Inflation Persistence in the Euro Area

Session I: Evidence from aggregate and sectoral data

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Congratulation!

This is excellent, serious work, deepening our understanding of inflation persistence

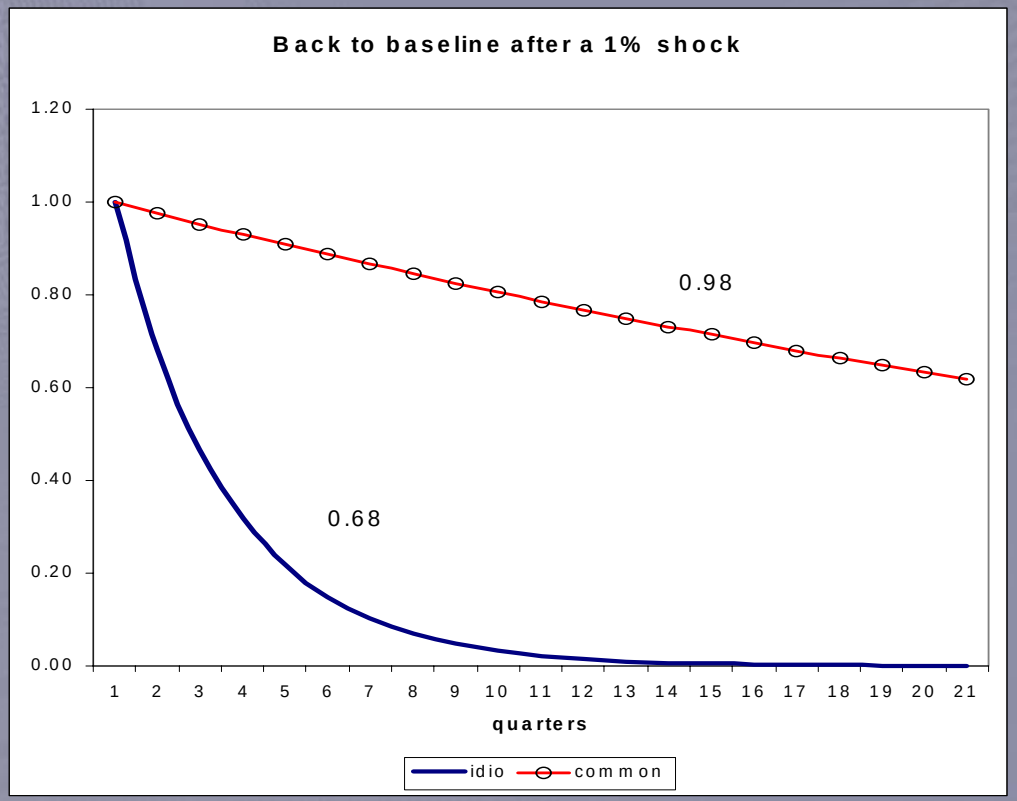
Outline of Presentation

- Background
- Summary
  - Data and Methods
  - Main common findings
- Discussion

Background- Definition

Inflation persistence: *Tendency of inflation to converge slowly towards its long-run value*

$$\pi_t = \mu(1-\rho) + \rho\pi_{t-1} + \varepsilon_t$$



Background – Sources of persistence

- *Intrinsic (past inflation and price-setting)*
- *Extrinsic (determinants, e.g. mark-up, output fluctuations, real rigidities)*
- *Expectations-based (formation of expectations)*
- *Error term persistence*

With some exception all papers of Session 1 discuss intrinsic persistence

Summary – Data and methods

Aggregate/Disaggregate Data

1. Reduced-form analysis and measure of persistence

- Robalo Marques (and Dias-RM) for a good critical survey and an innovative non-parametric measure linking persistence and mean reversion

$$\gamma = 1 - n/T$$

- Univariate time-series settings (Gadzinski-Orlandi, Hondroyiannis-Lazaretou, Levin-Piger, O'Reilly-Whelan, Corvoisier-Mojon)

$$\pi_t = \alpha + \rho\pi_{t-1} + \sum_{j=1}^{p} \psi_j \Delta\pi_{t-j} + \varepsilon_t$$

Summary – Data and methods

2. Structural or Multivariate analysis

- Dossche and Everaert use a structural time series approach and can disentangle between intrinsic persistence and something that measures the persistence in reaction to changes in the policy target of the central bank
- Corvoisier and Mojon employ some multivariate models to interpret breaks in the mean

3. Panel data analysis (Bilke, Lünnemann-Mathä)

4. Factor analysis (Altissimo-Mojon-Zaffaroni)

Summary – Data and methods

First warning on the importance of going beyond univariate set-ups:

1. These models are not necessarily able to distinguish between extrinsic and intrinsic persistence

2. They may miss endogeneity of persistence, e.g. the fact that persistence may depend on shocks and changes in regimes

3. They partially account for the latter by controlling for breaks in the long-run mean, but still cannot explain the determinants of the breaks

Summary – Findings

Finding number 1: on persistence

By simply estimating

$$\pi_t = \alpha + \rho\pi_{t-1} + \sum_{j=1}^{p} \psi_j \Delta\pi_{t-j} + \varepsilon_t$$

We cannot really reject the unit root hypothesis (both for Euro and US inflation)

Summary – Findings

Source	rho	Sample
Euro Area		
Altissimo, Mojon and Zaffaroni (2004)	0.93	1985:I-2004:I
Batini (2002)	**0.74**	1984:III-2002:II
Gadzinski and Orlandi (2004)	[1.02;1.04]	1970:II-2003:III
O'Reilly and Whelan (2004)	0.96	1970:I-2002:IV
Robalo Marques (2004)	0.85	1984:I-2002:IV
United States		
Gadzinski and Orlandi (2004)	[0.92;1.03]	1970:II-2003:III
Levin and Piger (2004)	[**0.65**;1.02]	1984:I-2003:IV
Robalo Marques (2004)	**0.66, 0.81**	1982:I-2002:IV

Note: Parameters in bold are able to reject the unit root hypothesis.

Where is the persistence arising ?

Summary – Findings

Finding number 2: on persistence and breaks

If we control for breaks in the mean or a TV mean

$$\pi_t = \alpha_t + \rho\pi_{t-1} + \sum_{j=1}^{p} \psi_j \Delta\pi_{t-j} + \varepsilon_t$$

Persistence drastically lower

Summary – Findings

Source	rho	Sample
Euro Area		
Dossche and Everaert (2004)	**0.4**	1971:II-2003:IV
Gadzinski and Orlandi (2004)	[**0.60**;0.90]	1984:I-2003:III
Lünnemann and Mathä (2004a)	**0.40**	1995:1-2000:12
Robalo Marques (2004)	**0.34**	1986:II-2002:IV
United States		
Dossche and Everaert (2004)	**0.58**	1971:II-2003:IV
Gadzinski and Orlandi (2004)	[**0.52**;0.80]	
Levin and Piger (2004)	[**0.37**;0.89]	1984-2003
Robalo Marques (2004)	**0.27, 0.28**	1983:I-2002:IV

Note: Parameters in bold are able to reject the unit root hypothesis.

Summary – Findings

All papers recognize that the long run mean of inflation plays a crucial role

Robalo Marques: "*Any estimate of persistence is to be seen as conditional on a given assumption for the mean*"

Several ways of dealing with this:

- Constant long run target
- Test for structural breaks (dummies)
- Exogenous time varying mean

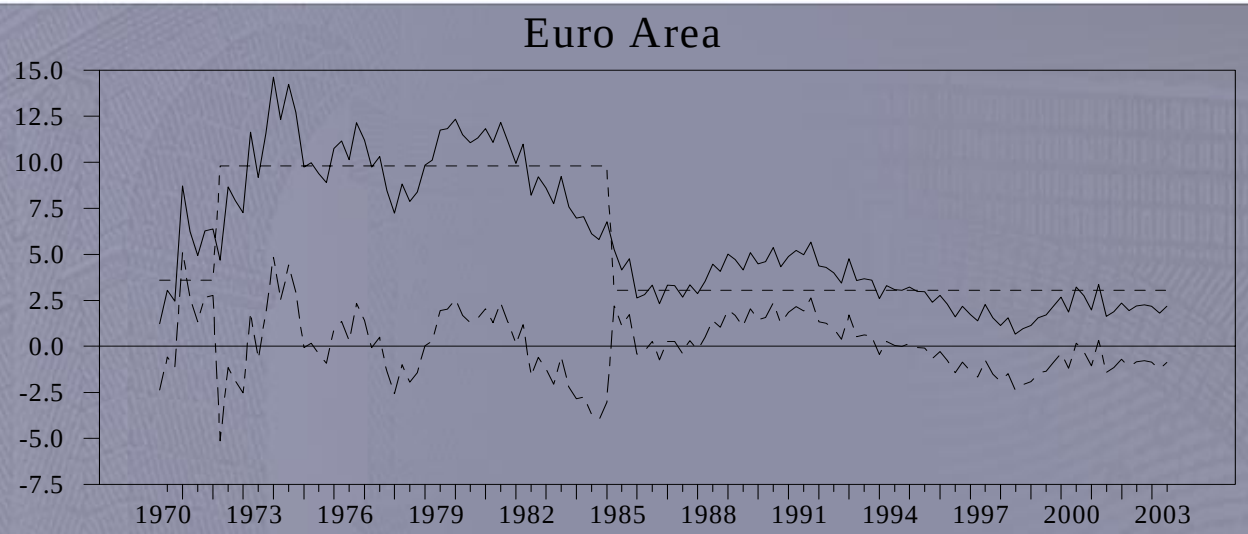
Summary – Findings

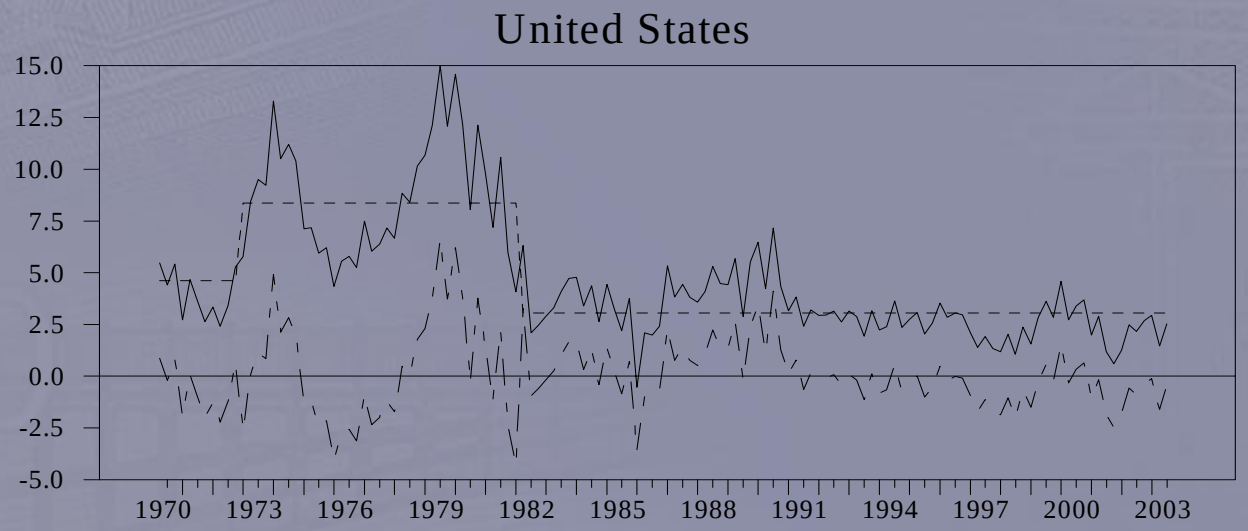
Table 1: Breaks in the mean of CPI/HICP and GDP deflator inflation

	wave 1						wave 2			wave 3		
	late 1960s			early 1970s			mid 1980s			early 1990s		
EA				3.60	72Q2	9.81	9.81	85Q2	3.04	4.69	93Q2*	2.06
AT				3.42	71Q1	5.82	5.82	84Q3	2.20			
BE				2.98	71Q2	7.03	7.03	85Q1	2.04			
DE							4.76	82Q3*	2.78	2.78	95Q3*	0.82
ES				6.15	72Q4	15.36	15.36	82Q2	9.60	6.33	92Q3*	3.57
							9.60	*86Q3*	*4.10*			
FI				4.99	72Q3	10.42	10.42	85Q1	2.64	5.79	90Q3*	1.81
FR				4.24	73Q1	10.00	10.00	85Q2	2.09			
GR				2.42	72Q4	16.61				16.61	93Q2	5.24
IE				5.19	72Q2	13.67	13.67	84Q2	3.14			
IT				3.99	72Q2	13.75	13.75	85Q4	3.91			
LU	2.25	69Q3	6.56				6.56	85Q2	2.03			
NL	3.66	68Q1	6.66				6.66	82Q2	2.16			
PT				4.26	70Q4	14.97	20.96	85Q1	10.54	10.54	92Q2	3.64
				14.97	*76Q2*	*20.96*						
DK				5.67	72Q4	9.48	9.48	85Q1	2.62	4.16	91Q1*	1.85
SE	3.67	69Q4	8.04							8.04	91Q4	1.58
UK	3.74	69Q4	8.95	8.95	74Q1	13.22	13.22	81Q4	5.65	5.65	91Q1	2.57
US	1.75	67Q3	4.61	4.61	73Q1	8.37	8.37	82Q2	3.06			
JP				5.41	72Q3	8.02	8.02	81Q2	0.98	2.30	92Q2*	-0.82
AU				2.50	70Q3	8.76				8.76	90Q4	2.36
CA				2.82	72Q2	9.21	9.21	82Q3	4.47	4.47	91Q2	1.83
NZ	3.34	69Q4	8.40	8.40	74Q1	13.91	13.91	82Q3	8.82	8.82	90Q2	1.87
NO	3.54	69Q1	8.07				8.07	88Q3	2.51			
CH										3.74	93Q2	0.86
Number of breaks			7			17			19			14	Total 57
Average inflation before and after the break			3.1			7.3	5.3		11.6	10.2		3.9	6.6		2.1	

Note: Authors calculation (see the main text). * break in the mean of the GDP deflator inflation

Summary – Findings





Summary – Findings

If don't account for breaks, the test for unit root is spurious. As a matter of fact, the more time variation allowed for, the lower the estimates for the persistence parameter.

O'Reilly-Whelan (2004) don't necessarily agree!

But…What are the breaks?

Summary – Findings

Finding number 3: on heterogeneity and aggregation effects

Heterogeneity across countries and sectors strongly motivates disaggregate analysis and points towards a word of caution when results are based on aggregates

Summary – Findings

As a matter of fact:

1. Inflation persistence of broad prices seems a result of aggregation and disaggregated prices are, on average, less persistent than aggregate. The most persistent sectors (services?) might drive the persistence of aggregates.

2. Differences across sectors may reflect different price settings (e.g. market-determined vs. administered)

3. Hierarchy: Euro area more persistent than country more persistent than sectors. See Altissimo et al. for a convincing explanation. They also square micro volatility and low persistence with macro smoothness and high persistence.

Summary – Findings

	France		Germany	Italy	Euro Area
	AMZ	Bilke	AMZ	AMZ	AMZ
Non-processed food	0.63	0.15	0.25	0.45	0.55
Energy	0.44	0.28	0.47	0.41	0.44
Processed food	0.34	0.34	0.60	0.69	0.61
Services	0.51	0.44	0.60	0.49	0.53
Industrial goods	0.68	0.72	0.65	0.70	0.68

Source: AMZ = Altissimo et al. (2004); Bilke (2004). AMZ report means of persistence of finer subindices; Bilke reports direct measures of persistence at the respective sectoral level.

Is there any common pattern?

Summary[2] – Findings

1. Estimates of inflation persistence fall when shifts in the mean inflation or time variation are accounted for.

2. Overall inflation persistence does not seem to be an inherent characteristics of industrial economies. There is one exception (O'Reilly-Whelan).

3. Persistence is also a result of aggregation. Heterogeneity is a feature to account for.

A couple of questions for discussion

1. (Is the finding of nonlinearity only apparent? Is it due to intrinsic high persistence or to structural instability in inflation time series instead?)

2. What are the breaks?

3. Is the analysis on heterogeneity conclusive?

A couple of questions for discussion

I am not going to discuss the first question.
A reference:

Koop and Potter (2001) using US postwar quarterly inflation data (1947:2-1998:4) find overwhelming evidence of structural instability (both in intercept and slopes).

Discussion – What drives the breaks?

2. What are the breaks? Is it monetary policy?

- The breaks do not occur in a similar fashion for most inflation series (Gadzinski-Orlandi, table 1)
- Methodological changes in measurement of prices or data collection (e.g. Break due to modified sales treatment cannot be disentangled form a possible monetary policy break in Lünnemann-Mathä)
- Different statistical methods and sample periods to identify breaks

Discussion – What drives the breaks?

Bilke (2004) finds that the breaks in French Inflation are driven by monetary policy, in that a large number of sectoral sub-indices cluster around a few months in mid-80s ("franc fort" policy)

Corvoisier and Mojon (2004) find similar result based on OECD countries. Their three waves (late 60s, mid 80s, early 90s) are more associated with breaks in the mean of nominal rather real variables

Discussion – What drives the breaks?

In general analysis is not conclusive

- Most studies are univariate and non structural: "Correlations" say little on causality
- Heterogeneities and different synchronization reflect in different transmission of a common shock to countries and sectors not identifiable in these models
- Too little discussion in all papers devoted to the relative influence of different factors which may explain breaks and to economic explanation!

Discussion – Heterogeneity

3. Is the analysis on heterogeneity conclusive?

- Not clear across studies which countries or sectors show more persistence. Clearer from other sessions?
- No common patterns across studies
- Problem with Administered Prices and Services. The inclusion of the former does not increase persistence, even though one would expect the contrary; the exclusion of the latter reduces persistence even though the sector *per se* does not seem to show a particularly high persistence.

Discussion – Heterogeneity

	BE	DE	GR	ES	FR	IE	IT	LU	NL	AT	PT	FI
Bilke (2004)					**0.76**							
Cecchetti and Debelle (2004)	**-0.11**	**-0.34**		**0.23**	**0.25**		**0.45**	**-0.62**	**-0.02**	**0.33**	**0.45**	**0.30**
Gadzinski and Orlandi (2004)	**0.01**	**0.13**	**0.63**	0.91	0.60	**0.14**	0.63	**0.32**	**0.34**	0.73	0.58	0.84
Hondroyiannis and Lazaretou (2004)			**0.78**									
Levin and Piger (2004)		**0.78**			**0.74**		**0.73**		**0.55**			
Lünnemann and Mathä (2004a)	**-0.33**	**-0.16**	**0.51**	**-0.50**	0.49	**0.38**	**0.23**	**-0.17**	**0.28**	0.43	**0.31**	**0.07**

- Cross-country heterogeneity

- Low persistence on average

but

- Cross-study heterogeneity and lack of common patterns !

Discussion – Heterogeneity

Remarks:

- Country by country or sector by sector studies interesting, but cannot be pursued in isolation: a global model with links is necessary (e.g. heterogeneous panel data regressions, factor analysis)

- Given the high level of disaggregation, a more sophisticated factor analysis could be pursued to explicitly consider a common factor, a country factor and a sector factor (e.g. Kose et al, 2003)

- Sometimes these studies are limited by data availability (e.g. Lünnemann-Mathä use quarterly data from 1995 to 2003, a period of stable inflation and with too few data for tests to have good power)

Discussion – Missing from the analysis

Shopping list

1. Little attention devoted to volatility. See literature on contagion on the importance of volatility when estimating ρ with possible omitted common factors

2. A better bridge to structural models to solve the main puzzles (e.g. see literature on DSGE as prior for VAR). In general there is little connection with structural models. Given lack of consensus try approaches with model/parameter uncertainty

3. Implications of persistence on forecasting inflation?

Discussion – Missing from the analysis

5. In general, papers have answered the question of *how much* but not always the question *why* and *how* heterogeneities affect aggregate persistence (Altissimo et al. more statistical than based on economic theory)

6. Some more economic discussion, also in historical perspective. (e.g. Did monetary authority more use of moving inflation targets in the past? Why? What's the role of fiscal policy?)

Discussion – Missing from the analysis

What I really find missing

A more international perspective in the econometric approaches

1. Links across countries or sectors sometimes are missing. Interdependencies reduce autoregressive coefficients and control for spillovers (e.g. Canova-Ciccarelli 2002, 2004, Pesaran et al. 2003)

Discussion – Missing from the analysis

We are […] very much dependent on the global evolution. We have an idea of the global evolution, but there are risks at the global level that we have to take into account.

(Jean-Claude Trichet, 2 December 2004, Frankfurt)

Discussion – Missing from the analysis

2. What if there were global driving forces? This would explain lack of consensus on breaks or the fact that traded and non-traded sectors break similarly, etc.

(see e.g. Kose, Otrok and Whiteman 2003 and Canova, Ciccarelli, Ortega, 2004 for global Business cycles)

Global Inflation (Ciccarelli and Mojon 2005)

Discussion – Missing from the analysis

Let's extract a common factor from inflations of 22 OECD countries

Variance decomposition

Sample 1960:1 - 2003:3

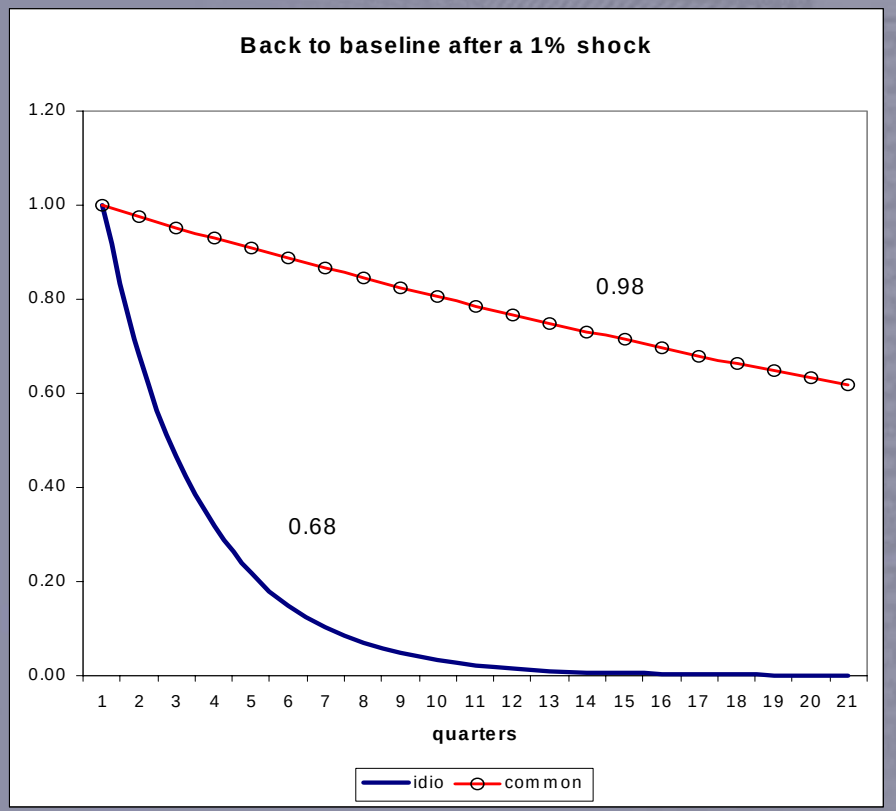
country	factor1	factor2	idiosyncratic
'IT'	0.814	0.029	0.157
'DE'	0.480	0.120	0.400
'FR'	0.854	0.001	0.145
'GB'	0.728	0.000	0.272
'US'	0.624	0.013	0.363
'JP'	0.428	0.111	0.461
'CA'	0.750	0.027	0.223
mean	0.668	0.043	0.289
median	0.728	0.027	0.272

Discussion – Missing from the analysis

Now use projections on common factor and measure persistence

Measure of persistence
factor analysis

factor	ρ-2*σ	ρ	ρ+2*σ
common	0.957	0.976	0.996
'IT'	0.527	0.651	0.776
'DE'	0.658	0.771	0.885
'FR'	0.476	0.621	0.765
'GB'	0.506	0.626	0.746
'US'	0.679	0.771	0.863
'JP'	0.714	0.805	0.896
'CA'	0.400	0.536	0.672
mean	0.566	0.683	0.800
median	0.527	0.651	0.776



Discussion - Global inflation

1. Is it by chance that inflation across countries with different institutions, structure or policies are driven by common causes?
2. If answer is no, then policy institutions should focus on identification of factors that explain the commonalities and channels that foster cross-country transmission (see our paper!)
3. Policies designed to counteract world tendencies may be not entirely effective

Conclusion

This is excellent, serious work, deepening our understanding of inflation persistence.

- Move on stronger links between structural theories and empirics, also in historical perspective. But account for model/parameter uncertainty
- A better analysis and discussion on driving forces of breaks needed. Economic arguments somehow missing
- More work with disaggregate data and on the mechanisms through which heterogeneities affect aggregate inflation persistence
- Adopt a more international perspective, exploiting commonalities and explaining differentials

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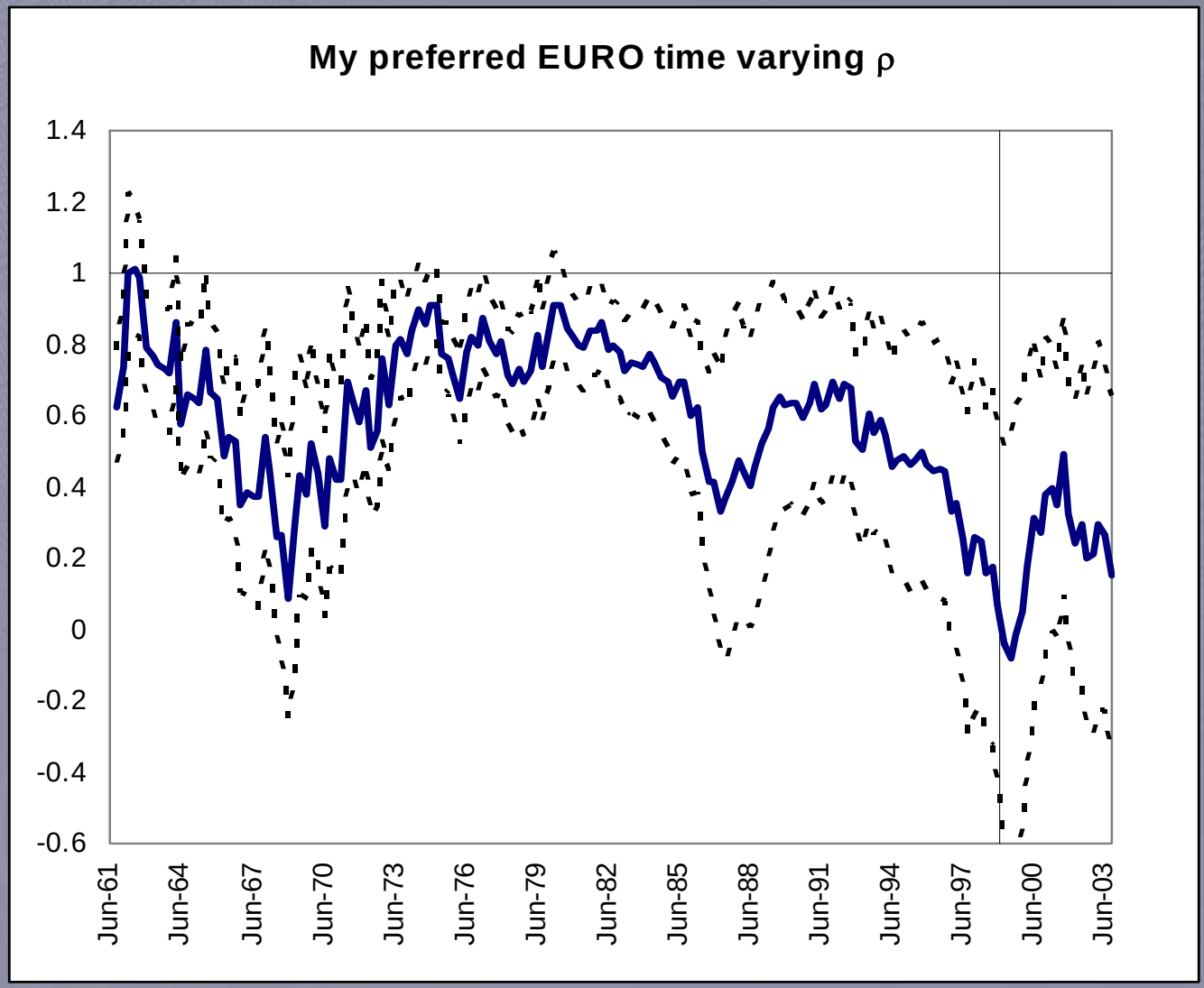
My preferred EURO time varying ρ
1.4
1.2
1
0.8
0.6
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Jun-61
Jun-64
Jun-67
Jun-70
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