and Section 6 concludes.

# 2 Data

## 2.1 Panel Study of Income Dynamics (PSID)

The Panel Study of Income Dynamics (PSID) is a survey that began in 1968, and in 2017 collected data for about 9,000 households. It asks interviewees detailed questions about housing, wealth, employment, and mobility and follows families across years.

This is the primary source of data for this paper. The richness of the PSID makes it particularly amenable to answering questions about wealth and mobility, since it contains details not only about (self-reported) home values, but also about the wealth portfolio of households. However, I only use data from the 2007 wave onwards. This is because while wealth data is available biennially until 1999, the local labor demand shock I construct can only be constructed at a biennial frequency from 2007 onwards, as will be discussed in the next subsection.

Additionally, the PSID also collects information on the geographical area that the household resides in. Since they interview a household biennially, I have details about a household's location at that frequency as well. Specifically, I use Metropolitan Statistical Areas (MSAs) as my unit of analysis.

It is important to note that since I am interested in wealth and mobility, I only use data on reference persons in the PSID, or the heads of households. Therefore, all in this paper only apply to this group of people. I also consider only the working age population (ages 18-64), and only those who never reported being out of the labor force during my sample period from 2007-2017. Further, only MSAs that have more than thirty observations per year are used in the analysis. This means that I only use 84 of the largest Metropolitan Statistical Areas in my analysis.

I provide summary statistics for the key variables in my dataset for the entire sample in Table 1. All dollar values are in thousands of 2017 dollars, and inflation is accounted for using CPI-U.

## 2.2 American Community Survey (ACS)

Data aggregated at the Metropolitan Statistical Area comes from the 2007-2017 1% Census individual-level and household-level extracts from the American Community Survey (ACS) made available through IPUMS. The data is limited to include only households living and working in metropolitan areas, and is used to construct the shift-share shock by using the industry categories of the individuals in the labor force.[1] This data is aggregated at the MSA level to get local employment shares and national level employment growth rates. I construct the local labor shock over a two year period, which means I use employment changes over two years, giving me 5 time periods for the shock – 2007-09, 2009-11, 20011-13, 2013-15, and 2015-17. This is because the location of the individuals in the sample is only available from 2005 onwards, and I fix the employment shares in each local area at their 2005 level to ensure that the shock is exogeneous (details of this are discussed in the next section).

These shift-share measures are then merged into the PSID based on the MSA in which the household resided in the preceeding interview wave (i.e. at $t-1$). So, the shock for 2007-09 is merged based on the location of the worker in 2007. This gives me short-term local labor demand shocks, which will be described in detail in the next section.

## 2.3 Saiz (2010) House Supply Elasticities

A key parameter of interest is the house supply elasticity, which determines the responsiveness of prices to population changes. Data for this comes from Saiz (2010), who uses local land availability measures to construct a measure of house supply elasticity that is plausibly exogenous to local labor market conditions. Essentially, these elasticities are a measure of

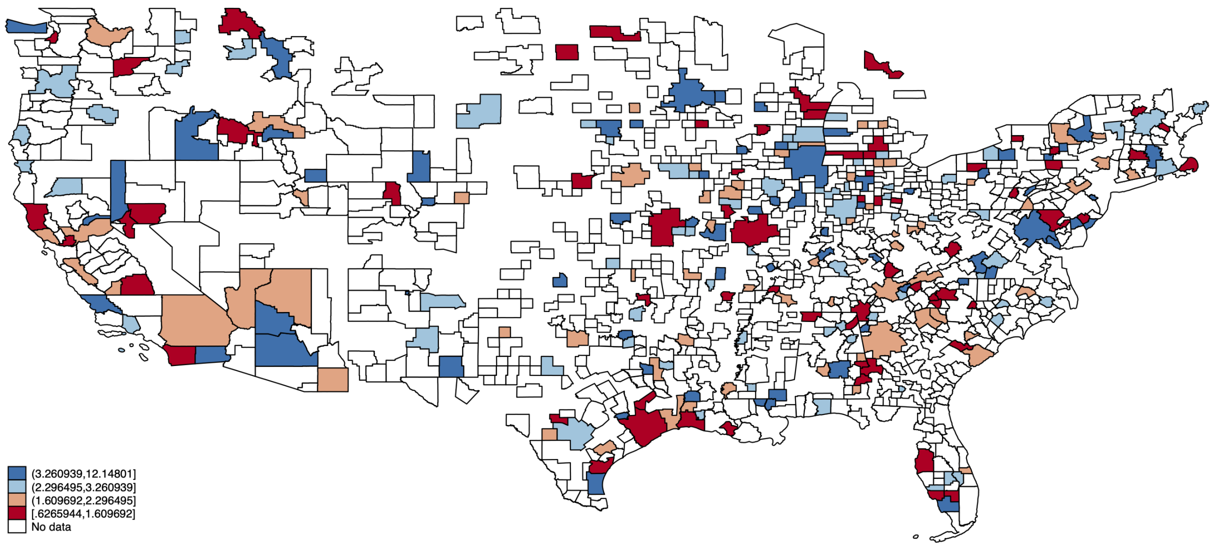
[1] 2-digit NAICS codes are used, and only those working in private industries are considered.

Table 1: Descriptive Statistics from the PSID sample

| | All MSAs | | | Low Elasticity MSAs | | | High Elasticity MSAs | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.D | Median | Mean | S.D | Median | Mean | S.D | Median |
| Mobility (across MSA) | 0.050 | 0.217 | 0 | 0.051 | 0.220 | 0 | 0.054 | 0.225 | 0 |
| Ownership | 0.47 | 0.50 | 0 | 0.46 | 0.50 | 0 | 0.47 | 0.50 | 0 |
| Rent (renters, monthly) | 0.734 | 0.536 | 0.676 | 0.828 | 0.619 | 0.754 | 0.597 | 0.371 | 0.598 |
| Home Value (owners) | 253.01 | 190.45 | 204.654 | 302.27 | 219.88 | 249.695 | 185.66 | 124.89 | 156.059 |
| Equity (owners) | 103.32 | 136.04 | 62.424 | 129.00 | 163.47 | 79.209 | 69.07 | 83.00 | 43.679 |
| Wealth (without equity) | 76.30 | 366.27 | 7.283 | 90.25 | 440.45 | 8.617 | 61.93 | 241.64 | 5.386 |
| Wealth (with equity) | 124.44 | 420.25 | 17.237 | 149.85 | 504.36 | 20.294 | 94.48 | 281.49 | 12.562 |
| Earnings (yearly) | 47.62 | 40.47 | 39.099 | 50.48 | 42.66 | 41.616 | 43.01 | 36.84 | 35.545 |
| Years of Education | 13.40 | 2.43 | 13 | 13.53 | 2.39 | 13 | 13.45 | 2.22 | 13 |
| Female % | 0.32 | 0.47 | 0 | 0.32 | 0.47 | 0 | 0.33 | 0.47 | 0 |
| Black % | 0.48 | 0.50 | 0 | 0.45 | 0.50 | 0 | 0.59 | 0.49 | 1 |
| N | | 12282 | | | 6788 | | | 3212 | |

Dollar values are reported in thousands of 2017 dollars, adjusted using CPI-U. To calculate these numbers, the sample in PSID is pooled across a 10 year period between 2007 and 2017, which means that each observation need not be a unique reference person. MSAs are categorized as being "high" or "low" elasticity according to whether they are in the top or bottom 40 percentiles of the house supply elasticity distribution. Statistics for the middle 20 percentiles are not shown, although they are part of the "All MSAs" sample.

Figure 1: House Supply Elasticity by MSA




NB: Darker regions represent areas with lower elasticities of housing supply.

how difficult it is to build new housing in an area. I categorize MSAs in my sample according to their rank in the house supply elasticity distribution of the United States. "Low elasticity MSAs" refer to MSAs whose house supply elasticity in the bottom 40 percentiles of this distribution, and "high elasticity MSAs" are those who fall in the top 40 percentiles. I choose this categorization purely for data availability reasons – the PSID sample seems to be drawn disproportionately from low-elasticity MSAs, which means I have to lower the threshold for high elasticity MSAs somewhat to get higher sample sizes. Nevertheless, all results are qualitatively robust to using the top and bottom 50 percentiles. Formally, MSAs are categorized in the following way:

$$\eta_j^{CAT} = \begin{cases} 0, & \text{if } \eta_j \text{ in bottom 40 percentile} \\ 1, & \text{if } \eta_j \text{ in middle 20 percentile} \\ 2, & \text{if } \eta_j \text{ in top 40 percentile} \end{cases}$$

The spatial distribution of the elasticities can be seen in Figure 1. As one would expect, the coasts have lower elasticities of housing supply than the interior of the US.

# 3 Trends in Mobility

The analysis in this paper focusses on the time period between 2007 and 2017, which means that it includes the Great Recession years and the associated housing bust. Additionally, it has been documented that the Great Recession led to a decrease in mobility across the United States (Farber (2012)). This decline in mobility for all workers can be seen in Figure 2, which uses data from the American Community Survey (ACS) to plot the across metro area migration rates of people living within the United States from 2005 to 2017 (the years for which the metro areas are identified for people within the ACS). One can see there is a sharp decline in across-metro area migration during the Great Recession, and these rates start recovering around 2011. By 2015, they seem to have recovered fully, approximately reaching their pre-2007 level.

A natural question to ask, given the housing bust, is how the migration rates of homeowners differed from that of renters during this period. This is considered in Farber (2012), but the data used there does not let the author identify the ownership status of the household *before* the move. The ACS data has the same limitations – it does not ask respondents about their ownership status in the preceeding year.

However, the panel structure of the Panel Study of Income Dynamics (PSID) makes it amenable to answering this question directly. Figure 3 plots the overall (biennial) migration rate of households, and also by ownership status in the wave *before* they moved. One can see that the overall rates of migration track the ACS graph fairly well, with a dip during the Great Recession and a recovery after 2011. An important thing to note is that these rates are biennial rates (which means they should be roughly twice as high as the ACS rates), and are plotted for households which had the same "reference person" (household head) in two consecutive interview waves (this means I don't include "splitoff" families, where for instance a child might have moved out to live independently, or a divorce might have led to a splitoff family).

The maroon line plots the migration rate for reference persons in the PSID who rented their home in the preceeding interview wave. This line also follows roughly the same pattern as the overall population, although the recovery after the dip in the Great Recession is slightly faster.

The green line plots the migration rate for homeowners, and it is clear that both in absolute and relative terms, the decline in migration rates was steeper for homeowners than renters. Moreover, the decline has been fairly persistent in the years following the Great Recession, and by 2017 had not yet fully recovered.

These national trends provide suggestive evidence that there are some differences in the mobility rates of owners and renters during and after the Great Recession (pre-trends up to 2005 are relatively similar). However, it should be noted that these do not provide evidence about the differential effect of the labor market on mobility rates.

To investigate this more carefully, I exploit spatial variation across the United States in local labor markets and the reaction of house prices to local labor market condition to quantify the role of wealth in mediating migration between metro areas.

# 4 Empirics

The trends presented in the previous section suggest that homeowners and renters might be affected differently in the wake of the Great Recession. However, there is substantial spatial heterogeneity in both labor (Blanchard and Katz (1992), Bartik (1991)) and housing markets (Mian and Sufi (2011), Mian et al. (2013)) which could be exploited to identify the effect of wealth in mediating mobility within the United States.

The theoretical (and empirical) literature on local labor markets makes the important point that a labor shock within an area leads to a decrease in population and this a fall in

Figure 2: Migration Between Metro Areas in the American Community Survey (ACS)

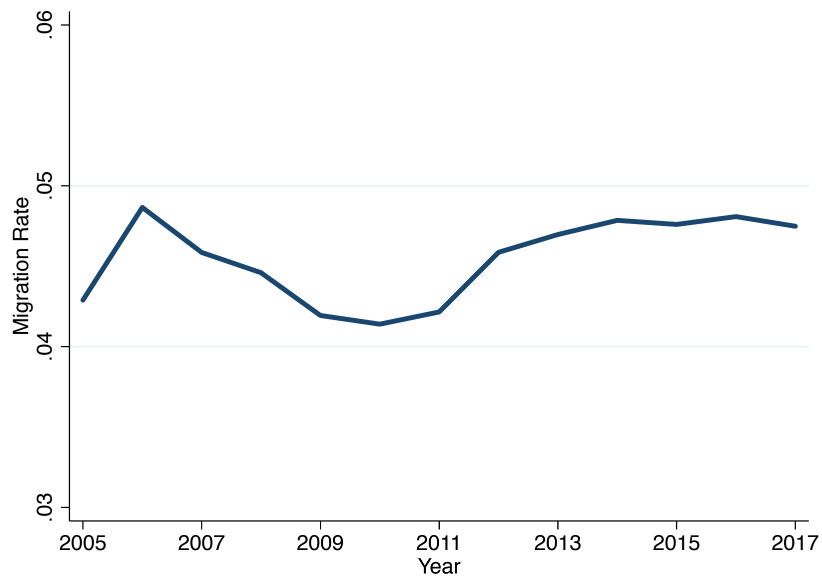
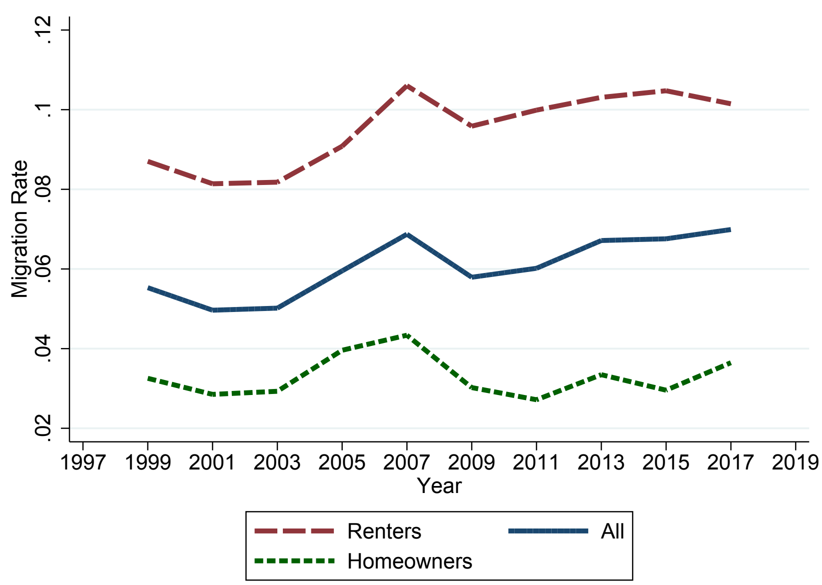



Figure 3: Migration Between Metro Areas in the Panel Study of Income Dynamics



housing demand, which in turn leads to declines in house prices. This makes it cheaper to live in that area, and means that real wages in the area do not fall as much as nominal wages. This first effect, the "real wage" effect, is one that is faced by both renters and homeowners (for homeowners, one can think of this as being a decline in user costs, or a decline in the opportunity cost of renting their unit out). However, homeowners also face a decline in wealth due to this house price decline, whereas renters don't. This motivates the idea of using difference-in-differences to uncover the wealth effects of local labor demand shocks. We can compare owners and renters that face the same labor demand shock (and therefore the same price declines) and "difference out" the real wage effect of the labor shock. What we are left with is the wealth effect.

Below, I describe the "reduced form" strategy in more detail, including the construction of the labor demand shock, and the assumptions required for identification of the wealth effect.

## 4.1 MSA-level Labor Demand Shock

Motivated by the literature (for instance Notowidigdo (2011) and Zabek (2017)), I construct local employment shift share shocks in the spirit of Bartik (1991) to measure changes in local labor demand. The shift-share shock, as illustrated in Goldsmith-Pinkham et al. (2017), takes the changes in national industrial employment and projects them onto the MSA-level employment shares. These give plausibly exogenous effects of labor demand shocks because they capture that part of the local labor demands which are industry specific and not location specific. To ensure exogeneity, I use employment shares for 2-digit NAICS private industries from 2005, and then project them onto leave-one-out national industry growth rates for the relevant time period. I use two-year changes to come up with a measure of the labor demand shock in order to match the biennial nature of the PSID dataset between 2007 and 2017. Note that using employment shares from 2005 somewhat alleviates the concern that shares themselves can be endogenous to local labor market conditions in the given time period. This shock is then matched with the MSA of the worker at the beginning of the period.

Specifically, the MSA-level aggregate "shift-share" shock is constructed as:

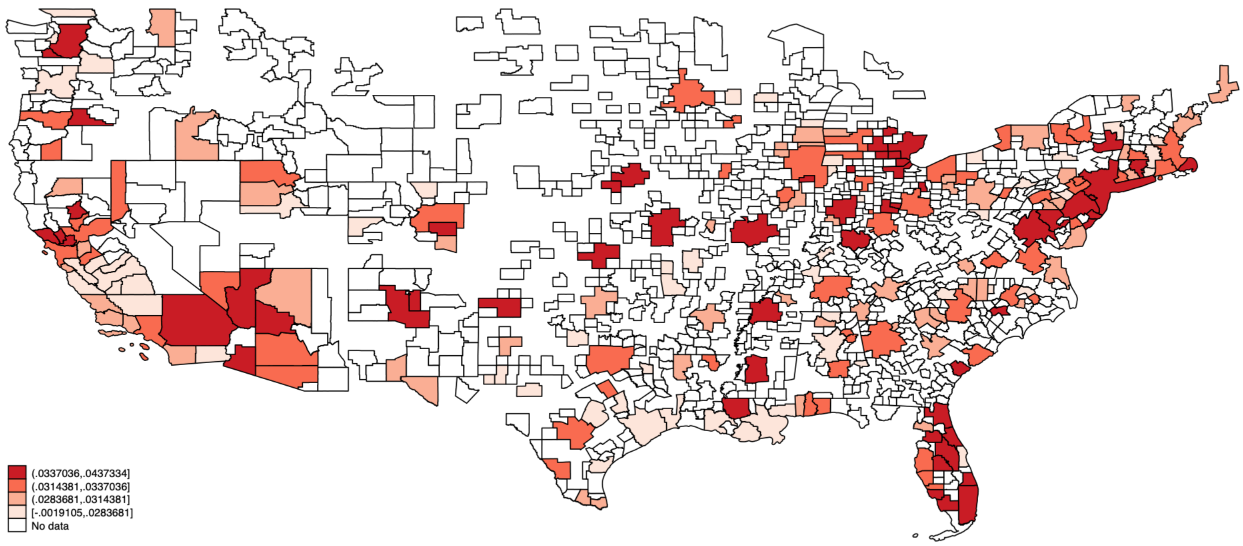
$$\Delta\theta_{j,t} = (-) \sum_{k \in ind} \left( \frac{L_{k,-j,t} - L_{k,-j,t-1}}{L_{k,-j,t-1}} \right) \frac{L_{k,j,2005}}{L_{j,2005}} \tag{1}$$

where $L_{k,j,t}$ is the total employment in industry $k$ in area $j$ at time $t$. I assume that everyone in the area is hit with the same local shock, and can choose to move in response to it. Further, I also "standardize" by demeaning it and dividing by the standard deviation – this aids interpretation, as now the shock can be measured in standard deviation units. The spatial distribution of the shock between 2015 and 2017 is plotted in Figure 4.

## 4.2 Difference-in-Differences

Before comparing owners and renters, focussing on the basic regression specification can fix some ideas. Consider the basic regression of the form:

Figure 4: Spatial Distribution of Labor Demand Shock in 2017




NB: Darker regions represent more positive labor demand shocks.

$$Moved_{i,j,t} = \beta_0 + \beta_1 \Delta\theta_{j,t} + \beta_4 X_{i,j,t-1} + \lambda_t + \mu_j + \epsilon_{i,j,t} \tag{2}$$

where $Moved$ equals 1 for reference person $i$ in area $j$ at time $t$ if she changed MSAs between $t-1$ and $t$, and 0 otherwise. $X$ is a vector of covariates that includes race, marital status, an interaction between race and marital status, gender, years of education, number of kids, a quadratic in birth year, wealth without equity, and labor earnings. $\Delta\theta_{j,t}$ is the labor demand shock defined previously, and I also include time and MSA specific fixed effects. Sample selection is the same as was described in the previous section, i.e. only reference persons between the ages of 18 and 64 who never report being out of the labor force are used. Additionally, I only use individuals who move *from* MSAs which have at least 30 households per year in the data.

Note that most papers use the labor demand shock as an instrument to predict actual employment growth in a certain period, it is used directly here. This choice is made because the PSID data does not have enough power to allow me to have an estimate of employment growth within each area over time. Therefore, it isn't possible to use the labor demand shock to "predict" employment growth within the PSID.

In Equation 2, the identifying assumption is that the local labor demand shock is uncorrelated with any unobserved factors that could affect a worker's decision to move. This means that any idiosyncratic factor that might induce a person to move (for instance an inheritance) must be uncorrelated with the aggregate shock to the area. In order to aid interpretation, a stronger assumption is also needed; I assume that $\Delta\theta_{j,t} = A$ and $\Delta\theta_{j,t} = -A$ represent shift in local labor demand of plausibly equal magnitude.

Now, to back out the wealth effect mentioned above, I compare the $\beta_1$ estimate for owners to the $\beta_1$ estimate for renters. To do this in a principled way, I use a difference-in-differences framework and estimate:

$$Moved_{i,j,t} = \beta_0 + \beta_1 \Delta\theta_{j,t} + \beta_2 Owner_{i,j,t-1} + \beta_3(\Delta\theta_{j,t} \text{x} Owner_{i,j,t-1}) + \\ \lambda_t + \mu_j + \beta_4 X_{i,j,t-1} + \epsilon_{i,j,t} \quad (3)$$

The identifying assumption here is trickier, and is best treated as a "differences-in-differences" estimation strategy. One can back out the "treatment effect" of the shock on owners as being $\beta_3$ when the comparison or "control" group is renters. This means, intuitively, that the renters take out that part of the change in mobility due to the shock that comes from changes in the real wage ($\beta_0+\beta_1$); the level difference term, $\beta_2$, takes out the part of the differences that occur due to owners being differently mobile across the board. This leaves $\beta_3$ as the difference in the mobility of owners and renters that is "caused" by the labor demand shock. In order to have a causal interpretation, I must assume that selection into ownership occurs only on observables, which means it only occurs on the vector of covariates contained in $X$. If this seems implausible, the estimates from this regression can be thought of as suggestive or descriptive evidence rather than causal, which is the interpretation I favor.

However, the change in house prices induced by the same labor demand shock can be different across MSAs. As local labor shocks lead to out-migration, housing demand goes down, and the extent to which this would affect house prices depends on the house supply elasticity in that area. In theory, a more inelastic housing supply should lead to greater declines in house prices than a more elastic one. This would further mean that we might expect the "wealth effect" in these places to be greater as well, since the wealth of homeowners is going down more in these areas. In order to exploit this hetergeneity, I use the (plausibly exogenous to local labor market conditions) house supply elasticities from Saiz (2010) and bin MSAs according to their rank in the house supply elasticity distribution.[2] As mentioned in Section 2,

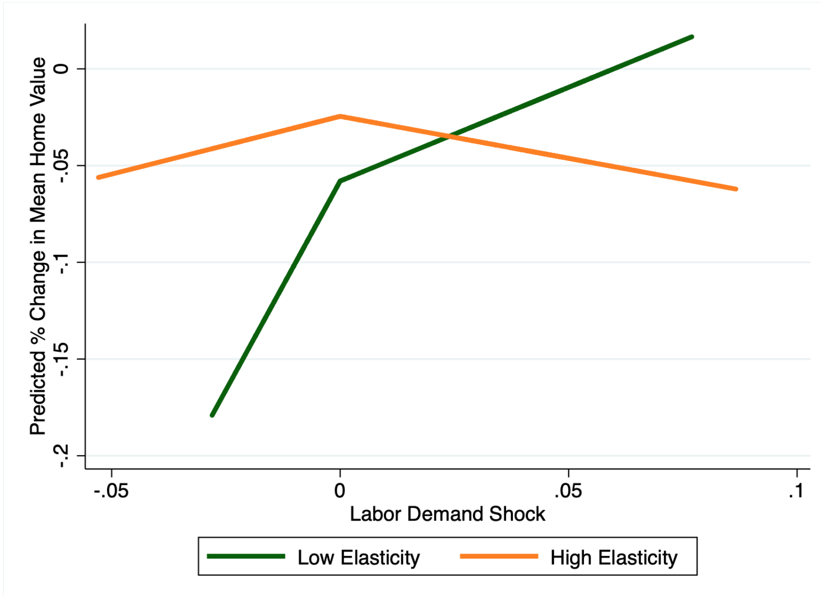
$$\eta_j^{CAT} = \begin{cases} 0, & \text{if } \eta_j \text{ in bottom 40 percentile} \\ 1, & \text{if } \eta_j \text{ in middle 20 percentile} \\ 2, & \text{if } \eta_j \text{ in top 40 percentile} \end{cases}$$

I then estimate Equation (3) for various subsamples of my overall sample. In particular, I estimate this regression separately for owners living in inelastic and elastic MSAs, and also run a pooled regression to see if the differences in the "treatment effects" across these subsamples are significant. This is essentially a triple-difference estimation:

$$Moved_{i,j,t} = \beta_0 + \beta_1 \Delta\theta_{j,t} + \beta_2 Owner_{i,j,t-1} + \beta_3(\Delta\theta_{j,t} \text{ x } Owner_{i,j,t-1}) + \beta_4 \eta_{j,t-1}^{CAT} \\ + \beta_5(\Delta\theta_{j,t} \text{ x } Owner_{i,j,t-1} \text{ x } \eta_{j,t-1}^{CAT}) + \lambda_t + \mu_j + \beta_4 X_{i,j,t-1} + \epsilon_{i,j,t} \quad (4)$$

[2] It bears noting that the house supply elasticity that I use to categorize MSAs as high or low elasticity areas have themselves been used as instruments in the literature (notably by Mian and Sufi (2011)). However, this is not the context I am using it in. I simply use it to find descriptive trends in the effect of a labor demand shock on owners compared to renters.

Figure 5: Predicted Mean House Price Changes and the Labor Demand Shock




Here, $\beta_5$, the triple difference coefficient, represents how the wealth effect, $\beta_3$, changes with housing supply elasticity. If wealth effects are important, then it seems reasonable that one might find that their importance depends on the level of price declines. Additionally, I also run this regression by using the continuous measure of house supply elasticity instead of dividing MSAs into categories.

However, there is a crucial assumption made here about the symmetry of house supply elasticity. I implicitly assume that price declines are steeper in less elastic MSAs, but this is at odds with the theory of durable housing supply (Glaeser and Gyourko (2005)), which claims that while housing curves are elastic when a city is growing, they are *always* inelastic when it is shrinking. Consider two cities, San Francisco (low elasticity of housing supply) and Indianapolis (high elasticity of housing supply). As they grow and housing demand increases, building restrictions would mean that house prices increase more in San Francisco than in Indianapolis. However, if they start declining, house prices might fall at the same rate because housing stock is *durable*, i.e. it has already been built and cannot be destroyed easily. I investigate this assumption using data on house prices from the ACS and find that while it is true that housing supply curves are more inelastic when there are negative labor demand shocks compared to positive ones, it is also true that price declines are still steeper in an inelastic MSA like San Francisco. Details of this investigation are provided in Appendix A. The estimated housing supply curves are plotted in Figure 5.

## 4.3 Heterogeneity Analysis

If the wealth effect is relevant for homeowners, then it is natural to ask why this is the case, and who are the homeowners that are affected. Theoretically, the direction in which these wealth effect should affect mobility isn't clear. For instance, if financing mobility costs is an important constraint, a negative labor shock to an area will lower the wealth holdings of homeowners and decrease their responsiveness to the shock. On the other hand, without important mobility costs, if a decline in housing wealth exactly offsets the decline in "user costs", or rents, then homeowners do not face the "real wage" effect at all (since the wealth effect "cancels" the real wage effect), and might be induced to move out *more* compared to renters.

To investigate this further, I perform a heterogeneity analysis with respect to the initial wealth holdings of homeowners. This helps us answer whether it the wealthier owners that choose to stay in the MSA even after a negative shock, or the poorer ones. These two selection mechanisms would tell very different stories about adjustments to local labor markets.

The PSID contains data on actual wealth holdings of housholds every interview wave which can be exploited to find out which homeowners move and which do not. First, I categorize homeowners according to their quartile in the wealth distribution of homeowners (wealth here includes all wealth holdings, including home equity). I then interact this with the labor demand shock and run the equivalent of Equation (2), but only for homeowners. I also run this separately across high and low elasticity MSAs.

The regression estimated is:

$$\begin{aligned} Moved_{i,j,t} = \beta_0 + \beta_1 \Delta\theta_{j,t} + \beta_2 Wealth^{CAT}_{i,j,t-1} + \beta_3(\Delta\theta_{j,t} \text{ x } Wealth^{CAT}_{i,j,t-1}) \\ + +\lambda_t + \mu_j + \beta_4 X_{i,j,t-1} + \epsilon_{i,j,t} \end{aligned} \quad (5)$$

where only reference persons who were homeowners in $t-1$ are part of the sample, and $Wealth^{CAT}_{i,j,t-1}$ represents the three highest quartiles of wealth (the first quartile is the excluded category). The caveat is that this presents descriptive evidence, and shouldn't be interpreted as the "causal" effect of wealth per se, but rather the causal effect of the local labor demand shock on homeowners in a particular wealth quartile.

I choose to do this analysis with a measure that aggregates all forms of wealth because it is important to look at the entire wealth portfolio of a homeowner. If housing wealth declines are large, a homeowner can still use other forms of wealth to compensate. Looking only at home equity could therefore be misleading.

In the next section, I describe the results from estimating these regressions.

# 5 Results

## 5.1 The Effect of the Local Labor Market Shock

First, I present results from estimating Equation (2), the basic regression framework that doesn't differentiate between owners and renters. The estimates provided in Table 2 show that there are significant effects of the labor demand shock on mobility, as one would expect from theory. In this first column, the coefficient on "*Shock*" indicates that a one standard deviation negative shock increases the out-migration rate of households by approximately 2 percentage points in the United States. This is off a base of 5% across-MSA mobility rate in the sample.

When comparing these estimates in Low and High Elasticity MSAs, we find that while out-migration rates go up by around 11 percentage points in high elasticity MSAs (like Indianapolis) in reponse to a local labor demand shock, they increase by only 2.6 percentage points in low elasticity MSAs (like San Francisco). This difference is consistent with theory, because the real wage effect of a labor demand shock is likely to be greater in high elasticity MSAs compared to low elasticity ones. This is the case because the same labor demand shock leads to house prices going down more in low elasticity MSAs, which means real wages in those areas do not decrease as much as nominal wages. In turn, this means that not as many people would want to move out of these areas relative to those who work in high elasticity MSAs.

Table 2: Effect of the Labor Demand Shock

| | All MSAs | Low Elasticity MSAs | High Elasticity MSAs | All MSAs |
|---|---|---|---|---|
| Shock | 0.020* | 0.026** | 0.110** | 0.021** |
| | (0.010) | (0.010) | (0.046) | (0.010) |
| Owner | -0.043*** | -0.050*** | -0.039** | -0.043*** |
| | (0.007) | (0.009) | (0.016) | (0.007) |
| High Elasticity | | | | 0.049*** |
| | | | | (0.018) |
| Shock x High Elasticity | | | | -0.002 |
| | | | | (0.005) |
| N | 12282 | 6788 | 3212 | 12282 |
| R-sq | 0.051 | 0.056 | 0.061 | 0.051 |

Robust standard errors clustered at the MSA-level in parenthesis. All regressions include controls for demographics, a quadratic in age, income, and wealth. They also include time period and MSA-specific fixed effects. MSAs are categorized as being "high" or "low" elasticity according to whether they are in the top or bottom 40 percentiles of the house supply elasticity distribution. Results for the middle 20 percentiles are not shown, although they are part of the "All MSAs" sample.

* p<0.10 ** p<0.05 *** p<0.01

## 5.2 Differences Between Owners and Renters

Are there differences between the way owners and renters react to labor demand shocks? Table 3 presents the results from estimating Equation 3.

The first column of Table 3, which considers all owners and renters in the sample, shows no evidence that owners react differently to renters when faced with a one standard deviation local labor shock in the United States. From the first row, one can see that renters increase their out-migration rates by 2.2 percentage points (off of a base of around 7.2 percentage points) in reaction to a local shock. There is also a level effect ($\beta_2$) which means that owners are about 4.3 percentage-points less likely to move than renters when there is no shock, but the "treatment effect", $\beta_3$, is small and insignificant. However, as can be seen in columns 2 and 3, this masks substantial spatial heterogeneity in these parameters.

The estimate in the third row of Column 2, which is the $\beta_3$ coefficient in Equation (3) for the subsample of workers who live in low elasticity MSAs, suggests that for a one standard deviation negative labor demand shock in low elasticity MSAs, owners increase their out-migration rates 1.3 percentage points less than renters. In other words, the labor demand shock affects owners and renters differently in low elasticity MSAs, with owners being less reponsive to the shock.

However, when considering owners and renters in high elasticity MSAs, this difference is small and insignificant. In high elasticity MSAs, the labor demand shock causes renters to increase out-migration rates by 10.8 percentage points. Owners also increase their out-migration rates by the same amount (the estimate in the last row of Column 3 is not significant statistically or economically compared to the estimate in the first row).

Further, I also run a triple difference regression which compares the wealth effect coefficient, $\beta_3$, in low and high elasticity MSAs. These estimates can be found in Column 4 of Table 3. When considering owners and renters in these two "types" of MSAs, the fourth row of Column 4 suggests that the wealth effects found in Columns 2 and 3 are, in fact, different. This is confirmed in the fifth column, where house supply elasticity enters in a continuous way in the regression.

Table 3: Effect of the Labor Demand Shock on Owners and Renters

| | All MSAs | Low Elasticity MSAs | High Elasticity MSAs | All MSAs | All MSAs |
|---|---|---|---|---|---|
| Shock | 0.022** | 0.032*** | 0.108** | 0.026** | 0.036*** |
| | (0.010) | (0.011) | (0.047) | (0.011) | (0.012) |
| Owner | -0.043*** | -0.049*** | -0.040** | -0.049*** | -0.053*** |
| | (0.007) | (0.009) | (0.017) | (0.008) | (0.012) |
| Shock x Owner | -0.004 | -0.013** | 0.008 | -0.012** | -0.025** |
| | (0.004) | (0.006) | (0.008) | (0.006) | (0.010) |
| Shock x Owner x High Elasticity | | | | 0.018* | |
| | | | | (0.010) | |
| Shock x Owner x Elasticity | | | | | 0.011** |
| | | | | | (0.005) |
| N | 12282 | 6788 | 3212 | 12282 | 12282 |
| R-sq | 0.051 | 0.057 | 0.062 | 0.052 | 0.052 |
| Avg. Mobility (All) | 0.05 | 0.051 | 0.054 | 0.05 | 0.05 |
| Avg. Mobility (Renters) | 0.072 | 0.077 | 0.071 | 0.072 | 0.072 |
| Avg. Mobility (Owners) | 0.024 | 0.021 | 0.034 | 0.024 | 0.024 |
| Interaction with Elasticity? | None | None | None | Categorical | Continuous |

Robust standard errors clustered at the MSA-level in parenthesis. All regressions include controls for demographics, a quadratic in age, income, and wealth. They also include time period and MSA-specific fixed effects. MSAs are categorized as being "high" or "low" elasticity according to whether they are in the top or bottom 40 percentiles of the house supply elasticity distribution. Results for the middle 20 percentiles are not shown, although they are part of the "All MSAs" sample.
* p<0.10 ** p<0.05 *** p<0.01

Taken together, these results suggest that although there are no significant differences between owners and renters when considering the United States as whole, this masks spatial heterogeneity. Using renters to difference out the real wage effect of a local labor demand shock, homeowners who live in areas that suffer the largest declines in wealth due to house price changes (i.e. homeowners in low elasticity MSAs) that follow from the labor shock move out at disproportionately lower rates compared to renters.

## 5.3 The Wealth of Owners

The results discussed above imply that homeowners are less responsive to labor demand shocks in areas where house price declines (and thus wealth declines for homeowners) are steeper. Is there something to be learnt by looking at the heterogeneity in initial wealth holdings of these homeowners and finding patterns that uncover a particular mechanism?

One such mechanism is that there might be important mobility costs that homeowners are now less able to pay due to their wealth going down. Since renters don't own their homes, they do not have to face these wealth declines. To corroborate this story, I perform a heterogeneity analysis which categorizes homeowners according to the quartile of their wealth holdings in period $t-1$ and estimate Equation 5 for the subsample of homeowners and for high and low elasticity MSAs separately.

It is important to remember that I club all positive and negative wealth holdings (including housing, stocks and bonds, debt, etc.) that a homeowner might have together when categorizing homeowners to quartiles. Later, I also perform the same analysis considering only non-housing wealth, and only home equity.

Results from estimating Equation 5 for all homeowners are presented in the left panel of Table 4. The estimates here are a bit hard to interpret, and so to aid interpretation I calculate the marginal effect of the labor demand shock on each wealth quartile. These are presented in Table 5.

Focussing on the second column, which provides estimates for homeowners in low elasticity MSAs, one can see that the effect of the labor shock is the least for the first quartile (first row of column 2). It suggests that homeowners in the first quartile of the wealth distribution increase their out-migration rates by 3.1 percentage points (off a base of about 2.5% migration rate). The effect of the shock increases for the second and third quartile, and decreases a bit for the top quartile. In relative terms, the effect is even starker. For instance, the effect of the shock is 50% higher for homeowners in the third quartile of wealth compared to those in the first quartile of wealth.

This heterogeneity is not found amongst homeowners in high elasticity MSAs. In the third column, one can see that only homeowners in the third quartile of the wealth distribution show a higher response to the shock, and even then the difference is small in relative terms. Considering the increase in out-migration rate for the third quartile, 13.1 percentage points, we can see that it is only 18% higher than the increase in out-migration rate for the first quartile (11.1 percentage points).

These results are plotted in Figure 6. To increase comparability across the estimates, I plot deviations from the average effect of the shock. The average effect of the shock in low elasticity MSAs (Figure 6a) is around 0.037, while the average effect in high elasticity MSAs (Figure 6b) is 0.111, so the plot points represent deviations from those numbers respectively.

There is an additional concern that the mobility of very low wealth households could be induced by default. Recall that the wealth holdings are measured in period $t-1$. So, for very low wealth households, this means that both labor and housing markets take a turn for the worse when they already have very little wealth. This might push them underwater into default – this itself *raises* the probability of moving (since they lose their homes).

To address this issue, I repeat the preceeding analysis, but *exclude* those homeowners who have net debt, i.e. have negative wealth holdings when all the assets and debts have been

Table 4: Heterogeneous Effects of Labor Demand Shock by Wealth

| | All Wealth Holdings | | | Non-negative Wealth Holdings | | |
|---|---|---|---|---|---|---|
| | All MSAs | Low Elasticity MSAs | High Elasticity MSAs | All MSAs | Low Elasticity MSAs | High Elasticity MSAs |
| Shock | 0.035** | 0.031** | 0.111** | 0.028* | 0.016 | 0.116** |
| | (0.014) | (0.012) | (0.045) | (0.015) | (0.012) | (0.048) |
| 2nd Quartile | -0.003 | -0.001 | 0.002 | -0.003 | 0.005 | -0.011 |
| | (0.006) | (0.009) | (0.011) | (0.006) | (0.007) | (0.015) |
| 3rd Quartile | 0.004 | -0.001 | 0.022 | 0.004 | 0.008 | 0.008 |
| | (0.006) | (0.007) | (0.015) | (0.006) | (0.007) | (0.017) |
| 4th Quartile | 0.009 | 0.009 | 0.011 | 0.009 | 0.019** | -0.004 |
| | (0.007) | (0.008) | (0.016) | (0.008) | (0.007) | (0.019) |
| Shock x 2nd Quartile | 0.002 | 0.007 | -0.000 | 0.001 | 0.010 | 0.004 |
| | (0.007) | (0.010) | (0.013) | (0.007) | (0.007) | (0.017) |
| Shock x 3rd Quartile | 0.008 | 0.014 | 0.020 | 0.007 | **0.015**** | 0.025 |
| | (0.006) | (0.009) | (0.014) | (0.007) | **(0.007)** | (0.016) |
| Shock x 4th Quartile | -0.002 | 0.006 | -0.003 | -0.003 | 0.005 | 0.001 |
| | (0.006) | (0.008) | (0.014) | (0.007) | (0.006) | (0.019) |
| N | 5303 | 2907 | 1419 | 4913 | 2617 | 1285 |
| R-sq | 0.050 | 0.051 | 0.073 | 0.051 | 0.053 | 0.074 |

Robust standard errors clustered at the MSA-level in parenthesis. All regressions include controls for demographics, a quadratic in age, income, and wealth. They also include time period and MSA-specific fixed effects. The reference group is the first quartile of wealth holdings. MSAs are categorized as being "high" or "low" elasticity according to whether they are in the top or bottom 40 percentiles of the house supply elasticity distribution. Results for the middle 20 percentiles are not shown, although they are part of the "All MSAs" sample.

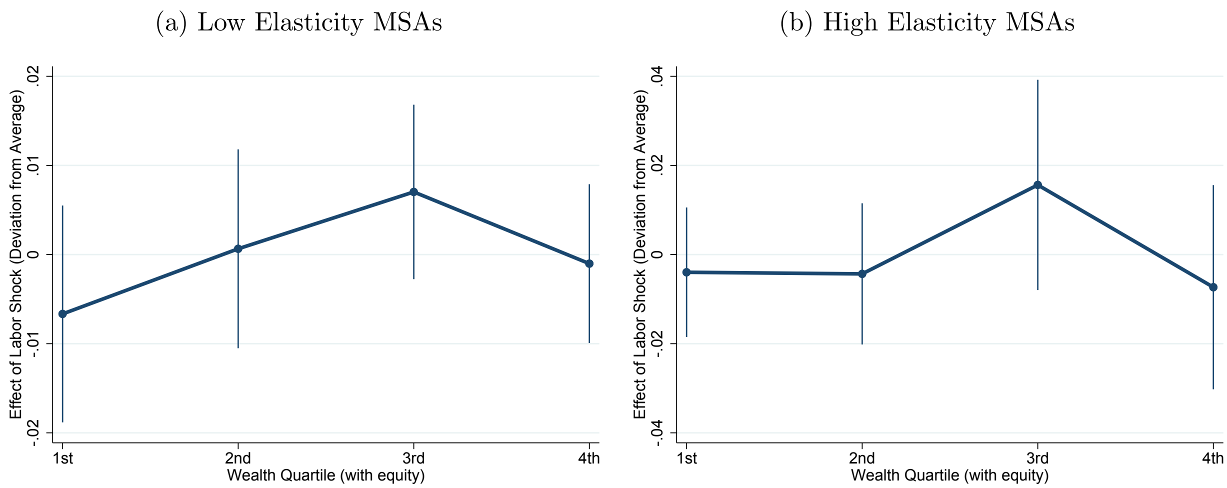
* p<0.10 ** p<0.05 *** p<0.01

Table 5: Heterogeneous Effects of Labor Demand Shock by Wealth

| | All Wealth Holdings | | | Non-negative Wealth Holdings | | |
|---|---|---|---|---|---|---|
| | All MSAs | Low Elasticity MSAs | High Elasticity MSAs | All MSAs | Low Elasticity MSAs | High Elasticity MSAs |
| First Quartile | 0.035** | 0.031** | 0.111** | 0.028* | 0.016 | 0.116** |
| | (0.014) | (0.012) | (0.045) | (0.015) | (0.012) | (0.048) |
| Second Quartile | 0.037** | 0.038** | 0.111** | 0.029* | 0.025* | 0.121** |
| | (0.016) | (0.015) | (0.051) | (0.016) | (0.014) | (0.055) |
| Third Quartile | 0.043*** | 0.044*** | 0.131** | 0.035** | 0.031** | 0.141** |
| | (0.016) | (0.016) | (0.054) | (0.016) | (0.014) | (0.057) |
| Fourth Quartile | 0.033** | 0.036** | 0.108** | 0.025 | 0.021 | 0.117** |
| | (0.016) | (0.015) | (0.048) | (0.016) | (0.014) | (0.051) |
| N | 5303 | 2907 | 1419 | 4913 | 2617 | 1285 |

Robust standard errors clustered at the MSA-level in parenthesis. All regressions include controls for demographics, a quadratic in age, income, and wealth. They also include time period and MSA-specific fixed effects. MSAs are categorized as being "high" or "low" elasticity according to whether they are in the top or bottom 40 percentiles of the house supply elasticity distribution. Results for the middle 20 percentiles are not shown, although they are part of the "All MSAs" sample.
* p<0.10 ** p<0.05 *** p<0.01

Figure 6: Effect of the Labor Demand Shock on Owners by Wealth Quartile




included. This is done to limit the possibility that the homeowners we consider are being forced to move out, and instead capture more of a choice to move to a different labor market. This obviously isn't a perfect proxy, but since I do not observe default, it is suggestive.

Results from this analysis are presented in the right panel of Table 4. The marginal effect of a labor demand shock is calculated in the right panel of Table 5. As one can see, most results from the previous analysis hold, although in low elasticity MSAs (column 5), the first quartile is now much *less* responsive to the labor demand shock – in fact, the effect of the labor demand shock on these homeowners is now statistically insignificant. Homeowners in the third quartile increase their out-migration rates by 3.1 percentage points, which is double that of the first quartile (the difference is statistically significant at the 5% level).

On the other hand, there is no change in the pattern of marginal effects for homeowners in high elasticity MSAs, as one might expect, given that house prices do not decline much in these areas.

These estimates are plotted in Figure 7. Again, these figures are deviations from the average effect of the labor shock; Figure 7a plots the estimates for low elasticity MSAs and Figure 7b plots them for high elasticity MSAs.

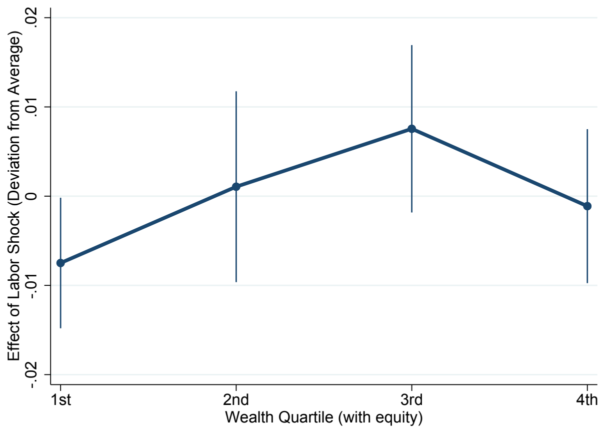
Since the PSID also contains information about various components of wealth holdings, it allows me to calculate similar estimates for wealth without home equity, and home equity. There are similar trends for these measures of wealth as well, although the increase in the effect of the labor shock across quartiles is not as strong. Figure 8 plots these for all three measures of wealth across low and high elasticity MSAs.

Within low elasticity MSAs, the increase in the effect of the shock across quartiles is the steepest when considering overall wealth holdings (wealth with equity). The two components – wealth without home equity, and home equity – also show a similar pattern, but the increase is not as steep. These point estimates also have considerable standard errors. To see this, Figure 9 plots the same graphs with confidence intervals.

These estimates suggest while homeowners tend to be less responsive to labor demand shocks in areas which have a lower elasticity of housing supply (and thus greater declines in

Figure 7: Effect of the Labor Demand Shock on Owners by Wealth Quartile (No Net Debt)

(a) Low Elasticity MSAs




(b) High Elasticity MSAs

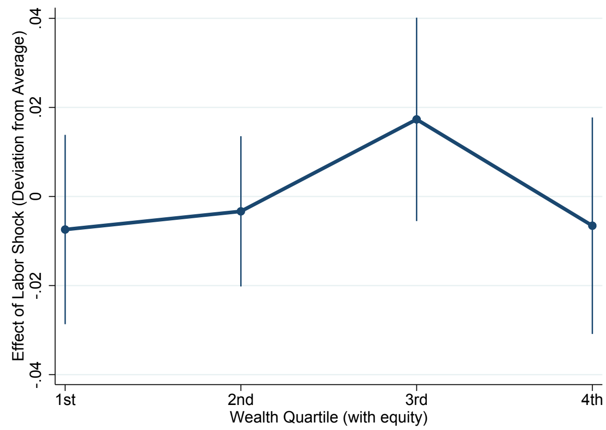



Figure 8: Effect of the Labor Demand Shock on Owners by Wealth Quartile

(a) Low Elasticity MSAs


(b) High Elasticity MSAs

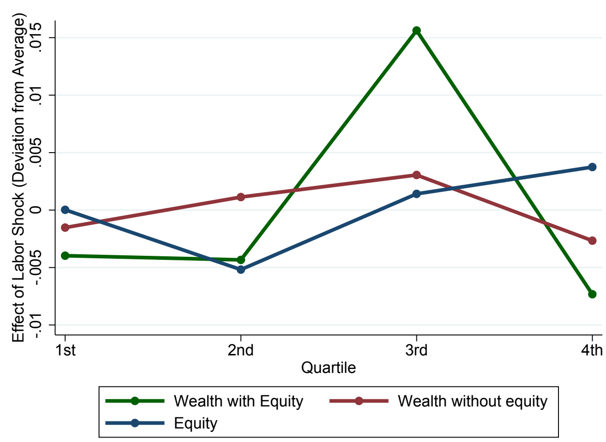


Figure 9: Effect of the Labor Demand Shock on Owners by Wealth Quartile


house prices in response to the same negative labor shock), there is heterogeneity within these owners. Specifically, low wealth owners move disproportionately less compared to their high wealth peers. This is consistent with the local labor demand shock pushing down the wealth of homeowners so that the poorest ones can no longer pay mobility costs. This heterogeneity is absent in high elasticity MSAs, which makes sense because their wealth holdings are, in theory, less affected by the labor demand shock.

# 6 Conclusion

Negative local labor demand shocks lead to declines in population, which lead to a decrease in demand for housing. Depending on the elasticity of housing supply, this leads to a decline in house prices. This decline in house prices “cushions” the decline in nominal wages that follows from the labor demand shock, but it also decreases the housing wealth of homeowners. This paper finds that the wealth effect of local labor demand shocks does (negatively) affect the way some homeowners are able to relocate to another labor market, but this depends on the extent of house price declines associated with the local labor market shock. Specifically, homeowners living in Metropolitan Statistical Areas (MSAs) with low elasticities of housing supply (i.e. in areas where house prices, and thus homeowner wealth, decline a lot in response to a labor shock) do increase their out-migration rates in response to a labor shock, but the increase is 1.3 percentage points *less* than that of renters in these areas. This difference is not found in MSAs with a high elasticity of housing supply, where owners and renters react similarly to negative labor demand shocks.

Additionally, I find that amongst homeowners in low elasticity MSAs, those who tend to respond least to labor demand shocks have lower wealth holdings to begin with. The responsiveness of homeowners increases across quartiles of the wealth distribution, which points to mobility costs and liquidity constraints being important barriers to mobility. Owners in the third quartile of wealth move out at a 1.3 percentage point higher rate compared to owners in the first quartile of wealth. If one ignores homeowners with negative wealth holdings (i.e. homeowners who have have net debt before the shock hits and are thus more likely to move due to defaulting on loans), then those in the third quartile move 1.5 percentage points more than those in the first quartile.

This heterogeneity amongst owners is absent in high elasticity MSAs, where homeowners of all types move at statistically similar rates in response to a negative labor demand shock.

These findings lead me to posit that the decline in wealth might prevent homeowners from moving in if they need to finance the fixed costs to moving using their own wealth. In this case, some homeowners will be pushed below this threshold by the labor demand shock, and be unable to move. These homeowners, additionally, would disproportionately be those who had lower wealth to begin with. I sketch a model to delineate this mechanism, although have not used to it generate simulations or policy counterfactuals so far. However, it helps fix ideas and provide a framework within which to interpret the findings of this paper.

There is one issue that the paper does not address theoretically or empirically – selection into homeownership. People who own homes tend to have expectations about the labor market and have made a "commitment" to living in an area for a long time – these are both endogenous to labor market outcomes. I could account for this selection through an instrumental variable approach or by using "Heckman"-type selection, but this analysis has not been performed yet. The assumption I make for my estimates is that selection into homeownershipi is random conditional on observables like home tenure, age, demographics, and income. As it stands, dealing more seriously with selection into homeownership is left for (near)-future work.

There is also scope to add several features of the housing market into the model, like refinancing a mortgage or borrowing out of home equity. These are also left as a useful extension for now.

This paper adds to the literature on local labor and housing markets by finding that wealth effects of local labor demand shocks are quantitative important within the United States. Specifically, low wealth homeowners living in areas where house price declines due to labor market shocks are steep suffer the most, and tend to relocate the least. In the context of Topel (1986), it would seem that they would be the ones facing the adverse consequences of living in an area that is declining.

Further, adverse impacts of negative equity on mobility have not been found in the literature. However, this paper looks specifically at local labor markets and finds that one might not find housing "lock-in" uniformly across the United States, but only in certain areas. It is also important to look at the entire wealth portfolio of a homeowner when looking for housing lock-in, since housing wealth declines can be compensated for by other forms of wealth. Within the context of this paper, the steepest increases across wealth quartiles for homeowners in low elasticity MSAs came when looking at overall wealth holdings, not home equity or wealth without equity separately.

The findings in this paper should also interest policy makers across several topics. For instance, policies aimed at making housing markets more elastically supplied would decrease price volatility, and benefit homeowners when a negative labor demand shock hits. Additionally, the finding that low wealth homeowners tend to be left behind in weak labor markets adds to concerns about wealth concentration within the United States. Generating policy counterfactuals that speak to these issues is left for future work.

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# A Housing Supply Curves and Durable Housing

How do house prices move in response to a labor demand shock? Suppose there is a positive (negative) labor shock in an area. This causes population to increase (decrease), which leads to a change in housing demand. In turn, this causes house prices to increase (decrease) in that area, although the extent of this increase depends on the house supply elasticity in the area. For instance, house prices will not change at all in areas with a perfectly elastic housing supply, but will change a lot in areas where it is perfectly inelastic.

However, the literature posits that housing stock is durable (Glaeser and Gyourko, 2005). This means that the housing supply is *asymmetric* – it is elastic in response to *positive* housing demanding shocks, but more *inelastic* in response to a negative demand shock of similar magnitude. The idea is that once housing stock is built, it is there for a long time – i.e., housing is *durable*. This suggests that while housing supply across areas can be more or less elastic in response to positive labor demand shocks, it should always be inelastic in response to negative demand shocks.

In this case, negative labor shocks, which lead to out migration of workers, should mean that house price declines due to them are similar in magnitude across areas regardless of some measured "elasticity" of housing supply. This is potentially troubling in the context of my paper on wealth, homeownership, and migration between local markets. The empirical findings in that paper rely on the implicit assumption that negative labor demand shocks decrease prices more in MSAs which have an inelastic supply of housing compared to MSAs which have more elastic housing supply curves. However, if all housing markets are inelastic in response to negative labor demand shocks, then this fails to hold.

Here, I provide preliminary evidence that while there is asymmetry in the response of house prices to labor demand shocks, there is still heterogeneity with respect to house supply elasticity as measured by Saiz (2010). As an example, consider San Francisco (inelastic housing supply) and Indianapolis (elastic housing supply). Postive labor demand shocks in both cities increase house prices *less* that negative shocks decrease them (which is the durable housing story) in that city. However, a negative labor demand shock of the same magnitude decreases house prices much *more* in San Francisco than Indianapolis.

For now, I make the case for this using data on population, self reported home values, and labor shocks from the American Community Survey (ACS), as well as house supply elasticities from Saiz (2010).

I run the following regression using this data:

$$\Delta Y_{j,t} = \beta_0 + \beta_1 \Delta\theta_{j,t} + \lambda_t + \epsilon_{j,t} \tag{6}$$

where $\Delta Y_{j,t}$ is the percent change in mean self-reported home value calculated from the ACS for area $j$ between time $t-1$ and $t$.

I first run this regression for the entire (balanced) sample of 185 MSAs for which data on labor demand shocks, population, home values and house supply elasticities are available. Then, I divide MSAs into categories depending on the house supply elasticity, $\eta_j$. I focus on MSAs in the top and bottom 40% of the house supply elasticity distribution. The top 40% MSAs are termed "Elastic MSAs" (e.g. Indianapolis) and the bottom ones termed "Inelastic

MSAs" (e.g. San Francisco).[3]

I now run the regression in (6) on the two subsamples separately. I also run a "pooled" regression, which tests whether the coefficient on $\beta_1$ is significantly different depending on the category of house supply elasticity, $\eta_j^{CAT}$:

$$\Delta Y_{j,t} = \beta_0 + \beta_1 \Delta\theta_{j,t} + \beta_2 \eta_j^{CAT} + \beta_3 \Delta\theta_{j,t} \text{ x } \eta_j^{CAT} + \lambda_t + \epsilon_{j,t} \tag{7}$$

where $\eta_j^{CAT}$ is defined as:

$$\eta_j^{CAT} = \begin{cases} 0, & \text{if } \eta_j \text{ in bottom 40 percentile} \\ 1, & \text{if } \eta_j \text{ in middle 20 percentile} \\ 2, & \text{if } \eta_j \text{ in top 40 percentile} \end{cases}$$

## A.1 Testing for Asymmetry in House Price Changes

The regressions mentioned so far impose an assumption of linearity, which essentially means that the response of house prices changes to labor market shocks is assumed to be symmetric: positive labor demand shocks, by construction, increase prices by the same amount as negative shocks decrease them. However, this might not be true in the context of the housing market. In order to investigate this, I test for asymmetry in the response of home values to labor demand shocks by allowing for a "kink" in the reaction of house prices to labor demand shocks.

First, I investigate separately the effect of positive and negative labor demand shocks on house prices. I provide estimates of Equation (7):

$$\Delta Y_{j,t} = \beta_0 + \beta_1 \Delta\theta_{j,t} + \beta_2 \eta_j^{CAT} + \beta_3 \Delta\theta_{j,t} \text{ x } \eta_j^{CAT} + \lambda_t + \epsilon_{j,t}$$

but only for the subsample of positive, and then negative labor demand shocks.

I then pool the data and allow the slope on the labor demand shock, $\Delta\theta_{j,t}$, to be different for positive and negative labor demand shocks. This is done using a linear spline, implicitly imposing the restriction that the intercepts for positive vs. negative shocks are not different and forcing the two lines to "meet" at zero, forming a kink at that point (there will be two such kinked lines corresponding to high and low elasticity MSAs). Formally, the regression estimated is:

$$\begin{aligned} \Delta Y_{j,t} = \beta_0 + \beta_1 \Delta\theta_{j,t} \mathbb{1}(\Delta\theta_{j,t} < 0) + \beta_2 \Delta\theta_{j,t} \mathbb{1}(\Delta\theta_{j,t} > 0) + \beta_3 \eta_j^{CAT} + \\ + \beta_5 (\Delta\theta_{j,t} \text{ x } \eta_j^{CAT}) \mathbb{1}(\Delta\theta_{j,t} < 0) + \beta_6 (\Delta\theta_{j,t} \text{ x } \eta_j^{CAT}) \mathbb{1}(\Delta\theta_{j,t} > 0) + \lambda_t + \epsilon_{j,t} \end{aligned} \tag{8}$$

In this regression, $\beta_1$ captures the effect of negative shocks on house prices in low elasticity areas, while $\beta_2$ captures the effect of positive shocks. The durable housing story is that

[3] Results are robust to defining categories as top and bottom 50% (i.e. above and below the median elasticity) but I choose this specification to match the micro data analysis in the PSID.

Table 6: Effect of the Labor Demand Shock on Home Values

| | All MSAs | Low Elasticity MSAs | High Elasticity MSAs | Pooled MSAs |
|---|---|---|---|---|
| Shock | 0.844** | 2.340*** | 0.178 | 2.052*** |
| | (0.414) | (0.609) | (0.614) | (0.438) |
| High Elasticity | | | | 0.049*** |
| | | | | (0.008) |
| High Elasticity x Shock | | | | -1.838*** |
| | | | | (0.233) |
| $N$ | 925 | 385 | 360 | 925 |
| $R^2$ | 0.409 | 0.599 | 0.276 | 0.450 |

Robust standard errors in parentheses. All regressions contain year fixed effects.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

$\beta_1 > \beta_2$.[4] The heterogeneity in house price movements in response to negative shocks across MSA elasticity categories is captured by $\beta_5$. $\beta_6$ captures the heterogeneity in response to positive shocks.

## A.2 Results

I first present the result of regressions of the type in Equation (6) for the entire (balanced) sample of 185 MSAs for which data on labor demand shocks, employment, home values and house supply elasticities are available.

Table 6 contains results from estimating the effect of the labor demand shock on percent changes in home values. Column 1 suggests that positive labor demand shocks do indeed lead to increases in average home values. However, Columns 2 and 3 indicate that this increase is much steeper in areas with a lower elasticity of housing supply (e.g. San Francisco) than in areas with a higher elasticity of housing supply (e.g. Indianapolis). Moreover, the difference in house price changes across these two types of MSAs is statistically significant, as can be seen in the last row of Column 4.

However, if housing is durable, the results in Table 6 could be driven purely by positive labor demand shocks (which cause increases in population, and thus housing demand). The main concern is that while house supply elasticity would make prices increase more in some places compared to others following an increase in housing demand, housing markets are always *inelastic* when faced with decreases in housing demand. This means that negative labor demand shocks (which decrease population and thus housing demand) might have a similar effect on house prices in a high elasticity area (Indianapolis) and a low elasticity area (San Francisco).

To test this, Equation (8) allows for the slope on the labor demand shock to be different

[4] $\beta_1+\beta_5$ captures the effect of negative shocks on house prices in high elasticity areas, while $\beta_2+\beta_6$ captures the effects of positive shocks.

Table 7: Negative and Positive Labor Demand Shocks and Home Values

| | Only Negative Shocks | Only Positive Shocks | All Shocks |
|---|---|---|---|
| Negative Shock | 5.802*** | | 4.322*** |
| | (1.358) | | (1.241) |
| High Elasticity x Negative Shock | -4.504*** | | -3.724*** |
| | (1.444) | | (1.296) |
| Positive Shock | | 1.459** | 0.969* |
| | | (0.717) | (0.556) |
| High Elasticity x Positive Shocks | | -1.660*** | -1.403*** |
| | | (0.591) | (0.391) |
| High Elasticity | 0.027 | 0.044* | 0.033** |
| | (0.018) | (0.023) | (0.015) |
| $N$ | 329 | 596 | 925 |
| $R^2$ | 0.182 | 0.376 | 0.454 |

Robust standard errors in parentheses. All regressions include year fixed effects.

$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

for negative versus positive shocks. The results from this regression are presented in the last column of Table 7. The first two columns confirm that in both high and low elasticity MSAs, negative shocks reduce house prices more than positive shocks increase them, but the effect of a labor demand shock is more muted in high elasticity areas (like Indianapolis) compared to low elasticity ones (like San Francisco).

The last column in Table 7 shows that house prices are significantly less responsive to the labor demand shocks in high elasticity MSAs, regardless of the direction of the shock ($\hat{\beta}_5 = -3.724$ and $\hat{\beta}_6 = -1.403$). This difference is significant at the 1% level for both positive and negative shocks. Table 8 shows that the results are robust to including a "continuous" measure of elasticity instead of dividing the sample into categories. To aid interpretation, I have also plotted the implied "housing supply curves" for high and low elasticity areas using estimates from the last column of Tables 7 and 8. These can be found in Figures 10 and 11 respectively. Overall, negative demand shocks reduce prices more than positive ones increase them, but this effect is more pronounced in both directions in low elasticity MSAs compared to high elasticity ones.

## A.3 Discussion

It is true that in general, housing markets are more inelastic when faced with decreases in housing demand than when faced with increases in housing demand, leading to a "kinked" supply curve. However, the extent of the kink also depends on the elasticity of housing

Table 8: Negative and Positive Labor Demand Shocks and Home Values

| | Only Negative Shocks | Only Positive Shocks | All Shocks |
|---|---|---|---|
| Negative Shock | 5.608*** | | 4.732*** |
| | (1.829) | | (1.589) |
| Elasticity x Negative Shock | -1.111** | | -1.190** |
| | (0.535) | | (0.476) |
| Positive Shock | | 2.257*** | 1.868*** |
| | | (0.811) | (0.639) |
| Elasticity x Positive Shock | | -0.568*** | -0.591*** |
| | | (0.180) | (0.140) |
| Elasticity | 0.018*** | 0.014** | 0.015*** |
| | (0.006) | (0.007) | (0.005) |
| $N$ | 329 | 596 | 925 |
| $R^2$ | 0.169 | 0.373 | 0.449 |

Robust standard errors in parentheses. All regressions include year fixed effects.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 10: Predicted Mean House Price Changes and the Labor Demand Shock

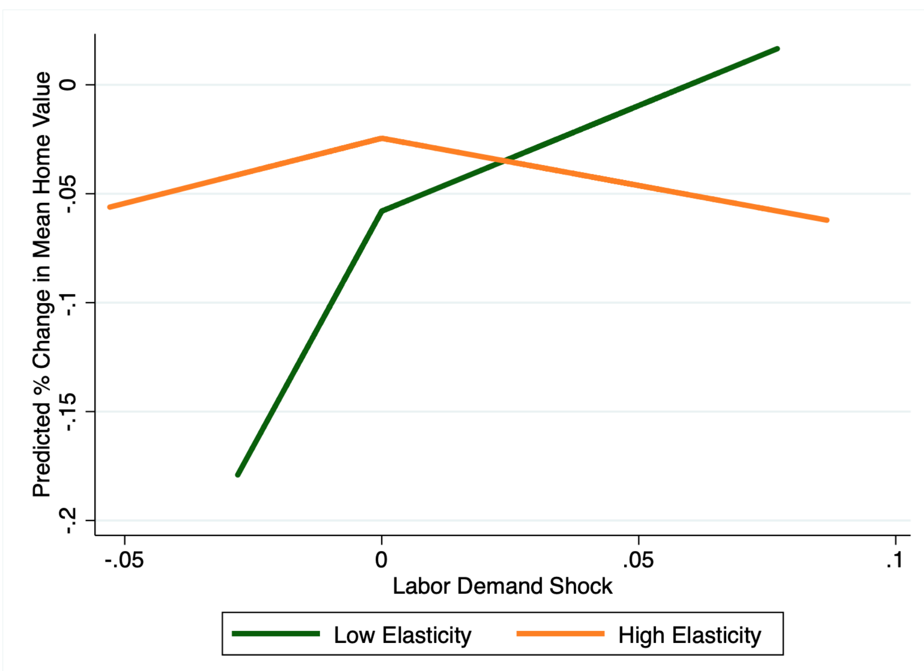
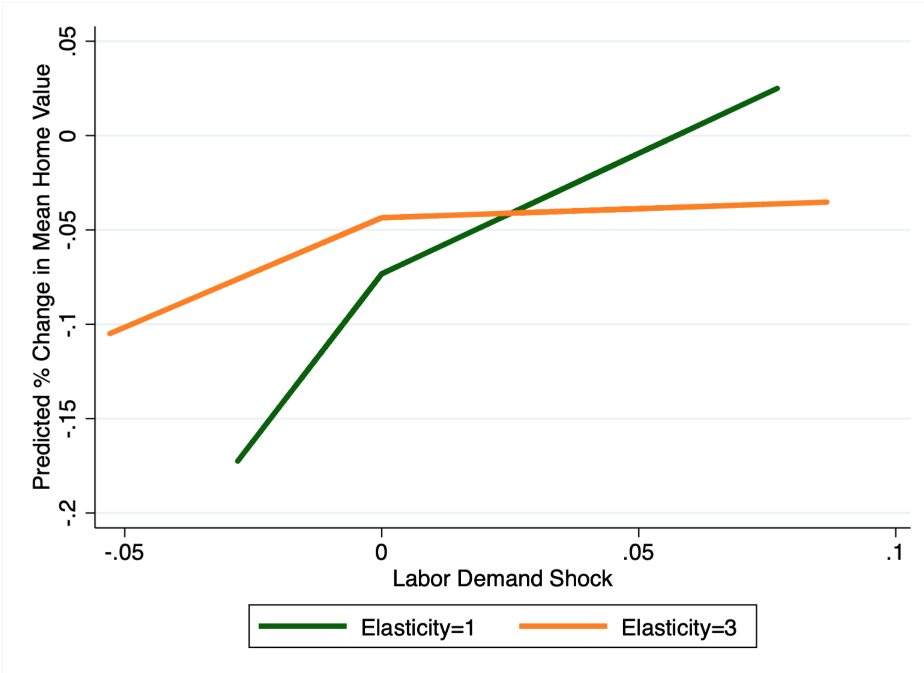


Figure 11: Predicted Mean House Price Changes and the Labor Demand Shock




supply. Low elasticity MSAs seem to have a sharper kink in their housing supply curve than high elasticity MSAs, where the housing supply is much flatter across the board.

In other words, a positive labor demand shock in Indianapolis (a high elasticity MSA) will cause house prices to increase less than a *negative* shock of equal magnitude will cause them to fall. The same fact is true in San Francisco (a low elasticity MSA). However, it is also true that a negative labor demand shock of the same magnitude will cause house prices to fall more in San Francisco than Indianapolis.

# B Alternate Categorization of MSAs

The main results presented in Section 5 are robust to assigning MSAs to their house supply elasticity categories in a different way. The main specification categorizes MSAs as high or low elasticity according to whether they are in the top or bottom 40 percentiles of the house supply elasticity distribution. However, one can also define high or low elasticity categories by whether the MSA's house supply elasticity is above or below the median. Results of estimating Equation (3) using these alternate categories can be seen in Table 9.

The wealth effect is strongest in low elasticity MSAs and absent in high elasticity ones. Moreover, the difference in the wealth effect is also significant across the two categories, as can be seen in the last row of the last column.

Table 9: Robustness Check: Effect of the Labor Demand Shock on Owners and Renters

| | All MSAs | Low Elasticity MSAs | High Elasticity MSAs | All MSAs |
|---|---|---|---|---|
| Shock | 0.022** | 0.021** | 0.046 | 0.028** |
| | (0.010) | (0.010) | (0.033) | (0.011) |
| Owner | -0.039*** | -0.040*** | -0.038*** | -0.044*** |
| | (0.007) | (0.008) | (0.012) | (0.008) |
| Shock x Owner | -0.004 | -0.013** | 0.010 | -0.012** |
| | (0.005) | (0.006) | (0.006) | (0.006) |
| Shock x Owner x | | | | 0.021** |
| High Elasticity | | | | (0.009) |
| N | 12282 | 7564 | 4718 | 12282 |
| R-sq | 0.051 | 0.056 | 0.048 | 0.052 |

Robust standard errors clustered at the MSA-level in parenthesis. All regressions include controls for demographics, a quadratic in age, income, and wealth. They also include time period and MSA-specific fixed effects. MSAs are categorized as "high" or "low" elasticity according to whether they are above or below the median of the house supply elasticity distribution.

* p<0.10 ** p<0.05 *** p<0.01