# The Housing Wealth Effect:
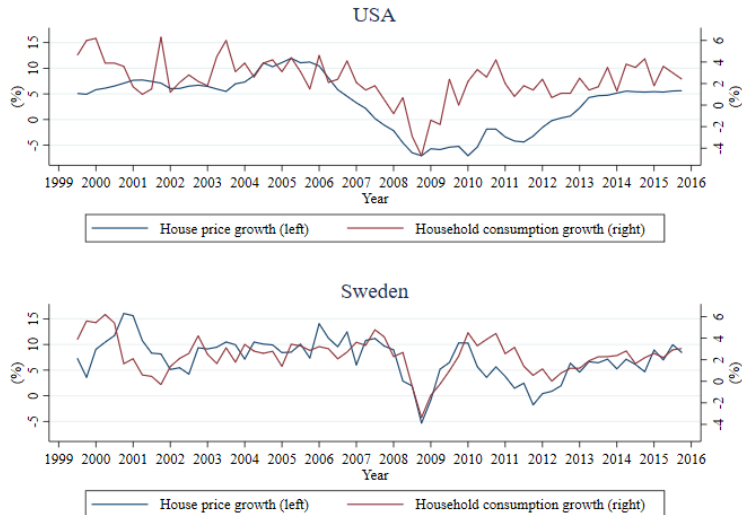# Quasi-Experimental Evidence

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AEA Annual Meeting, January 2024

# How much do house prices move consumption?



USA

Sweden

House price growth (left)    Household consumption growth (right)

# Econometric difficulties

- Consumption and house prices respond to the same factors:
  - Interest rate changes
  - Credit conditions
  - Aggregate income shocks
  - Economic outlook
- Existing instrumental variable regressions have been criticized:
  - Davidoff (2016), Kaplan, Mitman, and Violante (JPubE, 2020)

# Additional challenges

- A housing wealth shock over a large geographic region introduces general equilibrium effects

- Guren, McKay, Nakamura and Steinsson (2020): total effect consists of

  1. Response to a partial equilibrium (PE) housing wealth shock ▸ Chris Carroll
  2. A general equilibrium (GE) multiplier on the response.

- Papers use different outcome variables which leads to additional variation:

  - Non-durable consumption
  - Durables (cars) or loans
  - Retail employment

- The economy's state might matter

# We argue that these challenges contribute to variation in estimates
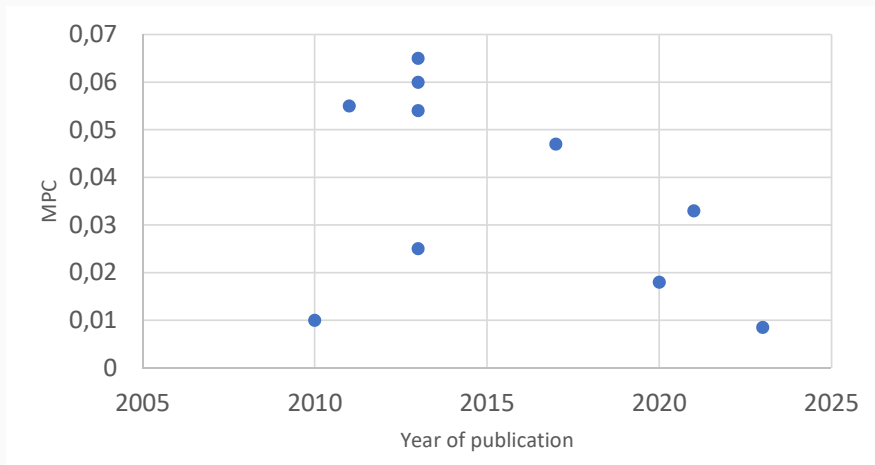
## What we do and our main findings

- Use a quasi-experiment to isolate a partial equilibrium house price shock:
  - Homeowners facing a $-20\%$ relative loss of wealth buy cheaper new cars: $-7.7\%$ (new car MPX of 0.025).
  - Balance sheet composition matters
  - Aggregate partial equilibrium car MPX of $0.12 - 0.38$ cents per dollar: smaller than previous estimates.

- Use a model to:
  - Replicate the experiment and compute a partial equilibrium total MPX (car+non-durable): 2 cents per dollar housing wealth.
  - Separate the role of wealth versus collateral
  - Illustrate importance of the economy's state

## Outline

# The quasi-experiment: Renewal of Bromma Airport's contract

- The airport relies on an operating contract with the municipality
  - Early 2000s: common understanding that airport would close in 2011
  - September 2006: Best ever election for the conservative party; center-right coalition negotiated a new contract behind closed doors
  - September 2007: announcement of renewal, extending operations to 2037

- Unexpected renewal:
  - Not part of the conservative party's election platform
  - Nothing in the news before press conference

- Pre-treatment period: 2004Q1 – 2007Q3

- Post-treatment period: 2007Q4 – 2008Q4
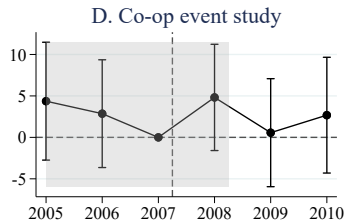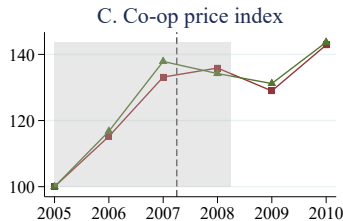
# Noise area: Noise contour + 1,000 meters
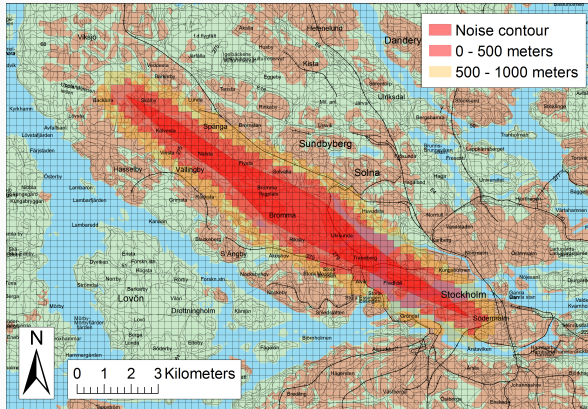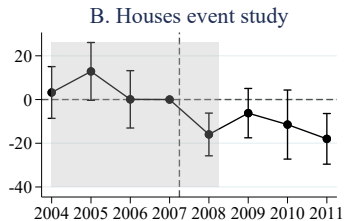


Sources: Land and Environment Court (2006) and own analysis.

Propagation of noise (decibels): $L_2 = L_1 + 10 \times \log^{10}\left(\frac{r_1^2}{r_2^2}\right)$

70 dB at border of noise contour $\Rightarrow$ 60 dB 1,000 meters away

# House prices respond (-19.4%), apartment prices do not



A. House price index

B. Houses event study

C. Co-op price index

D. Co-op event study

Sources: Lantmäteriet and Svensk Mäklarstatistik.

» Quarterly frequency   » Dose response   » Income variables

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## Outline
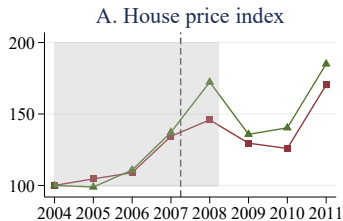
## Household data set

Panel data set, all Stockholm households, 2005Q1–2008Q3:

- All car transactions (quarterly freq.) and prices of new cars

- Geographic location, income, and other demographics

- Financial wealth, housing wealth, debt, housing tenure until 2007Q4

- Loan balance, type of loan, loan-to-value ratio until 2007Q4

## Fall in house prices leads to cheaper cars

For household $i$ in year-quarter $t$ we estimate

$$\text{car outcome}_{it} = \phi\,\text{Noise area}_i \times \text{Post}_t + \rho\,\text{Noise area}_i + \eta\,X_i + \eta_t + \varepsilon_{it} \tag{1}$$

$X_i$ contains age, hh size, disposable income, and net worth, in 2006

|  | Number new cars (extensive margin) | log new car value at purchase (intensive margin) |
|---|---|---|
| Noise area$_i$ × Post$_t$ | 0.00029 | −7.7*** |
|  | (0.00054) | (0.021) |
| Controls | Yes | Yes |
| Observations | 531,105 | 6045 |

## IV estimates for new cars: sizeable conditional responses

| | Full sample | | LTV | | Bank deposits | |
| --- | --- | --- | --- | --- | --- | --- |
| | | | $\leq$ 50% | $>$ 50% | $\leq$ P50 | $>$ P50 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| log(House price$_{it}$) | 0.398*** | 0.393*** | 0.269** | 0.526*** | 0.694*** | 0.123 |
| | (0.108) | (0.124) | (0.124) | (0.188) | (0.183) | (0.138) |
| Controls | No | Yes | Yes | Yes | Yes | Yes |
| Observations | 6045 | 6045 | 3945 | 2100 | 2748 | 3297 |
| Age | 52 | 52 | 56 | 45 | 50 | 54 |
| LTV | 42 | 42 | 22 | 80 | 51 | 35 |
| Net worth | 3860 | 3860 | 4950 | 1830 | 2440 | 5050 |
| Financial wealth | 1517 | 1517 | 1860 | 879 | 508 | 2360 |

$$-19.4\% \times 0.393 \approx -7.6\%$$

## Aggregate implications – Car MPX (new + used)

- Loss in housing wealth: SEK 774,060 (SEK $3,990,000 \times 19.4\%$)

- Reduction in spending: SEK 19,061 ($0.393 \times 19.4\% \times 250,000$)

- New car MPX of 0.025 (i.e., 2.5 cents per dollar)

- Comparison with geographically aggregated data: Overall new car MPX of 0.0012 ($0.049 \times 0.025$). Note: 0.12 cents per dollar.

- If assuming constant expenditure shares of used and new cars, car MPX of 0.38 cents per dollar.

  - Mian et al. 2013 estimate an MPX on cars of 1.8–2.3 cents per dollar on regional data (ZIP/County)

  - Aruoba et al. 2022 1.2 cents per dollar (household level).

## Outline

- **Replicating quasi-experiment:** An identical twin experiences an unexpected positive permanent shock to house value (MIT shock).

- Decompose the role of
  - Change in total wealth vs. change in mortgage borrowing constraint
  - "Normal times" vs. "crisis times" along two dimensions:
    1. Sign and size of the shock
    2. Household attentiveness

## Life-cycle model (1)

Households have utility over non-durable goods ($c$) and cars (durable, $d$) .

They own a house and receive stochastic transitory shocks to labor income.

### States:

- age $t$
- beginning-of-period cash on hand    (savings+income)
- beginning-of-period mortgage    (that has to be amortized)
- beginning-of-period cars    (that depreciates over time)

House prices: Constant but subject to MIT shock – households update perception of house prices infrequently, on average every 6th quarter (akin to McKay and Wieland, ECMA 2021).

## Life-cycle model (2)

Choices:

- Non-durable consumption $c_t$
- Sell/buy cars $d_t$,     subject to adjustment cost
- Uncollateralized borrowing or savings
- Refinance their mortgage,     subject to LTV constraint and adj. cost
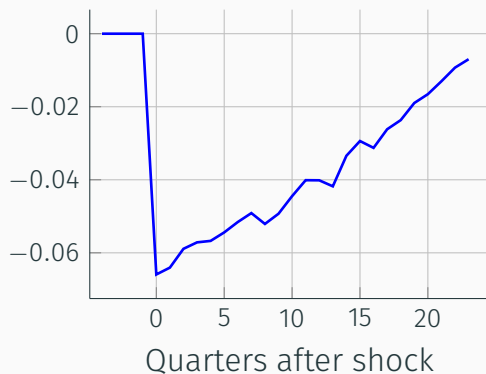
# Housing wealth effect – relative loss of $-19.4\%$

A. Consumption and expenditures (SEK 1,000)



Quarters after shock
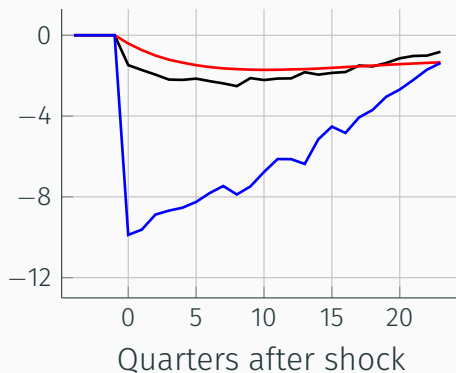
- Total $\exp_t$
- $c_t$
- $d_t \mid$ purchase

# Housing wealth effect – relative loss of $-19.4\%$



C. $\log d_t \mid \text{purchase}$

D. $\log c_t$

Quarters after shock

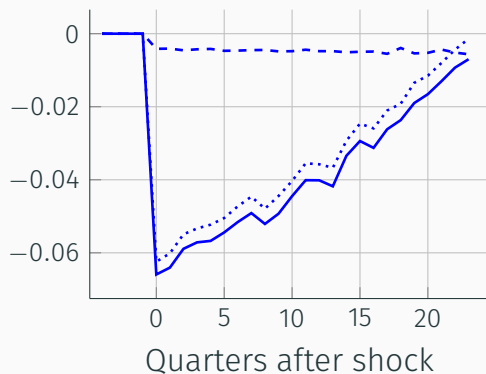Quarters after shock

Total effect
Only wealth effect
Only mortgage effect
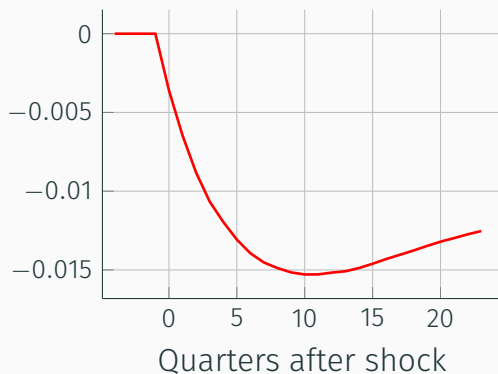
Total effect
Only wealth effect
Only mortgage effect

# Housing wealth effect – relative loss of $-19.4\%$



C. $\log d_t \mid \text{purchase}$

D. $\log c_t$

Quarters after shock

Quarters after shock

— Total effect
- - - Only wealth effect
······ Only mortgage effect

— Total effect
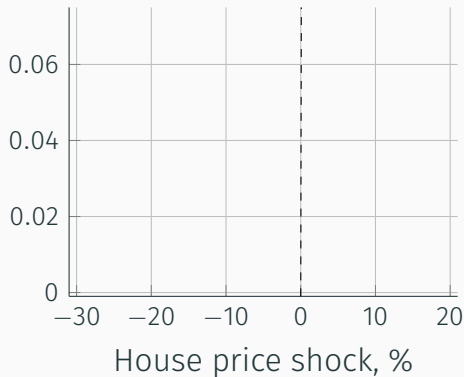- - - Only wealth effect
······ Only mortgage effect

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# Larger shocks lead to smaller PE spending responses per unit of loss/gain

A. Total MPX (incomplete info)

B. Car MPX (incomplete info)

*House price shock, %*

*House price shock, %*
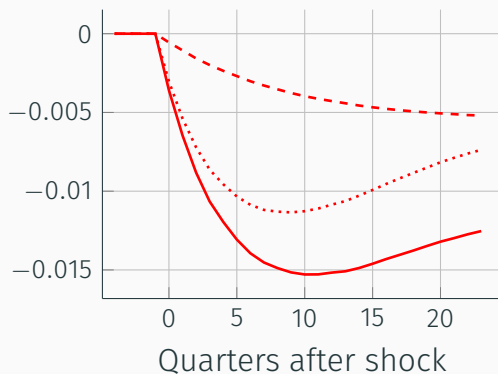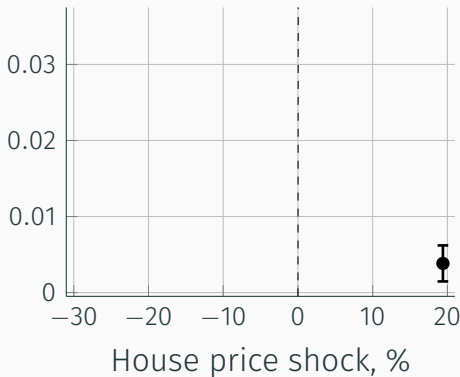
━●━ Empirical estimate

# Larger shocks lead to smaller PE spending responses per unit of loss/gain



A. Total MPX (incomplete info)

B. Car MPX (incomplete info)

House price shock, %

House price shock, %
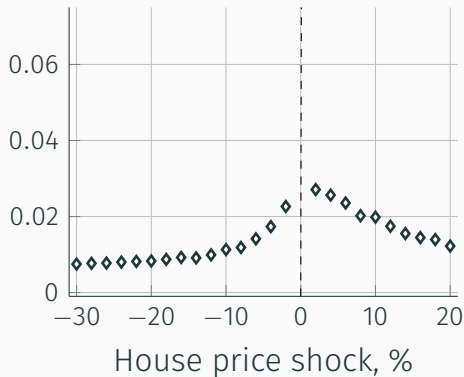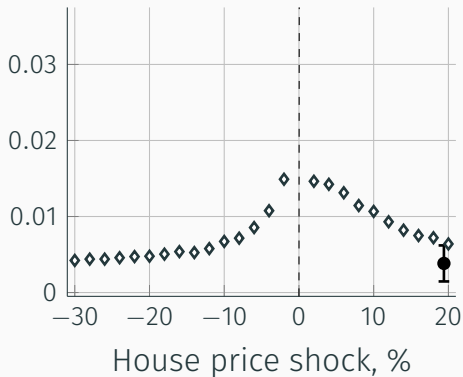
◇ 1-year post period  —●— Empirical estimate

# Normal vs. crisis times: Household attentiveness matters by factor of 2–3



C. Total MPX (full information)    D. Car MPX (full information)

House price shock, %    House price shock, %
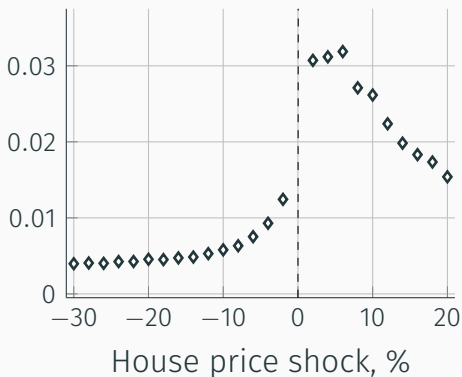
◇ 1-year post period

## Conclusions

- We use a quasi-experiment and household level data to estimate the partial equilibrium housing wealth effect.
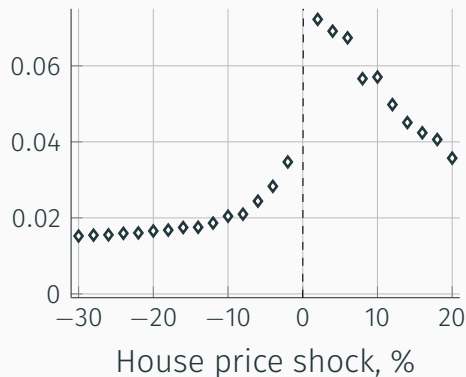
- We estimate a new car MPX that is substantial response for those that purchase a new car ($-7.7\%$), but small in the aggregate (0.12 cents per dollar).

- Balance sheet composition matters a lot – relevant for macroprudential regulations.

- Model verifies that small partial equilibrium response is reasonable. Total MPX $<0.02$. On the small side compared to previous estimates.

- Consistent with "normal economic times": absent general equilibrium effects, shifts in expectations, and a credit market freeze.

## Literature

**Consumption and housing wealth, empirics**   Campbell and Cocco (2007),
O. P. Attanasio et al. (2009), Christopher D. Carroll et al. (2011), Mian et al. (2013),
Browning et al. (2013), L. Guerrieri and Iacoviello (2017), Aladangady (2017),
A. M. Guren et al. (2021)

**Consumption and housing wealth, theory**   Buiter (2010), Kaplan et al. (2020),
Berger, V. Guerrieri, et al. (2018)

**Structural models, durable consumption and response dynamics**   Berger and
Vavra (2015), McKay and Wieland (2021), O. Attanasio et al. (2022),
Christopher D Carroll et al. (2020), Auclert et al. (2020)

## Estimates of housing wealth effect

| Study | Country | Elasticity | MPC | Car elasticity | Car MPX |
|---|---|---|---|---|---|
| Aladangady 2017 | U.S. | – | 0.047 | – | – |
| Aruoba et al. 2022 | U.S. | – | – | – | 0.012 |
| O. P. Attanasio et al. 2009 | U.K. | 0.0 | – | – | – |
| Browning et al. 2013 | DK | 0.0–0.13 | 0.003–0.05 | – | – |
| Calomiris et al. 2013 | U.S. | 0.163–0.270 | 0.049–0.081 | – | – |
| Campbell and Cocco 2007 | U.K. | 0–1.7 | – | – | – |
| Christopher D. Carroll et al. 2011 | U.S. | – | 0.02–0.09 | – | – |
| Case et al. 2013 | U.S. | 0.065–0.068 | – | – | – |
| Cloyne et al. 2019 | U.K. | 0.2–0.3 | – | – | – |
| Cooper 2013 | U.S. | 0.06 | 0.06 | – | – |
| Disney et al. 2010 | U.K. | 0.087–0.120 | 0.01 | – | – |
| Graham and Makridis 2023 | U.S. | 0.10 | 0.0078–0.0092 | – | – |
| L. Guerrieri and Iacoviello 2017 | U.S. | – | – | 0.24–0.49 | – |
| A. Guren et al. 2020 | U.S. | 0.040 | 0.018 | – | – |
| A. M. Guren et al. 2021 | U.S. | 0.072 | 0.033 | – | – |
| Kaplan et al. 2020 | U.S. | 0.06–0.12 | – | – | – |
| Mian et al. 2013 | U.S. | 0.13–0.26 | 0.054 | 0.33–0.43 | 0.018–0.023 |

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**Figure 1:** Effect on house prices, quarterly
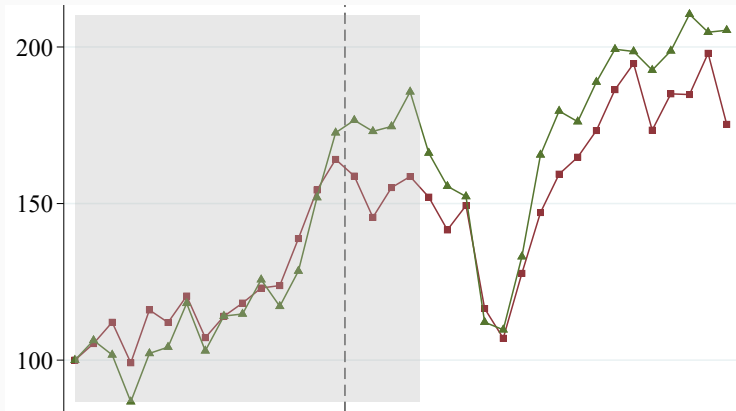
## Dose response

| | log single-family home prices | | log car value | |
|---|---|---|---|---|
| | **Single-family homes** | | | |
| | (1) | (2) | (3) | (4) |
| Post$_t$ × 0 | −0.288*** | | −0.105*** | |
| | (0.041) | | (0.028) | |
| Post$_t$ × (0, 500] | −0.216*** | | −0.052** | |
| | (0.055) | | (0.023) | |
| Post$_t$ × (500, 1000] | −0.143*** | | −0.069 | |
| | (0.052) | | (0.042) | |
| Post$_t$ × $-\log_{10}((1 + \text{dist}_i)^2)$ | | −0.053*** (0.007) | | −0.015*** (0.003) |
| Controls | Yes | Yes | Yes | Yes |
| Observations | 11,308 | 11,308 | 6045 | 6045 |
| *R*-squared | 0.331 | 0.334 | 0.043 | 0.042 |

## Panel A. Labor income
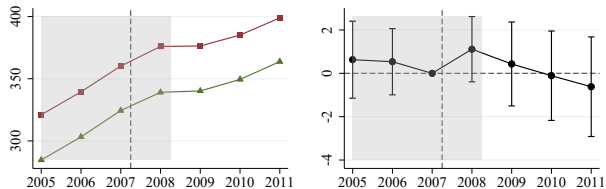


## Panel B. Capital income

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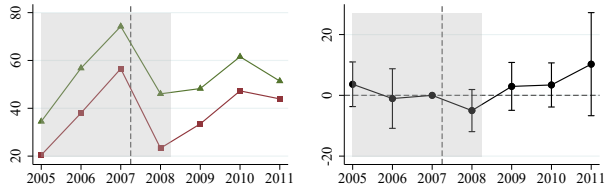
## Placebo (intensive margin)

| | Single-family home owners | | Co-op owners | | Renters | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Noise area$_i$ × Post$_t$ | −0.085*** | −0.077*** | 0.007 | 0.009 | −0.012 | −0.006 |
| | (0.019) | (0.021) | (0.019) | (0.018) | (0.039) | (0.038) |
| Noise area$_i$ | 0.000 | 0.004 | −0.029* | −0.026* | −0.018 | −0.008 |
| | (0.012) | (0.012) | (0.015) | (0.015) | (0.013) | (0.011) |
| Controls | No | Yes | No | Yes | No | Yes |
| Observations | 6045 | 6045 | 11,065 | 11,065 | 9334 | 9334 |
| *R*-squared | 0.011 | 0.042 | 0.007 | 0.043 | 0.006 | 0.051 |

## Credit financing of car purchases

$$
\begin{aligned}
\frac{\Delta \text{ credit}_{it}^{k}}{\text{car value bought}_{it}} = {}& \beta_l \left(\text{LTV}_{it-1} < 50\%\right) \\
& + \beta_m \left(\text{LTV}_{it-1} \in [50\%, 100\%)\right) \\
& + \beta_h \left(\text{LTV}_{it-1} \geq 100\%\right) + \eta X_{it} + \epsilon_{it}.
\end{aligned}
$$

## Marginal propensity to borrow by loan-to-value ratio

|  | All credit | | Mortgage | |
| --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) |
| Intercept | 0.467*** | | 0.333*** | |
|  | (0.031) | | (0.029) | |
| Low LTV, < 50% | | 0.458*** | | 0.354*** |
|  | | (0.033) | | (0.031) |
| Mid LTV, 50–100% | | 0.524*** | | 0.310*** |
|  | | (0.044) | | (0.040) |
| High LTV, > 100% | | 0.323*** | | 0.116 |
|  | | (0.094) | | (0.087) |
| Low LTV − Mid LTV | | −0.066 | | 0.044 |
| High LTV − Mid LTV | | −0.201** | | −0.194** |
| Observations | 6647 | 6647 | 6647 | 6647 |
| Controls | Yes | Yes | Yes | Yes |

Guren, McKay, Nakamura and Steinsson (NBER Macro Annual, 2020):

$$c_{it} = C_y y_{it} + C_p p_{it} + C_R R_t + C_\Omega \Omega_t$$

- The partial equilibrium housing wealth effect: $C_p$

- The general equilibrium housing wealth effect: $\frac{\partial C_{it}}{\partial y_{it}} \times \frac{\partial y_{it}}{\partial p_{it}}$

## Difference-in-difference (first stage)

**Table 1:** Effect on house prices

| | Log of house prices | | | Log of apartment prices | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Noise area$_i$ | −0.214*** | −0.214*** | −0.194*** | 0.027 | 0.002 | −0.019 |
| $\times$ Post$_t$ | (0.040) | (0.035) | (0.028) | (0.018) | (0.014) | (0.014) |
| Noise area$_i$ | 0.202*** | 0.211*** | 0.222*** | 0.042 | 0.135*** | 0.135*** |
| | (0.043) | (0.035) | (0.034) | (0.037) | (0.031) | (0.032) |
| Observations | 11,321 | 11,308 | 19,666 | 50,312 | 50,248 | 85,048 |
| R-squared | 0.102 | 0.330 | 0.374 | 0.049 | 0.430 | 0.437 |
| Pre-GFC | Yes | Yes | No | Yes | Yes | No |
| Controls | No | Yes | Yes | No | Yes | Yes |

*[…] to isolate a 'pure' housing wealth effect, one would want data on spending by individual households before and after some truly exogenous change in their house values, caused for example by the unexpected discovery of neighborhood sources of pollution. The perfect experiment observed in the perfect microeconomic dataset is however not available.*

— Carroll et al. (2010), "How Large are Housing and Financial Wealth Effects? A new Approach" ECB wp no. 1283 ▸ Back

# Cars in the aggregate data



Source: Statistics Sweden.

## bibliography
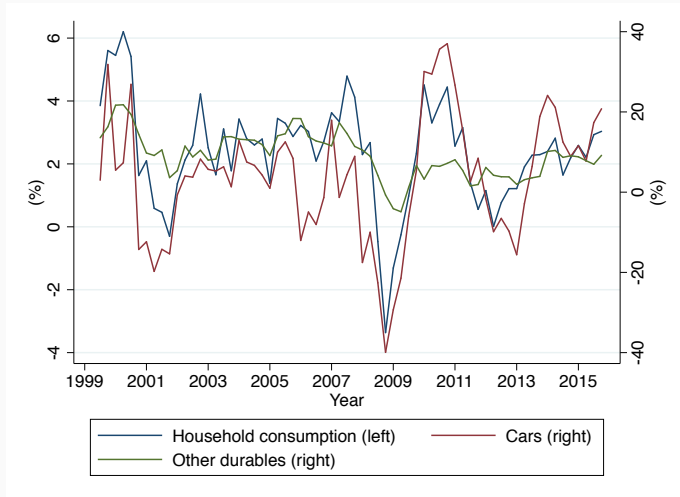
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