Inflation and Misallocation in New Keynesian models

Alberto Cavallo, Francesco Lippi, Ken Miyahara

Harvard Business School LUISS & EIEF LUISS & EIEF

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Introduction

- We focus on two questions:
  - Q1: The mechanism behind the recent inflation dynamics
  - Q2: The quantification of the “welfare costs”
- Classic analyses: “inflation as a tax on real balances”
  Bailey, Friedman, Fisher, Lucas, Lagos-Wright
- Today: analysis within CB’s dominant paradigm (NK model)

Welfare costs in CB's dominant paradigm

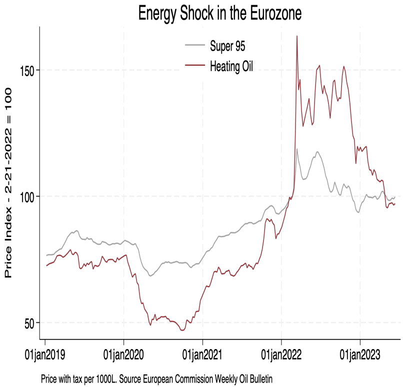
- Phillips-curve (sticky-price) models imply:
  - suboptimal pricing, $p_i \neq p_i^*$: misallocation of resources: χ
  - costly repricing: waste of resources: ϕ

- Measure unobserved distortions using model
  - in a (low inflation) steady state and after a large cost shock
  - select a model that can account for main data patterns

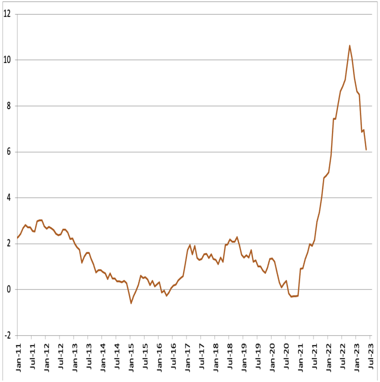
Motivation

- Large energy shocks followed by two-digit inflation in Europe

2019-2023 "energy prices"

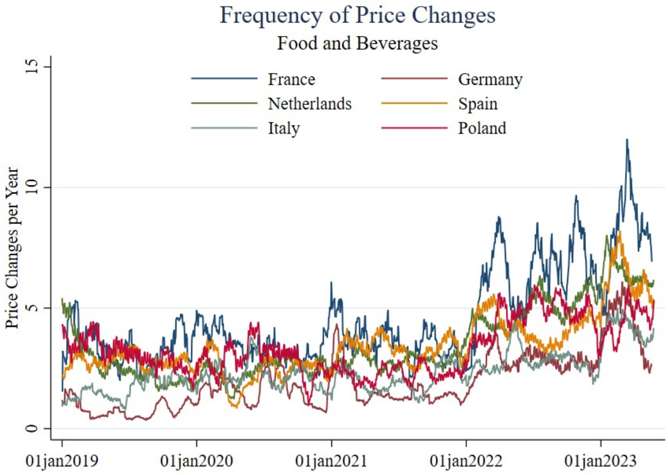


HICP inflation, Euro area



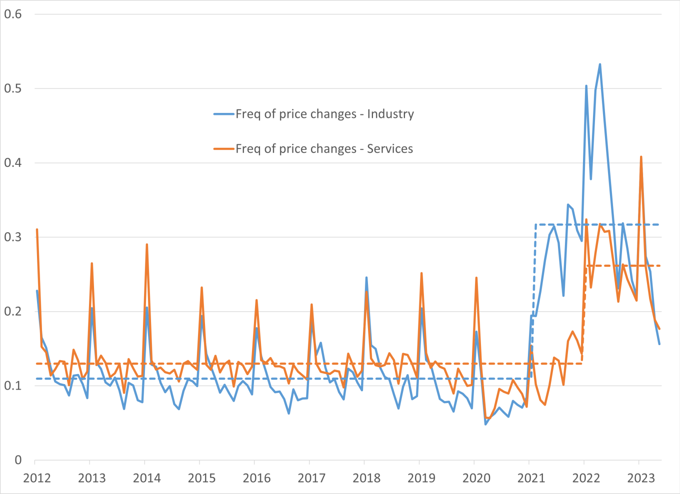
Our stylized view: firms' marginal costs increase by approx 10 - 20%

After 2022: higher frequency of price changes



PriceStats data (see Cavallo and Rigobon, 2016)

... frequency higher in all sectors



Banque de France Monthly business survey (see Dedola et al. 2023)

NK price setting model - essentials

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- Price-Gap $x_i(t) = \log P_i(t) - \log P_i^*(t)$ where $P_i^*(t) \equiv \underbrace{\frac{\eta}{\eta-1}}_{\text{markup}} \cdot \underbrace{mc_i(t)}_{\text{Marg. Cost } \sigma}$

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- The firm's decision problem (Caballero-Engel , 1999)

$$v(x) = \mathbb{E}\left[\int_0^\infty e^{-\rho s} \min_{x^*,\, \Lambda \geq 0} \left(\underbrace{\frac{\eta(\eta-1)}{2} x(s)^2}_{\text{costly mispricing}} + \underbrace{(\kappa\, \Lambda)^\gamma}_{\text{costly repricing}} \right) ds \,\middle|\, x(0) = x \right]$$

Optimal firm's policy $\Lambda(x)$: probability to reset price gap x

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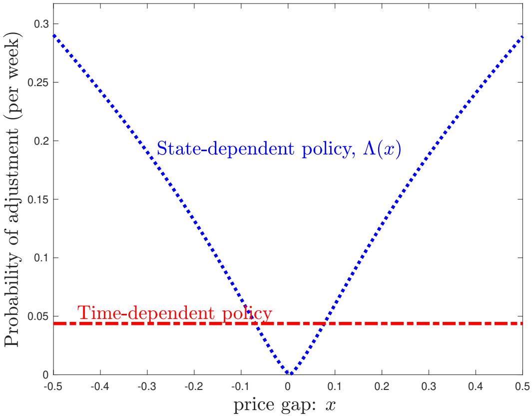
- 3 model parameters: $\{\sigma , \kappa , \gamma\}$ identified by 3 data moments

Hazard function $\Lambda(x)$, the firm's decision rule



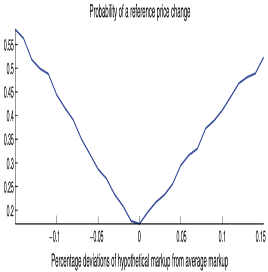
Recall: Price gap $x \equiv p_i - p_i^*$; if adjust set $x \approx 0$; inflation 2%

Frequency of price changes : $N \equiv \int \Lambda(x) f(x)\, dx$

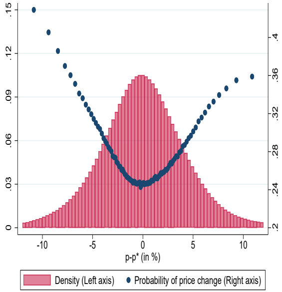
Hazard function $\Lambda(x)$: evidence from related studies

Prob. of price-change depends on “gap” from ideal price $x_i \equiv p_i - p_i^*$

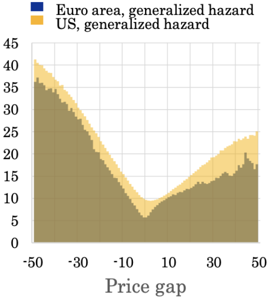
Eichenbaum et al. AER 2011



Gautier & Le Saout JMCB 2015



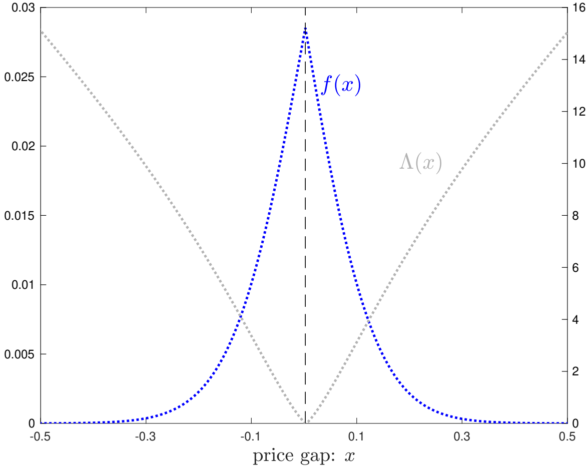
Karadi et al. JME 2023



Strong evidence of state-dependent behavior

Steady state distribution of price gaps

The firm hazard Λ implies cross-sectional distribution $f(x)$

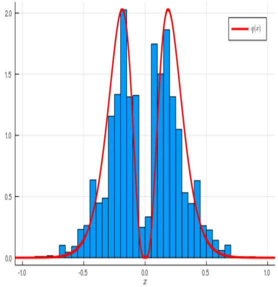


interesting object for our questions, but not observable....

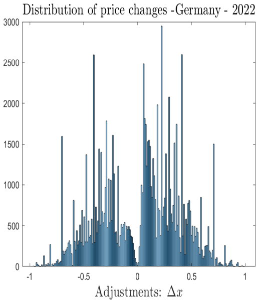
Distribution of the size of price changes $q(\Delta x)$

$$\color{red}{q(\Delta x)} \equiv \frac{\Lambda(x) f(x)}{N} \quad , \quad \Delta x \equiv x^* - x$$

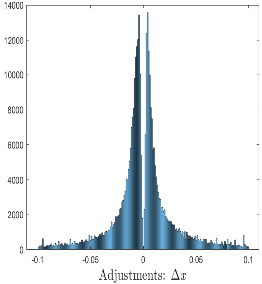
USA



Germany



France



Food and beverages ; PriceStats data 2021

Key pricing moments observed before 2022

Euro Area: Food and Beverages Sector (PriceStats, 2019-21)				
	STD (Δx)	Kurtosis (Δx)	Frequency (N)	Drift $\hat{\mu}$
EA6 Average	0.15	2.4	2.4	0.007

Map between Data and Model

$$\{ \underbrace{\text{STD}(\Delta x)}_{\textit{size}} , \underbrace{\text{Kurt}(\Delta x)}_{\textit{shape}} , \underbrace{N}_{\textit{frequency}} \} \Leftrightarrow \{ \underbrace{\kappa , \sigma , \gamma}_{\text{3 model parameters}} \}$$

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Euro Area Supermarket (IRi Data ; Karadi et al., 2023)

	STD (Δx)	Kurtosis (Δx)	Frequency (N)	Drift $\hat{\mu}$
EA4	0.13	3.2	1.1	-

Euro Area CPI (PRISMA Data, Gautier et al, 2022)

	STD (Δx)	Kurtosis (Δx)	Frequency (N)	Drift $\hat{\mu}$
Euro area	0.10	2.8*	1	0.025

Map between Data and Model

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The steady state welfare costs (due to p-stickiness)

Welfare cost of misallocation for $\mu \approx 0$

$$\chi = \frac{\eta}{2} \underbrace{\text{Var}(x)}_{\text{gaps dispersion}} = \frac{\eta}{2} \frac{\text{Var}(\Delta x)\,\text{Kurt}(\Delta x)}{6}$$

Welfare cost of price management ϕ (implied by model)

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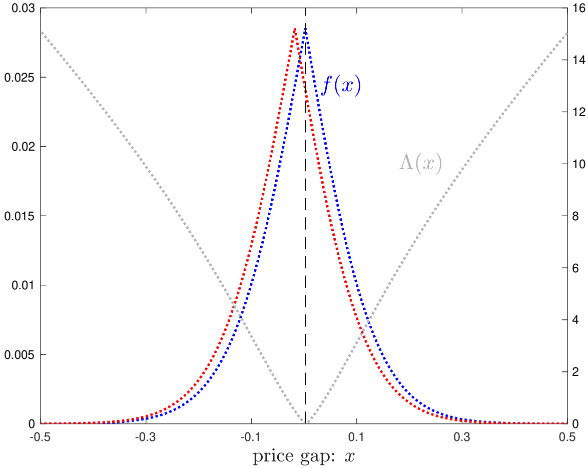
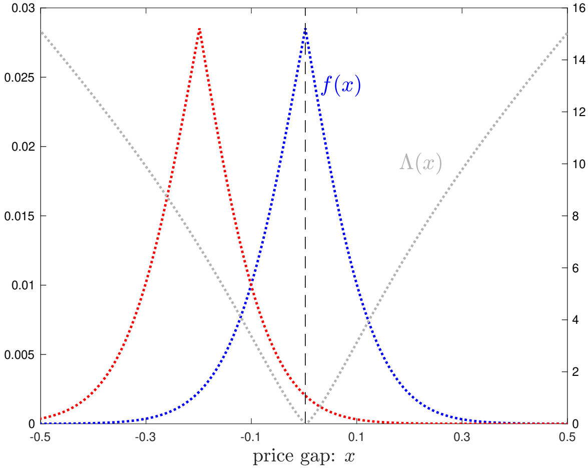
Welfare cost of price management ϕ (implied by model)

Loss Estimates as a fraction of Consumption ; assume $\eta = 6$	
Euro area CPI data (PRISMA data, period 2005-19, Gautier et al. 2022)	
Misallocation Cost	Price-management cost
$\widehat{\chi}$	$\widehat{\phi}$
0.015	0.005

Distribution of price gaps after small shock

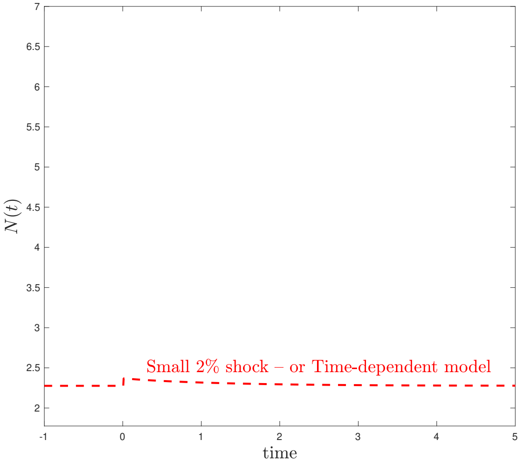


Distribution of price gaps after Large (20%) shock



Large shocks are different (non-linear Phillips Curve)

Frequency of price changes: $N(t)$



time-dependent model is ok when shocks are small

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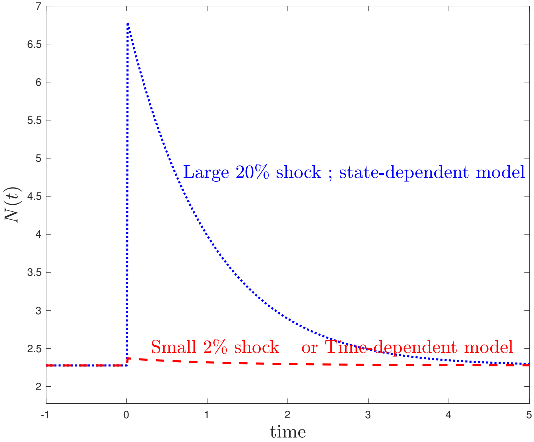
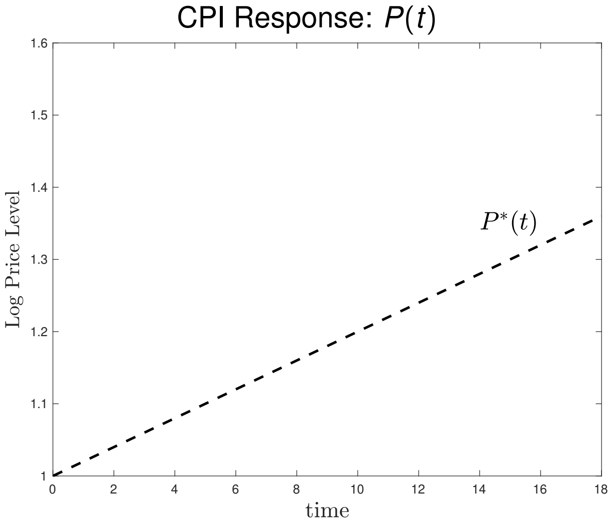


state-dependent model matches data

Large shocks travel fast (non-linear Phillips Curve)



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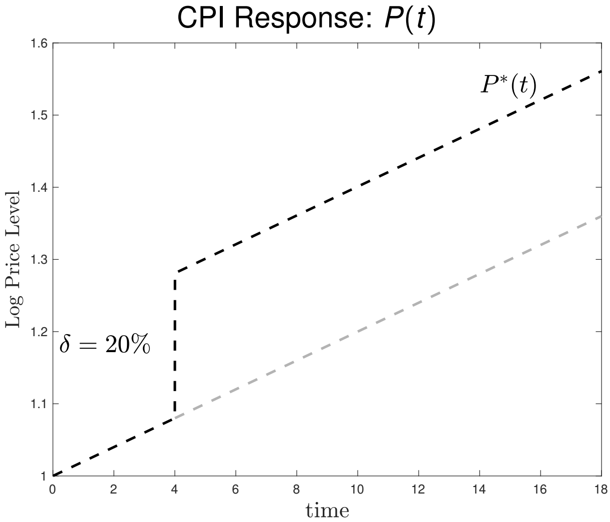

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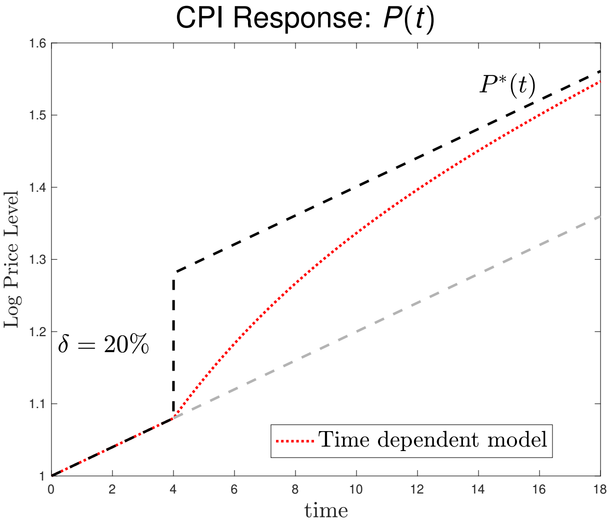

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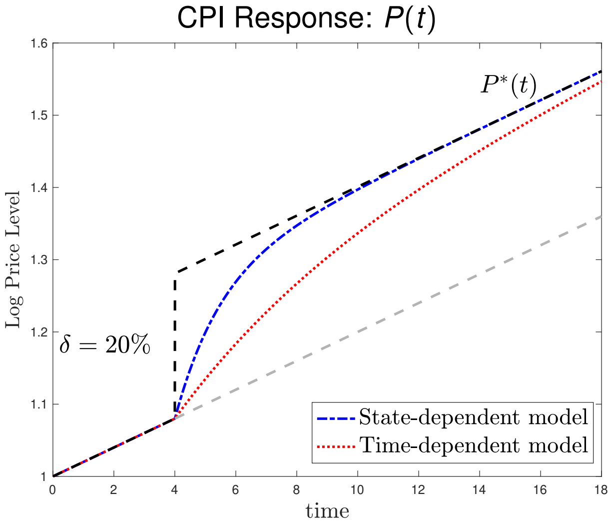
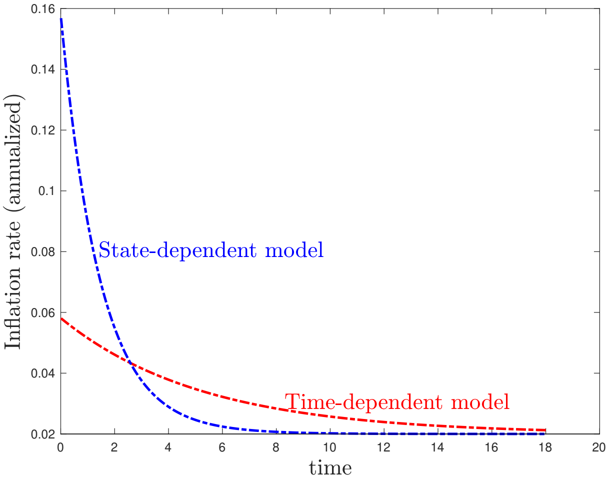


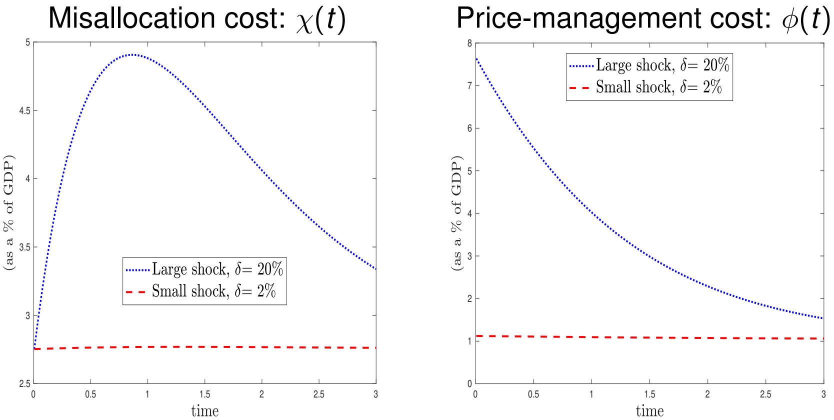
Insight #1: Large shocks make prices “more flexible”

Inflation is front loaded after a large shock



inflation starts earlier, and stops earlier (than “Calvo” suggests)

Welfare costs dynamics after large cost shock



Summary measure of welfare costs after large shock

Cumulative cost (as a fraction of GDP)

Model calibration $\delta = 20\%$	Misallocation	Price-management
CPI data , PRISMA data Gautier et al. 2022	0.015	0.014
Supermarket data Karadi et al. 2023	0.019	0.013
Food and Beverages data PriceStats	0.004	0.006

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Insight # 2: large energy shock increase welfare costs (3% GDP)

Summing up

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  - Do not use mechanistic “Old Phillips curve” to forecast inflation
- Q2: The quantification of the “welfare costs” in NK economy
  - Large energy shock boosts distortions (an additional 2.9% of GDP)
    (1/2 of the increase due to price management activity)

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We focussed on two questions:

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  - Do not use mechanistic "Old Phillips curve" to forecast inflation
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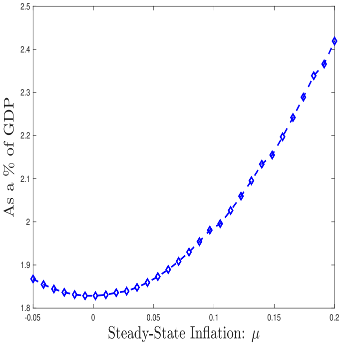
- Future: enhance measurement and theory
  (transitory shocks, sticky wages, HH heterogeneity)

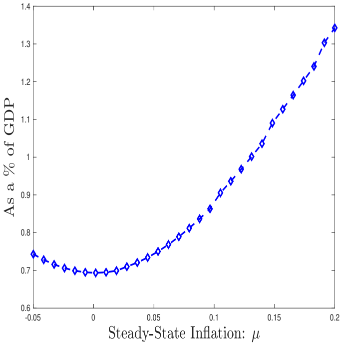
Thank you

Steady-state welfare cost at different inflation μ

Cost of Misallocation: $\chi(\mu)$



Cost of Price Management: $\phi(\mu)$



- Both $\chi(\mu)$ and $\phi(\mu)$ are symmetric functions, hence $\frac{\partial \chi(\mu)}{\partial \mu}\Big|_{\mu=0} = \frac{\partial \phi(\mu)}{\partial \mu}\Big|_{\mu=0} = 0$
- In the Calvo model e.g. $\chi(\mu) = \frac{\eta}{2}\ Var(x) = \frac{\eta}{2}\left[\left(\frac{\mu}{\zeta}\right)^2 + \frac{\sigma^2}{\zeta}\right]$