



Eesti Panga teadusseminar
25. mai 2023, 10:30-11:30

Fiscal Performance under Inflation and Inflation Surprises: Evidence from Fiscal Reaction Functions for the Euro Area

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Working Papers of Eesti Pank, no. 3/2023
Forthcoming working paper from Latvijas Banka

All viewpoints personal!

“Menu”

1. Introduction
2. Empirical literature
3. Data and methodology
4. Inflation and fiscal outcomes
5. Inflation surprises
6. Extensions and sensitivity
7. Final comments

1. Introduction

Does inflation or inflation surprises affect fiscal outcomes?

Motivation

- Budget deficits “moderate” in 2022 in euro area countries – in spite of spending on energy subsidies, refugees and war in Ukraine
- Very low or negative inflation in mid-2010s ~ budget balance ↓

NB: 2022 was extreme year! → data 1999-2021

Research question → estimate (causal) effect of inflation / inflation shocks on fiscal balance and other fiscal outcomes in EA12 (sorry Estonia!)

What we do!

- Standard fiscal reaction function & HICP inflation or HICP inflation surprises
- Panel data for EA12, initial euro area, 1999-2021
- Primary budget balance and various components
- Instrument HICP inflation or HICP inflation surprise (to limit reverse causality)

Contributions

- Few / no studies using fiscal reaction functions to estimate effect of inflation
 - Though some include inflation as control variable
- Sample → euro area large economy, homogeneous institutional setups
 - Inflation target of 2% for euro area, target of budget balance for individual countries (SGP, 3%)
- Many different fiscal outcome variables examined
- Inclusion of inflation ⇒ potentially reduce omitted variables bias if output gap and inflation are correlated, cf. e.g. Phillips curve effect

2. Related literature

Conceptual frameworks

The accountant's story

Budgets typically in nominal terms → inflation and (especially) inflation surprises may affect fiscal outcomes

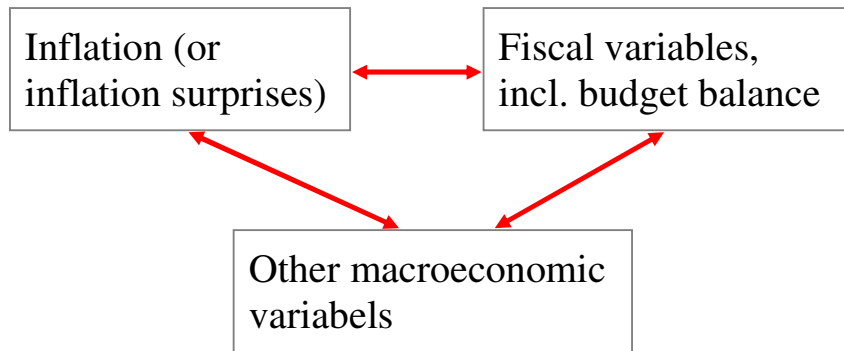
- Olivera-Tanzi effect → inflation ↑ ~ *real* revenue ↓ (if payment after obligation created, cash vs. accrual)
 - *Inverse* Olivera-Tanzi effect (Afonso & Jalles 2019)
- Patinkin effect → inflation ↑ ~ *real* expenditure ↓

Olivera-Tanzi and Patinkin effects for high or extreme inflation in Latin America

- Few systematic empirical studies of Olivera-Tanzi and Patinkin effects

The economist's story

Simultaneous partial / general equilibrium outcomes



Research question → other linkages in partial or general equilibrium model

Empirical studies

Using large-scale macroeconomic model

- Bankowski et al. (2023): “Fiscal policy and high inflation”, ECB Economic Bulletin, Feb. 2023
- Attinasi et al. (2015): “The effect of low inflation on public finances”, In *Beyond the Austerity Dispute: New Priorities for Fiscal Policy*, Bank of Italy
- Prammer & Reiss (2015): “Impact of inflation on fiscal aggregates in Austria”, *Monetary Policy & the Economy*, Oesterreichische Nationalbank
- de Cos et al. (2016): “Public finances and inflation: the case of Spain”, Occasional Paper, no. 1606, Bank of Spain

Using VAR model or Local Projection

- Cherif, Reda & Fuad Hasanov (2018): “Public debt dynamics: the effects of austerity, inflation, and growth shocks”, *Empirical Economics*
- Mallick, Sushanta K. & Mohammed Mohsin (2007): “On the effects of inflation shocks in a small open economy”, *Australian Economic Review*
- Hasko, Harri (2007): “Some unpleasant fiscal arithmetic: the role of monetary and fiscal policy in public debt dynamics since the 1970s”, Bank of Finland Research Discussion Papers
- Ahmed, Shaghil & John H. Rogers (2000): “Inflation and the great ratios: Long term evidence from the U.S.”, *Journal of Monetary Economics*, vol. 45, no. 1, pp. 3-35.
- Fukunaga, Ichiro, Takuji Komatsuzaki & Hideaki Matsuoka (2022): “Inflation and public debt reversals in advanced economies”, *Contemporary Economic Policy*, vol. 40, no. 1, pp.124-137.

Some with inflation in reaction functions
for robustness checks ...

Fiscal reaction functions

- Bohn (1998): “The behavior of U.S. public debt and deficits”, *QJE*
- Staehr (2008) → WE and CEE have different reaction functions, *Econ Sys*
- Berti et al. (2016): “Fiscal reaction functions for European union countries”
- Checherita-Westphal & Žďárek (2017) → fiscal fatigue in euro area (non-linear debt term), ECB WP 2036
- Tkačevs & Vilerts (2019) → interest rates in reaction functions
- ...

Real-time data in fiscal reaction functions

- Forni & Momigliano (2004): “Cyclical sensitivity of fiscal policies based on real-time data”, *Applied Economics Quarterly*
- Hallett, Kattai & Lewis (2012): “How reliable are cyclically adjusted budget balances in real time?”, *Contemporary Economic Policy*
- Cimadomo (2016): “Real-time data and fiscal policy analysis: a survey of the literature”, *JES*

3. Methodology and data

Methodology

Fiscal reaction function



Fiscal outcome, % of GDP

- Fiscal outcome, % of GDP (-1)
- Debt, % of GDP (-1)
- Output gap, % of potential output
- Inflation measure, %



Panel data estimations

- Annual data, so few observations per country

NB1: Fiscal outcome, % of GDP

$$\text{Fiscal outcome, \% of GDP} = \frac{\text{Nominal fiscal outcome}}{\text{Nominal GDP}} = \frac{\text{Real fiscal outcome} \times \text{Deflator}}{\text{Real GDP} \times \text{GDP deflator}}$$

Estimated coefficients of inflation variable(s) = net effect on volumes and deflators in nominator and denominator

- Same issue for e.g. output gap

NB2: Focus on short-term effects

Fiscal reaction function not suitable for simulations of long-term effects of e.g. inflation

- Lagged dependent variable included to “mop up” slow-moving country-specific variation → reduce risk of omitted variables bias

Data

Panel data

- First 12 countries in euro area = EA12
- Annual data 1999-2021
- Eurostat, Ameco, European Commission

LHS variables

Fiscal outcomes, % of GDP

- Primary balance
- Revenue
 - Indirect taxes
 - Direct taxes
 - Social security contributions
- Primary expenditure
 - Primary current expenditures
 - Capital expenditures

RHS variables

Lagged dependent variable, % of GDP

Debt, % of GDP

Output gap, gap between actual GDP and potential GDP, % of potential GDP

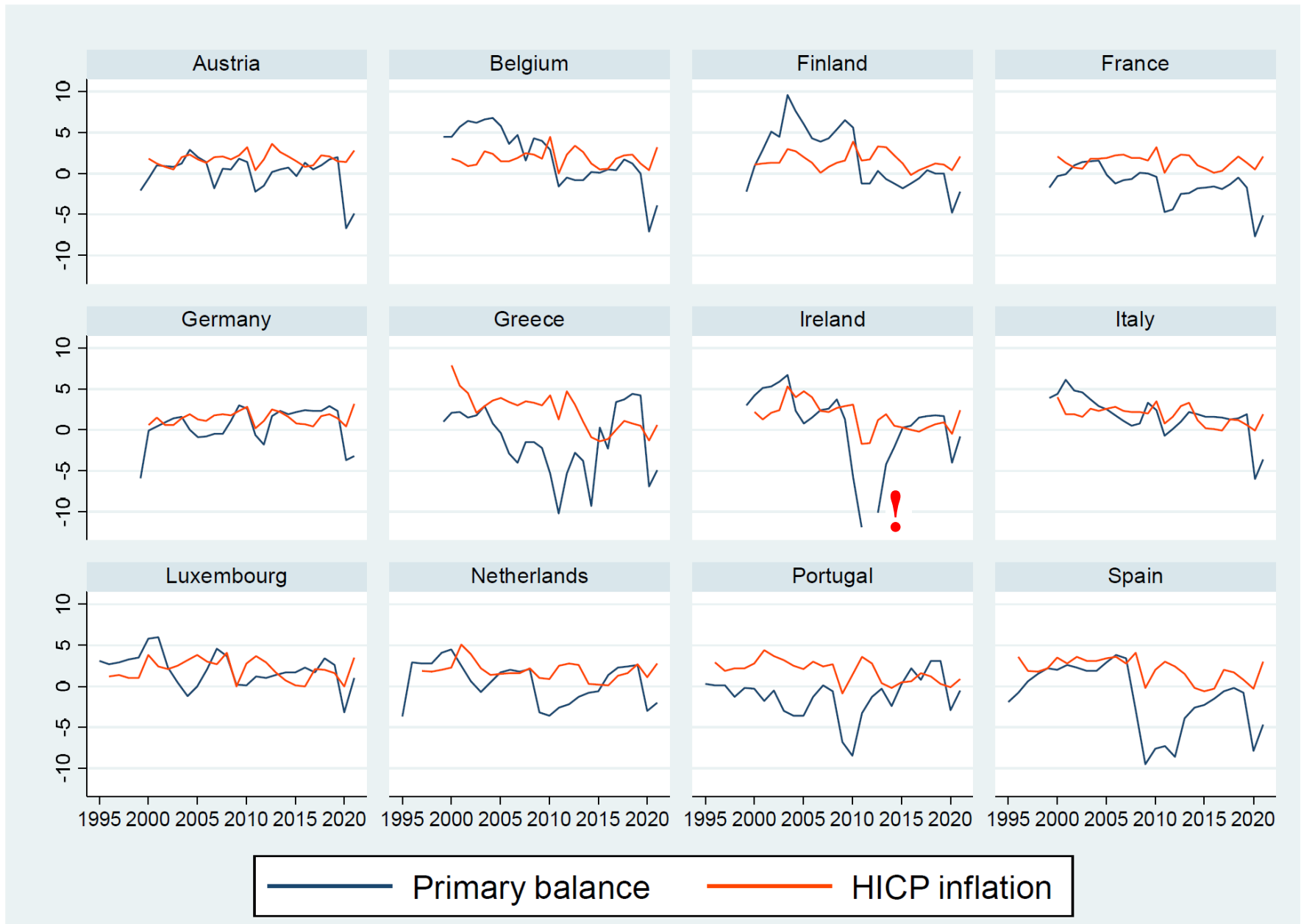
Inflation (HICP)

- Inflation, %
- Change in inflation, %-points

Forecasts (from Ameco / European Economy in autumn the year before)

- Inflation forecast error
- Output gap forecast
- Output gap forecast error

Figure 1: Primary budget balance (per cent of GDP), and HICP inflation (per cent)



4. Inflation and fiscal outcomes

Table 1. Baseline estimation results

	FE	FE	FE	System GMM	System GMM	System GMM
	(1)	(2)	(3)	(4)	(5)	(6)
	Primary balance	Total revenue	Primary expenditure	Primary balance	Total revenue	Primary expenditure
Lagged dependent	0.540*** (0.056)	0.880*** (0.063)	0.624*** (0.043)	0.565*** (0.075)	1.001*** (0.023)	0.802*** (0.070)
Lagged debt	0.055*** (0.008)	0.009 (0.006)	-0.038*** (0.010)	0.039*** (0.006)	0.001 (0.004)	-0.027*** (0.010)
Output gap	0.377*** (0.116)	-0.108*** (0.024)	-0.462*** (0.069)	0.294** (0.136)	-0.113*** (0.033)	-0.253*** (0.071)
HICP inflation	0.475*** (0.139)	0.286*** (0.068)	-0.254* (0.121)	0.666*** (0.138)	0.281*** (0.064)	-0.365** (0.157)
Constant	-4.856*** (0.904)	4.076 (2.443)	19.864*** (1.722)	-3.990*** (0.778)	-0.989 (1.028)	11.522*** (2.700)
Observations	276	276	276	276	276	276
R-square	0.709	0.814	0.777	..	..	..
Max lag	..	..	..	2	2	3
Hansen test	..	..	..	0.326	0.387	0.523
AR(1) test	..	..	..	0.069	0.005	0.046
AR(2) test	..	..	..	0.908	0.525	0.892



General results

- Coefficients of standard variables (lagged dependent, debt, output gap) 😊
- Feedback from debt in large part driven by expenditures 😊

Results for inflation variable

- Positive effect of HICP inflation on primary balance
 - Coefficient estimates have reasonable sign...
 - ... and are economically substantial
- Positive effect on revenues
 - Cannot reject *Inverse* Olivera-Tanzi effect
- Negative effect on expenditures (at 5% level)
 - Cannot reject Patinkin effect

Table 2. The impact of inflation on different components of primary balance

Estimation method: System GMM. Dependent variables:					
	(1)	(2)	(3)	(4)	(5)
	Indirect taxes	Direct taxes	Social security contributions	Primary current expenditure	Capital expenditure
Lagged dependent	0.940*** (0.052)	1.047*** (0.047)	0.963*** (0.031)	0.947*** (0.062)	0.245*** (0.029)
Lagged debt	0.003 (0.002)	0.003 (0.003)	0.000 (0.001)	-0.026*** (0.009)	-0.003 (0.004)
Output gap	-0.058*** (0.011)	-0.040** (0.019)	0.003 (0.014)	-0.194** (0.098)	-0.062*** (0.008)
HICP inflation	0.162*** (0.031)	0.149*** (0.043)	-0.052 (0.034)	-0.284* (0.162)	0.068 (0.073)
Constant	0.184 (0.597)	-1.080 (0.684)	0.605 (0.444)	4.789** (2.120)	3.486*** (0.404)
Observations	276	276	276	276	276
Max lag	2	3	2	2	2
Hansen test	0.580	0.504	0.399	0.216	0.595
AR(1) test	0.009	0.004	0.023	0.003	0.161
AR(2) test	0.380	0.142	0.907	0.116	0.385

Subcomponents

- Positive effect on revenues → indirect and direct taxes, but not social security contributions
- Negative effect on expenditures → current expenditures (10% level), not capital expenditures

NB: All budget measures in % of GDP

5. Inflation surprises

Table 3. The effect of a change in inflation on the primary balance, total revenue and primary expenditure

Estimation method: System GMM. Dependent variables:			
	(1)	(2)	(3)
	Primary balance	Total revenue	Primary expenditure
Lagged dependent	0.602*** (0.090)	0.995*** (0.049)	0.915*** (0.047)
Lagged debt	0.020* (0.011)	-0.003 (0.005)	-0.010 (0.015)
Output gap	0.233 (0.214)	-0.104*** (0.037)	0.011 (0.061)
Change in HICP inflation	0.558** (0.226)	0.142** (0.066)	-0.838*** (0.119)
Constant	-1.397** (0.665)	0.410 (2.012)	4.772*** (1.362)
Observations	276	276	276
Max lag	2	2	2
Hansen test	0.254	0.716	0.187
AR(1) test	0.076	0.007	0.025
AR(2) test	0.972	0.691	0.651

If adaptive (constant, backward-looking) expectations \Rightarrow Inflation surprise = change in inflation

Results for change in inflation

- Qualitatively similar effects as for inflation variable (though sizes of coefficients differ somewhat)

Table 4. The impact of the inflation forecast error on the primary balance, total revenues and primary expenditure

Estimation method: System GMM. Dependent variables:						
	(1)	(2)	(3)	(4)	(5)	(6)
	Primary balance	Total revenue	Primary expenditure	Primary balance	Total revenue	Primary expenditure
Lagged dependent	0.570*** (0.070)	1.004*** (0.028)	0.881*** (0.058)	0.627*** (0.056)	1.001*** (0.038)	0.903*** (0.060)
Lagged debt	0.026*** (0.005)	-0.001 (0.004)	-0.024* (0.013)	0.025*** (0.005)	0.003 (0.003)	-0.032** (0.013)
Output gap	0.254* (0.151)	-0.104*** (0.038)	-0.092** (0.041)	..	..	..
Output gap forecast error	..	..	..	0.401*** (0.117)	-0.074** (0.036)	-0.373*** (0.129)
Inflation forecast error	0.698*** (0.197)	0.355*** (0.072)	-0.835*** (0.117)	0.538*** (0.208)	0.372*** (0.079)	-0.562** (0.217)
Constant	-1.977*** (0.429)	-0.182 (1.172)	7.344*** (1.750)	-2.174*** (0.469)	-0.143 (1.558)	7.281*** (1.877)
Observations	256	256	256	239	239	239
Max lag	2	2	2	2	2	2
Hansen test	0.225	0.434	0.191	0.329	0.344	0.497
AR(1) test	0.091	0.018	0.031	0.113	0.027	0.079
AR(2) test	0.938	0.993	0.695	0.836	0.944	0.515

Using inflation forecast errors → very / fairly similar results as those for inflation



Inflation surprises could be behind the results found for the inflation variable!

6. Extensions and sensitivity

Additional specifications

- No sign of non-linearities of inflation
- Results not sensitive to different business cycle proxy or various political-economy variables
- Results not sensitive to removal of 3-year periods, including periods of crisis or “stress”
- Results not sensitive to individual countries in EA12 sample

Table 5. Non-linear effects of inflation on the primary balance, revenues and primary expenditure

Estimation method: System GMM. Dependent variables:						
	(1)	(2)	(3)	(1)	(2)	(3)
	Primary balance	Total revenue	Primary expenditure	Primary balance	Total revenue	Primary expenditure
Lagged dependent	0.561*** (0.074)	1.011*** (0.023)	0.796*** (0.074)	0.512*** (0.055)	1.009*** (0.021)	0.783*** (0.077)
Lagged debt	0.037*** (0.007)	0.000 (0.004)	-0.027** (0.012)	0.041*** (0.006)	0.002 (0.003)	-0.030** (0.012)
Output gap	0.311** (0.141)	-0.111*** (0.034)	-0.249*** (0.092)	0.432*** (0.081)	-0.096*** (0.047)	-0.306*** (0.080)
Inflation	0.782*** (0.207)	0.201** (0.103)	-0.518 (0.318)	0.542*** (0.193)	0.302*** (0.066)	-0.306 (0.240)
Inflation # high inflation	-0.166 (0.175)	0.070 (0.094)	0.126 (0.267)	..	..	..
Inflation # rising inflation	..	..	..	-0.110 (0.134)	-0.048 (0.054)	-0.034 (0.086)
Constant	-3.823*** (0.797)	-1.000 (1.037)	11.888*** (2.866)	-3.695*** (0.777)	-1.042 (0.963)	12.452*** (2.993)
Observations	276	276	276	276	276	276
Max lag	2	2	2	2	2	2
Hansen test	0.523	0.824	0.517	0.673	0.868	0.500
AR(1) test	0.067	0.005	0.046	0.066	0.005	0.041
AR(2) test	0.832	0.607	0.923	0.752	0.425	0.978

Table 6. The impact of a change in inflation on the primary balance, total revenue and primary expenditure: alternative regressors

Estimation method: System GMM. Dependent variables:						
Variables:	(1)	(2)	(3)	(4)	(5)	(6)
	Primary balance	Total revenue	Primary expenditure	Primary balance	Total revenue	Primary expenditure
Lagged dependent	0.584*** (0.092)	0.986*** (0.028)	0.713*** (0.059)	0.468*** (0.042)	0.941*** (0.052)	0.815*** (0.094)
Lagged debt	0.012** (0.006)	0.009*** (0.003)	0.001 (0.011)	0.049*** (0.011)	0.009* (0.005)	-0.039*** (0.012)
GDP growth	0.345*** (0.047)	-0.050** (0.020)	-0.439*** (0.051)	..	..	..
Output gap	..	..	..	0.481*** (0.051)	-0.096** (0.039)	-0.277*** (0.051)
Fiscal rules	..	..	..	1.775** (0.817)	0.121 (0.227)	-1.096** (0.515)
Elections	..	..	..	-0.332 (0.208)	-0.011 (0.139)	0.043 (0.280)
HICP inflation	0.492*** (0.134)	0.213*** (0.059)	-0.234*** (0.103)	0.679*** (0.141)	0.286** (0.113)	-0.584*** (0.190)
Constant	-2.444*** (0.602)	-0.276 (1.190)	14.101 (1.596)	-5.812*** (1.442)	1.297 (2.442)	13.129*** (3.736)
Observations	276	276	276	264	264	264
Max lag	2	2	3	2	1	2
Hansen test	0.199	0.416	0.541	0.562	0.862	0.250
AR(1) test	0.031	0.003	0.087	0.063	0.006	0.076
AR(2) test	0.792	0.568	0.805	0.514	0.438	0.813

Table B1. The impact of inflation on the primary balance estimated using different time samples

	Dependent variable: Primary balance. Time period:		
	(1)	(2)	(3)
	2002-2021	1999-2007, 2011-2021	1999-2018
Lagged dependent	0.543*** (0.069)	0.503*** (0.079)	0.612*** (0.089)
Lagged debt	0.036*** (0.005)	0.033*** (0.010)	0.029*** (0.008)
Output gap	0.248* (0.149)	0.350*** (0.100)	0.229 (0.099)
HICP inflation	0.654*** (0.145)	0.514*** (0.185)	0.458*** (0.116)
Constant	-3.904*** (0.871)	-3.009*** (1.110)	-2.912*** (0.723)
Observations	240	240	240
Max lag	2	2	2
Hansen test	0.236	0.334	0.241
AR(1) test	0.074	0.157	0.052
AR(2) test	0.972	0.471	0.691

Table B2. The coefficient of HICP inflation in the fiscal reaction functions for the primary balance, revenues and primary expenditure, excluding individual countries

Omitted country	Primary balance		Total revenues		Primary expenditures	
	Coeff	SE	Coeff	SE	Coeff	SE
Austria	0.661***	0.137	0.289***	0.066	-0.378**	0.161
Belgium	0.608***	0.126	0.264***	0.065	-0.308*	0.160
Finland	0.630***	0.140	0.266***	0.066	-0.398***	0.148
France	0.733***	0.124	0.295***	0.068	-0.386**	0.168
Germany	0.677***	0.136	0.288***	0.067	-0.365**	0.159
Greece	0.429**	0.168	0.303***	0.078	-0.362*	0.204
Ireland	0.856***	0.139	0.231***	0.075	-0.454***	0.170
Italy	0.641***	0.120	0.285***	0.067	-0.392**	0.161
Luxembourg	0.685***	0.145	0.299***	0.054	-0.405**	0.177
Netherlands	0.745***	0.145	0.309***	0.063	-0.437**	0.172
Portugal	0.648***	0.133	0.250***	0.069	-0.335**	0.144
Spain	0.652***	0.147	0.290***	0.068	-0.239*	0.146

7. Final comments

Takeaways

- Inflation seems of importance for main fiscal outcome variables in per cent of GDP
- Effect via both revenues (though not social security contributions) and expenditures (though not capital expenditures)
- Are inflation forecast surprises \approx inflation itself?
- No signs of non-linearities

Limitations (for follow-up papers)

- “Exogenous” vs. “endogenous” inflation shocks?
- Only short-term effects \leftarrow longer-term effects would involve e.g. dynamics of debt stock
- Mechanisms / channels not well established
- Only EA12 \leftarrow are CEE countries different?

Last slide

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All viewpoints personal!