

Are European bond markets overshooting?

Paul Hubert, Jérôme Creel, Christophe Blot, Fabien Labondance

▶ **To cite this version:**

Paul Hubert, Jérôme Creel, Christophe Blot, Fabien Labondance. Are European bond markets overshooting?. [Research Report] Parlement européen. 2017. hal-03471799

HAL Id: hal-03471799

https://sciencespo.hal.science/hal-03471799

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DIRECTORATE GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY

Are European bond markets overshooting?

IN-DEPTH ANALYSIS

Abstract

The recent rise in euro area long-term interest rates could jeopardize the on-going recovery if interest rates went beyond what the fundamentals require. We investigate possible overshooting after identifying the main determinants of long-term interest rates in the euro area and in some of its Member States since 1999. We include four categories of fundamentals (macroeconomic, financial, expectations, international). We find that monetary variables, spillovers from US financial markets, expectations and sovereign risks are the main determinants of long-term interest rates in the euro area. The empirical model has a very good fit and does not identify recent overshooting. The observed rise since August 2016 is attributed to two factors. The first one is the increase in US long-term interest rates after the reversal in the Fed's monetary stance. The second factor stems from the political tensions in France, Italy or Spain which generated higher perceived political risk. While the former factor might continue to drive euro area interest rates up, the second one might have receded with the results of the French presidential elections and drive interest rates down.

IP/A/ECON/2017-02 May 2017

PE 602.046 EN

This document was requested by the European Parliament's Committee on Economic and Monetary Affairs (ECON)

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Original: EN

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Manuscript completed in May 2017
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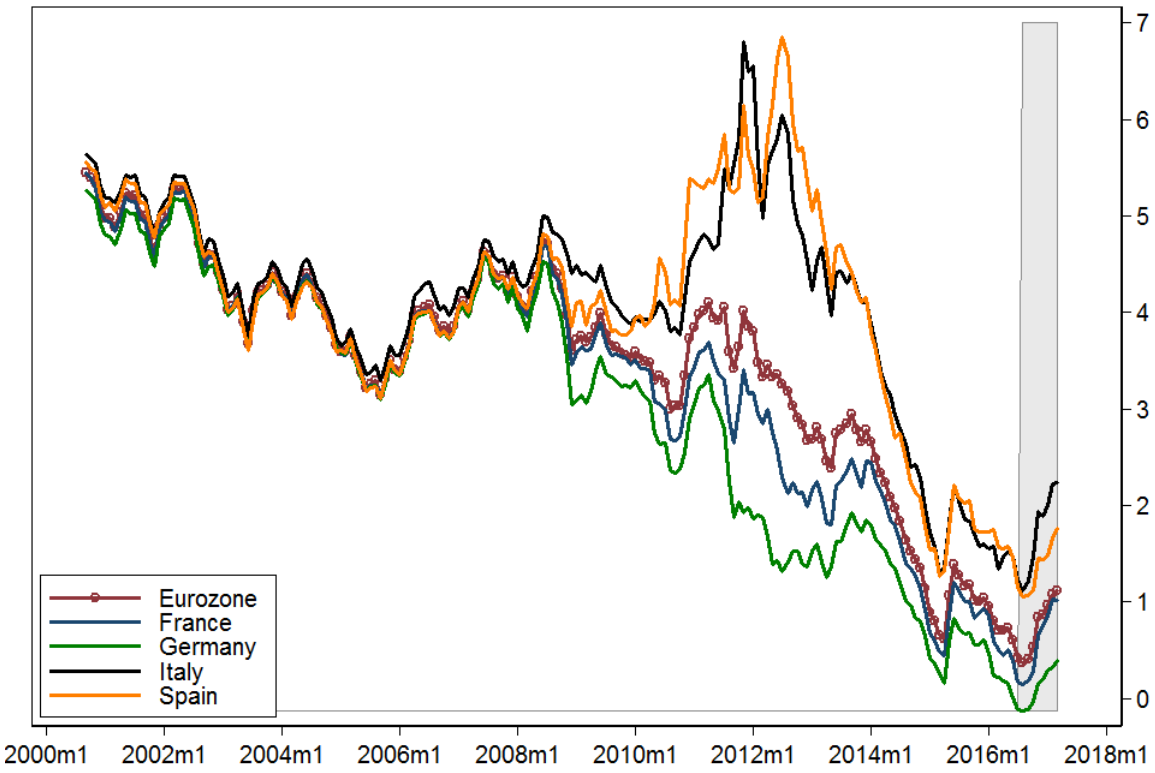
EXECUTIVE SUMMARY

- The recent rise in euro area long-term interest rates could jeopardize the on-going recovery if interest rates went beyond what the fundamentals require.
- The recent rise in euro area sovereign long-term interest rates can have several interpretations. One may be that, given the current economic and financial situations, the rise in long-term interest rates is only early evidence that expectations of future economic and financial conditions are positively oriented in the euro area. Another one may be that euro area bond markets are lagging behind US markets. Finally, if neither of these determinants explains long-term interest rates, there would be a case for overshooting: long-term interest rates would have moved beyond the values expected from the fundamentals.
- We propose an analysis that explains the evolution of long-term interest rates in the euro area and in some of its Member States since the birth of the euro in 1999.
- We include four categories of fundamentals (macroeconomic, financial, expectations, international) which have been key determinants of long-term interest rates in the literature. Long-term interest rates may move with the business cycle and inflation, both actual and expected, with monetary policy, domestic and foreign, and with financial instability and foreign financial trends.
- We find that monetary variables, spillovers from the US financial markets, output and inflation expectations and sovereign risks have been the main determinants of long-term interest rates in the euro area since 1999.
- The empirical model has a very good fit and explains the bulk of long-term interest rates' variations since 1999, at the euro area level and also at the level of countries. Fundamental variables explain at least 89% of the long-term interest rates' variation in Spain and 98% in Germany.
- Consequently, the model does not identify overshooting in the variations of the long-term interest rate over the recent period. The discrepancy between the actual long-term interest rate and the value that the model would predict is very small. In the euro area, French and German cases, the model rather identifies a recent period of undershooting.
- The rise in long-term interest rates observed since August 2016 is attributed to two factors. The first one is the increase in US long-term interest rates after the tightening of the Fed's monetary policy. The second factor stems from the political tensions in France, Italy or Spain which generated higher perceived political risk and then higher sovereign risk. While the former factor might continue to drive euro area interest rates up, the second one might have decreased with the results of the French presidential elections and drive interest rates down.

1. INTRODUCTION

Since the onset of the global financial crisis, the evolution of long-term interest rates in the euro area has shown large swings and periods of intense divergence among the Member States, most notably between 2010 and 2013 (figures 1 and 2). A sharp reduction in long-term rates started after July 2012 and the "whatever it takes" policy orientation of the ECB. Despite communication policy and the implementation and extension of the public sector purchase programme (PSPP), long-term interest rates have recently gone up again, though they remain at historical low levels. The recent rise has not occurred (yet?) on corporate rates.

Figure 1. Long-term sovereign interest rates in the euro area (in %)



Source: ECB.

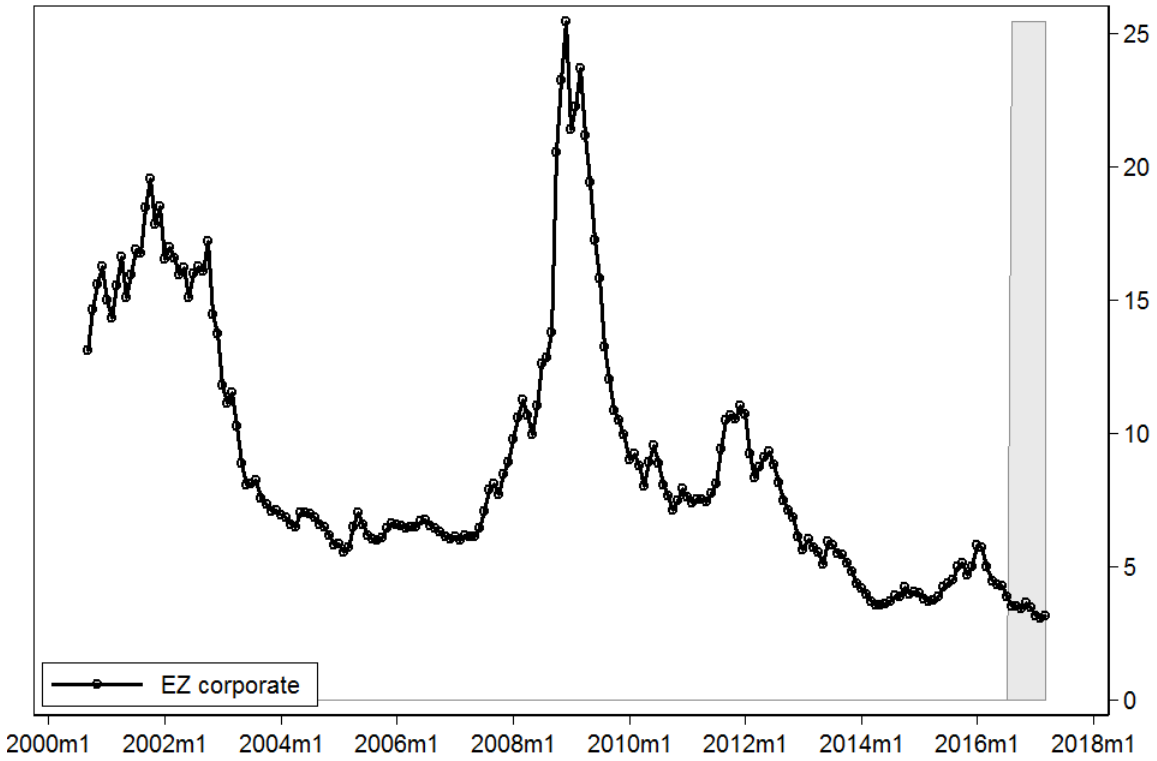
The recent rise in euro area sovereign long-term interest rates can have several interpretations. One may be that, given the current economic and financial situations, the rise in long-term interest rates is only early evidence that expectations of future economic and financial conditions are positively oriented in the euro area. Such an interpretation would signal that the fear of secular stagnation and the threat of deflation would vanish. Another one may be that euro area bond markets are lagging behind US markets: European rates would rise after US rates despite divergence between ECB and Fed's respective policy stances. The impact of foreign monetary policies on euro area long-term interest rates would be stronger than that of the domestic policy. Or the rise in euro area rates would go beyond what the fundamentals would require: consequently, they would jeopardize the on-going recovery and make it more difficult to deleverage where private and public debts remain high.

Long-term interest rates may react to expectations and to policies: monetary and fiscal, domestic and foreign. The question of the determinants of long-term interest rates is an important one: it permits to discriminate between different possible interpretations about

the variations in the long-term interest rates. The question of possible recent changes in these determinants is also of importance: it can shed light on short-lived or long-lasting effects on the interest rates.

In the following, we intend to give answers to both questions. We explain the evolution of long-term interest rates in the euro area and in some of its Member States since the birth of the euro. So doing, we highlight the key contributors – let us call them the fundamentals - to long term interest rates and compare them across the different countries under study. Then, we highlight the end of the time sample and verify whether these fundamentals have continued recently to explain long-term interest rates. Otherwise, there would be a case for overshooting: long-term interest rates would have moved beyond the values expected from the fundamentals. We also compute their respective contributions and compare them over time.

Figure 2. Long-term corporate interest rates in the euro area - Euro High Yield Index (in %)



Source: FRED (BofA Merrill Lynch).

2. LONG-TERM EQUILIBRIUM RATE IN THE EURO AREA

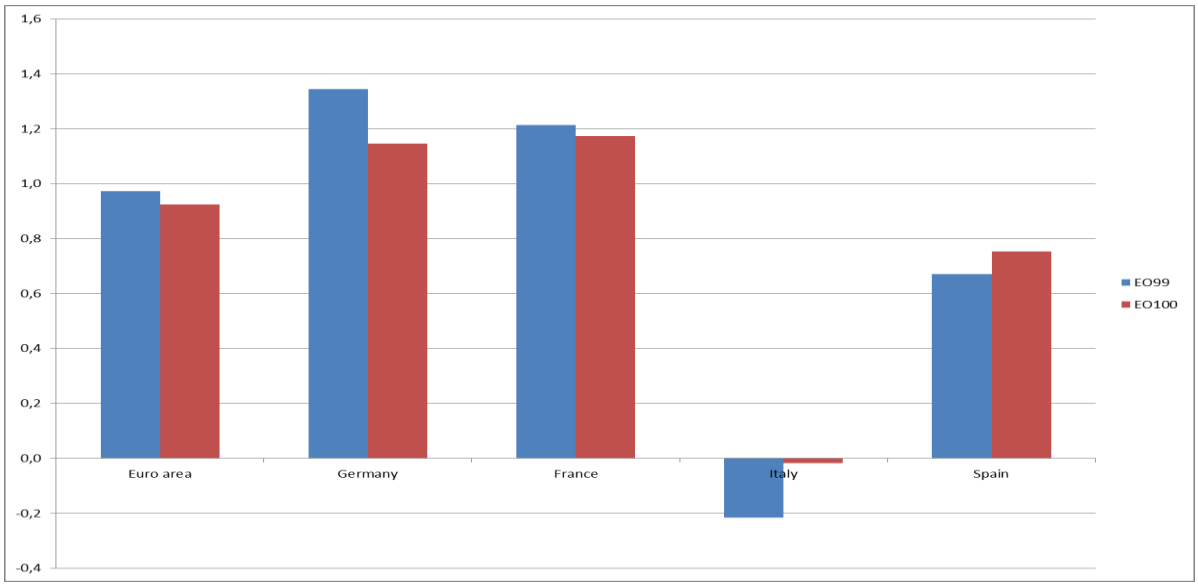
After a long period of decrease, long-term interest rates in the euro area have risen since the summer 2016 (figures 1 and 2). In Germany, the 10-year benchmark sovereign bond yield went out from the negative territory and reached 0.39% in March 2017. The rise was more rapid and abrupt for France, Italy and Spain, respectively 0.9, 1.1 and 0.7 pp (percentage point). It has notably been correlated with the upward trend observed in the United States. However, nominal long-term interest rates of industrial countries remain at very low levels from a historical perspective, which is also challenging for monetary policy makers (Bauer & Rudebusch, 2016). There is yet a need to explain the recent upward trend notably because monetary policy in the euro area is still accommodative as the ECB continues to buy assets in the financial markets.

Standard economic theory suggests that the long-term interest rate is driven by two key factors: expectations of future short-term rates and the term premium. According to Williams (2003), the future real short-term interest rate is expected to converge towards a "natural" real rate of interest. It corresponds to a short-term real interest rate that should prevail when the economy is at full employment. Consequently, the "natural" real rate of interest relates to the potential output while in nominal terms, it is also influenced by expected long-run inflation. Recent concerns have been raised about the risk of secular stagnation in the euro area that would reduce the "natural" real rate of interest. In this scenario, monetary policy would become less effective as it relies on the ability to stimulate (or slow down) the aggregate demand through its influence on market interest rates (short-term, long-term and retail banking interest rates) and long-term inflation expectations. Consequently, the period of low interest rates may have reflected the risk of secular stagnation and the attempt by the central bank to lower the interest rates below the "natural" interest rate. The recent rise could therefore signal that this risk is easing.

As a first approximation, we assess visually whether the rise in the long-term interest rates in the euro area may be at least partly explained by the potential output and inflation expectations.

Although the economic outlook has improved in the euro area and recovery has been confirmed, there is no significant upward trend in the estimate of potential output of the euro area and of its four largest Member States (Figure 3). Estimates of German and French potential output have decreased, whereas they have increased in Spain – to a low level – and Italy – though it remains negative-. According to OECD estimates, potential growth for the euro area in 2017 decreased by 0.1 between the June's (EO99: Economic Outlook nr. 99) and the November's (EO100) vintages.

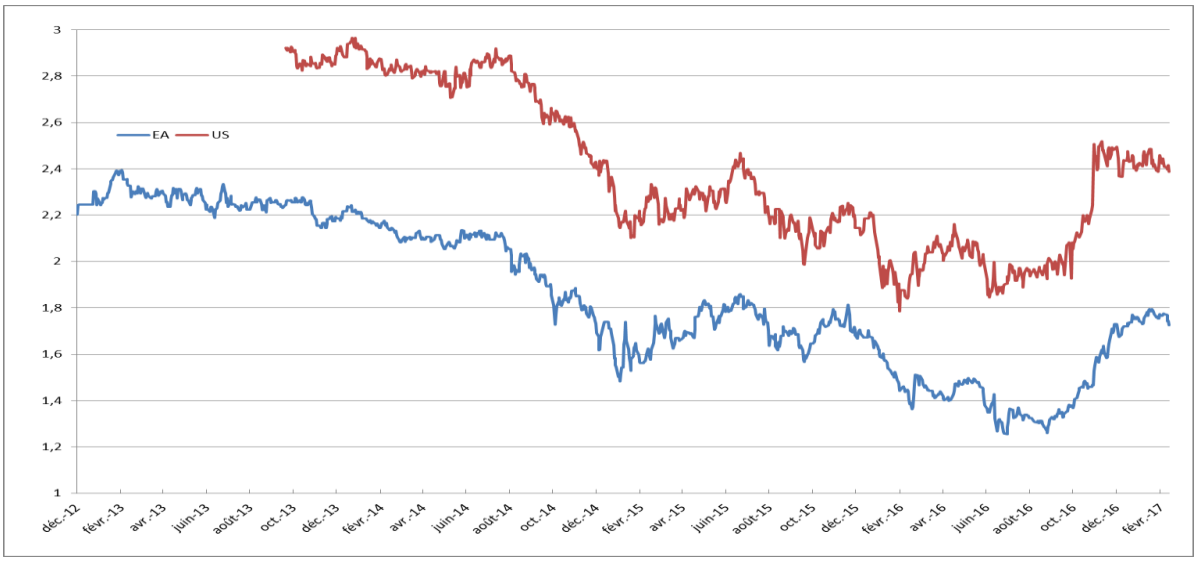
Figure 3. Real growth of the potential output (in %)



Source: OECD Economic Outlook n°99 and 100.

Contrary to the outlook for potential output, inflation rates in European countries have risen. They have been in line with the increase in oil prices, which rebounded after a trough below 30$ in January 2016. This rise was rapidly transmitted not only to the harmonised inflation rate – that went from -0.1% in 2016Q2 to 1.7% in 2017Q1 in the euro area– but also to long-term inflation expectations (Figure 4) in both the euro area and the United States. The rise in the nominal interest rates in the euro area may therefore be partly explained by a change in inflation expectations. Such an effect would also signal that the risk of deflation is vanishing. However, the visual correlation needs to be confirmed by data and a more structural analysis. Besides, long-term interest rates are not only influenced by potential output and expected inflations. Other macroeconomic and financial factors play a role, which must be taken into account to assess whether there has been some overshooting in European interest rates.

Figure 4. Long-term (5 years in 5 years) inflation expectations (in %)



Source: Thompson Reuters.

3. WHAT DETERMINES LONG-TERM INTEREST RATES IN THEORY?

There has long been an opposition between the loanable funds theory and the liquidity preference theory on interest rates. According to the former, the interest rate is set at the balance between domestic savings and investment whereas according to the latter, it is set at the balance between money supply and money demand. The loanable funds theory highlights the incidence of the structural environment on interest rates, i.e. those variables which influence either savings, like demography, or investment, like the future yields on capital; whereas the liquidity preference theory highlights the effects of monetary policy and short run output fluctuations (in the spirit of the well-known LM curve).

The usual distinction between both theories has long been related to the time dimension of the interest rate: the loanable funds theory applies to the long-term interest rate whereas the liquidity preference theory applies to the short-term interest rate. The distinction has therefore led to the complete separation of both interest rates and to the conclusion that monetary policy, via the setting of the short-term interest rate, would have no impact on long-term interest rates.

This separation vanishes if the term structure of the interest rate is being introduced. Under the (perfect) expectations hypothesis, the long-term interest rate would be a sequence of expected short-term rates. Under this specification, long-term interest rate would depend on expected monetary policy. If monetary policy can be described by a Taylor rule, the long-term interest rate would depend on expected inflation and expected output gap (or expected economic growth).

Drawing on these theories – loanable funds, liquidity preference and expectations hypothesis - it appears that the determinants of long-term interest rates can be separated into two parts: a macroeconomic part which illustrates the savings-investment nexus and includes current monetary policy and another part related to the expectations of future monetary policies.

The era of globalization which accelerated in the 1980s has added two new groups of determinants to long-term interest rates: highly opened economies have increased the interactions between foreign and domestic interest rates; they have also led to growing liquidity and many more opportunities of arbitrage between financial markets, between currencies and between maturities. Globalization has thus made long-term interest rates more sensitive to financialisation and to financial risk. Globalization has then impinged on long-term interest rates via exchange rate variations and intensified their sensitiveness to global shocks.

Overall, we distinguish four parts among the determinants of long-term interest rates: macroeconomic, expectations, international and financial parts.

4. WHAT DETERMINES LONG-TERM INTEREST RATES IN PRACTICE?

In order to understand the recent dynamics in the European bond markets, we propose an analysis in four steps. First, we present an econometric methodology to estimate the long-term interest rates in the euro area. Second, based on this methodology, we highlight the main determinants of European long-term interest rates. Third, exploiting the explanatory power of our methodology, we can assess if long-term interest rates are in line with fundamentals and if we can identify periods of under/over-shooting. We isolate periods of overshooting when the residuals of our estimations are positive. If that is the case , the fundamentals predict a lower level for the long-term interest rate compared to its actual level. Fourth, we focus on the factors that explain the recent rise of sovereign interest rates since August 2016 and check whether the contribution from key factors has changed recently.

4.1. Methodology to determine long-term interest rates

In order to evaluate whether the European bond market is overshooting, we estimate a simple model accounting for the determination of long-term interest rates for six types of long-term interest-rates: the 10-year sovereign long-term interest rates for the euro area, France, Germany, Italy and Spain, and an index of euro area corporate interest rates. The sample has a monthly frequency and it runs from January 1999 to February 2017.

We investigate the contribution of fundamentals to long-term interest rates ($i_{c,t}$) for country *c* at time *t*, and then we examine whether long-term interest rates are in line with the fundamentals or reveal over/under-shooting. We include four categories of fundamentals (macroeconomic, financial, expectations, international). The sources of data are reported in the appendix (table A.1).

First, to capture the effect of ECB monetary policy on long term-interest rates, we use the short-term interest rate (*eonia*) and the amount of securities held for monetary purposes (*shmpp*) which measures the stance of quantitative easing. We also include the industrial production index (*ipi*) and the inflation rate (*cpi*) to capture fundamentals linked to macroeconomic developments in the euro area. For robustness checks (see figures A.3 and 4 in the Appendix), we also include government debt and current account variables, which have long been considered as important contributors to long-term interest rates. They are not included in the benchmark model for the following reasons: i) government debt data are not available at a monthly frequency (only quarterly); ii) the latest government debt data currently available refer to the last quarter of 2016 and cannot therefore be used to investigate recent developments in long-term interest rates; iii) as current account data are available since 1999 for the euro area and only since 2008 for Member States, a comparison is not possible.

Second, long-term interest rates may be influenced by international factors. Effective exchange rates (*eer*) and oil prices are thus taken into account. We also include the US federal fund rate (*ffr*) and the US 10-year sovereign interest rate (i_{us}) to capture spillovers stemming from the US money and financial markets.

Third, financial risks can explain the long-term interest rates. Aggregate risks are explained by the US volatility index (*VIX*) and by specific sovereign risks in the euro area measured by the composite indicator of systemic risk (*CISS*) provided by the ECB.

Fourth, the influence of expectations is modelled with two variables, the forecast of inflation (*spf_cpi_2y*) and the forecast of GDP growth (*spf_gdp_2y*) both at a 2-year horizon. These variables are available from the Survey of professional forecasters published by the ECB.

These four categories of fundamentals are summarized in the following equation of the long-term interest rate:

$$\begin{aligned} i_{c,t} = {} & eonia_t + shmpp_t + ipi_{c,t} + cpi_{c,t} \\ & + eer_t + oil_t + vix_t + ciss_{c,t} \\ & + i_{us,t} + ffr_t + spf_cpi_t + spf_gdp_t + \varepsilon_{c,t} \end{aligned}$$

4.2. Determinants of long-term interest rates in the euro area

Table 1 reports the results of the six estimations. We emphasize the most important ones:

1. Monetary policy variables (*eonia* and *shmpp*) are highly relevant to determine long-term interest rates. In particular, the asset purchase programmes represented by the shmpp variable have a significant and negative effect on all sovereign long-term interest rates but the 10-year corporate long-term interest rate. This is consistent with the fact that the ECB has bought more sovereign bonds than corporate assets. As for the influence of the ECB policy rate, once the estimations are performed before the zero-lower bound was hit, its sign is significantly positive and consistent with the expectations hypothesis (see appendix, table A.2 and figure A.1).
2. International spillovers effects coming from the US 10-year interest rate affect positively all European long-term interest rates.
3. GDP expectations affect positively all European long-term interest rates and inflation expectations also influence positively all long-term interest rates but Italian sovereign and euro area corporate.
4. Risks measured through the CISS also affect positively long-term interest rates. The CISS captures financial, economic but also political risks. The coefficient associated with the CISS is significantly higher in Italy and Spain than in Germany and France.
5. The empirical model has a very good fit. The adjusted R2, which shows the percentage of variation of the long-term interest rates explained by the variables included in the regression, is high and between 0.89 (Spain, equation 5) and 0.98 (Germany, equation 3). Fundamentals thus explain at least 89% of the long-term interest rates variation in the Spanish case and 98% in the German case.

Table 1: Long-term interest rates determination

	(1) ez_s10y	(2) fr_s10y	(3) de_s10y	(4) it_s10y	(5) es_s10y	(6) ez_c10y
eonia	-0.138***	-0.07	0.178***	0.133**	-0.401***	0.883***
	[0.05]	[0.06]	[0.05]	[0.06]	[0.08]	[0.29]
shmpp	-0.293***	-0.287***	-0.220***	-0.213***	-0.400***	-0.043
	[0.03]	[0.03]	[0.03]	[0.03]	[0.04]	[0.15]
ipi	-0.043***	-0.013*	-0.005	-0.017***	-0.046***	-0.404***
	[0.01]	[0.01]	[0.00]	[0.01]	[0.01]	[0.03]
cpi	0.007	0.024	-0.100***	0.022	-0.083**	-0.007
	[0.04]	[0.05]	[0.03]	[0.04]	[0.04]	[0.26]
eer	0.010**	0.002	0.000	0.016***	0.007	-0.147***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]	[0.02]
oil	0.002	0.007***	0.008***	0.001	0.001	0.008
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]
ffr	-0.004	-0.104***	-0.203***	-0.035	0.132***	-0.482***
	[0.03]	[0.03]	[0.02]	[0.03]	[0.04]	[0.16]
us_s10y	0.693***	0.794***	0.921***	0.566***	0.331***	1.107***
	[0.04]	[0.05]	[0.04]	[0.05]	[0.07]	[0.24]
vix	0.001	0.015***	0.012***	-0.002	0.002	0.254***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]	[0.02]
ciss	3.731***	2.135***	0.561**	4.718***	4.347***	4.479***
	[0.26]	[0.40]	[0.24]	[0.22]	[0.25]	[1.60]
spf_cpi_2y	1.331***	1.435***	1.864***	-0.204	1.594***	-0.25
	[0.24]	[0.25]	[0.20]	[0.30]	[0.44]	[1.45]
spf_gdp_2y	1.281***	0.709***	0.303***	0.798***	2.041***	2.260***
	[0.11]	[0.14]	[0.10]	[0.12]	[0.18]	[0.68]
constant	-4.232***	-3.692***	-4.209***	-0.341	-4.253***	-5.134*
	[0.43]	[0.50]	[0.38]	[0.52]	[0.76]	[2.61]
N	198	198	198	198	198	198
Adj. R^2	0.96	0.96	0.98	0.93	0.89	0.91

Standard errors in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01.

Source: authors' computations.

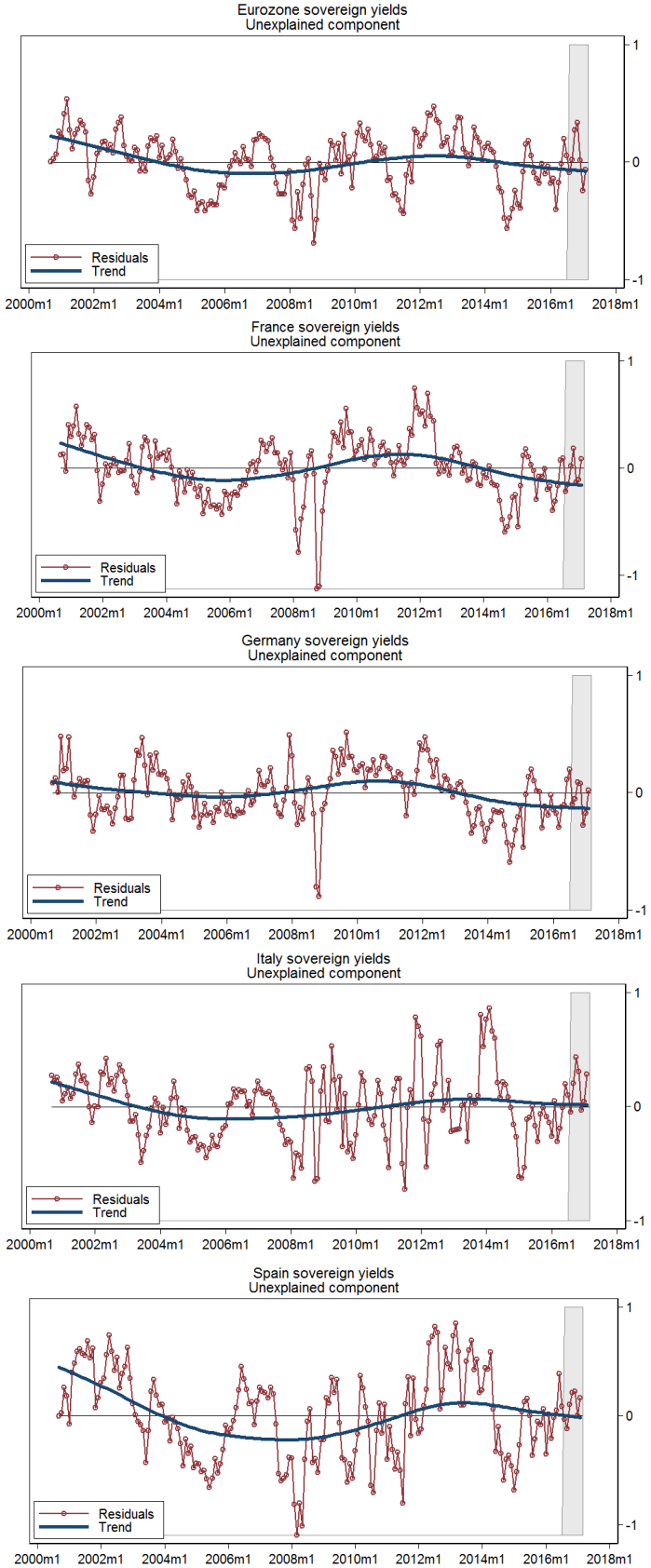
4.3. Is the European bond market overshooting?

We interpret overshooting (or undershooting) as the discrepancy between the actual value of the long-term interest rate and the predicted value from the fundamentals. If the long-term interest rate rises substantially even though the fundamentals predict only a smooth increase, the discrepancy can be interpreted as an overshooting. Technically, this occurrence will be made visible in the residuals of the respective estimations. But the residuals are usually very volatile. Therefore we smooth out their volatility by a Hodrick-Prescott filter to obtain the underlying trend. We identify episodes of overshooting (resp. undershooting) when the trend of the residual is positive (resp. negative).[1]

Figures 5 and 6 report the residuals and their trends for the estimations of the six long-term interest rates. In grey we highlight the period since August 2016. Results do not show periods of overshooting during the recent period. On the contrary, the trend of the residual turns out to negative in euro area, German and French sovereign interest rates for several months, which suggests undershooting long-term interest rates. In Italy, Spain and for the euro area corporate rates, there is neither evidence of overshooting nor evidence of undershooting.

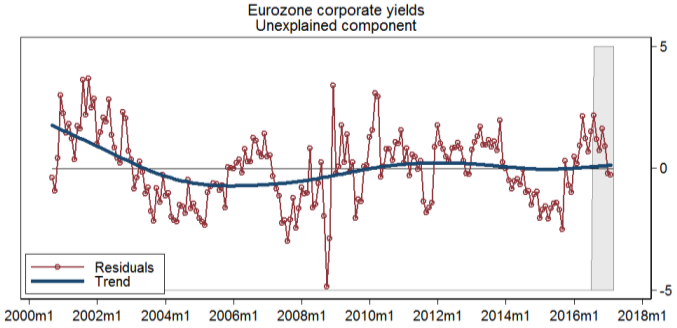
[1] As a robustness check (figure A.2), we also model the residuals as a GARCH process. Conclusions are not altered.

Figure 5: Unexplained component in sovereign interest rates



Source: authors' computations.

Figure 6: Unexplained component in corporate interest rates



Source: authors' computations.

4.4 What explains the recent rise in long-term interest rates?

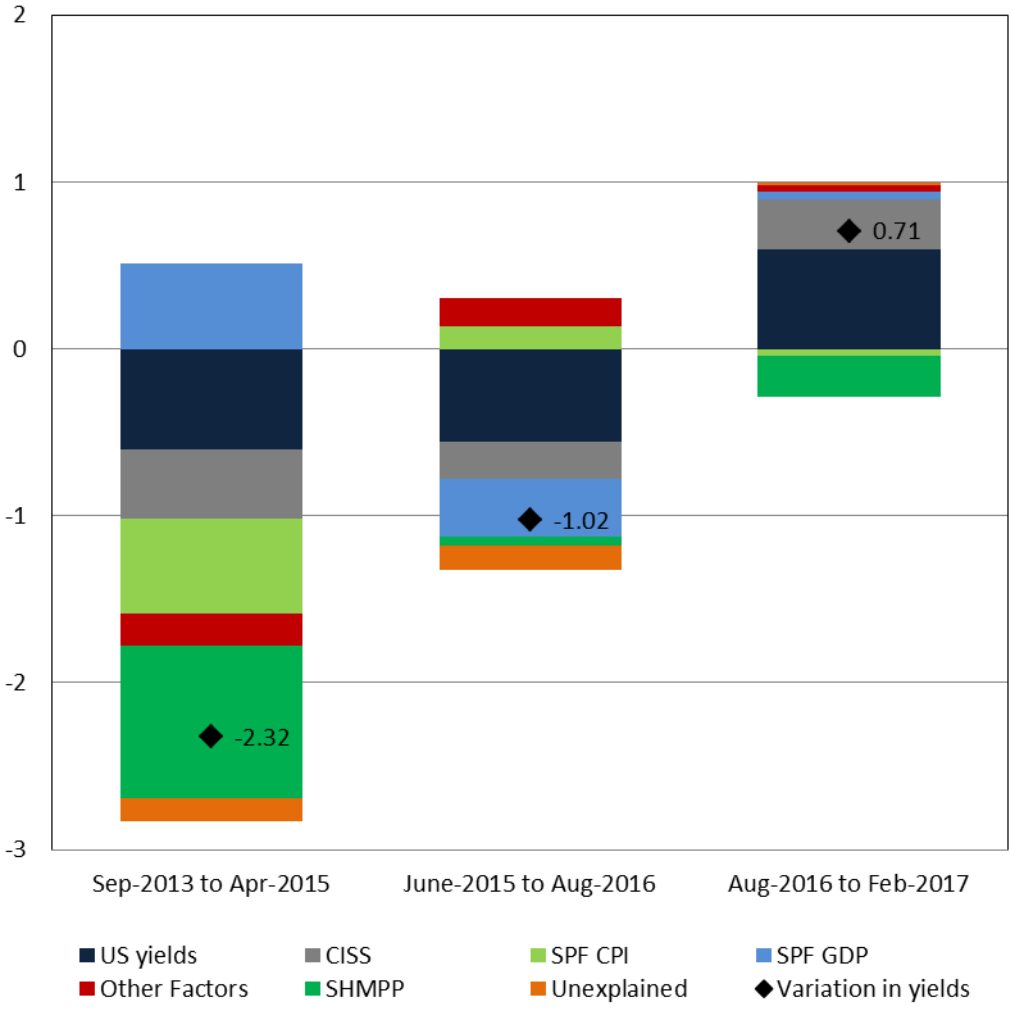
Our methodology allows to understand the factors behind the rise of sovereign interest rates since the end of the second half of 2016. We can compute the contributions of the different determinants of the long-term interest rates and highlight the most important ones. Figure 7 reports the main factors that affect positively and negatively the euro area long-term interest rates on three different periods.

Between September 2013 and April 2015, the euro area long-term interest rate declined by 2.3 pp. Over this period, only expectations about GDP growth affected positively the interest rate while all other factors pushed it to the downside. In particular, the US long-term interest rate, inflation expectations, the reduction in the sovereign risk and ECB unconventional policies (*shmpp*) contributed to the decline in the euro area interest rate.

Between June 2015 and August 2016, the new decline by about 1 pp, was mostly explained by two factors: the US long-term interest rate and GDP growth expectations.

Between August 2016 and February 2017, the long-term interest rates grew by 0.7 pp. While ECB's asset purchase program contributed to lower the interest rate, two factors contributed to its rise. The first is the increase in US long-term interest rates after the tightening of the Fed's monetary policy. The second factor stems from the political tensions in France, Italy or Spain which generated higher perceived political risk and then higher sovereign risk. While the former factor might continue to drive euro area interest rates up, the latter one might have receded with the results of the French presidential elections and drive interest rates down.

Figure 7: Contributions to euro area sovereign yields variation



Source: authors' computations.

5. DISCUSSION AND POLICY RECOMMENDATIONS

Quite interestingly, long-term interest rates in the euro area have been on a downward trend since 1999 and the adoption of the euro. This trend took place despite the so-called sovereign-debt crisis between 2010 and 2015.

However, long-term interest rates in the euro area on average and in euro area Member States in particular have risen since August 2016 although the ECB monetary policy stance was highly accommodative. The recent evolution of long term-interest rates casts doubts on the rationality of financial markets: Are interest rates overshooting their determinants?

We distinguish four main determinants of long-term interest rates and among them, we include risk. In contrast with the notion of uncertainty, risk is measurable (probabilistic notion) whose influence can be identified in the evolution of long-term interest rates.

An important conclusion of our empirical investigation is the persistent influence of three factors on euro area long-term rates: ECB unconventional monetary policy, the spillover from the US financial markets and risk. The former continues to dampen long-term interest rates whereas the two others have played differently on euro area interest rates over time, driving euro area rates down until August 2016 and up ever since. Under the assumption that risk is a fundamental determinant of long-term interest rates, our results clearly rule out a case of recent overshooting. We assume that the composite index of systemic stress (CISS) is a good proxy for risk in both the euro area and its Member States.

To sum up, the empirical investigation shows that long-term interest rates in Europe depend on domestic monetary policy, both conventional (it worked before the short-term interest rate hit the zero-lower-bound) and unconventional, and on monetary and financial spillovers from the US markets.

Any exit strategy from current monetary policy stance will therefore require some vigilance from the ECB. The reversal in the ECB monetary stance may have a disproportionate impact on euro area long-term interest rates as it will be associated with US monetary and financial data.

Moreover, we highlighted the impact and contribution of risk on long-term interest rates. Managing risk is certainly not an easy task. Nevertheless, a smooth transition of long-term interest rates after ECB's tapering will require that risk remains under control. Transparency and forward guidance on the side of the ECB will be crucial in this respect, as will be the willingness of European governments to support and revive the European integration process through active cooperation.

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APPENDIX

Table A.1. Data

	Sources	Frequency	Availability
Interest rates			
Sovereign yields for the Eurozone, Germany, France, Italy & Spain	ECB	Monthly	1999:M1 – 2017:M3
Corporate yield (Euro High Yield Index)	Fred (Merrill Lynch)	Monthly	1999:M1 – 2017:M3
Eurozone monetary policy			
EONIA	ECB	Monthly	1999:M1 – 2017:M3
Securities held for monetary purpose (shmpp)	ECB	Monthly	2009:M7 – 2017:M3
International factors			
Euro Effective exchange rate	ECB	Monthly	1999:M1 – 2017:M3
Federal funds rate	Fred	Monthly	1999:M1 – 2017:M3
Oil price	Fred	Monthly	1999:M1 – 2017:M3
US long-term sovereign yield	Fred	Monthly	1999:M1 – 2017:M3
Eurozone Macroeconomic fundamentals			
Industrial production (Eurozone, Germany, France, Italy & Spain)	Eurostat	Monthly	1999:M1 – 2017:M3
Consumer price Index (Eurozone, Germany, France, Italy & Spain)	Eurostat	Monthly	1999:M1 – 2017:M3
Eurozone Current account	Eurostat	Monthly	1999:M1 – 2017M2
Eurozone Public debt (as % of GPD)	Eurostat	Quarterly	2000Q1 – 2016Q4
Financial factors			
VIX	Fred	Monthly	1999:M1 – 2017:M3
CISS (Composite index of systemic risk, Eurozone, Germany, France, Italy & Spain)	ECB	Monthly	2000:M9 – 2017:M3
Expectations			
Eurozone 2-year ahead expected inflation	ECB (SPF)	Quarterly	1999:Q1 – 2017:Q1
Eurozone 2-year ahead expected GDP growth	ECB (SPF)	Quarterly	2000:Q1 – 2017:Q1

Table A.2. Pre and post zero-lower-bound period's estimates

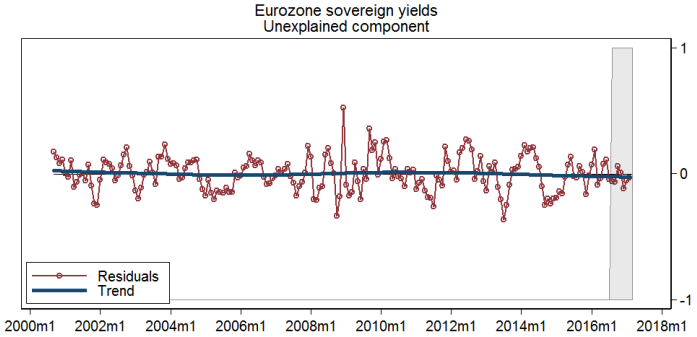
Long-term interest rates determination

	ez_s10y		fr_s10y		de_s10y		it_s10y		es_s10y		ez_c10y	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Pre ZLB	Post ZLB	Pre ZLB	Post ZLB	Pre ZLB	Post ZLB	Pre ZLB	Post ZLB	Pre ZLB	Post ZLB	Pre ZLB	Post ZLB
eonia	0.287***		0.272***		0.300***		0.335***		0.304***		2.857***	
	[0.06]		[0.05]		[0.04]		[0.05]		[0.06]		[0.52]	
shmpp		-0.071**		-0.066**		-0.119***		-0.115**		-0.178***		0.033
		[0.03]		[0.03]		[0.03]		[0.06]		[0.05]		[0.16]
ipi	0.003	-0.015***	-0.003	-0.007	0.007	0	-0.002	-0.002	-0.014	0.002	-0.533***	-0.264***
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.09]	[0.03]
cpi	-0.090**	0.056	-0.014	0.159***	-0.069**	-0.115**	0.02	0.371***	-0.032	-0.013	0.169	-0.435*
	[0.04]	[0.05]	[0.03]	[0.05]	[0.03]	[0.05]	[0.04]	[0.07]	[0.02]	[0.05]	[0.39]	[0.26]
eer	0.012***	0.014***	0.017***	0.008*	0.013***	-0.013***	0.010**	0.039***	0.011**	0.01	-0.161***	-0.080***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]	[0.00]	[0.01]	[0.04]	[0.02]
oil	0	-0.001	0	-0.001	0	0.006**	-0.002	0.002	-0.001	0.003	-0.015	0.025**
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.02]	[0.01]
ffr	0.744***	0.811***	0.743***	1.036***	0.728***	1.122***	0.750***	0.500***	0.748***	0.268***	0.773*	1.551***
	[0.05]	[0.03]	[0.05]	[0.04]	[0.04]	[0.04]	[0.05]	[0.07]	[0.05]	[0.06]	[0.43]	[0.19]
us_s10y	-0.178***	-1.123***	-0.168***	-1.250***	-0.196***	-0.563**	-0.167***	-1.447***	-0.167***	-1.012**	-0.902***	2.285*
	[0.03]	[0.24]	[0.02]	[0.24]	[0.02]	[0.28]	[0.03]	[0.48]	[0.03]	[0.46]	[0.25]	[1.33]
vix	0.004	-0.004	0.004	0.006	0.001	0.006	0.007**	0.009	0.008***	-0.008	0.241***	0.247***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]	[0.00]	[0.01]	[0.00]	[0.01]	[0.02]	[0.02]
ciss	1.278***	3.788***	0.733***	3.502***	0.408**	1.786***	1.453***	2.939***	0.582**	3.874***	-12.417***	7.895***
	[0.34]	[0.32]	[0.26]	[0.39]	[0.18]	[0.55]	[0.41]	[0.37]	[0.26]	[0.29]	[3.15]	[1.76]
spf_cpi_2y	0.562*	1.318***	0.738**	1.326***	0.644**	2.586***	0.587*	-0.044	0.662**	2.261***	0.676	2.368*
	[0.30]	[0.22]	[0.28]	[0.20]	[0.30]	[0.23]	[0.33]	[0.42]	[0.31]	[0.50]	[2.79]	[1.21]
spf_gdp_2y	0.613***	-0.226	0.591***	0.029	0.496***	-0.081	0.415***	-0.261	0.615***	-0.119	0	-1.088
	[0.12]	[0.14]	[0.11]	[0.15]	[0.09]	[0.17]	[0.13]	[0.30]	[0.13]	[0.24]	[1.14]	[0.79]
constant	-1.868**	-2.177***	-2.281***	-3.133***	-1.713**	-5.282***	-1.808**	1.448*	-2.248***	-1.576*	-3.39	-5.976**
	[0.74]	[0.42]	[0.69]	[0.40]	[0.66]	[0.46]	[0.85]	[0.80]	[0.75]	[0.84]	[6.83]	[2.33]
N	100	98	100	98	100	98	100	98	100	98	100	98
Adj. R^2	0.94	0.98	0.94	0.98	0.94	0.97	0.93	0.96	0.95	0.97	0.93	0.96

Standard errors in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01.

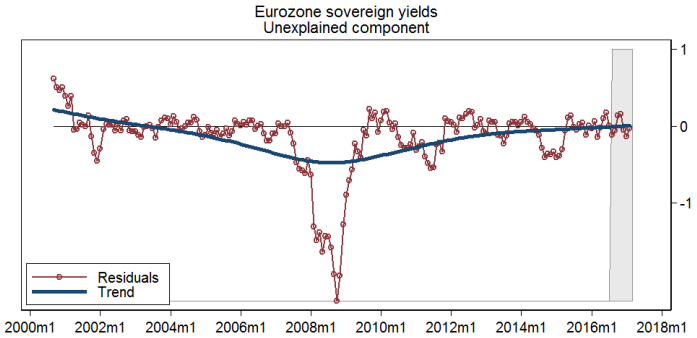
Source: authors' computations.

Figure A.1. Pre/post ZLB estimation



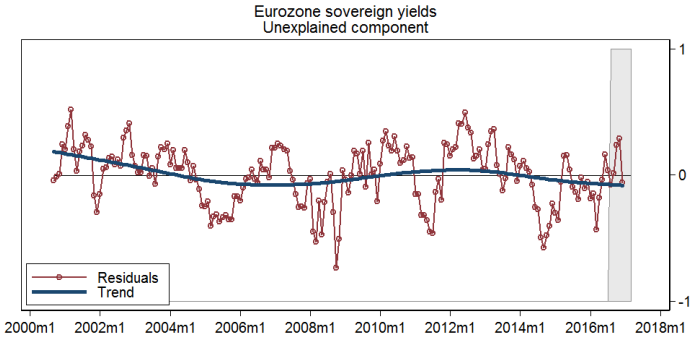
Source: authors' computations.

Figure A.2. GARCH estimation



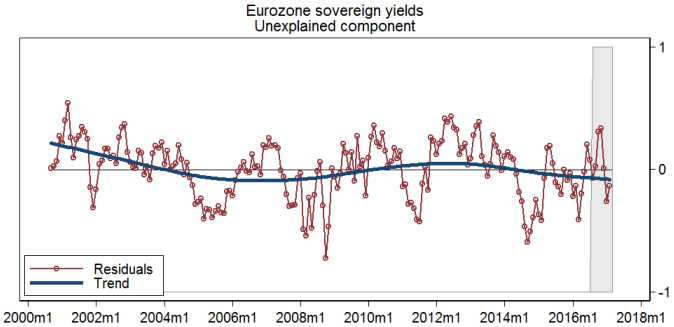
Source: authors' computations.

Figure A.3 Including public debt



Source: authors' computations.

Figure A.4. Including current account



Source: authors' computations.