Internal or external devaluation?

What does the consumer survey tell us about macroeconomic adjustment in the euro area?

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Abstract

This paper explores the dynamics of regional inflation expectations within the euro area during the crisis. Using the European Commission's Consumer Survey, we find that the strong anchoring of area-wide inflation expectations which is typically found in the literature, does not extend to individual member states. We next measure the effect of the crisis on national inflation expectations using sovereign bond spreads. We find that sharp increases in sovereign risk during the crisis have a significant negative effect on inflation expectations, suggesting that consumers expect their country to adjust through internal devaluation. In contrast, we find no evidence that tensions in the sovereign bond markets increase inflation expectations, as one would be expect under an exit or breakup scenario.

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1. Introduction

Since 1999, the European Central Bank (ECB) has been conducting monetary policy for the euro area a whole. As the ECB lacks the instruments to target its policies to macroeconomic conditions in individual member states, it tends to focus on area-wide price stability. Thus, in defending the ECB's track record during the height of the euro crisis, former ECB president Trichet claimed that the euro area as a whole had a better track record of price stability than Germany, France or the Netherlands over the 50 years before the euro (Trichet, 2011). In addition to establishing a track record of low and stable actual inflation rates, the anchoring of inflation expectations is also deemed of great importance to central bankers (Bernanke, 2007). During the crisis, the ECB's mantra has been that inflation expectations in the euro area are in line with its definition of price stability, implying that the financial markets and the public have confidence in the ECB's ability to deliver on its mandate. This view is underpinned by recent research done at the ECB (Autrup & Grothe, 2014) which confirms the strong anchoring of inflation expectations in the Economic and Monetary Union (EMU) compared to the United States. This research also concludes that the financial crisis did not change the anchoring of inflation expectations in the euro area.

The official view of area-wide monetary stability sits uneasily with the large macroeconomic imbalances within the euro area which have come to the fore during the crisis. Even before the crisis, substantial cross-country differences in key macroeconomic variables existed. For example, a large body of literature documents the slow convergence in prices and inflation rates after the introduction of the euro (Angeloni & Ehrmann, 2007). These differences have attracted more attention during the crisis, as the crisis' negative impact was felt in a more extreme way in the Southern problem countries than in Northern Europe. Since the crisis, some problem countries have also experienced falling price levels, which seems hard to reconcile with the ECB's objective to maintain inflation rates below, but close to 2%.

This paper poses the question whether the stable anchoring of area-wide inflation expectations that we observe in the euro area extends to the individual member states. This research question would be irrelevant if price stability as measured using an area-wide consumer price index is a sufficient condition for price stability as perceived by economic agents across the union. But it is unlikely that this is the case. For most economic decision making, national inflation rates are still more relevant than area-wide inflation rates. For example, as few inhabitants of the euro area consume according to the area-wide consumer price index, national price indices will remain dominant in wage setting. At the same time, the volatility of national inflation rates has been much higher than that of area-wide inflation. During Ireland's stay in the euro area, an Irish citizen will have experienced an inflation rate of 4% in the boom years 1999-2003 versus a deflation of almost -2% in the crisis year 2009. Over the whole period, the standard deviation of Irish inflation has been 2%, compared to 0.8% for the euro area. The ECB's emphasis on maintaining area-wide price stability may then remind one of the

statistician who confidently tried to cross a river that was 1 meter deep on average and drowned. We therefore agree with Van der Cruijsen and Demertzis (2011, p. 287) that "inflation expectations at the euro area level are not a simple average of the country magnitudes. Country dynamics in the relationship between the two variables may be a source of instability and should therefore be monitored." Area-wide price stability can thus better be viewed as a necessary but not a sufficient condition for price stability at the country level.

The destabilizing potential of differentials in (expected) inflation within a monetary union is well-known (Honohan & Lane, 2003; Arnold & Kool, 2004). In the short run, a regional boom may induce procyclical effects on economic activity, as higher inflation leads to lower real interest rates and higher housing prices. This is the famous Walters critique that a monetary union is inherently unstable (Walters, 1990). In the long run, the effect of a worsening real exchange rate vis-à-vis partners in the union may, however, act as a countervailing force, by eroding the competitive position of the booming regions. The current difficult adjustment process of troubled EMU countries illustrates the complicated role of inflation differentials in the macroeconomic adjustment mechanism. While the need for internal devaluation vis-à-vis partners to regain competitiveness is undisputed, it brings about higher real expected interest rates and makes it more difficult to reduce the real value of public and private indebtedness.

The present study explores the dynamics of regional inflation expectations within the euro area. First, we build on Van der Cruijsen and Demertzis (2011) by investigating whether the findings of strong anchoring of area-wide inflation expectations which is typically found in the literature also holds for disaggregated country data. In contrast to Van der Cruijsen and Demertzis (2011), we analyse the complete set of euro area countries during the full crisis period. Our data on inflation expectations originate from the European Commission's Consumer Survey. We employ the methodology proposed by Dias, Duarte, and Rua (2010) to extract quantitative inflation expectations from qualitative survey data. We estimate a VAR specification similar to Van der Cruijsen and Demertzis (2011) to test the disconnection between inflation and inflation expectations at the level of individual EMU member states.

We next focus on the crisis period and investigate the effect of the financial crisis on national inflation expectations. As the financial market tensions were strongest in the sovereign bond markets, we take sovereign bond spreads as our crisis variable. We hypothesize three possible outcomes for the effect of the crisis on national inflation expectations:

1) Zero effect (anchoring)

   When consumers' inflation expectations are fully anchored in line with the ECB's price stability objective, sovereign bond spreads should have no effect on inflation expectations in individual countries;

2) Negative effect (internal devaluation)

When consumers in problem countries anticipate that the need to regain competitiveness and the imposition of austerity measures will lead to a process of internal devaluation, sovereign bond spreads will have a negative effect on inflation expectations. This implies that tension in the bond market will lead to a downward adjustment of inflation expectations (compared to other countries in the union).

3) Positive effect (external devaluation)

When consumers in problem countries expect that their country will not be able to sustain membership of the union and anticipate an exit or breakup, we hypothesize a positive effect. An exit from the union will lead to a strong devaluation of the new currency. This will feed through to domestic inflation via higher import prices.

We estimate the effect of sovereign bond spreads on inflation expectations in two ways. As a first pass, we estimate a panel regression model for all EMU member states jointly. We next allow for time and cross-country variation in the relationship between bond spreads and inflation expectations by estimating state space models which allow for time-varying coefficients for each country separately.

The outline of this paper is as follows. The next section provides a brief overview of the relevant literature. Sections 3 and 4 describe the data and the methodological approach. In section 5, we report the empirical results. Section 6 concludes.

2. Literature

Our empirical analysis is related to two different strands of the literature. The first consists of studies on the anchoring of inflations expectations in the euro area. The second entails the role of regional differences in (expected) inflation in the macroeconomic adjustment mechanism. We will address them in respective ordering.

Aghion et al. (2008) and Branch and Evans (2011) stress the importance of anchored inflation expectations for the conduct of monetary policy and attribute a key role to financial integration. The importance of the pre-crisis progress in area-wide financial integration for the anchoring of inflation expectations in the euro area is confirmed by Woodford (2007), Benati (2008) and Beck et al. (2009). Baele et al. (2004) argue that the synchronization of EMU member states' financial business cycles stems from the eradication of their ability to adjust exchange rates, the internalization of monetary policy decisions, financial risk sharing and cross-border linkages. Likewise, consumers now form their expectations not just based on domestic economic developments, but also take into account developments in neighbouring countries and the euro area as a whole (European Commission, 2006).

A host of studies report that inflation expectations have become more anchored since the changeover to the euro. Early contributions are by the ECB (2003), Allington et al. (2005) and Berk and Hebbink (2006). Angeloni and Ehrmann (2007) provide an overview of this early work. A comprehensive survey on regional inflation differentials is provided by De Haan (2010). More recent papers on anchoring are by Ehrmann et al. (2011), Glushenkova and Zachariadis (2014), Beechey et al. (2011) and Autrup and Gothe (2014). The consensus which emerges from this literature is that inflation expectations are better anchored within the euro area than in the United States. While responses to macroeconomic news announcements by European financial markets are generally short-lived, Beechey et al. (2011) find significantly stronger and prolonged effects in the United States. A common feature of most papers on euro-area anchoring is that they take an area-wide perspective, using aggregated data for the euro area as a whole.

Even so, the anchoring of European inflation expectations is still far from complete. Rogers (2001), Berk and Swank (2002), Ortega (2003), Arnold and Lemmen (2008), and Van der Cruijsen and Demertzis (2011) report evidence of regional differences in the anchoring of inflation expectations. Honohan and Lane (1999) stress that the absence of a federal fiscal system, the presence of migration barriers, divergences of financial cycles, ineffective banking resolution and a substandard macro-prudential regulatory system inhibit the anchoring of inflation expectations. Van der Cruijsen and Demertzis (2011) conclude that a credible disconnect between country-specific inflation experiences and consumers' expectations remains lacking in the euro area and that his may pose problems in the transmission of monetary policy.

In principle, in a well-integrated monetary union with strongly anchored inflation expectations, regional differentials in (expected) inflation should have limited relevance in the macroeconomic adjustment mechanisms of member states (Rogers, 2007; Sturm et al, 2009). Yet, the idiosyncratic transmission of financial shocks following the global financial crisis and the European debt crisis has shown the asymmetric nature of the macroeconomic adjustment of member states (Lane, 2012). The debt crisis resulted in a sharp increase in sovereign risk for a set of predominately Southern-European countries. When solvency concerns are addressed with contractionary austerity policies, an increase in sovereign risk may have a negative effect on inflation expectations. With a uniform monetary policy, the internal adjustment mechanism can then become self-reinforcing (Honohan and Lane, 2003; Hofmann and Remsperger, 2005; Arnold and Kool, 2004). As short-term nominal interest rates are set by the ECB based on the area-wide macroeconomic performance, domestic (expected) real interest rates are still influenced by domestic (expected) inflation. Consequently, countries with high inflation will have lower real interest rates, sacrificing savings for consumption and investments, and inflation may rise even further. This procyclical transmission channel is reinforced through housing markets, as low real rates tend to fuel real estate booms. In the Southern problem countries, the mechanism works in reverse, as high real interest rates discourage investment and depress housing

markets. Real exchange rate appreciation, real wage adjustment and factor mobility may act as brakes on this destabilizing process (Arnold and Kool, 2004). The ECB (2003) argues that these brakes are a natural part of the adjustment mechanism and do not have to be an issue for monetary policymakers. Yet they may be too slow to keep up with the procyclical effects of real interest rate divergence (Toroj, 2009; Deroose, Langedijk and Roeger, 2004). Together with the lack of a common fiscal system and the presence of asymmetric regional economic shocks, the divergence in (expected) real interest rates due to inflation differentials poses a considerable challenge for the ECB.

The ECB (2003) maintains that, instead of relying on accommodative monetary policy, domestic-oriented policies need to resolve the issues resulting from asymmetries in the macroeconomic adjustment mechanism. Absent an adequate functioning of the internal macroeconomic adjustment, economic agents may, however, question the sustainability of a country's membership in the monetary union. This may increase the likelihood of a euro exit and a subsequent external devaluation of a country's new currency against the euro. Increases in import prices following an exit could then lead to a surge in inflation expectations. In this way, redenomination risk may be a further reason why inflation expectations are not anchored in crisis countries.

3. Data

Our data on inflation expectations originate from the Consumer Survey of the European Commission. Respondents are asked about their expectations regarding the development of consumer prices in the next year. The Consumer Survey starts in 1985, except for countries entering the European Union at a later date. For Luxembourg no data are available. For Ireland, there is a gap in the data from May 2008 to April 2009. We resolved this data issue by linear interpolation. According to the European Commission, each country's sample consists of at least 1500 observations, which are collected nationally on a monthly basis. An advantage of using the Consumer Survey is that it provides a direct measure of consumers' inflation expectations based on a large-scale survey, in contrast to measures based on either yield curves or on small-scale surveys among professional economists (such as the Consensus survey). A further advantage is that the data are available for all EMU countries, including peripheral countries for which yield curve estimates cannot be made and for which Consensus forecasts are lacking. The main limitations of the Consumer Survey are that the forecast horizon is one year and that the data are qualitative. The latter issue is resolved by the quantification process which will be described in the next section. With regard to the time horizon, we belief that a one-year time window suffices to make the first effects of the crisis on the macroeconomic adjustment visible.

We take the responses of Questions [5] and [6] of the Consumer Survey. Question [5] asks consumers to assess price developments over the past year: "How do you think that consumer prices have developed over the last 12 months? They have…

1 Risen a lot
2 Risen moderately
3 Risen slightly
4 Stayed about the same
5 Fallen
6 Don't know"

Question [6] next asks consumers about future price developments: "By comparison with the past 12 months, how do you expect consumer prices will develop in the next 12 months? They will …

1 Increase more rapidly
2 Increase at the same rate
3 Increase at a slower rate
4 Stay about the same
5 Fall
6 Don't know"

The European Commission summarizes the qualitative responses by constructing a balance statistic, which is computed as follows:

$$Balance_t = \left(S_t^1 + \frac{1}{2}S_t^2\right) - \left(\frac{1}{2}S_t^4 + S_t^5\right), \quad (1)$$

where S_t^i is the sample proportion in the corresponding category. Actual inflation is measured using the harmonized consumer price index (HCIP All Items, indexed to 2005), which is taken from Eurostat. We use industrial production, also from Eurostat, as our measure of economic activity. Sovereign risk is measured using bond spreads vis-à-vis Germany, using 10-year bond yields from Datastream. The countries in our sample are: Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Ireland, Italy, Malta, the Netherlands, Portugal, Slovenia, and Spain, all of which introduced the euro prior to the outbreak of the global financial crisis.

4. Methodology

Our empirical approach consists of three parts. First, we extract quantitative inflation expectations from the qualitative Consumer Survey data. Second, we test for the anchoring of the national inflation expectations according to the Vector Auto-Regressive (VAR) approach proposed by Van der Cruijsen and Demertzis (2011). Finally, we employ both panel and state space models to examine the impact of sovereign risk on inflation expectations.

4.1. Extraction of quantitative inflation expectations

The literature on the extraction of quantitative inflation expectations from qualitative survey responses using the probability approach goes back to Carlson and Parkin (1975) and Batchelor and Orr (1988). Applications can be found in Berk (1999), Gerberding (2001), Forsells and Kenny (2004) and Paloviita (2004). According to the probability approach, the shares of responses to each response category can be interpreted as estimates of areas under the density function of aggregate inflation expectations (i.e. as a probability). Forsells and Kenny (2004) provide a more detailed methodological exposition. The probability approach requires the specification of a distribution function. Because of the Central Limit Theorem, the aggregate density function is usually assumed to follow a normal or logistic distribution. Gerberding (2001) shows that both alternatives lead to similar results.

The extraction procedure requires a measure for perceived inflation. We follow the recent extension of the literature by Dias, Duarte, and Rua (2010), henceforth DDR, according to which perceived inflation is based on a smoothed measure of actual inflation. Perceived inflation (π_t^p) is derived from a distribution-adjusted Hodrick-Prescott filtered inflation (π_t^{HP}) as follows:

$$\pi_t^p = -\pi_t^{HP}\left[\frac{(Z_t^1+Z_t^2)}{Z_t^1+Z_t^2-Z_t^3-Z_t^4}\right], \tag{2}$$

Where the $Z_t^{i'}s$ in equation (2) reflects the statistical distribution of Question [5] from the Consumer Survey and are determined as follows:

$$\begin{aligned} Z_t^1 &= N^{-1}[1-S_t^1], \\ Z_t^2 &= N^{-1}[1-S_t^1-S_t^2], \\ Z_t^3 &= N^{-1}[1-S_t^1-S_t^2-S_t^3], \\ Z_t^4 &= N^{-1}[S_t^5], \end{aligned} \tag{3}$$

where S_t^i is the sample proportion for response category i and N^{-1} refers to the inverse of the cumulative normal distribution function applied in the DDR transformation procedure. Hodrick-Prescott smoothing is done by penalizing deviations of actual inflation from trend. We took 14.400 as the value for the smoothing parameter λ for monthly data. Based on our measure for perceived inflation, we next use the responses to Question [6] from the Consumer Survey to derive the mean expected inflation 12 months ahead (π_{t+12}^e) and its standard deviation (σ_{t+12}^e):

$$\pi_{t+12}^e = -\pi_t^p \left[\frac{(Z_t^3+Z_t^4)}{Z_t^1+Z_t^2-Z_t^3-Z_t^4}\right] \tag{4}$$

$$\sigma_{t+12}^e = \pi_t^p \left[\frac{2}{Z_t^1+Z_t^2-Z_t^3-Z_t^4}\right], \tag{5}$$

where the $Z_t^{i'}s$ in equations (3) and (4) now reflect the statistical distribution of Question [6] from the Consumer Survey and are determined according to equation (3). The inflation expectation derived from the quantification process (π_{t+12}^e) is the basis of our empirical analysis and will be denoted as π_t^e from now onwards.

4.2. Anchoring of inflation expectations

In order to measure the impact of national inflation on households' inflation expectations, we apply the VAR methodology suggested by Van der Cruijsen en Demertzis (2011). Our VAR is defined as:

$$\begin{pmatrix}\pi_t \\ \pi_t^e\end{pmatrix} = \begin{pmatrix}c1 \\ c2\end{pmatrix} + \begin{pmatrix}a_{11} & a_{12} \\ a_{21} & a_{22}\end{pmatrix}\begin{pmatrix}\pi_{t-1} \\ \pi_{t-1}^e\end{pmatrix} + \begin{pmatrix}e_{1t} \\ e_{2t}\end{pmatrix}, \tag{6}$$

$$\text{with} \quad \begin{pmatrix}e_{1t} \\ e_{2t}\end{pmatrix} \sim i.i.d.\left(\begin{pmatrix}0 \\ 0\end{pmatrix}, \begin{pmatrix}\sigma_{11} & \sigma_{12} \\ \sigma_{12} & \sigma_{22}\end{pmatrix}\right),$$

where π_t and π_t^e are actual and expected inflation. The VAR approach allows for cross-sectional interdependence, the presence of correlated error terms and the calculation of White's heteroskedastic standard errors. Lag selection is based on the Schwarz Information Criterion. In this VAR system, we are interested in coefficient a_{21} as it measures the impact of national inflation on households' inflation expectations. If national price changes do not affect domestic inflation expectations, this is

taken as evidence in support of anchoring. When all EMU member states would have a strong level of anchoring, the ECB would not have to be concerned about regional asymmetries in inflation expectations. The more elaborate test procedure used in Van der Cruijsen and Demertzis (2011) defines a strong level of anchoring as the rejection of the following five hypotheses:

H1: Consumers' expectations do not have a significant impact on domestic inflation, i.e. $a_{12} = 0$.

H2: Lagged observed inflation does not affect inflation expectations, i.e. $a_{21} = 0$.

H3: Inflation expectations are anchored to a constant, i.e. $a_{21} = 0$ and $a_{22} = 0$.

H4: Domestic inflation's persistence decreases in the level of anchoring, the sum of coefficients of a_{11} diminishes.

H5: There is no pass-through of unexpected shocks in domestic inflation to inflation expectations or vice versa, i.e. $\sigma_{12} = 0$.

This paper tests for H1-H3 and for H5, but not H4, as it is deemed less relevant for the anchoring of inflation expectations. H1-H3 are tested using X-squared statistics. H5 is evaluated by testing *corr(e_{1t}, e_{2t})* according to the Fischer-transformation $Z = 0.5 \ln((1+\rho)/(1-\rho))$. This statistic is approximately normally distributed, with mean zero and standard deviation $\sigma = 1/\sqrt{N-3}$, where *N* is the sample size.

4.3. Internal or external devaluation?

We explore the effects of the crisis on consumers' inflation expectations using two econometric approaches. First, we estimate a fixed-effects panel regression model which includes the sovereign bond spread as crisis variable:

$$\pi^e_{i,t} - \pi^e_{GE,t} = \alpha_i + \gamma_t + \beta_1(\pi^e_{i,t-1} - \pi^e_{GE,t-1}) + \beta_2(i_{i,t-1} - i_{GE,t-1}) + \beta_3(y_{i,t-1} - y_{GE,t-1}) + \varepsilon_{it} \quad (7)$$

$$\varepsilon_{it} \sim i.d.d.N(0, \sigma^2_{\varepsilon i}).$$

In (7), the variables for country *i* are all taken in deviation from Germany (*GE*), which serves as our benchmark country. This choice reflects the fact that for macroeconomic adjustment through internal devaluation, a downward movement in expected inflation is not enough. The downward adjustment

should also be stronger than that of countries which do not need adjustment. The choice for Germany makes sense, as it has been the most competitive country prior to the crisis. Regarding the measurement of sovereign risk using bond spreads, Germany is also an obvious benchmark, as German bunds are the de facto safe asset in the euro area.

Equation (7) relates expected inflation to its lagged value to account for possible inertia in expectation formation. The sovereign bond spreads, denoted $i_{i,t-1} - i_{GE,t-1}$, are also lagged. This ensures that the bond yields were known to the public at the time when the Consumer Survey was held (which is a month prior to the publication of the survey). As our final variable, we include industrial production, denoted $y_{i,t-1} - y_{GE,t-1}$, as a measure of economic activity. The rationale for this follows from the aggregate supply curve in New Keynesian models, according to which strong economic activity will increase (expected) inflation. This variable is also included with a lag. Finally, the specification includes fixed cross-section effects (α_i) and fixed time effects (γ_t). The former fixed effects take into account other country-specific influences on inflation expectations, while the latter fixed effects capture common time effects due to, for example, oil price developments. Equation (7) is estimated using OLS with White standard errors.

Our main interest is in parameter β_2. An insignificant estimate of β_2 suggests that the turmoil in the euro area has not affected consumers' inflation expectations and is supportive of the ECB's view that expectations are anchored in line with the ECB's price stability objective. A significant negative effect would indicate that tension in national bond markets leads consumers to adjust their inflation expectations downward (relative to Germany) and suggests that consumers are aware of the need for internal devaluation. Finally, a positive estimate for β_2 would be compatible with the anticipation of a euro exit or breakup, as a strong devaluation of the new currency will feed through to domestic inflation via higher import prices.

The panel regression yields a single estimate of β_2, which is the overall effect of sovereign bond spreads on expected inflation during the crisis periods. A more detailed analysis would take into account possible variation of this effect across time and across countries. To this end we adapt (7) to a state space model which incorporates a time-varying coefficient for sovereign risk. State space models offer a convenient tool to work with unobserved parameters such as time-varying parameters and have become widespread in macroeconomics and finance. A state space model distinguishes between a measurement and a transition equation. The measurement equation relates the observed variable to unobserved state variables, observed explanatory variables and disturbances. The transition equation next specifies how the unobserved state variables move over time. Below, equation (8) represents the measurement equation and equation (9) the transition equation.

$$\pi_t^e - \pi_{GE,t}^e = \alpha + \beta_1(\pi_{t-1}^e - \pi_{GE,t-1}^e) + \beta_{2t}(i_{t-1} - i_{GE,t-1}) + \beta_3(y_{t-1} - y_{GE,t-1}) + \varepsilon_t \qquad (8)$$

$\varepsilon_t \sim i.d.d.N(0, \sigma_\varepsilon^2)$.

$$\beta_{2t} = \beta_{2t-1} + \nu_t \qquad \nu_t \sim \text{idd } N(0,\sigma_\nu^2). \tag{9}$$

The time varying coefficient in equation (9) is modeled as a random walk and serves to capture the time-dependent effect of sovereign risk on inflation expectations. Estimation of the state space model is done separately for each country using the Maximum Likelihood algorithm of Marquardt. The Kalman filter is used to produce smoothed estimates of the state variable β_{2t}. In a survey of estimation strategies for models with time varying parameters, Neumann (2003) concludes that a state space model of this type generally performs very well. We have also experimented with time variation in β_1 and β_3 but dropped a random walk specification for these coefficients due to a lack of time variation. Both the panel regression model and the state space model are estimated for the crisis sample period, which runs from 2008:08 to 2014:08.

5. Empirical findings

5.1. Extraction of quantitative inflation expectations

Figure 1 plots euro area inflation against the inflation expectations extracted from the Consumer Survey using the procedure outline above. The graph includes expectations derived using the logistic distribution, the normal distribution and the DDR procedure. It can be seen that the differences between these measures are minor, corroborating the findings in Berk (1999) and Gerberding (2001). Figure 1 confirms that from an area-wide perspective the ECB has been quite successful in achieving its goal of maintaining inflation below, but close to 2%. In addition, consumers' inflation expectations have also been close to 2%, with the exception of two episodes. First, following the Lehman collapse in the fall of 2008, inflation expectations plunged for a brief period, coinciding with the sharp recession in 2009. In 2010, inflation expectations returned to pre-crisis levels. Since 2012, inflation expectations are heading downwards again, increasing concerns about deflation among policymakers and financial market participants.

[Figure 1 – 3 about here]

Figure 2 zooms in on the cross-country differences in expected inflation (using the DDR methodology) within the euro area. It shows that substantial differences in expected inflation are a recurring phenomenon. As our objective is to study the role of (expected) inflation in the macroeconomic adjustment mechanism, we have clustered the EMU countries in two groups. The GIIPS group consists of Greece, Ireland, Italy, Portugal and Spain. During the crisis, these countries have been grouped on the basis of their high indebtness, lack of competitiveness, lack of investor confidence and need for macroeconomic adjustment. The remaining EMU members are labeled as non-GIIPS countries. Figure 3 plots the average inflation expectations for these two groups and contains the gist of this paper's argument. Before the crisis, the inflation expectations within the GIIPS group were consistently above those within the non-GIIPS group, reflecting the erosion of competitiveness, high public spending or the presence of housing bubbles in these countries. The crisis has reversed this picture, as GIIPS inflation expectations have dropped below non-GIIPS levels in 2010 and have remained lower since. This reversal suggests that international devaluation is at work. This will be submitted to formal testing below.

5.2. Anchoring of inflation expectations

Table 1 and 2 report the results for the tests of anchoring, using the methodology proposed by Van der Cruijsen and Demertzis (2011). For Table 1 we use the data from the crisis period, while Table 2 reports the results for the full sample. The tables summarize the results for the anchoring hypotheses H1, H2 and H5. The results for H3 go unreported as this hypothesis was strongly rejected for all countries in our sample. Hence there is not a single country where inflation expectations are anchored to a constant. For each EMU country, the first row in Tables 1 and 2 shows the X^2-statistic and the p-value for H1. P-values below 5% lead to a rejection of the hypothesis that national inflation expectations do not influence domestic inflation. The X^2-statistic and the corresponding p-value for the H2 test are in the second row. Here, p-values below 5% lead to a rejection of the hypothesis that domestic inflation does not influence consumers' inflation expectations. Finally, H5 tests for the correlation of unexpected shocks in inflation and inflation expectations. This correlation is reported in the final column ($corr(e_{1t}, e_{2t})$); its significance at a 5% level is indicated in boldface.

[Tables 1 and 2 about here]

Overall, the results of testing hypotheses H1, H2 and H5 are mixed, showing a scattered pattern of anchoring across the euro area, depending on the specific test. For the crisis period, H1 is rejected for 4 out of 14 countries and H2 for 6 out of 14 countries. H5 is rejected for 9 out of 14 countries. For the

euro area and the two GIIPS and non-GIIPS groups, H2 and H5 are always rejected. For the full sample results in Table 2, the rejection rates are slightly higher. These results show that within the euro area the interaction between inflation and expectation formation still has a strong regional character.

5.3. Internal or external devaluation

Table 3 reports the estimation results for the panel regression model in equation (7). Our crisis variable is negatively and significantly related to expected inflation. Higher sovereign bond spreads thus lead to inflation expectations which are lower relative to the German benchmark. This result confirms the visual impression from Figure 3, which also pointed in the direction of internal devaluation as adjustment mechanism. In contrast to bond spreads, industrial production is insignificantly related to inflation expectations.

[Table 3 about here]

We next allow for time- and country-dependent variation in the relationship between bond spreads and expected inflation by estimated the state space model in equation (8). Table 4 reports two parameters in the state space model: parameter Δ indicates whether the relationship between bond spreads and inflation expectation has been time-variant during the sample period. As the variance of β_{2t} equals e^{Δ}, a more negative value for Δ indicates less time variation. The second parameter is β_3, which measures the relationship between the development in industrial production and expected inflation. Except for Finland, the time-variation in β_{2t} is significant, which supports the use of a time-varying parameter model. In contrast, with the exception of Ireland, the estimates of β_3 are insignificant at a 5% level, corroborating the outcome from the panel regression.

[Table 4 about here]

Finally, Figures 4 and 5 plot for each country the smoothed state estimate of β_{2t}. We present two sets of results. Figure 4 is based on the estimation of state space models including industrial production; Figure 5 shows the estimates once we exclude this mostly insignificant variable. While the results are very similar, the significance of β_{2t} is generally stronger in Figure 5, due to the smaller error bands which result from the exclusion of an insignificant variable.

The general pattern which emerges from Figure 4 and 5 is that the effect of bond spreads on inflation expectations has turned more negative and more significant during the crisis, except for the non-GIIPS countries Austria, Finland, France, Netherlands and Slovenia. With regard to Ireland, β_{2t} turns negative and significant much earlier than in other GIIPS countries, reflecting the fact that macroeconomic adjustment in Ireland took place relatively quickly following the collapse of the Irish banking sector. According to many commentators and financial market participants, Greece has been the prime candidate for a euro exit. Yet even for Greece, the β_{2t} turned more negative during the course of the crisis. Apparently, Greek consumers' did not agree with those who predicted a Grexit and instead anticipated a lengthy and painful process of austerity and internal devaluation.

[Insert Figures 4 and 5 about here]

6. Conclusions

In a well-integrated monetary union, one would expect regional differences in inflation expectations to be small and of minor importance in the conduct of monetary policy. A central bank managing such a union could focus on maintaining area-wide price stability, trusting that this would translate into price stability for the public across the union. In this case, inflation expectations of consumers would be anchored to the central bank's objective and disconnected from local macroeconomic developments.

Alas, the euro area does not conform to this ideal. The European economy is still imperfectly integrated and in many places lacks flexible markets in goods, services and production factors. Moreover, the regional segmentation in the European housing markets adds an important determinant of a region-specific business cycle. In the euro area, regional differences in inflation and inflation expectations thus play a complicated role in the macroeconomic adjustment process. Through the expected real interest rate channel and the wealth channel, regional inflation differentials exert a procyclical effect which is detrimental to the smooth functioning of the union. Regional adjustment inside the union has to come through internal devaluation, which works in an anti-cyclical way.

In contrast to a literature which takes an area-wide perspective, this paper has shown that consumers' inflation expectations in member states are not disconnected from what happens at home. Using a VAR approach, we find a strong regional bias in the adjustment of consumer expectations, implying that the anchoring of inflation expectations in line with the ECB's mandate is not complete.

Given the size of the macroeconomic imbalances that have built up within the monetary union before the crisis, as measured by housing market booms, North-South capital flows and current account imbalances, the anchoring of inflation expectations in countries which were hit most by the crisis

would have been too much to expect. After all, regional differentials in (expected) inflation need to be able to play their role in the internal macroeconomic adjustment mechanism. The state space estimates reported in this paper show that high sovereign spreads, indicating bond market tensions, lead to a downward adjustment of consumers' inflation expectations. This suggests that consumers in countries that were most affected by the euro crisis, indeed anticipated that efforts to regain competitiveness and to impose fiscal discipline would lead to internal devaluation. In contrast, we find no evidence that consumers anticipated higher inflation due to external devaluation and increases in import prices following a euro area exit or breakup. This suggests that the breakup concerns which have preoccupied financial market participants have not spilled over to the consumers in the euro area.

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Table 1: Anchoring in the euro area (crisis sample: 2008:08-2014:08)

	Dependent	*Excluded*	*df*	X^2	*p-value*	$Corr_{e1,e2}$
Austria	π	π^e	1	2.495	0.114	**0.329**
	π^e	π	1	2.247	0.134	
Belgium	π	π^e	1	2.967	0.085	**0.384**
	π^e	π	1	0.015	0.902	
Cyprus	π	π^e	2	3.745	0.154	0.224
	π^e	π	2	1.312	0.519	
Germany	π	π^e	1	0.005	0.946	**0.407**
	π^e	π	1	**49.298**	0.000	
Greece	π	π^e	1	1.282	0.257	**0.273**
	π^e	π	1	**15.914**	0.000	
Spain	π	π^e	1	0.801	0.371	**0.237**
	π^e	π	1	**7.143**	0.008	
Finland	π	π^e	1	**19.615**	0.000	0.154
	π^e	π	1	**4.248**	0.039	
France	π	π^e	1	**4.215**	0.040	**0.417**
	π^e	π	1	0.437	0.508	
Ireland	π	π^e	1	0.093	0.760	0.208
	π^e	π	1	1.012	0.314	
Italy	π	π^e	1	2.782	0.095	**0.474**
	π^e	π	1	**7.079**	0.008	
Malta	π	π^e	1	1.630	0.202	0.000
	π^e	π	1	0.342	0.559	
Netherlands	π	π^e	1	**11.475**	0.001	0.116
	π^e	π	1	0.061	0.804	
Portugal	π	π^e	1	**4.724**	0.030	**0.294**
	π^e	π	1	2.014	0.156	
Slovenia	π	π^e	1	0.867	0.352	**0.310**
	π^e	π	1	**20.313**	0.000	
EA	π	π^e	2	3.182	0.204	**0.499**
	π^e	π	2	**13.260**	0.001	
GIIPS	π	π^e	2	0.878	0.645	**0.371**
	π^e	π	2	**14.363**	0.001	
Non-GIIPS	π	π^e	2	**12.823**	0.002	**0.367**
	π^e	π	2	**12.363**	0.002	

Note: Bold expressions denote rejection of the hypothesis at a 5% significance level.

Table 2: Anchoring in the euro area (full sample: 1999:01-2014:08)

	Dependent	*Excluded*	*df*	X^2	*p-value*	$Corr_{e1,e2}$
Austria	π	π^e	1	3.140	0.076	**0.310**
	π^e	π	1	**4.468**	0.035	
Belgium	π	π^e	1	0.757	0.384	**0.223**
	π^e	π	1	**7.053**	0.008	
Cyprus	π	π^e	2	**7.660**	0.022	0.060
	π^e	π	2	3.655	0.161	
Germany	π	π^e	1	**11.764**	0.001	**0.324**
	π^e	π	1	2.758	0.097	
Greece	π	π^e	1	**18.579**	0.000	**0.252**
	π^e	π	1	0.022	0.883	
Spain	π	π^e	1	3.429	0.064	**0.303**
	π^e	π	1	1.745	0.187	
Finland	π	π^e	1	**3.830**	0.050	**0.224**
	π^e	π	1	**26.737**	0.000	
France	π	π^e	1	2.008	0.157	**0.304**
	π^e	π	1	3.659	0.056	
Ireland	π	π^e	1	1.100	0.294	**0.238**
	π^e	π	1	2.682	0.102	
Italy	π	π^e	1	3.018	0.082	**0.348**
	π^e	π	1	**12.499**	0.000	
Malta	π	π^e	1	0.694	0.405	0.000
	π^e	π	1	0.510	0.475	
Netherlands	π	π^e	1	0.515	0.473	0.115
	π^e	π	1	**32.174**	0.000	
Portugal	π	π^e	1	**3.999**	0.046	0.119
	π^e	π	1	**12.988**	0.000	
Slovenia	π	π^e	1	**6.874**	0.009	**0.311**
	π^e	π	1	**6.738**	0.009	
EA	π	π^e	2	**8.135**	0.017	**0.474**
	π^e	π	2	**13.013**	0.002	
GIIPS	π	π^e	2	5.215	0.074	**0.391**
	π^e	π	2	**20.581**	0.000	
Non-GIIPS	π	π^e	2	**14.774**	0.001	**0.359**
	π^e	π	2	**19.131**	0.000	

Note: Bold expressions denote rejection of the hypothesis at a 5% significance level.

Table 3: Panel regression for inflation expectations (crisis sample: 2008:08-2014:08)

	Coefficient	Std. Error	t-statistic	p-value
Constant	0.0819	0.0241	3.3999	0.0007
$\pi^{e}_{i,t-1} - \pi^{e}_{GE,t-1}$	0.8890	0.0269	32.9977	0.0000
$i_{i,t-1} - i_{GE,t-1}$	-0.0179	0.0069	-2.5823	0.0100
$y_{i,t-1} - y_{GE,t-1}$	0.1716	0.1746	0.9833	0.3258
Fixed Effects				
Austria	0.0023			
Belgium	0.0030			
Cyprus	-0.0074			
Greece	0.1728			
Spain	-0.0738			
Ireland	-0.0958			
Italy	-0.0452			
Finland	-0.0613			
France	-0.0529			
Portugal	0.0151			
Netherlands	-0.0592			
Malta	0.2070			
Slovenia	-0.0046			
Observations (pooled)	803	Sum squared resid	93.7489	
R-squared	0.9312	Log likelihood	-248.2053	
Adjusted R-squared	0.9242	F-statistic	133.8694	
S.E. of regression	0.3300	Prob(F-statistic)	0.0000	

Note: The panel regression includes country and time fixed effects. Out of space considerations, the time effects go unreported.

Table 4: Estimates of the time-variation in β_{2t} (Δ) and of β_3

	Country	*Coefficient*	*St.Err*	*Z-Statistic*	*P-Value*
Δ	Austria	-4.70***	1.06	-4.43	0.00
	Belgium	-3.08***	0.35	-8.86	0.00
	Cyprus	-7.85***	1.27	-6.17	0.00
	Greece	-8.79***	1.63	-5.40	0.00
	Spain	-5.54***	0.27	-20.36	0.00
	Finland	-29.79	2.35E+10	0.00	1.00
	France	-7.14***	2.65	-2.70	0.01
	Ireland	-10.57***	1.41	-7.48	0.00
	Italy	-5.92***	0.49	-12.10	0.00
	Malta	-4.41***	0.86	-5.15	0.00
	Netherlands	-2.67***	0.51	-5.27	0.00
	Portugal	-8.12***	0.61	-13.27	0.00
	Slovenia	-8.93*	4.66	-1.92	0.06
β_3	Austria	-0.23	1.05	-0.22	0.83
	Belgium	-0.77	1.41	-0.54	0.59
	Cyprus	0.98	0.64	1.54	0.12
	Greece	1.57	1.15	1.36	0.17
	Spain	-0.22	0.74	-0.30	0.77
	Finland	0.24	0.21	1.16	0.25
	France	0.41	0.58	0.71	0.48
	Ireland	0.45**	0.20	2.20	0.03
	Italy	1.60*	0.97	1.65	0.10
	Malta	2.29	1.71	1.34	0.18
	Netherlands	1.18	0.78	1.51	0.13
	Portugal	0.25	0.61	0.41	0.68
	Slovenia	5.41***	1.89	2.86	0.00

Note: The significance levels are denoted as follows: * 0.10, ** 0.05, and *** 0.01.
The variance of β_{2t} equals e^{Δ}.

Figure 1: Actual and expected euro area inflation

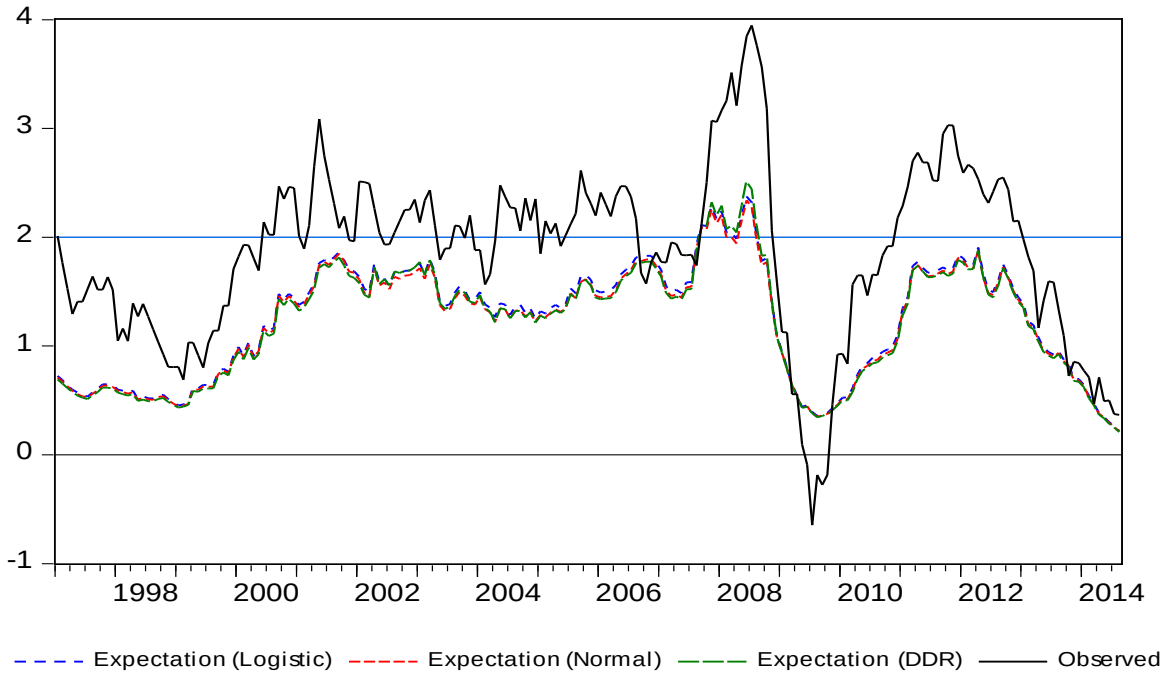


Figure 2: Regional inflation expectations in the euro area

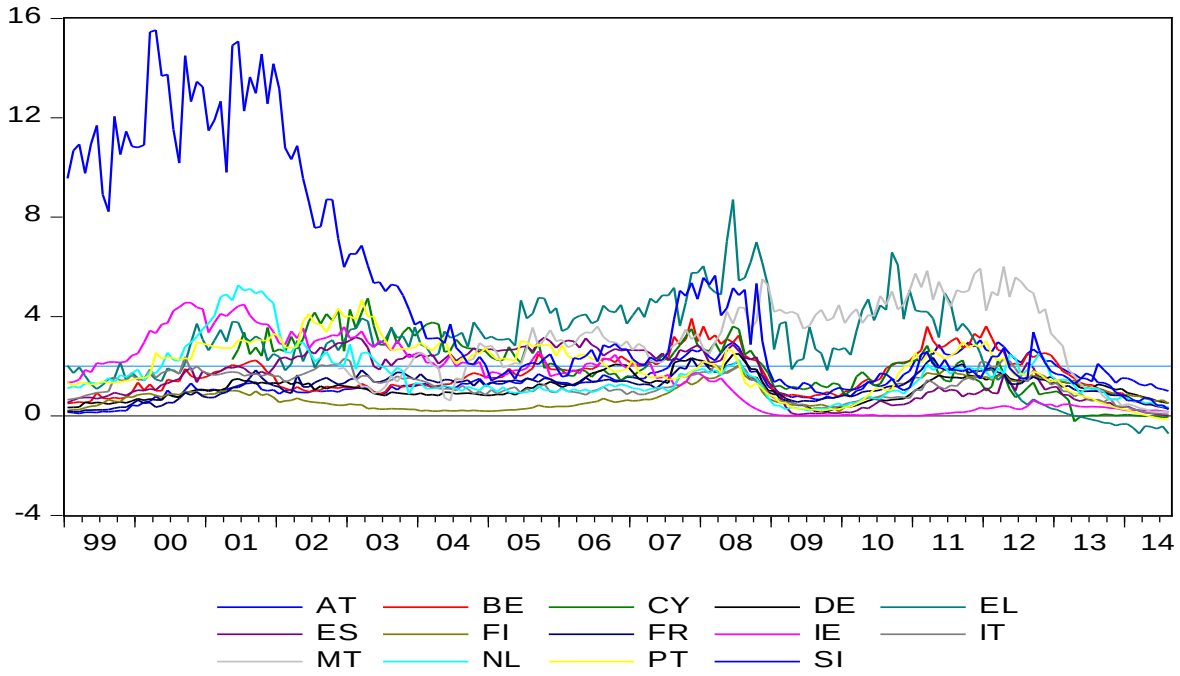


Figure 3: Actual and expected inflation: GIIPS versus Non-GIIPS countries.

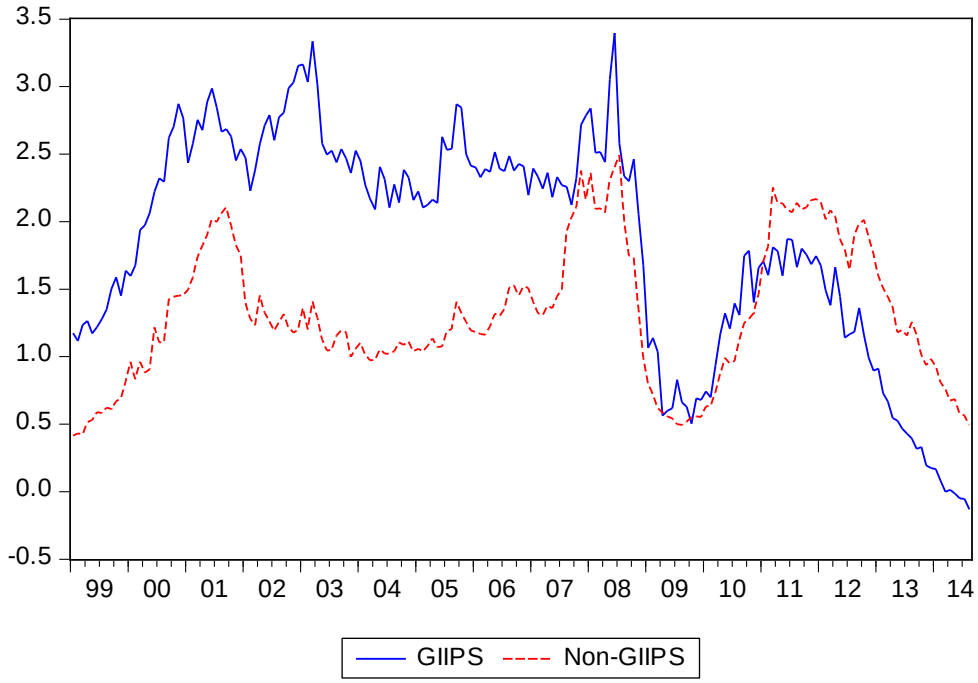
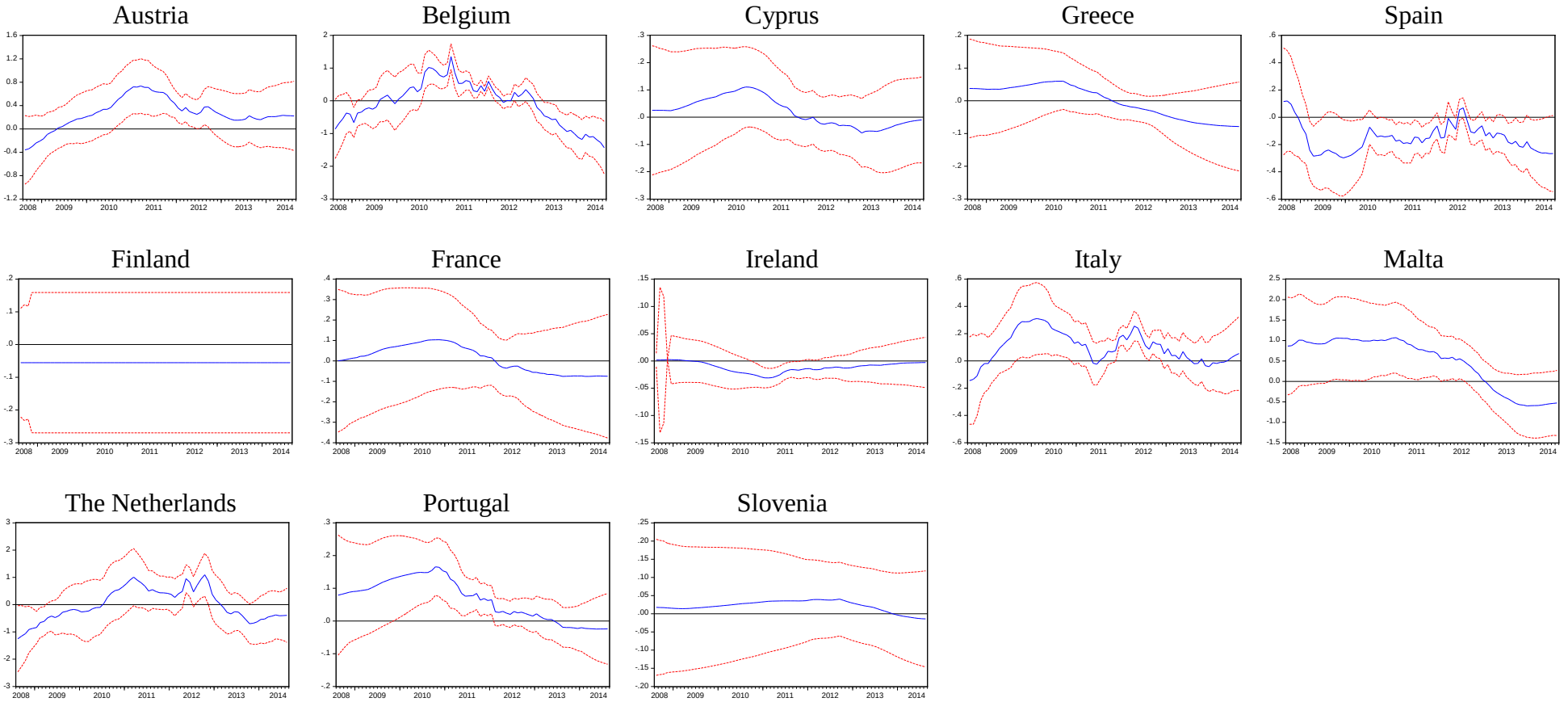
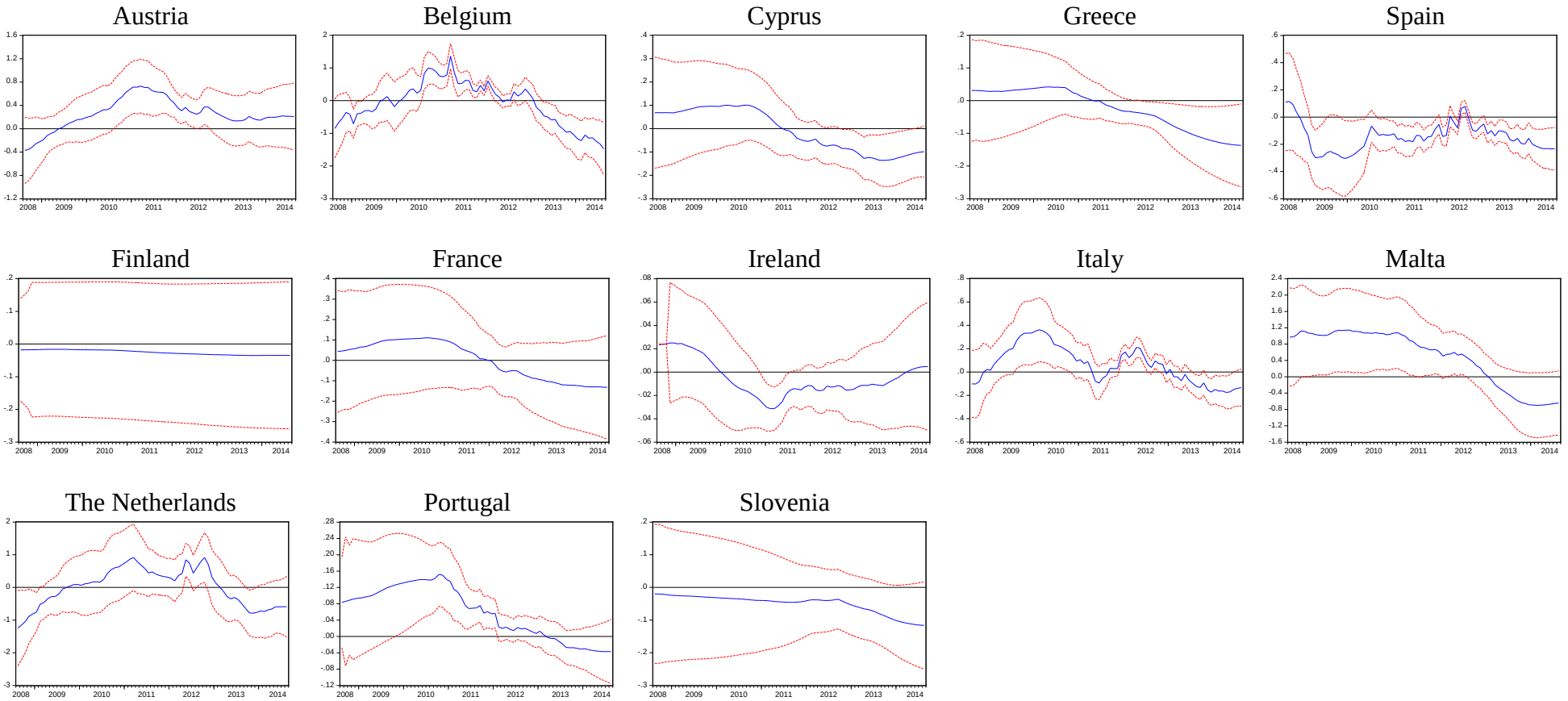


Figure 4: β_{2t} (sovereign risk; model including industrial production)



Note: The blue line represents the smoothed state estimate, while the red lines denote ±2 standard errors.

Figure 5: β_{2t} (sovereign risk; model excluding industrial production)



Note: The blue line represents the individual state estimate, while the red lines denote ±2 standard errors.