Sales and Promotions and the Great Recession Deflation

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Introduction

Motivation

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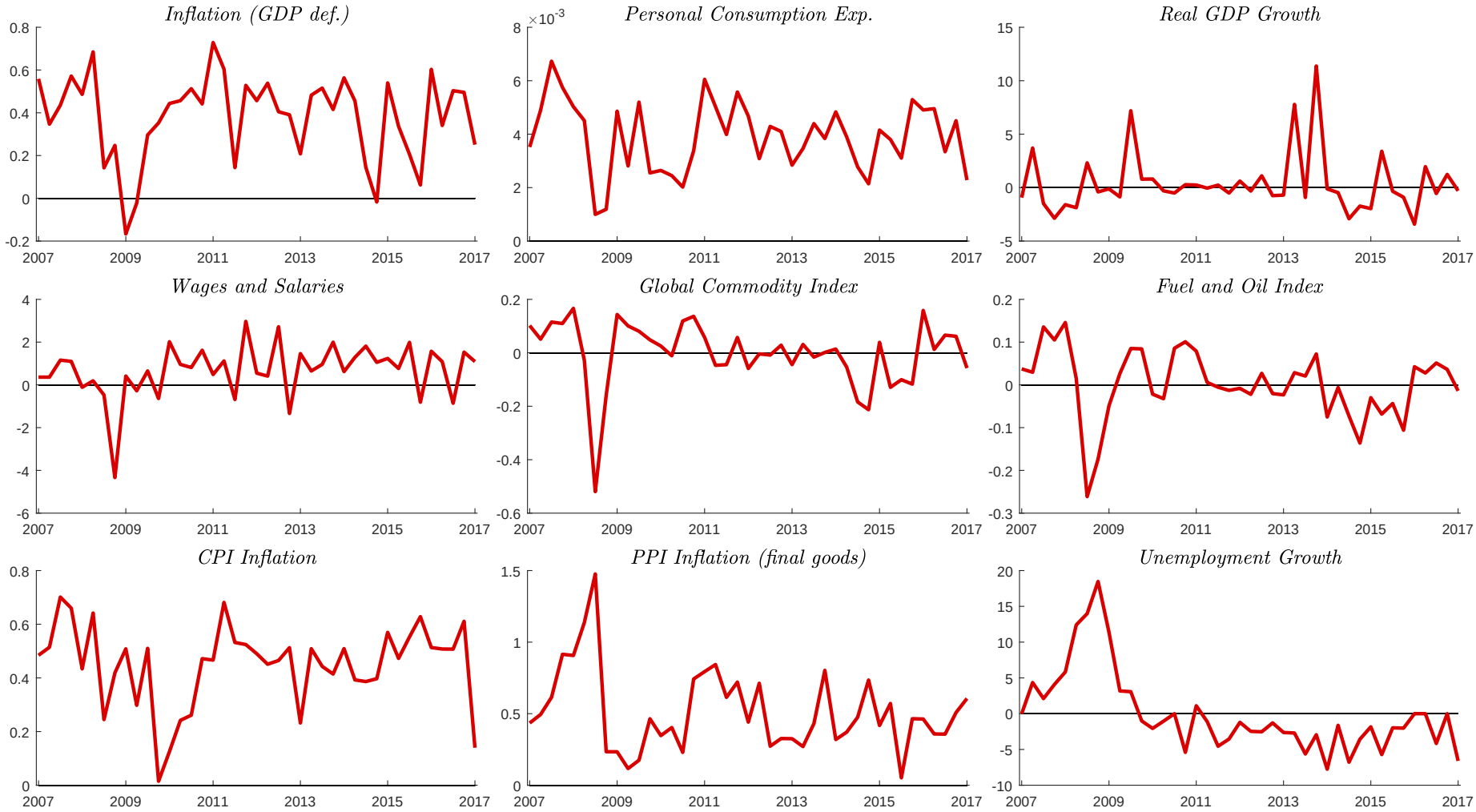
Inflation Measures and the Phillips Curve

Motivation

- Consumer price inflation, (personal consumption expenditures price index), was 2% between 2003 and 2007
- It only declined to 1.5% for the next 8 years, through the deepest contraction since the Great Depression (Gilchrist et al. 2017)
- It even casts doubt on the relevance of the Phillips curve relationship.
- Explanations involve the anchored expectations hypothesis or alternative definitions of economic slackness or even the financial accelerator
  - Ball and Mazumder (2011); Gordon (2013); Krueger, Cramer, and Cho (2014); Coibion and Gorodnichenk (2015); Del Negro, Giannoni, and Schorfheide (2015) and others

Growth rates (Price Indices)

From St. Louis FRED



Main Findings

Main Goal

- We provide a different explanation as we show theoretically that occasional sales can have a significant effect in the cyclicality of price indexes.
- A theoretical model is provided where firms post sales on products infrequently.
- We report that price indexes that disregard sales are less volatile and more persistent than they would otherwise be.
- Moreover, when agents form expectations using indices net of sales, recessions are exacerbated.
- Infrequent Sales do not affect the inflation measures if the economy is at steady state.

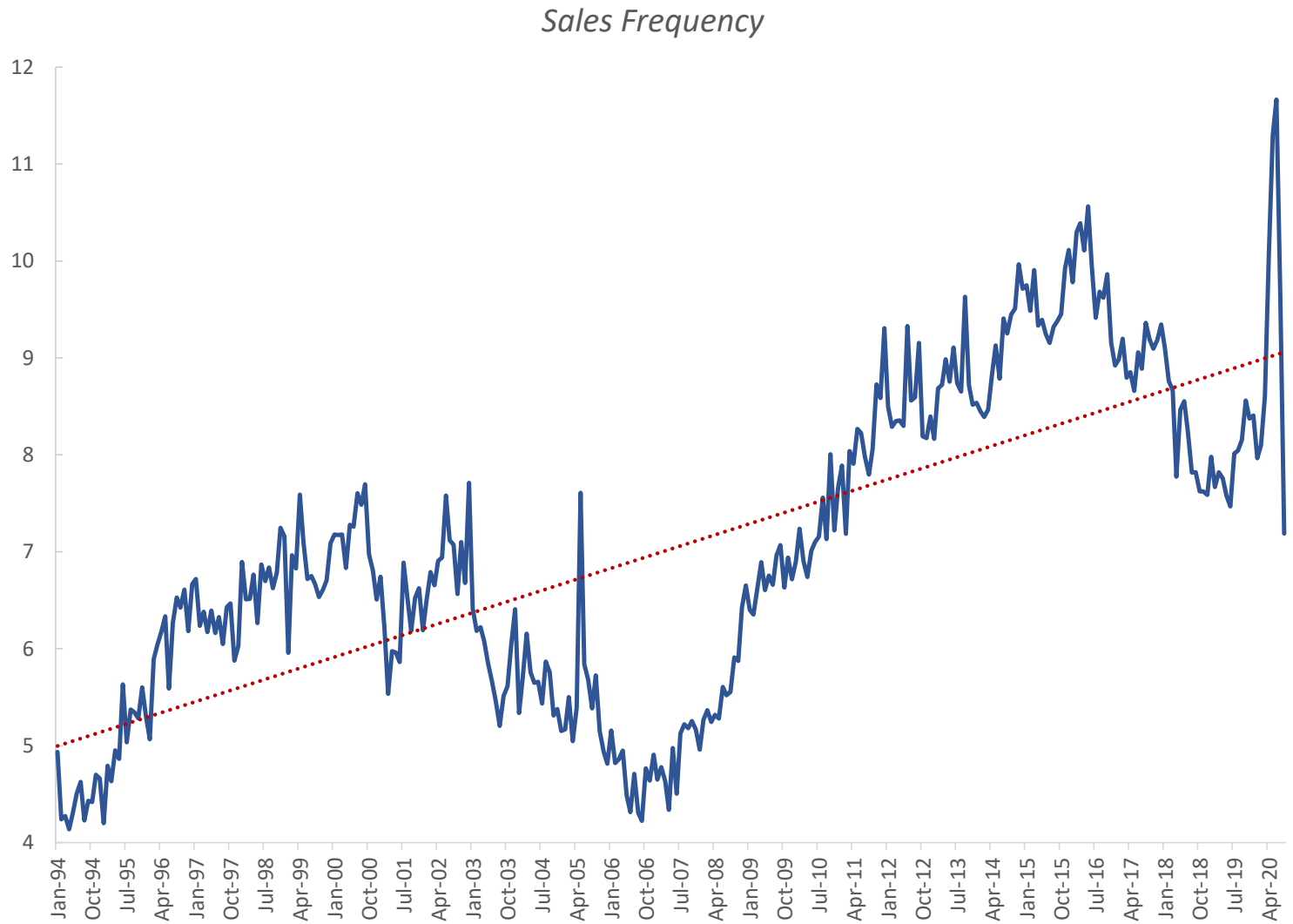
Main Findings

Main Goal

- We demonstrate that in a recession:
  - Sales become more generous
  - Sales are more frequent
  - Consumers devote more effort in identifying those bargains
- We re-estimate a simple Phillips curve relationship
  - We find that the UK CPI inflation with a higher weight on sale items correlates better with output gap and unemployment
  - The traditional CPI inflation is uncorrelated with output gap and unemployment as in Gali and Gertler (1999).

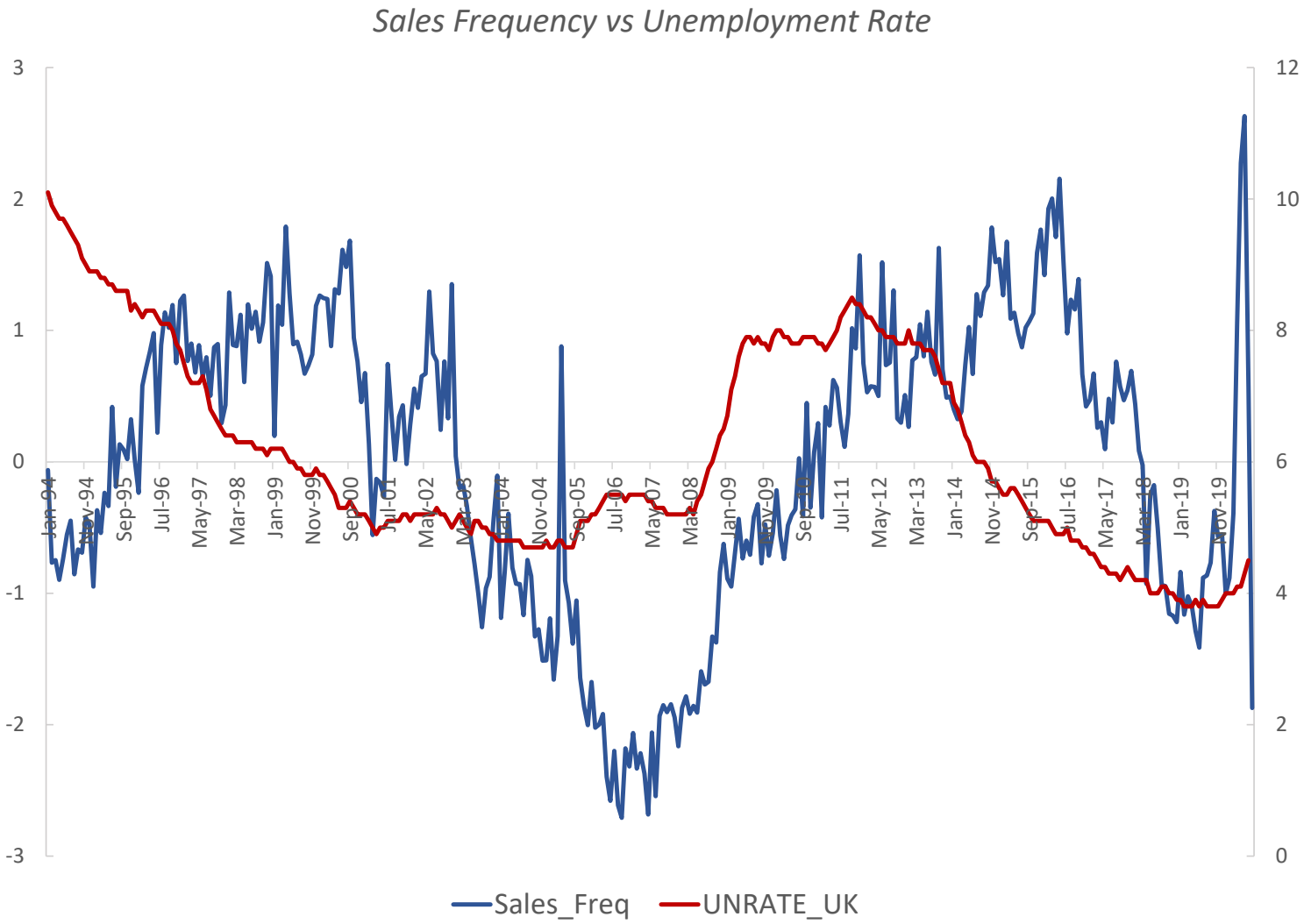
Frequency of Sales

Relative number of goods on sale



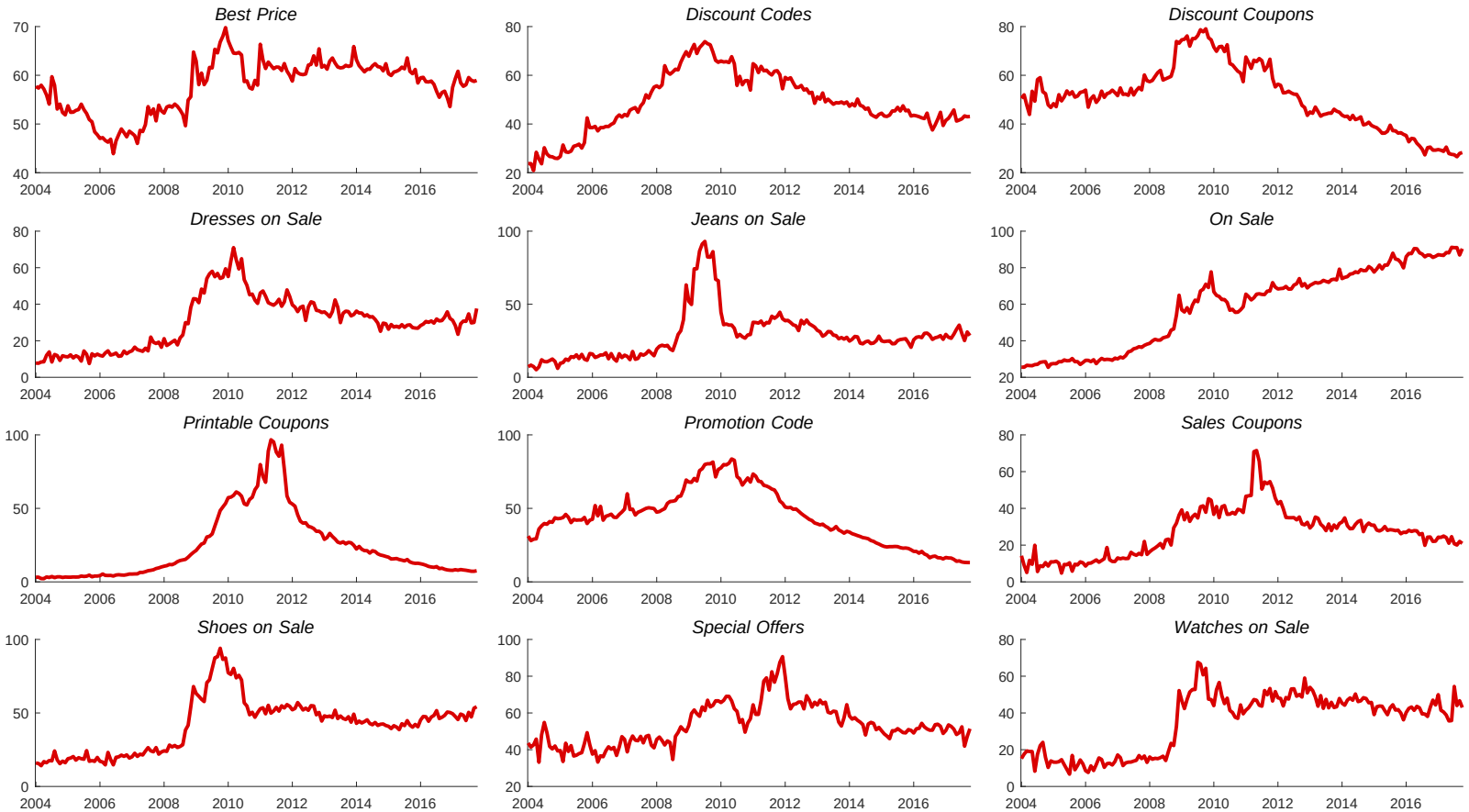
Frequency of Sales and Unemployment

Relative number of goods on sale and Unemployment



Popularity in various Google searches across time

Sales Hunting

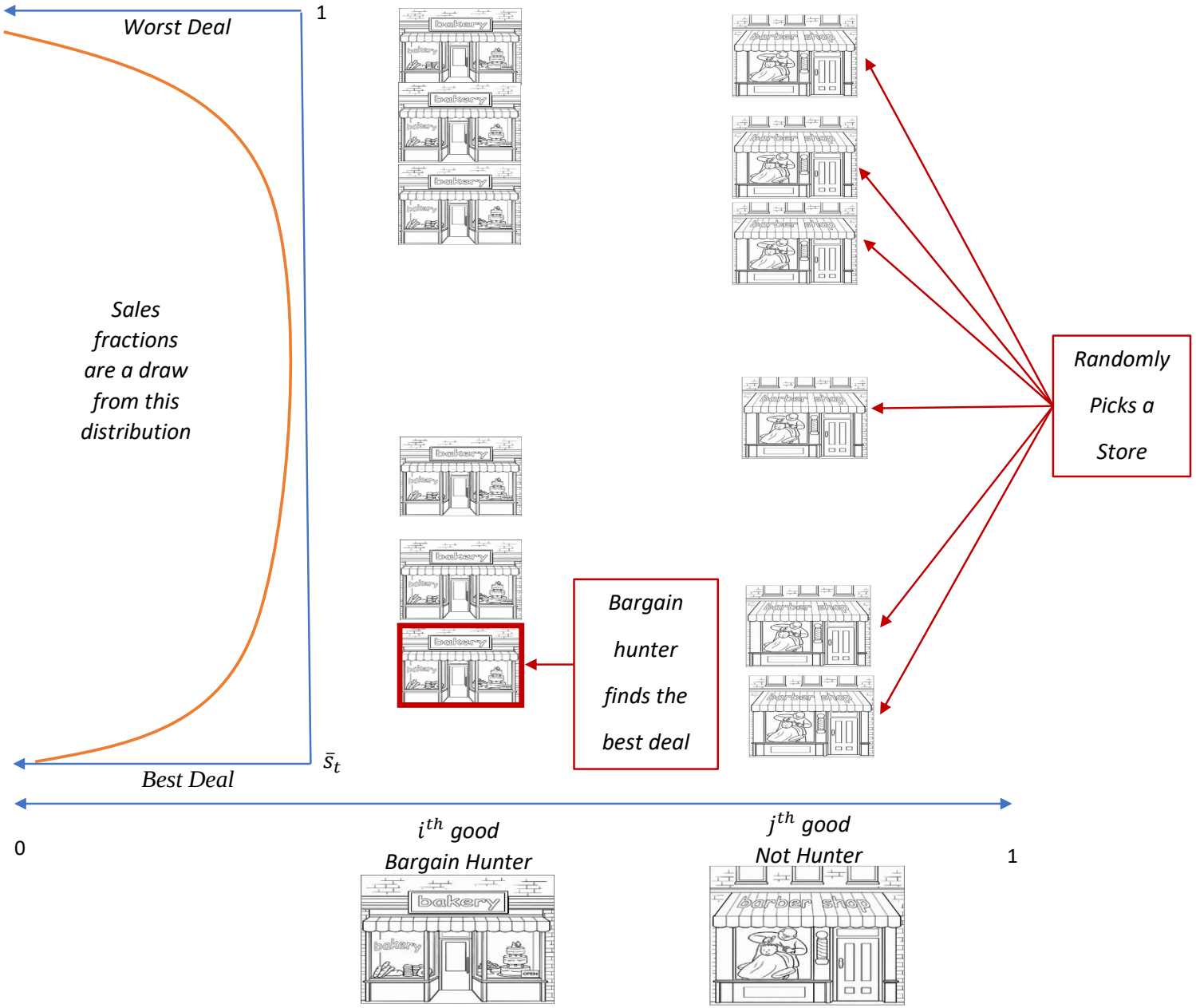


Methodology

The Model

- A Standard New Keynesian Model is modified with occasional sales
- Prices p_{it} are subject to menu costs
- Sales $s_{it} \in [\bar{s}_t, 1]$ and thus the price paid by consumers for the i^{th} good is $s_{it} p_{it}$.
- Sales are unpredictable and are a draw from an endogenous distribution of sales. (similar to Varian (1980))
- Households send V_t share of consumers to search for bargains and $1 - V_t$ randomly pick a store.
- The true price index in the economy is:

$$P_t = \left[\begin{array}{c} (1 - V_t) (p_{it})^{1-\theta} \int_{\bar{s}_t}^{1} (s_{it})^{1-\theta} f(s_{it}) \, ds_{it} \\ + V_t (p_{it})^{1-\theta} \int_{\bar{s}_t}^{1} (s_{jt})^{1-\theta} (1 - F(s_{jt}))^{N-1} f(s_{jt}) \, ds_{jt} \end{array} \right]^{\frac{1}{1-\theta}}$$


Worst Deal
1
Sales fractions are a draw from this distribution
Best Deal
$\bar{s}_t$
0
Randomly Picks a Store
Bargain hunter finds the best deal
i^{th} good
Bargain Hunter
j^{th} good
Not Hunter
1

The Model

Firms

- There is no equilibrium in pure strategies in this model but there is one in mixed strategies.
- $F(s_t) \equiv \Pr(s_{it} < s_t)$ for $i \in \{1, 2, ..., N\}$ is the probability the i^{th} producer to have a lower sale fraction than s_t
- The Profit for a firm is

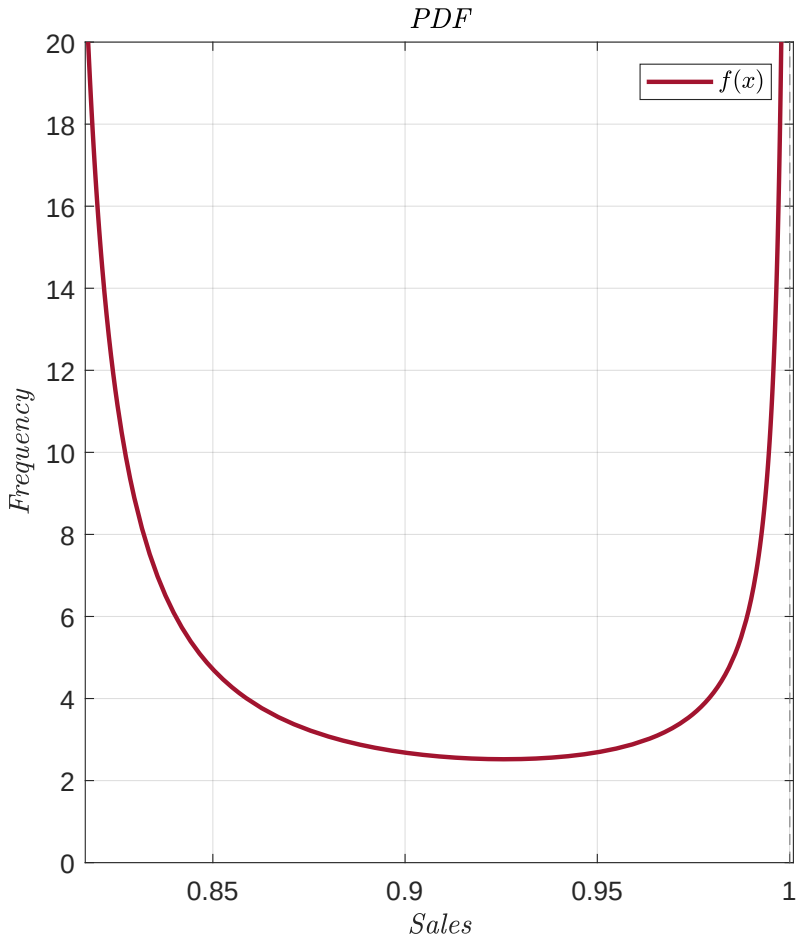
$$\Xi(s_t) = \Pi_t^V(s_t)(1 - F(s_t))^{N-1} + \Pi_t^{NV}(s_t)\left(1 - (1 - F(s_t))^{N-1}\right)$$

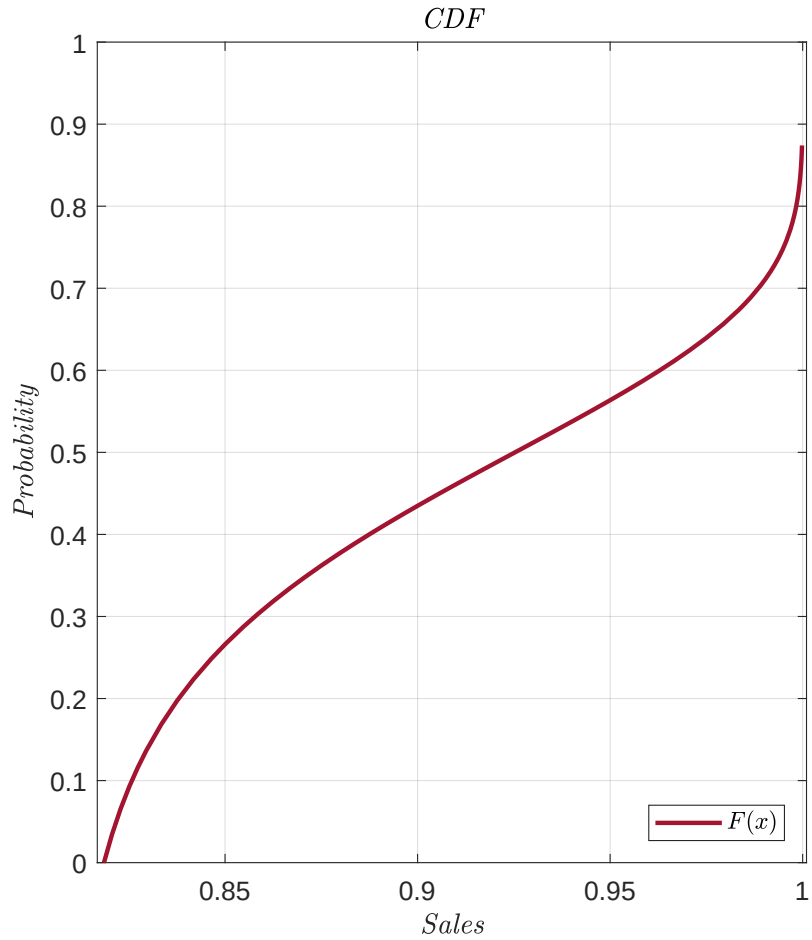
- In mixed strategies any $s_t \in [\bar{s}_t, 1]$ should give the same expected profit to the firm.
- Therefore, $\Xi(s_t) = \Xi(1)$
- From this, the distribution of sales can be identified:

$$F(s_t) = 1 - \left[\frac{1 - V_t}{V_t}\frac{1}{N}\left(\frac{\frac{p_t}{P_t} - m_t}{s_t\frac{p_t}{P_t} - m_t}s_t^{\theta} - 1\right)\right]^{\frac{1}{N-1}}$$

- Differentiating gives the pdf: $f\left(s_t; N, V_t, \frac{p_t}{P_t}, m_t\right) = \frac{dF(s_t)}{ds_t}$

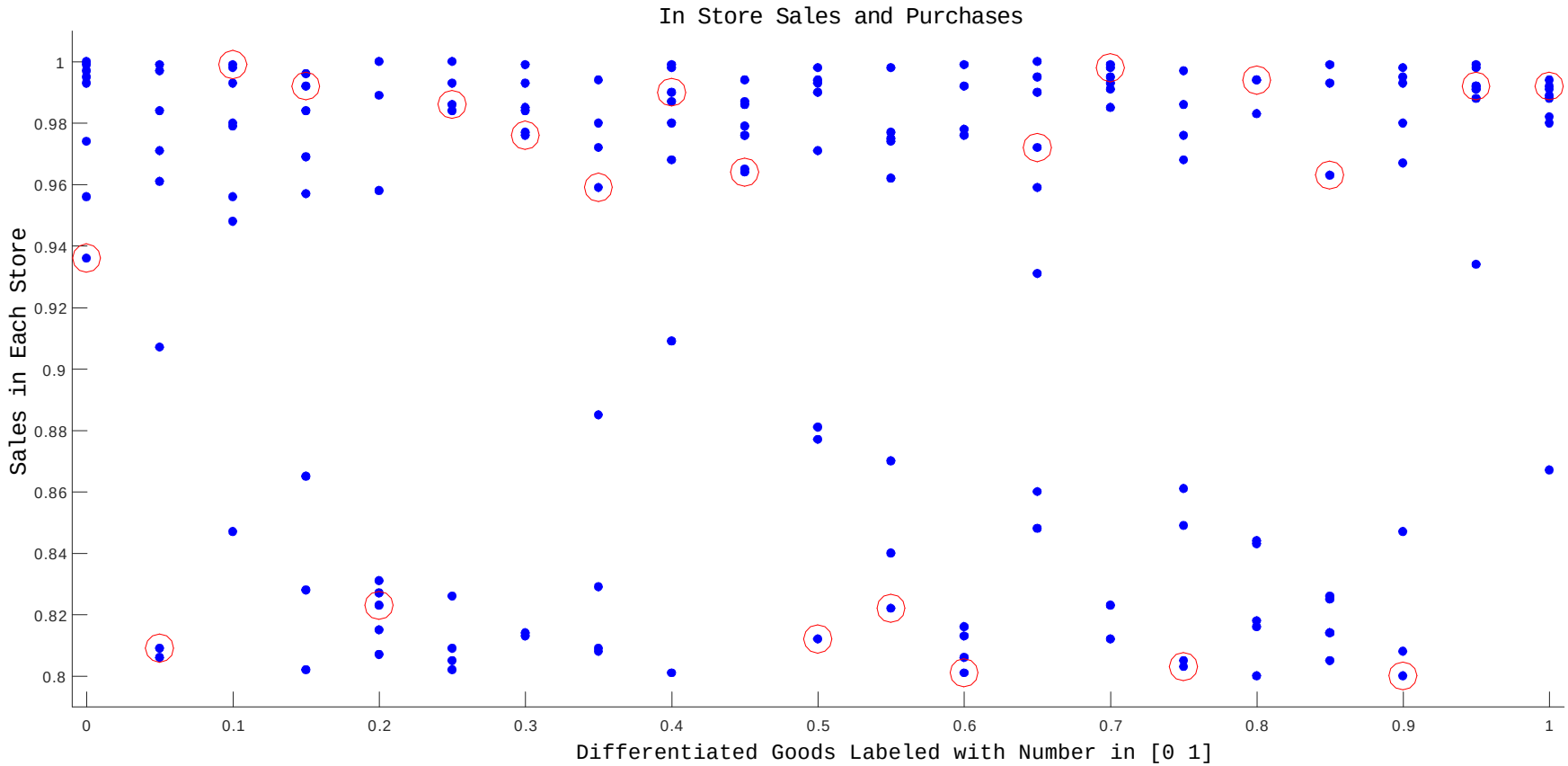
The PDF and CDF of Sales





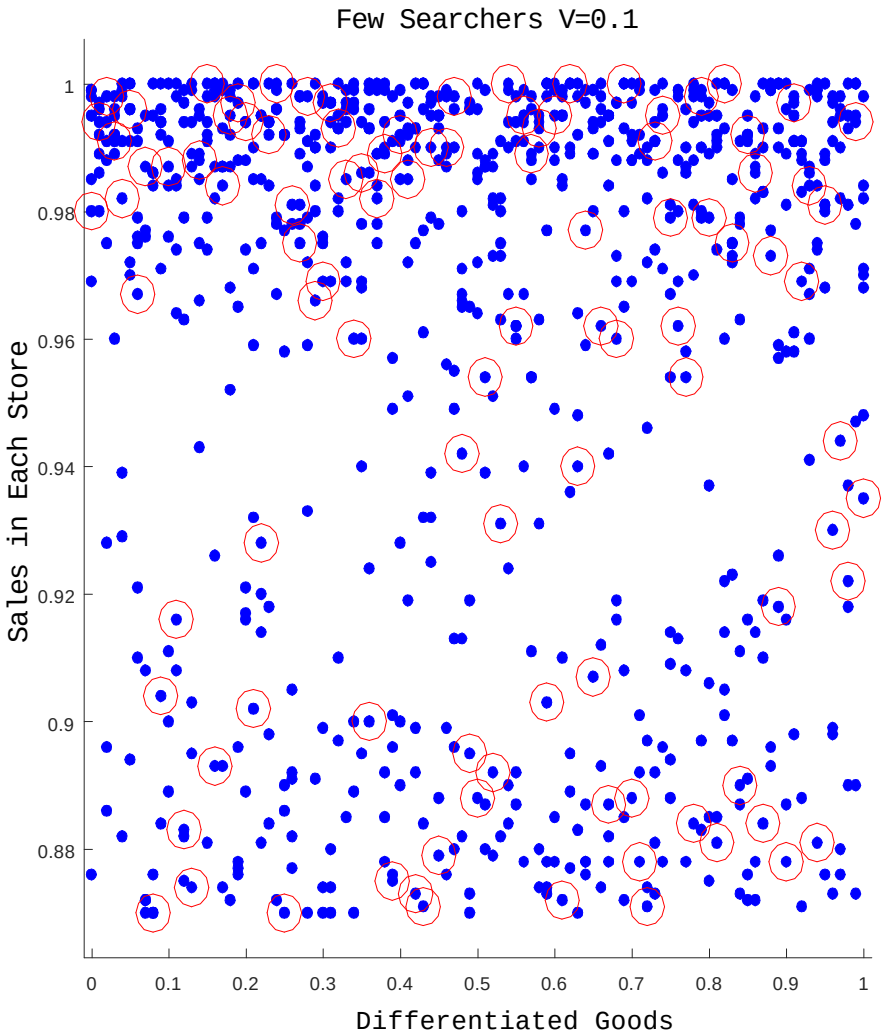
An Example of Realized Sales by store

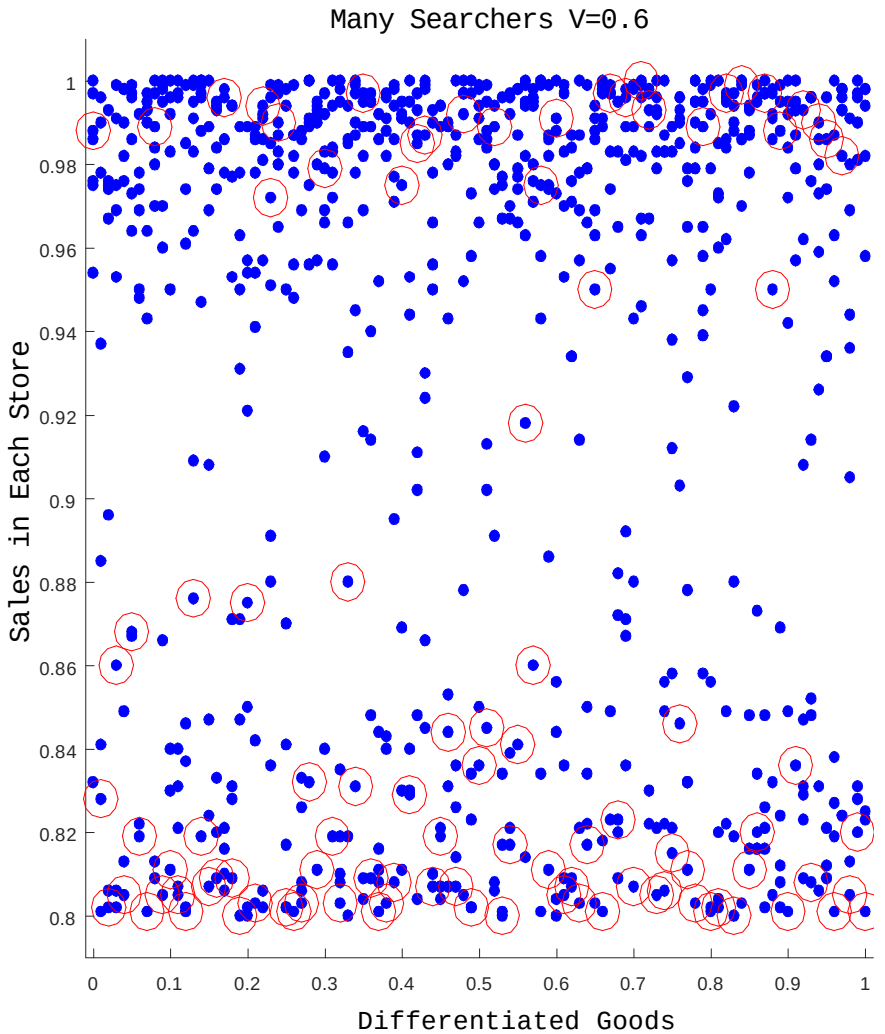
Circles are the choices by a household with 0.5 of members as bargain hunters



Sales and Prices in Recession

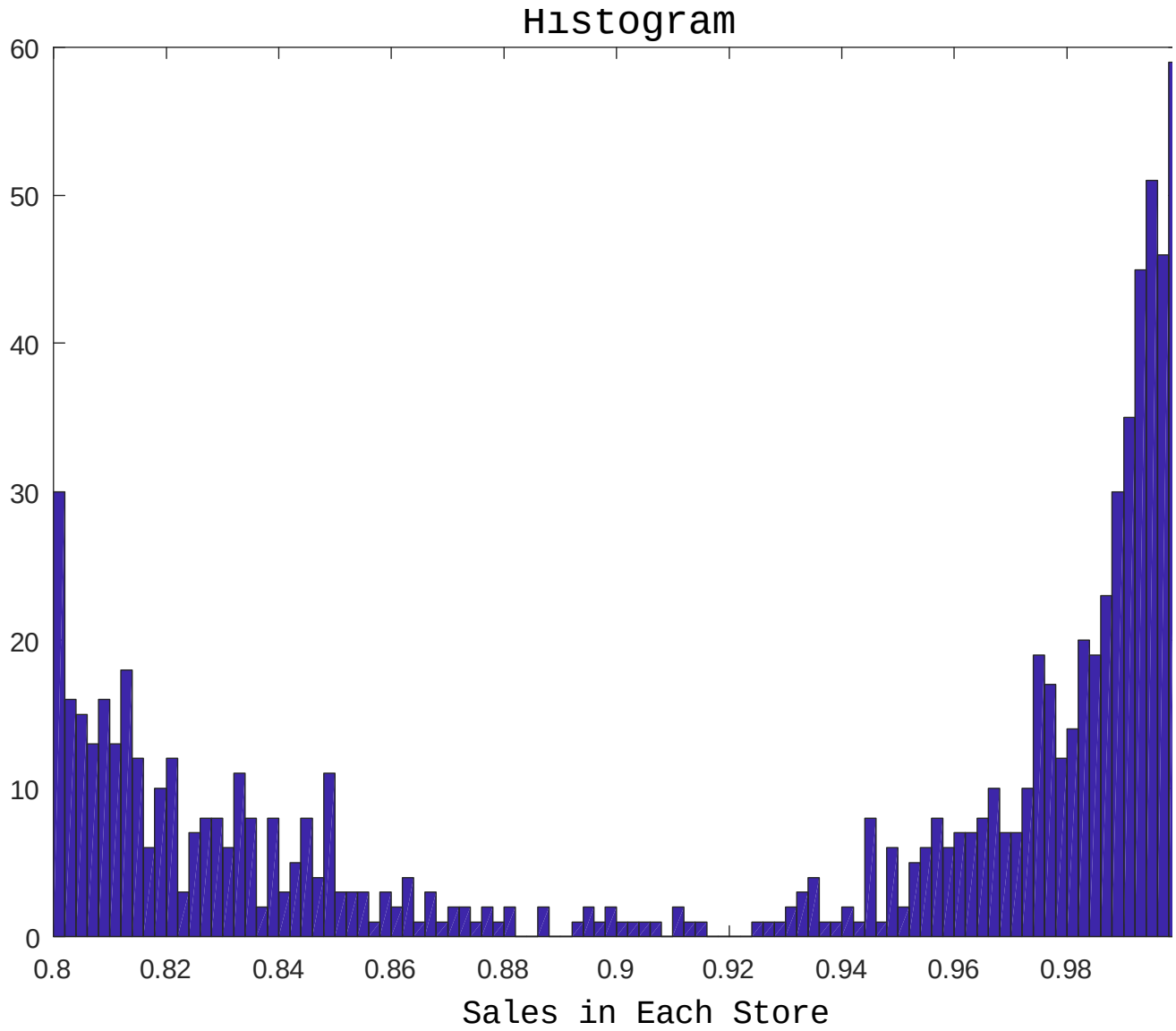
Shows how prices paid by customers change during recessions



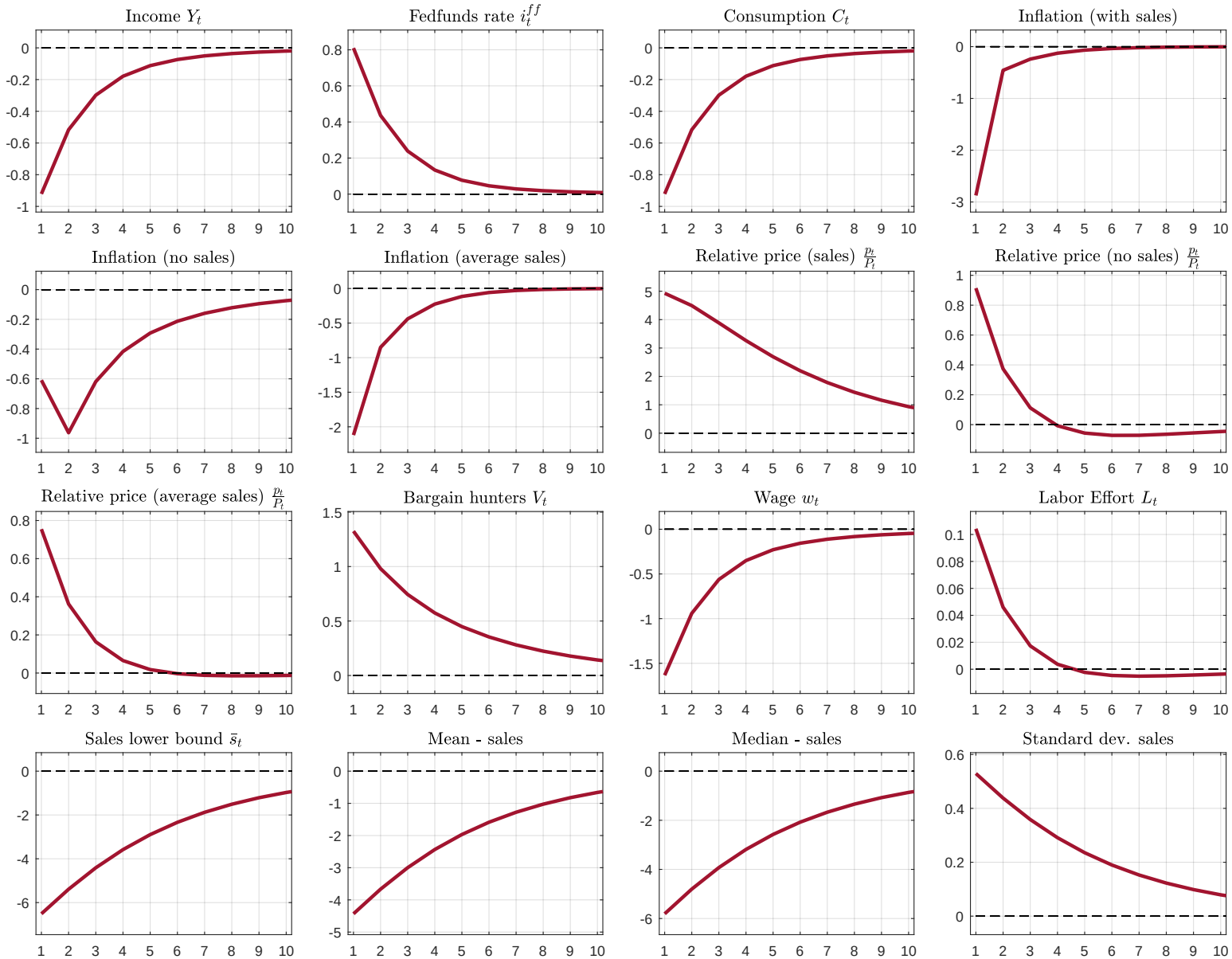


The histogram From the Previous Example

Captures the Distribution of Sales

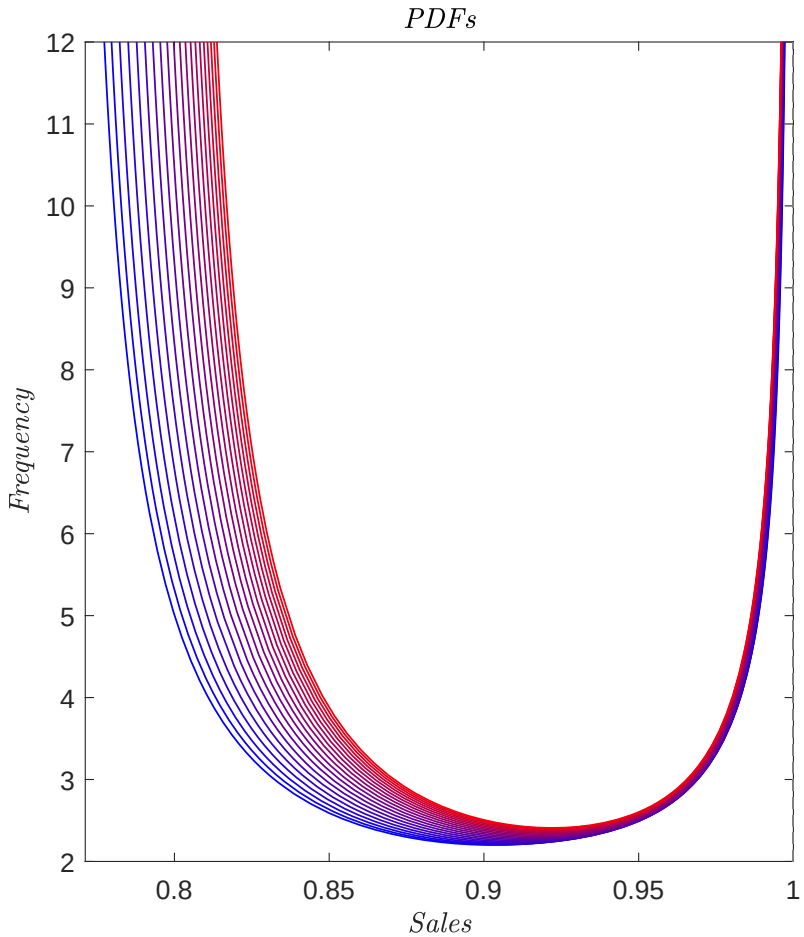


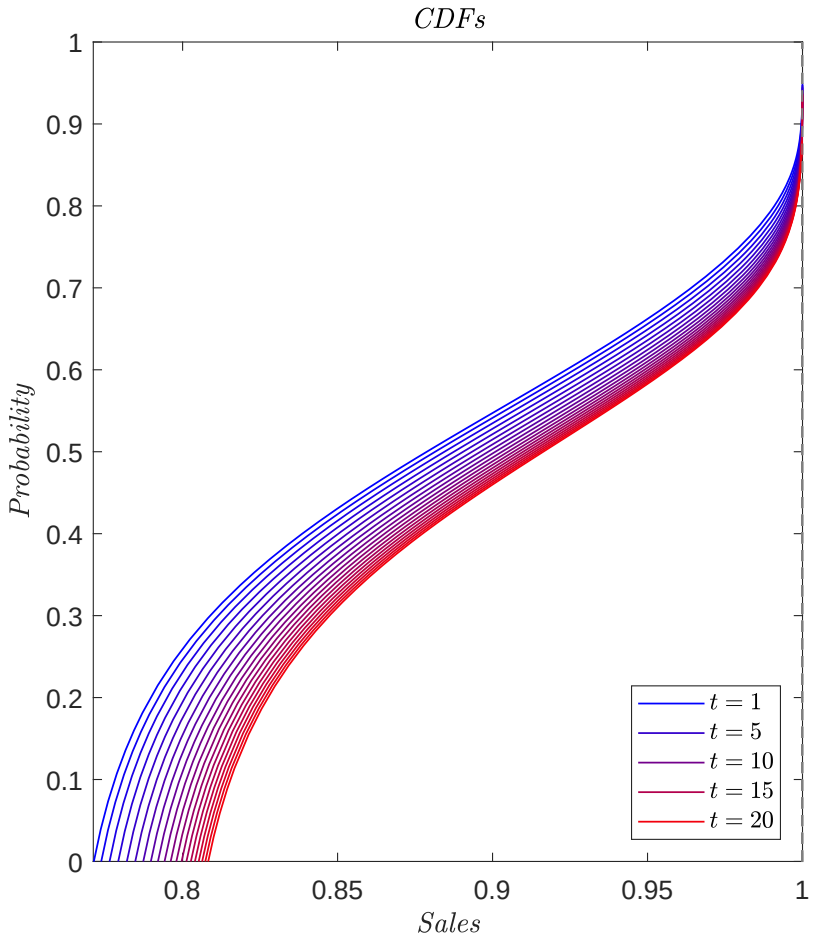
IRFs after a 1 sd Increase in Federal Funds Rate



Dynamic Distribution of Sales after 1 SD Increase in Federal Funds Rate

Movement from red to the rightmost blue line





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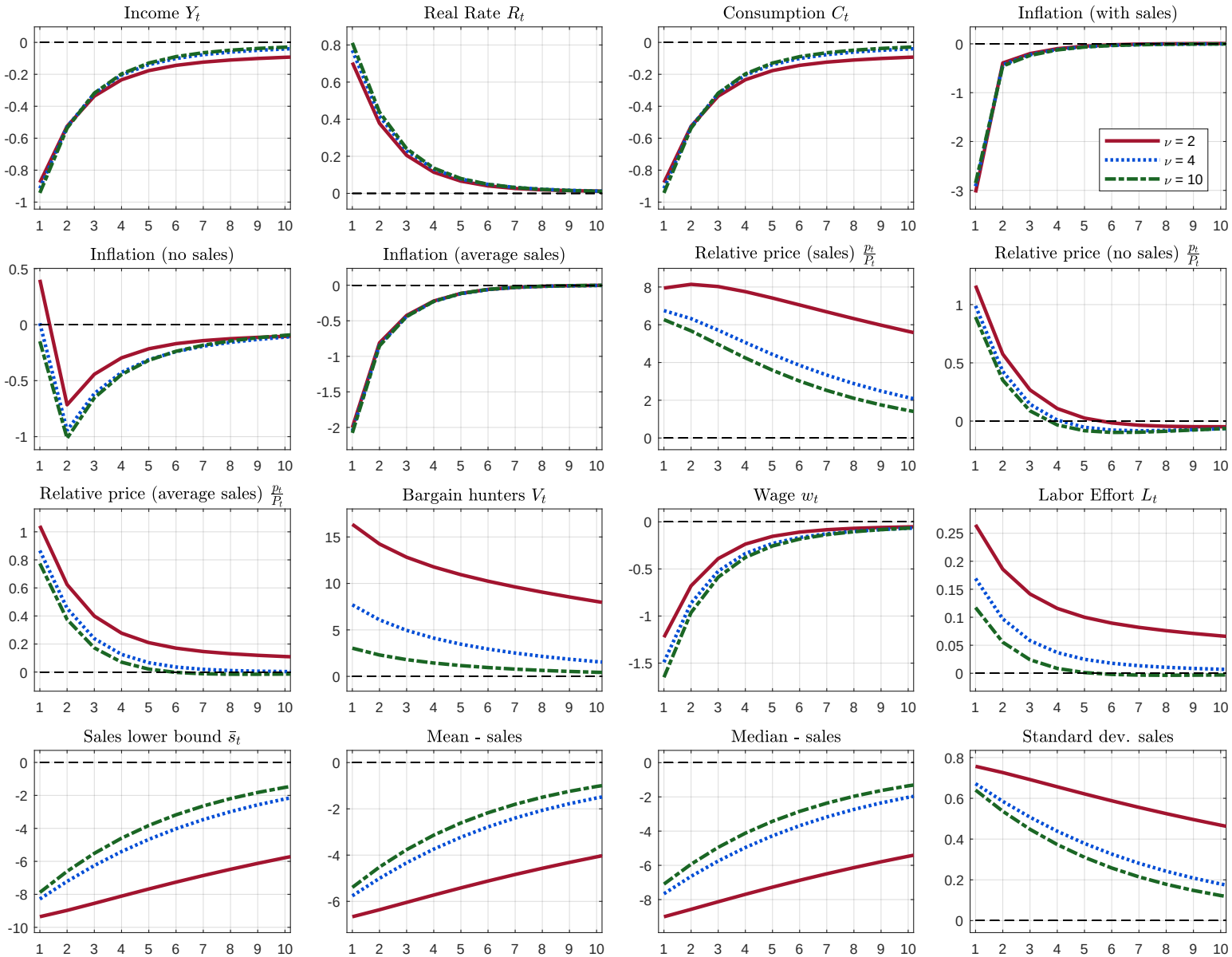


Taylor Rule

The Importance of Persistence

- The log-linear Euler equation is:

$$\hat{y}_t = E_t \hat{y}_{t+1} - (i_t - E_t \pi_{t+1}) \tag{1}$$

where $\hat{y}_t$ is the log deviation of output Y_t from its steady state, π_t the inflation and i_t the log linearized gross nominal rate from its steady state.

- The log-linearized Taylor rule according to which the central bank sets the interest rate is

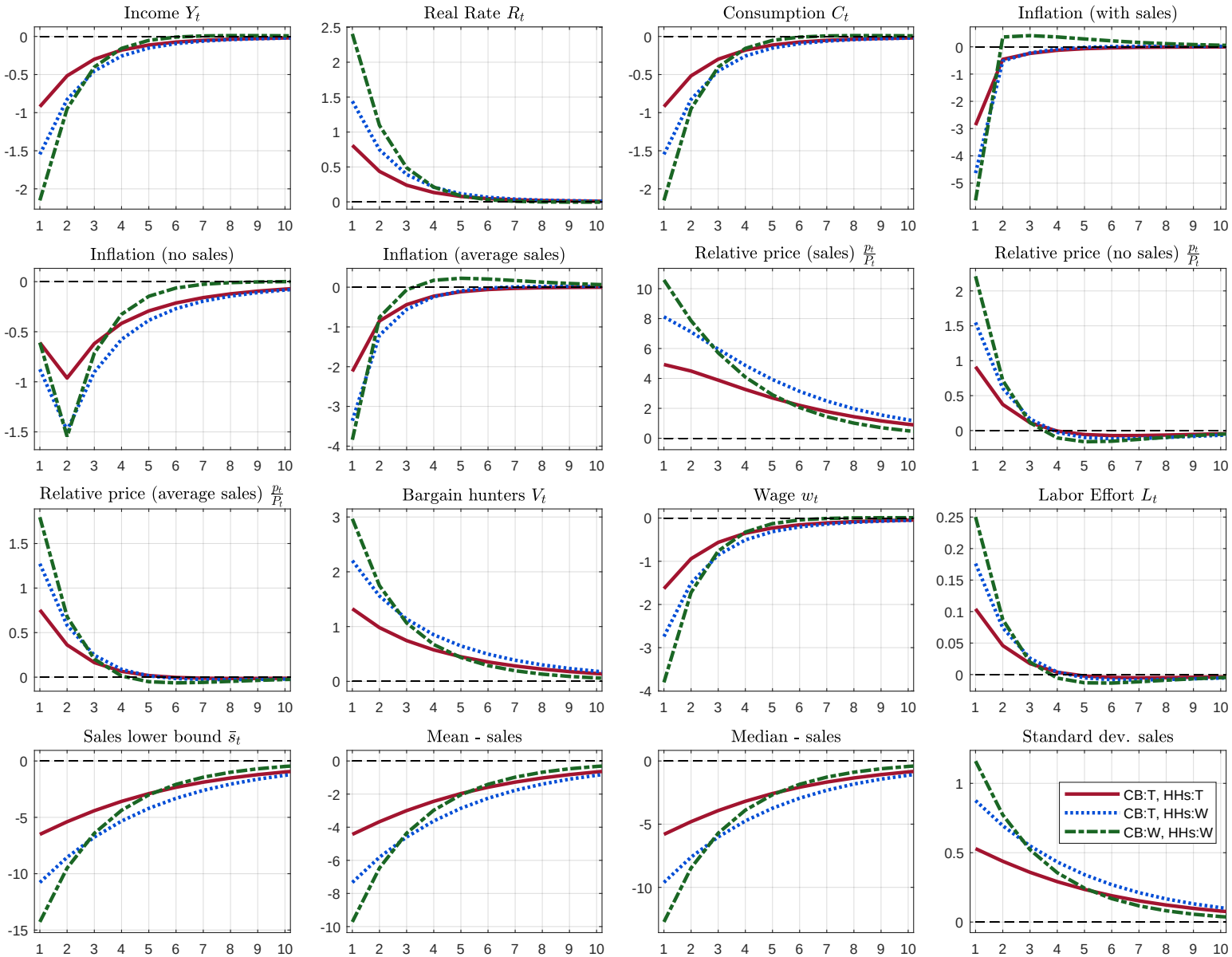
$$i_t = \rho^i i_{t-1} + \left(1 - \rho^i\right)\left(\rho^\pi \pi_t + \rho^y \hat{y}_t\right)$$

- Solving equation (1) forward implies

$$\hat{y}_t = -\sum_{i=0}^{\infty} E_t \left(i_{t+i} - E_t \pi_{t+i+1}\right)$$

- The deviation of current income from steady state is the sum of all deviations of future real interest rates from steady state.

IRFs after a 1 sd Increase in Federal Funds Rate



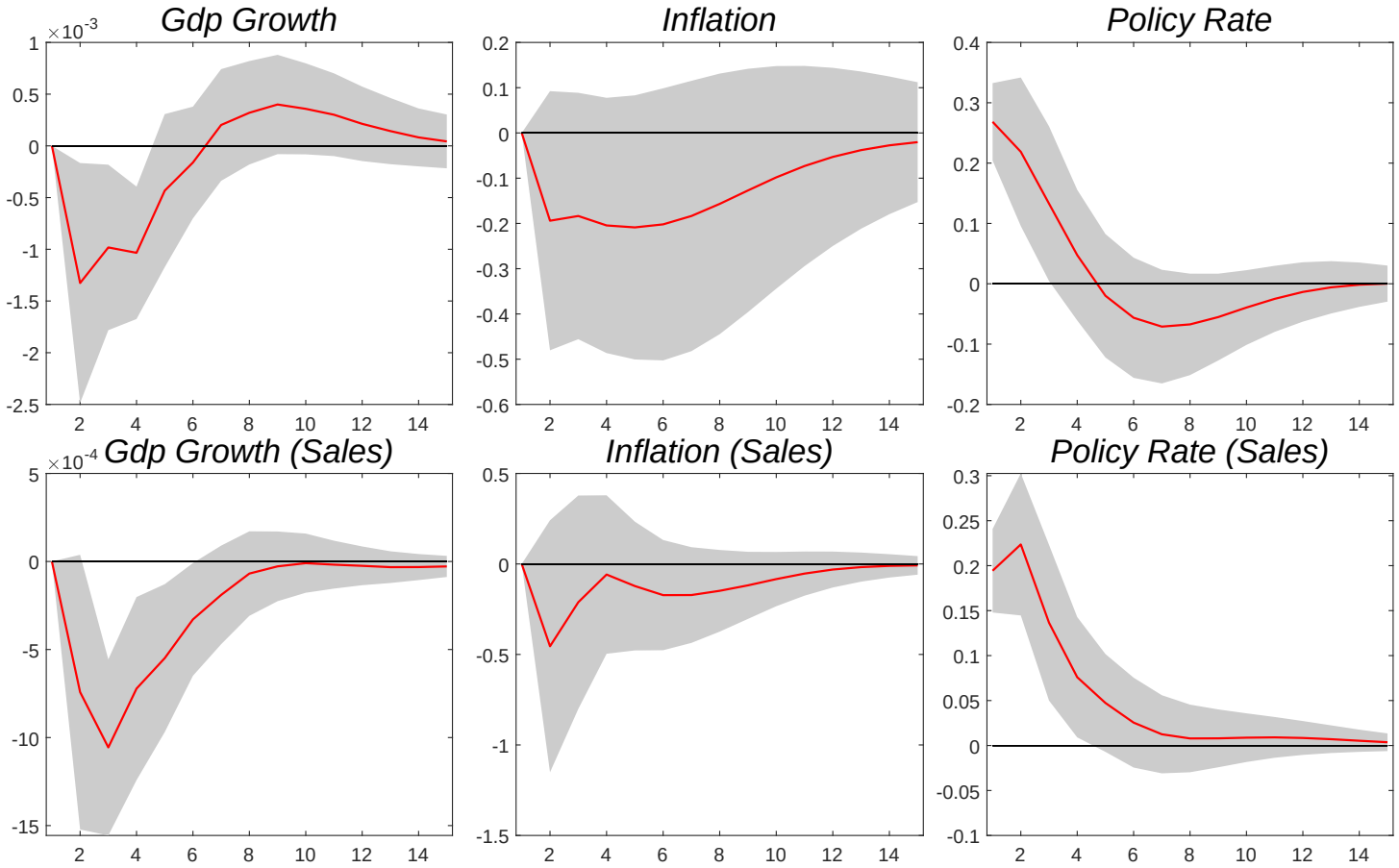
Empirical Exercise

Phillips Curve Estimation

Dependent variable: π_t CPI				
	Model 1	**Model 2**	**Model 3**	**Model 4**
Constant	5.974*	5.457*	2.782***	2.763***
	(3.203)	(3.326)	(0.707)	(0.689)
Inflation π_{t-1}	0.055	0.055	0.079	0.082
	(0.109)	(0.110)	(0.097)	(0.090)
Output gap x_t			0.008	
			(0.009)	
Output gap x_{t-1}				0.007
				(0.008)
Unemp. rate u_t	-0.498			
	(0.410)			
Unemp. rate u_{t-1}		-0.413		
		(0.431)		
Dependent variable: π_t^s CPI, weight sale flags				
Constant	22.440***	18.541**	2.616	2.665
	(7.734)	(7.825)	(1.596)	(1.589)
Inflation π_{t-1}	-0.209	-0.194	-0.166	-0.154
	(0.129)	(0.134)	(0.142)	(0.144)
Output gap x_t			0.053**	
			(0.024)	
Output gap x_{t-1}				0.050**
				(0.024)
Unemp. rate u_t	-3.152***			
	(1.114)			
Unemp. rate u_{t-1}		-2.522**		
		(1.125)		

Empirical IRFs after a 1 sd Increase in Federal Funds Rate

Figure: *Two VARs after a shock that increases the policy rate in UK. Each column is a VAR with different measure of inflation*



Conclusion

Extensions

- Sales may be temporary but they are more frequent and attract more attention during downturns.
- This may understate the true inflation as prices reported by producers are not as volatile as what consumers pay.
- Moreover, recessions appear to be deeper when all agents and especially the CB responds to CPI instead of a sales-adjusted price index inflation.
- Placing more weight on sales items may revive the Phillips curve relationship