Markups Across Space and Time

Eric Anderson Sergio Rebelo Arlene Wong

Northwestern Northwestern Princeton

May 2019

Motivation

$$\mu = \frac{P}{MC}$$

- Cyclical properties are key to evaluating business cycle models.

- Some models imply countercyclical markups.
  - Standard New-Keynesian models with sticky prices and procyclical marginal costs (e.g. Woodford (2003)).
  - Ravn, Schmitt-Grohe, and Uribe (2008)'s deep-habit model, and Jaimovich and Floetotto (2008)'s entry and exit model.

- Other models imply acyclical or procyclical markups.
  - Models with both sticky prices and marginal costs.
  - Erceg, Henderson, and Levin (2000), Christano, Eichenbaum and Evans (2005) and Christano, Eichenbaum and Trabandt (2015)).

Measuring markups

$$\mu = \frac{P}{MC}$$

- Existing studies use structural approaches that rely on assumptions about production functions and market structure.

- We provide direct empirical evidence on the cyclical properties μ based on gross margins for the retail industry.

  - Focus on the retail sector due to marginal cost data.

  - Retail CPI and scanner data commonly used.

  - Direct evidence of costs and provide new evidence on consumption assortment. Generalize to firm and industry analysis.

- Provide a unifying theory to explain the time series and cross-sectional markup patterns.

Approach and data

- Study margins at 3 levels of aggregation:
  - Product level: using scanner data from a large retailer.
  - Firm level: using Compustat data.
  - Retail sector: using Census of Retail Trade and Compustat data.

Gross and net operating margins (firm and industry level)

$$\text{Gross margin} = \frac{\text{Sales} - \text{Cost of goods sold}}{\text{Sales}} = \frac{pq - cq}{pq}$$

$$\text{Net operating profit margin} = \frac{\text{Sales} - \text{Cost of goods sold} - \text{Other expenses}}{\text{Sales}}$$

$$= \text{Gross margin} - \frac{\text{Other expenses}}{\text{Sales}}$$

Other expenses include overhead costs, rent and other selling and administrative expenses. For retail firms, these include fixed expenses.

Scanner data (product level)

- Data from a large retailer with store-level weekly data.
- Quantities sold, retail price and costs for each item from 2006-2009.
- Retailer sells 3.6 million item-store pairs across 79 product categories (including grocery, health and beauty, and general merchandise)
- This retailer's margins are representative of a typical retail firm's margins.

Scanner data (product level)

- Construct for each item i at store s in county k at time t

$$\text{Gross margin}_{iskt} = \frac{\text{Price}_{iskt} - \text{Replacement cost}_{iskt}}{\text{Price}_{iskt}}$$

- Replacement cost:
  - is defined as the cost the store would incur if it were to replace the item i that it just sold at in time t.
  - is used internally by the store for tracking store profits, which manager bonuses and evaluations are tied to.
  - compared to the aggregate SEC annual report numbers, and county level wholesale costs from Nielsen.

- Compute gross margins for every product in every store. Aggregate to construct quarterly data.

Scanner data (product level)

- Construct for each item i at store s in county k at time t

$$\text{Gross margin}_{iskt} = \frac{\text{Price}_{iskt} - \text{Replacement cost}_{iskt}}{\text{Price}_{iskt}}$$

- County-level margins

$$\text{Gross margin}_{kt} = \sum_{i,s} w_{ist} \text{Gross margin}_{ist}$$

where w_{ist} are weights.

- For confidentiality reasons, the level of markups are normalized relative to the average 2006-07 markup.
  - I.e. Mean normalized markup in 2006-07 is zero.
  - The level of retail industry margins is about 0.3.

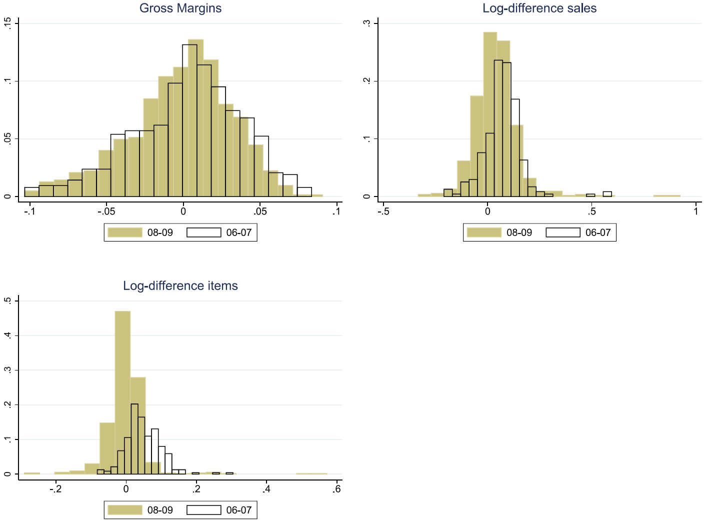
Outline

Business cycle properties

Cross-sectional properties

Implications for macroeconomic and trade models

Distributions of Gross Margins, Sales, and Number of Items



Each observation is a county-quarter. Details

Cyclicality of Retailer Margins

To study cyclicality more formally, we estimate:

$$\triangle y_{mt} = \beta_0 + \beta_1 \triangle Z_{mt} + \gamma X_m + \varepsilon_m,$$

- m denotes region. Log-differences between 2006-07 and 2008-09.
- $\triangle y_{mt}$: consider margins; prices; costs; sales; items.
- $\triangle Z_{mt}$: consider $\triangle$ local unemployment; $\triangle$ local house prices (IV housing supply elasticity).

  For firm and industry level, also consider $\triangle$ GDP, and conditioning on shocks (oil and monetary).
- β_1: elasticity with respect to change in local area activity.

Cyclicality of Retailer Margins

$$\triangle y_{mt} = \beta_0 + \beta_1 \triangle Z_{mt} + \gamma X_m + \varepsilon_m,$$

- m denotes region. Log-differences between 2006-07 and 2008-09.

	Elasticity with to local house prices	
Gross margin	0.075**	(0.034)
Price	0.096	(0.077)
Replacement cost	0.021	(0.082)
Sales	0.249*	(0.150)
Number of items	0.208*	(0.122)

- If house prices rise by 10%, margins increase by 0.7ppts (significant, but small relative to an industry mean of 30%).
- In contrast, sales and unique items sold increase by 2-2.5ppts.

Cyclicality of Retailer Margins

$$\triangle y_{mt} = \beta_0 + \beta_1 \triangle Z_{mt} + \gamma X_m + \varepsilon_m,$$

- m denotes region. Log-differences between 2006-07 and 2008-09.

	Elasticity with to local house prices	
Gross margin	0.075**	(0.034)
Price	0.096	(0.077)
Replacement cost	0.021	(0.082)
Sales	0.249*	(0.150)
Number of items	0.208*	(0.122)

- Gross margin is slightly procyclical/acyclical.
- Sales and unique items are strongly pro-cyclical. OLS Volatility Cost
- These results holds when conditioning on the cyclicality of costs. Details

Cyclicality of Aggregate Retail Trade Variables

We estimate

$$\triangle y_t = \beta_0 + \beta_1 \triangle GDP_t + \eta_t$$

	Elasticity wrt GDP			
	Quarterly		Annual	
Gross margins	0.162	(0.256)	0.376	(0.616)
Operating profit margins	2.286**	(0.895)	5.233	(3.632)
Sales	8.089***	(0.45)	9.279***	(1.976)
Cost of goods sold	8.104***	(0.43)	9.140***	(2.154)

Sample: 1980-2007.

- Gross margin is slightly procyclical/acyclical.
- In contrast, sales and COGS are highly procyclical. Firm-level
- Operating profit margins are also procyclical. Inv Time Series Volatility

Summary of business cycle properties

- We also studied the conditional response of retailer firm margins different types of aggregate shocks:
  - Oil price shocks
  - Monetary policy shocks
- Gross margins are mildly procyclical / roughly stable. Details
- Findings are consistent at all levels of aggregation:
  - product, firm, and industry.

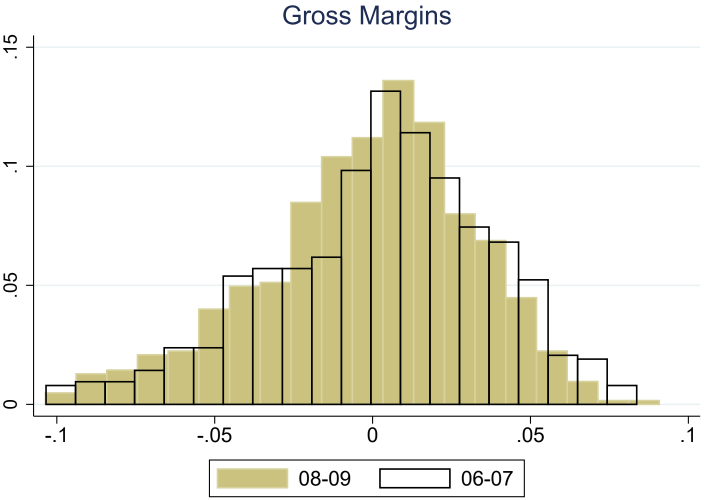
Outline

Business cycle properties

Cross-sectional properties

Implications for macroeconomic and trade models

Decomposing the gross margins variance



For confidentiality reasons, the margins are normalized relative to the mean margins in 2006-07.

Decomposing the gross margins variance

$$
\begin{aligned}
Var\left(\mu_{mt}\right) &= \frac{1}{TM-1}\sum_t\sum_m\left[\mu_{mt}-\mu\right]^2 \\
&= \frac{1}{TM-1}\sum_t\sum_m\left[\mu_{mt}-\mu_t+\mu_t-\mu\right]^2 \\
&\approx \underbrace{\frac{\sum_t\sum_m\left(\mu_t-\mu\right)^2}{TM-1}}_{Var(\mu_t)} + \frac{1}{T}\underbrace{\sum_t\frac{\sum_m\left(\mu_{mt}-\mu_t\right)^2}{M-1}}_{Var_t(\mu_m)} + \text{Cov}(.)
\end{aligned}
$$

	County-level (%) variance	Contribution to total variance
Total	0.117	1.000
Time variation	0.013	0.112
Spatial variation	0.103	0.886
Covariance term	0.000	0.002

Decomposing the Cross-sectional Dispersion

Decomposing spatial component further:

$$\begin{aligned} var_t(\mu_m) &= var_t(\sum_j \mu_{jm} w_{jm}) \\ &= \underbrace{var(\sum_j (\mu_{jm} - \bar{\mu}_j)\, \bar{w}_j)}_{\text{differences in gross margins for same item}} + \underbrace{var(\sum_j (w_{jm} - \bar{w}_j)\, \bar{\mu}_j)}_{\text{differences in assortment}} \\ &+ \underbrace{var(\sum_j (\mu_{jm} - \bar{\mu}_j)\, (w_{jm} - \bar{w}_j))}_{\text{interaction term}} + covar(\cdot). \end{aligned}$$

Decomposing the Cross-sectional Dispersion

Spatial variation due to:	Item sold everywhere	All items
(i) Differences in gross margins for the same item	10%	3%
(ii) Differences in assortment composition	85%	81%
(iii) Interaction term	1%	1%
(iv) Covariance term	4%	15%

- Majority of spatial dispersion comes from the composition mix of items consumed. E.g. Dove cream vs L'Oreal Age Perfect.
- Differences in composition is mainly due to differences in items purchased, rather than availability of assortment.

Cross-sectional dispersion and county characteristics

	Correlation
Log household income	0.215
Log median house value	0.304
Share colleged educated	0.442
Herfindahl index	-0.079
Rural county	-0.041

- Markups positively correlated with measures of income and wealth.
- Markups uncorrelated with measures of competition and a proxy for higher transport costs.

Summary of cyclical and cross-sectional properties

1. Margins are mildly procyclical and stable over time.
2. Margins vary significantly across regions.
3. Cross-sectional variation reflects composition of consumption, rather than deviations from uniform pricing or differences in the assortment of available products.

Outline

Business cycle properties

Cross-sectional properties

Implications for macroeconomic and trade models

Implications for macro models

1. Distinguishing between different macro models:
   - Flexible price retail models: informative about particular preferences.
   - Sticky price retail models: rules out models with flexible marginal cost and sticky prices.
2. Welfare implications of markups:
   - Rise in markups can be due to endogenous choices by household.
   - Welfare implications differ from those implied by productivity differences or lack of competition.

Implications for macro models

Flexible price retailers

	Cyclicality of Retail Markup
Dixit-Stiglitz	Acyclical
Search models	Procyclical
Deep habits/Entry exit	Countercyclical

Sticky price retailers

Procyclical cost	Cyclicality of Retail Markup
Dixit Stiglitz (Midrigan (2011), Golosov and Lucas (2007))	Countercyclical
Acyclical cost	
Nakamura and Steinsson (2010), Pasten, et al (2016) Woodford (2003), Coibion et al (2015)	Acyclical

Markups in trade models

- Trade models with non-homothetic preferences generate a positive correlation between markups and income.
  - Bertoletti and Etro (2014) consider version of Dixit-Stiglitz model with non-homothetic aggregator. Details
  - In Jajgelbaum, Grossman and Helpman (2011), households choose quantity of homogeneous good and quality of differentiated good. Details
- Embed non-homotheticity into standard macro set-up. Examine how and why markups change in response to cyclical and permanent shocks.

Endogeneous Assortment Model of Consumption

- Dixit-Stiglitz set-up; households choose differentiated varieties.
- More differentiated goods have higher markup.
- Households consume more differentiated goods when income rises, so markups rise with income:
  - Response to temporary shocks can be mildly procyclical.
  - Response to permanent and large income differences generate large variations in markups (i.e. consistent with cross-sectional data).

Endogeneous Assortment Model of Consumption

- Representative household maximizes life time utility

$$U = E_0 \sum_{t=0}^{\infty} \beta_t \left[\log \left(C_t^{\alpha} Z_t^{1-\alpha} \right) + \theta_t \log(1 - N_t) \right].$$

- N_t is hours of labor and θ_t represents a shock to the labor supply.

- Z_t is consumption of an homogenous good. Normalize the price of the homogeneous good.

- C_t is a composite of n_t differentiated goods.

Household's problem

$$C_t = q_t^{\gamma} \left[\int_0^{n_t} x_{iqt}^{1/v(q_t)} di \right]^{\nu(q_t)},$$

- $x_{iqt} \geq 1$ is the quantity consumed of variety i with quality q at time t.
- Assume $v(q_t)$ increases in q_t. As in Fajgelbaum, Grossman and Helpman (2011), higher quality consumption bundles a produced with more differentiated inputs.
- For $\gamma > 1$, households prefer more differentiated baskets.
- For tractability, consider a simple linear case with $v_t = q_t$.

Household's problem

- The first-order conditions of the household problem imply:

$$\frac{x_{it}(v)}{x_{jt}(v)} = \left(\frac{p_{it}(v)}{p_{jt}(v)}\right)^{\nu/(1-\nu)}$$

- The elasticity of substitution between any two goods is $-\nu/(1-\nu) \geq 0$.

- The case of $v = \infty$ is the Cobb-Douglas case. Finite values of v have a lower elasticity of substitution than Cobb-Douglas.

- Prices

$$p_{ivt} = \nu_t^{\gamma/v_t} P_t C_t^{(v_t-1)/v_t} x_{ivt}^{(1-v_t)/\nu_t}.$$

$$P_t = v_t^{-\gamma} \left[\int_0^n p_{ivt}^{1/(1-v_t)} di\right]^{1-v_t}.$$

Household's problem

- Maximize lifetime utility subject to budget constraint

$$\max_{C_t, Z_t, N_t} E_0 \sum_{t=0}^{\infty} \beta_t \left[\log\left(C_t^{\alpha} Z_t^{1-\alpha} \right) + \theta_t \log(1 - N_t) \right].$$

s.t.

$$P_t C_t + Z_t = w_t N_t + \int_0^{n_t} \pi_{it} di \equiv Y_t$$

- First-order conditions:

$$\begin{aligned} \frac{\theta_t}{1 - N_t} &= (1-\alpha)\frac{w_t}{Z_t}, \\ P_t C_t &= \alpha Y_t, \\ Z_t &= (1-\alpha) Y_t. \end{aligned}$$

- Price of Z_t is normalized.

Producer of differentiated good

- Each intermediate good of quality ν_t is produced with labor:

$$x_{ivt} = A_t(1+g)^t N_{ivt},$$

- A_t is a stationary shock to productivity. g is long-run growth rate of productivity.

- Monopolist of variety i supplies the level of quality demanded by consumers. Maximizes:

$$\pi_{it} = p_{ivt}x_{ivt} - \frac{w_t}{A_t(1+g)^t}x_{ivt} - \psi,$$

- ψ denotes a fixed cost (denoted in units of the homogeneous good) that the firm must incur each period.

Producer of differentiated good

- Optimal price is:

$$p_{ivt} = \nu_t \frac{w_t}{A_t(1+g)^t}.$$

- Higher markup for more differentiated (higher quality) goods.
- Markups are the same for goods of the same quality (uniform pricing).

Producer of homogeneous good

- Producers of homogeneous good has production function

$$Y_t^z = (1+g)^t N_{zt} = Z_t + n_t \psi.$$

- Continuum of measure one of homogeneous-good producers.
- The problem of the representative producer is to maximize:

$$\pi_{zt} = \max_{N_{zt}} Y_t^z \left[1 - \frac{w_t}{(1+g)^t} \right].$$

- Therefore, equilibrium wage

$$w_t = (1+g)^t.$$

Equilibrium

- Households maximize their utility, taking the wage rate and prices as given.
- Monopolists maximize profits taking the wage rate, the aggregate consumption bundle, C_t, and the aggregate price of the bundle of consumption varieties, P_t, as given.
- Producers of the homogeneous good maximize profits, taking prices as given.
- Labor and goods market clear.

Consider a symmetric equilibrium: Households

- In a symmetric equilibrium, $x_{ivt} = x_{jvt}$. Thus:

$$C_t = \nu_t^{\gamma-1} n_t^{v-1} \alpha Y_t A_t$$

  where

$$x_{vt} = \frac{\alpha A_t Y_t}{\nu_t n_t}.$$

  Recall ν_t is quality (markup), and n_t is number of varieties.

- Since utility is increasing in ν_t, the constraint $x_{vt} \geq 1$ is binding. Hence,

$$\nu_t = \frac{\alpha A_t Y_t}{n_t}.$$

- Households consume more differentiated goods when income rises. Therefore markups rise with income.

Consider a symmetric equilibrium: Firms

- Monopolists profits are
$$\pi_t = \frac{1}{A_t}(\nu_t - 1) - \psi$$
where ν_t is the markup (and quality), and ψ is the fixed cost.

- Free entry implies
$$\nu_t = 1 + \psi A_t, \quad \text{and} \quad n_t = \frac{\alpha A_t Y_t}{1 + \psi A_t}.$$

- When fixed costs ψ increase:
  - Fewer firms, but with higher markups in equilibrium.
  - Variation in ψ in the cross-section can generate dispersion in markups due to composition of consumption.

More equilibrium conditions

Model implications: Increase in A_t

- Markup is

$$\nu_t = 1 + \psi A_t$$

- Elasticity of markup with respect to productivity:

$$\frac{d\nu_t}{v} = \frac{A\psi}{1 + A\psi}\frac{dA_t}{A} > 0.$$

1. Elasticity approaches zero as fixed cost ψ approaches zero.
   - For low values of ψ markups are mildly procyclical.
2. Permanent increases in A_t leads to permanent changes in markups. Households increase consumption of more differentiated goods.

Model implications: Increase in A_t

- Markup is

$$\nu_t = 1 + \psi A_t$$

- Elasticity of markup with respect to productivity:

$$\frac{d\nu_t}{v} = \frac{A\psi}{1 + A\psi} \frac{dA_t}{A} > 0.$$

1. Elasticity approaches zero as fixed cost ψ approaches zero.
   - For low values of ψ markups are mildly procyclical.
2. Permanent increases in A_t leads to permanent changes in markups. Households increase consumption of more differentiated goods.

Model implications: Increase in θ_t

- Shock reduces labor supply, real income, and number of firms that produce differentiated goods.

- Markup remains constant

$$\nu_t = 1 + \psi A_t$$

where ψ is the fixed costs.

Model implications: Summary

- Markups are mildly procyclical to temporary shocks.
- Permanent changes in income can lead to compositional changes and endogenously higher markups over time.
- Understanding endogeneous product choice matters for interpreting trends in markups.

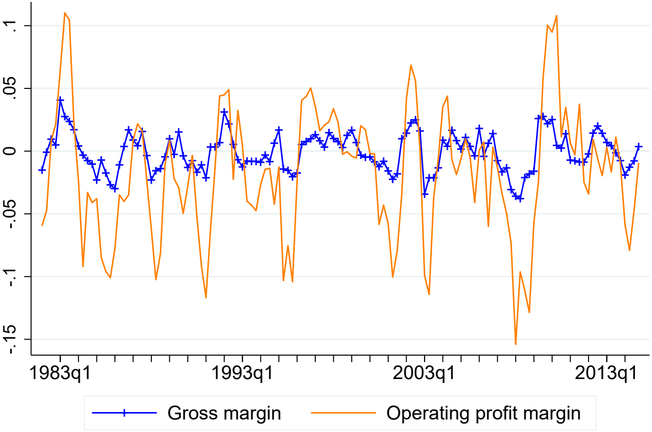
Conclusion

1. Markups are relatively stable over time and mildly procyclical.
2. In contrast, there is large regional dispersion in markups.
3. Markups are positively correlated with local income in the cross-section.
4. Reflects differences in assortment rather than deviation in uniform pricing for the same item.

Propose model consistent with these facts. Highlight the role of consumption composition.

Provides a framework for understanding potential reasons for long-run changes in markups.

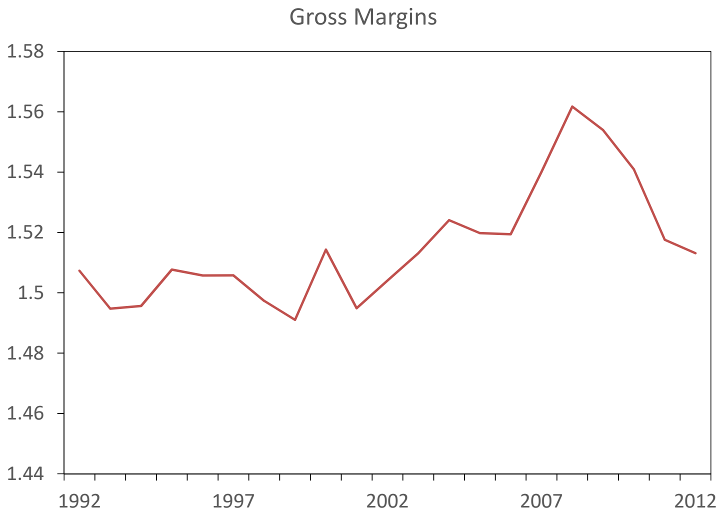
Volatility of Aggregate Retail Trade Variables



Operating profit margins are 3.4 times more volatile than gross margins. Back

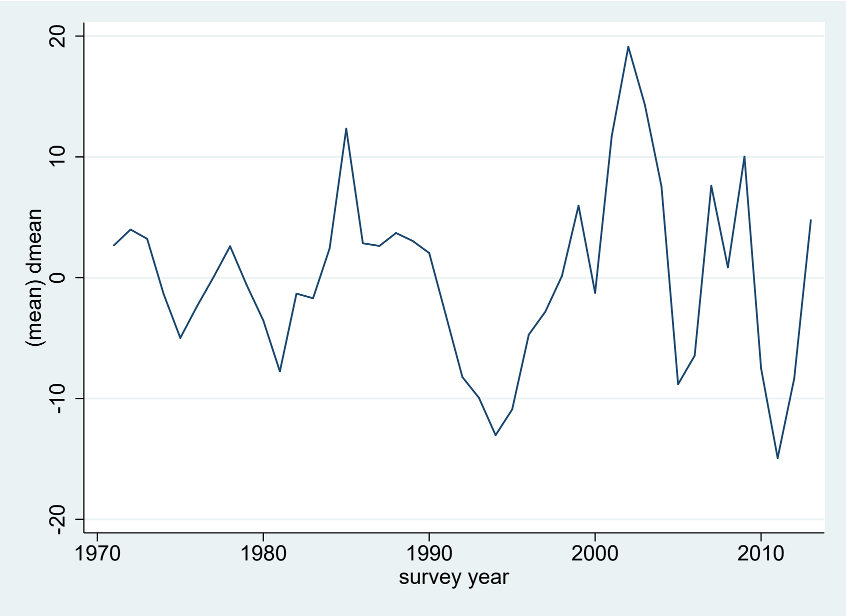
Gross Margins for Retail Industry

- Rise in margins is small. Back



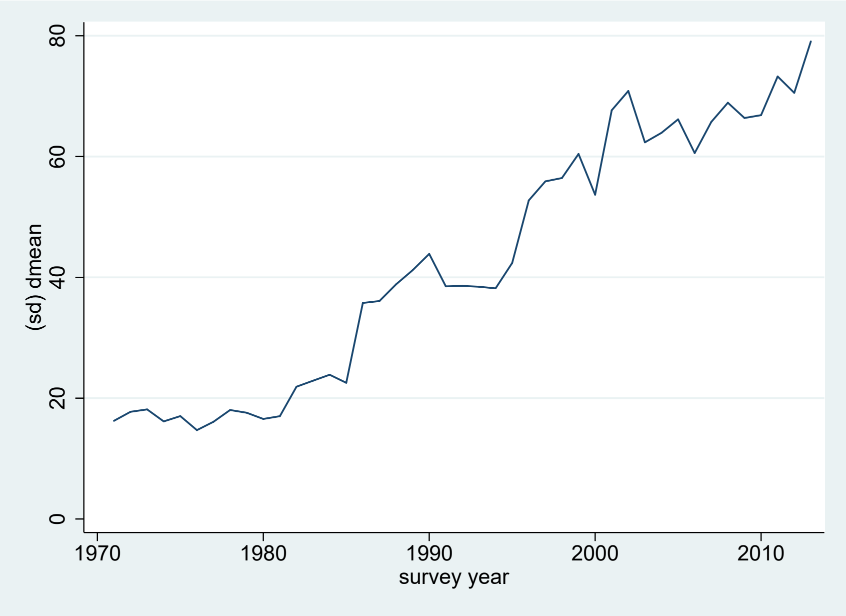
Time series variation in aggregate income

Time series variation in aggregate (real) income, detrended.



Cross-sectional variation in income

Cross-county standard deviation, plotted over time.



Markups in Bertoletti and Etro (2014)

The indirect utility function can be written as:

$$V = \int_0^n v\left(p_j/Y\right) dj$$

When v takes an exponential form:

$$v(p_j/Y) = \exp\left[-\tau\left(p_j/Y\right)\right]$$

The markup is given by:

$$\frac{p}{c} = 1 + \frac{Y}{\tau c}$$

Markups in Bertoletti and Etro (2014)

When v takes an addilog form:

$$v(p_j/Y) = \left[a - (p_j/Y)\right]^{1+\gamma}$$

The markup is given by:

$$\frac{p}{c} = \frac{\gamma + a(Y/c)}{1+\gamma}$$

If cyclicality of income and marginal costs similar, then markups roughly acyclical.

If marginal costs across regions are similar but there is dispersion in income levels, markups are higher in higher income regions. Back

Markups in Fajgelbaum, Grossman and Helpman model (2011)

- Consume different quality goods. Higher quality goods have less substitutability and higher markups.

- Regions with higher income pay higher markups but consume higher quality items. Variations driven by differences in assortment, consistent with our cross-sectional evidence.

- However, time-series variation in markups is counter-cyclical

$$\frac{p_{ij}}{c_i} = 1 + \frac{\theta_i}{q_i c_i},$$

where θ_i is the dissimilarity parameter for an item of quality q_i and brand j. Back

Distributions of Gross Margins, Sales, and Number of Items

	Mean	p10	p50	p90
Margins (levels)				
Difference	-0.005	-0.003	-0.003	-0.007
Log difference in sales				
2006-07	0.072	-0.026	0.072	0.154
2008-09	0.038	-0.074	0.034	0.145
Difference	-0.034	-0.048	-0.037	-0.009
Log difference in number of items				
2006-07	0.050	-0.007	0.044	0.111
2008-09	0.000	-0.053	-0.001	0.043
Difference	-0.050	-0.046	-0.045	-0.068

For confidentiality reasons, the markups are normalized relative to the mean markup in 2006-07.

- Gross margin moments are similar across the two periods.
- Sales and number of items moments are lower in the recession. Back

Volatility of Aggregate Retail Trade Variables

Standard Deviation	Quarterly	Annual
Gross margins	0.017	0.011
Operating profit margins	0.057	0.051
Sales	0.046	0.062
Cost of goods sold	0.045	0.060

- Gross margins are also relatively stable compared to other variables.
- Sales and costs are 2.6 times more volatile than gross margins.
- Operating profit margins are 3.4 times more volatile than gross margins.
- High volatility of operating profit margins implies role of fixed costs. Back

Volatility of Firm-Level Variables

Standard Deviation	Quarterly	Annual
Gross margins	0.061	0.480
Operating profit margins	0.254	0.699
Sales	0.080	0.364
Cost of goods sold	0.084	0.407

- Gross margins are relatively stable compared to operating profit margins.
- Operating profit margins are the most volatile variable. Back

Potential sources of measurement error

- Two potential sources of measurement error in aggregate data:
  - Margins constructed with average costs, instead of marginal costs.
  - Inventories affect the cost of goods sold, and can potentially affect the cyclical properties of our measured gross margin.
- Study scanner data, free from two sources of measurement error:
  - Observe actual replacement cost and price of item sold.

Adjusting Cost of Goods Sold for Inventories

- Some of COGS today may reflect purchases made in previous periods.
- What we want to measure is cost of goods sold, valued at purchase prices in the same period that items are sold.

Adjusting Cost of Goods Sold for Inventories

- Perpetual inventory approach.

- Denote $\bar{C}_t$ = observed COGS and C_t = true COGS.

- The observed COGS is

$$\bar{C}_t = \alpha_t \bar{C}_{t-1} + (1 - \alpha_t) C_t$$

  where

$$\alpha_t = \frac{\text{Starting period inventories}_t}{\text{Sales}_t}.$$

- Assume if $\alpha_t \geq 1$, then

$$\bar{C}_t = C_t / (1 + \pi_t)$$

  where π_t is the PPI for final goods.

- Assume a starting value of

$$\bar{C}_0 = C_0.$$

Adjusting Cost of Goods Sold for Inventories

- We can compute the true COGS

$$C_t = \frac{\bar{C}_t - \alpha_t \bar{C}_{t-1}}{1 - \alpha_t}, \quad \text{if } \alpha_t < 1$$

and

$$\bar{C}_t = C_t/(1 + \pi_t), \quad \text{if } \alpha_t \geq 1.$$

- The adjusted gross margin is given by

$$\frac{\text{Sales}_t - \text{C}_t}{\text{Sales}_t}.$$

Gross Margins, Adjusted for Inventories

- Elasticity with respect to GDP growth is statistically insignificant.

	Gross Margin Elasticity wrt GDP			
	Quarterly		Annual	
Regressions: baseline				
Industry-level regression	0.162	(0.256)	0.376	(0.616)
Firm-level regression	0.310	(0.373)	0.152	(0.548)
Regressions: with inventory adjustment				
Industry-level regression	-0.231	(1.45)	-0.522	(0.924)
Firm-level regression	-0.550	(2.647)	-0.351	(0.678)

Back

Distributions of Gross Margins, Sales, and Number of Items

	Mean	p10	p50	p90
Margins (levels)				
Difference	-0.005	-0.003	-0.003	-0.007
Log difference in sales				
2006-07	0.072	-0.026	0.072	0.154
2008-09	0.038	-0.074	0.034	0.145
Difference	-0.034	-0.048	-0.037	-0.009
Log difference in number of items				
2006-07	0.050	-0.007	0.044	0.111
2008-09	0.000	-0.053	-0.001	0.043
Difference	-0.050	-0.046	-0.045	-0.068

For confidentiality reasons, the markups are normalized relative to the mean markup in 2006-07.

- Gross margin moments are similar across the two periods.
- Sales and number of items moments are lower in the recession. Back

Cyclicality of Retailer Margin: Split by Cyclicality of Cost

- For each category, define cyclicality by regressing costs on local area outcomes (change in unemployment rate or house prices).

- Estimate for each cyclicality group

$$\triangle y_{mt} = \beta_0 + \beta_1 \triangle Z_{mt} + \gamma X_m + \varepsilon_m,$$

where m denotes region. Log-differences between 2006-07 and 2008-09.

Gross margins	Elasticity with to local house prices		Elasticity with with respect to local UR	
Items with				
(i) procyclical costs	0.098**	(0.006)	-0.027	(0.018)
(ii) acyclical costs	0.055**	(0.006)	-0.020	(0.013)

Back

Conditional Responses to Shocks

- Estimate for gross margin and net operating profit margins

$$\triangle y_{ft} = \beta_0 + \sum_k \beta_k \epsilon_{t-k} + \lambda_f + \eta_{ft},$$

- $\triangle y_{ft}$ is the year-year log-difference in of firm f's margin at time t.
- ϵ_{t-k} is the aggregate shock at time $t-k$.
- λ_f are firm fixed effects. We can also include recession fixed effects and seasonality controls.
- Consider monetary policy shocks and oil price shocks.

Conditional Responses to Shocks

- Monetary Policy Shocks:
  - High frequency data on Federal Funds Futures contracts. Also used in Kuttner (2001), Cochrane and Piazessi (2002), Nakamura and Steinsson (2018), and others. Details

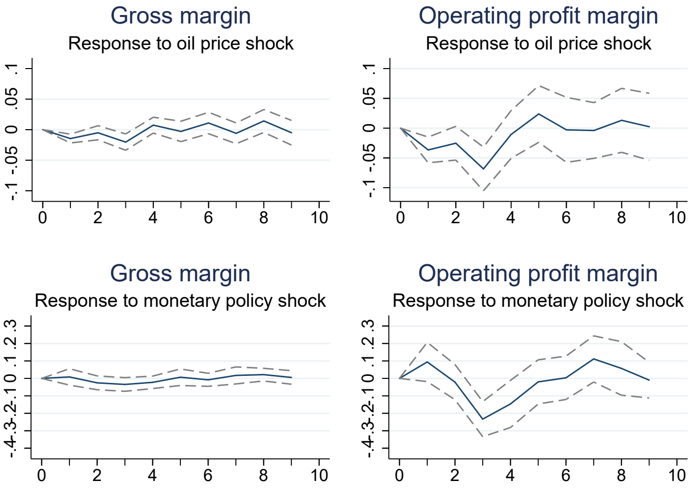
- Oil Price Shocks:
  - Following Ramey and Vine (2010), estimate a VAR system

    $$Y_t = A(L)Y_{t-1} + U_t.$$

    Y_t includes the following variables (in order): nominal price of oil, the CPI, nominal wages of private production workers, industrial production, civilian hours, and the federal funds rates.

  - Oil price shock identified using standard Cholesky decomposition.

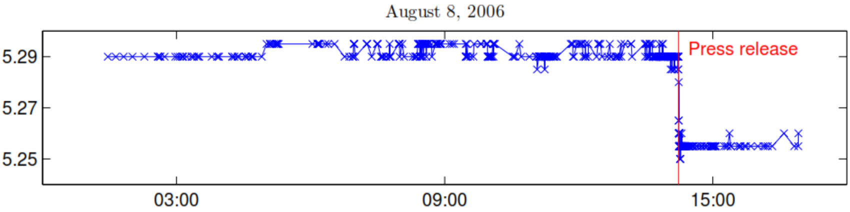
Conditional Responses to Shocks



Notes: The figure depicts the impulse response functions of the (log-differenced) gross margins and net operating profit margins to a 1ppt monetary policy shock and an oil price shock. Back

Monetary policy shocks

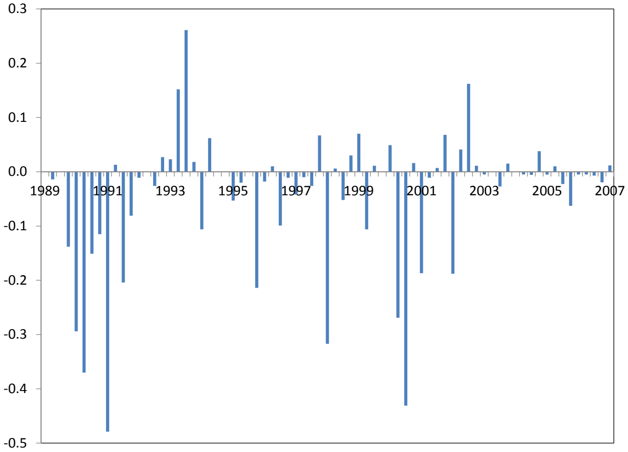
Shock measured using Fed Funds futures and 2-year Treasuries.



Source: Gorodnichenko and Weber (2015)

Approach as in Kuttner (2001), Rigobon and Sacks (2004), Nakamura and Steinsson (2013), Gorodnichenko and Weber (2015), Gertler and Karadi (2015), etc Back

Monetary policy shocks



Back

Cyclicality of margins

$$\triangle y_{mt} = \beta_0 + \beta_1 \triangle Z_{mt} + \gamma X_m + \varepsilon_m,$$

- *m* denotes region. Log-differences between 2006-07 and 2008-09.

	Elasticity with respect to local		
	ΔUR	ΔlogHP (OLS)	ΔlogHP (IV)
Gross margin	0.021	0.089	0.075**
	(0.026)	(0.06)	(0.03)
Price	-1.465	-0.012	0.10
	(1.206)	(0.021)	(0.08)
Replacement cost	-0.358	-0.042	0.021
	(0.638)	(0.033)	(0.08)
Sales	-0.902**	0.254***	0.249*
	(0.36)	(0.087)	(0.15)
Number of items	-1.057***	0.486	0.208*
	(0.02)	(0.467)	(0.12)

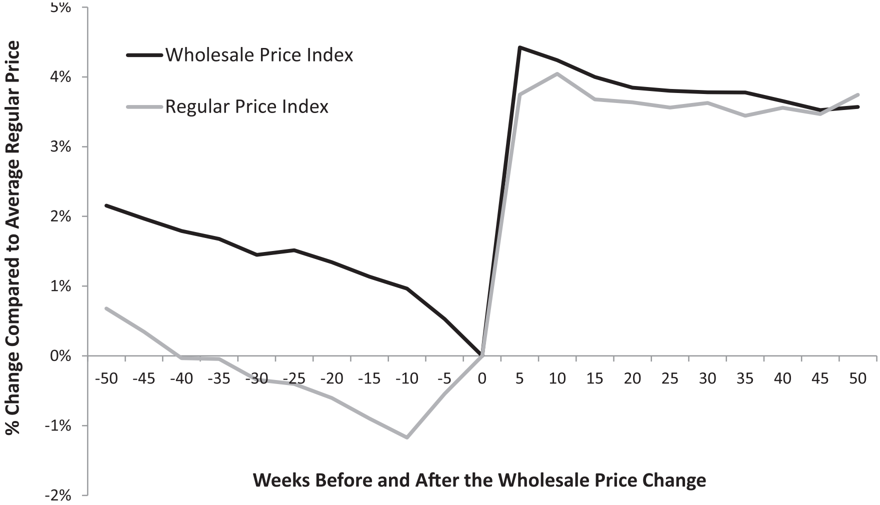
Back

Volatility of margins

	Stdev
Markup	0.026
Price	0.009
Replacement cost	0.005
Sales	0.220
Number of items	0.118

- Standard deviation of year-on-year log changes.
- Markups, price and cost of goods sold are relatively stable.
- Sales and number of items sold are quite volatile. Back

Changes in costs and prices



Source: Anderson et al (2017) Back

Cyclicality of Firm-Level Variables

We estimate

$$\triangle y_{ft} = \beta_0 + \beta_1 \triangle GDP_t + \lambda_f + \eta_t$$

	Elasticity wrt GDP			
	Quarterly		Annual	
Gross margins	0.31	(0.37)	0.15	(0.55)
Operating profit margins	3.03***	(0.96)	3.60***	(1.11)
Sales	3.18***	(0.32)	3.64***	(0.67)
Cost of goods sold	3.09***	(0.32)	3.58***	(0.70)

Sample: 1980-2007.

- Gross margins roughly acyclical or slightly procyclical.
- In contrast, sales and COGS are highly procylical.
- Operating profit margins are also procyclical. Back

Consider a symmetric equilibrium

The equilibrium is described by the following:

$$
\begin{aligned}
w_t &= (1+g)^t, \\
x_{ivt} &= 1, \\
Y_t &= w_t N_t = \frac{(1+g_t)^t}{1+\theta_t}, \\
n_t &= \frac{\alpha A_t (1+g_t)^t}{(1+\psi A_t)(1+\theta_t)}, \\
p_{ivt} &= \nu_t \frac{w_t}{A_t (1+g)^t} \\
\nu_t &= 1 + \psi A_t \\
N_t &= \frac{1}{1+\theta_t} \\
\tilde{Y}_t &= \frac{A_t^{\alpha} \left(\frac{\alpha}{\psi + 1/A_t} \frac{1}{1+\theta_t} \right)^{\alpha \psi A_t}}{(1+\psi A_t)^{(1-\gamma)\alpha}} \frac{1}{1+\theta_t} \left[(1+g)^{1+\alpha\psi A_t} \right]^t
\end{aligned}
$$

Real income, $\tilde{Y}_t$, increases in A_t and decreases in θ_t. Back