Discussion of "The Real Effects of Liquidity During the Financial Crisis: Evidence from Automobiles"

Gabriel Chodorow-Reich
Harvard University and NBER

NBER Corporate Finance Meeting
November 14, 2014

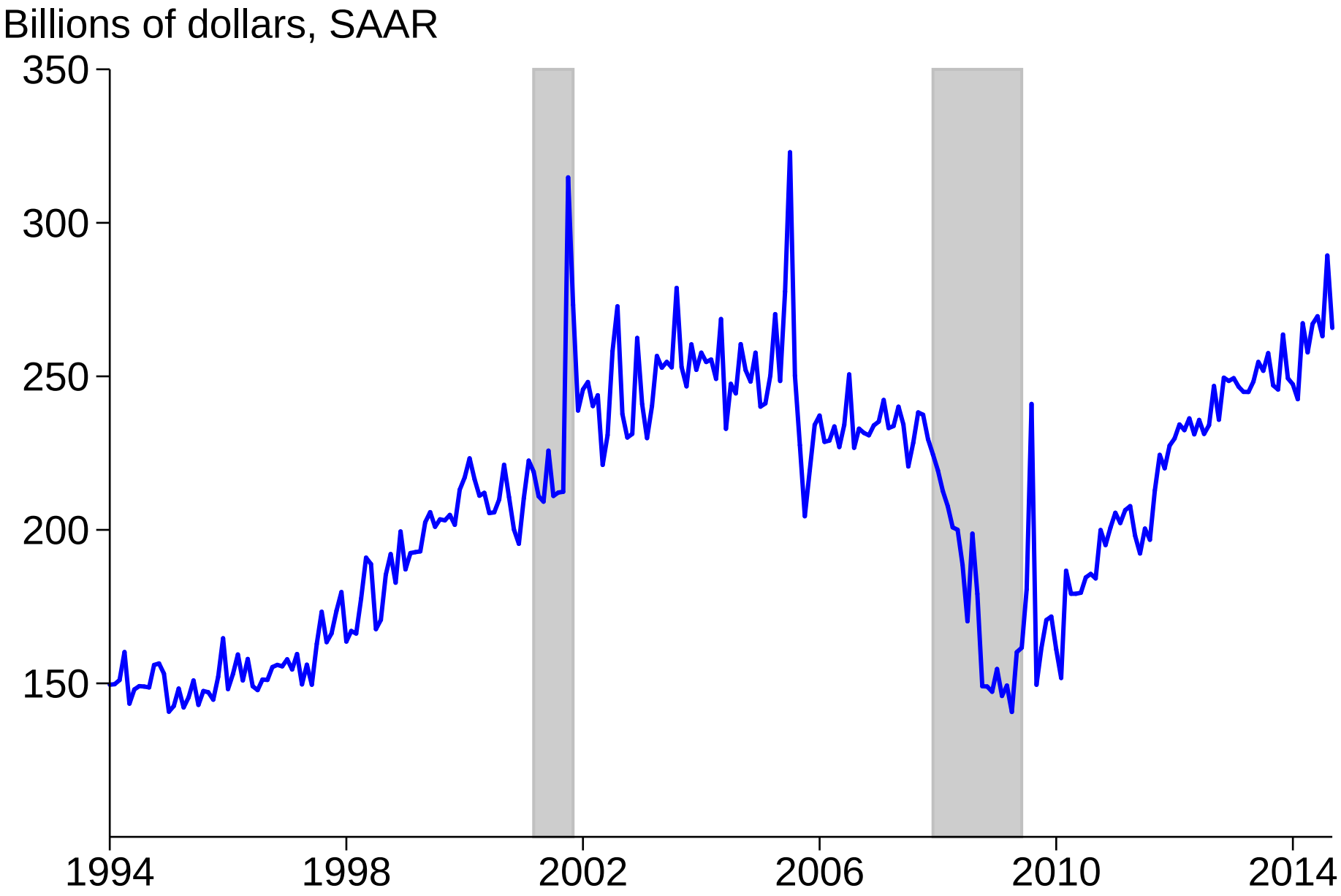
Overview

1. Big picture and BMR story.
2. Most convincing result.
3. Puzzling result.
4. Quantitative importance.

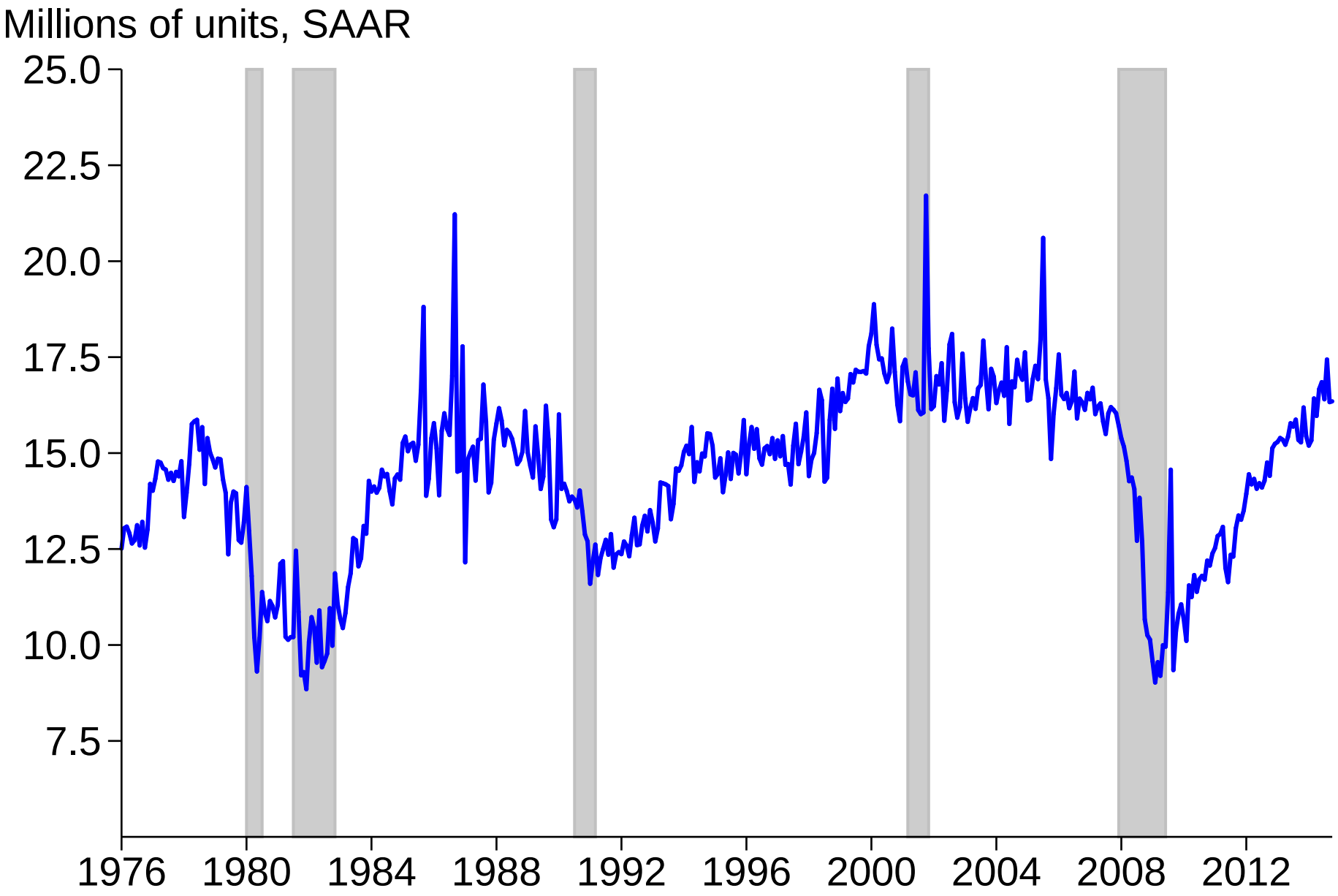
Big picture and BMR story

- Collapse in new auto sales in 2008-09.

Light weight vehicle sales



Light weight vehicle sales

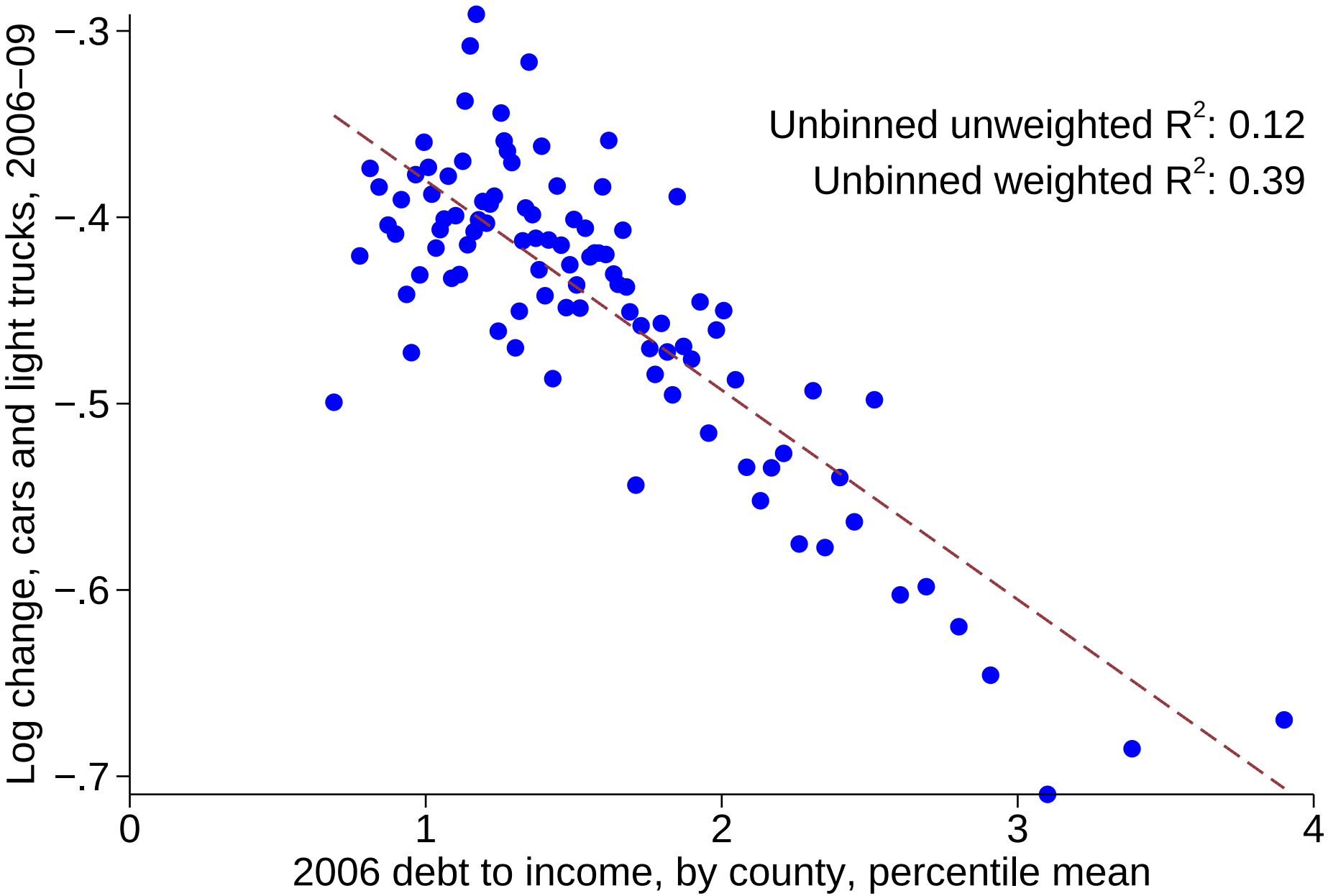


Big picture and BMR story

- Collapse in new auto sales in 2008-09.

- Existing literature finds strong cross-sectional relationship between decline in auto sales and 2006 debt to income, house price decline, etc. (Mian, Rao and Sufi QJE 2013).

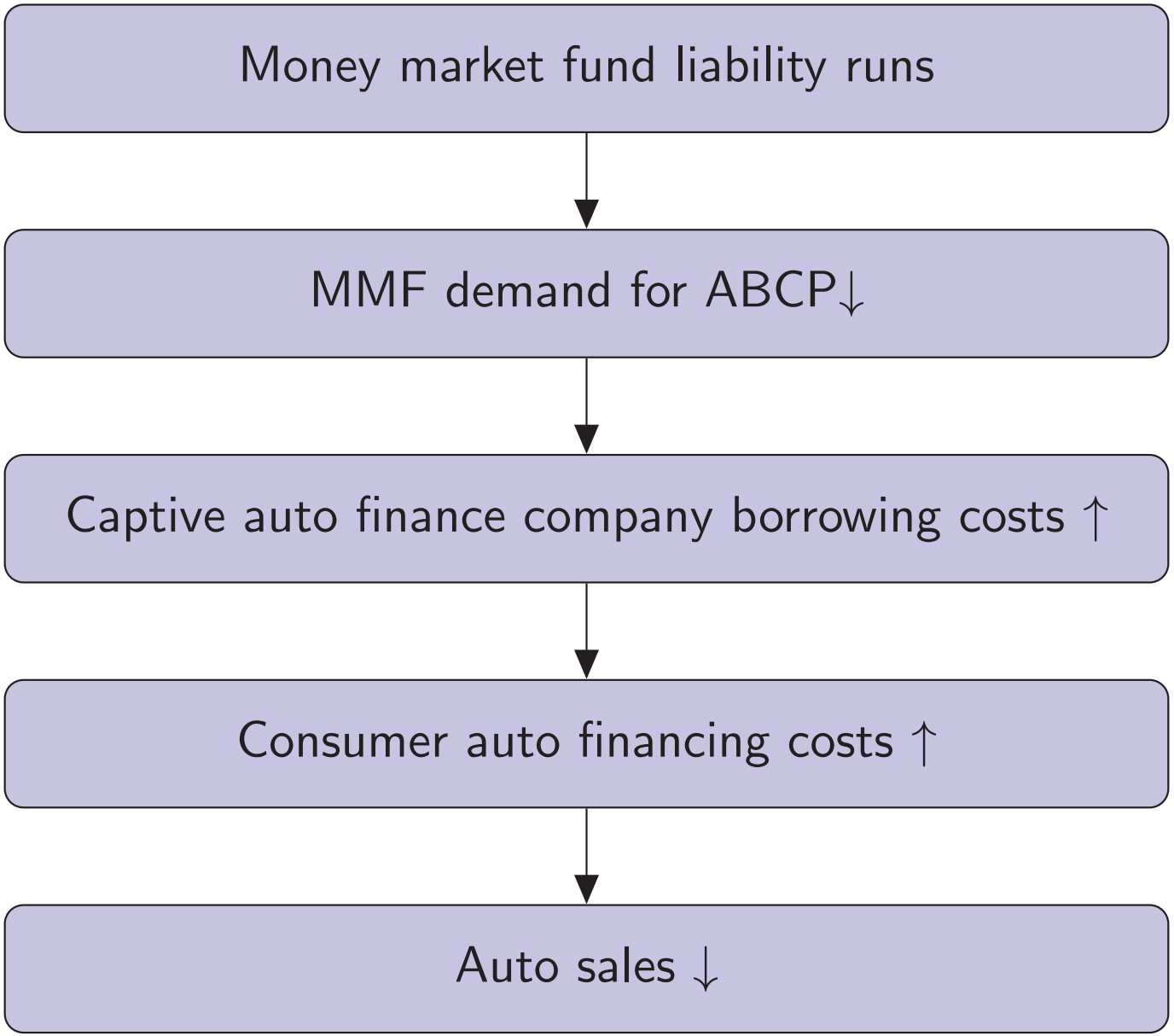
Decline of auto purchases and debt to income



Big picture and BMR story

- Collapse in new auto sales in 2008-09.
- Existing literature finds strong cross-sectional relationship between decline in auto sales and 2006 debt to income, house price decline, etc. (Mian, Rao and Sufi QJE 2013).
- BMR introduce cross-sectional variation in auto financing.

BMR Story


Money market fund liability runs
MMF demand for ABCP↓
Captive auto finance company borrowing costs ↑
Consumer auto financing costs ↑
Auto sales ↓

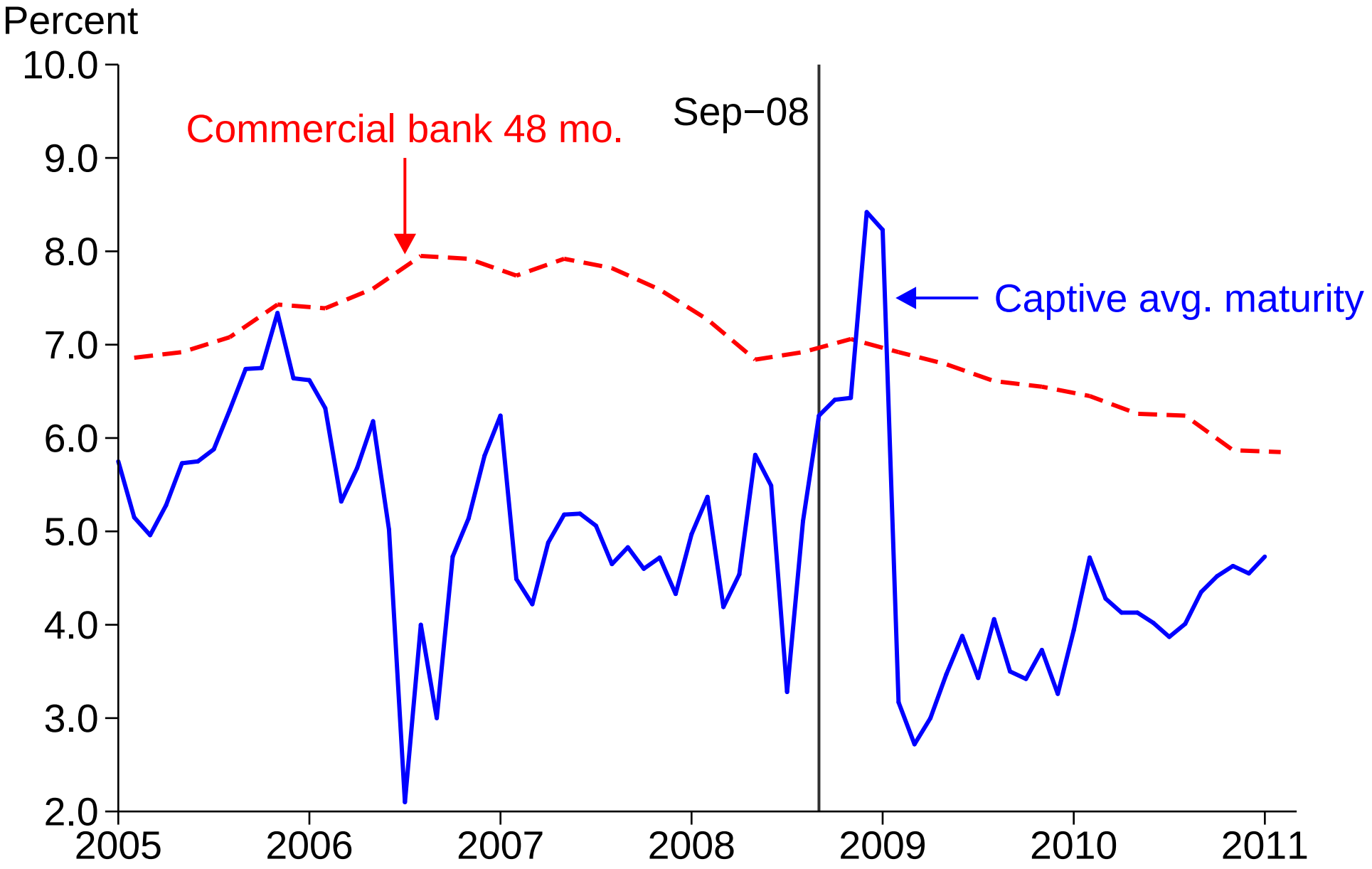
A priori plausible?

- Auto finance companies heavy users of Federal Reserve CPFF.
- But CPFF already available in Jan-09, and TALF begins lending against new auto ABS in Mar-09.
- Capital losses could also explain lending contraction.
  - GMAC had substantial exposure to subprime real estate.
- Relative interest rate of captives spikes briefly in late 2008.
  - Not adjusted for borrower quality, LTV, etc.
  - Retail interest rate, not floorplan finance rate.
- Paper contains nice narrative evidence that financing shock mattered.

A prior Plausible? Financing of ABCP from CPFF, January 1, 2009

Rank	Firm	Billions outstanding
1	The Liberty Hampshire Company	16.358
2	BSN Holdings	14.645
3	Hudson Castle	13.032
4	Fortis Bank SA/NV	12.025
5	American International Group	7.828
6	GMAC LLC	7.480
7	Ford Credit	6.938
8	State Street Bank & Trust	5.653
9	Royal Bank of Scotland Group	5.097
10	Citigroup	3.427
18	Chrysler Financial Services	1.495

A priori plausible? Auto finance interest rates



Most convincing result

- Specification:

$$\ln Q^f_{imst} = \alpha_{is} + \alpha_m + \beta_1 \ln Q^f_{imst-1} + \beta_2 s_{imst-1} + \varepsilon^f_{imst}.$$

  - Q^f_{imst}: New cars purchased in county i, of make m in segment s, financed by type $f \in \{\text{captive,non-captive}\}$, at time t.
  - s_{imst-1}: captive finance share for segment s and make m in county i at time $t-1$.

- Example: [decline in GM sales in mid-size cars in county *i* *relative to* national decline in GM sales] *relative to* [decline in Ford sales in mid-size cars in county *i* *relative to* national decline in Ford sales] *as function of* [captive share of GM mid-size cars in county *i* *relative to* average GM captive share] *relative to* [captive share of Ford mid-size cars in county *i* *relative to* average Ford captive share].

Variables	(1) captive transactions	(2) substitution: non-captive transactions	(3) all transactions	(4) all transactions segments
Captive Dependence	-0.306***	0.0357	-0.0189*	-0.0165**
	(0.0323)	(0.0325)	(0.0101)	(0.007)
Log Number of Cars Financed in 2008	Yes	Yes	Yes	Yes
Market Share	Yes	Yes	Yes	Yes
Make Fixed Effect	Yes	Yes	Yes	Yes
County Fixed Effect	Yes	Yes	Yes	No
County-Segment Fixed Effect	No	No	No	Yes
Observations	11,526	11,546	11,624	33,844
R-squared	0.363	0.486	0.408	0.94

Standard errors are clustered at the state level. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively.

Puzzling result

- Their baseline specification:

$$\ln Q_{it}^c = \beta_0^c + \beta_1^c \ln Q_{it-1}^c + \beta_2^c s_{it-1} + X_{it}' \beta_3^c + \varepsilon_{it}^c.$$

  - Dependent variable is log cars financed by captives, not total cars sold.

- $\beta_2^c < 0$.
- Log additive decomposition into county demand shock and financier supply shock predicts zero relationship between intial share and log change in purchases financed by captive financiers:

$$\Delta \ln Q_i^f = \alpha_i + \alpha_f + \varepsilon_{if} \Longrightarrow \beta_2 < 0, \beta_2^c = 0.$$

- Pricing model predicts *smaller* decline in captive-financed auto sales in counties with larger initial share, i.e. $\beta_2^c > 0$.
- Intuition is general: same % decline generates larger general equilibrium disruption in places where initial market share is higher.

Variables	(1) captive transactions	(2) substitution: non-captive transactions	(3) all transactions	(4) all transactions segments
Captive Dependence	-0.306***	0.0357	-0.0189*	-0.0165**
	(0.0323)	(0.0325)	(0.0101)	(0.007)
Log Number of Cars Financed in 2008	Yes	Yes	Yes	Yes
Market Share	Yes	Yes	Yes	Yes
Make Fixed Effect	Yes	Yes	Yes	Yes
County Fixed Effect	Yes	Yes	Yes	No
County-Segment Fixed Effect	No	No	No	Yes
Observations	11,526	11,546	11,624	33,844
R-squared	0.363	0.486	0.408	0.94

Standard errors are clustered at the state level. ***, **, * denotes significance at the 1%, 5%, and 10% levels, respectively.

Simple model

- Captive finance company c, non-captive n, areas indexed by i.
- Upward sloping credit supply:

$$r_{it}^c = \alpha_t^c + \gamma\left(\ln Q_{it}^c - \ln \bar{Q}_i^c\right),$$
$$r_{it}^n = \alpha_t^n + \gamma\left(\ln Q_{it}^n - \ln \bar{Q}_i^n\right).$$

  - α_t^f: national cost of funds for type $f \in \{c, n\}$.
  - $\bar{Q}_i^f$: area-specific target sales. Interpret as sales infrastructure.
  - $\gamma > 0$: When sales rise above the target, interest rate increases.
- Downward sloping credit demand:

$$\ln Q_{it} = \pi_{it}^0 - \pi^1 r_{it}.$$

- Equilibrium in car market:

$$Q_{it} = Q_{it}^c + Q_{it}^n \quad \forall i.$$

Model solution

- Bertrand competition over interest rates:

$$Q_{it}^{n} = \kappa_t \left[\frac{\bar{Q}_i^n}{\bar{Q}_i^c} \right] Q_{it}^{c}, \;\; \kappa_t \equiv \exp \left[\frac{\alpha_t^c - \alpha_t^n}{\gamma} \right].$$

- Market share s_{it}:

$$s_{it} \equiv \frac{Q_{it}^c}{Q_{it}} = \frac{\bar{Q}_i^c}{\bar{Q}_i^c + \kappa_t \bar{Q}_i^n}.$$

- Solution for quantities:

$$\begin{aligned}
\ln Q_{it}^c &= \left[1 + \pi^1 \gamma\right]^{-1} \left[\pi_{it}^0 - \pi^1 \left(\alpha_t^c - \gamma \ln \bar{Q}_i^c\right) + \ln s_{it}\right], \\
\ln Q_{it} &= \left[1 + \pi^1 \gamma\right]^{-1} \left[\pi_{it}^0 - \pi^1 \left(\alpha_t^c - \gamma \ln \bar{Q}_i^c\right)\right] - \pi^1 \gamma \left[1 + \pi^1 \gamma\right]^{-1} \ln s_{it}, \\
\ln Q_{it}^n &= \ln Q_{it} + \ln(1 - s_{it}).
\end{aligned}$$

Regression equation, all autos

$$\begin{aligned}\Delta \ln Q_{it} &= \left[1+\pi^1\gamma\right]^{-1}\left[\Delta\pi^0_{it} - \pi^1\Delta\alpha^c_t + \Delta\ln s_{it}\right] - \Delta\ln s_{it} \\ &\approx \left[1+\pi^1\gamma\right]^{-1}\left[\Delta\pi^0_{it} - \pi^1\Delta\alpha^c_t\right] - \frac{\pi^1\gamma}{1+\pi^1\gamma}\left[s_{it-1}-1\right]\left[\kappa_t - 1\right] \\ &= \beta_0 + \beta_2 s_{it-1} + \varepsilon_i,\end{aligned}$$

where:

- $\beta_0 \equiv -\pi^1\left[1+\pi^1\gamma\right]^{-1}\left[\Delta\alpha^c_t - \gamma(\kappa_t - 1)\right]$: national shock to captive finance cost of credit;
- $\beta_2 \equiv -\frac{\pi^1\gamma}{1+\pi^1\gamma}\left[\kappa_t - 1\right] < 0$;
- $\varepsilon^c_i \equiv \left[1+\pi^1\gamma\right]^{-1}\Delta\pi^0_{it}$: county-specific demand shock;
- $\Delta\ln s_{it} \approx \left[s_{it-1}-1\right]\left[\kappa_t - 1\right]$: first order approximation around $\kappa_t = 1$;
- $\alpha^c_{t-1} = \alpha^n_{t-1}$: assumed for simplicity.

Regression equation, captive-financed autos

$$\begin{aligned}\Delta \ln Q_{it}^c &= \left[1+\pi^1\gamma\right]^{-1}\left[\Delta\pi_{it}^0 - \pi^1\Delta\alpha_t^c + \Delta\ln s_{it}\right] \\ &\approx \left[1+\pi^1\gamma\right]^{-1}\left[\Delta\pi_{it}^0 - \pi^1\Delta\alpha_t^c + \left[s_{it-1}-1\right]\left[\kappa_t - 1\right]\right] \\ &= \beta_0^c + \beta_2^c s_{it-1} + \varepsilon_i^c,\end{aligned}$$

where:

- $\beta_0^c \equiv -\left[1+\pi^1\gamma\right]^{-1}\left[\pi^1\Delta\alpha_t^c + \kappa_t - 1\right] < 0$: national shock to captive finance cost of credit;
- $\beta_2^c \equiv \left[1+\pi^1\gamma\right]^{-1}\left[\kappa_t - 1\right] > 0$;
- $\varepsilon_i^c \equiv \left[1+\pi^1\gamma\right]^{-1}\Delta\pi_{it}^0$: county-specific demand shock;
- $\Delta\ln s_{it} \approx \left[s_{it-1}-1\right]\left[\kappa_t - 1\right]$: first order approximation around $\kappa_t = 1$;
- $\alpha_{t-1}^c = \alpha_{t-1}^n$: assumed for simplicity.

Why $\beta_2^c > 0$?

- Dealer floor plan financing harder to substitute than retail financing, and floor plan financing from captives correlated with retail financing from captives.
- Transitory shocks to captive finance share and mean reversion.
- Residual demand shocks.
- Other?

Quantitative importance

- Total sales fall 23.5 log points from 2008 to 2009.
- Coefficient in total sales specification: 1 sd increase in captive dependence $\Rightarrow$ 1.5-2.5% fewer total sales.
- Similar magnitude to effect of household balance sheets in 2008-09:

	Dep.var.: $\Delta \ln$[car purchases]					
	06-09	06-09	06-09	06-07	07-08	08-09
Housing net worth shock	0.106**					
	(0.014)					
2006 debt to income		−0.119**	−0.084**	−0.024**	−0.040**	−0.020*
		(0.012)	(0.014)	(0.006)	(0.005)	(0.008)
Estimator	OLS	OLS	OLS	OLS	OLS	OLS
Demographic controls	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.42	0.45	0.35	0.11	0.27	0.18
Observations	919	919	2180	2180	2180	2180

Displayed right hand side variables normalized to have unit variance.

- Similar magnitude to effect of credit availability on employment in Chodorow-Reich (2014): 1 sd $\Rightarrow \approx$ 2% lower employment.

Smaller comments

- Would be useful to better pin down timing. 2008Q2 versus 2009Q2, or seasonally adjust and 2008Q2 versus 2008Q4.
- Making dependent variable log change would help in comparing across specifications and make R^2s meaningful.
- Would be useful to see non-parametric binned scatter plots.
- Partial equilibrium adding up exercise would give alternative sense of magnitude.

Summary

1. I buy the bottom line result that they identify an effect of a credit supply shock.
2. More on the economics would be useful. Why do captive-financed sales fall more in areas with a larger initial captive finance share?
3. Quantitative magnitude appears similar to related papers, but small relative to the magnitude of the decline in auto sales.