Money demand and the role of monetary indicators in forecasting euro area inflation

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Contribution of the paper

- Monetary analysis provides nominal anchor for price stability
  - Inflation a monetary phenomenon at the long run
  - Risk that lose monetary stance can lead to higher inflation regime
  - Suitability of money aggregates to forecast inflation in the euro area
- Excess liquidity measures based on money demand
- Stability analysis and forecasting performance of monetary indicators
- Compare ECB Quarterly Monetary Assessment

Money demand analysis

$$m - p = f(y, w, oc)$$

- *m* nominal money, *p* price level, *y* real income, *w* wealth, *oc* opportunity costs of holding money
  - Opportunity costs: short and long term interest rates, inflation rate
- Income has positive, opportunity costs negative impact on real money balances
- Inflation ambiguous sign, proxy for several channels
- Wealth positive scale, negative substitution effect

Stability of money demand

- Stability fragile
  - Inclusion of financial uncertainty (Greiber and Lemke (2005), Carstensen (2006))
  - Core components of variables (Neumann and Greiber (2004), Gerlach (2004))
- Opportunity costs should also include inflation
  - Dreger and Wolters (2010): Relaxes homogeneity restriction between money and prices in short run, adjustment in real and nominal terms distinguished
- Shift in income elasticity: Introduction of euro as cash in 2002
  - Dreger and Wolters (2009): Wealth effects relevant, house prices outperform stock prices

Design of analysis

- Introduction of the euro in 1999Q1
- Artificial data required in pre-euro period
- Aggregation methods might influence the results
  - Artis and Beyer (2004)
  - Not a problem for stability analysis of money demand
- Differences are neglectable after 1983
  - Bosker, 2006
  - Sample period : 1983Q1 (EMS)-2010Q4
- Impulse dummies: German unification (1990Q2), stock market turbulences (2001Q1)
- Step dummy (s2002.1): w^*=s2002.1w

Cointegration rank (I)

Variables	Rank null hypothesis	Trace test	Trace (corrected)	Rank
m-p, *y*, *π*	0	44.53 (0.032)	42.02 (0.060)	1
	1	22.77 (0.116)	21.49 (0.161)	
	2	5.81 (0.496)	4.85 (0.624)	
m-p, *y*, *w**, *π*	0	106.21 (0.000)	98.00 (0.000)	2
	1	53.38 (0.003)	47.05 (0.017)	
	2	21.46 (0.163)	17.83 (0.363)	
	3	6.32 (0.432)	5.95 (0.477)	
m-p, *y*, *w**, *π*, *rl-rs*	0	136.40 (0.000)	123.86 (0.000)	2-3
	1	84.71 (0.000)	71.50 (0.009)	
	2	45.89 (0.023)	38.87 (0.120)	
	3	21.93 (0.144)	18.75 (0.302)	
	4	6.29 (0.435)	5.90 (0.484)	

VAR(2): Akaike, constant and trend restricted to cointegration space

Cointegration rank (II)

- Two cointegration vectors
  - Third vector trivial and related to stationarity of the term structure
  - Recursive eigenvalues, cointegration vectors and feedback mechanisms almost constant
- Long run vectors interpreted in terms of money demand and inflation equation
- Likelihood ratio tests to identify cointegration and feedback vectors
  - Income, wealth and term structure weakly exogenous

Restricted system

	α_1	α_2
$\Delta(m\text{-}p)$	-0.158 (0.022)	0.403 (0.084)
$\Delta\pi$	0.225 (0.057)	-1.213 (0.217)

	β_1	β_2
m-p	1.000	0.000
y	-1.397 (0.053)	-0.339 (0.065)
*w**	-1.017 (0.075)	-0.178 (0.027)
π	2.982 (0.261)	1.000
rl-rs	1.694 (0.391)	0.000
trend	0.000	0.003 (0.001)

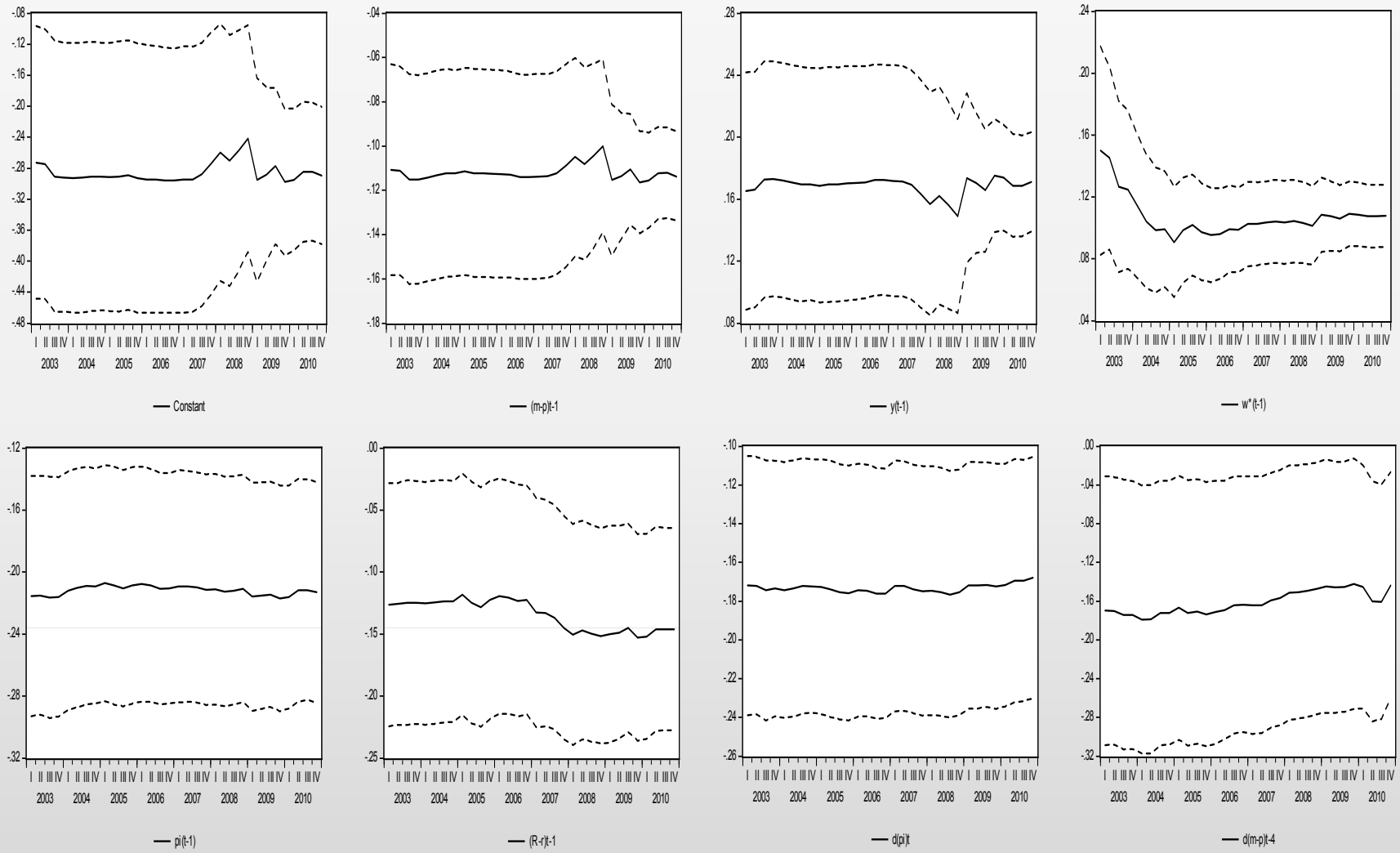
ECM single equation

Con	*d*902	*d*011	$(m\text{-}p)_{t\text{-}1}$	$y_{t\text{-}1}$	$w^*_{t\text{-}1}$	$\pi_{t\text{-}1}$	$(R\text{-}r)_{t\text{-}1}$	$\Delta\pi_t$	$\Delta(m\text{-}p)_{t\text{-}4}$
-0.290	0.029	0.026	-0.114	0.171	0.108	-0.213	-0.146	-0.168	-0.144
(6.531)	(6.924)	(6.047)	(11.27)	(10.64)	(10.67)	(5.984)	(3.574)	(5.387)	(2.456)

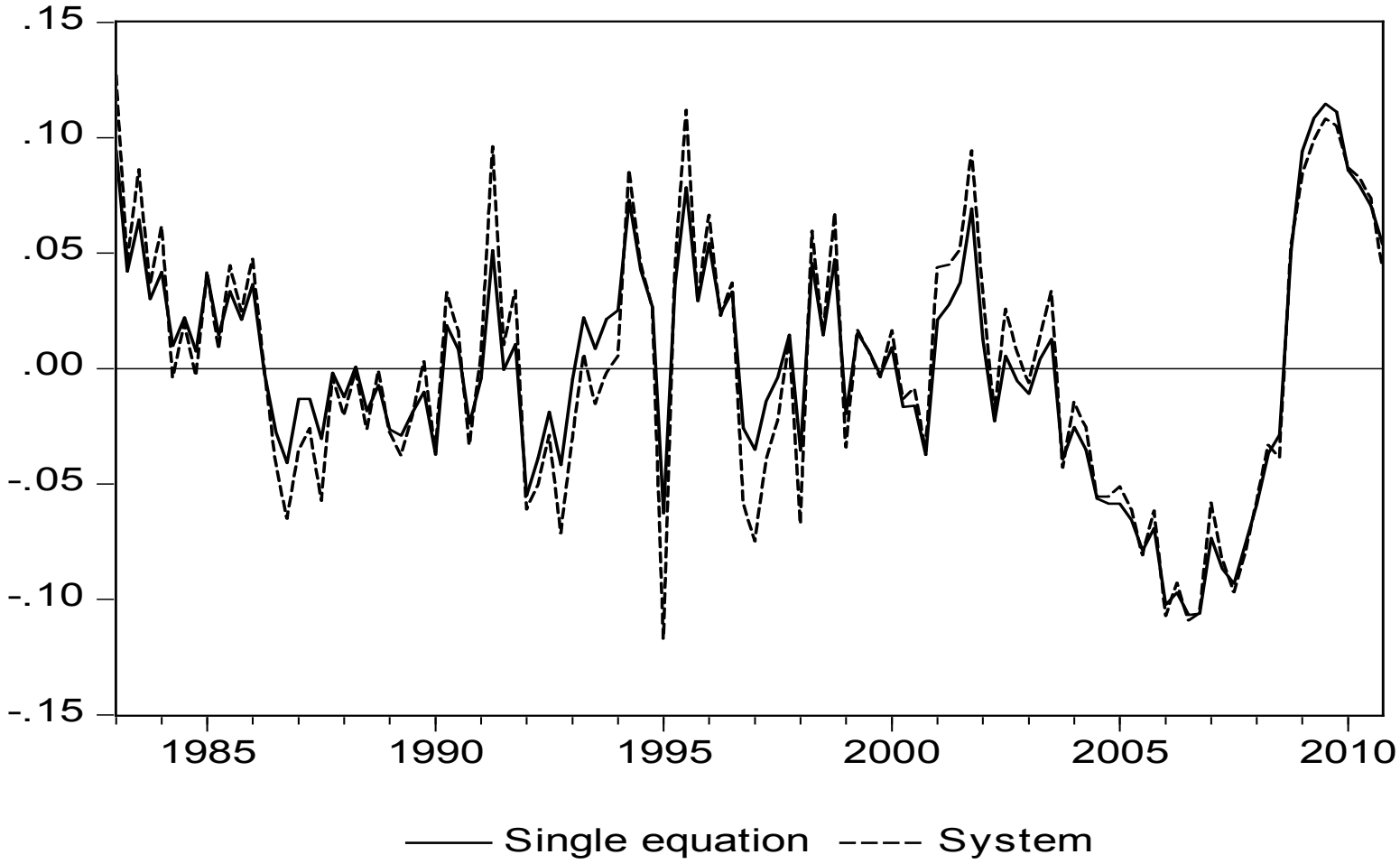
$$m - p = 1.504y + 0.947w^* - 1.873\pi - 1.285(R - r)$$

JB=2.96 (0.23)	ARCH(1)=1.96 (0.16)	ARCH(2)=1.14 (0.32)	LM(1)=1.20 (0.28)
LM(2)=0.63 (0.54)	LM(4)=1.70 (0.16)	RESET(1)=0.40 (0.53)	RESET(1)=0.38 (0.68)
CF(03.1)=0.79 (0.76)	CF(04.1)=0.82 (0.72)	CF(05.1)=0.85 (0.67)	CF(06.1)=0.73 (0.79)
CF(07.1)=0.88 (0.60)	CF(08.1)=0.73 (0.72)	CF(09.1)=0.88 (0.54)	CF(10.1)=0.70 (0.59)

Recursive regression coefficients



Excess liquidity



Inflation forecasts

$$\pi_{c,t}^{k} = 4\log(pc_t / pc_{t-k})/k \quad , \quad \pi_{c,t+k}^{k} = \alpha(L)\pi_{c,t}^{1} + \beta x_t + u_{t+k}$$

- Out of sample forecasting comparison
  - Annual change of CPI, average cumulative inflation for biennial and triennial horizon (*k*=4,8,12)
- Forecasts via direct approach in recursive way
  - First estimation sample 1983Q1-2002Q4, first forecast for annual inflation 2003Q4, extending estimation sample by 1 quarter and so on
  - AR benchmark extended by M3 growth, excess liquidity and term structure
- Tests on equal predictive accuracy as well as encompassing tests

RMS forecast errors

Horizon	Benchmark	Money	Exc. liquidity	Term structure
4	1.37	1.00 (0.50)	0.91 (0.07)	0.94 (0.04)
8	1.02	1.15 (0.76)	0.91 (0.07)	0.92 (0.00)
12	0.74	1.20 (0.71)	0.70 (0.06)	0.84 (0.00)

In parentheses P-values of Ho: Model including particular variable has equal predictive accuracy than the benchmark

Encompassing tests

Annual	Money growth	Excess liquidity	Term structure
Money growth		0.77	0.42
Excess liquidity	0.06		0.14
Term structure	0.13	0.53	

Triennial	Money growth	Excess liquidity	Term structure
Money growth		0.99	0.02
Excess liquidity	0.00		0.00
Term structure	0.00	0.02	

P-values of Ho: Forecasting in the row does not add information to the forecasting in the column

Conclusions

- Robust bivariate VECM for money and inflation
  - Money and inflation not weakly exogeneous
- Excess liquidity relevant for inflation, no role for money per se
- Conditional single equation analysis feasible
- Combined forecasts for triennial inflation rates are superior
  - Based on excess liquidity and the term structure
- Monetary growth is encompassed by excess liquidity at all forecasting horizons