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Dynamism Diminished: The Role of Housing Markets and Credit Conditions

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Abstract

The share of American employees at young firms (less than five years old) moves procyclically around a declining trend in recent decades, falling from 18 percent in 1987 to 9 percent in 2013. The Great Recession and its aftermath involve the worst relative performance of young firms in the past 35 years. In this light, we investigate the role of housing markets and credit conditions in the fortunes of younger firms. We show that young-firm employment shares covary strongly and positively with local cycle conditions and local house price growth. We then pursue several empirical strategies to assess the effects of housing prices and credit supply on young-firm activity. Our preferred IV estimates in annual MSA-level data show large effects of local house price changes on changes in young-firm activity shares and a separate role for exogenous shifts in bank lending supply. Aggregating the local effects to the national level, housing market ups and downs are an important driver of medium-run fluctuations in young-firm activity since at least the mid-1980s. The great housing bust after the mid-2000s largely drove the further collapse of young-firm activity during the Great Recession, reinforced by the effects of a contraction in bank loan supply.

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I. Introduction

Workers at young firms – less than 60 months since first paid employee – fell from 17.9 percent of private sector employees in 1987 to 9.1 percent in 2013 (Figure 1). This pronounced shift away from young firms is part of a broader secular decline in business formation rates, business volatility, the pace of job reallocation, and worker mobility rates in the United States.[1] Overlaying these long-term developments, Figure 2 shows how the growth of young-firm activity varies cyclically. Each bar shows the average annual log change in the young-firm employment share during the indicated cycle episode, deviated about the mean annual change from 1981 to 2013. The young-firm share typically rises relative to trend in aggregate expansions and falls in contractions. Except for the early 2000s, the negative young-firm response to contractions intensified over time, and the positive response to expansions weakened. Indeed, the Great Recession and its aftermath involve the worst relative performance for young firms in the last 35 years.

In light of these developments, we investigate two related questions: First, what is the role of credit market conditions in the fortunes of younger firms? Second, what is the role of housing market developments, especially the massive boom and bust since the late 1990s? To address these questions, we exploit abundant spatial and time-series variation in local housing market and credit conditions. Our main goal is to understand the forces that drive cyclical and medium-run fluctuations in the performance and activity shares of young firms at the local and national levels. Recent work by Davis and Haltiwanger (2014) and Karahan et al. (2015), for example, consider forces behind the long-term shift away from younger firms.

Section II describes our data sources for young-firm activity measures, housing prices, housing supply elasticities, credit supply shifts, and cyclical conditions at the aggregate and local levels. Section III first expands on our characterization of trend and cyclical movements in young-firm activity. At the national level, the Great Recession involved an historic deterioration in young-firm performance (relative to a declining trend) on multiple margins, including the firm startup rate and the growth rate of young relative to older firms. At the state level, changes in young-firm employment shares covary strongly and positively with local cycle conditions and

[1] These secular developments are well documented in recent work and the subject of active study. See Davis et al. (2007), Davis et al. (2010), Davis, Faberman and Haltiwanger (2012), Fujita (2012), Lazear and Spletzer (2012), Hyatt and Spletzer (2013), Davis and Haltiwanger (2014), Decker et al. (2014ab), Haltiwanger, Hathaway and Miranda (2014), Hathaway and Litan (2014ab), Karahan et al. (2015), Pugsley and Şahin (2015) and Raven et al. (2016).

with the growth rate of local house prices. Motivated by this evidence, Section IV discusses several channels through which local house price movements potentially drive young-firm activity. We stress that housing market conditions can affect young firms and the local economy through a variety of wealth, liquidity, collateral, credit supply and consumption demand effects.

Section V takes up several approaches to estimating causal effects on young-firm activity. We first consider state-level panel regressions that relate changes in young-firm employment shares from 1981 to 2013 to changes in local house prices, while controlling for state fixed effects and local and national business cycle conditions. Here, identification relies on a difference-in-difference empirical design plus controls to isolate causal effects of house price movements. We then fit panel vector auto regressions (VARs) to the state-level data and rely on Cholesky decompositions to achieve identification. Both approaches suggest that housing price movements play an important role in medium-run fluctuations in young-firm activity shares. To quantify this role, we feed the state-level driving forces through the estimated panel regression or VAR model to obtain model-implied state-level paths for young-firm activity shares. We aggregate the state-level results to the national level and ask how well they account for the episode-by-episode cycle movements in Figure 2 and in analogs to Figure 2 that display year-by-year changes in young-firm activity shares.

Section V also considers estimation by instrumental variables (IV) in panel regressions using annual SMSA-level data. To obtain instruments that isolate exogenous variation in local house price movements, we interact local cycle variables with the Saiz (2010) housing supply elasticity measure. His measure reflects detailed studies of local zoning, regulatory and natural barriers to housing construction. The idea behind the IV strategy is that a given shock to local housing demand generates large differences in local house price movements due to exogenous spatial differences in housing supply elasticities. In the same spirit, previous studies exploit the Saiz measure to estimate the effects of local house price movements on the demand for locally produced goods and services, as in Mian and Sufi (2011). We supplement our IV approach for housing prices by building on Greenstone, Mas and Ngyugen (2015) to measure exogenous SMSA-level shifts in the supply of bank lending to small (and presumably younger) firms. The idea here is that large bank holding companies differ in their financial fortunes, geographic footprints and propensities to lend to smaller and younger firms. When a national bank pulls back from lending to smaller and younger firms in a given SMSA for reasons other than local economic conditions, it produces an exogenous drop in loan supply to young firms in the SMSA.

Compared to OLS estimation and the panel VAR specification, the IV approach yields larger estimated effects of local house price changes on young-firm activity shares. We also find a distinct role for exogenous shifts in local bank lending supply. Aggregating the local effects to the national level, housing market ups and downs are a major driver of medium-run fluctuations in young-firm activity shares, especially since the late 1990s. The great housing bust after the mid-2000s largely drove the further collapse of young-firm activity shares (relative to a declining trend) during the Great Recession, reinforced by the effects of a contraction in bank loan supply. Shifts in the supply of bank lending also played a material role in certain other cycle episodes – for example, contributing to the unusually mild cyclical contraction in young-firm activity in the early 2000s (shown in Figure 2). According to our estimates, a rebound in bank lending to smaller and younger firms in the 2010-13 expansion episode helped prevent an even larger decline in the young-firm employment share. Although data limitations compel us to use shorter sample periods in the IV estimation, we verify that OLS estimates of local house price movements on young-firm activity shares are similar when using state-level data from 1981 to 2013 or data on 222 SMSAs in shorter samples.

In Section VI, we turn to data and empirical designs that exploit industry-level variation, typically in combination with some form of spatial variation, to improve our understanding of the channels through which local house price changes drive changes in the local young-firm activity shares. ***To be completed.***

We discuss related research at various points in the paper, including Section IV and the penultimate Section VII. Section VIII takes stock of what we learn from our empirical investigation and offers concluding remarks.

II. Data Sources

a. Young-Firm Activity Measures

Fort et al. (2013) and Davis and Haltiwanger (2014) show that spatial and industry variation in job flows, worker flows, and growth rate differentials by firm size and age provide much scope for analysis and identification. We adopt a broadly similar approach, exploiting data sets that offer variation by firm age, firm size, industry and geography (State or SMSA). Our outcome data derive from administrative records that cover all firms with paid employees. A key advantage of the resulting activity measures is that they are not subject to missing observations or sampling variability, even within narrow geographic and industry cells.

Our analysis of young-firm activity relies heavily on two Census Bureau statistical products: Business Dynamic Statistics (BDS) and Quarterly Workforce Indicators (QWI). The BDS includes employment statistics by firm size, firm age, state, SMSA and industry tabulated from micro data in the Longitudinal Business Database (LBD).[2] The LBD covers the universe of firms and establishments in the nonfarm business sector with at least one paid employee. Employee counts pertain to the payroll period covering the 12th of March in each year from 1976 to 2013. While firm characteristics reflect the national firm, the BDS state (SMSA) activity measures cover all establishments operating in the state (SMSA) for the industry, firm size or firm age group. Because the BDS is built up from establishment-level data in the LBD, we know the detailed location of economic activity. A limitation of BDS statistics is that young-firm activity measures are available only for the 222 largest SMSAs.

For our purposes, it is essential to measure firm age in a suitable manner and to consistently track young-firm activity over time. Firm age in the BDS reflects the age of its oldest establishment when the firm first became a legal entity. In turn, establishment age equals the number of years since operations began (as indicated by one or more paid employees) in the establishment's current narrowly defined industry. For a startup business comprised of all new establishments, firm age is initially set to zero. For firms newly created from one or more existing establishments through a merger, spinoff or corporate reorganization, firm age is initially set to the age of its oldest establishment. From that point forward, the firm ages naturally as long as it exists. Simple ownership changes do not trigger a change in firm age, and the BDS concept of business startups reflects the number of new firms with only age-zero establishments. These features of the BDS are a major strength, as they ensure that our young-firm activity measures and their evolution are not distorted by firm restructurings and ownership changes.

For simplicity and brevity, our analysis focuses on two age groups: "young" firms less than five years old (fewer than 60 months), and "mature" firms that are at least five years old. Using these definitions, the BDS enables us to track young- and mature-firm activity measures at the national and state levels in a consistent manner from 1981 to 2013 and from 1992 to 2013 at the SMSA level. The BDS reports employment and firm counts as of March in the indicated year and March-to-March changes and growth rates. Appendix A provides more information about the level, change and growth rate statistics in the BDS and how we exploit the data.

[2] The BDS is a public use database and is downloadable at www.census.gov/ces/dataproducts/bds/index.html.

The BDS does not simultaneously classify young-firm activity measures by state (or SMSA) and industry. To overcome this limitation, we turn to the QWI for parts of our analysis. The QWI tracks young-firm employment on a quarterly basis by state (or SMSA), firm age and industry for more than 30 states starting in 1998:1 and continuing through 2014:4. The firm age concept in the QWI follows the BDS exactly.

b. Local and National Cycle Indicators

We supplement our young-firm activity measures with local and national business cycle indicators. At the state and SMSA level, we use unemployment rates from the BLS Local Area Unemployment Statistics (LAUS) program, which draws on data from the Current Population Survey, Current Employment Statistics, claims for unemployment insurance benefits and other sources. We have consistent measures of unemployment rates at the state level from 1980 to 2013 and at the SMSA level from 1990 to 2013. We use real GDP growth rates as a national business cycle indicator.

c. Local Housing Price and Supply Elasticity Measures

We measure house price changes using data at the state and SMSA levels from the Federal Housing Finance Agency (FHFA). These data are available for the entire 1981-2013 period considered in our analysis. Local house price movements are undoubtedly endogenous with respect to local economic conditions. As we detail below, we isolate exogenous variation in local house price movements by interacting indicators of local business cycle conditions with the Saiz (2010) measure of the local housing supply elasticity. His measure, available at the SMSA level, reflects a careful effort to quantify supply elasticities based on detailed studies of local zoning, regulatory and natural topographic and geophysical barriers to residential housing construction. Compared to previous work that exploits the Saiz measure to isolate exogenous variation in local house price movements, we take a different approach to instrument construction. We also consider the effects of house prices on local young-firm activity rather than their effects on the demand for local non-traded goods and services (e.g., Mian and Sufi, 2011) or on self-employment and employment in small establishments (e.g., Adelino et al, 2015).

d. Bank Lending Measures

We follow Greenstone, Mas and Ngyugen (2015) (hereafter GMN) in using data on small business loan activity that banks file in compliance with the Community Re-Investment Act of 1996 (CRA). The CRA requires banks with assets greater than 1 billion to report annually on small business loans at the county level. We aggregate these CRA data to the SMSA level. Like

GMN, we consider the volume of loans to businesses with less than $1 million in gross revenue. We build on the GMN approach to construct local "small" business loan supply shocks using a modified Bartik-like approach, as detailed in Section V.d below. Although the CRA data explicitly specify loans to small business, we think there is likely to be considerable overlap between credit supply shifts for small business lending and credit supply shifts for young business lending. Our empirical results support that view.

When integrating data across sources, we pay careful attention to the timing of the observations. BDS employment covers the payroll period covering the 12th day of March in each calendar year. We measure employment changes and changes in all other variables over the same March-to-March intervals. It is straightforward to align the timing for most of our variables, because they are available on a monthly or quarterly basis. The annual CRA data are an exception. Appendix C provides details of how we construct our CRA-based measures.

III. Secular, Cyclical and Spatial Patterns in Young-Firm Activity

a. Aggregate Measures of Young-Firm Activity

The patterns depicted in Figures 1 and 2 reflect changes along several margins at young and mature firms. To see this point, write the change from *t-1* to *t* in young-firm employment as

$$E_t^{a<5} - E_{t-1}^{a<5} = [E_t^0 + \sum_{a=1}^{4}(E_t^a - E_{t-1}^{a-1})] - E_{t-1}^4 \equiv NET_t^{a<5} - E_{t-1}^4 \qquad \text{(III.1)}$$

where $E_t^{a<5}$ is employment in young firms (age<5) in year *t*, E_t^0 is employment in startup firms (age=0) in *t,* and E_t^a is employment in firms of age *a* in *t*. This accounting identity says that the young-firm employment change equals the net change among firms that remain young, inclusive of new employment at startup firms, minus employment at firms that age out of the young group. Similarly, the employment change from *t-1* to *t* among mature firms is the net change among the already mature as of *t-1* plus employment at firms that age into the mature group in *t.* A parallel set of accounting relationships holds for the numbers of young and mature firms.

We typically express young-firm employment as a share of total private-sector employment. Thus, Figure 1 plots the evolution of $E_t^{a<5}/E_t$, where E_t is the count of all paid employees in the nonfarm private sector in March of year *t.* Figure 2 plots the average annual value of $ln(E_t^{a<5}/E_t) - ln(E_{t-1}^{a<5}/E_{t-1})$ for each cycle episode, deviated about its mean value from 1981 to 2013. See Appendix A for more on how we measure young-firm activity.

Appendix B presents additional evidence on the secular and cyclical behavior of young-firm activity measures, which we summarize here. Appendix Figure B1 shows a strong secular decline in the firm startup rate since the mid 1980s, a further large drop in the Great Recession, and little recovery afterwards. The firm exit rate moves counter cyclically with little or no trend.[3] The net entry rate of firms actually turned negative in the Great Recession for the first time since at least 1981, and it remains near zero more recently. These developments translate into a pronounced drop in the share of firms with paid employees that are less than five years old – from nearly 45 percent in 1981 to 28 percent in 2013 (Figure B2).

Figure B3 reports net growth rates for young-firm and mature-firm employment, inclusive of entry and exit for each age group.[4] For changes from *t-1* to *t,* the BDS classifies establishments into firm age groups based on age of parent firm at *t*. Young firms exhibit much higher net growth rates than mature firms. This pattern underscores the importance of young firms in the job creation process, as highlighted in Haltiwanger et al. (2013). However, young firms exhibit larger growth rate declines in downturns, especially so in the Great Recession. In fact, the net employment growth rate of young firms plummeted from 24 percent in 2006 to 8 percent in 2009, a dramatic negative swing of 16 percentage points. By way of comparison, the net employment growth rate of mature firms fell from zero in 2006 to minus 6 percent in 2009.

The appendix also presents analogs to Figure 2 for other young-firm activity measures. Figure B4 shows that the early 1980s and the Great Recession saw especially large declines relative to trend in the young-firm share of all firms with paid employees. Figure B5 shows that the net employment growth rate of young firms saw especially large declines relative to mature firms in the 1990-91 downturn and in the Great Recession. It's worth stressing that the Great Recession involved an historic deterioration in young-firm performance for all of the activity measures we consider. In what follows, we focus on the young-firm employment share, but Figures A1-A5 show that secular declines and procyclical movements in young-firm performance are present on several margins.

b. State-Level Fluctuations in Young-Firm Employment Shares

[3] The BDS measure of firm exit rates reflect legal entities that shut down all establishments. Like the startup rate, the BDS exit rate concept is designed to abstract from firm ownership changes and M&A activity.

[4] The BDS follows Davis, Haltiwanger and Schuh (1996) in calculating group-level growth rates as the employment weighted average of establishment-level growth rates in the group, where each establishment's growth rate is measured as its change from *t-1* to *t* divided by the simple average of its employment in *t-1* and *t.*

Our empirical study exploits spatial and time variation to investigate the influence of credit conditions and housing markets on young-firm activity. To help motivate this approach, Figure 3a presents a scatter plot of log differences in young-firm employment shares (vertical axis) against changes in the unemployment rate (horizontal axis) at the state-year level for the period from 1981 to 2013. There is considerable state-level time series variation in these measures, which we will use in our econometric investigation. Figure 3a also highlights a strong inverse relationship between changes in young-firm employment shares and changes in local economic conditions. An increase in the state-level unemployment rate of one percentage point is associated with a 1.77 log point drop in the state's young-firm employment share.

Figure 3b provides additional motivation for our econometric investigation. It shows the contemporaneous relationship between log differences in the young-firm employment share (vertical axis) and log differences in real housing prices at the state-year level from 1981 to 2013. Greater house price appreciation in a state tends to coincide with a larger rise (or smaller fall) in its young-firm employment share. A real house price gain of 10 log points in a state is associated with an increase in its young-firm employment share of 3 log points. The *t*-statistic for this relationship is about 15.[5] Appendix Figures B6 and B7 show that greater house price appreciation in a state also coincides with a larger rise (or smaller fall) in the young-firm share of all firms with paid employees and in the firm startup rate.

Figure 3b and the related results in Figures B6 and B7 might appear at odds with results in Hurst and Lusardi (2004). Using data from the Panel Study of Income Dynamics (PSID) and regional house price variation from 1985 to 1988, they test whether households in Census regions with strong house price gains were as unlikely to start a business as households in other regions. They do not reject this hypothesis. Restricting our state-level panel data to the 1985-1988 period in Hurst and Lusardi, and rerunning our Figure 3b regression, yields an estimated coefficient of 0.29 (0.06). So different sample periods do not explain our different results. Instead, we think the different results reflect important conceptual and measurement differences between our study and theirs. First, business starts in the PSID include those with no employees, while our measures consider only firms with paid employees. Davis et. al. (2009) show that non-

[5] There are some large outliers in Figure 3b in terms of the log difference in the young employment share. We find that the estimated relationship is robust to winsorizing the log difference in the young employment share at the 99.75 and the 0.25 (one quarter of one percent) percentiles. The estimated slope coefficient is 0.29 (0.02) with the winsorized data compared to 0.30 (0.02) in Figure 3b.

employer businesses are much more numerous than employer businesses, but most non-employer businesses are very small, contribute little to aggregate economic activity, and have low probabilities of ever hiring a worker. Second, our use of administrative data sources yields much more precise estimates of young-firm activity in narrower geographic areas.

Figures 3a and 3b also indicate that the empirical relationships among changes in unemployment rates, house prices and young-firm employment shares are approximately (log) linear in our data. We will largely stick to linear specifications in our econometric analysis below. In unreported results for the panel regressions in Section V below, we found little evidence of departures from linearity.

In summary, Figures 3a and 3b tell us that stronger state-level economic conditions and rising house prices in a state involve an increase in the state's *share* of economic activity accounted for by young firms. Of course, these empirical relationships do not tell us why young-firm activity shares covary strongly with local conditions, but they suggest the possibility that housing market developments have important causal effects on young-firm activity shares. Hurst and Stafford (2004), Mian and Sufi (2011), Mian, Sufi and Trebbi (2015) and Agarwal et al. (2015), among others, find evidence that house price appreciation stimulates household spending and local economic activity more generally. As noted, our focus is on the effects of house price movements on young-firm activity shares.

IV. Housing Price and Credit Market Transmission Channels

Local housing market conditions potentially affect young-firm activity and the local economy through a variety of wealth, liquidity, collateral, credit supply, and consumption demand channels. Independent of housing market conditions, other local and national developments can shift the supply of credit that young firms tap to finance their activities. Empirically, Robb and Robinson (2012) show that young firms finance their activities using home equity loans, personal loans, bank loans, and personal wealth.

Much previous research finds a positive empirical relationship between personal wealth and the propensity to start or own a business. Examples include Evans and Jovanovic (1989), Holtz-Eakin et al. (1994), Gentry and Hubbard (2004) and Hurst and Lusardi (2004). Empirical studies that specifically consider the impact of changes in home equity values on the propensity to become self-employed or otherwise start a business include Black et al. (1996), Fan and White (2003), Fairlie and Krashinsky (2012), Harding and Rosenthal (2013), Adelino et al. (2015) and

Schmalz, Sraer and Thesmar (2015). Jensen et al. (2014) exploit high-quality Danish micro data and a legal change in 1992 that, for the first time, allowed home equity to serve as collateral in bank loans to finance consumption expenditures or business investment. This exogenous relaxation of collateral constraints led to an increase in new business formation, more so for households that experienced larger increases in usable collateral.

We now describe several channels through which house price changes and credit supply shifts can affect business startup rates and young-firm activity shares.

Wealth Effects

A classic paper by Khilstrom and Laffont (1979) models the choice between operating a risky firm and working for a riskless wage in general equilibrium. Individuals in their model differ in absolute risk aversion levels. The least risk-averse individuals become entrepreneurs, and the rest choose to be workers. Under certain regularity conditions, greater risk tolerances in the population lead to a greater number of entrepreneurs in equilibrium and higher wages. While Khilstrom and Laffont do not model the determinants of risk aversion, a time-honored view in economics holds that absolute risk tolerance increases with wealth. Guiso and Paiella (2008) provide evidence. Thus, by raising wealth levels, a local house-price boom increases risk tolerances among local homeowners and thereby stimulates new firm formation.

If existing young-firm owners face a similar tradeoff between less risky (stay small) and more risky (become larger) undertakings, then wealth gains among existing young-firm owners lead to increases in their business activity levels. Kihlstrom and Laffont describe conditions that ensure more risk-tolerant entrepreneurs run larger firms. Thus, insofar as many young-firm owners also own homes, a housing price boom (bust) will lead to an expansion (contraction) in young-firm activity levels. Of course, this mechanism also applies to homeowners who own mature firms. We think local young-firm activity levels are likely to exhibit a larger proportional response to local house price growth for two reasons: young-firm owners are more likely to own a home in the same area as their businesses, and home equity is likely to form a larger share of overall wealth for young-firm owners as compared to mature-firm owners.

In short, the entrepreneurial choice model of Khilstrom and Laffont, plus standard views about wealth and risk tolerance, imply that local house price booms (busts) cause an upturn (downturn) in the local firm startup rate and in the local young-firm activity share. The latter implication also rests on an auxiliary assumption of greater proportional responses to local house price changes among young-firm owners.

Wealth effects on young-firm activity shares can also arise for other reasons. Hurst and Pugsley (2015) focus on the non-pecuniary benefits of business ownership such as "wanting to be my own boss" and "wanting to pursue my passion." They model the non-pecuniary benefits of business ownership as separable from the utility of other consumption goods. Thus, as wealth rises and the marginal utility of other consumption falls, households become more inclined to indulge their tastes for business ownership. Effectively, owning a business is a normal good, the demand for which rises with wealth. If local house price gains (losses) lead to higher (lower) expenditures on other consumption goods, then housing booms (busts) nudge additional households into (out of) business ownership. Local house price movements are likely to affect expenditures on other consumption goods in the same direction, either because households are willing to finance those expenditures with home equity, or because they anticipate moving to another locality later in life.

The Hurst-Pugsley mechanism provides a clear transmission channel from increased housing wealth to greater self-employment. The implications for startups with paid employees and young-firm activity shares are less clear. "Wanting to be my own boss" is a motive for self-employment, but it does not require a business with paid employees. However, owning a business with paid employees indulges a taste for bossing others. So, depending on their precise nature, the non-pecuniary benefits of owning a business may or may not translate into a wealth effect on the formation of new businesses with paid employees or on young-firm activity shares.

Liquidity and Collateral Effects

Evans and Jovanovic (1989) focus on differences in entrepreneurial ability and liquidity constraints as the key factors determining which individuals start a business. A large follow-on literature concludes that relaxing credit constraints at the household level leads to greater self-employment and more business startups. Examples include most of the studies cited above on the impact of changes in home equity values on the propensity to become self-employed or otherwise start a business. The idea in these studies is that households can tap home equity gains to relax liquidity constraints, increasing their ability to finance new and young businesses. Moreover, banks that make loans to these households (or their businesses) collateralized by home equity become more willing to extend credit as house price gains yield greater home collateral values. Of course, home equity collateral can serve to finance the expansion of mature firms as well. As in our discussion of wealth effects, we think there are sound reasons to

anticipate proportionally greater effects of local house price gains on local young-firm activity relative to local mature-firm activity.

As stressed by Hurst and Lusardi (2004) and Hurst and Pugsley (2015), it can be quite challenging to disentangle wealth and liquidity effects on the propensity to own or start a business. If house-price movements affect young-firm activity shares predominantly through wealth effects due to the non-pecuniary considerations stressed in Hurst and Pugsley (2015), we might expect to see more pronounced effects of exogenous local house-price movements on young-firm activity shares in businesses that require little in the way of start-up costs or working capital. Such businesses offer non-pecuniary benefits of business ownership at lower costs and less risk than businesses with high startup costs and working-capital requirements. This observation motivates some of our investigations with industry-level data in Section VI.

Credit Supply Shifts

New and young firms often rely on the owner's personal wealth to finance business activities, but their very newness implies little accumulation of business equity. And only a small fraction of young firms are well positioned to raise equity or debt capital from external investors. For these reasons, new and young businesses are likely to be especially sensitive to credit supply shifts. In this regard, we include bank loans to young businesses, bank loans to the owners of young businesses (perhaps secured by housing collateral), personal credit cards, and any other sources of credit that young-firm owners or young firms tap to finance young-firm activities.

For our purposes, it is important to distinguish among various sources of shifts in local credit supply. First, the lending capacity of local banks is affected by local economic conditions. Insofar as new and younger firms are relatively dependent on credit from local banks, shocks to the lending capacity of local banks has a greater (proportional) effect on young firms. The same point holds for local housing market developments that affect the lending capacity of local banks. When local banks suffer losses due to a bust in the local housing market, their lending capacities diminish and the credit supply effects are likely to weigh more heavily on younger firms. In other words, the effect of house price movements on young-firm activity shares works partly through the impact of housing market developments on the capacity of local lending institutions to extend credit to young firms and their owners. This observation motivates some of our empirical investigations that exploit cross-area differences in the importance of local versus national banks. Other things equal, the impact of local housing market developments on local

young-firm activity shares – working through the credit supply channel – is smaller when local banks are less important as a source of credit to the local economy.

Second, both local and national banks are likely to see local housing prices as indicators of (future) local business conditions, affecting their willingness to lend. To be sure, this link between house prices and bank lending reflects a perceived shift in business fundamentals rather than a shift in credit supply for businesses of a given quality. Nevertheless, the impact of such a shift in bank willingness to lend to local businesses or their owners falls more heavily on young firms for reasons we have discussed.

Empirically, local house price changes are strongly related to changes in the real volume of bank loans extended to local small (and presumably younger) businesses. We document this empirical regularity in Figure 4. To construct the figure, we first regress annual log changes in real housing prices and the real volume of bank loans to small businesses on state and year effects and annual changes in the state-level unemployment rate. We use the state-level small business loan volume measure described in Section II.d. We then plot the residuals from the loan volume change regression against the ones from the house price change regression. Even after sweeping out state, year and local cycle effects, we obtain a strong relationship between house prices and bank loan volume to small businesses. The empirical elasticity of local small business loan volume with respect to local house prices is 0.46 with a t-statistic of about 8.

Third, local credit supply can shift due to factors that are exogenous to local economic conditions and to local businesses. For example, when a national bank pulls back from lending to smaller and younger firms in a given SMSA for reasons other than local economic conditions, it produces an exogenous drop in loan supply to young firms in the SMSA. Our empirical investigations below exploit this type of exogenous variation in bank loan supply to estimate the causal effects of local credit supply shifts on local young-firm activity shares.

Non-uniform Consumption Expenditure Responses

Perhaps young firms supply goods and services with demands that are relatively sensitive to house price fluctuations. In this regard, it's worth recalling our earlier evidence that changes in young-firm activity shares covary strongly with business cycle conditions in national and state-level data. These patterns suggest that demands for the goods and services supplied by young firms are more income elastic than the demands for mature-firm products. If so, then local young-firm demands are also likely to be more elastic with respect to wealth shifts induced by local housing market ups and downs.

To assess whether this type of non-uniform consumption demand shift drives a greater response of young-firm activity shares to local house price movements, we undertake two sets of investigations in Section VI below. First, we ask whether local young-firm activity shares are more responsive to local house price changes in industries that produce mainly for local consumption. Second, we ask whether the response of local *industry-level* activity to local house price changes depends on the industry's firm-age structure in the local economy. The firm-age structure of the local industry is irrelevant for the size of the non-uniform consumption expenditure effect. In contrast, the wealth, liquidity and credit supply effects imply that the response of local industry-level activity increases in the young-firm share of industry activity.

V. Estimating Effects on Young-Firm Activity Shares

a. Overview of Estimation, Identification and Aggregation

We consider several approaches to estimating the effects of housing markets and credit conditions on young-firm activity. We start with panel regressions that relate log changes in young-firm activity shares to log changes in real house prices from 1981 to 2013. We include state effects in the regressions to control for omitted factors that drive trend differences across states in the evolution of young-firm shares, and we include national and local cycle indicators to control for the endogeneity of housing prices with respect to economic conditions. Our panel regressions correctly identify the causal effect of local house price changes on local young-firm activity shares only if the difference-in-difference design and the right-side variables fully control for house price endogeneity and omitted factors correlated with house price changes.

Next, we fit panel VARs to the same data. Imposing a Cholesky ordering on the reduced-form residuals, the VAR identifies housing price innovations that are orthogonal to lagged and contemporaneous local and national cycle variables. It also identifies dynamic responses to those innovations. While the VAR approach more fully controls for the effects of economic conditions on house price movements, it remains subject to concerns about endogeneity and omitted variable bias. Despite the uncertain identification of causal effects in the panel regressions and panel VARs, they are, at a minimum, useful tools for characterizing the contemporaneous and dynamic relationships between housing prices and young-firm activity shares.

Our preferred approach to estimating causal effects of local house price changes relies on an instrumental variables (IV) strategy. We use SMSA-level variation in housing supply elasticities from Saiz (2010) interacted with time-varying local economic conditions to construct

instruments. The basic idea of our IV strategy is the same as in Mian and Sufi (2011) and several other studies. Our instrument construction differs, however, because we want local time-series variation. Our SMSA-level investigation also considers local small business loan supply shocks following GMN (2015). We combine the IV strategy for estimating the causal effect of house price changes on young-firm activity shares with the GMN approach to identify a distinct role for exogenous loan supply shifts.

We use our estimation results to quantify the contribution of house price movements and exogenous loan supply shifts on aggregate young-firm activity shares. For each approach to estimation and identification, we obtain model-implied paths for changes in the local young-firm employment shares, which we aggregate to the national level. These exercises help assess the quantitative implications of our estimates. Their interpretation warrants some care, however – in part, because correctly identified causal effects at the local level need not aggregate in a simple manner. For example, a drop in young-firm activity in one area may lead to greater young-firm activity in other areas. When this type of spatial equilibrium response is important, our aggregation overstates the national effects of house price movements. Alternatively, if young-firm activity in one area has positive spillover effects on young-firm activity in other areas, our aggregation understates the national effects of house price movements. In addition, our specifications neglect the effects of house-price declines in other areas on young-firm activity shares in, say, area A, when actual or prospective owners of young firms in A own homes in other parts of the country. Insofar as this pattern is prevalent, our estimates and aggregation exercises understate the national effects of house price movements. Finally, our specifications are unlikely to capture the full impact of national housing booms and busts working through their effects on credit supply. Our measure of exogenous shifts in local small business loan supply is helpful in this respect, but it imperfectly measures shifts in credit supply to young firms, and it does not isolate shifts due to housing market developments.

In thinking about the interpretation of our aggregation exercises, it is also important to distinguish between the role of locally exogenous house price changes in driving young-firm activity shares and the role of local house price changes in the transmission channel for shocks that originate elsewhere. For example, higher oil prices boost housing demand and housing prices in oil-producing areas, which potentially increases the area's young-firm activity share through the effects described in Section IV. In this example, housing price changes are part of the transmission channel through which an oil price shock affects young-firm activity.

When we quantify and aggregate the estimated effects of house price changes on young-firm activity shares, we multiply the IV estimates by the full changes in local housing prices. This exercise captures the full effect of housing price changes on young-firm activity shares, including the role of housing prices as a transmission channel through which other exogenous shocks drive fluctuations in housing prices. We think this full effect is an interesting and important quantity. Isolating the role of house-price changes as an exogenous driver of young-firm activity shares requires additional assumptions to disentangle the exogenous and endogenous components of house-price movements.[6] In fact, our panel VAR approach isolates the exogenous component of local house price movements and their dynamic effects on young-firm activity shares under the (strong) Cholesky ordering assumption. In short, if our IV and panel VAR identification assumptions hold, and our estimated local effects are suitable for aggregation, the panel VAR approach captures the effects of locally exogenous housing price movements on young-firm activity shares, and the IV results give us the full effect.

b. State-Level Panel Regressions

In this section, we report the results from using panel regression specifications such as:

$$Y_{st} = \lambda_s + \lambda_t + \alpha * CYC_{st} + \beta * HP_{st} + \varepsilon_{st} \qquad \text{(V.1)}$$

where *s* is state, *t* is time period (year), *Y* is the log difference in the share of employment accounted for by young firms, λ_s is a set of state fixed effects, λ_t is a set of time fixed effects, CYC_{st} is a local cyclical indicator, HP_{st} is the growth in real housing prices in the state year cell, and ε_{st} is the residual.[7] The local cyclical indicator is the change in the unemployment rate at the state level. We consider specifications with and without time (year) fixed effects. Even without time effects, the specification controls for both national and local cyclical variation since the state-level change in the unemployment rate reflects variation at both the national and local level.[8] The estimates without year effects are of interest since they exploit aggregate variation

[6] The first-stage in the IV estimation identifies exogenous house-price movements, but there's no reason to think that it captures most or all of the exogenous house-price movements.

[7] In unreported results, we have estimated specifications with the dependent variable being the share of young firms and the net difference in the employment growth rates between young and mature firms. During contractions, the share of young firms declines and the net differential in employment growth rates between young and mature firms declines. Increases in housing yield increases in both of these measures.

[8] In unreported results, we have also estimated the specifications without year effects with

in housing prices that may be important for identifying the impact of housing prices on young firm activity, while controlling for cyclical variation at the national and local level.

Table 2 reports OLS regression results of equation (1) using data from 1981-2013. The chief result is the strong positive impact of local housing price growth on young firm activity. A 10 log point increase in local real housing prices results in a 2.2 log point increase in the local young-firm employment share without year effects and 1.2 log point increase with year effects. These estimated effects are statistically significant at the 1 percent level. In interpreting these results, observe that it reflects the impact of local housing prices controlling for the business cycle. In terms of the influence of the latter, we find that, consistent with the basic facts reported in section III (and Figures 1 and 2), the share of young firm activity declines sharply in economic contractions.

To quantify the economic significance of the estimates in Table 2, we use the estimated coefficients on the impact of housing prices and actual housing price growth rates to quantify the variation in the young firm share of activity due to housing price changes alone. We compare this to actual variation in Figure 5 on an annualized basis for indicated cyclical episodes. These housing price counterfactuals are reported using the specification with and without year effects. For each specification, we construct the counterfactuals using the actual housing price changes but with the estimated coefficients from the relevant specification. We conduct this exercise at the state-year level and then aggregate using appropriate employment weights: the state-level young firm share of employment averaged over t-1 and t. We express both actual and counterfactual as deviations from the mean to facilitate comparisons.[9]

Housing price variation tends to contribute substantially to the declines in the young employment shares in contractions and the rise in young employment shares in expansions. However, in the early 2000s, the rise in housing prices yields an implied increase in the young employment share relative to trend even in the contraction in 2001-03. During the Great

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additional national level controls. Specifically, we have included a quadratic in the growth rate of national GDP. The estimated coefficients on housing prices are very similar to those reported in Table 1. We focus on the more parsimonious specification in this section since it makes the impact of cyclical factors on the young employment share more transparent. In instrumental variable specifications considered in sections V.c and V.d where we rely even more heavily on specifications without year effects, our main specifications without year effects include these additional national controls.

[9] In unreported results, we have compared the actual growth in national housing prices with the employment-weighted growth of state-level housing price growth. The two series are virtually identical.

Recession, the sharp decline in housing prices accounts for about 45 percent of the actual decline of the young employment share in the specification without year effects and 24 percent with year effects. The continued decline in housing prices post Great Recession acted as a continued adverse influence on the young employment share.

Figure 5b illustrates the same counterfactuals on an annual basis. The year-by-year results show that the housing boom attenuated the secular decline in young firm employment share from 1998-2007 and accelerated the decline after 2007. [10] During the 1998-2007 period, the cumulative increase in the young employment share due to housing prices is 9 log points (relative to trend). During the 2008-13 period, the cumulative decrease in the young employment share due to housing prices is 7.4 log points (relative to trend). As noted above, caution needs to be used in interpreting these magnitudes given possible general equilibrium effects that may attenuate these effects. In addition, interpreting the panel regression estimates as causal requires stronger assumptions relative to the identification approaches we turn to now.

c. State-Level Panel VARs

We now turn to a panel VAR analysis. The specification we consider has the following form:

$$Z_{s,t} = A(L)Z_{st} + \lambda_s + \lambda_t + \varepsilon_{st} \qquad \text{(V.2)}$$

where Z is a vector of covariates, L is a lag operator of length L, and A(L) a matrix of lagged coefficients, λ_s and λ_t represent state fixed and year fixed effects and ε_{st} is the residual vector of innovations to each of the covariates. Identification is achieved both by taking into account lags (A(L)) but also by specifying a relationship between the reduced form innovations and structural innovations. That is, after absorbing the state and year effects we can invert the AR representation to form the MA representation given by:

$$\hat{Z}_{s,t} = D(L)\varepsilon_{st} = B(L)\eta_{st} \qquad \text{(V.3)}$$

where $\hat{Z}$ is the variation in *Z* after absorbing the state and year effects, D(L) are the MA coefficients from inverting the AR representation, and η_{st} represents the innovations to each of

[10] This figure uses the parameter estimates based on the specification without year effects.

the orthogonalized "structural" innovations after making some identifying assumptions. The relationship between D(L) and B(L) can be specified by: $B(L) = B_o D(L)$ where B_o represents the short run identifying assumptions. This panel VAR specification is consistent with the approach developed by Holtz-Eakin et. al. (1988). Like with the panel regression specifications considered above, we also consider specifications without year effects.

We specify Z={Change in State-Level Unemployment Rate, State-level Housing Price Growth, Log Difference in the Young Employment Share}. For identification, we use a simple lower triangular matrix for B_o– i.e., we use a Cholesky causal ordering. The change in unemployment rate at the state level is put first in the causal ordering. In the specifications with year effects, this is interpretable as an innovation to a generic state-specific cyclical shock. State-level housing price growth is next in the ordering. In the specifications with year effects, this does not reflect national housing price variation given the year effects. Also, since housing prices are second in the system, the housing price innovation is orthogonal to an indicator of local business cycle conditions. Even in the specifications without year effects, the orthogonalized housing price innovation reflects variation that is orthogonal to national and local cyclical factors since housing prices are second in the Cholesky ordering. The third variable in the ordering is the outcome variable of interest. We don't focus on innovations to this variable but such variation is interpretable as residual factors (such as allocative shocks) that impact the relative performance of young vs. mature firms independent of cyclical factors and housing prices.

Impulse response functions for one standard deviation innovations are reported in Figures B.8.a-B.8.d. The growth rate in housing prices declines sharply with an innovation to the change in the unemployment rate but has considerable residual and persistent variation (Figure A.6.b). The young employment share declines sharply with a positive innovation in the change in the unemployment rate and rises substantially with an innovation in the growth of housing prices. A one standard deviation in the orthogonalized innovation to housing prices (which itself is about 4 log points as seen in Figure B8.b) yields a one long point increase in the young-firm employment share. These effects diminish over time but still exhibit substantial persistence.

Figures 6a and 6b illustrate counterfactual exercises using the panel VAR results similar in spirit to those for Figures 5a and 5b. However, important details differ in the construction of these counterfactuals. In this case, we use the estimated impulse response functions in combination with the orthogonalized innovations estimated from the panel VAR model to

generate the counterfactuals.[11] In Figure 6a, we report results with and without year effects. For the specification with year effects, we use the estimated impulse response functions from that specification along with the shock process in the model without such year effects. The objective is to exploit national variation in housing prices in the counterfactual while using the impulse response functions that are estimated without exploiting such variation. For the specification without year effects, we use the estimated impulse response functions for that specification along with the same orthogonalized shocks that emerge from the same specification. Figure 6b reports the annual counterfactuals using the specification without year effects.

Despite rather different methodologies, the patterns in Figures 6a and 6b are quite similar to those in Figures 5a and 5b. If anything, the contribution of housing prices to the variation in the young employment share is greater in the panel VAR relative to the panel regression results. As in the panel regression results, the year-by-year results from the panel VAR show that the housing boom attenuated the secular decline in young firm employment share from1998-2007 and accelerated the decline after 2007. [12] During the 1998-2007 period, the cumulative increase in the young employment share due to housing prices is 9 log points (relative to trend) in Figure 6b. During the 2008-13 period, the cumulative decrease in the young employment share due to housing prices is 8 log points in Figure 6b.

We note that for Figure 6a and 6b we are exploiting only the orthogonalized innovations in quantifying the contribution of housing prices. Under the assumption that the Cholesky ordering yields causal estimates and appropriately parcels out the exogenous variation in housing prices, the exercise illustrated in Figure 6a and 6b is not subject to the concern raised above about using the full change in housing prices to calculate aggregate implications.

d. Panel Regressions with Instrumental Variables Estimation: Housing Prices

We return to panel regression specifications in this section but now using an instrumental variable approach for estimating the effect of housing price variation on the dynamics of young firm activity. To accomplish this, we use data at the SMSA level which permits exploiting SMSA variation in housing supply elasticities as developed by Saiz (2010). Specifically, we estimate specifications such as:

$$Y_{mt} = \lambda_m + \alpha * CYC_{mt} + \beta * HP_{mt} + X_t'A + \varepsilon_{mt} \qquad \text{(V.4)}$$

[11] This is essentially using an historical decomposition from the panel VAR based on the housing price shocks.

[12] This figure uses the counterfactual without year effects.

where m is SMSA, t is time period (year), Y is the log difference in the young employment share, λ_m is a set of SMSA fixed effects, CYC_{mt} is the change in the unemployment rate at the SMSA year level, HP_{mt} is the growth in real housing prices in the SMSA year cell, X_t is a set of economy-wide controls, and ε_{mt} is the residual. As with the specifications considered above, one specification is with year effects so X_t reflects year effects in this case. For the specifications without year effects, we include additional national level controls for the business cycle. Specifically, we include a quadratic in the national GDP growth rate. The use of additional cyclical controls facilitates our instrumental variables approach outlined below. Due to data availability at the SMSA level, we are restricted to estimating this specification over a shorter panel from 1992-2013.

We use Saiz (2010) housing supply elasticities in our instrumental variable approach. Saiz housing supply elasticities only vary in the cross section across SMSAs and we require instruments for housing price growth that vary both in the cross section and over time. We accomplish this by using as instruments the Saiz elasticities interacting with time varying factors. Specifically, we use a cubic in the (log) Saiz elasticity interacted with CYC_{mt}. That is, letting η_m be the (log) Saiz elasticity for SMSA m, the instruments are: $\eta_m * CYC_{mt}$, $\eta_m^2 * CYC_{mt}$, and $\eta_m^3 * CYC_{mt}$. Since we are controlling for SMSA fixed effects and CYC_{mt} directly in the second stage, identification is based on local housing price variation in each period that systematically varies with the Saiz elasticity differences across local markets in that period. The motivation for the use of the Saiz (2010) elasticities as instruments is similar to that of others who have used them for this purpose in the related literature (e.g., Mian and Sufi (2011)). Local markets with more inelastic housing supply should have greater changes in housing prices for a given change in local housing demand. The motivation for the use of a cubic interaction is to permit a flexible non-linear relationship between housing price variation and the Saiz elasticity in a given local market in each period.

OLS and instrumental variable estimates of the impact of housing price growth on the young employment share using equation (V.4) are reported in Table 2.[13] These results are based on the 1992-2013 period for the 222 SMSAs covered in the BDS. The OLS results using this shorter time period and SMSA-level variation are very similar to those from Table 1 that use a longer time period and state-level variation. The preferred instrumental variable estimates in

[13] We only report the main coefficient of interest on housing price growth in Table 2.

columns 2 and 4 of Table 2 yield a positive and statistically significant impact of housing prices on the young employment share. The estimated instrumental variable coefficients are very similar for the specifications with and without year effects (although estimated more precisely for the latter). A 10 log point increase in local housing prices yields a 2.7 log point increase in the local young-firm employment share without year effects and 2.8 log point increase with year effects. These instrumental variable estimates are larger than the OLS estimates. We also note that the overidentification test for columns 2 and 4 fail to reject the null of instrument validity.

Figures 7a and 7b depict the counterfactual contribution of housing prices using the estimated instrumental variable coefficients from Table 2. In order to be able to make these results comparable to those above, we construct the actual and counterfactuals using variation that includes all geographic areas (and not just the 222 SMSAs we have available for estimating the coefficients). This is accomplished by integrating the Table 2 instrumental variable estimates into the state-by-year data used for Figure 5 and constructing the actual and counterfactuals accordingly.[14]

Using the preferred instrumental variable estimates, the contribution of housing price variation accounts for even a larger amount of the variation over time in the young employment share compared to the alternative identification approaches considered above. About 55 percent of the sharp decline in the young employment share in Great Recession is due to housing prices in the specification without year effects. The corresponding contribution with year effects is even slightly larger – about 57 percent. The year-by-year results in Figure 7b enhance the finding reported above that the housing boom attenuated the secular decline in young firm employment share from1998-2007 and accelerated the decline after 2007. [15] During the 1998-2007 period, the cumulative increase in the young employment share due to housing prices is 11 log points (relative to trend) in Figure 7b. During the 2008-13 period, the cumulative decrease in the young employment share due to housing prices is 9 log points (relative to trend) in Figure 7b.

e. Panel Regressions with Instrumental Variables Estimation: Housing Prices and Small Business Lending Shocks

We extend this instrumental variables identification strategy by considering specifications that also incorporate the possible direct influence of small business loan supply shocks on young business activity. As discussed in section IV, there are a number of channels

[14] This amounts to using the same national housing price variation in Figures 5 and 7.
[15] This figure uses the parameter estimates from the specification without year effects. The effects are slightly larger using the parameter estimates from the specification with year effects.

through which local housing price variation can influence young business activity including the possible impact in local lending activity by banks. However, it is possible that variation in local small business lending activity by banks stems from local credit supply shocks independent of housing price variation. Following the approach of GMN (2015), local markets may have larger fluctuations in small business lending supply if the banks that experience the largest variation in financial conditions nationally have a larger relative footprint locally.

The identification of small business lending shocks begins with the CRA based data on small business lending.[16] We estimate for every pair of years a panel regression specification given by:

$$g_{ijt} = Area_{it} + Bank_{jt} + \varepsilon_{ijt} \quad \text{(V.5)}$$

where g_{ijt} is the growth rate of the volume of real small business loans by bank holding company *j* in geographic area *i* between *t* and *t-1*, $Area_{it}$ is a set of geographic fixed effects for the pair of years *t-1* and *t,* and $Bank_{jt}$ is a set of bank holding company fixed effects for this same pair of years. The geographic fixed effects control for general economic conditions in the geographic area in each pair of years. The bank holding company effects capture in an unrestricted manner the variation at the national level the growth of small business for each bank holding company in the period. This panel regression is estimated on an activity weighted basis using the level of lending by the bank holding company in the geographic area in the base year.

To estimate the small business lending shock, we use a Bartik-like approach by constructing a local shock given by:

$$SBL_{it} = \sum_j \omega_{ijt-1} Bank_{jt} \quad \text{(V.6)}$$

where ω_{ijt-1} is bank holding company j's small business lending share in geographic area state *i* at *t.* This variable captures the variation in the growth of small business lending across geographic areas in a given period induced by the different base period geographic footprint of bank holding companies who are experiencing different national variation. SBL_{it} is a direct

[16] More detail on our use of CRA data and the construction of small business lending shocks is provided in appendix C.

measure of local small business lending credit supply conditions which we use in our regression analysis.

The construction of the local small business lending shock permits us to estimate the following specification:

$$Y_{mt} = \lambda_m + \alpha * CYC_{mt} + \beta * HP_{mt} + \delta * SBL_{mt} + X_t'A + \varepsilon_{mt} \qquad \text{(V.7)}$$

where *m* is state, *t* is time period (year), *Y* is the log difference in the young employment share, λ_m is a set of SMSA fixed effects, CYC_{mt} is a local cyclical indicator, HP_{mt} is the growth in real housing prices in the SMSA year cell, SBL_{mt} is the small business loan shock for SMSA *m* in period *t,* X_t is a set of economy-wide controls and ε_{mt} is the residual. We estimate this specification with the same instrumental variables approach for housing prices considered in section V.c. This is our most preferred specification as it uses exogenous variation in housing prices through the instrumental variables approach while simultaneously estimating the potentially independent impact of local small business lending shocks. The primary limitation of this specification is that we can only estimate it for the period 1998-2013. The substantially shorter time period limits our ability to control for year effects in this specification. However, the results in section IV.c showed that the instrumental variables results with and without year effects are similar when using a longer sample period.

Estimates for equation (V.7) are reported in Table 3. OLS estimates with and without the small business loan shock are reported in the first two columns. Our preferred instrumental variable estimates are reported in the last two columns. Both OLS and instrumental variable estimates imply that housing prices and small business loan supply shocks have a positive and statistically significant impact on the young employment share. The preferred instrumental variable estimates of housing prices are larger than the OLS estimates and similar in magnitude (although slightly larger) than the instrumental variable estimates for the longer sample in Table 2. The instrumental variable estimates in column 4 imply that a 10 log point increase in local housing prices yields 3 log point increase in the local young-firm employment share. A 10 log point increase in the local small business lending shock yields a 0.3 log point increase in the local young-firm employment share.

Figure 8a illustrates counterfactual contributions of housing prices and small business lending supply shocks to the young employment share. Depicted are the actual, the contribution

of housing prices alone, the contribution of small business lending supply shocks alone and their combined effect. This exercise uses the estimated coefficients from column 4 (IV estimates) of Table 3. To generate the counterfactuals we use the same type of approach as in Figure 7 to exploit the national variation in the two driving forces while using the estimated coefficients from the SMSA-level data for the 222 SMSAs covered by the BDS.[17] In interpreting the results, it is useful to note that we are using only the identified exogenous component of small business lending given our construction of the small business lending shocks.

In combination, the sharp decline in housing prices along with the decline in small business lending shocks accounts for almost all (90 percent) of the sharp decline in the young employment share in the Great Recession. 70 percent of the 90 percent is due to housing prices and 20 percent due to small business lending shocks. Other periods also show a substantial contribution to variation in the young employment share from these two indicators of financial market conditions especially relevant for young businesses. During the 2001-03 period both housing prices and small business lending shocks imply an increase in the young employment share when the actual share declines slightly. These indicators of financial market conditions for young businesses help explain why there is only a modest cyclical decline in the young employment share in this period. During the 2003-08 period, these indicators also imply a larger increase in the young employment share than the actual. The inference for both of these periods is that favorable financial market conditions for young businesses in the 2000-08 period acted to buoy the young employment share against other factors. Of course, this all turned around in the Great Recession. During the post Great Recession period, housing prices and small business lending worked in opposite directions. Housing prices continued to act as a drag on the young employment share while small business lending helped offset this decline.

Figure 8b shows the annual counterfactual contributions of housing prices alone. The patterns in Figure 8b highlight the large cumulative contribution of housing prices to increases and then decreases to the young employment share. During the 1998-2007 period, the cumulative contribution of housing prices to the young employment share increase relative to trend is 12 log points while these gains are completely reversed during the 2008-13 period due to the collapse of housing prices over this period of time. These represent large, offsetting medium

[17] That is, we integrate the estimated parameters from the SMSA-level specification into the state by year data that covers the entire nation and aggregate the state-level effects in the same manner we have in all of the counterfactual exercises.

run swings in the young employment share.[18]

VI. Exploiting Cross-Industry and Cross-Area Differences

We are gathering and constructing data to pursue the following ideas:

1. If the estimated effect of local house price changes on local young-firm activity shares mainly reflects a non-uniform response of consumption expenditures to local wealth shocks, as discussed in Section IV, the effects on young-firm activity shares will be concentrated in industries that produce for local consumption. We will test this hypothesis directly using QWI data on 4-digit NAICS by age groups from 1998 onwards for 30 states and at the SMSA level for the same period using 2-digit NAICS.
2. In its strong form, whereby non-uniform consumption responses drive the entire effect of housing prices on young-firm activity shares, the firm-age structure of the local industry is irrelevant to the responsiveness of local *industry-level* activity to local house price movements. We will test this hypothesis directly using QWI data on 4-digit NAICS by age group from 1998 onwards for 30 states and at the SMSA level for the same period using 2-digit NAICS.
3. In contrast, the wealth, liquidity and credit supply effects imply that the response of local *industry-level* activity increases in the young-firm share of industry activity in the local economy. We will test this proposition, which is a one-sided alternative to the hypothesis in 2. We will test this hypothesis directly using QWI data on 4-digit NAICS by age groups from 1998 onwards for 30 states and at the SMSA level for the same period using 2-digit NAICS.
4. Stories that stress wealth effects due to "wanting to be my own boss" suggest larger effects of house-price changes on young-firm activity shares (and young-firm startup rates) in industries with modest startup costs and working capital requirements. We will test this hypothesis directly using the Hurst-Pugsley (2011, 2015) industry breakdowns. These identify small business intensive sectors.
5. Stories that stress wealth effects due to a taste for bossing others suggest larger effects on young-firm activity shares in labor-intensive industries. We will test this hypothesis directly using standard sources on labor's share of total costs or the value of shipments.
6. Insofar as local house price changes drive young-firm activity shares through their effects on the lending capacity of local banks, the effects of local house price changes will be larger in states and SMSAs with a more dominant role for local banks. We will test this hypothesis directly by exploiting cross-area differences in the composition of local

[18] In unreported results, we have examined the year-by-year contribution of small business lending which reveals little additional information relative to Figure 8a. The reason is that unlike housing prices the patterns of small business lending shocks are more tied to the cyclical episodes with less evidence of the medium run variation evident for housing prices that is easier to detect with the depiction of year-by-year variation.

banking activity (local vs. national). The CRA data can be used to construct such measures starting in the late 1990s.

7. We will compare the estimated effects of house price changes on the activity shares of young establishments owned by mature firms to the effects on activity shares of young establishments of young firms. This comparison will throw light on whether there is something about young establishments, as opposed to young firms, that accounts for the estimated effects of local house price changes on local young business activity shares. We will use the BDS measures by firm age and establishment age to construct these measures. We can implement this investigation at the state-year level back to 1981, and we can implement it using SMSA-level data (with IV estimation) back to the early 1990s.

8. We will investigate whether we are picking up size or age effects or both. That would be especially helpful in allaying concerns about our use of measured small business loan supply shifts as a proxy for shifts in the supply of credit available to young firms. We can implement this investigation at the state-year level back to 1981, and we can implement it using SMSA-level data (with IV estimation) back to the early 1990s.

We will also investigate whether estimated effects of housing price changes are larger before, during or after the Great Recession. Perhaps, for example, house price changes have larger effects on business startup rates and young-firm activity shares before the Great Recession, when banks were more willing to lend against home equity.

VII. Other Related Research

This section will explain how our work relates to, and differs from, the existing literature. For now, we just list papers to discuss and set forth some brief notes. A key distinction to highlight is that the vast bulk of related empirical work considers self-employment (heavily dominated by non-employer businesses) and small-business outcome measures. In contrast, we consider young-firm activity measures and restrict attention to firms with paid employees. We also make much greater use of outcome measures derived from administrative record sources than most of the previous literature. We will highlight the advantages of the administrative record sources.

- Gertler and Gilchrist (1994) highlight greater responsiveness of small firms to monetary policy and credit shocks. Supporting evidence in Sharpe (1994) and Chari, Christiano, and Kehoe (2013)
- Fort et. al. (2013) find local housing price shocks adversely affect young/small businesses. They focus on the impact of housing prices on the net differential in growth rates between young/small and large/mature businesses. Focusing only on the net

differential does not capture the changing share of young-firm employment which is the focus of the current analysis.

- Robb and Wolken (2002) and Robb and Robinson (2012) highlight role of home equity for young firms. Fairlie and Krashinsky (2012) and Corradin and Popov (2015) find local housing price gains increase transition rates into self-employment.
- Adelino et al. (2015) find that small establishments experience stronger employment growth (compared to larger ones) in regions with greater housing price appreciation, which they interpret as evidence for the importance of housing collateral in lending to small businesses.
- Mian and Sufi (2011) highlight a net worth/aggregate demand channel of local housing price shocks on local non-tradables. No direct implication for young and small firms, but these firms may be more sensitive to such shocks for several reasons, as we discuss.
- Greenstone, Mas and Nguyen (2015) show connection between small business bank lending and small business employment growth at the local level. They use an IV method to identify the contribution of bank loan supply shifts.
- Morgan, Rime and Strahan (2004) argue that banking deregulation made small firms less sensitive to local banking conditions.
- Previous work suggests that the effects of local credit and housing market conditions on young-firm activity are likely to influence economic performance and propagate forward in time through several channels. See Ouimet and Zarutskie (2014) and Moreira (2015). The latter study finds that demand conditions at entry affect the average size and productivity of new businesses, and that these effects are highly persistent as the entry cohort ages. Our results on the cyclicality of the young-firm employment share coupled with with the greater propensity of younger firms to hirer younger workers (Ouimet and Zarutskie, 2014) helps explain why labor market entry when conditions are depressed has large, persistent negative effects on employment and earnings (Kahn (2010) and Oreopoulos et al., 2012).
- Other papers: Chaney et al. (2012), Chodorow-Reich (2014), Corradin and Popov (2015), Kerr, Kerr and Nanda (2015), Pugsley and Sahin (2015).
- Lux and Greeene (2015), Shane (2013, 2015), Wallison (2015).

VIII. Concluding Remarks

The share of American workers at young firms (less than five years old) displays a clear pattern of procyclical movements about a declining trend in recent decades. Cyclical drops in the young-firm share have intensified over time, and cyclical recoveries have weakened. Indeed, the Great Recession and its aftermath involve the worst relative performance of young firms since at least the early 1980s. Turning to annual state-level data, we find that changes in young-firm employment shares covary in a strongly positive manner with state-level cyclical conditions and with the growth of real housing prices. The same pattern holds in state-year data for the young-firm share of firms with paid employees and for the startup rate of firms with paid employees.

These observations motivate our efforts to estimate the effects of housing market developments and credit supply shifts on young-firm employment shares. We consider several empirical strategies. In our preferred instrumental variables approach using annual SMSA-level panel data, we estimate large positive effects of local house price changes on changes in local young-firm activity shares and a distinct role for exogenous shifts in bank loan supply. Aggregating the local effects to the national level, housing market ups and downs are a major driver of medium-run fluctuations in young-firm activity shares – especially in the last 15 years. According to our analysis, the housing boom from 1998 to (March) 2007 drove a cumulative 12-log point gain in the young-firm employment share relative to trend. The ensuing collapse in housing prices fully reversed the earlier gains relative to trend. A contraction in bank loan supply drove a further collapse in young-firm employment shares during the Great Recession. A partial rebound in bank loan supply in the years after the Great Recession prevented an even larger decline in young-firm activity shares.

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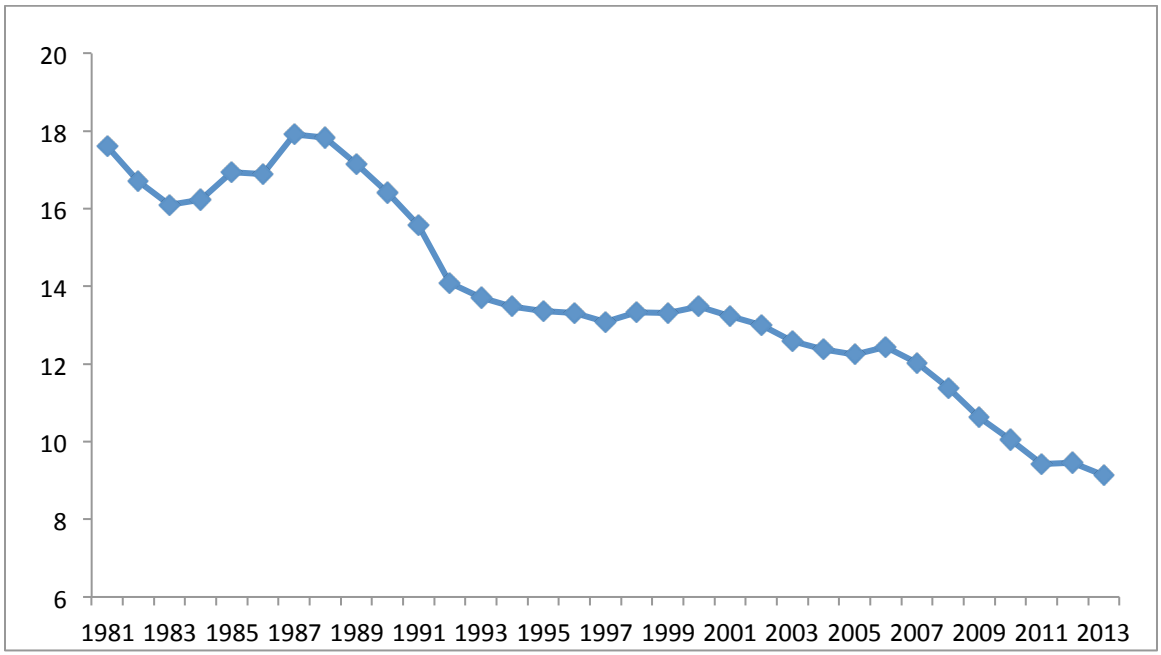
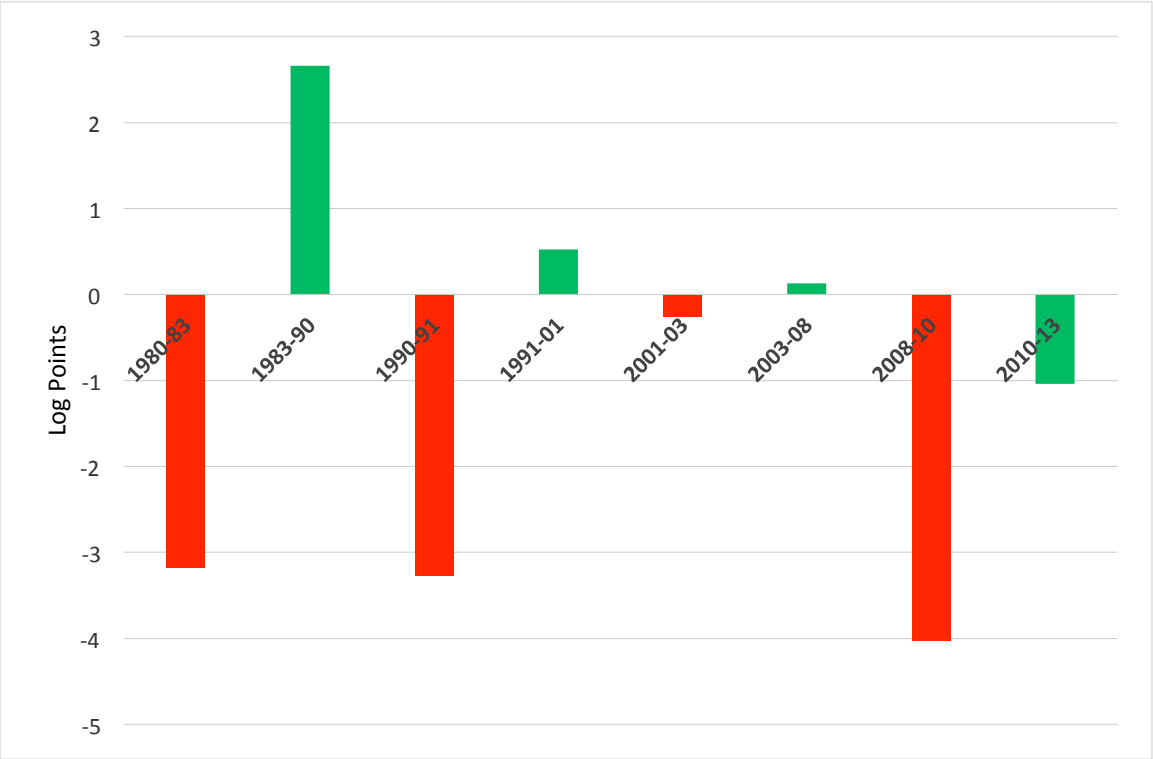
Figure 1. Share of Employees at Young Firms, 1981-2013, U.S. Nonfarm Private Economy



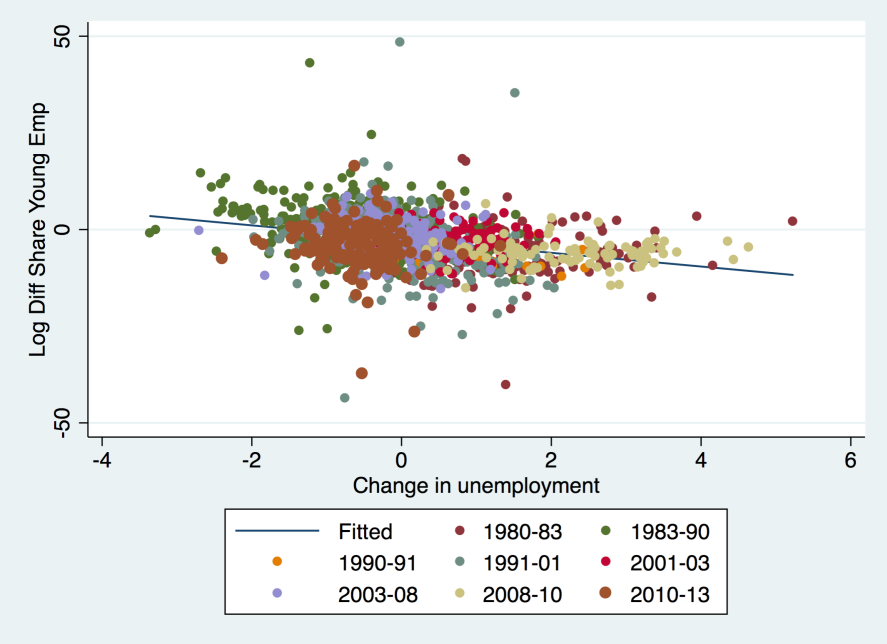
Notes: Data are from Business Dynamic Statistics (BDS) and reflect mid-March payrolls in the indicated calendar year. Reported statistic as percent of employment. When it first becomes a legal entity, firm age equals the then-current age of its oldest establishment in years. Thereafter, firm age advances by one with the passage of each year. Establishment age reflects the number of years in operation in the same narrowly defined industry. "Young" means fewer than five years (60 months) since hiring the first paid employee.

Figure 2. Cyclicality of Log Changes in the Young-Firm Share of Private Sector Employees



Notes: Each bar shows the annual average log change in the share of private sector employees at young firms during the indicated cyclical episode, deviated about the sample mean log change of minus 2.3 log points per year. Green bars denote aggregate expansion episodes, and red bars denote aggregate contraction episodes. All annual changes are from one mid-March payroll period to the next. For each cyclical episode, the reported interval represents the average annual log change from March of the initial to March of the ending year. For example, 1980-83 represents the average annual log changes for 1980-81, 1981-82 and 1982-83. See notes to Figure 1 for additional information and Section 2 for an exact description of the calculations.

Figure 3a Relationship Between Log Difference in Young Employment Share and the Change in Unemployment, State by Year Cells, 1981-2013



Notes: Scale is log points on vertical axis and percentage points on horizontal axis. Slope = -1.77 (0.13). See notes to Figure 2 for the timing convention of intervals.

Figure 3b Relationship Between Log Difference in Young Employment Share and Growth Rate of Real Housing Price, State by Year Cells, 1981-2013

Notes: Scales are log points on each axis. Slope = 0.30 (0.02). See notes to Figure 2 for the timing convention of reported intervals.

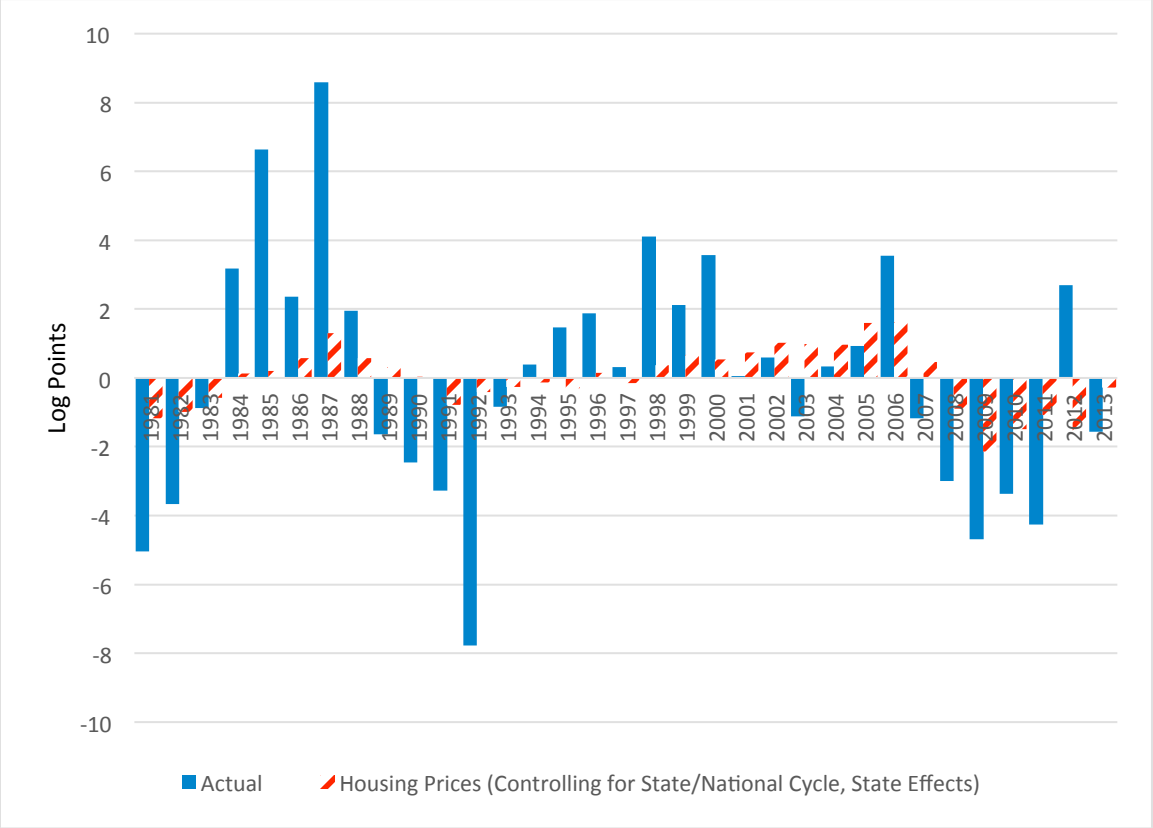
Figure 4 Relationship Between Housing Prices and Small Business Loans (Controlling for State, Year and Local Cyclical Variation), 1998-2013

Notes: Scale is log points on both axis. Slope=0.46 (0.06). See notes to Figure 2 for the timing convention of reported intervals.

Figure 5a Log Difference in Young Employment Share by Cyclical Episode: Actual and Due to Housing Prices (Using OLS Panel Regression Estimates in Table 1).

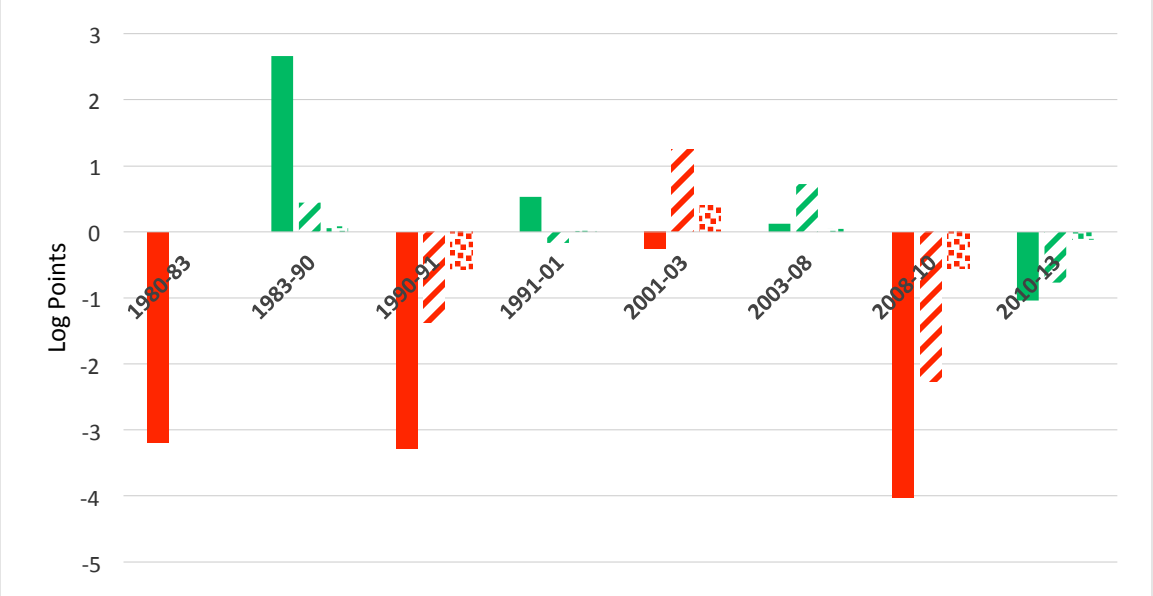
Notes: Solid Bar is Actual, Striped Bar is Counterfactual (State effects), Dotted Bar is Counterfactual (State and Year Effects). Panel regression estimates from Table 1 used in these counterfactuals. Annualized deviations from overall means depicted. The mean decline is 2.3 log points per year. See notes to Figure 2 for the timing convention of reported intervals.

Figure 5b Annual Log Difference in Young Employment Share: Actual and Due to Housing Prices (Using OLS Panel Regression Estimates in Table 1).



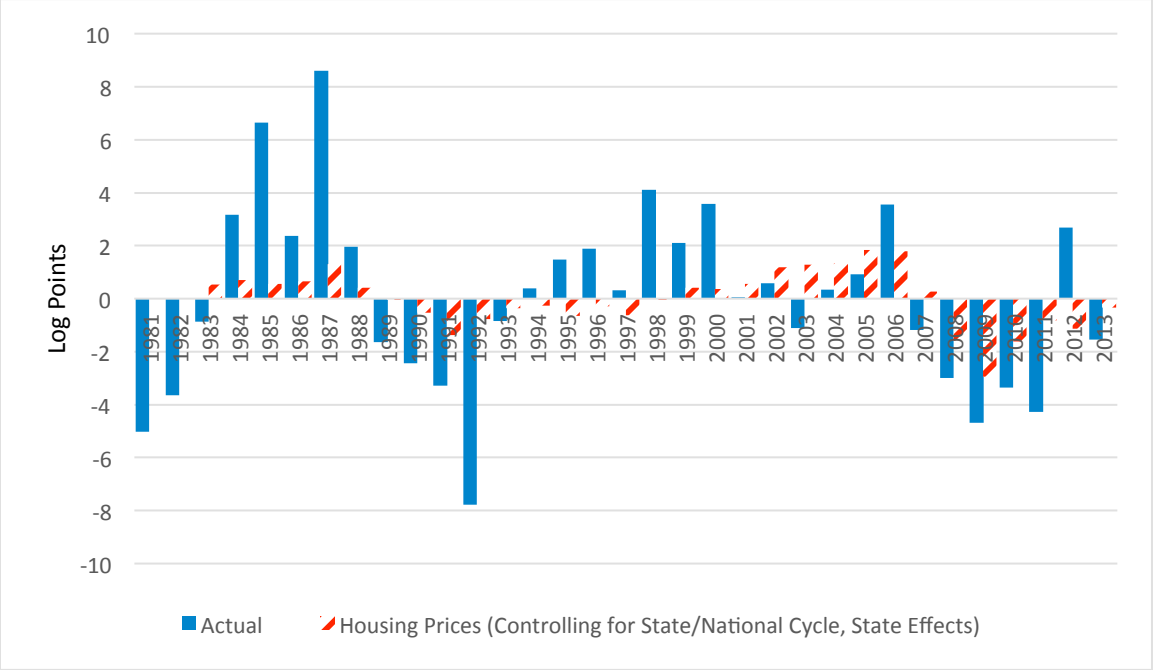
Note: Cumulative increase from Housing Prices from 1998-2007 is 9 log points. Cumulative decrease from Housing Prices from 1998-2013 is 7.4 log points. Estimates based on Table 1, column 1.

Figure 6a Log Difference in Young Employment Share by Cyclical Episode: Actual and Due to Housing Prices (Using Panel VAR Estimates).



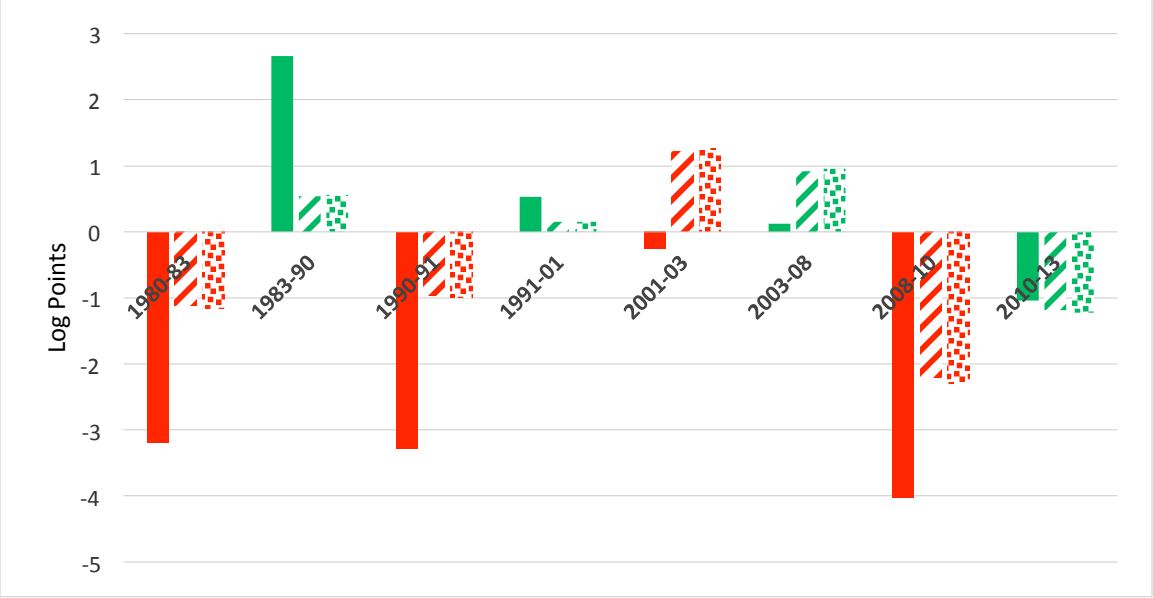
Notes: Solid Bar is Actual, Striped Bar is Counterfactual (State effects), Dotted Bar is Counterfactual (State and Year Effects). In both counterfactuals, we feed through the sequences of housing price shocks implied by the model with state effects only. However, we use impulse response functions from different panel VAR models – one with state effects only, and one with state and year effects. The panel VAR does not yield counterfactuals for 1980-83. See notes to Figure 2 for the timing convention of reported intervals.

Figure 6b Annual Log Difference in Young Employment Share: Actual and Due to Housing Prices (Using Panel VAR Estimates).



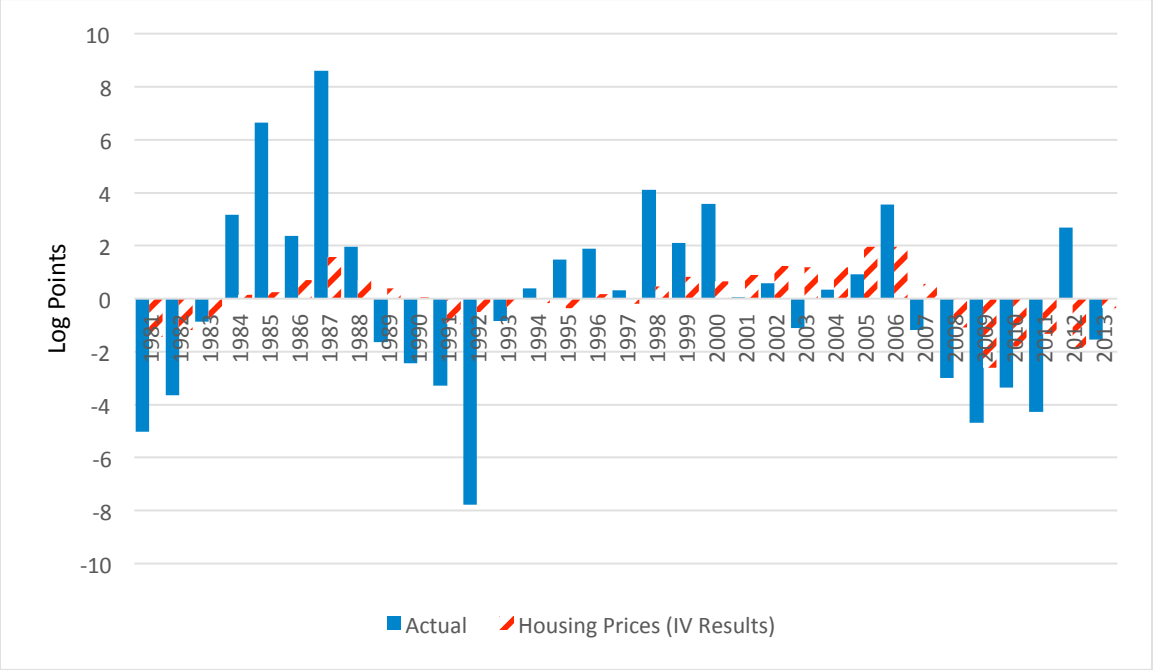
Note: Cumulative increase from Housing Prices from 1998-2007 is 9 log points. Cumulative decrease from Housing Prices from 2008-2013 is 8 log points. Estimates based on panel VAR results (state effects).

Figure 7a Log Difference in Young Employment Share by Cyclical Episode: Actual and Due to Housing Prices (Using IV estimates from Table 2).



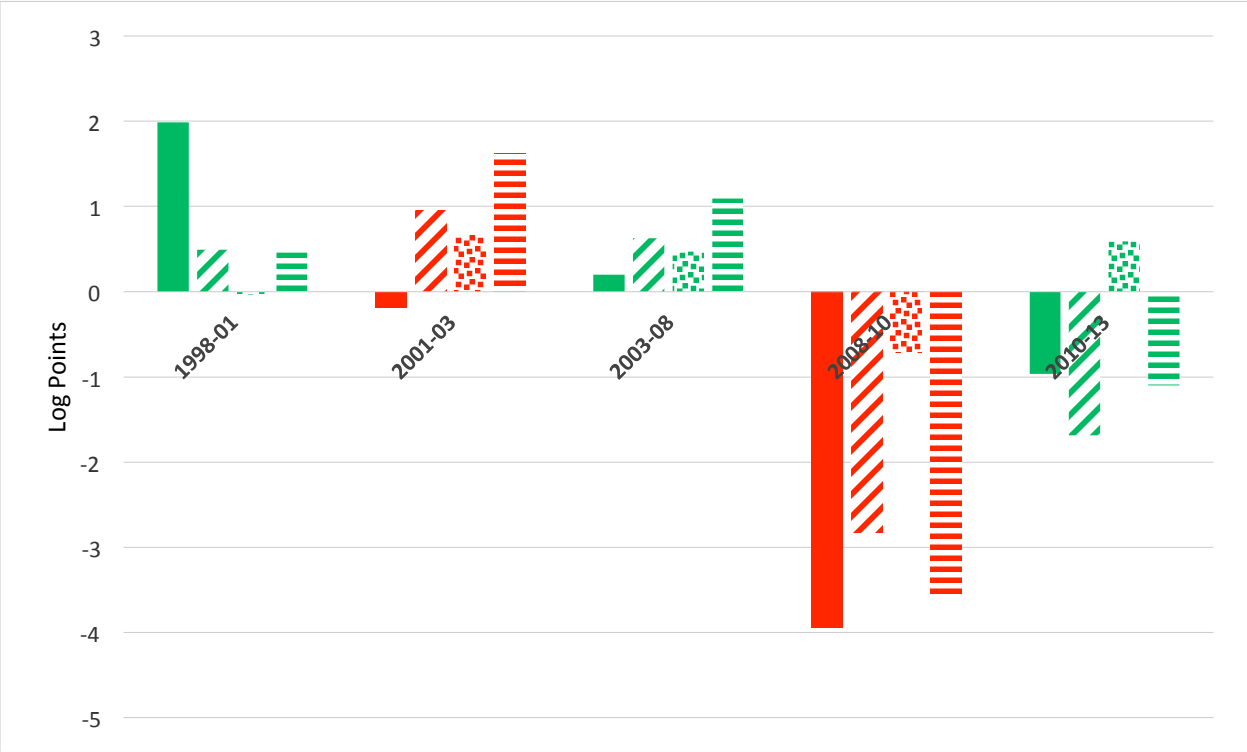
Solid Bar is Actual, Striped Bar is Counterfactual (State effects), Dotted Bar is Counterfactual (State and Year Effects). Using IV estimates from Table 3. Annualized deviations from overall means depicted. The mean decline is 2.3 log points per year. See notes to Figure 2 for the timing convention of reported intervals.

Figure 7b Annual Log Difference in Young Employment Share: Actual and Due to Housing Prices (Using IV Estimates from Table 2).



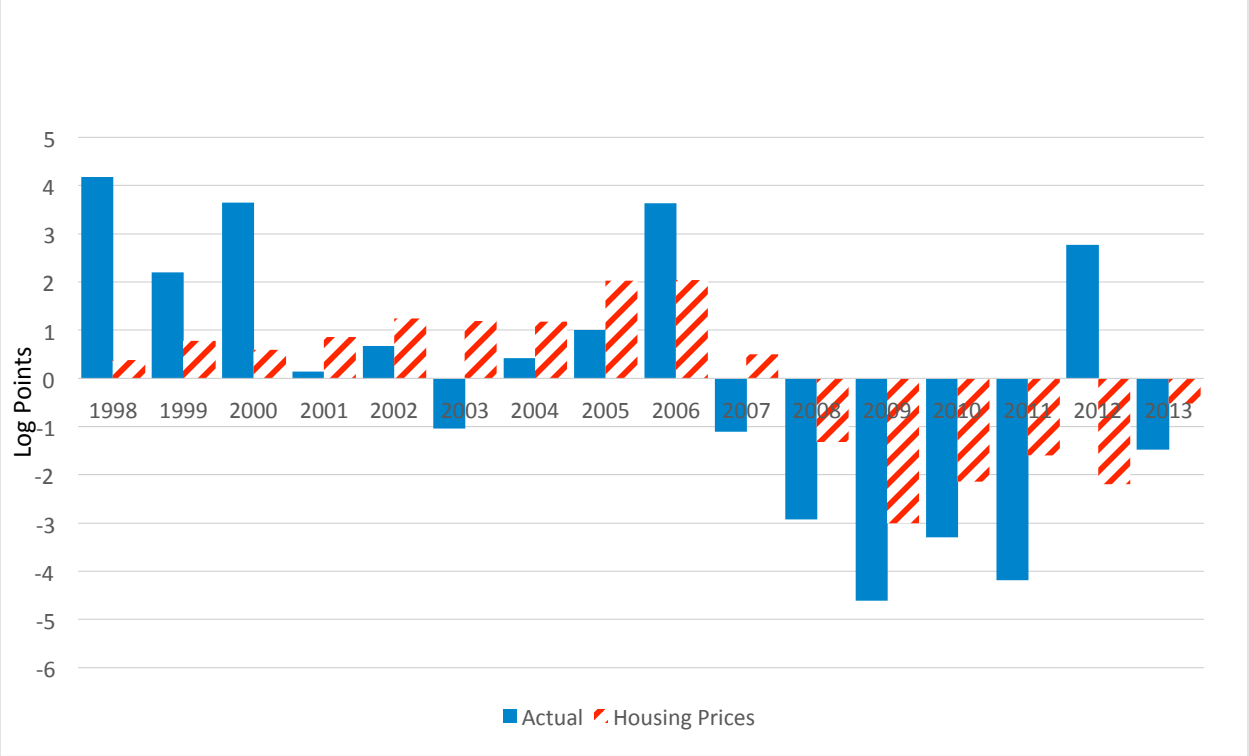
Note: Cumulative increase from Housing Prices from 1998-2007 is 11 log points. Cumulative decrease from Housing Prices from 1998-2013 is 9 log points. Estimates based on IV results (Table 2, column 2). See notes to Figure 2 for the timing convention of reported intervals.

Table 8a Log Difference in Young Employment Share by Cyclical Episode: Actual and Due to Housing Prices and Small Business Lending Shocks (Using IV estimates from Table 3).



Solid Bar is Actual, Diagonal Striped Bar is Counterfactual using Housing Prices only, Dotted Bar is Counterfactual using Small Business Loan Shocks only, Horizontal Striped Bar is Counterfactual using both Housing Price and Small Business Loans. Using IV estimates from Table 4. Annualized deviations from overall means depicted. The mean decline is 2.3 log points per year.

Figure 8b Annual Log Difference in Young Employment Share: Actual and Due to Housing Prices (Using IV estimates from Table 3).



Note: Cumulative increase from Housing Prices from 1998-2007 is 12 log points. Cumulative decrease from Housing Prices plus Small Business Loans from 2008-2013 is 12 log points. Estimates based on IV results (Table 4, column 4).

Table 1: Log Difference in Young Employment Share, 1981-2013 using State, Year Observations

Change in unemployment rate	-1.420***	-0.917***
	(0.134)	(0.239)
Growth in real housing price	0.221***	0.118***
	(0.025)	(0.026)
State Effects	Yes	Yes
Year Effects	No	Yes
R^2	0.146	0.336
Observations	1683	1683

Notes: Standard errors in parentheses clustered at State Level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Log Difference in Young Employment Share, Using MSA by Year Data from 1992-2013

	(OLS) Growth rate of the employment share for young firms	(IV) Growth rate of the employment share for young firms	(OLS) Growth rate of the employment share for young firms	(IV) Growth rate of the employment share for young firms
Growth in real housing price	0.190***	0.269***	0.094***	0.280*
	(0.027)	(0.101)	(0.031)	(0.154)
MSA Effects	Yes	Yes	Yes	Yes
Year Effects	No	No	Yes	Yes
R^2	0.049	0.048	0.106	0.102
Observations	4847	4847	4847	4847

Notes: Standard errors in parentheses clustered at MSA level. All include the Change in MSA level Unemployment Rate. Specifications without year effects (first two columns) include a quadratic in National GDP Growth. Three instruments for each IV specification: Change in MSA level Unemployment Rate*Log(MSA Elasticity), Change in MSA Level Unemployment Rate*(Log(MSA Elasticity))^2, Change in MSA Level Unemployment Rate*(Log(MSA Elasticity))^3. For IV estimates, overidentification tests show we cannot reject the null of instrument validity.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3. Log Difference in Young Employment Share Using MSA by Year Data from 1998-2013

	(OLS) Growth rate of the employment share for young firms	(OLS) Growth rate of the employment share for young firms	(IV) Growth rate of the employment share for young firms	(IV) Growth rate of the employment share for young firms
Growth in real housing price	0.178***	0.171***	0.333***	0.298***
	(0.028)	(0.028)	(0.076)	(0.077)
Local Small Business Loan Shock (GMN approach)		0.034***		0.032***
		(0.009)		(0.009)
R^2	0.061	0.066	0.055	0.062
Observations	3552	3552	3552	3552

Notes: Standard errors in parentheses clustered at MSA Level. All specifications include MSA Effects, Change in MSA level Unemployment Rate, and a quadratic in National GDP Growth. Three instruments for each IV specification: Change in MSA level Unemployment Rate*Log(MSA Elasticity), Change in MSA Level Unemployment Rate*(Log(MSA Elasticity))^2, Change in MSA Level Unemployment Rate*(Log(MSA Elasticity))^3. For IV estimates, overidentification tests show we cannot reject the null of instrument validity.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix A: Measurement of Young Firm Dynamics in the BDS

The Business Dynamic Statistics (BDS) reports tabulations from the Census Longitudinal Business Database (LBD). The LBD is a longitudinal establishment-level database with establishment and firm-level characteristics. Firms are defined based on operational control. As described in section II, firm age is based on the age of the oldest establishment when a new legal entity originates. Establishment-level net employment growth rates underlying the BDS tabulations use the Davis, Haltiwanger and Schuh (1996) (DHS) growth rate measure:

$$g_{et} = \left(\frac{E_{et} - E_{et-1}}{X_{et}}\right), \quad X_{et} = 0.5 * (E_{et} + E_{et-1}) \tag{B.1}$$

where *e* indexes establishments and *t* indexes years. The DHS growth rate measure is a 2nd order approximation of the log first difference, is bounded between -2 and 2, and accommodates zeros in *t* (exit) or *t-1* (entry). The employment at the establishment-level in the LBD in year *t* is the number of employees of workers on the payroll for the payroll period including March 12th. As such the net employment growth rates (and all change measures in the LBD and BDS) represent changes from March in *t-1* to March of *t*.

The net employment growth rate for establishments classified into a cell *S* in *t* (e.g., a firm age and state cell) is given by:

$$g_{st} = \sum_{e \in s} \frac{X_{est}}{X_{st}} g_{est} \tag{B.2}$$

where *S* is the characteristics of the establishment in year t. The BDS provides net employment growth rate statistics as well as the decomposition into job creation, job destruction (by continuing, entering and exiting establishments) by a wide range of cells *S* defined by industry, firm age, firm size, establishment age, establishment size, and geographic cells defined by state and SMSA. The BDS also reports these changes in terms of levels as well as the levels of employment and number of firms in each of classification cells.

For any given classification into cells of type *S*, the aggregate net employment growth is defined as the employment-weighted average of the cell based growth rates:

$$g_t = \sum_s \frac{X_{st}}{X_t} g_{st} \tag{B.3}$$

Relating the above measurement concepts to the measures from the BDS used in the paper, Figures B3 and B5 exploit the BDS net employment growth rate statistics defined by firm age (specifically, we use broad firm age categories as described in section II). The measures

used in these figures capture within firm age group net employment growth rates. While instructive, such within firm age group net growth rates don't permit a characterization of the changing composition of employment by firm age (and likewise the changing composition of firms by firm age). For the latter, we use the share of young firm employment and the share of young firms as described in the main text. These can be directly measured from the BDS since the number of employees and firms are reported for all classifications in the BDS. Section III includes discussion of how the changing employment by firm age is related to net change within firm age groups and the changing composition.

Firm age is censored in the BDS given that firm and establishment age cannot be determined for establishments that exist in 1976 (the first year of the LBD). This implies that in each year subsequent to 1976 more firm age categories can be defined. We commence our analysis in 1981 where five firm age categories can be defined: firm age 0 (establishments in 1981 whose parent firm have all new establishments in 1981), 1, 2, 3, 4 and 5+. This permits consistent measures of young firm activity measures starting in 1981. For example, in 1981 we can measure net employment growth rates for young firms which reflects the growth rate of the establishments from March 1980 to March 1981.

The BDS also provides the statistics to compute directly the employment of young firms (less than five years old) starting in 1981. We use the young-employment shares to compute the log change in the share of young-firm employment which, our focus in the main text. This measure is directly computable from BDS statistics starting in 1982 (e.g., the log change in 1982 is the log difference of the young-firm share from 1981 to 1982). Given the focus on cyclical episodes in our analysis, it is advantageous to define the early 1980s cyclical downturn as the March 1980 to March 1983 interval. This requires measures of the relevant change statistics starting in 1981. For net employment growth rates young firms in Figures B3 and B5, this is readily computable from the BDS. For the log change in the young-firm employment share in 1981, additional computations are required. In 1980, the BDS yields the employment of firms less than four years old directly, but to measure the employment of firms less than five years old in 1980 we need an estimate of employment at firms age=4 in 1980. We impute the latter in 1980 using the product of the share of employment of age=4 year old firms in 1981 and total employment in 1980. This imputation is feasible at the national, state and SMSA levels of aggregation. We note that all of our results using the log change in the young-firm employment share are robust to starting the analysis in 1982 instead of 1981.

Appendix B: Supplemental Figures and Tables

Figure B1. Startup and Exit Rates

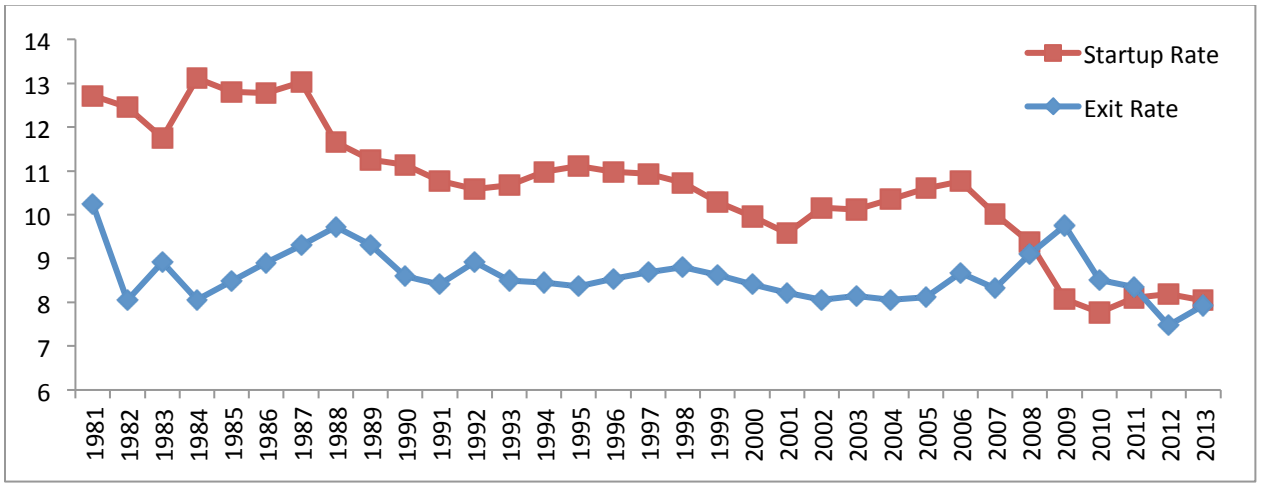
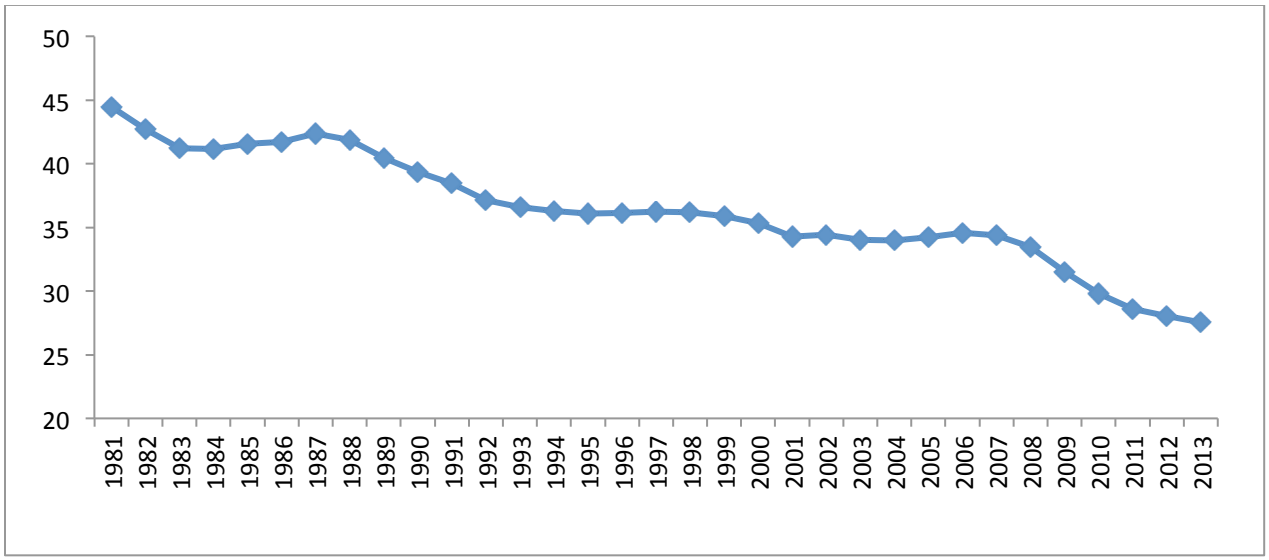
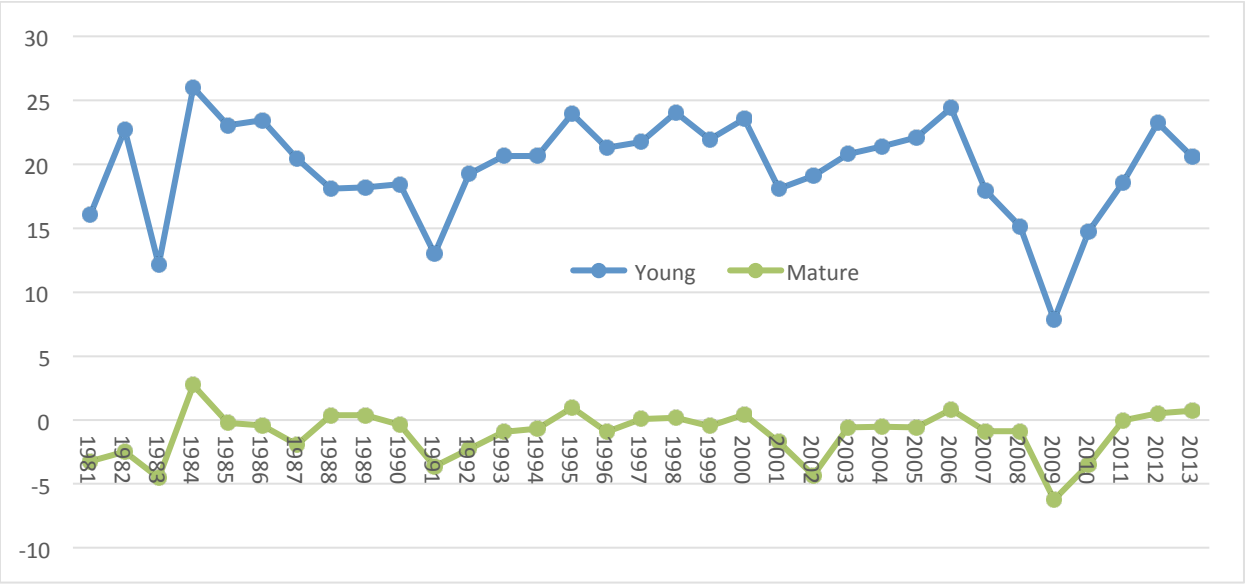


Figure B2. Share of Firms that are Young (<5 years old)



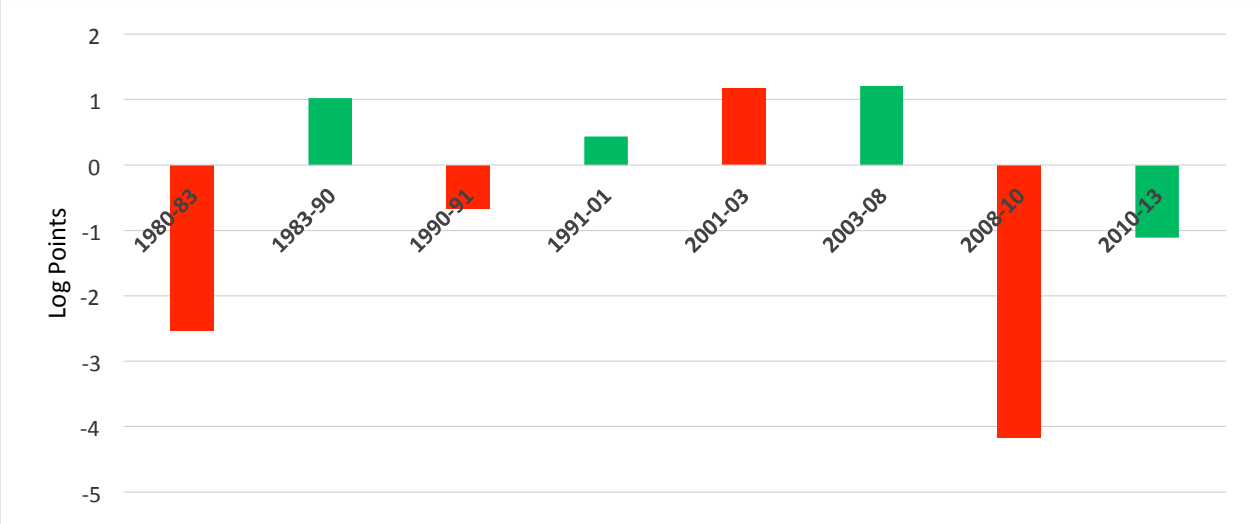
Notes: The young-firm share of firms is the number of firms of age<5 as a share of all firms.

Figure B3. Annual Net Employment Growth Rates for Young and Mature Firms



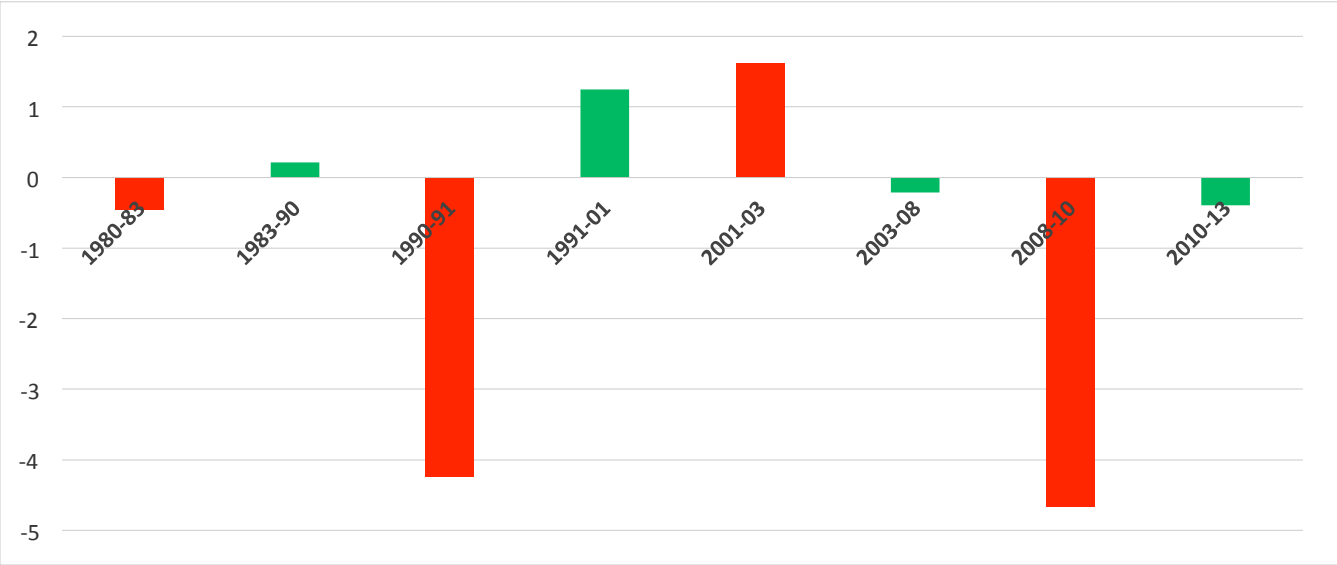
Notes: Net growth rates for each age group is the employment-weighted establishment-level DHS net growth rate for establishments classified in age group in year *t*. Net growth is inclusive of entry and exit of establishments from March of *t-1* to March of *t*.

Figure B4 Cyclicality of Log Changes in the Young-Firm Share of Firms



Notes: Each bar shows the annual average log change in the share of private sector firms at young firms during the indicated cyclical episode, deviated about the sample mean log change of minus 1.7 log points per year. See notes to Figure 2 for further notes.

Figure B5. Cyclicality of Net Growth Rate Differential Between Young and Mature Firms



Notes: Each bar shows the annual average net employment growth differential between young and mature firms during the indicated cyclical episode, deviated about the sample mean net differential of 21 percent per year. See notes to Figure 2 for further notes.

Figure B6 Relationship Between Log Difference in Young Firm Share and Growth Rate of Real Housing Price, State by Year Cells, 1981-2013

Notes: Scales are log points on each axis. Slope = 0.28 (0.01). See notes to Figure 2 for the timing convention of reported intervals.

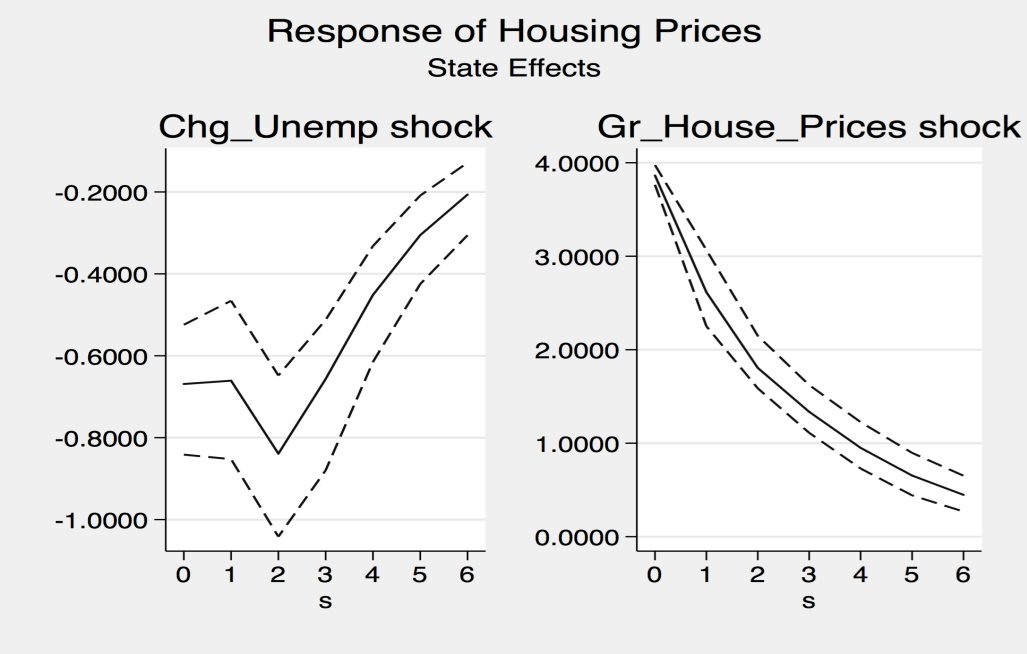
Figure B7 Relationship Between Log Difference in Startup Rate and Growth Rate of Real Housing Price, State by Year Cells, 1981-2013

Notes: Scales are log points on each axis. Slope = 0.25 (0.03). See notes to Figure 2 for the timing convention of reported intervals. The log difference of the startup rate has been winsorized at the 99.75 and 0.25 (quarter of a percentile) levels. This has relatively little impact on the relationship. Using the unadjusted data the slope = 0.27 (0.03).

Figure B8.a Panel VAR IRFs Using State by Year for 1981-2013

Notes: Solid lines depict Impulse Response Functions (shocks to one standard deviation orthogonalized innovations). Confidence interval (dashed lines) at 5th and 95th percentiles. Specification with state effects.

Figure B8.b Panel VAR IRFs Using State by Year for 1981-2013

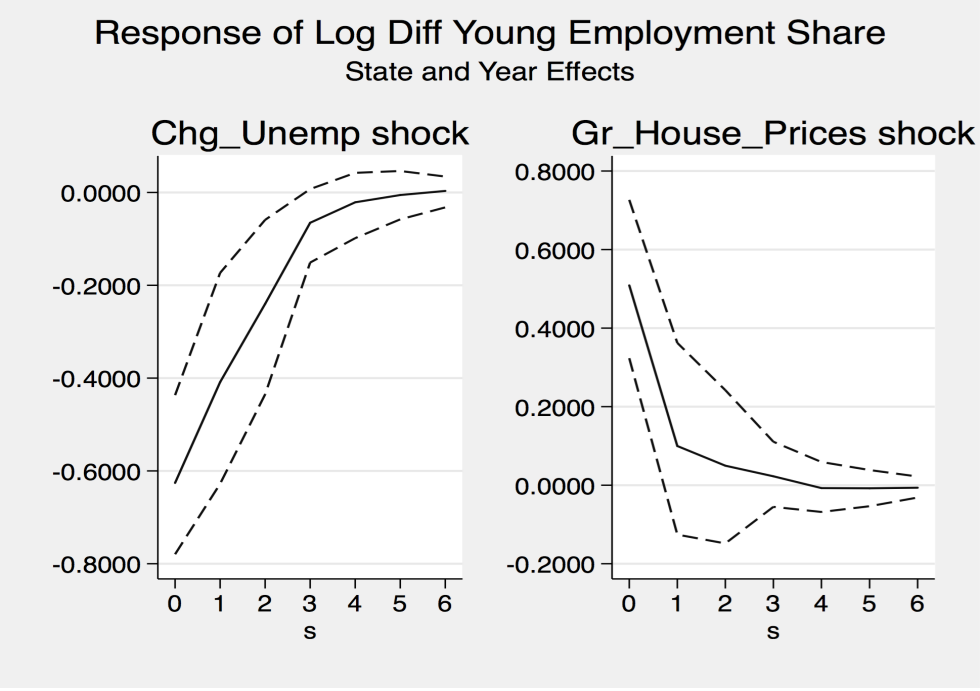


Notes: Solid lines depict Impulse Response Functions (shocks to one standard deviation orthogonalized innovations). Confidence interval (dashed lines) at 5th and 95th percentiles. Specification with state effects.

Figure B8.c Panel VAR IRFs Using State by Year for 1981-2013

Notes: Solid lines depict Impulse Response Functions (shocks to one standard deviation orthogonalized innovations). Confidence interval (dashed lines) at 5th and 95th percentiles. Specification with state effects.

Figure B.8.d Panel VAR IRFs Using State by Year for 1981-2013



Notes: Solid lines depict Impulse Response Functions (shocks to one standard deviation orthogonalized innovations). Confidence interval (dashed lines) at 5th and 95th percentiles. Specification with state and year effects.

Table B1: Relationship Between Small Business Loans, Housing Prices, and Unemployment Rates, 1998-2013

	(1) Growth in small business loans	(2) Growth in Real Housing Price
Change in unemployment	-1.782***	-1.862***
	(0.439)	(0.255)
State Effects	Yes	Yes
Year Effects	Yes	Yes
R^2	0.945	0.649
Observations	816	816

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix C: Constructing the Small Business Loan Supply Shock

To construct the small business loan supply shock, we exploit CRA data and build on the approach of GMN (2014). CRA data provide bank-level information on the volume of business loan originations to firms with less than $1 million in revenue by bank *j* in local area *i* (state or SMSA) during year *t.* We deflate nominal loan volumes by the same-year GDP implicit price deflator from the Bureau of Economic Analysis to obtain the real volume of small business loans. Following GMN, we roll up the bank level data to the bank holding company level, using data sources from the FDIC and the Federal Reserve call reports. We also rely on data from the Federal Reserve Bank of Chicago that tracks mergers and acquisitions, so that for any pair of years *t-1* and *t* we assign banks to its owner in year *t*.

Using data at the bank holding company level for each local area *i* and each pair of years *t-1* and *t,* we fit the following regression by least squares, weighting each bank holding company *j* by its *t-1* share of small business lending in area *i*:

$$g_{ijt} = Area_{it} + Bank_{jt} + \varepsilon_{ijt}$$

where g_{ijt} is the growth rate of real small business loan volume by bank holding company *j* in area *i* between *t-1* and *t*, $Area_{it}$ is a set of area fixed effects for the pair of years *t-1* and *t,* and $Bank_{jt}$ is a set of bank holding company fixed effects for the same pair of years. We consider two alternative measures of g_{ijt} : the log first difference of the small business real loan volume, and the Davis, Haltiwanger and Schuh (1996) growth rate. The DHS measure is equivalent to the log first difference up to a second-order Taylor Series approximation. Both measures are symmetric about zero, but the DHS measure accommodates zeros. Like GMN, we only use pairwise continuers in fitting the regression above, so zeros do not affect the analysis here. Because the DHS growth rate lies in the interval [-2, 2], it tends to reduce the influence of outliers relative to the log change. As it turns out, the two measures produce very similar results. The text reports results based on the DHS growth rate measure.

Given the regression results, we construct the small business bank loan supply shock for area *i* in year *t* as the weighted sum of estimated bank effects, $\widehat{Bank}_{jt}$:

$$SBL_{it} = \sum_{j} \omega_{ijt-1} \widehat{Bank}_{jt}$$

where ω_{ijt-1} is bank holding company *j*'s small business lending share in area *i* during year *t-1*.

Finally, we re-time the calendar-year SBL_{it} measure above to align it with the March-to-March employment changes in the BDS. Specifically, in our regression analysis, the loan supply

shock for area *i* and year *t* is $0.75 * SBL_{it-1} + 0.25 * SBL_{it}$. In practice, the correlation between this re-timed measure for year *t* and the unadjusted measure for year *t-1* is 0.95 for the SMSA-level data used to produce Table 3. Replacing the re-timed SBL measure for year *t* with the corresponding lagged value of the unadjusted SBL measure yields very similar results.