

Appendix

We summarize data sources and details of the estimation behind Figure 7 in the text.

Data Sources

Debt-to-book equity and the level of debt for the investment banking sector are collected from Compustat. These are taken from all firms in the sub-industries that comprise the broad NAICS code 523, “Securities, Commodity Contracts, and Other Financial Investments and Related Activities”. Total liabilities (Compustat code: LTQ), and total assets (Compustat code: ATQ) are summed across firms in the industry at each point in time. Aggregate book equity is then computed as assets less liabilities.

In terms of state-level data, house price data are a Purchase Only Index from the Federal Housing Authority. Mortgage data are from the New York Federal Reserve Bank/Equifax Consumer Credit Panel (note, this excludes HELOCs). Personal income data are from the Bureau of Economic Analysis Regional Accounts. Employment and population data are from the Bureau of Labor Statistics Employment and Unemployment reports. Employment data for the construction, retail, and manufacturing industries are obtained from FRED.

To construct cross-state averages displayed in Figure 6 we compute the house price depreciation for each state between 2006:Q3 and 2009:Q3. Quantiles of the price depreciation distribution are computed using population weights from 2009:Q3. For any given state-level variable, we then compute the cross-state average for states between the house price depreciation quantiles: 0-20 percent (largest depreciations), 20-50 percent (moderate depreciations), and 50-100 percent (smallest depreciations).

With the exception of state-level house prices and the excess financial bond premium all data relevant for the empirical analysis is available over the period 1990-2016. Data on state-level house prices begins in 1991:Q1. The excess financial bond premium is available up until 2012:Q3. Allowing for four lags in quarterly data, we therefore estimate the house price and financial excess bond premium equations using ordinary least squares over the period 1992:Q2-2012:Q3. The state house price regression is estimated as a pooled panel with state-level fixed effects. Observations are weighted using the state-level mean population over this period as weights. We construct shocks to house prices and the financial bond premium over these 82 time periods. At each horizon, we then estimate the local projection with a shifting sample of 82 time periods such that we may include all available shocks as right hand side variables. Thus for $h = 1$ the estimation period for the local projection is 1992:Q3-2012:Q4 whereas for $h = 8$ the estimation period is 1994:Q3-2014:Q4. These state-level equations are also estimated as a pooled least squares regression using the same population weights and allowing for state-level fixed effects. For $h > 1$ our local projection uses overlapping data which induces serial correlation. Reported standard errors in Table 1 are computed by clustering at the state level and therefore are robust to arbitrary serial correlation over time. Finally, the employment data plotted in Figure 7 are detrended over the period 1990:Q2-2014:Q4.

Methods

First, we use a panel-data vector autoregression to identify “shocks” to state-level house prices and to our indicator of aggregate financial conditions. Let s_t denote the financial excess bond premium at time t . We regress the financial bond premium s_t on four lags of itself and current and four lags of quarterly aggregate house price growth $\Delta \log P_{t-i}$ and quarterly aggregate employment growth $\Delta \log E_{t-i}$:

$$s_t = \sum_{i=1}^4 \alpha_i^s s_{t-i} + \sum_{i=0}^4 \gamma_i^s \Delta \log P_{t-i} + \sum_{i=0}^4 \omega_i^s \Delta \log E_{t-i} + \varepsilon_t$$

The residual ε_t in this regression reflects movements in s_t that are orthogonal to lagged values of itself and also to current and lagged movements in $\Delta \log P_t$ and $\Delta \log E_t$. As noted in the text, one cannot reject that ε_t is serially uncorrelated. The implied timing restrictions are also discussed in the text.

Similarly, to obtain the shock in state-level house prices we regress the quarterly change in house prices $\Delta \log P_{j,t}$ for each state j on four lags of itself, four lags of the financial bond premium and the current and four lagged values of state j 's employment growth $\Delta \log E_{j,t-i}$:

$$\Delta \log P_{j,t} = \sum_{i=1}^4 \alpha_i^p s_{t-i} + \sum_{i=1}^4 \gamma_i^p \Delta \log P_{j,t-i} + \sum_{i=0}^4 \omega_i^p \Delta \log E_{j,t-i} + \mu_{j,t}$$

The residual in this equation $\mu_{j,t}$ provides our measure of shocks to house prices in state j . Again, as with ε_t , one cannot reject that $\mu_{j,t}$ is serially uncorrelated, and the timing assumption is discussed in the main text.

We next turn to estimating the effect of the orthogonalized shocks to house prices and the financial conditions indicator on state level employment growth. We estimate the following relation for the h quarter ahead growth in employment in state j , $\log E_{j,t+h} - \log E_{j,t}$:

$$\log E_{j,t+h} - \log E_{j,t} = \beta_{p,h} \mu_{j,t} + \beta_{b,h} [Crisis = 1] \frac{M_j}{Y_j} \mu_{j,t} + \beta_{s,h} \varepsilon_t + \epsilon_{j,t,h} + \epsilon_{j,h}$$

where $\epsilon_{j,h}$ is a state-specific fixed effect for horizon h and $\epsilon_{j,t,h}$ is the error term.

We allow $\log E_{j,t+h} - \log E_{j,t}$ to depend on the shock to state-specific house prices and the aggregate shock to the financial excess bond premium, ε_t . Let M_j/Y_j be the mortgage to income ratio in state j at the end of the house price boom, 2006:Q4, and let $Crisis = 1$ be an indicator variable that takes on a value of unity over the crisis period where house prices were declining, 2007:Q1-2009:Q4, and zero otherwise. We refer to $(M_j/Y_j)\mu_{j,t}$ as the leverage adjusted house price shock.

Results

Given the estimates from Table 1 reported in the text, we can now provide a measure of the relative contributions of each of the shocks to the behavior of aggregate employment over the Great Recession. We first construct measures of the aggregate house price shock μ_t as a population-weighted average of the individual state price shocks $\mu_{j,t}$: We then construct a measure of the aggregate leverage adjusted house price shock, $\mu_{b,t}$ as a population weighted average of the state level leverage adjusted shocks $(M_j/Y_j)\mu_{j,t}$. We can then decompose the movements in aggregate employment over the crisis period into the distinct contributions of the three aggregate shocks, μ_t , $\mu_{b,t}$ and the financial shock ε_t .

To do the decomposition, we exploit the fact that house price shocks and financial shocks are serially uncorrelated. Let $\log \hat{E}_{p,t}$ be the component of employment due to house price shocks independent of balance sheet effects; $\log \hat{E}_{b,t}$ the part due to house price shocks operating through balance sheets; and $\log \hat{E}_{s,t}$ the part due to shocks to financial conditions. To obtain these components we construct the cumulative response to previous house price and financial shocks, as follows:

$$\log \hat{E}_{p,t} = \sum_h \beta_{p,h} \mu_{t-h} ; \quad \hat{E}_{b,t} = \sum_h \beta_{b,h} \mu_{b,t-h} ; \quad \log \hat{E}_{s,t} = \sum_h \beta_{s,h} \varepsilon_{t-h}$$

The cumulative responses are then reported in Figure 7.