Homeowner Balance Sheets and Monetary Policy \(^1\)

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\(^1\) This research was conducted with restricted access to Bureau of Labor Statistics (BLS) data. The views expressed here do not necessarily reflect the views of the BLS.
Motivating questions:

- How does consumption respond to house price gains?
- Does this arise due to wealth effects or collateral effects?
- How does this affect how monetary shocks are transmitted to the real economy?
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Approach:

- National monetary shocks shift local housing demand
- Cities differ in housing supply elasticity → Differ in house price response
- Compare consumption response across elastic/inelastic cities
Preview of Results

- 100 basis point shock to Federal Funds causes 1-2.5% decline in real house prices
  - Peaks over period of 8-12 qtrs.
  - Largest response in land-constrained, regulated areas

- Avg. Non-housing consumption rises $6 - 9\%$ for every $1 increase in local house prices
  - Positive effect for owners only, no effect for renters
  - Primarily driven by heavy debt users (High Debt Service Ratio and Equity Extractors)
    - Evidence for collateral channel rather than wealth effect

- Implies 100 basis point shock to federal funds causes 1.5-3.75% change in real spending for owners through “homeowner balance sheets”
  - Effect varies by region & ownership status
Why Housing?

- **Housing & Household Balance Sheets:**
  - Approx. 50% of household balance sheet wealth (higher for younger households)
  - Collateralizable - Mortgages, Home Equity Loans/HELOCs, etc
  - Collateral determines borrowing cost and hence consumption

- **Link between Housing & Consumption:**
  - Wealth Effect - Increase in lifetime wealth (but also in cost of living).
  - Collateral Effect - Increase in collateral and borrowing capacity.

Regional Heterogeneity:

- House = Structure + Land
  → not reproducible & limited supply
  - Land availability & regulation
  → supply elasticity
  - Heterogeneity in price & construction responses
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- **Regional Heterogeneity:**
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  - Land availability & regulation → supply elasticity
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Heterogeneity in House Prices

Source: FHFA House Price Index (Seasonally Adjusted, 1995q1=100); Privately-owned Single-unit Housing Starts (FRED, Federal Reserve Bank of St. Louis)
Geography & Regulation Measures

- **Land Availability Measure (Saiz, 2010)** - % “buildable land” in 50km radius of MSA’s city-center
  - “Buildable land” excludes water bodies & steep grades
  - Measure of long-run supply of land in a city
  - Fixed radius accounts for differences in MSA size & sprawl

- **Wharton Land Use Regulation Index (Gyourko, et al, 2008)**
  - Survey-based Index of strictness of zoning laws in MSA’s
  - Measures time and financial cost of acquiring permits & beginning construction

- Total of 269 MSA’s (over 816 counties) represented
  - Roughly 80% of population & 20% of land area
Geography & Regulation Measures

Geographic Constraints
Proportion of Unavailable Land in 50km of City Center

Wharton Land Use Regulation Index

Source: Land availability data from Saiz (2010).
Source: Data from Gyorko, Saiz, Summers (2008) acquired on Albert Saiz’s website.
Does monetary policy affect house prices? Does the response vary by local geography/regulation?

Estimate a Monetary VAR:

- Including GDP, Inflation, Federal Funds Rate, Mortgage Rate
- PLUS 4 house price indices for quartiles of elasticity measure
- Identify Monetary Shocks using recursive ordering:
  - Current GDP & Inflation are ordered prior to Fed Funds
  - Home values are ordered after
Heterogeneous Effects on House Prices (2)

House Price Index Responses to Monetary Shock

- Most Inelastic
- Inelastic
- Elastic
- Most Elastic

Quarters after Shock

95% CI  Response to 1sd Monetary Shock

Responses to 1sd (72bp) innovation in fed funds.
Public-Use Micro-data (Interview Survey)

- Rotating Panel: 5,000-7,500 Households/Quarter interviewed for 4 qtrs
- Quarterly Survey of 500+ categories comprising most of expenditures
  - Consumption measure aggregates nondurables
- First & last wave include income/balance sheet questions
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Restricted Access Geocodes:

- Matched to County FIPS codes
- Link households to local housing & income variables
Consumer Expenditure Survey Micro-Data

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- Sample:
  - 1986q1-2008q4
  - ages 20-80, not in subsidized/school housing
  - dropped inconsistent changes in age/sex, large changes in family size
  - trimmed top/bottom 1% of expenditures growth
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Qtrly Expenditures</td>
<td>$9,563</td>
<td>$7,213</td>
<td>$8,835</td>
</tr>
<tr>
<td>Family After-Tax Income</td>
<td>$43,551</td>
<td>$31,000</td>
<td>$46,820</td>
</tr>
<tr>
<td>Home Value (owners)</td>
<td>$194,829</td>
<td>$136,000</td>
<td>$210,521</td>
</tr>
<tr>
<td>Age of Head</td>
<td>46.66</td>
<td>45</td>
<td>16.13</td>
</tr>
<tr>
<td>Family Size</td>
<td>2.61</td>
<td>2</td>
<td>1.52</td>
</tr>
<tr>
<td>% Owning Homes</td>
<td>64.62%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% w/ Mtg. Reported</td>
<td>24.42%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Renting</td>
<td>33.25%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Housing Supply Elasticity Data

- Cross-section of 269 MSA’s
  - Land Available = % of land 50km from city-center with no geographic barriers
  - Wharton Zoning Regulation Index

- Land and Regulations account for most variation in supply elasticity (Saiz, 2010)

House Price Index (Federal Housing Finance Agency)

- Quarterly, Repeat-Sales Index of MSA house prices
- Based on Fannie/Freddie Conforming Loans (no cash purchases, subprimes, jumbos)
  - Robustness checks include Zillow Home Value Index (1996-2008)

Macro Data: GDP, CPI, Fed Funds, and Mortgage Rates
1. Identify national monetary shocks in a VAR
   - Monetary shocks $\rightarrow$ household consumption/house prices
   - Household/Local variables $\Rightarrow$ national aggregates

2. Utilize difference in house price responses to construct instrument
   - Only "inelastic supply" MSA’s will have price change
   - Use shock $\eta_t$ and measure of elasticity $z_i$ to construct instrument

3. Estimate $\beta_1$ using instrumental variables
Monetary shock $\eta_t$ identified from Fed Funds equation in a recursive \textit{VAR}

- Ordered GDP, Inflation, Fed Funds, 30yr Mortgage Rate, House Price Index
- Baseline Assumption: Policy rule reacts to only GDP and Inflation within quarter

$$ff_t = a_1gdp_t + a_2\pi_t + a_3(L)Y_{t-1} + D_t + \eta_t$$

- Note: Policy rule excludes local/individual variables
Identifying Effect of House Price on Consumption

- Estimate responses of consumption $c_{it}$ to house prices $q_{it}$ and monetary shock $\eta_t$:

$$\Delta c_{i,t+1} = \beta_1 \Delta q_{i,t+1} + \beta_2 (L) \eta_t + \beta_3 \Delta x_{i,t+1} + u_{i,t+1}$$

$$\Delta q_{i,t+1} = \gamma (L) \eta_t + \gamma_4 \Delta x_{i,t+1} + v_{i,t+1}$$

- Econometric issue:
  - House Price growth endogenous to unobserved shocks to wealth/productivity
  - OLS estimate of $\beta_1$ is biased

- Interact shock with Land Availability & Regulation to use as instrument:
  - Only geographically/regulation-constrained MSA’s will have $\Delta q_{it} \neq 0$ after a demand shock
  - Compare response between elastic & inelastic MSA’s
\[ \Delta c_{it} = \beta_1 \Delta q_{it} + \beta_2 (L) \eta_t + \beta_3 \Delta X_{it} + u_{it} \]
\[ \Delta q_{it} = \gamma_1 z_i + (\gamma_2 (L) z_i + \gamma_3 (L)) \eta_t + \gamma_4 \Delta X_{it} + v_{it} \]

- Excluded instruments: \( z_i = [geog_i, reg_i] \) & interaction \( \eta_t z_i \)
- Controls:
  - Life-cycle: age polynomial & change in family size
  - Local & household income growth controls potential correlations between \( z_i \) and local productivity
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- Identifying Assumptions:
  - \( E [z_i u_{it}] = 0 \) & \( E [z_i \eta_t u_{it}] = 0 \)
  - Trend consumption and response to \( \eta_t \) do not vary systematically with \( z_i \)
### Consumption Growth Regressions

<table>
<thead>
<tr>
<th></th>
<th>(1) Owners Only</th>
<th>(2) Renters Only</th>
<th>(3) All Households</th>
</tr>
</thead>
<tbody>
<tr>
<td>House Price Growth</td>
<td>1.503***</td>
<td>-0.00227</td>
<td>0.178</td>
</tr>
<tr>
<td></td>
<td>(0.400)</td>
<td>(0.447)</td>
<td>(0.295)</td>
</tr>
<tr>
<td>CU Inc. Growth</td>
<td>0.0235***</td>
<td>0.0174***</td>
<td>0.0239***</td>
</tr>
<tr>
<td></td>
<td>(0.00552)</td>
<td>(0.00609)</td>
<td>(0.00456)</td>
</tr>
<tr>
<td>Age</td>
<td>-0.104**</td>
<td>0.0360</td>
<td>0.0163</td>
</tr>
<tr>
<td></td>
<td>(0.0442)</td>
<td>(0.0727)</td>
<td>(0.0425)</td>
</tr>
<tr>
<td>Age²</td>
<td>0.00139***</td>
<td>0.000202</td>
<td>0.000231</td>
</tr>
<tr>
<td></td>
<td>(0.000394)</td>
<td>(0.000699)</td>
<td>(0.000400)</td>
</tr>
<tr>
<td>Chg. Family Size</td>
<td>9.932***</td>
<td>6.655***</td>
<td>7.296***</td>
</tr>
<tr>
<td></td>
<td>(0.896)</td>
<td>(0.929)</td>
<td>(0.709)</td>
</tr>
<tr>
<td>Observations</td>
<td>24,270</td>
<td>10,345</td>
<td>34,615</td>
</tr>
</tbody>
</table>

All regressions also include qtr. dummies & direct effects of monetary shocks. Standard errors in parentheses are clustered at MSA-level. *** p<0.01, ** p<0.05, * p<0.1
## Selected Robustness Checks

<table>
<thead>
<tr>
<th></th>
<th>(1) Pre-Bubble (1986-2000)</th>
<th>(2) Zillow House Prices</th>
<th>(3) Asset Returns</th>
<th>(4) Excluding Regulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>House Price Growth</td>
<td>1.201** (0.487)</td>
<td>0.962*** (0.160)</td>
<td>1.533*** (0.401)</td>
<td>0.950* (0.505)</td>
</tr>
<tr>
<td>Household Inc. Growth</td>
<td>0.0146*** (0.00506)</td>
<td>0.0463*** (0.00608)</td>
<td>0.0245*** (0.00555)</td>
<td>0.0333*** (0.00738)</td>
</tr>
<tr>
<td>10-yr Treasury Return</td>
<td></td>
<td></td>
<td>0.653*** (0.123)</td>
<td></td>
</tr>
<tr>
<td>1-yr SP500 Return</td>
<td></td>
<td></td>
<td>-0.00984 (0.0173)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>16,083</td>
<td>12,864</td>
<td>24,270</td>
<td>38,694</td>
</tr>
</tbody>
</table>

All regressions include age, family changes, qtr. dummies & direct effects of monetary shocks. Standard errors in parentheses are clustered at MSA-level. *** p<0.01, ** p<0.05, * p<0.1
Why? Collateral vs Wealth

- Owner is both landlord and tenant
  - Rising home value raises asset wealth (landlord)...
  - ...and also cost of living (tenant)
  - Infinitely-lived agent is hedged against fluctuations (Sinai & Souleles, 2005)

- Wealth effects for buyers/sellers only
  - Rising price helps seller & hurts buyer
  - Transfer of wealth = small aggregate effects

- Collateral effects
  - Two types of agents: natural borrowers vs natural savers
  - Borrowers cannot commit to repay
  - Rising home value circumvents the agency cost
Two measures to identify “constrained” households:

1. High Debt-Service Ratio: $DSR = \frac{\text{Debt Service Payments}}{\text{Income}}$
   - Top 25% DSR likely constrained (Li & Johnson, 2007)

2. Home Equity Extraction: Mortgage, Home Equity Loans, & HELOC’s
   - Reported increase in home debt balance during survey period

Split sample between constrained & unconstrained

Do constrained have higher response?
## Credit Constraints: Results

### Consumption Growth Regressions (Constrained vs Unconstrained)

<table>
<thead>
<tr>
<th></th>
<th>(1) Constrained (high DSR)</th>
<th>(2) Unconstrained (low DSR)</th>
<th>(3) Increased Home Debt</th>
<th>(4) No Increase Home Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>House Price Growth</strong></td>
<td>2.857*** (1.028)</td>
<td>-0.0655 (0.495)</td>
<td>3.569*** (1.203)</td>
<td>1.389*** (0.374)</td>
</tr>
<tr>
<td><strong>Household Inc. Growth</strong></td>
<td>0.0516*** (0.0103)</td>
<td>0.0188** (0.00845)</td>
<td>0.00943** (0.00468)</td>
<td>0.0544*** (0.0111)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>-0.900*** (0.139)</td>
<td>0.124** (0.0542)</td>
<td>-0.253* (0.137)</td>
<td>0.0365 (0.0632)</td>
</tr>
<tr>
<td><strong>Age^2</strong></td>
<td>0.00966*** (0.00146)</td>
<td>-0.000607 (0.000488)</td>
<td>0.00257* (0.00143)</td>
<td>0.000167 (0.000603)</td>
</tr>
<tr>
<td><strong>Chg. Family Size</strong></td>
<td>0.803 (1.893)</td>
<td>7.516*** (1.120)</td>
<td>10.63*** (1.570)</td>
<td>7.988*** (1.108)</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>3,496</td>
<td>14,700</td>
<td>3,586</td>
<td>15,273</td>
</tr>
</tbody>
</table>

All regressions include qtr. dummies & direct effects of monetary shocks. Standard errors in parentheses are clustered at MSA-level. *** p<0.01, ** p<0.05, * p<0.1
Evidence for a “balance sheet” channel (Iacoviello, 2005; Bernanke, Gertler, & Gilchrist, 1999)

- 100bp increase in Fed Funds causes 1-2.5% fall in real house price
- Elasticity of consumption to house prices is approx 1.5
- Implies a 1.5-3.75% peak consumption response

Heterogeneity of responses:

- “Inelastic” supply regions affected more
- Owners and Credit Constrained most affected

Construct responses by MSA using reduced form
Cumulative Consumption Response

Consumption Response to Monetary Shock
Response vs % Land Unavailable

Consumption Response to Monetary Shock
Response vs Local Regulation

- 4qtr Response
- 8qtr Response
- 12qtr Response
- 16qtr Response
Cumulative Consumption Response

Heterogeneity in Consumption Response (4qtrs)
Response to 1st Monetary Shock (72bp)

Heterogeneity in Consumption Response (8qtrs)
Response to 1st Monetary Shock (72bp)
Cumulative Consumption Response

Heterogeneity in Consumption Response (12qtrs)
Response to 1st Monetary Shock (72bp)

Heterogeneity in Consumption Response (16qtrs)
Response to 1st Monetary Shock (72bp)
Relation to Macro/Housing Literature

- “Financial Accelerator” Models (Iacoviello, 2005; Bernanke, Gertler, & Gilchrist, 1999)
  - Chaney, Sraer, Thesmar (2013) - empirical evidence on firm investment side

- Housing Bubble and Consumer Credit
  - Cooper (2009) - Evidence Propensity to consume out of housing wealth
  - Mian & Sufi (2010) - Evidence of Credit responses to housing wealth

- Other Literatures:
  - Regional Heterogeneity in Housing (Saiz, 2010; Gyourko, et al, 2008; Paciorek, 2013)
  - Monetary Policy & Inequality (Gorodnichenko, et al, 2012)
Conclusions

- Local house prices respond to monetary shocks
  - differ based on geography & local regulations
- Average propensity to consume out of housing wealth: 6 – 9¢ for every $1 increase in local house prices
  - Positive effect for owners only, no effect for renters
  - Primarily due to credit constrained households → Collateral Effects
- Implies 100 basis point shock to federal funds causes 1.5-3.75% change in spending for owners through “homeowner balance sheets”
  - Effect varies substantially by region & ownership status
Heterogeneity in Land

Dallas

San Francisco