

# THE ELUSIVE COSTS OF INFLATION: PRICE DISPERSION DURING THE U.S. GREAT INFLATION

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# OPTIMAL LEVEL OF INFLATION

What level of inflation should central banks target?

- Pre-crisis policy consensus to target roughly 2% inflation per year
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(Schmitt-Grohe and Uribe, 2011; Coibon et al., 2012)
- Great Recession has lead to increasing calls for higher inflation targets
  - Blanchard, Dell’Ariccia, Mauro (2010), Ball (2014), Krugman (2014)
  - Blanco (2015)

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# PRICE DISPERSION AND THE COSTS OF INFLATION

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  - Distorts allocative role of the price system
- In standard New Keynesian models, these costs are very large
  - Going from 0% to 12% inflation per year yields a 10% loss of welfare
- Much more costly than business cycle fluctuations in output in these same models

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### 12 Month CPI Inflation



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- 2 Difficulty in interpreting raw price dispersion
  - Heterogeneity in size and quality of products
  - Absolute size of price changes informative about inefficient price dispersion

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- No evidence of increased price dispersion in Great Inflation period:
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  - Even standard deviation of absolute size is completely flat
- Main cost of inflation in New Keynesian models completely elusive
- Optimality of low inflation based on these models needs to be reassessed

(Other costs of inflation may be important)

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- Have prices become more flexible over past 40 years?
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  - Service sector has no sales
  - Prices not more flexible in service sector
  
- Frequency of price change very sensitive to inflation
- Both absolute size and frequency facts favor menu cost model over Calvo model

# EXISTING EMPIRICAL EVIDENCE

Earlier work on standard deviation of sectoral inflation:

- Vining and Elwertowski 76, Parks 78, Fisher 81

Earlier work on price *change* dispersion:

- Van Hoomissen 88, Lach and Tsiddon 92, Vavra 14;

Very limited literature on price dispersion:

- Reinsdorf 94 (US BLS data, 1980-1982),  
Sheremirov 13 (US IRI data 2002-2009)
- Alvarez et al. 16 (Argentine hyperinflation)

Why Is Inflation so Costly  
in Standard Sticky Price Models?

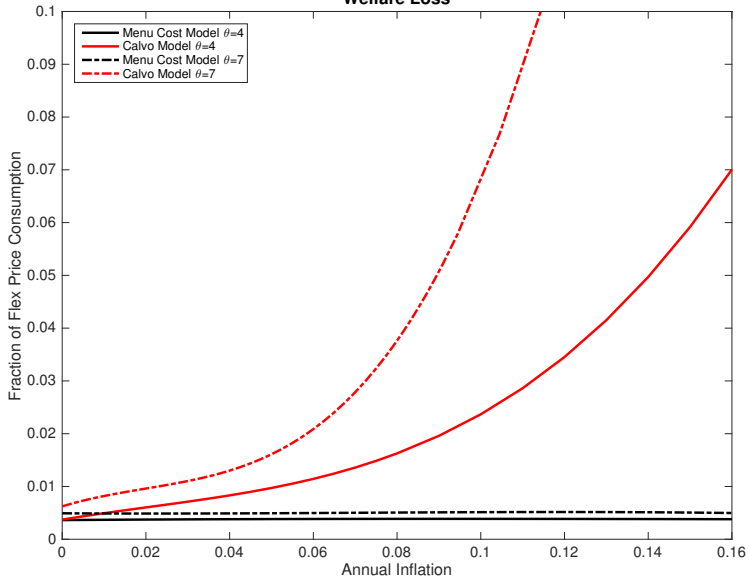
# STANDARD STICKY PRICE MODEL

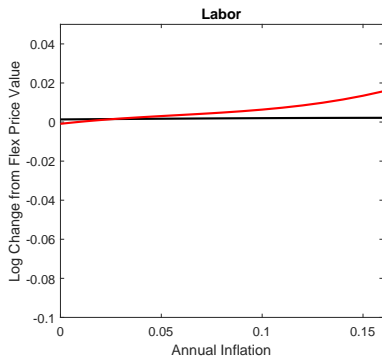
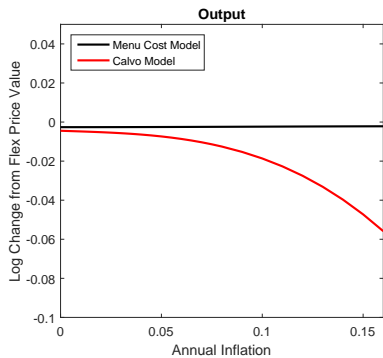
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- Monopolistically competitive firms produce with labor
- Firms face costs of changing price (we contrast Calvo vs. menu costs)
- Standard calibration (consider  $\theta = 4$  and  $\theta = 7$ )

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- We vary average inflation rate
- Consider welfare relative to flexible price benchmark (consumption equivalent loss)

## Welfare Loss







# BOTTOM LINE

## Menu Cost Model:

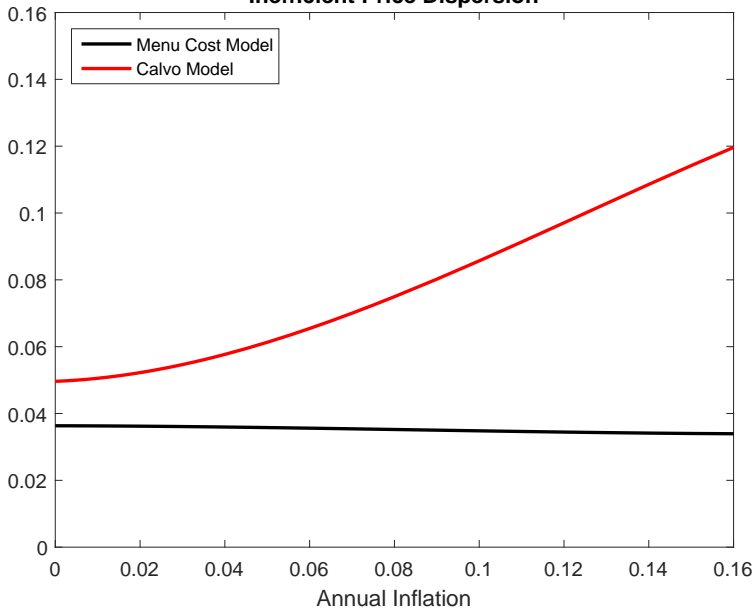
- Welfare costs are small
- Welfare costs are unresponsive to moderate inflation

## Calvo Model:

- Welfare costs rise rapidly with inflation
- Welfare costs arise from loss in labor productivity

$$A_t(\bar{\pi}) = \left[ \int_0^1 \left( \frac{p_{it}}{P_t} \right)^{-\theta} A_{it}^{-1} di \right]^{-1}$$

## Inefficient Price Dispersion



# New Micro Data on Consumer Prices During the U.S. Great Inflation

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- We digitized micro data underlying the U.S. CPI for period May 1977 to October 1986
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- Full sample 1978 to 2014
  - Drop 1977 data (quality concerns)
  - 6 month gap in 1986-1987

# INFORMATION IN DATASET

- Product category (ELI) (e.g., toothpaste)
  - Location (e.g., Chicago)
  - Outlet (e.g., Pathmark at corner of 125th St. and Lex Ave)
  - Product (e.g., 2L bottle of Diet Coke)
  - Price
  - Sales flag, imputation flag
- 
- Sample size: Varies from 80k to 100k per month

Two phases:

- Scanning of microfilm images
  - Obsolete cartridges which don't fit modern scanners
- Conversion of scanned images to machine readable form
  - Customer optical character recognition software

PSU/HS/POPS/CL OUTLET/QTE/VER O-T/CHAIN/POP	BASE PR BP W/TX QL ADJ	8001	8002	8003	8004	8005	8006	8007	8008	8009	8010	8011	EF PR FFFSCCF & CH
A101/B/118105C 0054853/001/009 012/ /B	3.423R 3.697R	-	-	-	0	0	0	0	0	0	-15	0	-4
A101/B/118/05C 0054853/001/010 012/ /B	-	-	-	-	-	-	-	-	-	-	-	-	5.500 RN1
A101/B/118/05C 0054853/002/006 012/ /B	3.874R 4.197R	3.990 AA1	3.990 AA1	3.868 T RN1I	3.990 RA1	3.990 AA1	3.990 AA1	3.990 AA1	3.990 AA1	3.990 AA1	3.990 AA1	3.990 AA1	3.990 AA1
A101/A/118/01D 0055222/001/010 016/ /B	37.055C 40.020C	-	-	0	-3	3	0	0	0	0	0	0	0
A101/A/118/01D 0055222/001/011 016/ /B	37.055C 40.020C	-	-	-	-	-	-	-	-	-	-	-	44.9 RN1
A101/B/118/01D 0055765/001/004 001/ /U	18.907C 20.280C	25.000 RA1	25.000 RA1	23.000 RA1	23.000 AA1	23.000 AA1	23.000 AA1	23.000 AA1	23.000 AA1	23.000 AA1	23.000 AA1	23.000 AA1	23.000 AA1
A101/8/118/02D 0055765/002/007 001/ /U	58.484R 62.583R	60.000 AA1	60.000 RA1	60.000 AA1	60.000 AA1	60.000 AA1	60.000 AA1	60.000 AA1	60.000 AA1	60.000 AA1	60.000 AA1	60.000 AA1	60.000 AA1
A101/8/118/01D 0055958/001/005 018/ /B	13.448C 14.432C	13.990 RA1	13.990 AA1	13.990 AA1	13.990 AA1	13.990 AA1	13.990 AA1	13.990 AA1	13.990 AA1	X 1	-	-	-
A101/8/118/01D 0055958/001/006 018/ /B	13.448C 14.432C	-	-	0	0	0	0	0	0	-	-	-	-
A101/8/118/05C 0055958/002/005 018/ /B	3.990C 4.309C	5.990 AA1	5.990 AA1	5.990 AA1	5.990 AA1	6.057 T RN1I	X 1	-	-	-	-	-	-
A101/8/118/05C 0055958/002/006 018/ /B	5.049R 5.403R	-	-	0	0	0	1	-	-	-	-	-	-
A101/8/118/05C 0055958/002/007 018/ /B	5.049C 5.403C	-	-	-	-	-	-	4.990 RN1	4.990 AA1	4.990 AA1	4.990 AA1	X 1	-
A101/8/118/02D 0057534/004/012 001/ /W	42.266C 45.644C	-	-	-	-	-	-	0	0	-	-	-	-
		-	-	-	-	58.000 RC1	58.000 AA1	58.000 AA1	39.990 B RA1	24.990 B RA1	X 1	-	-
		-	-	-	-	0	0	-31	-38	-	-	-	-



# ELIMINATING OCR ERRORS

- Great deal of redundancy on Scanned Images
  - Each image contains data from 12 months (i.e., current an 11 past months)
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- Only use prices accepted by one of two algorithms
- Similar procedures for sales flag, imputations flag

# Empirical Results

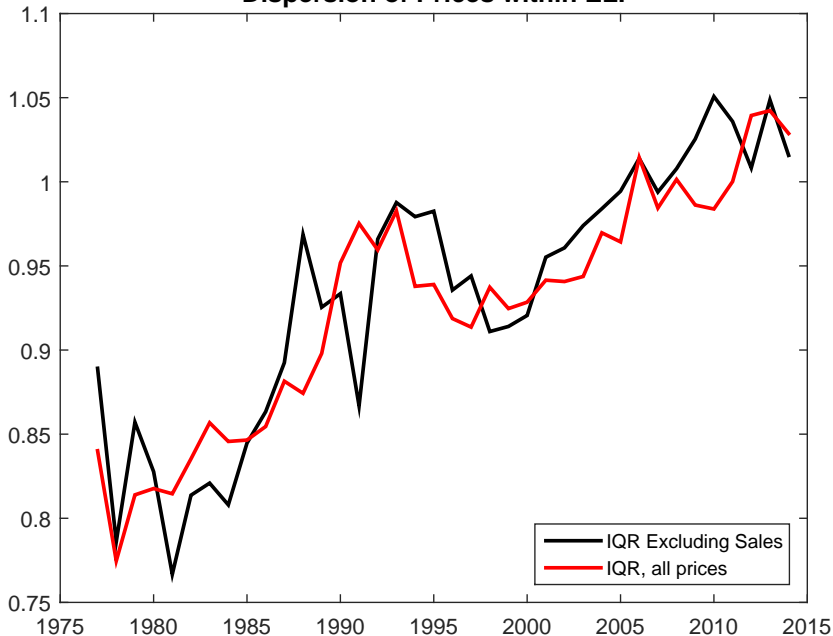
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- If all products were homogenous within product category ...
  - ... simply calculate cross-sectional variance
- In practice, large amount of heterogeneity in size and quality within product category
- This creates “efficient” dispersion in prices
- “Efficient” dispersion may dwarf “inefficient” dispersion

## Dispersion of Prices within ELI



# DISPERSION AND ABSOLUTE SIZE

Alternative approach: Focus on *absolute size* of price changes

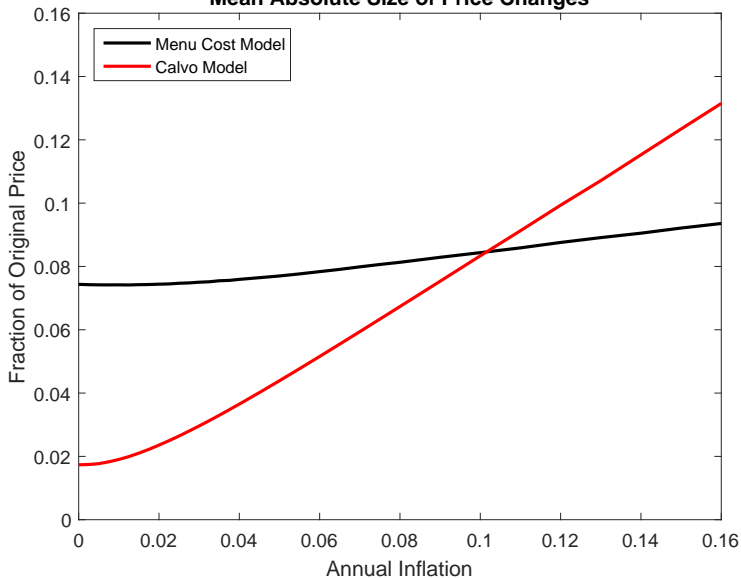


# DISPERSION AND ABSOLUTE SIZE

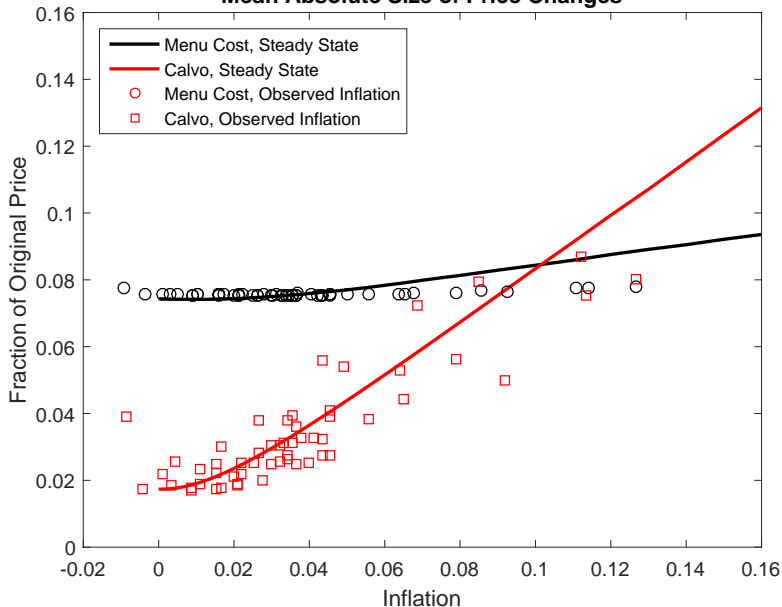
Alternative approach: Focus on *absolute size* of price changes

- Absolute size reveals distance of prices from desired prices
- If prices are drifting further from desired level due to inflation should change by more when they change

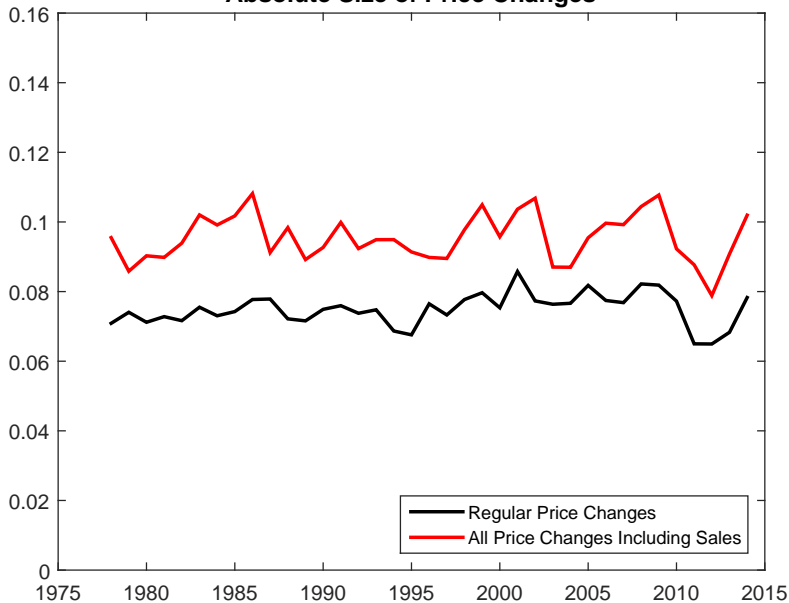
## Mean Absolute Size of Price Changes



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## Absolute Size of Price Changes



Sectors

Quantiles

# STANDARD DEVIATION OF ABSOLUTE SIZE

- Welfare losses non-linear in deviation of price from efficient price

$$A_t(\bar{\pi}) = \left[ \int_0^1 \left( \frac{p_{it}}{P_t} \right)^{-\theta} A_{it}^{-1} di \right]^{-1}$$

- Largest deviations matter disproportionately

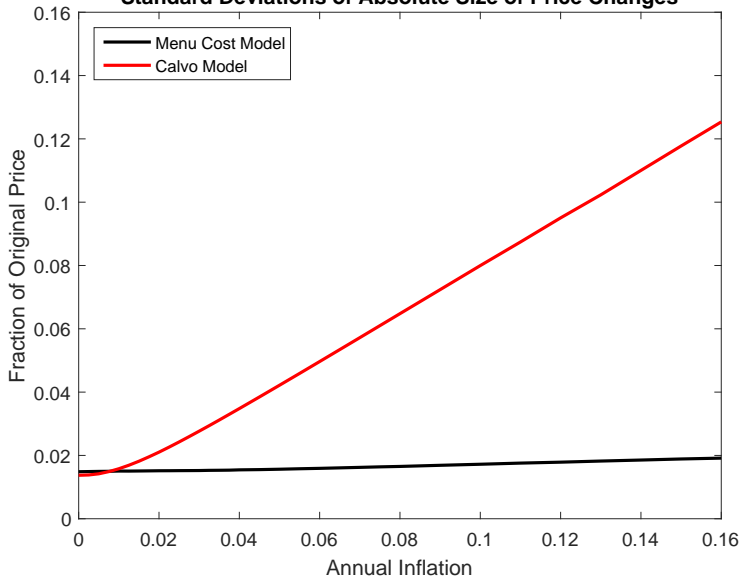
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- Largest deviations matter disproportionately
- Conditional on mean absolute size, standard deviation informative about prevalence of very large price changes

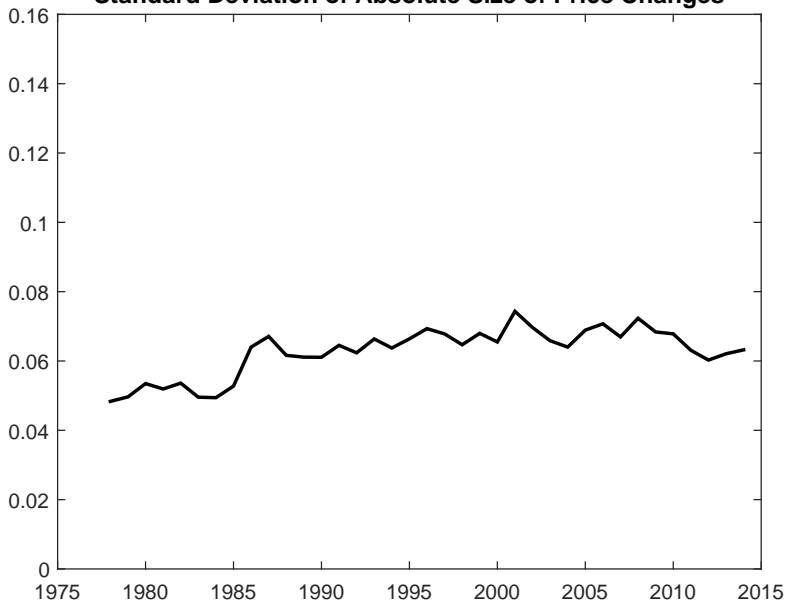
## Standard Deviations of Absolute Size of Price Changes



Transitory Inflation

Calvo Varying

## Standard Deviation of Absolute Size of Price Changes





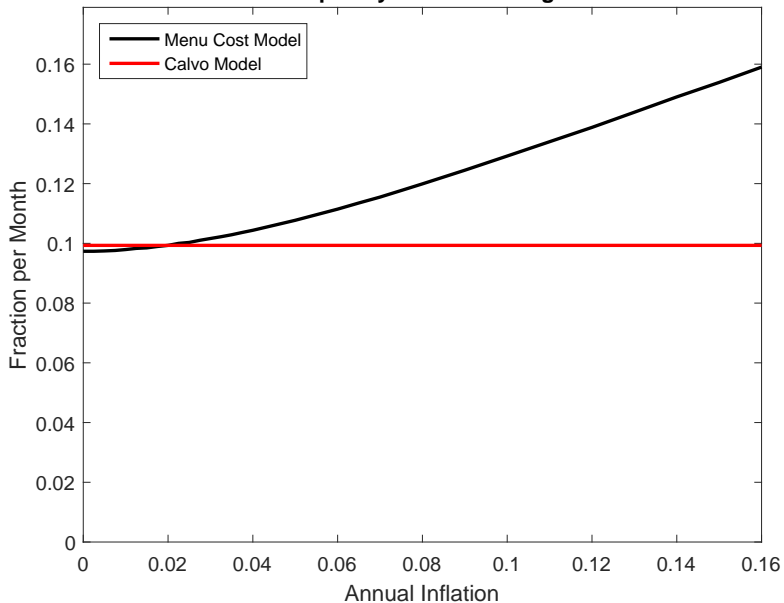
# SUMMARY

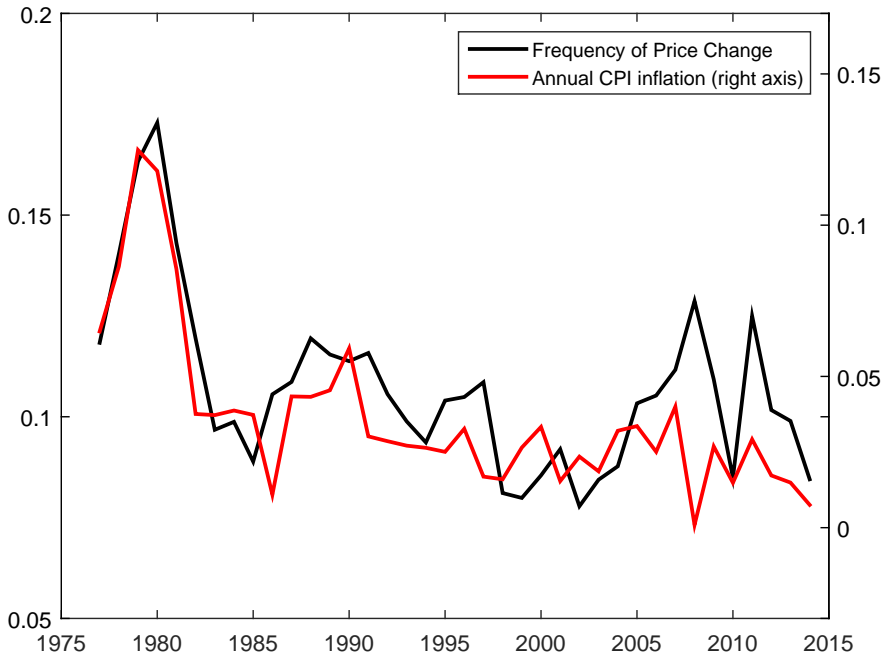
- No evidence that mean or standard deviation of absolute size of price changes rose during Great Inflation
- Suggests inefficient price dispersion not any higher during Great Inflation
- Costs of inflation emphasized in New Keynesian models elusive

# FREQUENCY OF PRICE CHANGE

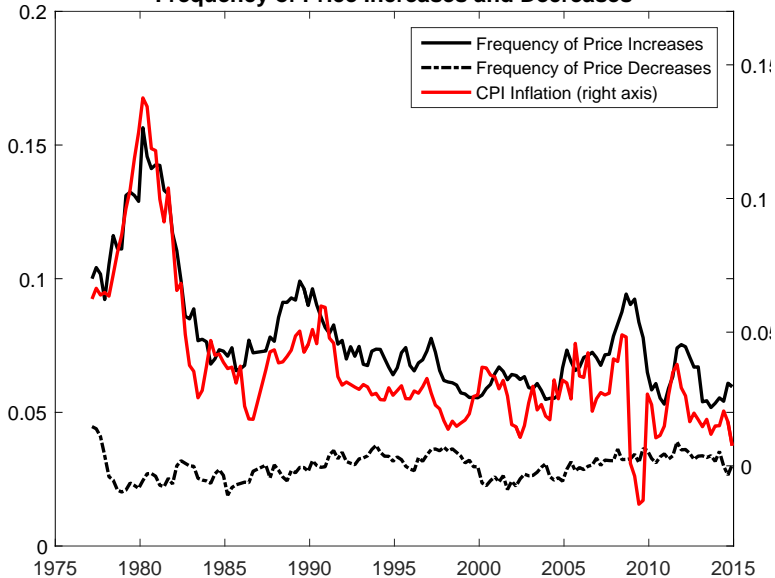
- Flip-side of “size” is frequency of price change
  - If size unaffected by inflation, frequency must vary
- Useful to distinguish between models of price setting:
  - Frequency constant in Calvo model ...  
... but varies with inflation in menu cost model

## Frequency of Price Change





## Frequency of Price Increases and Decreases



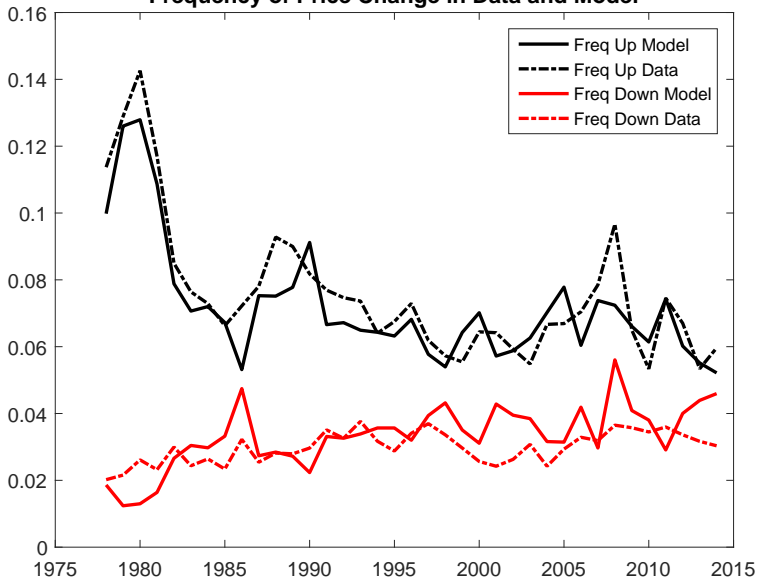
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- Can evolution of frequency of price (excluding sales) change be explained by menu cost model with a constant menu cost over entire sample period?

## Frequency of Price Change in Data and Model

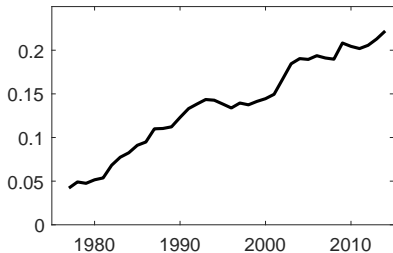




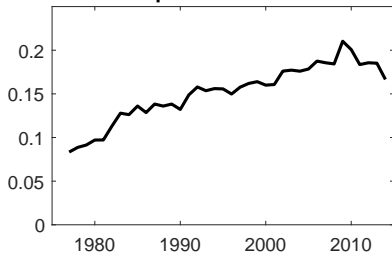
# HAVE PRICES BECOME MORE FLEXIBLE?

- Regular prices (excluding sales) have not become more flexible
- What about temporary sales? Have they become more prevalent?

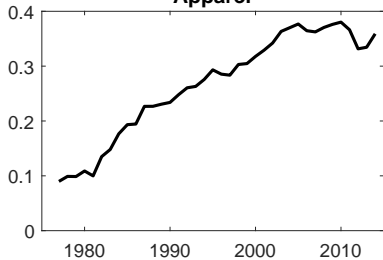
### Processed Food



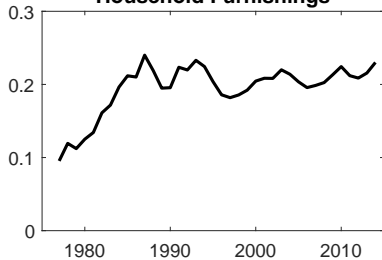
### Unprocessed Food



### Apparel



### Household Furnishings



# SALES AND PRICE FLEXIBILITY

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  - i.e., how rapidly aggregate price level responds to shocks
- Sizable recent literature has largely concluded that effects of sales on aggregate price flexibility are small:
  - Sales are very transient
  - Sales are strategic substitutes
  - Sales are “on autopilot”

# CONCLUSIONS

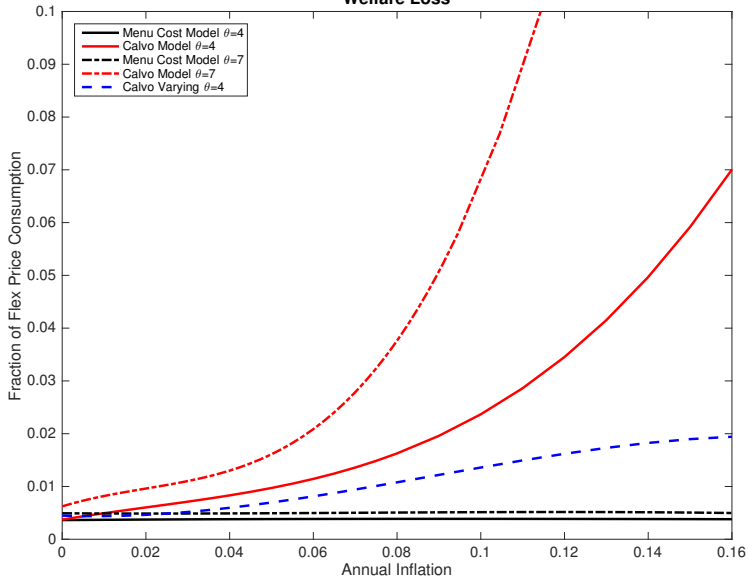
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- Main costs of inflation in New Keynesian models elusive in data
  
- No change in price flexibility of regular prices over 40 years
- Dramatic increase in frequency of temporary sales

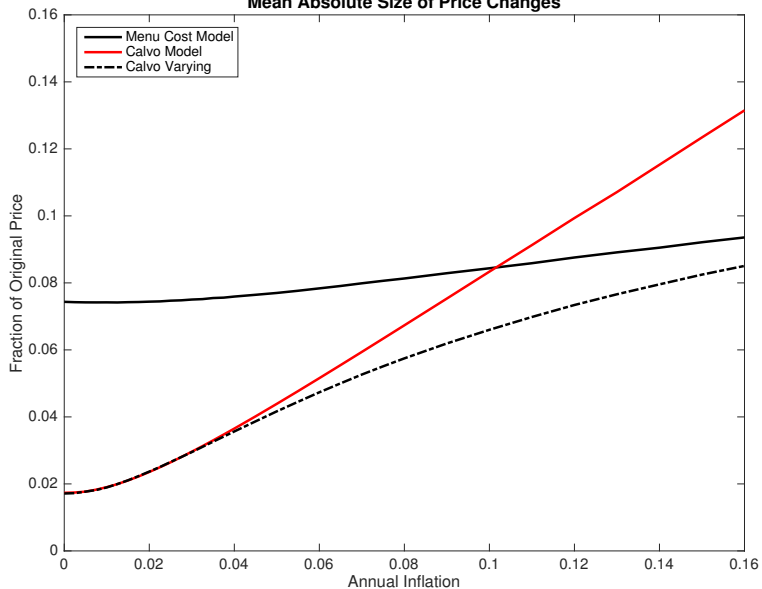
# Appendix

## Welfare Loss

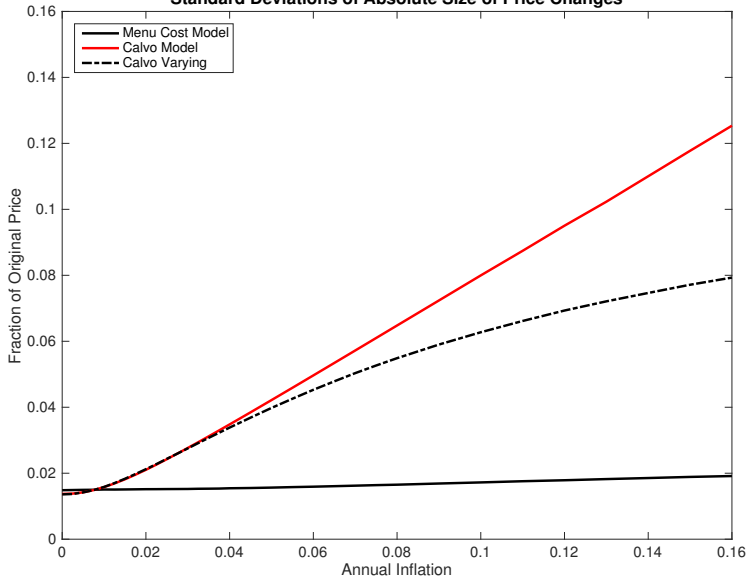




### Mean Absolute Size of Price Changes

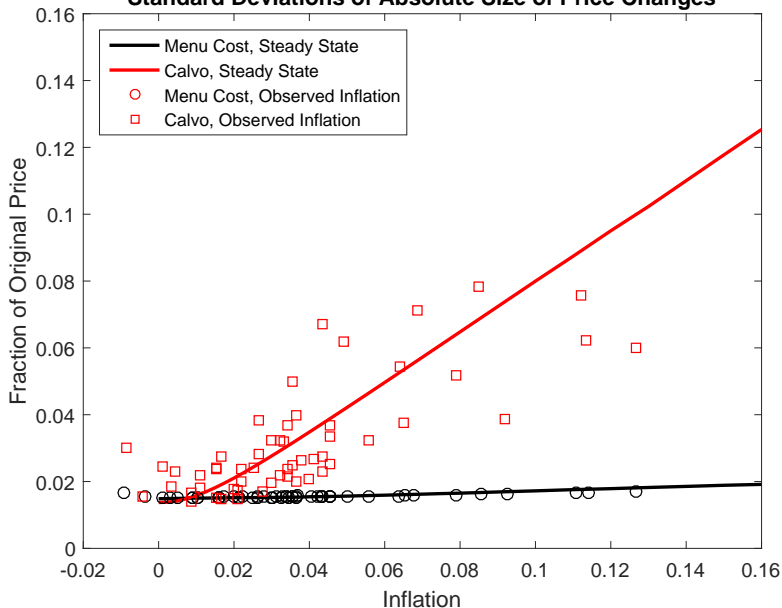


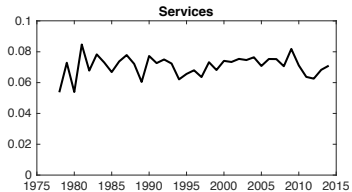
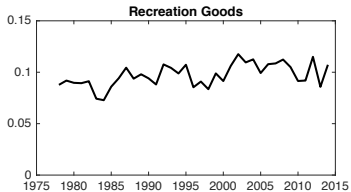
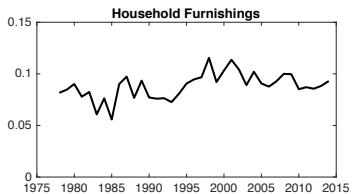
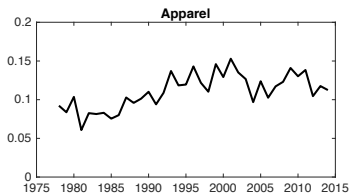
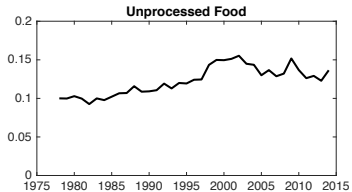
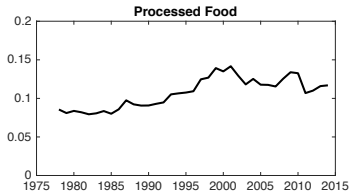
### Standard Deviations of Absolute Size of Price Changes



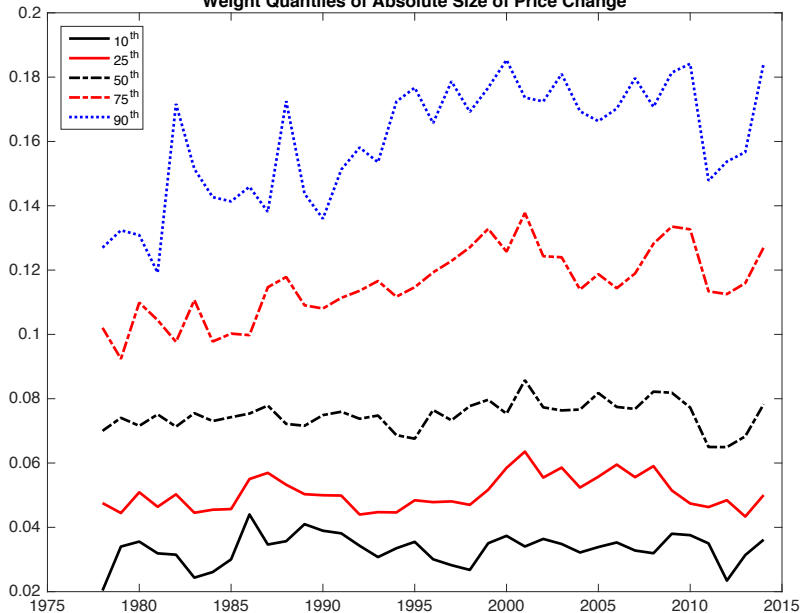
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## Standard Deviations of Absolute Size of Price Changes



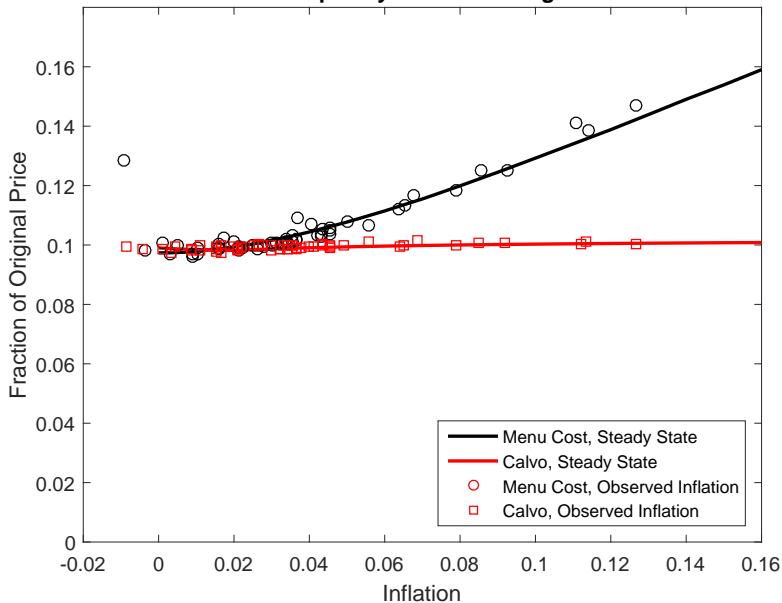


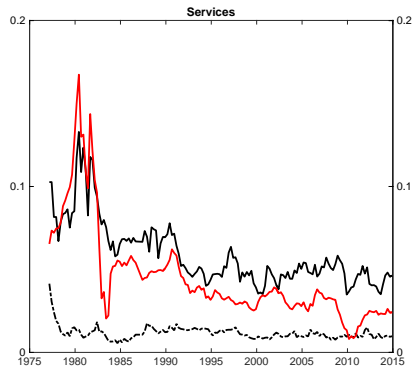
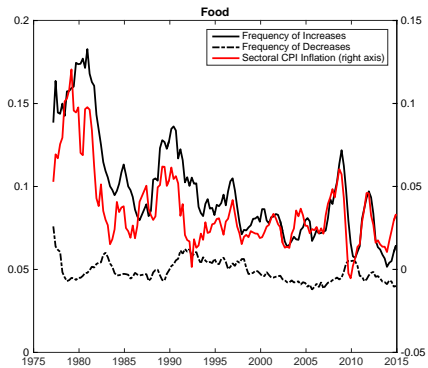
### Weight Quantiles of Absolute Size of Price Change



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## Frequency of Price Change





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Sample	1978-1987	1988-2014	1979-2014
Frequency of Price Changes	0.124	0.101	0.107
Frequency of Price Increases	0.095	0.069	0.076
Frequency of Price Decreases	0.025	0.031	0.030
Fraction of Price Increases	0.760	0.661	0.688
Absolute Size of Price Changes	0.073	0.075	0.075
Absolute Size of Price Increases	0.073	0.071	0.072
Absolute Size of Price Decreases	0.068	0.082	0.078
Std. Of Price Changes	0.050	0.055	0.054

TABLE: Summary Statistics by Sample

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