Menu Costs, Multi-Product Firms and Aggregate Fluctuations

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New Keynesian Business Cycle Models

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    - Taylor ’79, Calvo ’83
    - incomplete micro-foundations
    - reduced-form approximation to menu-cost models

Question

Are the aggregate properties of economies with

- menu costs
- pricing patterns consistent with micro data

similar to those of time-dependent pricing models?

The Debate

- Klenow & Kryvtsov ’04: Yes, similar properties
- Golosov & Lucas ’03: No, different properties
- Difference due to focus on narrow set of micro facts
  - fraction of price changes constant over time
  - large magnitude of price changes time

This paper

- Document additional features of micro-data:
  - Large number of small price changes
  - Excess kurtosis of distribution of price changes
- Study menu-cost economy consistent with these facts

Bottom line: aggregate properties of menu-cost economies similar to those of time-dependent setups

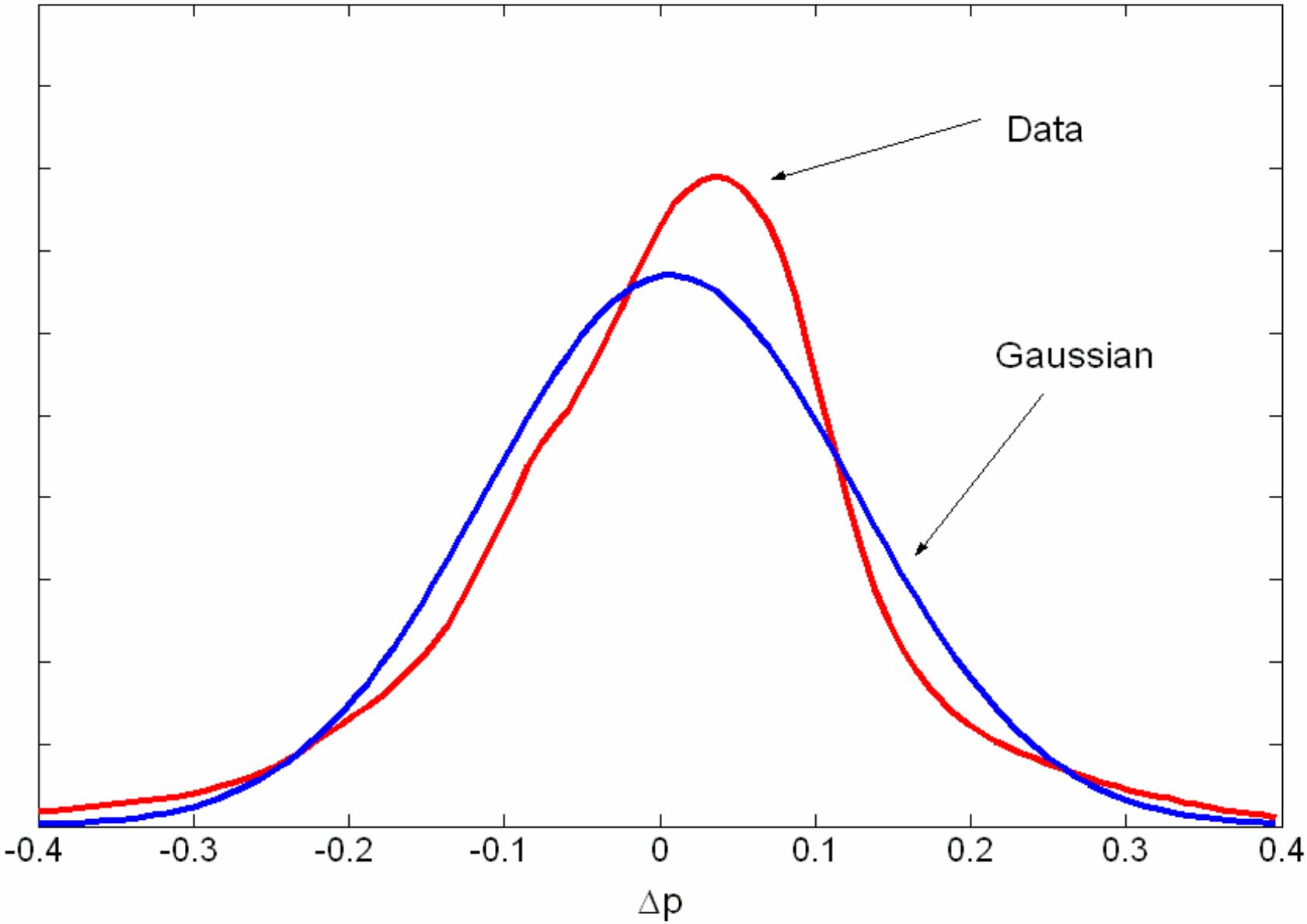
Outline

- Micro-price data
- Menu-cost model
- Quantitative results

Micro price data

- Scanner price data in grocery stores
  - Marketing database at Chicago GSB
    - 32 stores, 5000 goods, 1989-1997
    - non-perishable foodstuffs & households supplies
  - Monthly, ‘regular’ price series

Distribution of non-zero price changes



Summary statistics

	Data
mean ($\lvert\Delta p\rvert$), %	9.0
fraction changes < 1/2 mean ($\lvert\Delta p\rvert$)	0.30
kurtosis of price changes	4.5

Micro price data

- Distribution of non-zero price changes:
  - Many small price changes
  - Excess kurtosis (leptokurtic)
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  - supermarkets (Kackmeister ’05)

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- Are these facts specific to grocery stores?
- No, also in:
  - industrial prices (Calton ’86)
  - catalogue prices (Kashyap ’95)
  - supermarkets (Kackmeister ’05)
  - 70% of consumer expenditure (Klenow & Kryvtsov ’04)

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- Variance of |Δp| due to good, store, time effects?

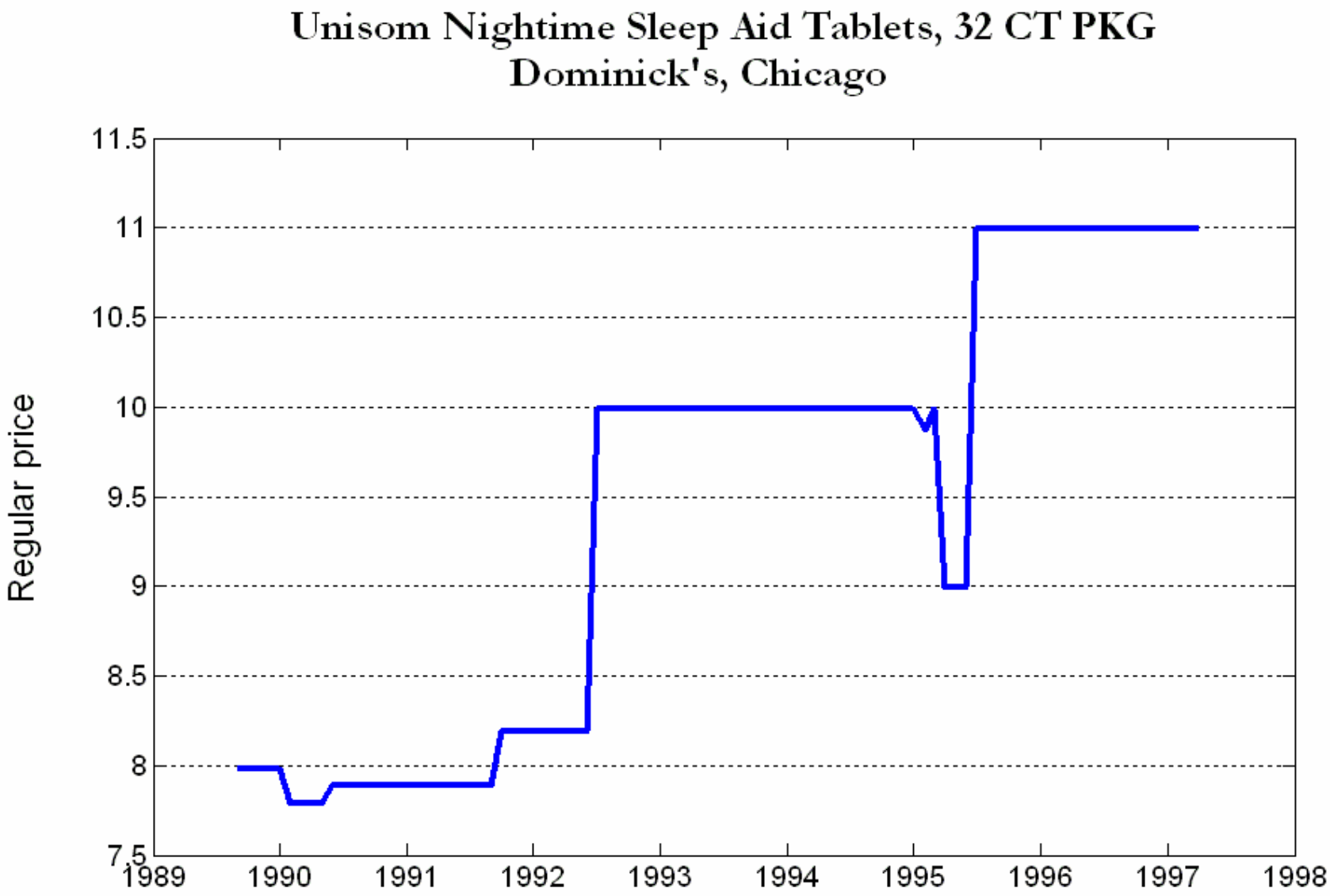
Ex-ante heterogeneity?

Fraction of variation in $|\Delta p|$ due to ex-ante heterogeneity

store	0.04
good	0.15
month	0.04

Note: average for the two datasets reported.
Product category × manufacturer instead of good effects reported for Dominick's.

Example of price series



Data poses problem for simple menu-cost model

- Simple menu-cost model:
  - single-product firms
  - time-invariant menu costs
- Generates no small price changes:

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  - time-invariant menu costs
- Generates no small price changes:
  - only optimal to pay fixed cost for large price change

Menu-cost model: no small price changes

- Possible solutions:

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  - time-varying menu costs

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  - time-varying menu costs
  - time-varying consumer search costs

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    - Levy et. al ’97, Lach & Tsiddon ’05

Menu-cost model: no small price changes

- Possible solutions:
  - time-varying menu costs
  - time-varying consumer search costs
  - economies of scope in price adjustment
    - restaurant, catalogue prices
    - Levy et. al ’97, Lach & Tsiddon ’05
    - also motivated by within-store synchronization

Outline

- Micro-price data
- Menu-cost model

Model Overview

- Consumers
  - Preferences over continuum of goods, leisure
- Firms
  - Monopolistic competitors
  - Menu costs of changing prices
- Uncertainty
  - Aggregate money shocks
  - Firm-level productivity shocks

Departures from GL'03

- Firms sell 2 goods each
  - economies of scope in price adjustment
    - fixed cost of changing menu of prices
- Calibrate distribution of idiosyncratic shocks
- Additional targets:
  - # small price changes
  - kurtosis of distribution of non-zero price changes

Firm's problem

$$V = \max(V^a, V^n)$$

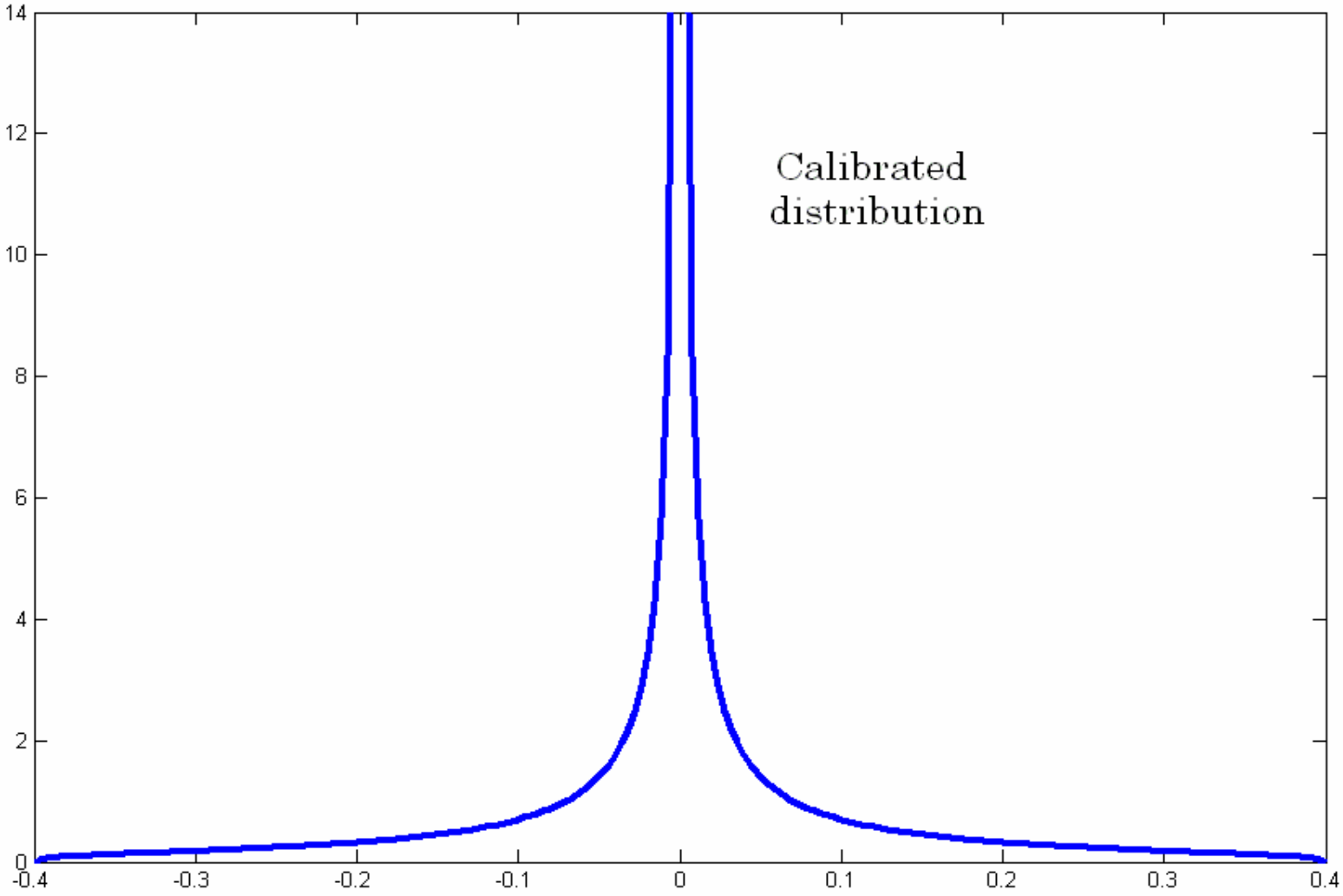
Adjust:

$$V^a(a; s) = \max_p \left[\frac{U_c}{P} (\Pi(p) - \xi W) + \beta E \left\{ V(p, a', s') | a, s \right\} \right]$$

Dont adjust:

$$V^n(p_{-1}, a; s) = \frac{U_c}{P} \Pi(p_{-1}) + \beta E \left\{ V(p_{-1}, a', s') | a, s \right\}$$

Distribution of productivity shocks



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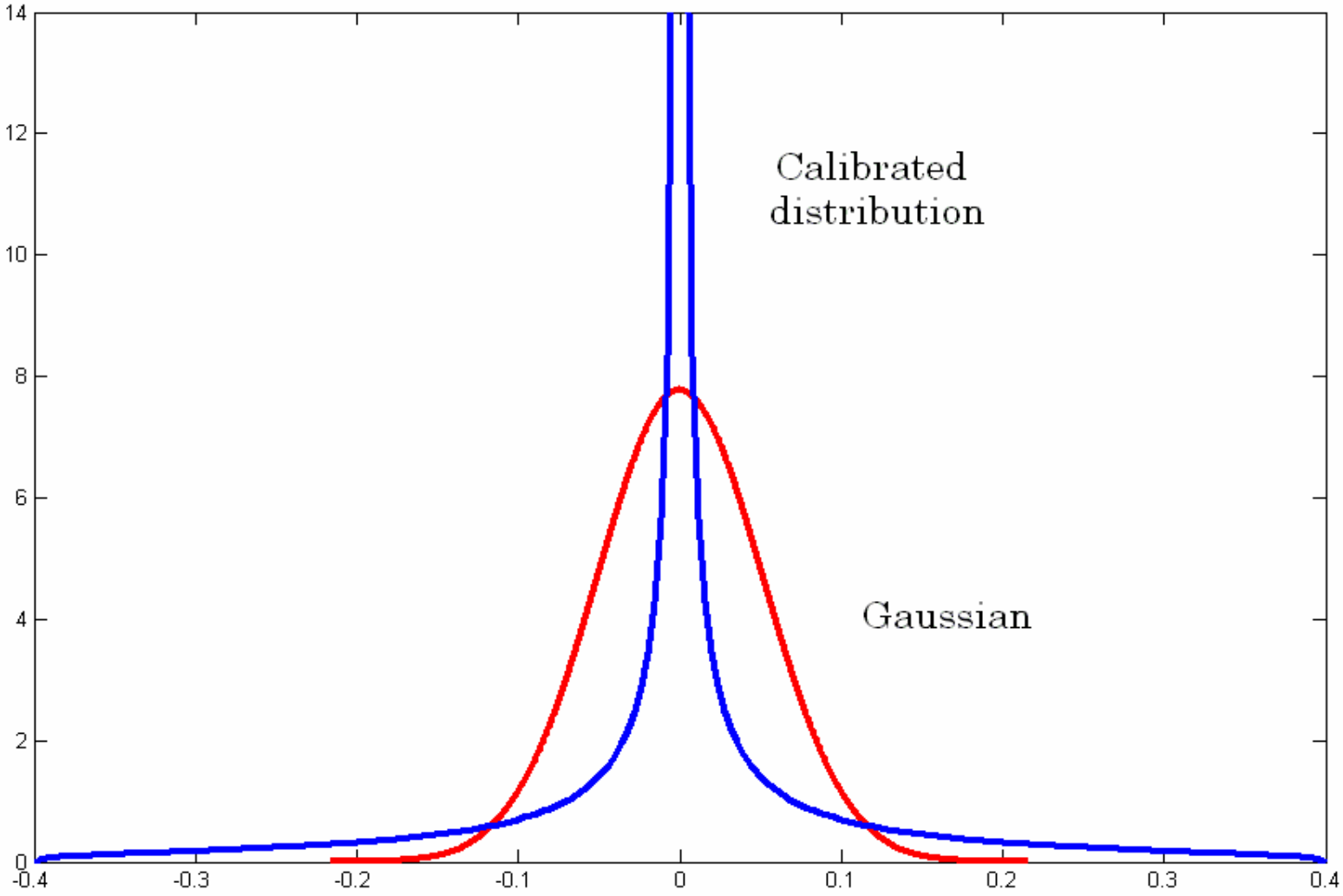

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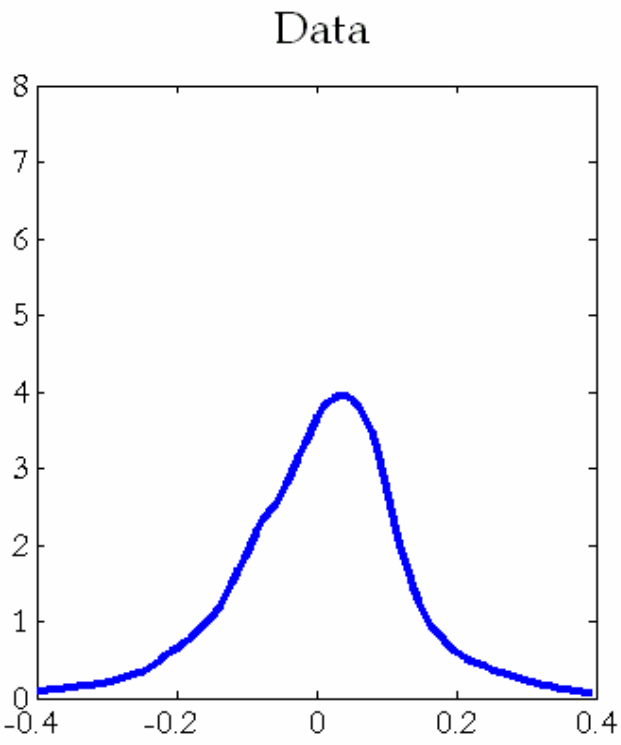
Benchmark for comparison

- Compare my setup to Golosov-Lucas ’03 setup:
  - Single-product firms
  - Gaussian idiosyncratic shocks
- Compare both menu-cost economies to Calvo
  - Same frequency & size of price changes

Micro-properties of menu-cost economies: distribution of non-zero price changes



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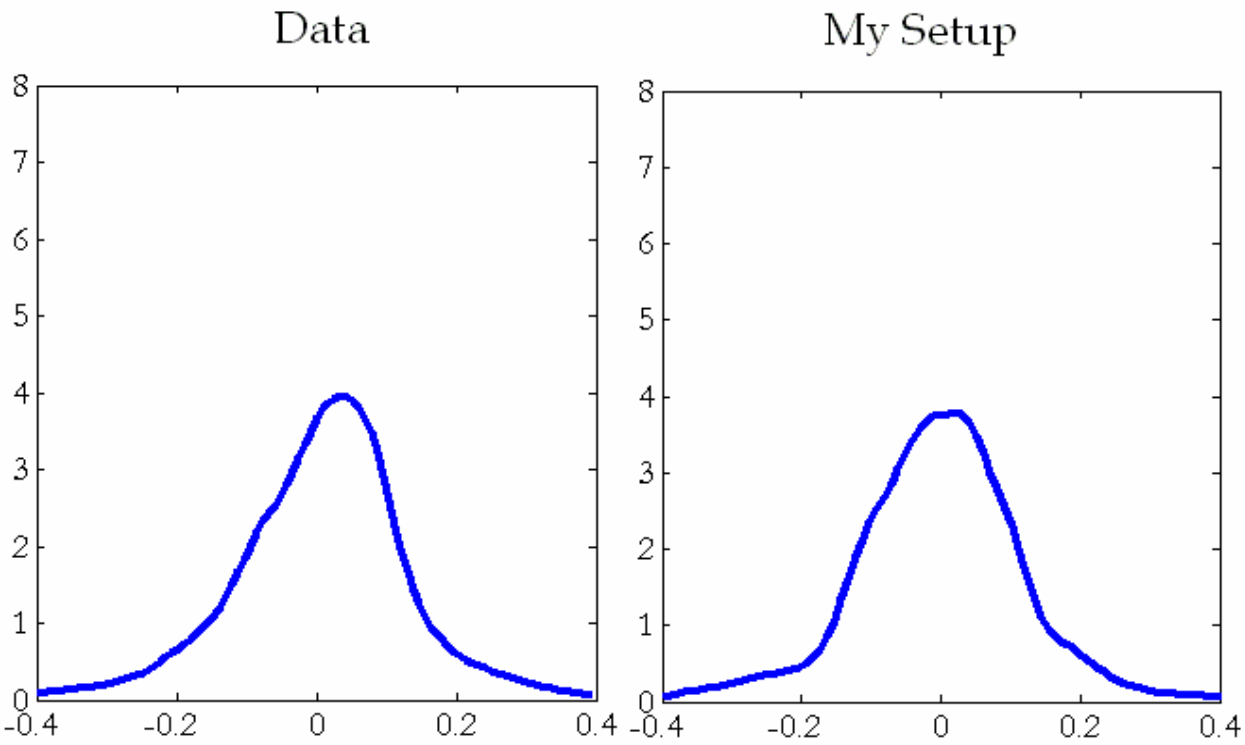

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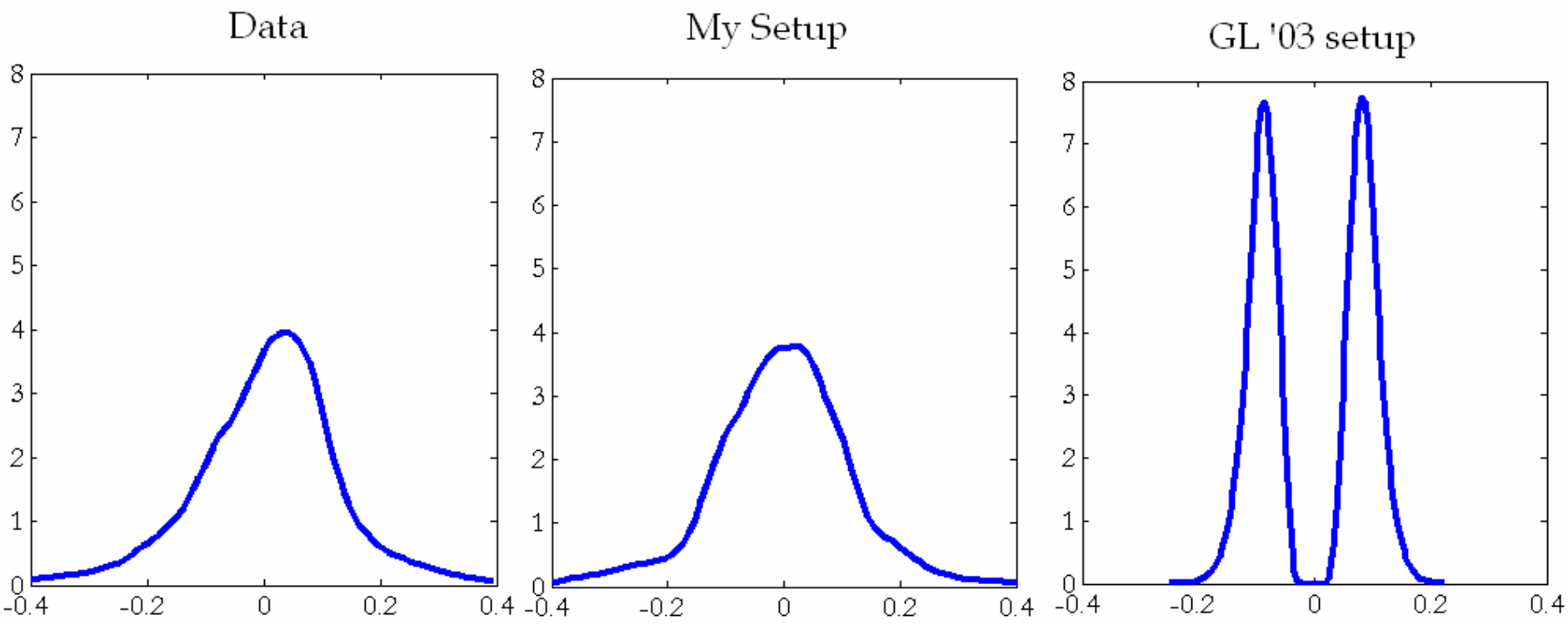


Macro implications

Deviation of output from HP trend

	My setup	GL'03 setup	Calvo
std. dev., %	0.61	0.15	0.75
autocorrelation	0.94	0.75	0.93

Role of 2 departures from GL'03: multi-product firms and leptokurtic shocks

	Data	My setup	GL' 03
kurtosis Δp	4.5	4.3	1.3
fraction small Δp	0.30	0.33	0.00
consumption volatility, %		0.61	0.15

Role of 2 departures from GL'03: multi-product firms and leptokurtic shocks

	Data	My setup	GL' 03	2-good Gaussian
kurtosis Δp	4.5	4.3	1.3	1.7
fraction small Δp	0.30	0.33	0.00	0.21
consumption volatility, %		0.61	0.15	0.26

Role of 2 departures from GL'03: multi-product firms and leptokurtic shocks

	Data	My setup	GL' 03	2-good Gaussian	1-good Leptokurtic
kurtosis Δp	4.5	4.3	1.3	1.7	4.0
fraction small Δp	0.30	0.33	0.00	0.21	0.11
consumption volatility, %		0.61	0.15	0.26	0.46

Role of 2 departures from GL'03: multi-product firms and leptokurtic shocks

	Data	My setup	GL' 03	2-good Gaussian	1-good Leptokurtic
kurtosis Δp	4.5	4.3	1.3	1.7	4.0
fraction small Δp	0.30	0.33	0.00	0.21	0.11
consumption volatility, %		0.61	0.15	0.26	0.46

Bottom line: need both departures from GL'03 to match micro-data.

Both increase consumption volatility.

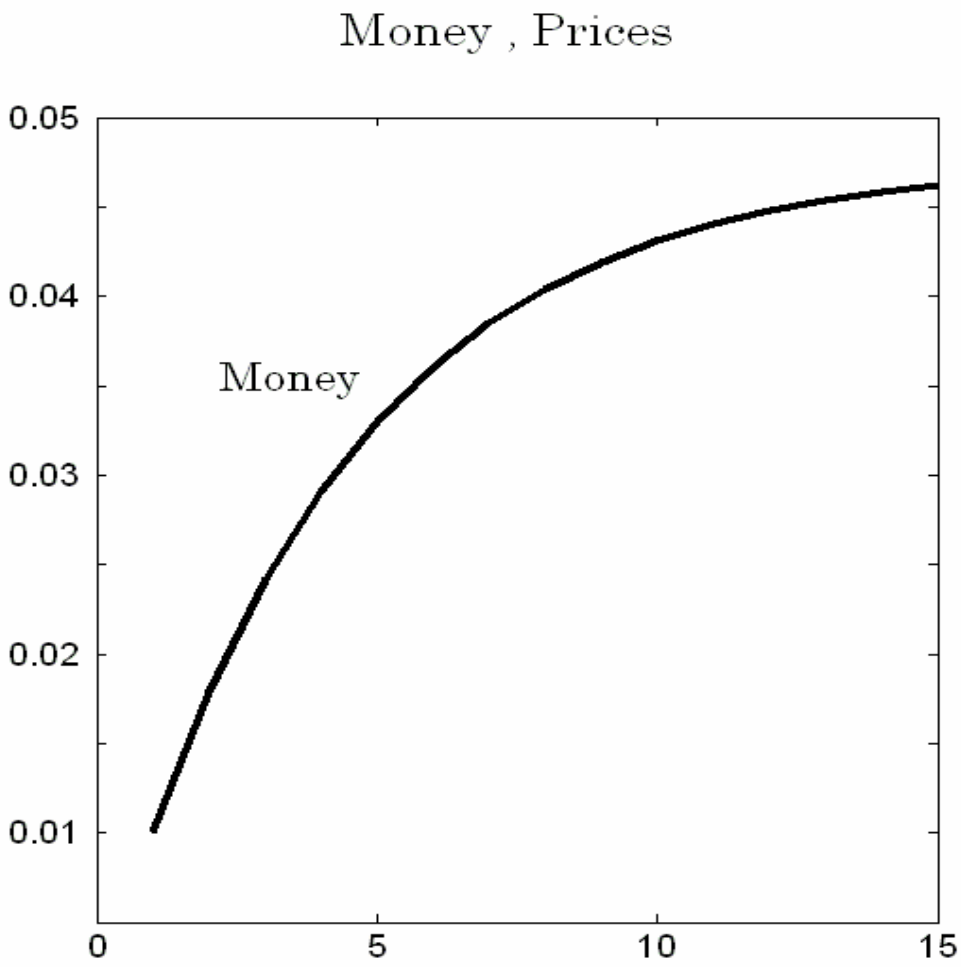
Macro implications

Why is consumption less volatile in GL'03 setup?

	My setup	GL '03 setup
	menu-cost	menu-cost
std. dev., %	0.61	0.15
autocorrelation	0.94	0.75

Impulse response to 1% money shock

$$M = PC$$



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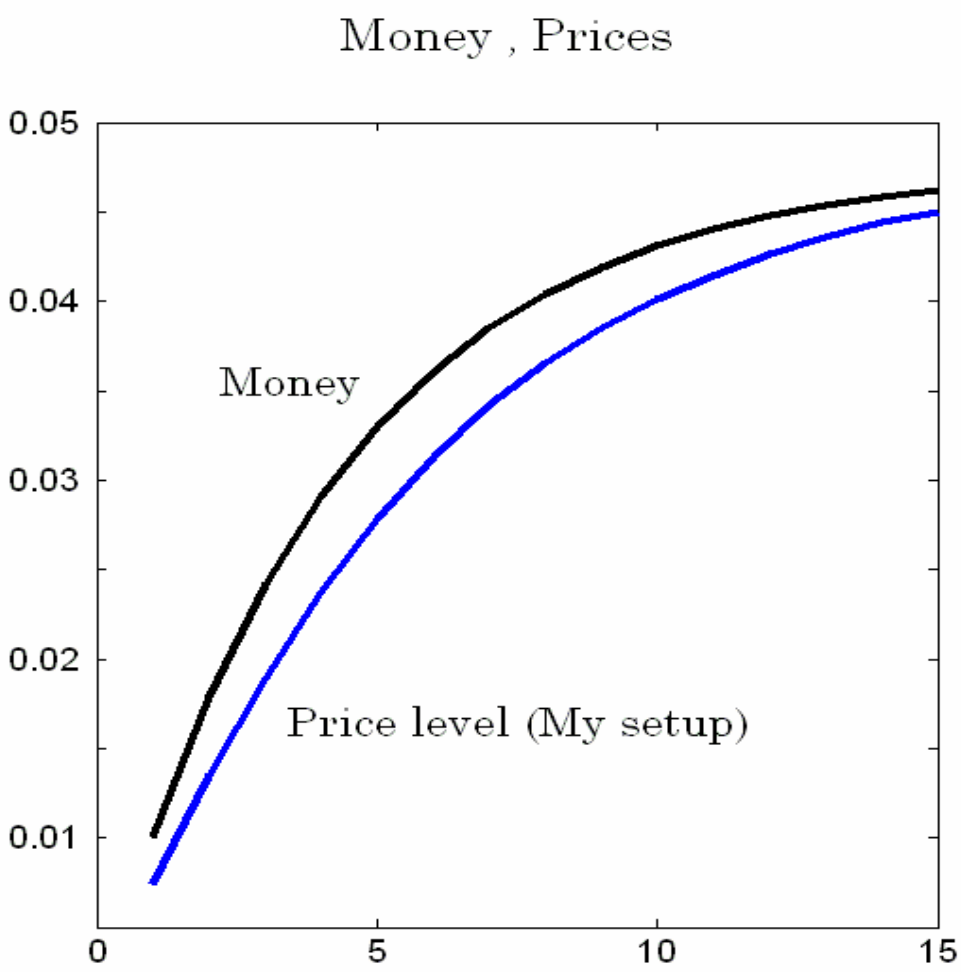

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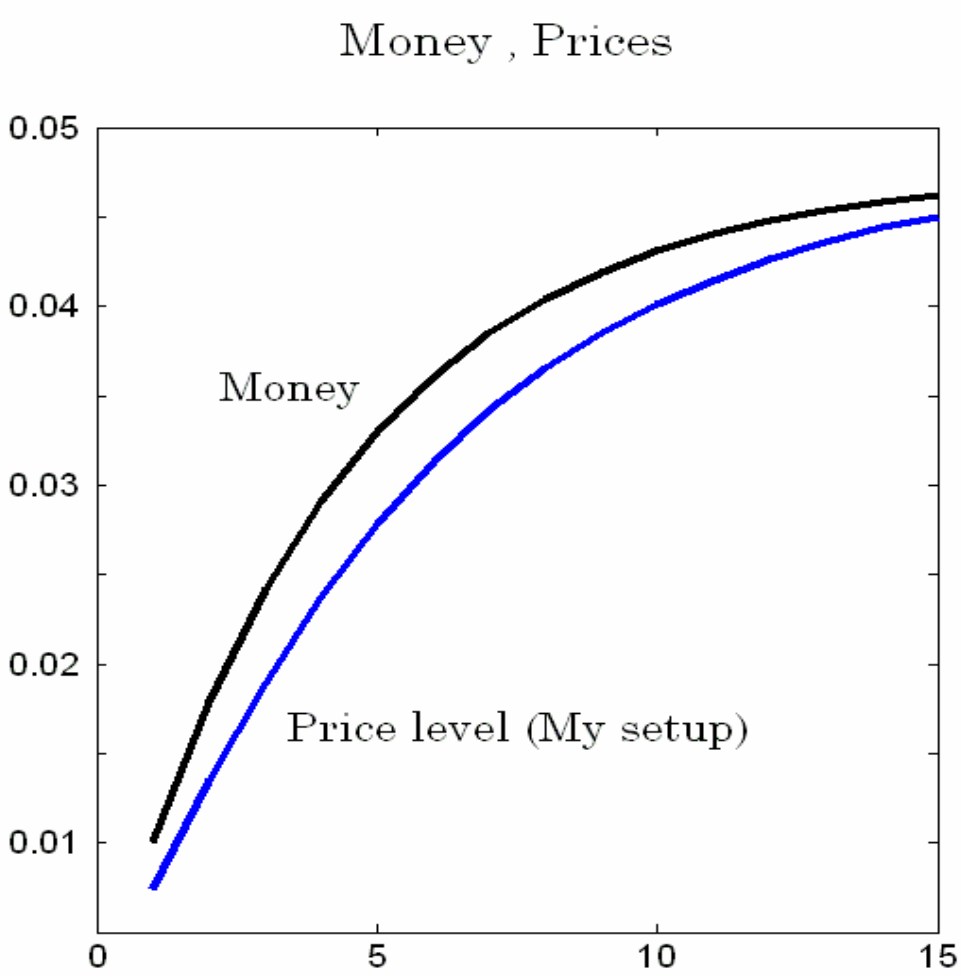

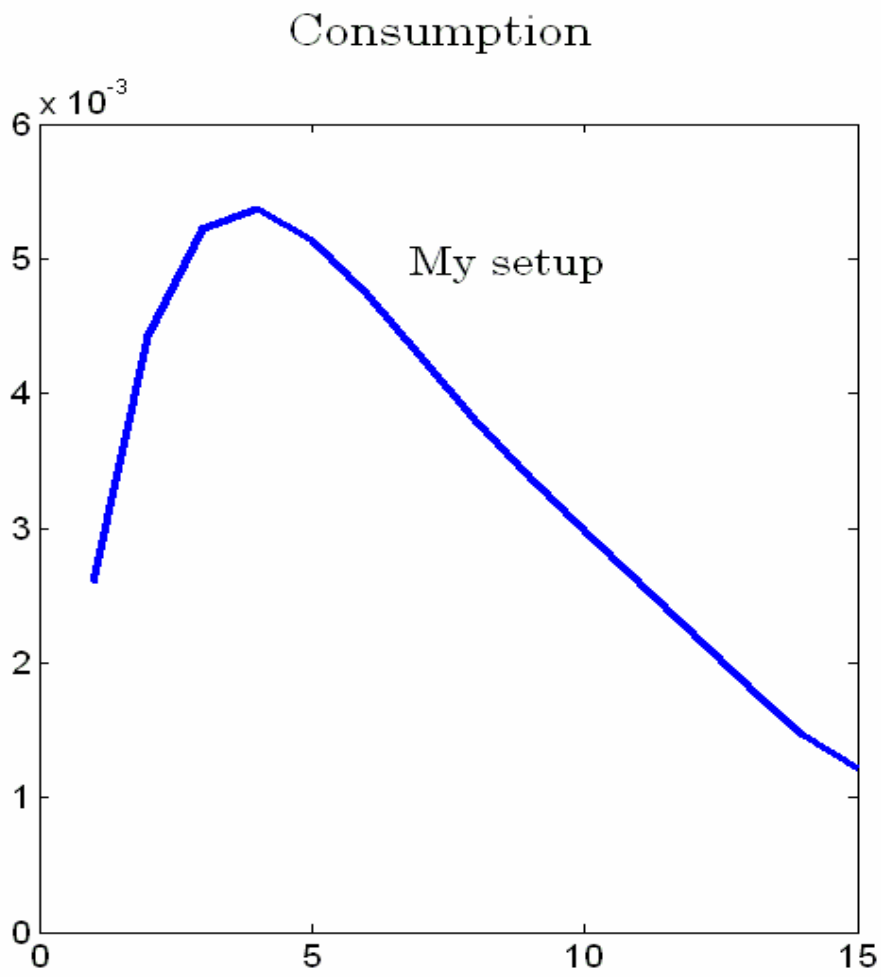

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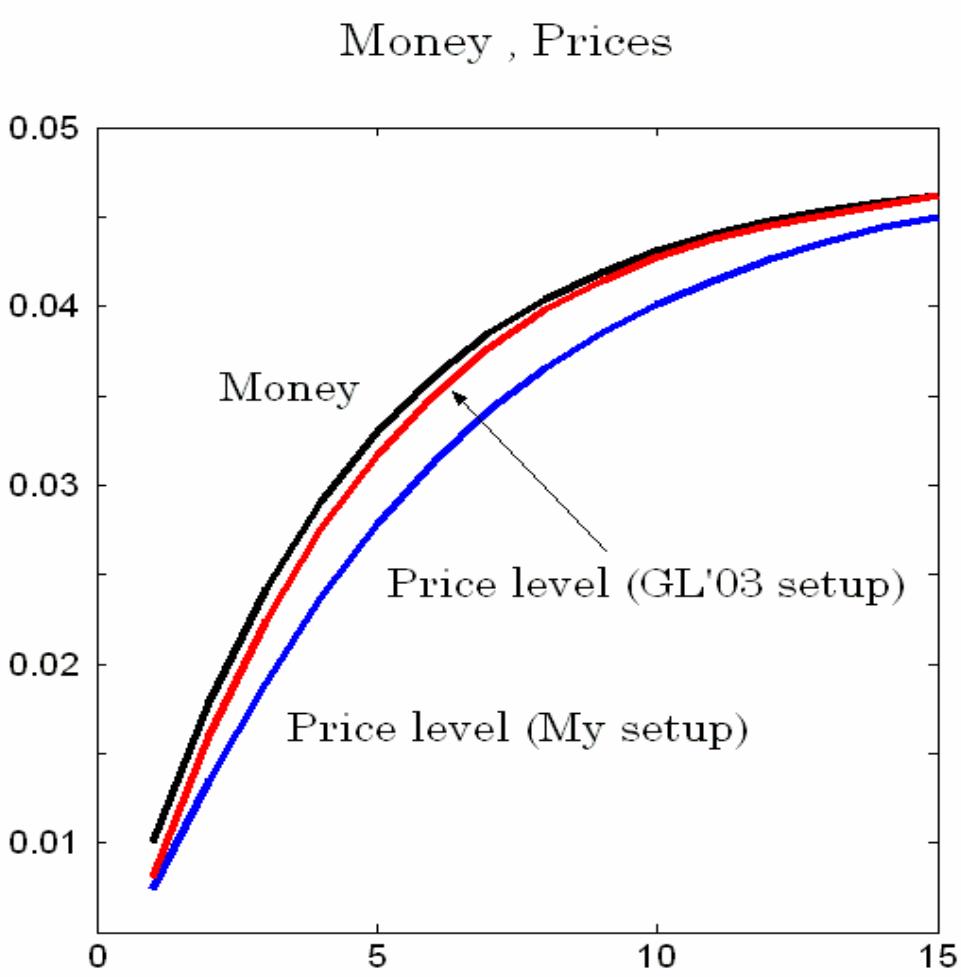

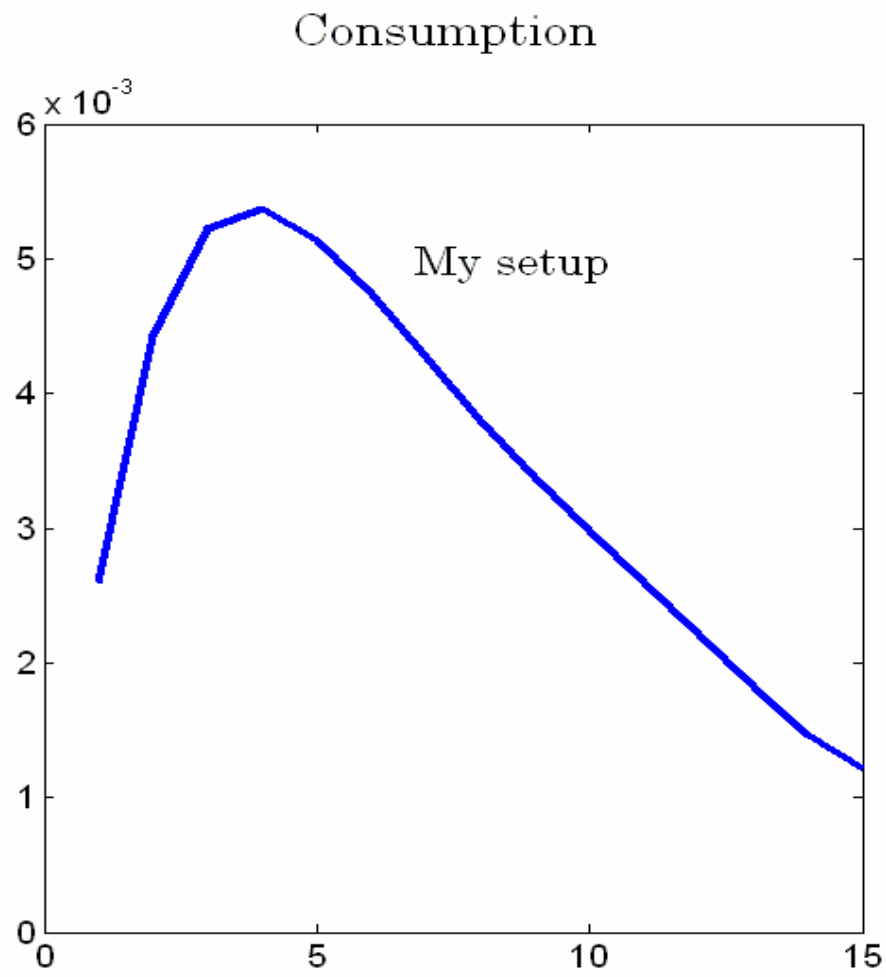

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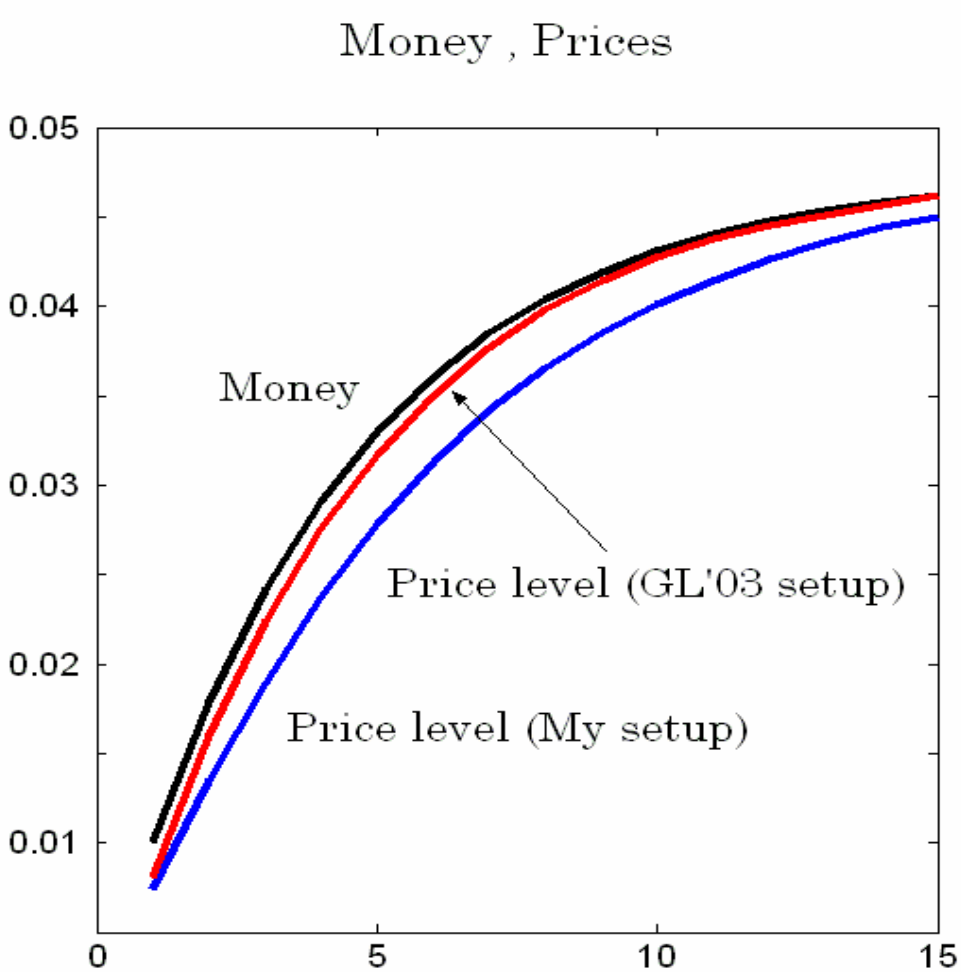

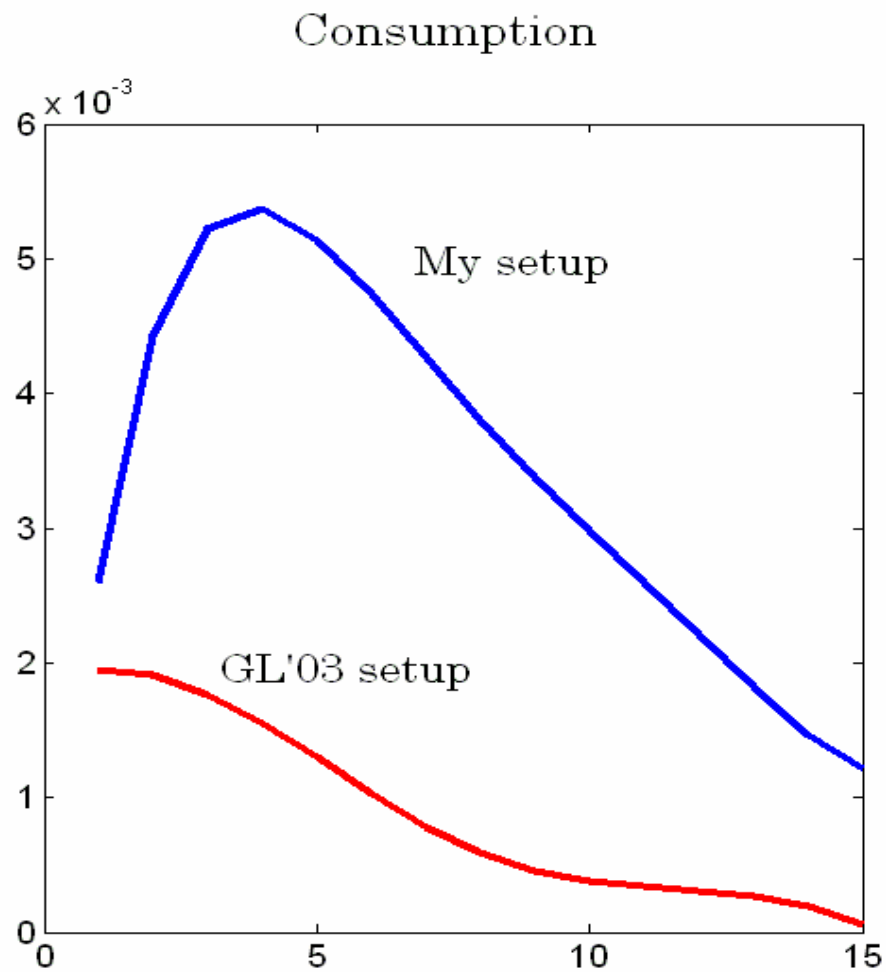

Why is price response stronger in GL'03 setup?

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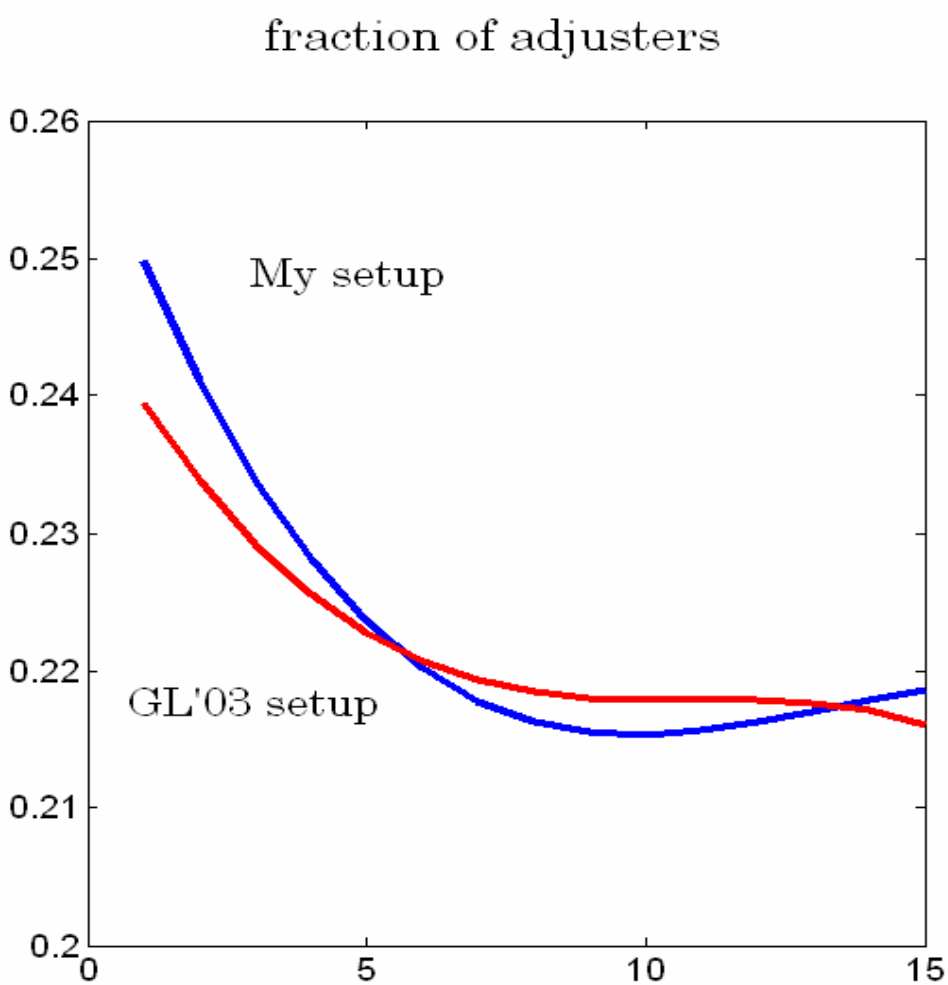

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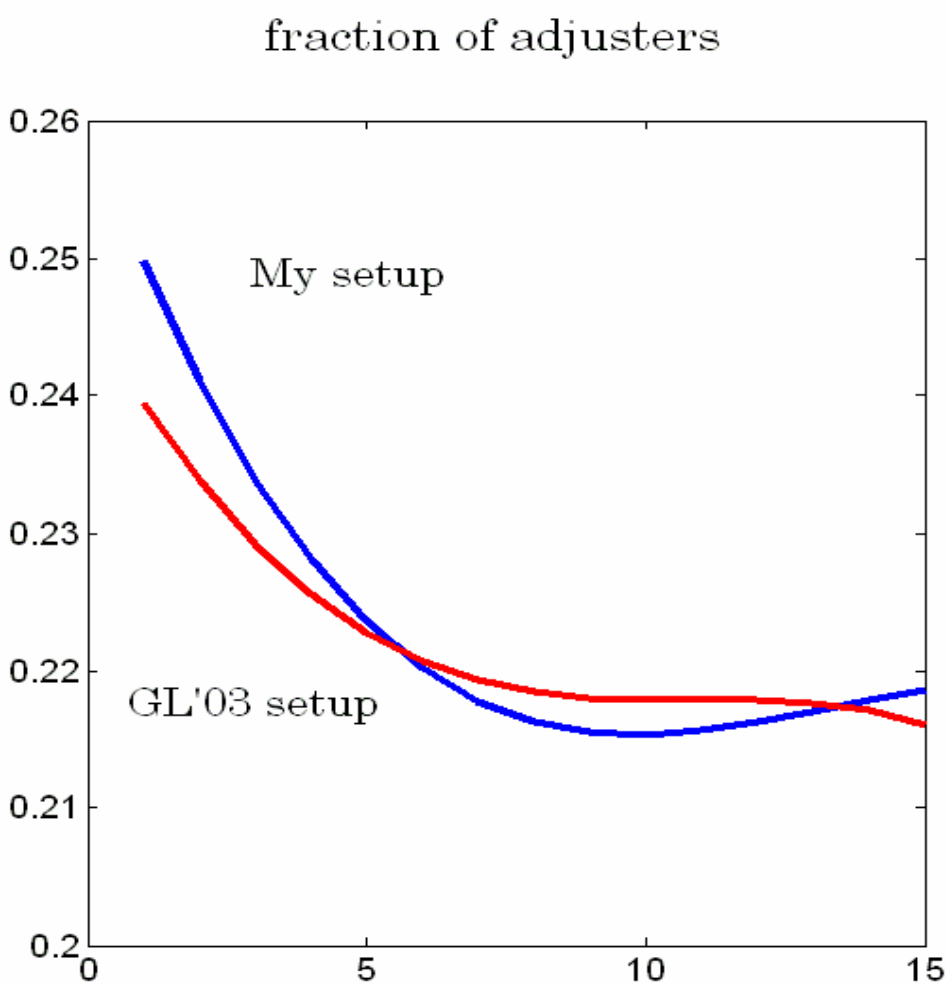
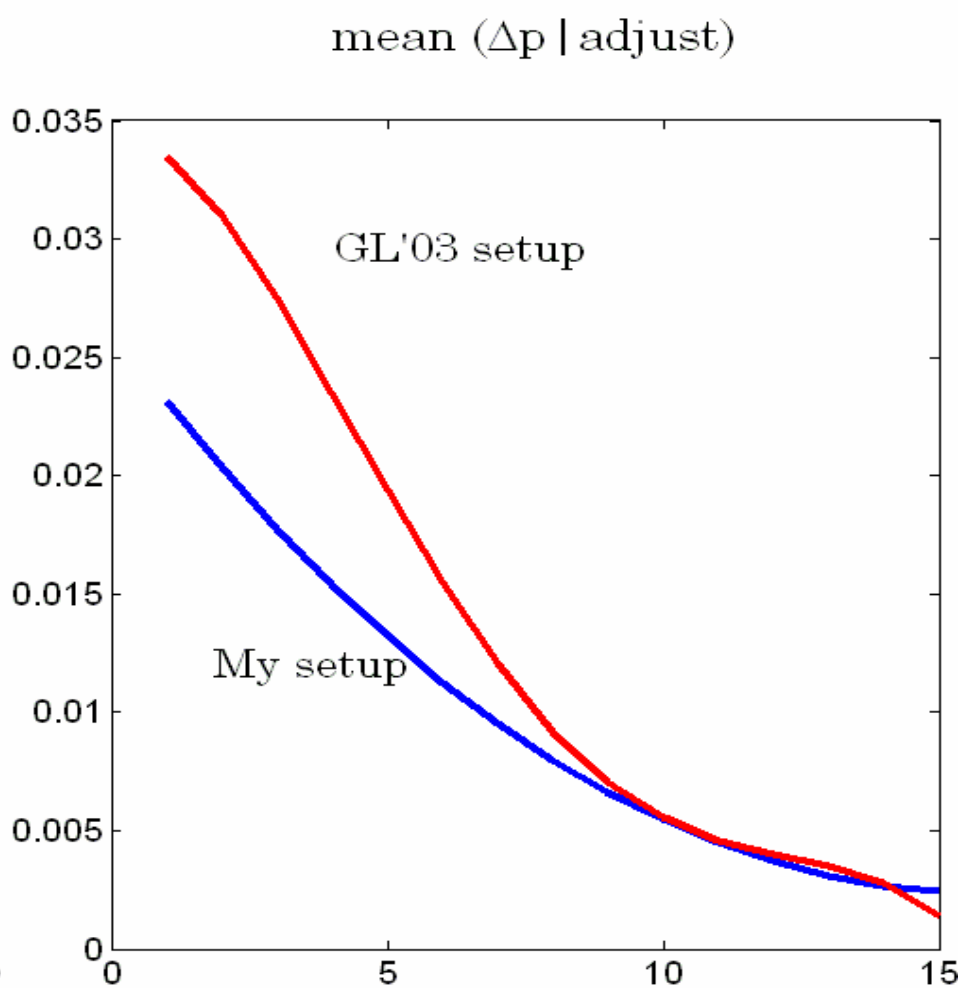
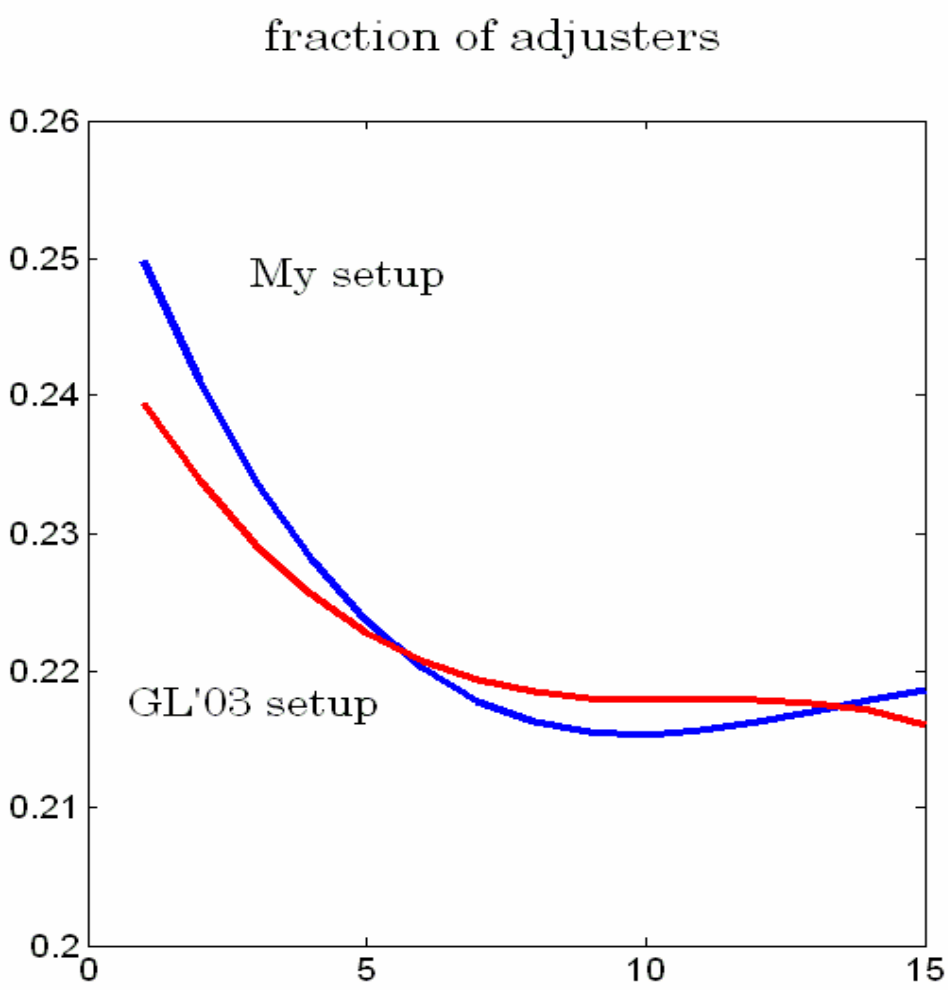
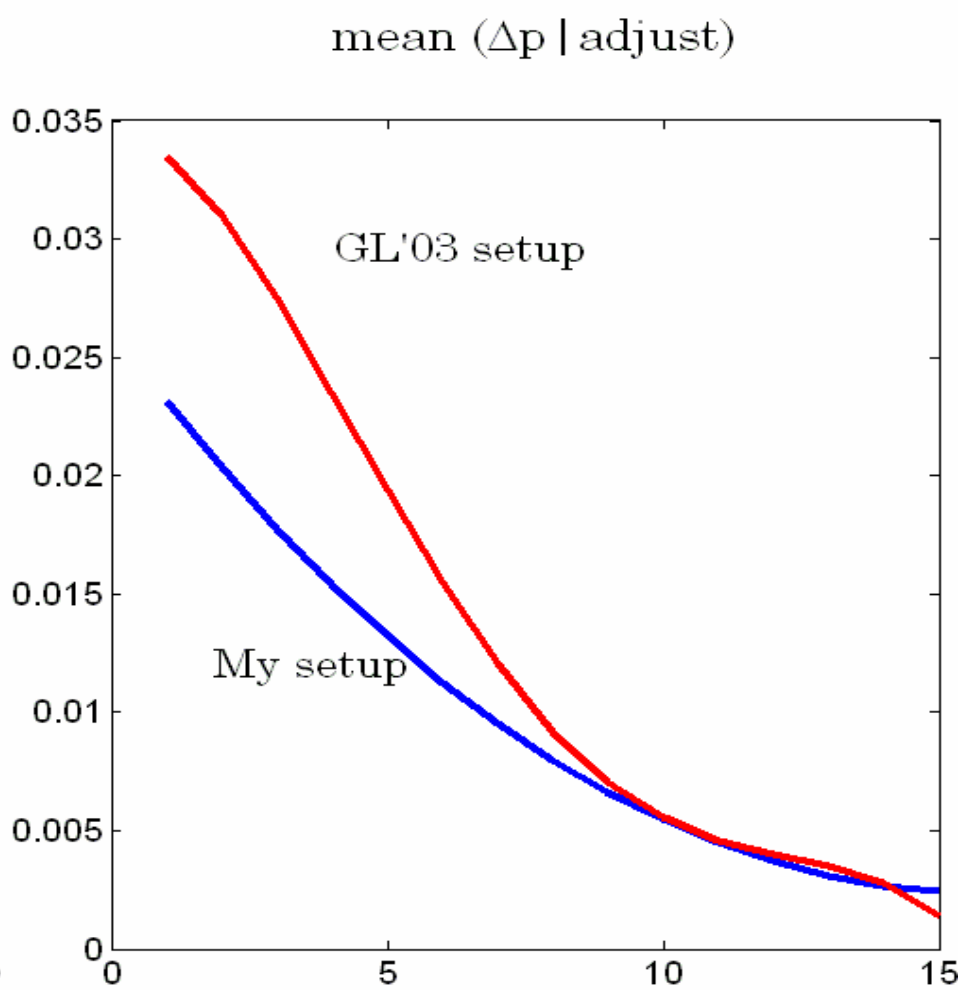




Why is price response stronger in GL'03 setup?

Because adjusting firms respond stronger to money shocks





Why do adjusters respond stronger to money shocks in GL ’03 setup?

- Self-selection
  - identity of adjusters endogenous with menu costs
- Adjusting firms:
  - high cost firms adjust upward
  - low cost firms adjust downward
- In GL’03 money has larger effect on identity of adjusters

Why does money have larger effect on identity of adjusters in GL ’03 setup?

- Two differences between my setup and GL ’03:
  - Gaussian vs. leptokurtic idiosyncratic shocks
  - Single-product vs. multi-product firms

Gaussian vs. Leptokurtic shocks

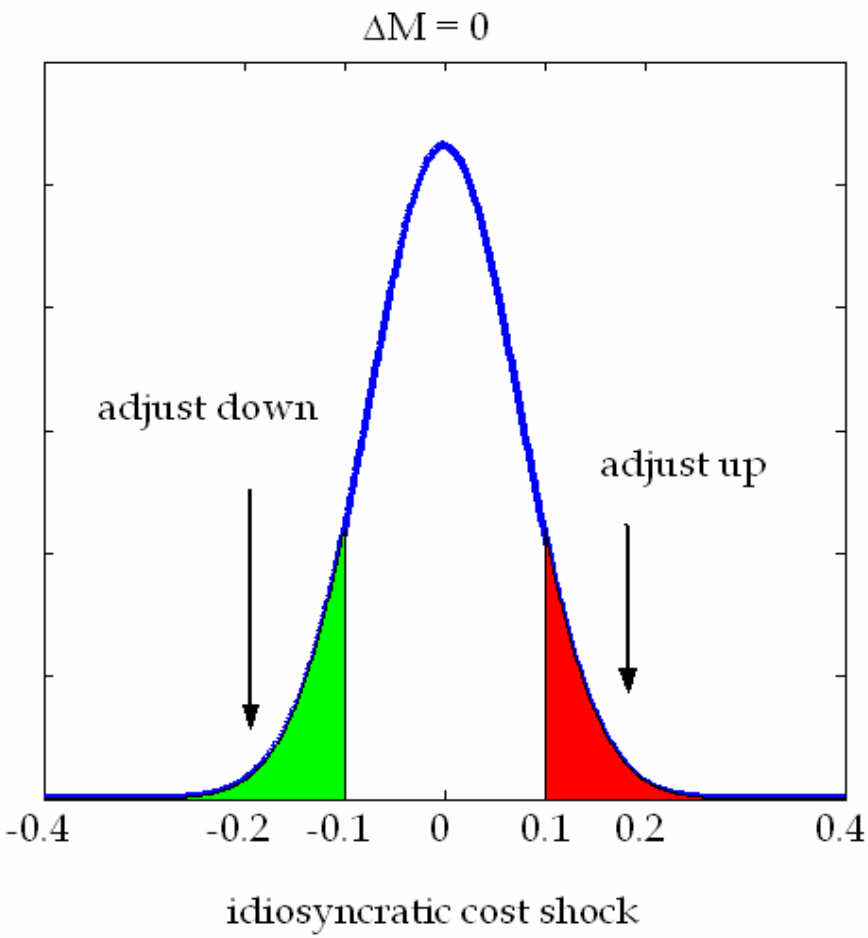
Gaussian vs. Leptokurtic shocks

- Illustrate difference with simple example:

Gaussian vs. Leptokurtic shocks

- Illustrate difference with simple example:
  - Single-product firms
  - Symmetric (S,s) bands = $\pm$ 10%
  - Past prices optimal
  - Idiosyncratic cost shocks
  - Aggregate money shocks

Effect of 5% money shock on identity of adjusters: Gaussian cost shocks (GL '03)



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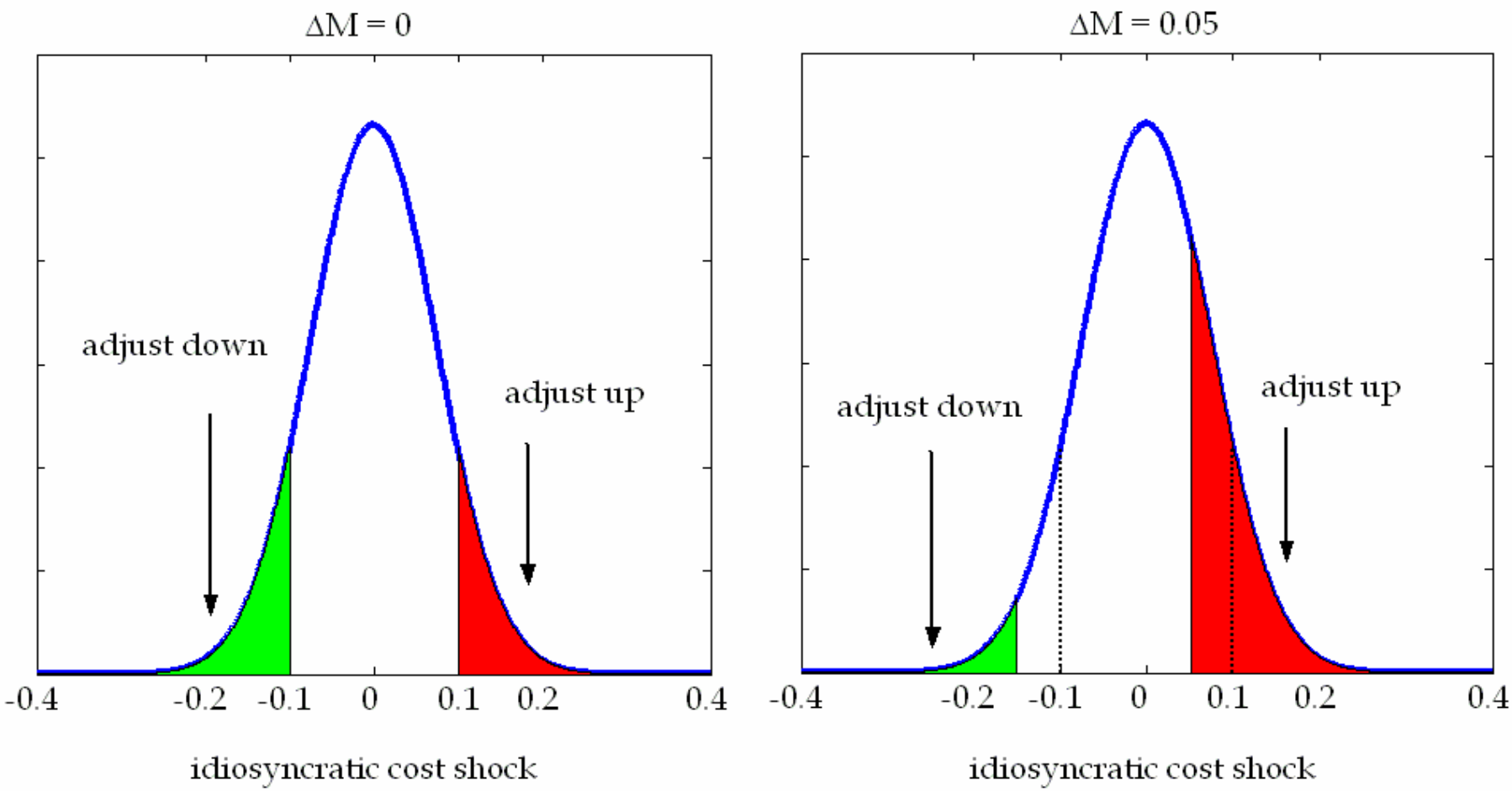
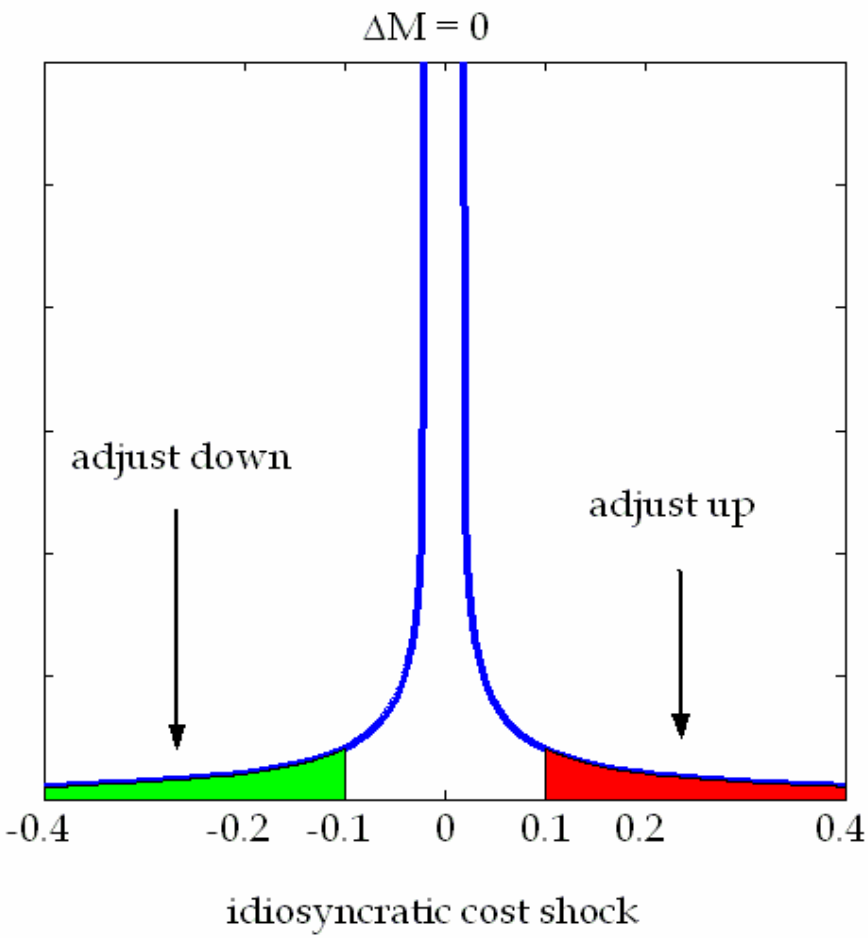


Effect of 5% money shock on identity of adjusters: Leptokurtic cost shocks (my setup)



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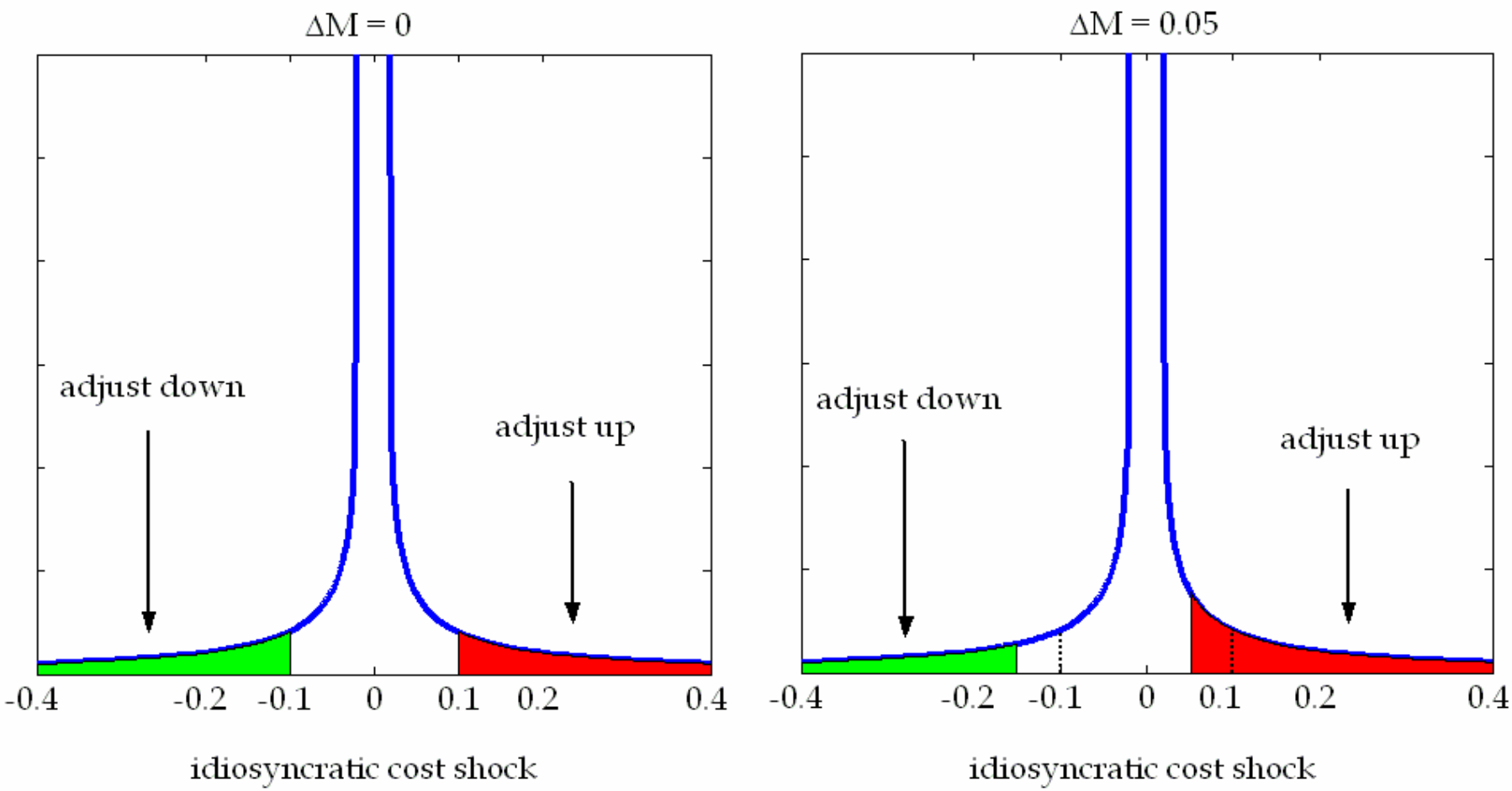
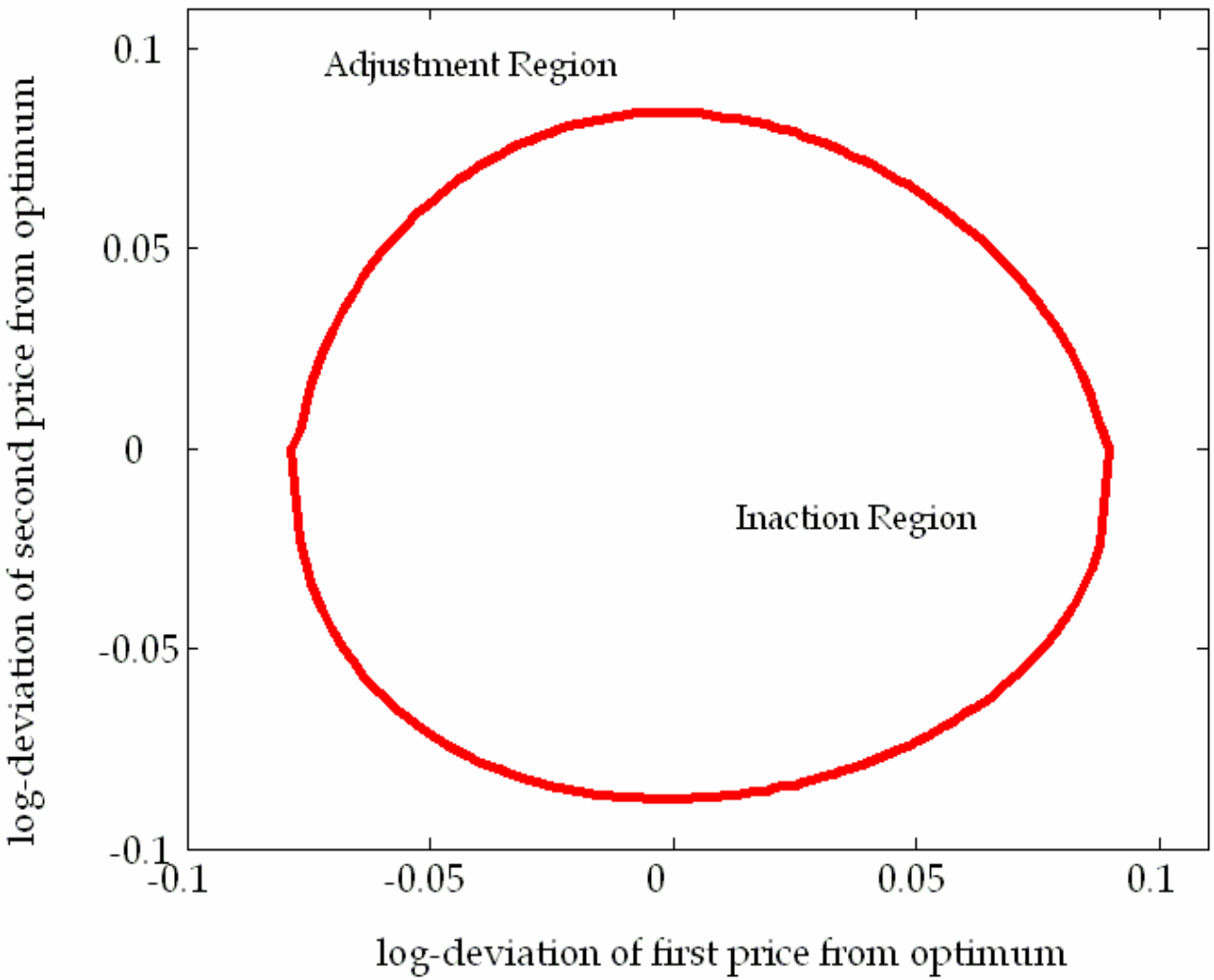


Single vs. multi-product firms

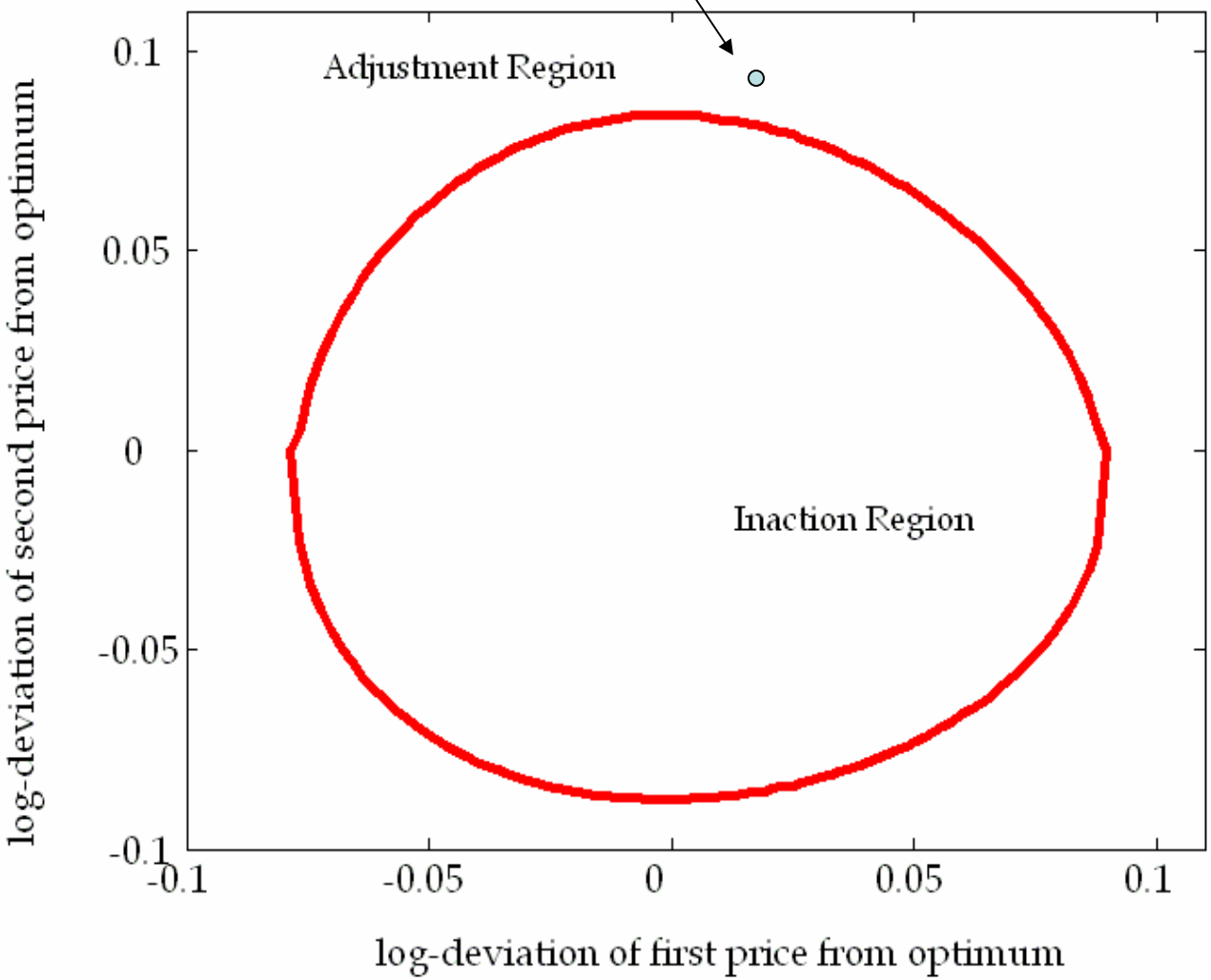
- With economies of scope in price adjustment:
  - Many small price changes

Inaction region for multi-product firms



Inaction region for multi-product firms

Some price changes are small



Single vs. multi-product firms

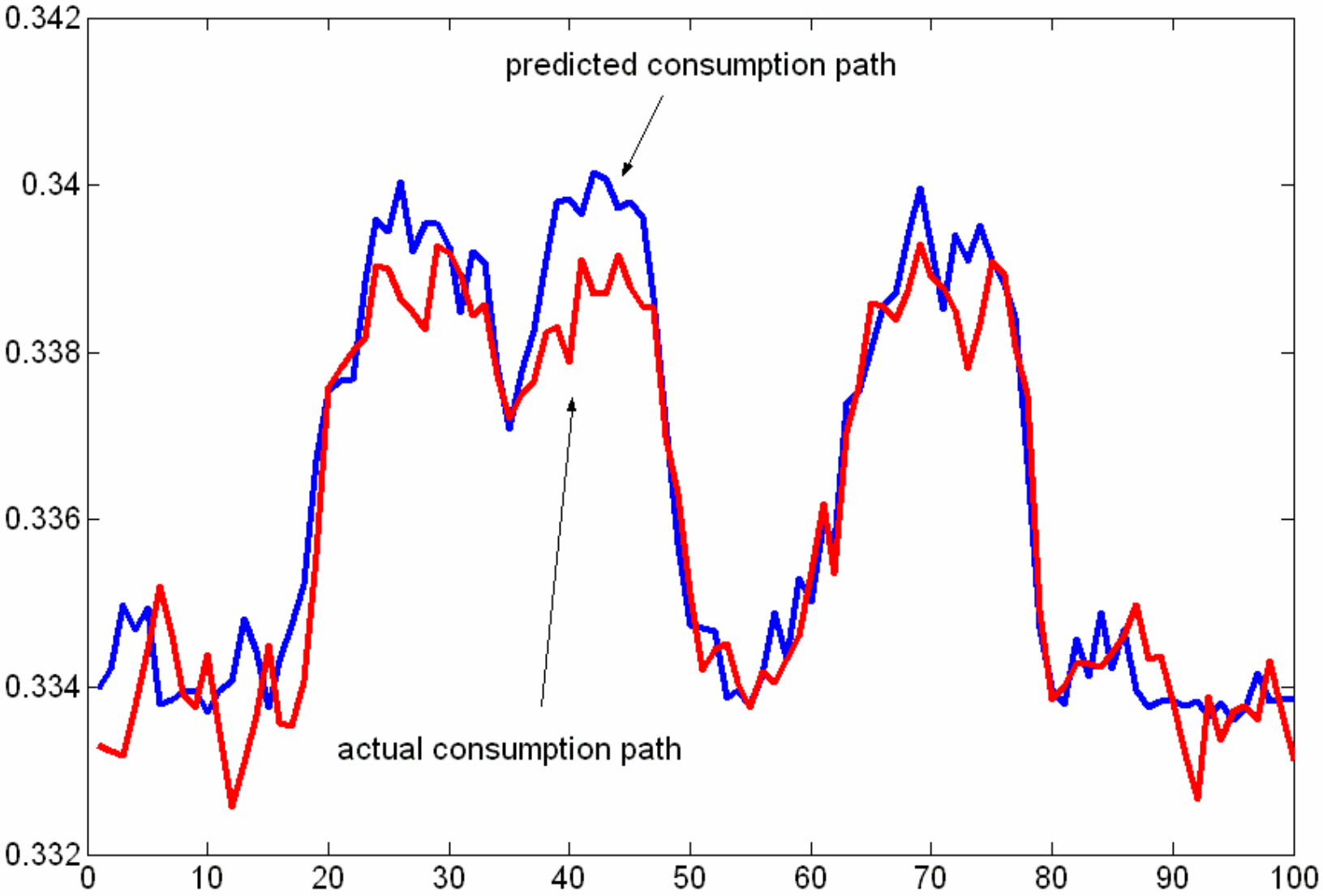
- With economies of scope in price adjustment:
  - Many small price changes
  - Fewer large price increases in times of monetary expansion

Conclusions

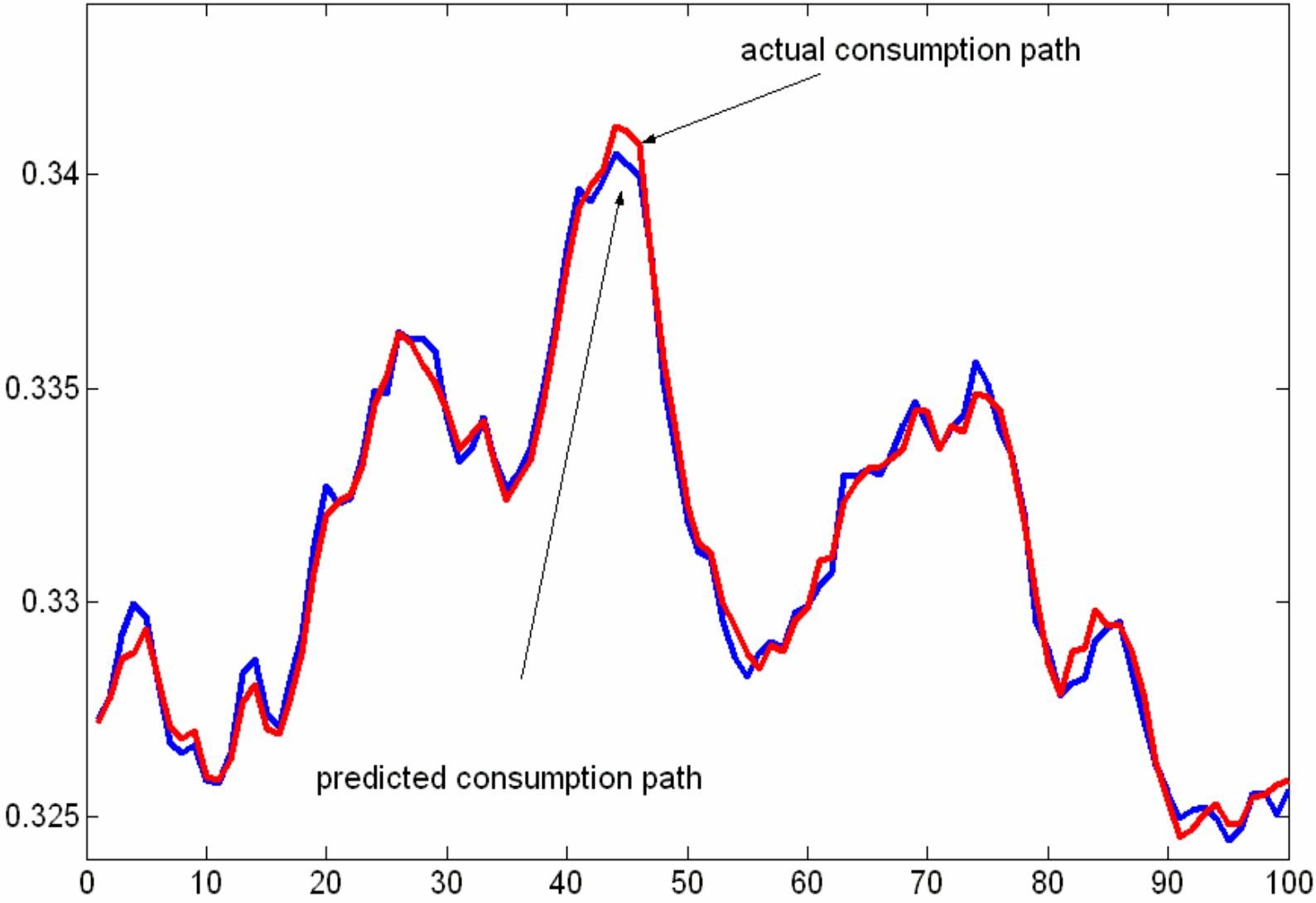
- Can menu costs generate output fluctuations?

- Yes, almost as large as in Calvo if :
  - many small price changes
  - fat-tailed distribution of price changes

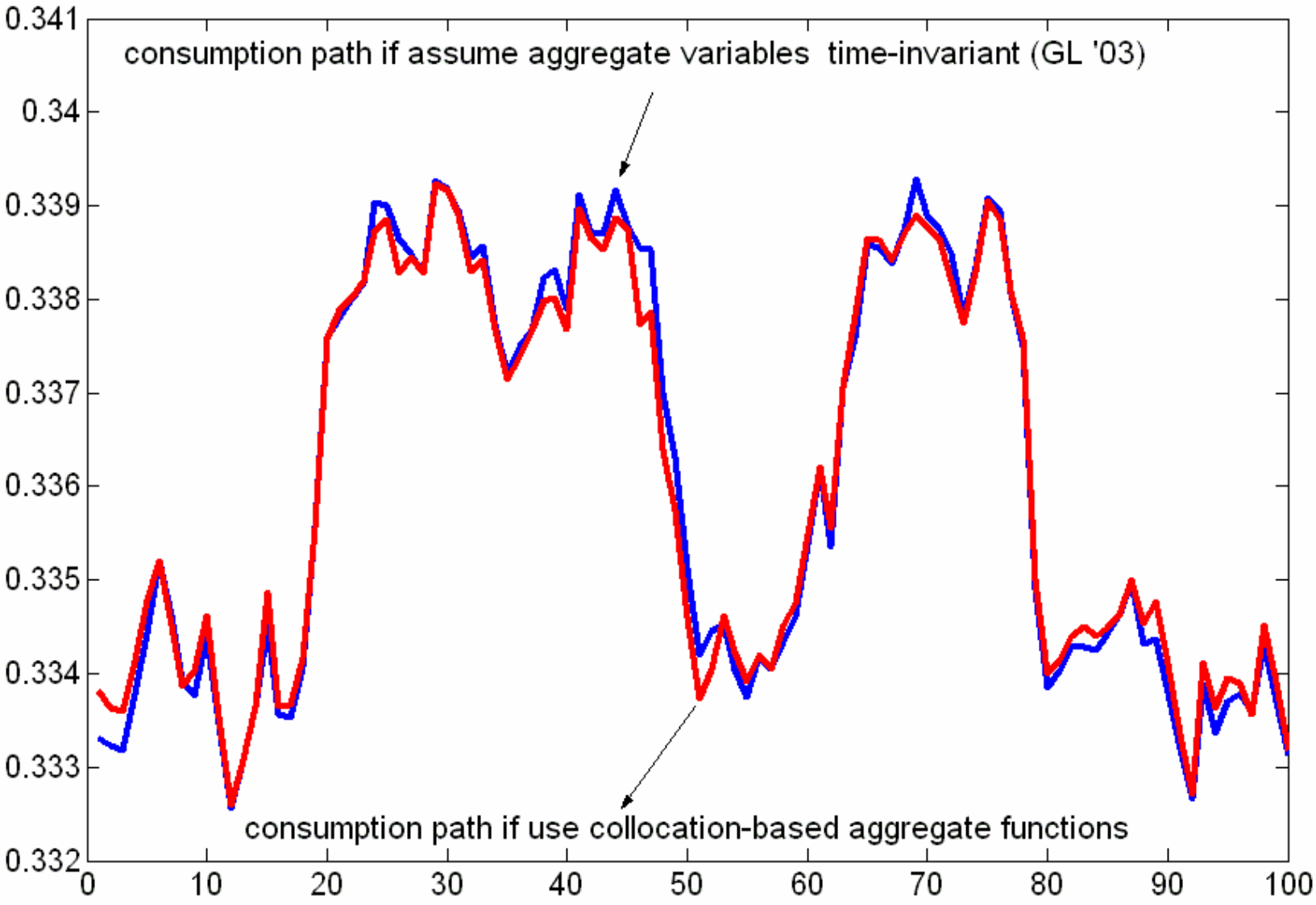
Accuracy of aggregate functions: menu-cost model



Accuracy of aggregate functions: Calvo model



No strategic complementarities



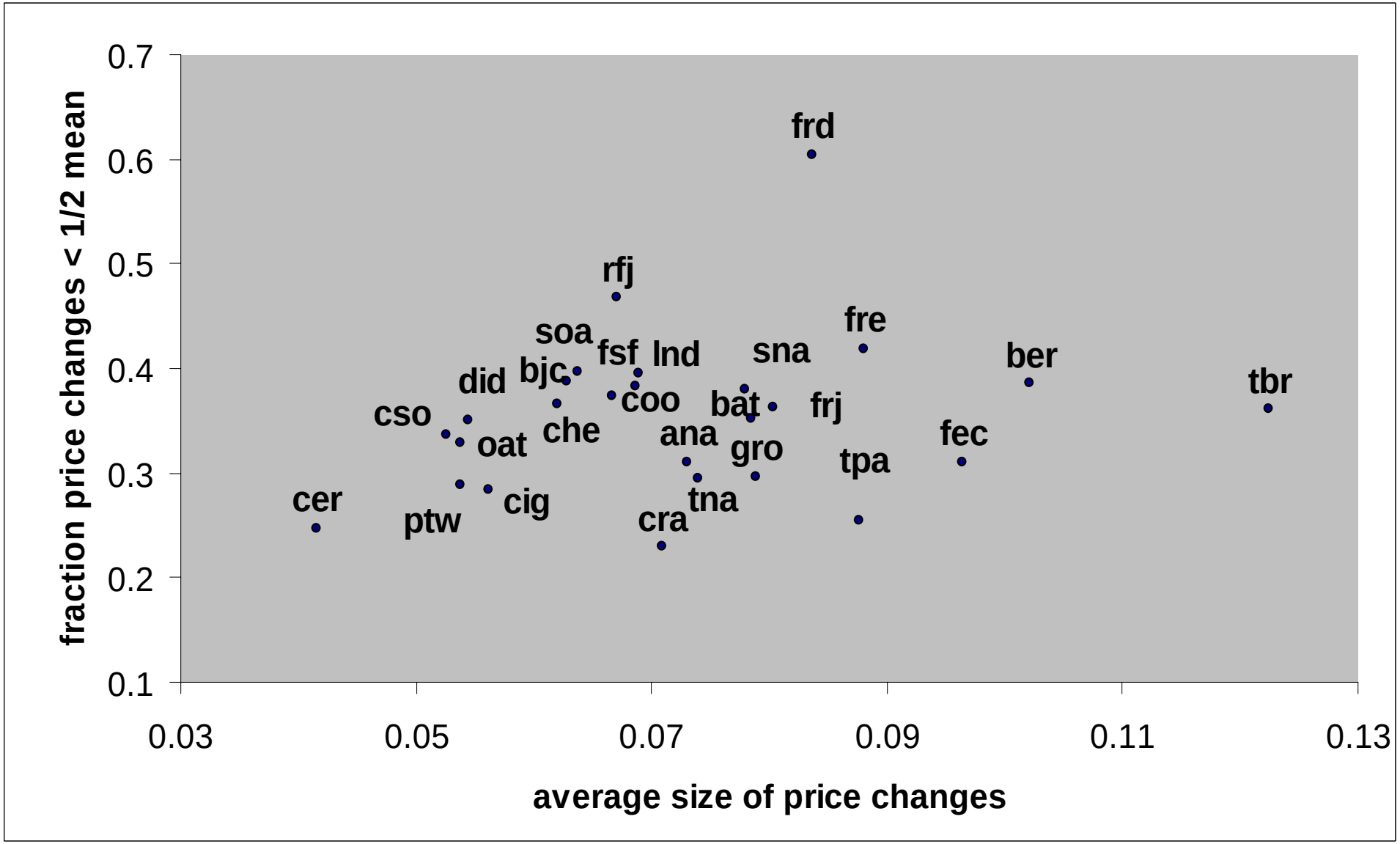
Alternative source of small price changes

- 10% of firms -- zero menu cost in a given period
- same setup/ stochastic processes as in my setup
- calibrate menu cost to match duration of price spells

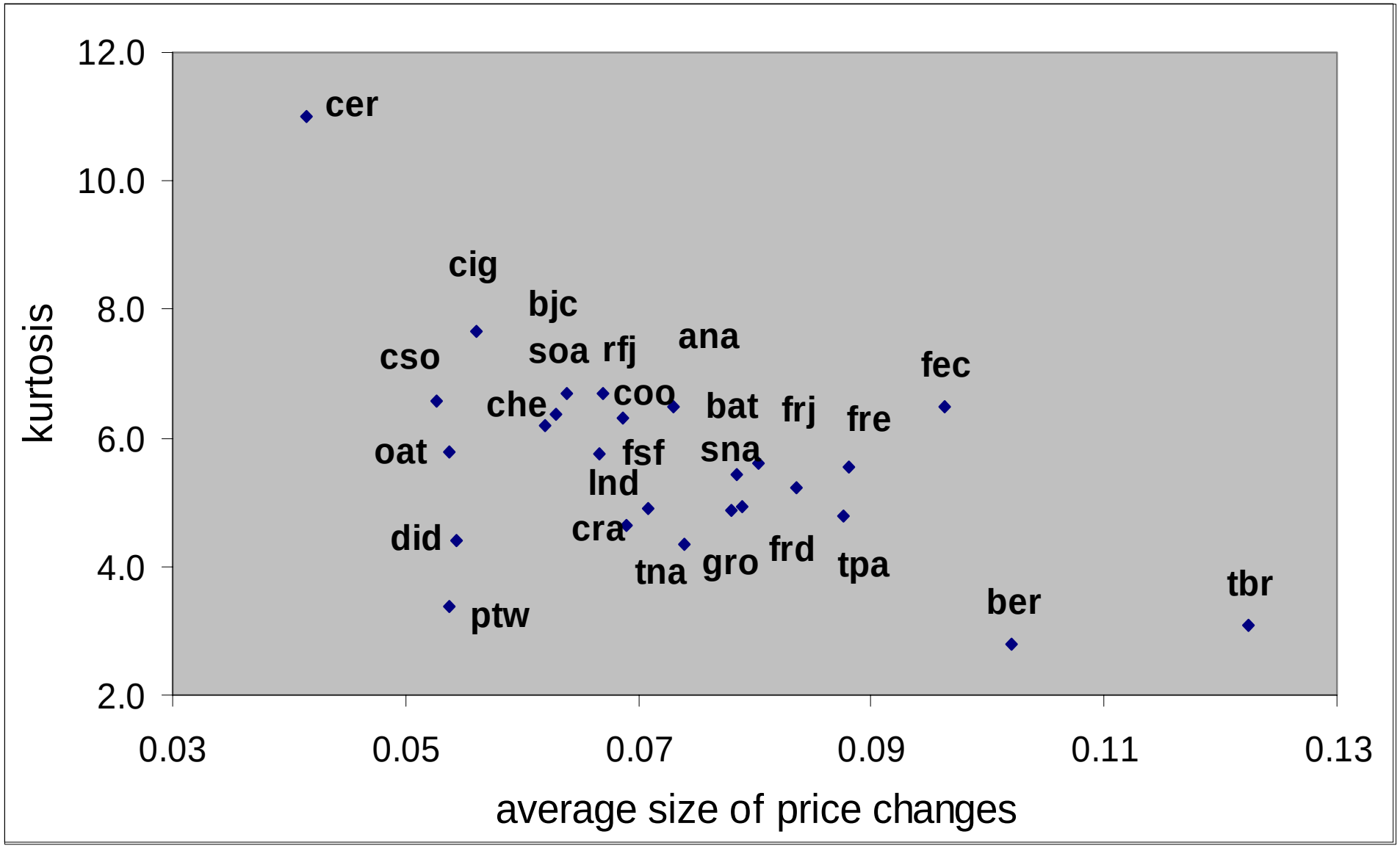
Properties of model economies

	My setup	Random menu cost
mean size of price changes, %	8.8	8.4
kurtosis of price changes	4.3	4.7
fraction of price changes < 4.5%	0.33	0.30
consumption volatility, %	0.61	0.62
consumption autocorrelation	0.94	0.93

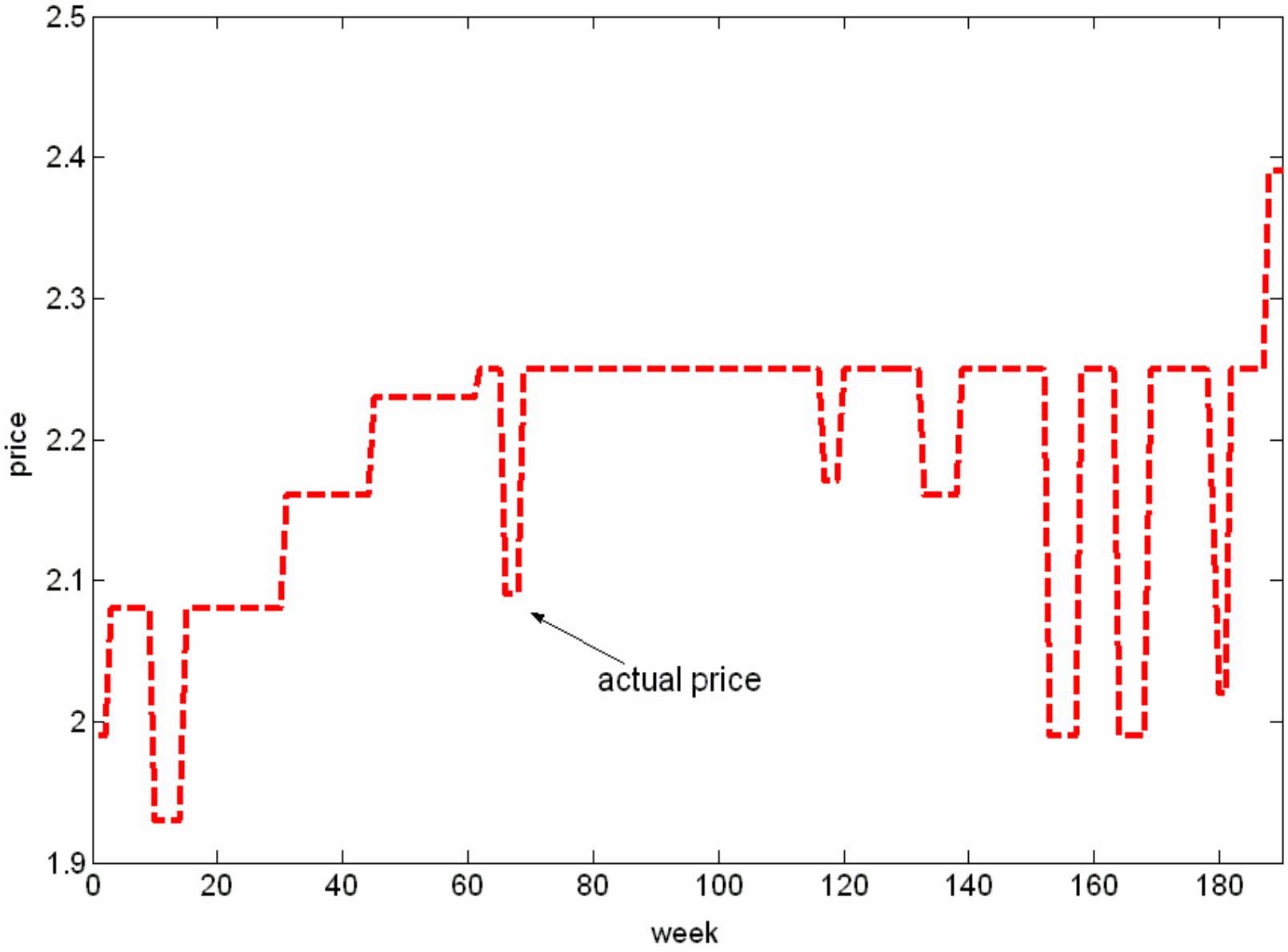
Fraction of small price changes in narrow product categories: Dominick's



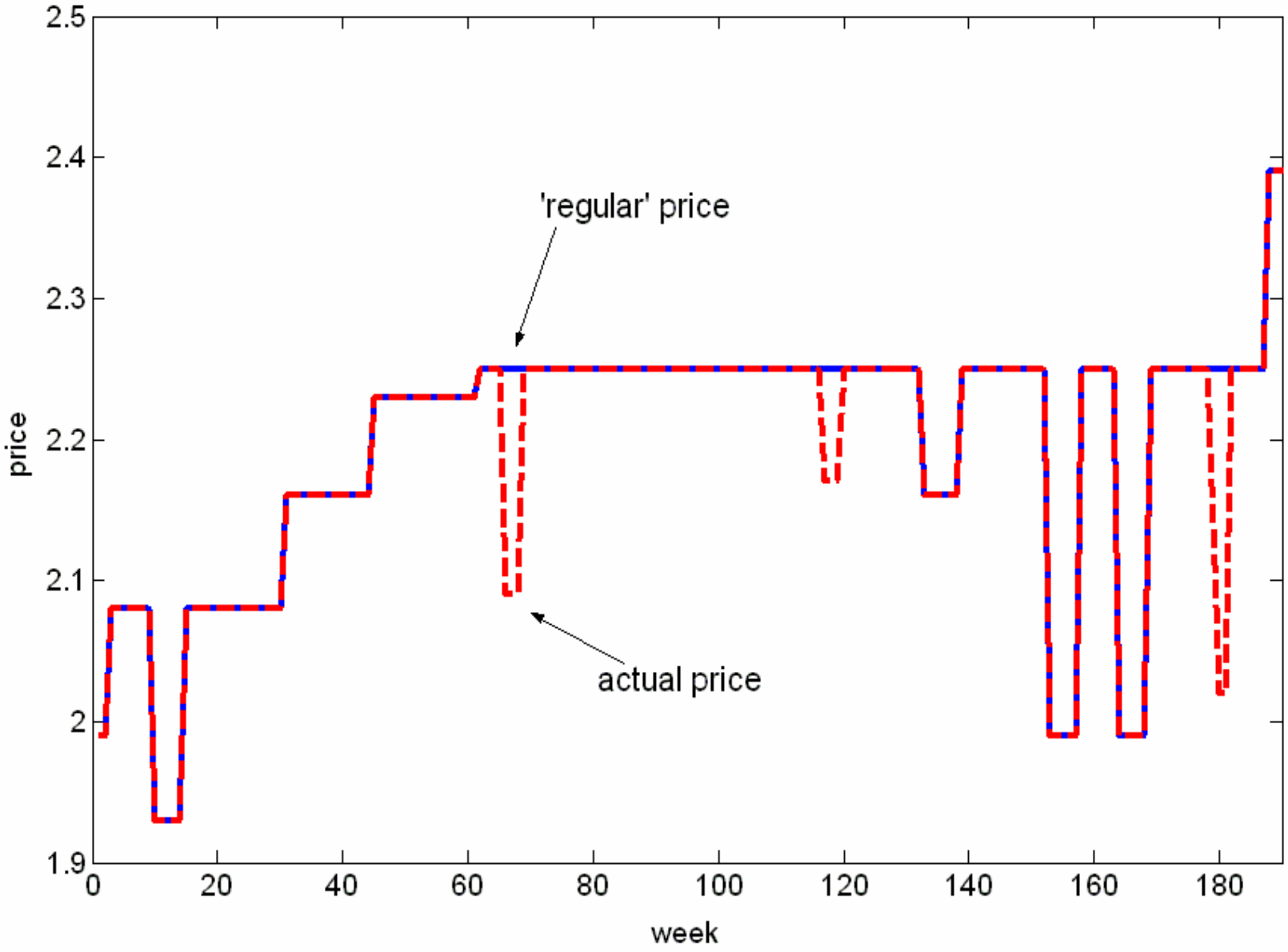
Kurtosis of price changes in narrow product categories: Dominick's



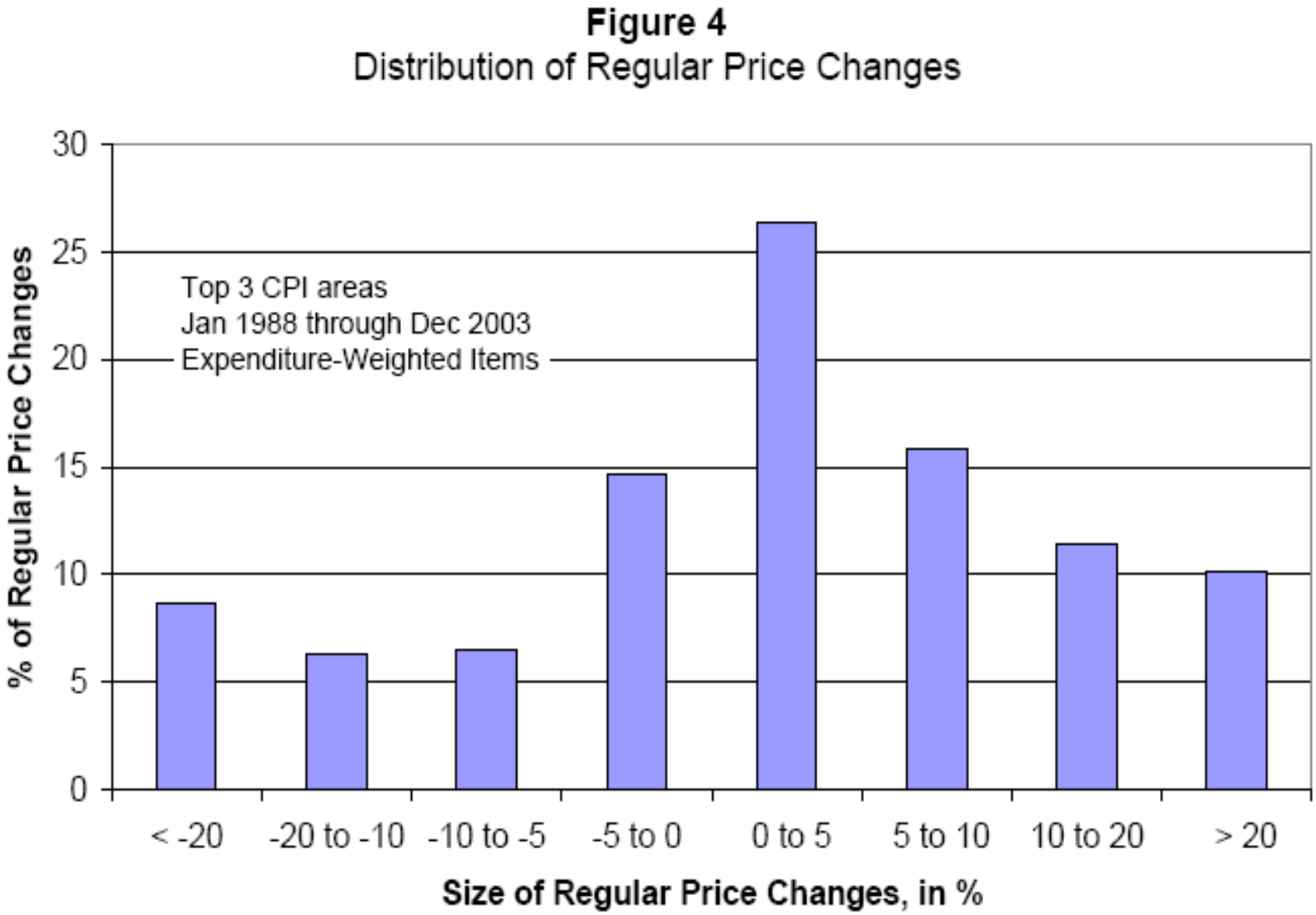
Example of actual and ‘regular’ price series



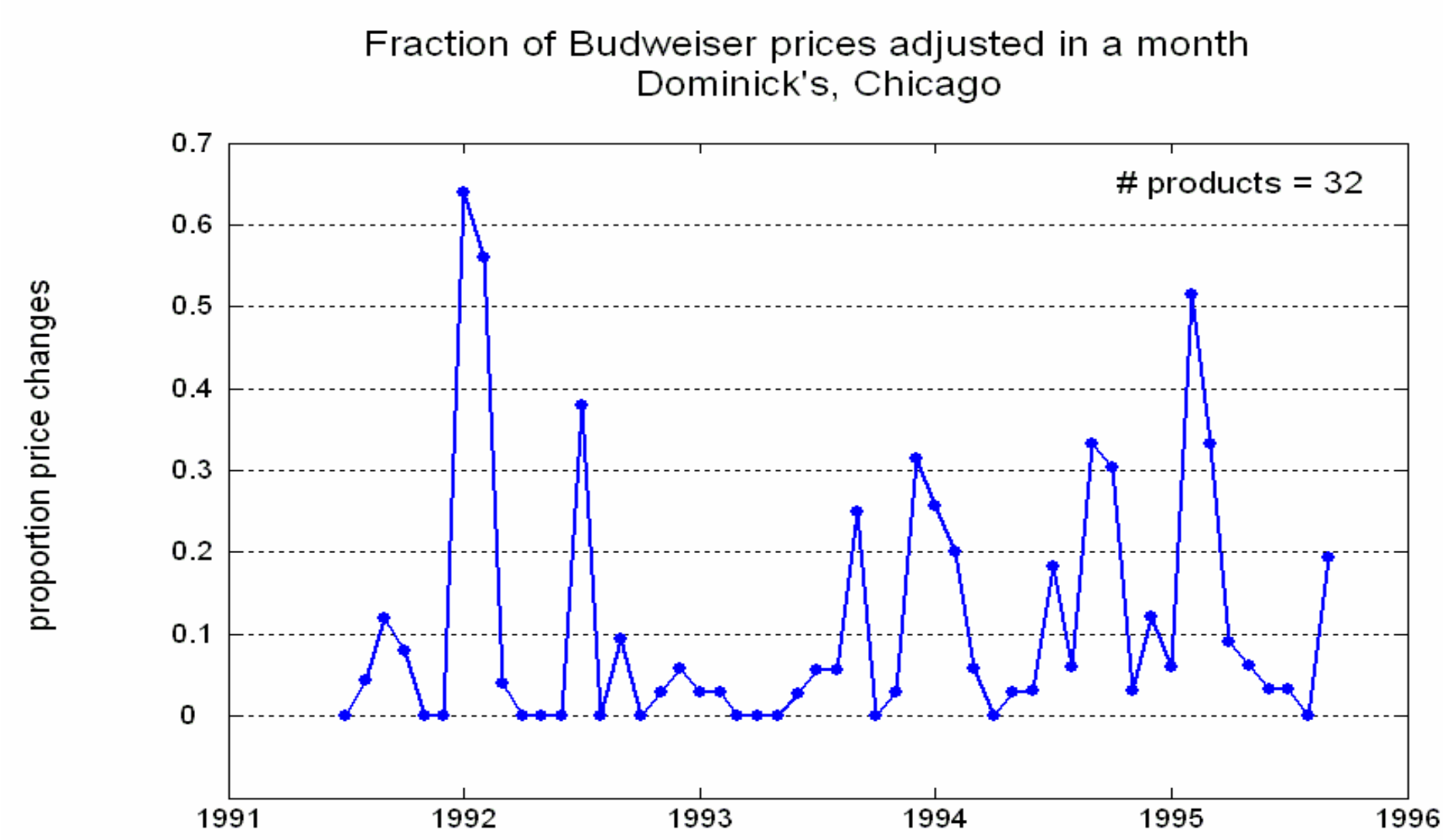
Example of actual and ‘regular’ price series



Klenow & Kryvtsov (2004)



Motivation for economies of scope: within-store synchronization



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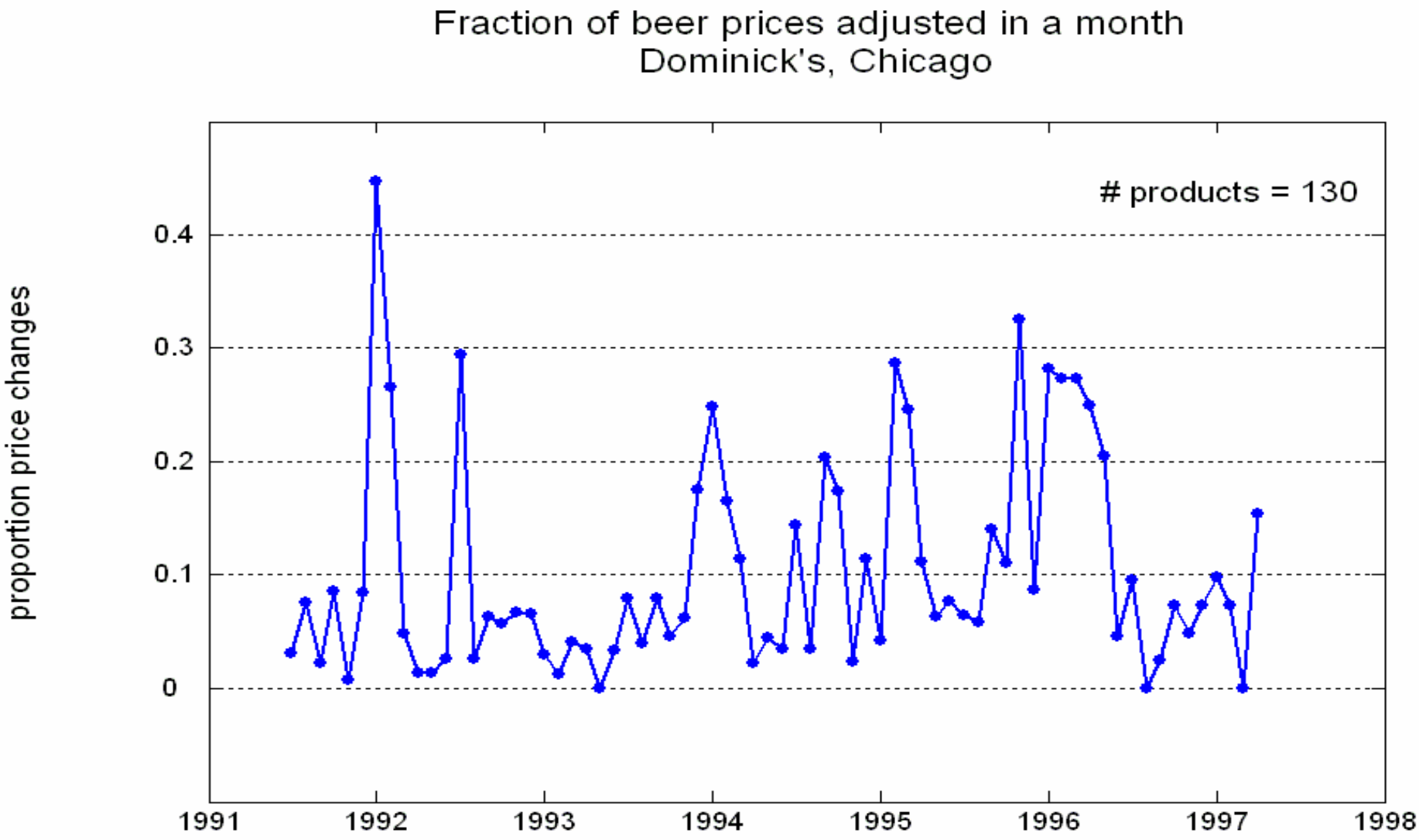

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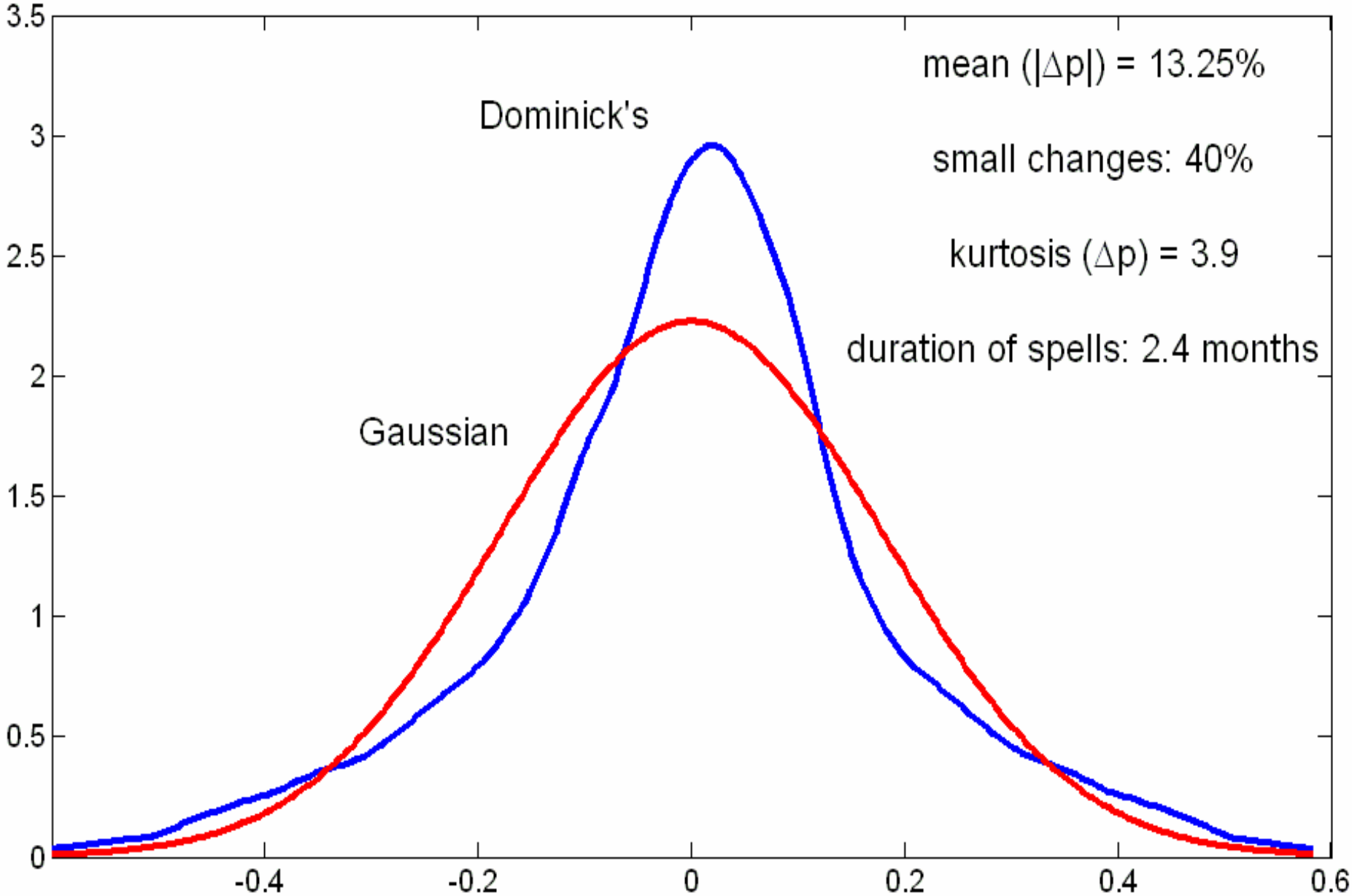
Distribution of non-zero price changes (including sales)



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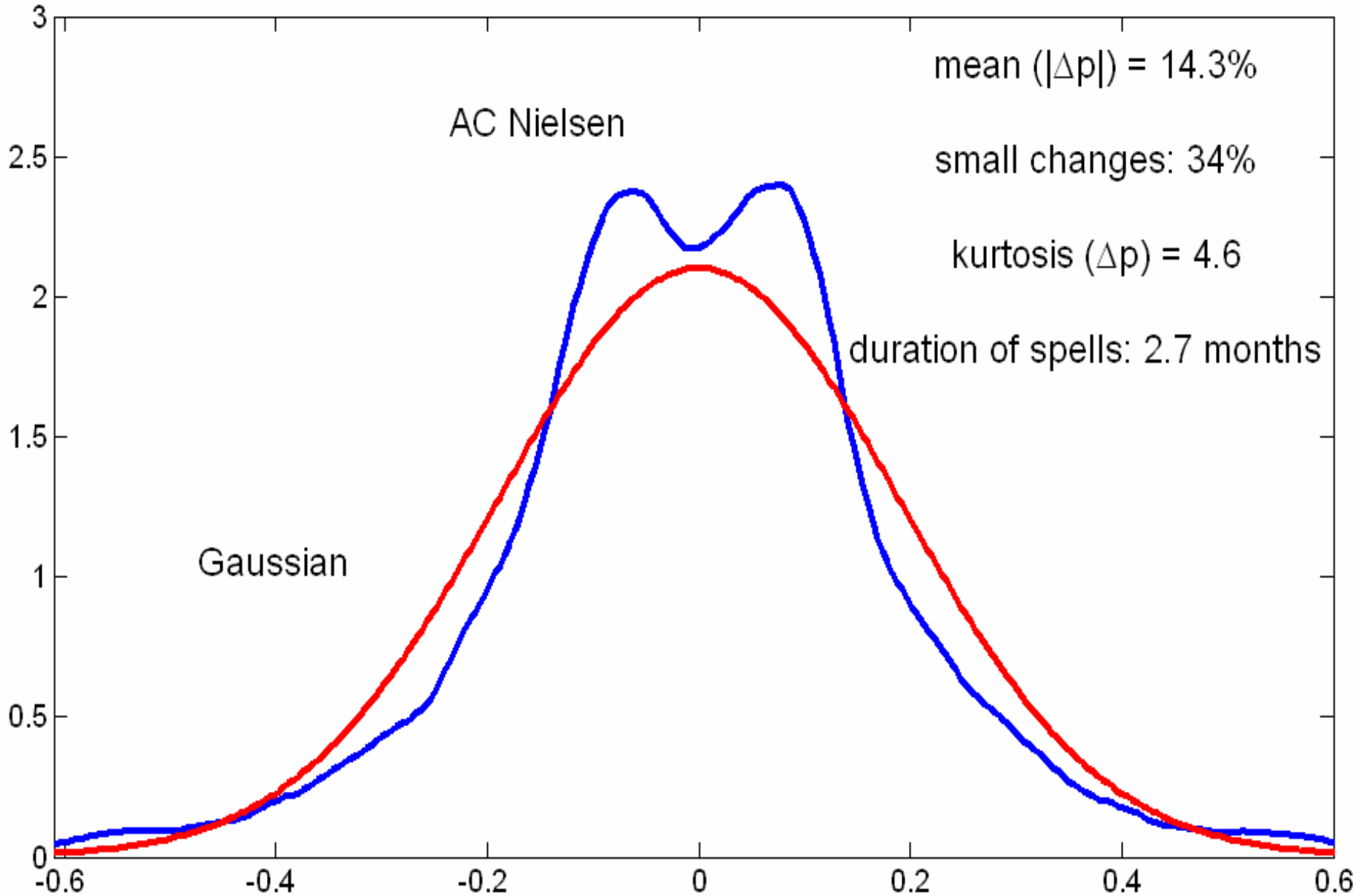

Additional moments: dynamic properties

- Duration of price spells
  - average # months between consecutive price changes

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- Duration of price spells
  - average # months between consecutive price changes
- 24-month deviance ratio
  - measures how persistently prices deviate from trend

$$\frac{mean(abs(p_t - p_{t-24}))}{mean(abs(\Delta p_t)|\text{adjust})}$$

  - p_t – deviation of price from linear trend