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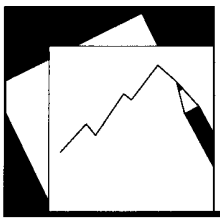

IMF Working Paper

Determinants of Inflation in the Euro Area: The Role of Labor and Product Market Institutions

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Abstract

While inflation differentials in a monetary union can be benign, reflecting a catch-up process, or an adjustment mechanism to asymmetric shocks or different business cycles, they may also indicate distortions related to inefficiencies in domestic product and labor markets that amplify or make more persistent the impact of shocks on inflation. The paper examines the determinants of inflation differentials in the euro area, with emphasis on the role of country specific labor and product market institutions. The analysis uses a traditional backward-looking Phillips curve equation and augments it to explore the role of collective bargaining systems, union density, employment protection, and product market regulation. The model is estimated over a panel dataset of 10 euro area countries over the period 1983-2007. Results show that high employment protection, intermediate coordination of collective bargaining, and high union density increase the persistence of inflation. Oil and raw materials price shocks are also more likely to be accommodated by wage increases when the degree of coordination in collective bargaining is intermediate. These results are robust to different estimation methods, model specifications, and outliers. The paper suggests that reforming labor market institutions may improve the functioning of the euro area by reducing the risk of persistent inflation differentials.

JEL Classification Numbers: E30; F41.

Keywords: Inflation, inflation differentials, inflation persistence, euro area, labor and product market institutions, regulations

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I. INTRODUCTION

Since the launch of the euro, periphery countries maintained large and persistent inflation differentials with the average of the euro area. Inflation differentials are per se not always worrisome. Some inflation differentials are benign, either because they reflect a catch-up process, are part of an equilibrating mechanism, or result from temporary shocks. In contrast, structural inefficiencies in domestic product, labor or other factor markets could lead to undesirable outcomes: some institutions may amplify or make more persistent the impact of shocks. The inflation differentials in periphery countries became persistent and cumulated into losses of competitiveness, putting under strain the tradable sector of these economies and their current account. In absence of an exchange rate policy tool for countries within the monetary union, these losses of competitiveness can only be offset through a painful and protracted process of internal devaluation, which is putting the cohesion of the euro area at risk. This raises the question of how euro area countries can help prevent and/or correct diverging adverse developments in their domestic inflation and international competitiveness.

The literature has identified various factors that can at least partly explain inflation differentials in the euro area.[1] Honohan and Lane (2003) attribute much of inflation divergence in the euro area to movements in the nominal effective exchange rate in addition to the convergence of price levels across euro area countries and different business cycle positions. The authors do not, however, account for persistence in inflation differentials, which has been shown to be an important feature in the euro area (Rogers (2001), Berk and Swank (2002), and Ortega (2003)). In fact, Angeloni and Ehrmann (2004) and Arnold and Verhoef (2004) show that external determinants of euro area inflation differentials, such as movements in the nominal effective exchange rate, lose their explanatory power once the persistence of inflation differentials is accounted for. Similarly, Stavrev (2007) finds that price level convergence, business cycle positions and past inflation differentials are the main determinants of euro area inflation differentials. Angeloni and Ehrmann (2007) also highlight that inflation persistence plays a central role in amplifying and perpetuating inflation differentials within the euro area.

Beyond traditional determinants, a number of theoretical papers underscore the importance of labor and product market institutions to explain inflation differentials in a monetary union. Labor and product market characteristics influence the dynamics of real wages and of the marginal cost of firms, which, in the standard new-keynesian model, are a main driver of inflation. Small calibrated models with microeconomic foundations are usually used. For instance, Campolmi and Faia (2004) examine the impact on inflation differentials of common monetary policy and technology shocks, using a dynamic general equilibrium model with a

[1] See de Haan (2010) for a review of the literature. Another possible explanation of inflation differentials would be the Balassa-Samuelson effect. However, little evidence of this effect can be found (see Rabanal, 2009 for Spain; Beck et al., 2009 and ECB, 2005 for broader samples of euro area countries).

variety of frictions[2] calibrated for the euro area. They demonstrate that labor and product market institutions (proxied by differences in unemployment benefit replacement rates and demand elasticities, respectively) can generate significant and persistent inflation differentials. The responsiveness of inflation to shocks is higher—i.e. persistence is lower—under either lower unemployment benefits or higher demand elasticity. Focusing only on inflation differentials in the tradable sector, Andres, Ortega and Vallés (2008) use a two-country model with a common monetary policy, calibrated to mimic the characteristics of the larger and less open euro area countries.[3] In their model, inflation reacts faster to shocks in countries with more competitive markets and with lower price adjustment costs. Even asymmetric or regional shocks cannot reproduce the observed dispersion of inflation rates unless they assume cross-country heterogeneity in the degree of nominal and real rigidities.

The empirical evidence on the relevance of labor and product market regulation for inflation differentials is still tentative. Only a few papers have empirically examined the impact of labor and product market institutions on inflation divergence in the euro area. Andersson et al. (2010) augments the traditional determinants of inflation with product market regulation and shows that inflation differentials in the euro area are to some extent driven by changes in product market regulations and wage growth differentials. Correa-López et al. (2010) examine the impact of labor and product market institutions on the persistence of inflation and its responsiveness to traditional determinants. They find that higher product market regulation raises inflation persistence and reduces the responsiveness of inflation to changes in productivity growth. Their results on wage bargaining are mixed, with higher coordination reducing inflation persistence and the responsiveness of inflation to import prices, but also reducing the responsiveness of inflation to changes in productivity growth. In the same vein, Biroli et al (2010) find some evidence that regulations reducing price and wage flexibility, pertaining to product markets, minimum wages, union density, wage bargaining structure and employment protection, impede relative price adjustment to idiosyncratic shocks and increase inflation persistence. However, they only test the impact of one variable at a time, do not test all channels simultaneously, and results are not very robust across samples.

Against this background, this paper examines the determinants of inflation dynamics in 10 euro area countries over the period 1983–2007 in order to explain inflation differentials, with a special focus on the role of inefficiencies in labor and product markets. Following the studies above, the analysis uses a traditional backward-looking Phillips curve equation and augments it

[2] The model has two regions that form a currency union and that are characterized by a variety of frictions: matching frictions and wage rigidity in the labor market, monopolistic competition in product markets and adjustment costs on pricing.

[3] Andres, Ortega and Vallés (2008) argue that inflation differentials in a monetary union are often assumed to originate primarily from the lack of competition in the non-traded sector but there is evidence showing substantial differences among traded goods inflation rates. In their model, each country produces differentiated goods traded in monopolistic competitive markets. Price discrimination across countries is possible due to differences in the degree of market competition.

to explore the role of a broad set of labor and product market indicators through their impact on inflation persistence and on the responsiveness of inflation to the output gap and macroeconomic shocks. The paper contributes to the existing literature in a number of ways. First, it uses a broader set of indicators than in some other papers and tests all structural indicators and channels simultaneously. Special attention is paid to robustness by applying several estimation methods and carrying out a number of extensive robustness checks. Second, the paper contributes to the debate on why inflation persistence in the euro area is high (Galí et al. (2001), Levin and Piger (2004), and Angeloni and Ehrmann (2007)). Inflation persistence could relate to the ability of the monetary policy regime to anchor long-term inflationary expectations or to underlying structural factors. This paper sheds light on the contribution of the product and labor market institutional features to inflation persistence phenomena. Finally, the paper quantifies the impact of structural factors in explaining inflation and presents some estimates of the potential inflation benefits from structural reforms.

The findings point to an important role of labor market institutions in inflation dynamics and underlie the need for reform to facilitate the correction of accumulated losses of competitiveness and help prevent their recurrence. Of all the structural indicators tested, the most robust results are found for employment protection, union density, and intermediate coordination in collective bargaining which all increase the persistence of inflation and in the case of intermediate bargaining, also amplify the impact of supply shocks. Contrary to the studies mentioned above, the evidence on the role of product market regulation is mixed. The paper's results therefore suggest that high employment protection and intermediate coordination in collective bargaining, which characterize the labor markets of most high-inflation countries, have contributed significantly to the high and persistent inflation differentials of these countries in the run-up to the crisis. These labor market institutions have also prevented a quick downward adjustment of inflation at the beginning of the crisis, increasing the short-term inflation-output trade-off. While the paper finds evidence that inflation persistence has declined over time in euro area countries, it does not seem to reflect structural reforms—which have been meager for the significant variables—but rather an anchoring of inflation expectations. As a matter of fact, one could argue that the relatively high inflation persistence in Europe, e.g. relative to the United States, reflects the generally less efficient labor market institutions in Europe. Reforms of labor market institutions would generate significant gains in terms of lower inflation for individual countries but would likely also improve the functioning of the euro area by increasing the flexibility of prices and wages and reducing the persistence of inflation differentials.

The note is structured as follows. Section II provides stylized facts on inflation performance in euro area countries before and after the Great Recession and looks at a supply-side decomposition of inflation. Section III presents the empirical analysis of the determinants of inflation in euro area countries. Section IV quantifies the impact of the various determinants of inflation and discusses policy implications. Section V concludes.

II. STYLIZED FACTS

Inflation differentials

Euro area inflation hovered around 2 percent, but with large and persistent differences across countries. The difference between minimum and maximum inflation in the euro area averaged three percentage points during the period 1999–2008 (Figure 1). While differences in inflation across countries are not per se worrisome—as they can reflect a catch-up process, different business cycle positions or adjustment to different shocks—inflation differentials persisted for most of the period. Countries that had the highest (persistent) inflation included Ireland, Greece, Spain, Portugal and Luxembourg, with inflation around 3 percent, implying an average inflation differential relative to the euro area ranging between 0.7 and 1.2 percentage points (Table 1).[4] In contrast, the lowest average inflation was observed in Germany at 1.7 percent, below the 2 percent target of the ECB. Cumulated over ten years, the sustained inflation differentials of high-inflation countries led to a cumulative price differential of about 10 percent relative to the euro area, and contributed to the deterioration in competitiveness of these countries.

The inflation differentials were broad-based, with differences in services inflation playing a key role. The GDP deflator and core inflation show a similar picture to headline inflation, with the exception of Luxembourg where the core inflation differential was small and inflation was mostly driven by food and energy prices. In Greece, Ireland, Portugal and Spain, the high inflation reflected mostly strong core inflation, but also a relatively large contribution of food price inflation (reflecting a higher share of food in the consumption basket and in Greece and Spain also stronger food price increases) (Figures 2 and 4). The contribution of energy prices was not different from the euro area average. Consumer price inflation in services was much stronger for high-inflation countries than for the average of the euro area.[5] In contrast the differential for inflation in goods was usually smaller, and even nil in the case of Ireland (Figure 5). Nevertheless, goods inflation also contributed significantly to the overall inflation differential because the share of goods in the consumption basket is much larger than that of services.

Inflation has moderated during the Great Recession, but with the exception of Ireland not enough to stat correcting substantially the accumulated inflation differential with the euro area (Figures 1 and 3). Ireland had a large and sustained decline in inflation and the inflation differential, leading to a substantial correction of the accumulated price differences with the euro area. Inflation and the inflation differential also turned negative in Portugal and Spain, but for a short period as transitory factors (large energy price increases and increases

[4] Cyprus, Malta, Slovakia and Slovenia are excluded from the comparison since they joined the euro area much later (in or after the mid-2000s).

[5] Services in the consumption basket include items such as communication, housing, recreation and personal care, and transport.

in VAT) returned the inflation differential to positive territory in 2010 and 2011, while in Greece the inflation differential remained positive throughout the period. The inflation differential excluding changes in indirect taxes—which is more relevant for competitiveness, as exports are not subject to VAT—remained favorable to Portugal and Spain in 2010 and early 2011, and became favorable to Greece in 2011. However, even by this measure, these countries have not yet achieved a significant correction of the accumulated price differences with the euro area.

Supply-side decomposition of inflation

Inflation can be decomposed into the contributions of labor costs, profits, and net taxes, to gain insight into the driving forces from the supply side. This analysis provides some preliminary evidence on whether price developments arose from the labor market and/or from the product market side. The nominal value of GDP is the sum of the costs of labor, gross operating surplus and net taxes.

$$PY = wL + GOS + TAXN.$$

where P denotes the GDP deflator and Y the GDP volume; w is the nominal compensation per worker and L is the number of workers; GOS is the gross operating surplus; and TAXN represents net taxes. Accordingly, the GDP deflator equals the sum of the unit labor cost, the unit gross operating surplus, and the unit net tax.

$$P = w(L/Y) + GOS/Y + TAXN/Y$$
$$= ULC + UGOS + UTAXN.$$

Hence, the change in the GDP deflator is by definition a weighted average of the changes in the various components, where the weights are the shares of the respective unit cost components in the GDP deflator:

$$dP/P = (dULC/ULC)(ULC/P) + (dUGOS/UGOS)(UGOS/P)$$
$$+ (dUTAXN/UTAXN)(UTAXN/P).$$

The contribution of each unit cost component to GDP deflator inflation is defined as the product of the percent change in the unit cost component and its share in total unit costs.

The strong price increases in high-inflation countries were largely driven by a fast growth of unit labor costs.[6] Unit labor costs in these countries grew much faster than in the euro area up until 2008, with a cumulative differential between 12 to 23 percentage points depending on the country (Figure 6). In turn, this unit labor cost growth differential with the euro area was

[6] ECB (2005) also finds that services prices and differences in wage developments have been major sources of inflation persistence.

mostly due to faster growth in labor cost per hour rather than slower labor productivity growth per hour (Table 2). Nevertheless, the unit gross operating surplus also contributed significantly to the overall inflation differential in all high-inflation countries with the exception of Portugal, but for different reasons. In Spain, the unit gross operating surplus grew much faster than in the euro area, while in Greece and Ireland the contribution of the unit gross operating surplus to inflation reflected a much larger weight of this component in the GDP deflator (i.e. a much larger share of the gross operating surplus in GDP). It is striking that while unit labor costs averaged 3 to 4 percent per year of growth in the high-inflation countries, they barely grew in Germany over the period 1999–2008, at about 0.2 percent per year.

Unit labor cost moderation still has a long way to go. The burden of reducing inflation was shared by all factors in Ireland, with strong declines in unit labor costs, unit gross operating surplus and unit net taxes. In Spain, the modest adjustment was borne mostly by unit labor costs, and partly offset by continued strong growth in the unit gross operating surplus. In Portugal, the negative GDP deflator differential reflected mostly declines in net taxes while strong growth in the unit gross operating surplus and minimal unit labor cost moderation led to a positive GDP deflator differential in Greece. Even in Ireland and Spain where unit labor costs moderated, this reflected mostly increases in labor productivity growth as employment fell drastically (see Table 2). Labor cost have started moderating and have been weaker than in the euro area—especially in Ireland and to a lesser extent in Greece, but more will be needed to correct accumulated price differences.

III. ANALYSIS

The framework

To examine more formally the role of labor and product market institutions in explaining inflation, the paper uses a traditional backward-looking Phillips curve framework, in line with Bowdler and Nunziata (2007), Biroli et al. (2010) and Correa-López et al. (2010). In this model, inflation is a function of its own lag (to capture persistence), the initial relative price level, the output gap, changes in the nominal effective exchange rate, time dummies (to capture common shocks such as an oil price or monetary policy shock), and country fixed effects (that proxy for differences across countries in the long-run price levels).[7] Following these studies, the structural indicators are allowed to affect inflation through their impact on (i) inflation persistence; (ii) the response of inflation to the output gap; and (iii) the response

[7] A more refined way to measure external shocks (currently captured by time dummies and changes in the nominal effective exchange rate) would be to control for imported good prices, distinguishing between oil and non-oil, and to interact these respectively with the share of oil-refined products in the consumption basket and with the degree of openness of the country. An element missing in the analysis is the role of indirect taxation and government-set prices in explaining inflation developments.

of inflation to common shocks. The full specification thus looks like:

$$\pi_{i,t} = \left(\gamma_1 + \sum_j \gamma_j X_{j,i,t}\right)\pi_{i,t-1} + \left(\lambda_1 + \sum_j \lambda_j X_{j,i,t}\right) ygap_{i,t} + \beta relp_{i,t-1} + \eta_1 dneer_{i,t} + \eta_2 dneer_{i,t-1}$$
$$+ \left(1 + \sum_j \phi_j X_{j,i,t}\right)\theta_t T_t + \mu_i + \varepsilon_{i,t},$$

where π denotes inflation, *ygap* the output gap, *relp* the price level relative to that of the euro area, *dneer* the percent change in the nominal effective exchange rate, X the structural indicators, T time dummies, and μ the country fixed effects. The paper first estimates a linear version of the model, which does not allow the response of inflation to common shocks to vary with structural factors (i.e. it excludes the interaction terms between structural indicators and time dummies). Afterwards, it estimates the full model by nonlinear least squares, including the interactions terms between structural indicators and time dummies.

Initially, a wide range of indicators of labor and product market institutions were tested, including the degree of coordination of collective bargaining, union density (i.e. the number of employees registered with unions), employment protection, the minimum wage, unemployment benefit replacement rates and various measures of product market regulation. The institutions presented in the paper are those found most significant, namely the degree of coordination of collective bargaining, union density, employment protection, and product market regulation.[8] Unfortunately, the extent of inflation indexation—a potentially very relevant labor market factor—could not be introduced due to the lack of a broadly available indicator.

Key features of the data

Panel estimations on annual inflation rates are conducted on a sample covering 10 euro area countries for the period 1983–2007.[9] The baseline regressions do not include the crisis period (2008–09) which could result in structural breaks biasing the estimators. However, the robustness of the results is subsequently tested on a sample including crisis years. Headline inflation rates and the output gaps were retrieved from the IMF World Economic Outlook. The comparative price level indices were collected from Eurostat and the Penn World Tables and are expressed relative to the euro area. The nominal effective exchange rates stem from the IMF International Financial Statistics. An increase in the index indicates an appreciation. Structural indicators are from the OECD. The indicator of coordination in collective bargaining takes the value 1 for uncoordinated systems, 2 for systems with intermediate

[8] In addition to the institutions presented in the paper, we also looked at the impact of minimum wages (which were never significant) and unemployment benefit replacement rates (which had the wrong sign but were not robust).

[9] The sample countries are Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal, and Spain. Greece and Luxembourg could not be included because the collective bargaining indicator is not available for them.

coordination, and 3 for highly coordinated systems, and was taken from Bassanini and Duval (2009). For the regressions, three dummy variables are created based on this indicator, one for each level of coordination. Union density is the OECD measure of the share of workers affiliated to a trade union. Employment protection is measured by the OECD summary indicator of employment protection legislation. Product market regulation is measured by the OECD summary indicator of regulatory impediments to product market competition in seven non-manufacturing industries, including gas, electricity, post, telecoms, passenger air transport, railways, and road freight. In robustness tests, the paper also used alternative OECD measures of product market regulation, which are more detailed but only available for a shorter time period, including sub-indicators such as state control, barrier to entrepreneurship, regulatory and administrative opacity, administrative burden on start-ups, barriers to competition as well as professional services regulations. Most of the structural variables vary both across countries and over time. All structural variables are standardized to have zero mean and unit standard deviation to facilitate the interpretations of results.

Empirical results

We apply a dynamic panel analysis to estimate variants of equation (1) in order to identify the determinants of inflation rates in the euro area. All specifications include time dummies which capture euro area-wide common changes in inflation and the explanatory variables. Therefore the regressions are explaining inflation differentials in terms of idiosyncratic national changes in its determinants.

Main results

We first estimate the linear model (which excludes the interactions between time dummies and structural indicators). Results are reported in Table 3. Column (1) shows the instrumental variable estimator of the linear model. The lagged inflation, the output gap, and all their interactions with the labor and product market variables are instrumented to correct for their potential endogeneity. The set of instruments includes the second lag of inflation, the first and second lags of the output gap, and the first lag of all interaction terms. The tests of whether instruments are strong and valid are satisfied in all cases (underidentification and weak identification tests of instruments, and the Sargan-Hansen test of overidentifying restrictions). The estimates confirm the standard determinants of inflation. Inflation is positively correlated with its lag, pointing to persistence. Inflation increases with the output gap and decreases when the nominal effective exchange rate appreciates. However, the initial relative price level has no significant impact on inflation in line with the more recent literature. Turning to our variables of interest, the results show a significant and positive impact of some labor market institutions on inflation persistence. Inflation is more persistent when union density is high, employment protection is high, and collective bargaining is characterized by intermediate coordination (instead of high or low coordination). The interactions of institutions with the output gap yield less significant results. Only the interaction of the output gap with product market regulation is significant at the 5 percent

level and shows that higher product market regulation tends to increase the sensitivity of inflation to the output gap. In column (2), the specification is reduced to eliminate insignificant variables through an iterative process in which the least significant variable is eliminated and the model is re-estimated until all variables are significant at least at the 10 percent level. The joint test that all eliminated variables are insignificant is accepted and the reduced model confirms the robustness of the previous findings.

Turning to the non-linear model, the estimations are conducted using the non-linear least squares estimator. The results, reported in column (3) of Table 3, confirm the findings of the linear estimation, for the variables that are common to both models. A new finding is that intermediate coordination increases the impact of common shocks (captured by the time dummies) on inflation. Other interaction terms between structural variables and time dummies are insignificant. These results are also confirmed once the specification is reduced iteratively to eliminate insignificant variables (column (4)).

Interpretation of results

Apart from confirming standard determinants of inflation, the model shows an important role of institutions through several channels. The results are broadly robust to a large number of sensitivity tests (see below).

- Less efficient labor market institutions increase the persistence of inflation. Inflation is more persistent when employment protection is high, collective bargaining is characterized by intermediate coordination, and union density is high. High employment protection, high union density and some coordination of unions in collective bargaining give workers more market power to negotiate increases in their wages that compensate for inflation and thereby contribute to future inflation. The relationship with the coordination in bargaining is non-linear, in the sense that both low and high coordination would lead to less inflation persistence than intermediate coordination. In the case of low coordination, workers have little market power, while in the case of very high coordination, the unions which recognize their market power take into account the effect of their wage demands on inflation and unemployment (the argument of Calmfors and Driffill, 1988).

- Collective bargaining systems with intermediate coordination are also less suited to face common shocks (captured by time dummies interacted with institutions). Oil and raw materials price shocks are more likely to be accommodated by wage increases when the degree of coordination in collective bargaining is intermediate. The argument is similar to the one made above.

- There is no strong evidence that reducing product market regulation lowers inflation, contrary to the evidence in some other papers. In some models, the degree of product market regulation increases the sensitivity of inflation to the output gap. Results are

not improved by looking at alternative indicators of product market regulation.[10] Theoretically, the effect of product market regulation could be ambiguous (Aghion, 2002). Indeed, when competition is low, firms faced with an increase in their costs could decide to either use their market power to raise prices (and thereby protect their profit margins) or to absorb the shock by reducing their profit margins to maintain market share. When competition is high, however, profit margins are very low and firms are more likely to be forced to raise prices when faced with increases in costs. In practice, the PMR indicator used in the analysis may also be an imperfect measure of market power.

Robustness tests

Table 4 reports a number of robustness tests for the linear regressions. Columns (1) and (2) report the fixed effect estimator and the ordinary least squares estimator for comparison. The fixed effect estimator shows similar results but the coefficient of the output gap is smaller suggesting there is an endogeneity bias. Estimating the model without country fixed effects makes the results for structural indicators weaker, both in terms of significance and magnitude of the effects. Coefficients for interaction terms are smaller across the board. The interaction of lagged inflation with employment protection remains very significant, and the interactions of lagged inflation with union density and intermediate coordination marginally significant, at the 6 percent and 16 percent level respectively, while the interaction of the output gap with product market regulation becomes insignificant. But the results are broadly similar, and the most robust result appears to be the impact of employment protection on persistence. However, the test that all country fixed effects are insignificant can be rejected at the 1 percent level, suggesting that country fixed effects are needed in the regressions. In column (3), we re-estimate the linear model with the structural indicators not only in interaction terms but also in levels as independent regressors to check the robustness of our results. Results for our interaction terms are unchanged, and all levels of the structural variables are insignificant (individually and jointly). In column (4), we follow Anderson et al. (2010) which test for the impact of the change in product market regulation on inflation and re-estimate the linear model with adding the changes of the structural variables. Again, results for our interaction terms are unchanged, and all changes of the structural variables are insignificant (individually and jointly). Finally, in column (5), we re-run the regression including the crisis years and find that most results are confirmed, except for the interaction of the output gap with product market regulation.

Table 5 reports estimation results from introducing structural indicators one at a time in the inflation regression. The estimations show similar results to above for employment

[10] Using the more comprehensive OECD product market variable (only available for a shorter time period) and disaggregating it into its different sub-indicators (state control, barrier to entrepreneurship, regulatory and administrative opacity, administrative burden on start-ups, and barriers to competition) did not show a significant impact either.

protection, intermediate coordination, low coordination, and product market regulation. However, when entered on its own, union density becomes very insignificant. A very stringent test, which uses Bayesian model averaging technique to test all permutations of variables and calculates the robustness of variables by the frequency with which they appear in the best-fitting models, was also implemented (through a publicly available program called R). The most robust variables appeared to be the lagged inflation, the change in the nominal effective exchange rate, the output gap and the interaction of the lagged inflation with employment protection. The interaction of lagged inflation with intermediate coordination in collective bargaining and union density also appeared in a good fraction of the best fitting-models. Other variables were not robust.

Table 6 shows the results of rolling regressions, with a window of 20 years. The main results, for union density, intermediate coordination, and employment protection are broadly robust, though less significant in a few regressions. Finally, our results are robust to dropping one country at a time, as reported in Table 7.

The role of relative productivity levels

Differences in productivity levels may contribute to inflation differentials by affecting the long-run price level toward which the countries are converging (Anderson et al., 2010). In our regression, differences in relative long-run price levels are captured by country fixed effects. Hence, it is not surprising that when the log of labor productivity is added to the regression, it turns out to be insignificant (Table 8). However, when productivity is added to the model without country fixed effects, it is positive and significant and makes the coefficient on the initial relative price level (whose effect on inflation was negative but insignificant) become significant. Although the preferred specification is the one with country fixed effects, these results provide some evidence in support of the argument that differences in productivity levels contribute to explaining inflation differentials.

The role of inflation expectations

The literature has emphasized the role of inflation expectations in determining inflation. We try to address this issue in two different ways. First, we test the robustness of our results to the possibility that inflation expectations have become gradually more anchored over time. Second, we do a simple test of the impact of institutions on inflation in the framework of a hybrid New Keynesian Phillips curve, which includes both lags and leads of inflation.

The literature has found evidence that inflation expectations have become progressively more anchored, especially as central banks have opted for inflation targeting and/or gained more credibility in their efforts to maintain moderate inflation. Under anchored inflation expectations, the persistence of inflation would be less since agents expect inflation to return relatively quickly to the announced target; similarly, the response of inflation to the output gap could be smaller. As the anchoring takes place progressively over time, we would expect inflation persistence to have fallen progressively over time. In order to test whether our

results on structural factors are robust to controlling for an anchoring of inflation expectations, we add interaction terms between lagged inflation and a time trend, and the output gap and a time trend. We tested different start dates for the time trend: the early 1980s; 1995, the start of the EMU; and 1999, the start of the euro (see Table 8). The trend that starts in the early 1980s and covers the entire sample period is significant in its interaction with lagged inflation, indeed pointing to declining persistence over time. Shorter trends are insignificant, including if they are added jointly with the longer trend. Hence, there is no evidence of a trend related to the EMU project. Our results on structural indicators are robust to the inclusion of the trend to capture inflation expectations anchoring.

Another approach to incorporating inflation expectations in the determination of inflation is the hybrid New Keynesian Phillips curve, which includes both lags and leads of inflation. Typically, future inflation is included in the model and instrumented with lags of inflation and the output gap. Although the main analysis has not been undertaken using this framework, a simple regression along the lines just described suggests a role of labor market institutions in the formation of inflation expectations. Looking at the first-stage results for future inflation, employment protection is found to increase the impact of lagged inflation on (expected) future inflation, thereby increasing inflation persistence (results available on demand). The fact that inflation expectations matter for current inflation does not per se imply less persistence or an absence of role for structural indicators. Indeed, the evidence seems to suggest that inflation expectations are formed to some extent in a backward-looking way based on past inflation and rational agents incorporate their knowledge on how labor market institutions influence wage and price dynamics to form these expectations.

IV. POLICY IMPLICATIONS

The analysis shows that high EPL and intermediate collective bargaining played a major role in the persistent inflation differentials in Greece, Portugal, and Spain.[11] Over 1999–2010, the inflation differential of Greece, Portugal and Spain relative to the 10 euro area countries that are in the estimation sample was on average 0.7 percentage points per year. This inflation differential can be decomposed into the contributions of all the regressors.[12] Of this inflation

[11] Although the formal indicator is not available for Greece, its bargaining system can best be described as having an intermediate level of coordination.

[12] The contribution of each regressor to the inflation differential can be calculated as the product of the regressor's coefficient and the difference between the values of the regressor for the country and the euro area average. For interaction terms, e.g. X*π, the contribution of X is calculated as $\sum_{l \in EA} \left(X_i - X_l\right)\left(\frac{\pi_i + \pi_l}{2}\right)$ and the contribution of π is calculated as $\sum_{l \in EA} \left(\pi_i - \pi_l\right)\left(\frac{X_i + X_l}{2}\right)$, where i denotes the country of interest and l denotes all 10 sample countries that belong to the euro area.

differential, about 0.4 percentage points can be attributed to the specifics of their labor markets, while the contribution of product market regulation was negligible (Figure 7). Employment protection legislation contributed for 0.2 percentage points and intermediate coordination in bargaining for 0.4 percentage points, partly offset by lower union density (-0.2 percentage points).[13] In the case of Ireland, the positive inflation differential cannot be explained by inefficient labor market institutions.[14] In contrast to high-inflation countries, Germany benefitted from its more efficient labor market institutions, in particular a highly coordinated bargaining system and lower employment protection, which contributed to keep inflation low, explaining ¼ percentage point of the negative 0.6 percentage point differential with the euro area.

These labor market institutions have also prevented a quick downward adjustment of inflation at the beginning of the crisis, increasing the short-term inflation-output trade-off. Labor market institutions kept pushing inflation up in 2008 and 2009 reflecting the high lagged inflation despite the onset of the crisis (see Figure 7). As a result, this prevented a quick adjustment of wages and prices to the new economic conditions, imposing a higher real cost on the economy. This effect faded over time as inflation adjusted and in 2010, their contribution to the inflation differential became neutral reflecting the small lagged inflation differential of 2009. However, as is the case with other inflation models in the literature, the model does not explain very well the behavior of inflation in crisis years, as inflation fell more than it would have predicted, especially in 2008 and 2009.

Inefficient institutions contribute substantially to the relatively high inflation persistence in the euro area, despite evidence of some anchoring of expectations. Inefficient labor market institutions push up inflation persistence in Portugal, Spain and Greece, but also Finland, France and Belgium (Figure 8). As a matter of fact, one could argue that the relatively high inflation persistence in Europe, e.g. relative to the United States, reflects the generally less efficient labor market institutions in Europe. While the paper finds evidence that inflation persistence has declined over time in euro area countries, it does not seem to reflect structural reforms—which have been meager for the significant variables—but rather an anchoring of inflation expectations.

Moving to best practice could yield substantial benefits in terms of reducing inflation (Figure 9). For Portugal and Spain (and Greece), moving away from intermediate

[13] These are likely underestimates though since they are a simple average of first-year effects on inflation, and do not take into account the dynamic effects of lower inflation on subsequent years. A similar decomposition of the inflation differential using the non-linear model shows similar contributions, with a somewhat larger role of labor market institutions.

[14] Indeed, Ireland's labor market institutions are more efficient than the euro area average, and the inflation differential is mostly captured by a country fixed effect. There is some evidence that among other factors, differences in relative productivity levels may have contributed to the inflation differentials (positively for Ireland and negatively for Portugal and Spain) by affecting the long-run price level toward which the countries are converging.

coordination of collective bargaining to either full coordination or full decentralization would have a first-year impact of reducing inflation by about 0.6 percentage points (evaluated at their average inflation level over 1999–2010). Similarly, bringing their EPL to the lowest value observed in the sample would reduce inflation by about 0.6 percentage point (again evaluated at their average inflation level over 1999–2010). A simulation of what Spanish inflation would have been, had Spain exhibited the best possible combination of labor institutions, suggests that inflation would have hovered below 2 percent, more than 1 percentage point below the observed level.[15]

V. CONCLUSION

Despite being in the monetary union for many years, euro area countries still exhibit different inflation dynamics. Inflation differentials may reflect different business cycle positions, catching-up processes, or structural rigidities. In the absence of the exchange rate policy tool and the presence of low labor mobility, inflation differentials in a monetary union play an important role as a macroeconomic adjustment mechanism in response to asymmetric shocks. However, diverging inflation dynamics can be harmful if they reflect economic distortions or wage and price rigidities due structural inefficiencies in labor and product markets. Persistent inflation differentials can have adverse consequences for the competitiveness of high-inflation countries. Moreover, different inflation rates across countries in the monetary union along with identical short-term nominal interest rates can lead to different real interest rates with a potentially destabilizing macroeconomic impact. Member countries with higher inflation rates experience lower real interest rates, which would stimulate investment and consumption raising aggregate demand and perhaps causing higher inflation, if not fully offset by the loss of competitiveness.

The paper explores the role of country-specific labor and product market institutions in determining inflation differentials among euro area countries. Different institutional characteristics influence wage developments, production costs, profit margins, and in turn inflation persistence and dynamics. Structural sources of inflation divergence may be deeper and more long-lasting than transitory causes such as convergence, or adjustment to different business cycle positions. There is no clear consensus in the literature regarding the explanation of the high inflation persistence phenomenon in the euro area or the extent to which country-specific labor and product market institutions contribute to inflation differentials in the euro area. This paper offers new evidence on these open questions.

The results suggest a significant role of inefficient labor market institutions in explaining inflation differentials in the euro area. Labor market features appear to matter for both inflation inertia and the country-specific adjustment to common shocks. In particular, the

[15] This simulation is based on the linear model and takes into account the impact on inflation in subsequent years through lower lagged inflation but not through lower output gap (since we do not have a model of the output gap).

impact of common (and probably asymmetric) shocks on inflation was amplified by the structure of collective bargaining which features an intermediate level of coordination. Moreover, the intermediate coordination in bargaining and high employment protection made shocks to inflation more persistent. The results have implications for the design of adjustment-friendly labor market reforms.

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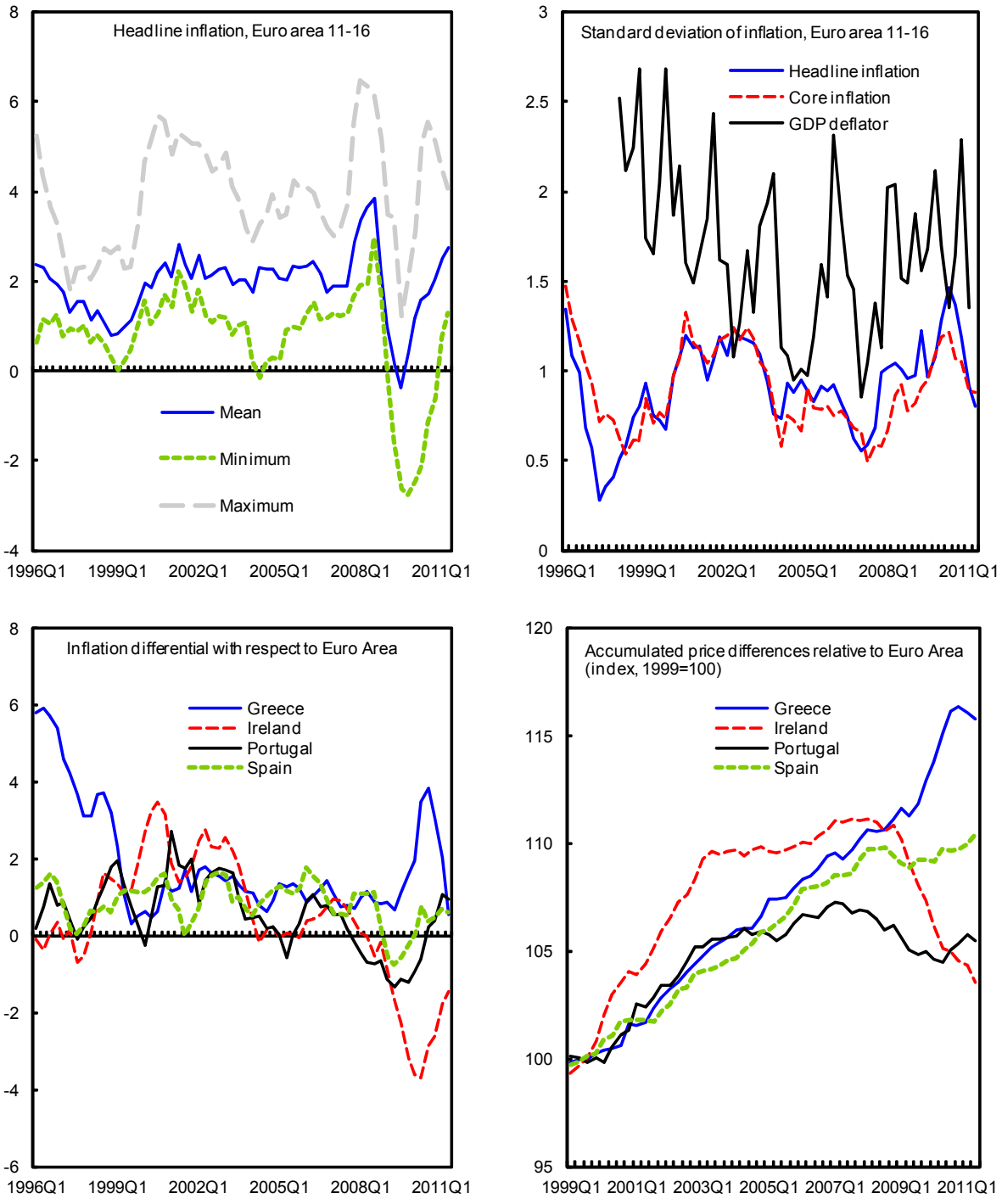
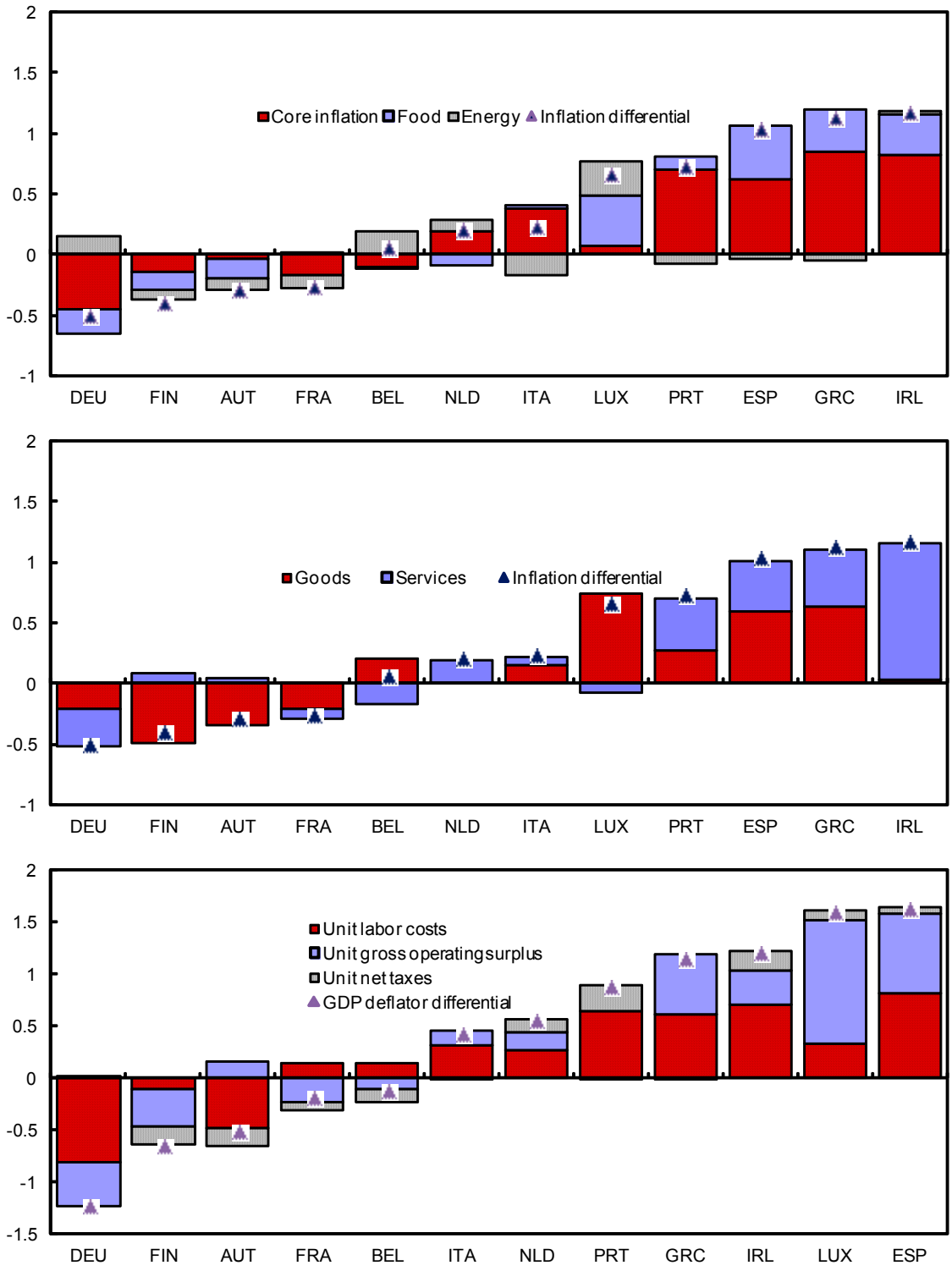
Figure 1. Euro Area: Cross-Country Variation in Inflation, 1996-2011



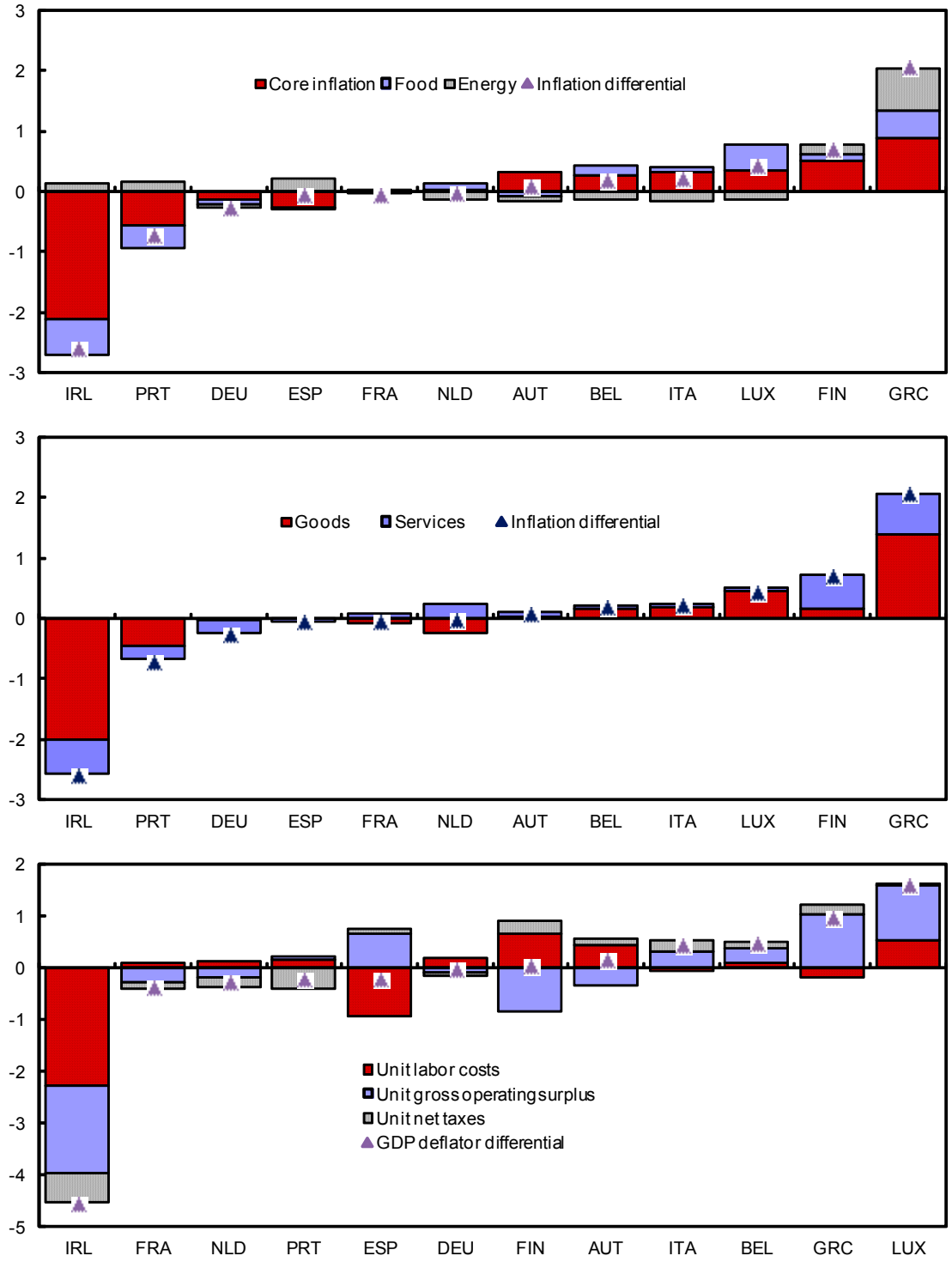
Source: Eurostat; staff calculations.

Figure 2. Euro Area Countries: Contributions of Inflation Components to Inflation Differential with Euro Area, Average 1999-2008 1/



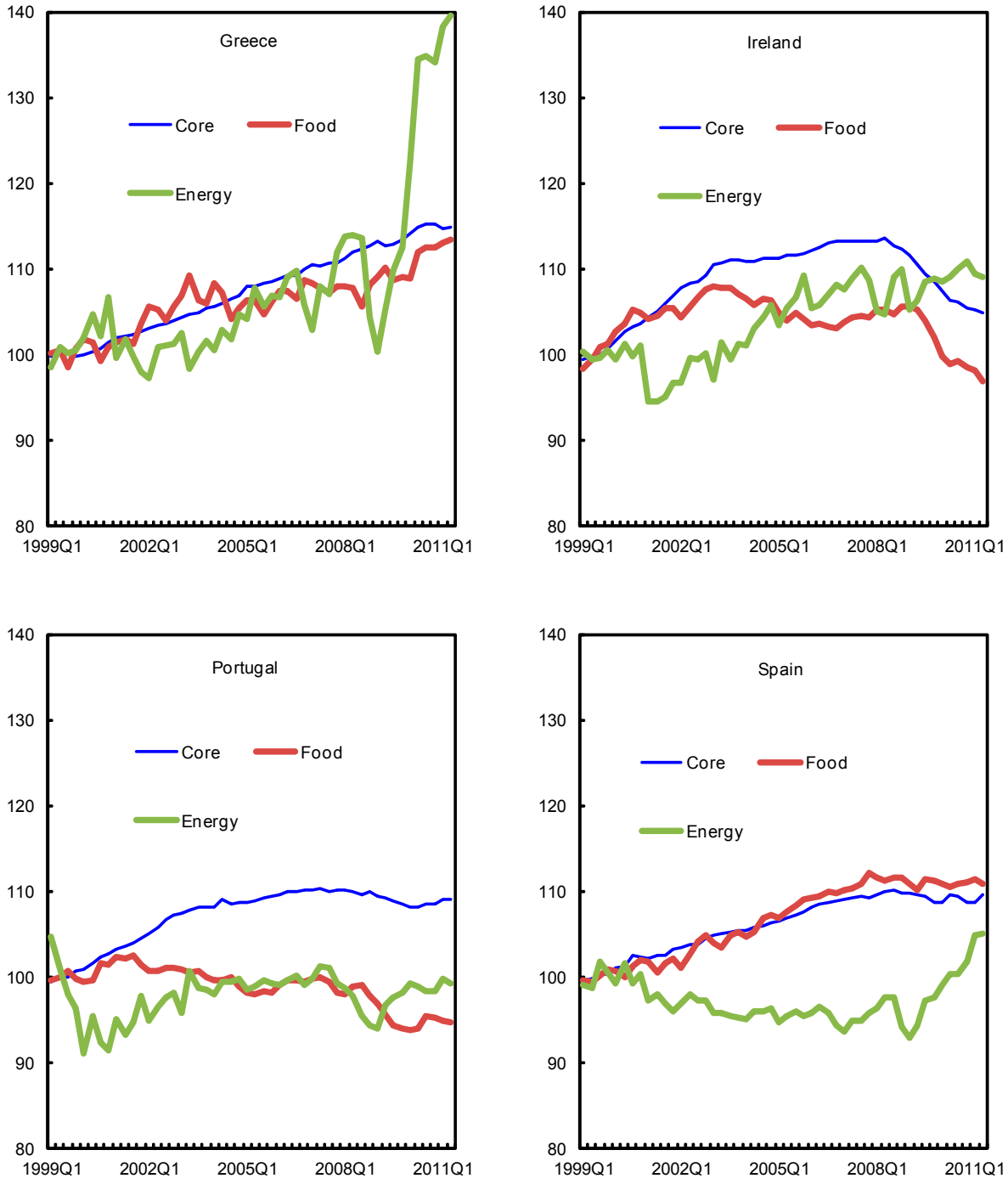
Source: Eurostat; staff calculations.
1/ 2001-2008 for GDP deflator differential and contributions of unit labor costs, unit gross operating surplus and unit net taxes for Greece..

Figure 3. Euro Area Countries: Contributions of Inflation Components to Inflation Differential with Euro Area, Average 2009-2010



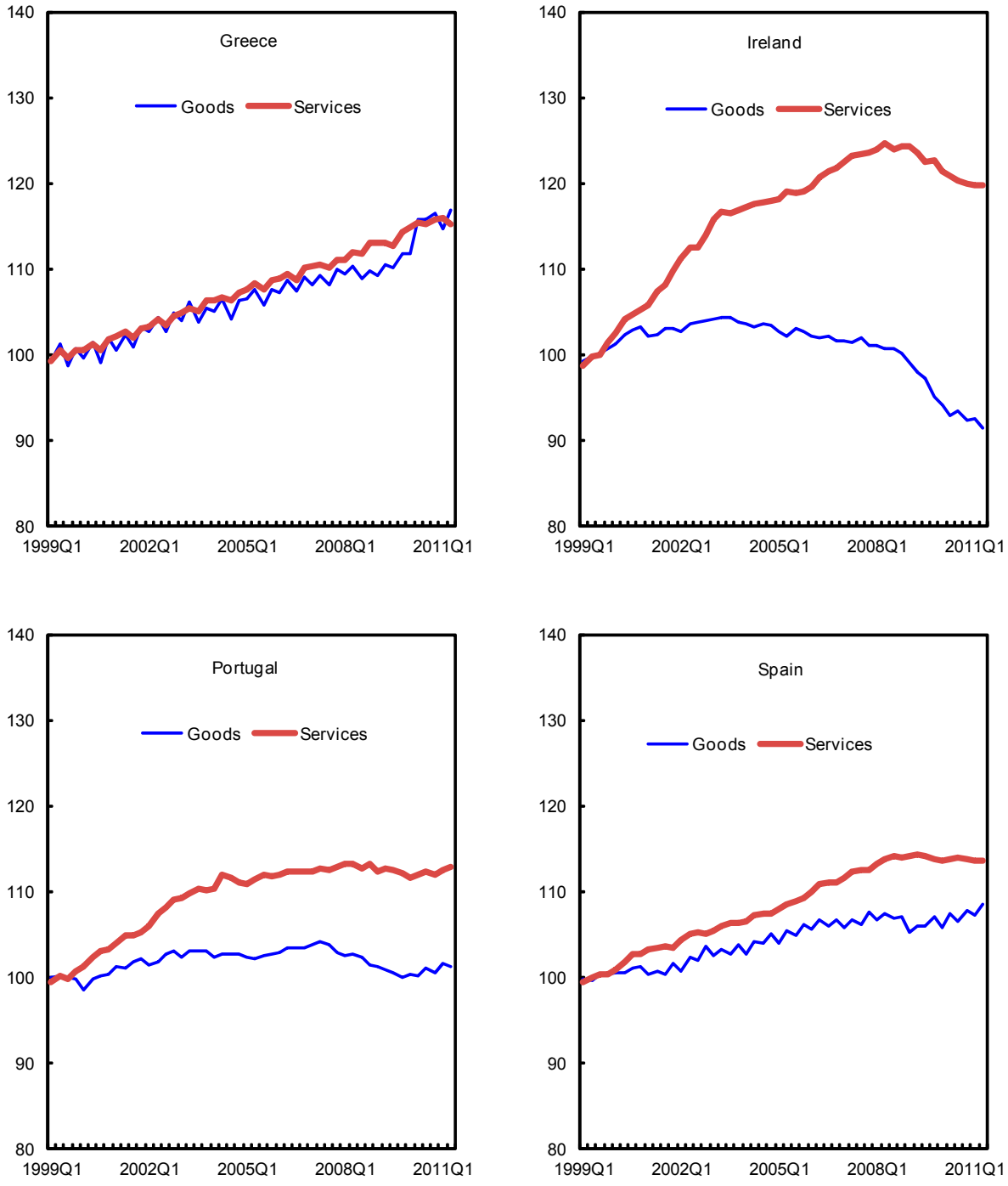
Source: Eurostat; staff calculations.

Figure 4. High-Inflation Euro Area Countries: Accumulated Price Differences Relative to Euro Area for Core, Food and Energy, 1999-2011



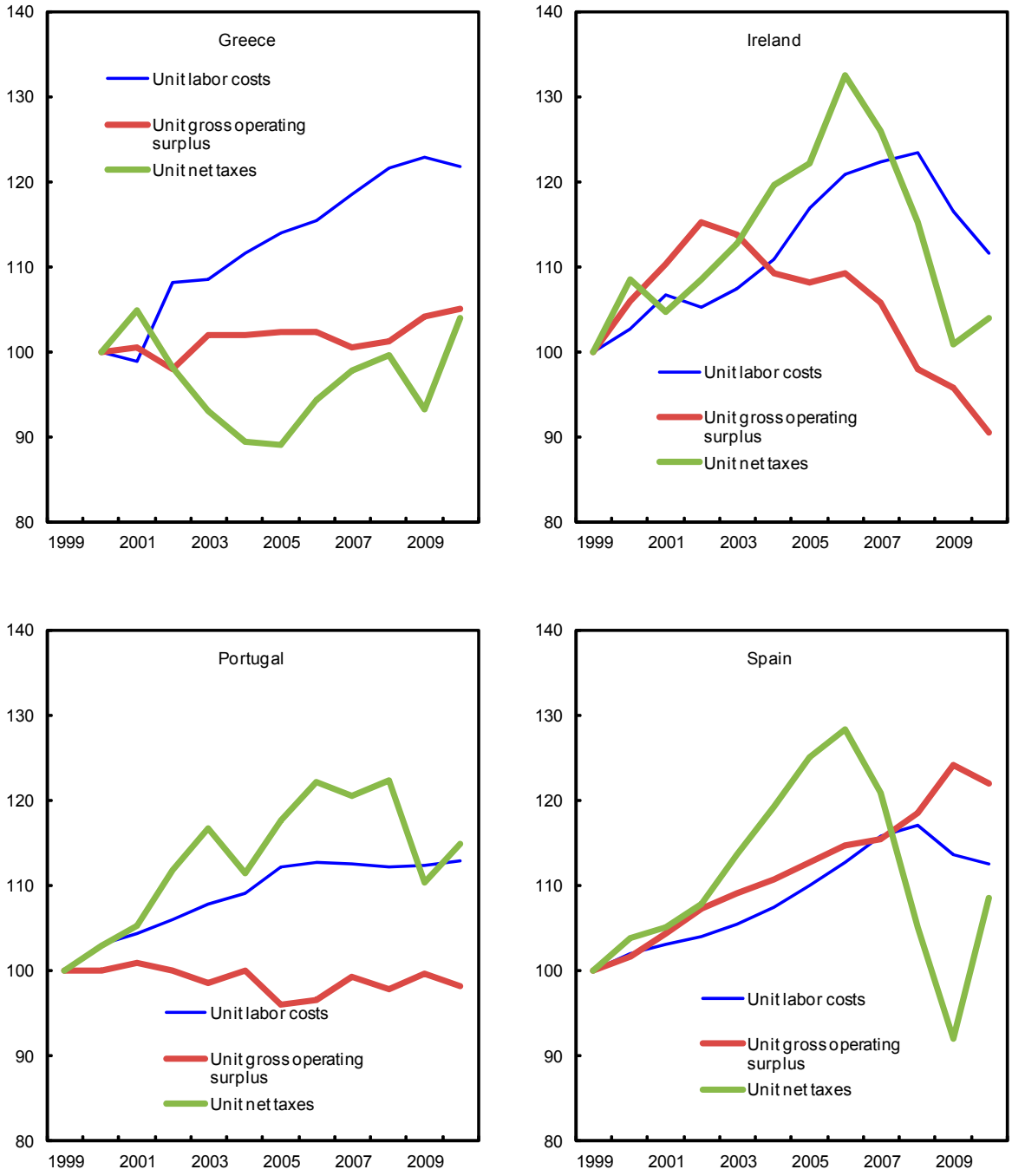
Source: Eurostat; staff calculations.

Figure 5. High-Inflation Euro Area Countries: Accumulated Price Differences Relative to Euro Area for Goods and Services, 1999-2011



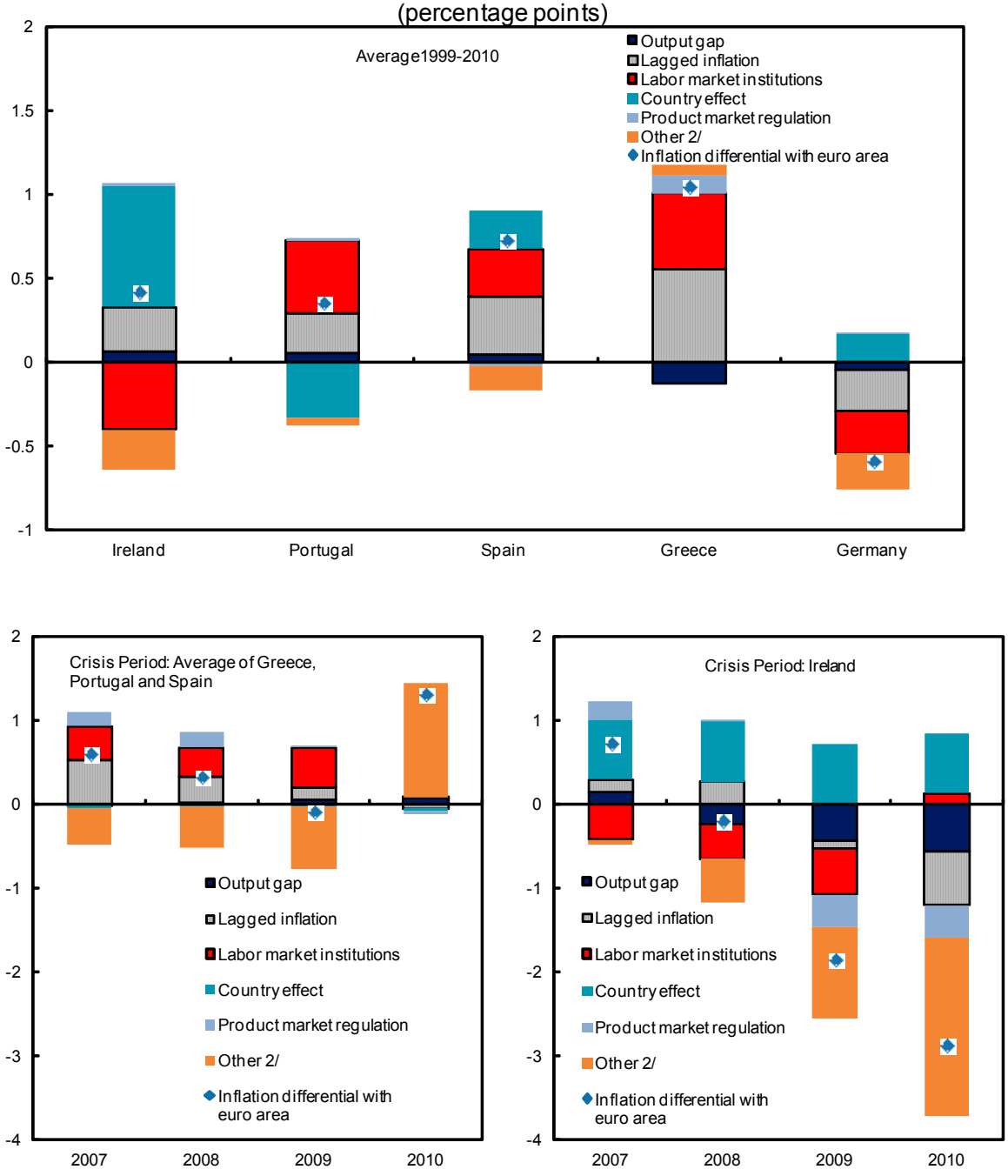
Source: Eurostat; staff calculations.

Figure 6. High-Inflation Euro Area Countries: Accumulated Cost Differences Relative to Euro Area, 1999-2010



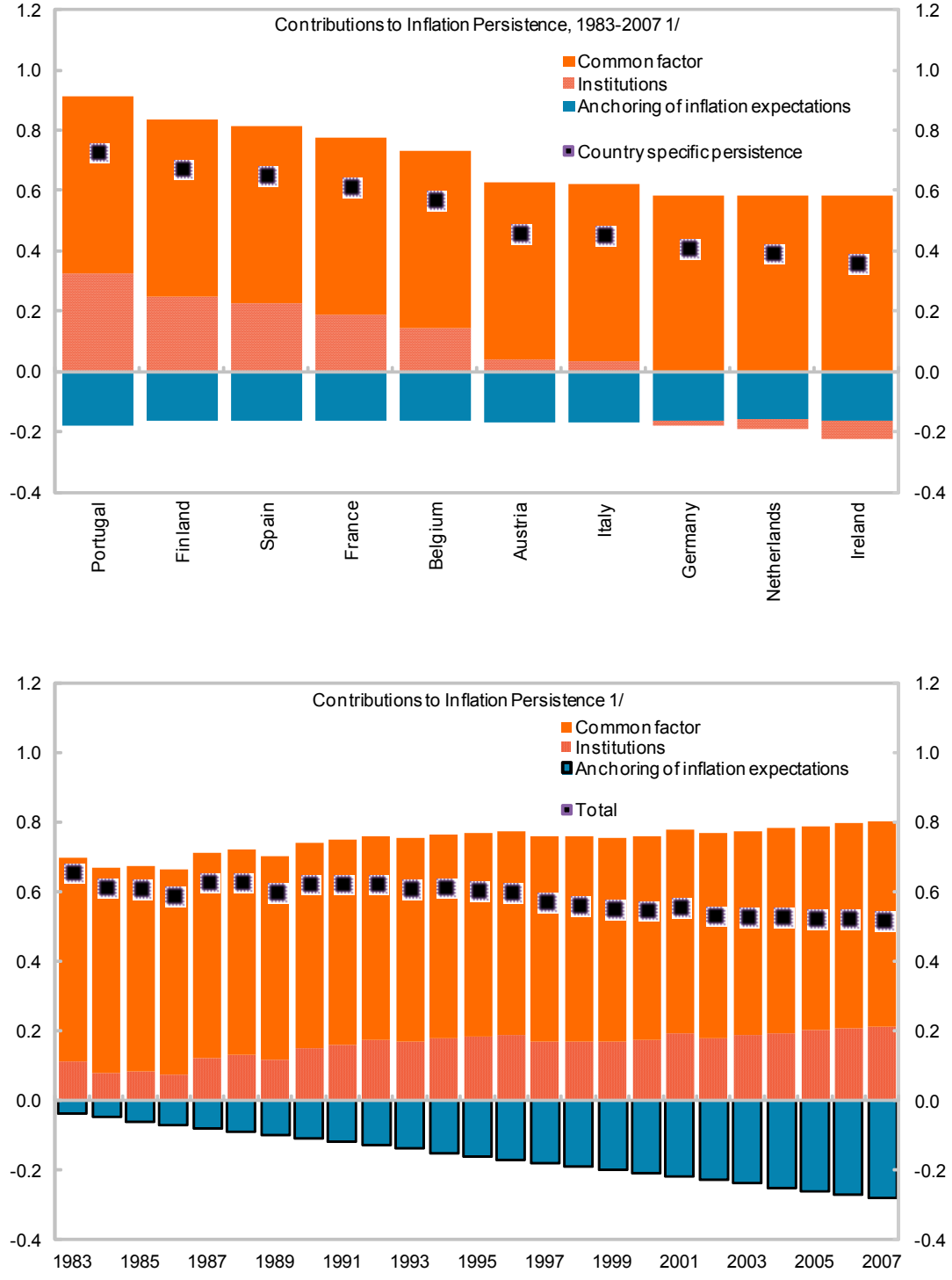
Source: Eurostat; staff calculations.

Figure 7. Selected Euro Area Countries: Contributions to Inflation Differential with the Euro Area 1/
(percentage points)



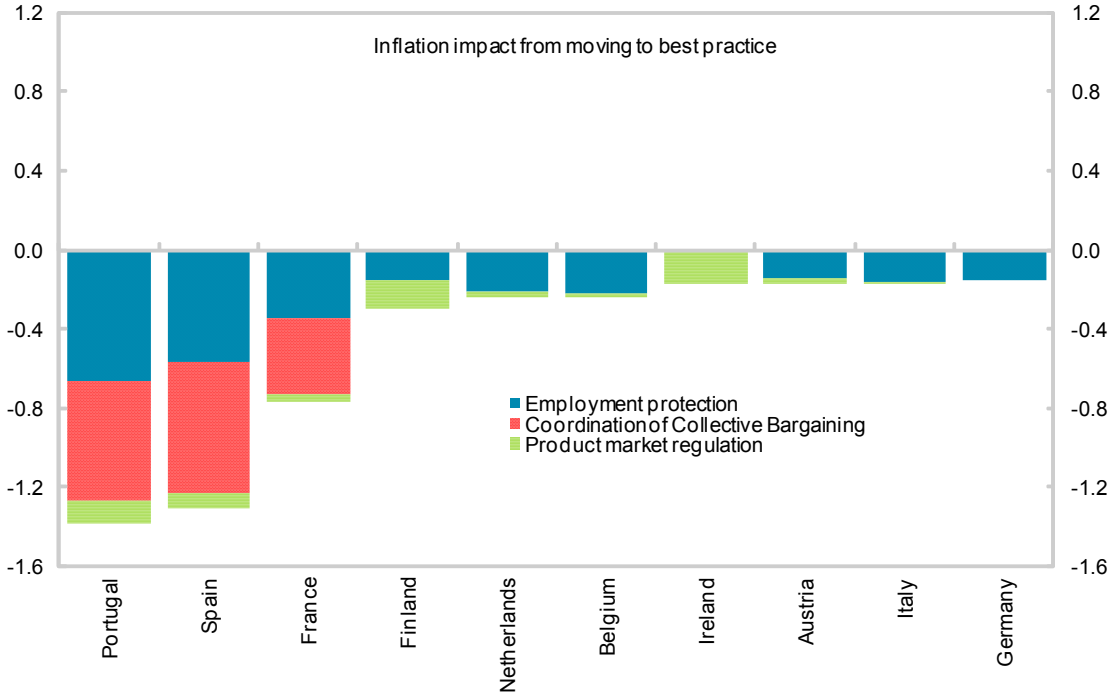
Source: Staff calculations.
1/ Based on linear model. For Greece, although the formal indicator is not available, its bargaining system can best be described as having an intermediate level of coordination. Institutions are assumed to remain unchanged for 2008-2010.
2/ Other includes the contributions of changes in the nominal effective exchange rate and of the residual. For Greece, it also includes the country fixed effect.

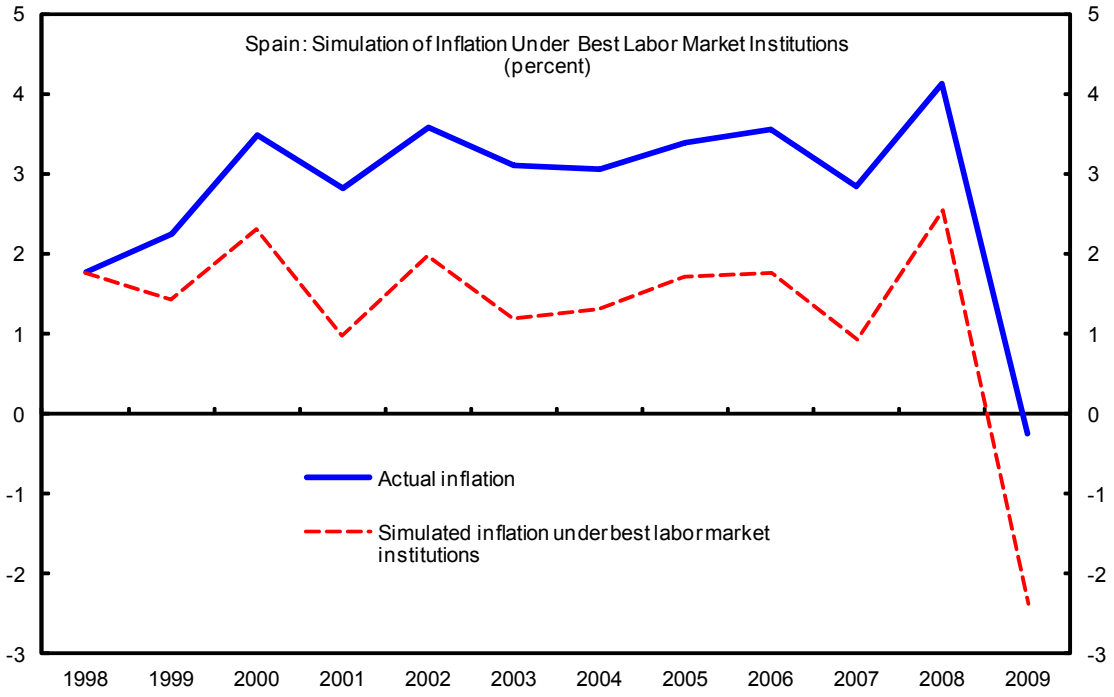
Figure 8. Contribution of Labor and Product Market Institutions to Inflation



Source: Staff calculations.
1/ Based on the model with anchoring of inflation expectations.

Figure 9. Inflation Impact from Moving to Best Practice Institutions





Source: IMF staff calculations.

Table 1. Average Inflation Differentials with Respect to Euro Area, 1999-2008 1/2/

	Headline inflation	Core inflation	GDP deflator inflation
Austria	-0.3	-0.1	-0.6
Belgium	0.1	-0.1	-0.1
Finland	-0.4	-0.1	-0.7
France	-0.3	-0.2	-0.2
Germany	-0.5	-0.7	-1.2
Greece	1.1	1.3	1.0
Ireland	1.2	1.3	1.0
Italy	0.2	0.5	0.4
Luxembourg	0.7	0.3	1.6
Netherlands	0.2	0.2	0.6
Portugal	0.7	1.1	0.9
Spain	1.0	1.1	1.7

Source: Eurostat.

1/ 2001-2008 for Greece's GDP deflator inflation.

2/ EA11-16 for headline and core inflation; EA16 for GDP deflator inflation.

Table 2. Contributions of Labor Cost and Labor Productivity to Nominal ULC Growth

2000-2008	Euro Area	Greece	Ireland	Portugal	Spain
Growth in ULC	16.0	32.1	41.6	26.6	30.4
Growth in labor cost per hour 1/	25.0	58.4	64.9	36.5	39.7
Growth in labor productivity per hour 1/	7.8	19.9	16.5	7.8	7.2

2008-2010	Euro Area	Greece	Ireland	Portugal	Spain
Growth in ULC	3.3	3.5	-9.1	4.1	-0.8
Growth in labor cost per hour 1/	4.0	-0.5	-1.5	5.5	3.5
Growth in labor productivity per hour 1/	0.7	-3.9	8.4	1.4	4.3

Source: Eurostat.

1/ Labor productivity and labor cost are per person employed for Greece.

Table 3. Determinants of Inflation: Main Results

	(1) Linear Model Full Form	(2) Non-linear Full Form	(3) Linear Model Reduced Form	(4) Non-linear Reduced Form
Lag inflation	0.420***	0.450***	0.504***	0.501**
	(0.0744)	(0.0608)	(0.0547)	(0.0473)
Output gap	0.282***	0.170***	0.223***	0.166***
	(0.0714)	(0.0442)	(0.0489)	(0.0347)
Lag relative price level	-0.906	0.349		
	(1.422)	(1.065)		
Change of NEER	-0.0658***	-0.0541***	-0.0652***	-0.0613***
	(0.0190)	(0.0186)	(0.0169)	(0.0165)
Lag change of NEER	-0.0415**	-0.0443***	-0.0443***	-0.0328**
	(0.0161)	(0.0152)	(0.0156)	(0.0151)
Lag inflation * union density	0.151***	0.155***	0.124***	0.128***
	(0.0302)	(0.0303)	(0.0247)	(0.0232)
Lag inflation * EPL	0.114***	0.132***	0.0820***	0.0985***
	(0.0230)	(0.0201)	(0.0168)	(0.0151)
Lag inflation * interm coord	0.149***	0.109**	0.0983***	0.0756**
	(0.0429)	(0.0421)	(0.0315)	(0.0299)
Lag inflation * low coord	0.0195	0.0230		
	(0.0167)	(0.0144)		
Lag inflation * PMR	-0.0957	-0.101*		
	(0.0695)	(0.0565)		
Output gap * union density	-0.0374	0.0177		
	(0.0446)	(0.0289)		
Output gap * EPL	0.0497	0.0571		
	(0.0510)	(0.0362)		
Output gap * interm coord	-0.143*	-0.0391		
	(0.0744)	(0.0485)		
Output gap * low coord	-0.0968	-0.0303		
	(0.0863)	(0.0257)		
Output gap * PMR	0.141**	0.0673*	0.122**	0.0694**
	(0.0547)	(0.0398)	(0.0486)	(0.0344)
Time * union density		0.0760		
		(0.0664)		
Time * EPL		-0.0318		
		(0.0476)		
Time * interm coord		0.270**		0.233**
		(0.106)		(0.114)
Time * low coord		-0.000474		
		(0.0396)		
Time * PMR		0.0588		
		(0.0661)		
Observations	242	242	242	242
Adjusted R^2	0.93	0.98	0.93	0.98

Notes: Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Linear model is estimated with instrumental variables; non-linear model by nonlinear least squares. All models include time effects and country fixed effects and outliers are excluded.

Table 4. Determinants of Inflation: Additional Robustness Tests

	(1) Fixed Effects	(2) OLS	(3) With levels of structural variables	(4) With changes of structural variables	(5) Including 2008–09 in the sample
Lag inflation	0.479***	0.565***	0.395***	0.426***	0.476***
	(0.0529)	(0.0541)	(0.0853)	(0.0702)	(0.0812)
Output gap	0.186***	0.174***	0.267***	0.281***	0.280***
	(0.0462)	(0.0406)	(0.0738)	(0.0706)	(0.0602)
Lag relative price level	0.0446	-0.822	-0.517	-1.130	-1.557
	(1.156)	(0.511)	(1.508)	(1.370)	(1.244)
Change of NEER	-0.0544***	-0.0774***	-0.0612***	-0.0646***	-0.0582***
	(0.0193)	(0.0183)	(0.0199)	(0.0204)	(0.0203)
Lag change of NEER	-0.0458**	-0.0307*	-0.0441**	-0.0379**	-0.0298*
	(0.0162)	(0.0176)	(0.0167)	(0.0163)	(0.0174)
Lag infl*union density	0.138***	0.0581*	0.154***	0.151***	0.149***
	(0.0267)	(0.0301)	(0.0303)	(0.0304)	(0.0331)
Lag inflation*EPL	0.118***	0.0605***	0.105***	0.105***	0.124***
	(0.0161)	(0.0176)	(0.0245)	(0.0210)	(0.0236)
Lag infl*interm coord	0.140***	0.0404	0.151***	0.144***	0.147***
	(0.0359)	(0.0287)	(0.0506)	(0.0427)	(0.0441)
Lag infl*low coord	0.0202*	0.000829	0.0116	0.0177	0.0212
	(0.0107)	(0.0106)	(0.0333)	(0.0162)	(0.0151)
Lag infl*PMR	-0.0841*	0.0317	-0.0695	-0.0803	-0.125*
	(0.0496)	(0.0383)	(0.0865)	(0.0662)	(0.0740)
Output gap*union density	0.00141	-0.00513	-0.0355	-0.0444	-0.0315
	(0.0256)	(0.0262)	(0.0436)	(0.0432)	(0.0480)
Output gap*EPL	0.0517	0.0219	0.0682	0.0279	0.0540
	(0.0339)	(0.0391)	(0.0581)	(0.0445)	(0.0597)
Output gap*interm coord	-0.0586	-0.0251	-0.162*	-0.134**	-0.159*
	(0.0396)	(0.0419)	(0.0828)	(0.0648)	(0.0872)
Output gap*low coord	-0.0389	-0.0228	-0.106	-0.0781	-0.127
	(0.0247)	(0.0396)	(0.0885)	(0.0676)	(0.104)
Output gap*PMR	0.0967**	0.0285	0.136*	0.149***	0.0820
	(0.0386)	(0.0400)	(0.0718)	(0.0548)	(0.0552)
Union Density			0.0400		
			(0.345)		
EPL			0.299		
			(0.208)		
Low coordination			0.00280		
			(0.200)		
PMR			-0.267		
			(0.365)		
Change in union density				-0.496	
				(0.845)	
Change in EPL				0.0572	
				(0.238)	
Change in low coord				-0.122	
				(0.164)	
Change in PMR				0.464	
				(0.389)	
Observations	242	242	242	242	261
Adjusted R^2	0.95	0.94	0.92	0.92	0.91

Notes: Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Models (3) to (5) are estimated using instrumental variables. All models include country and time fixed effects (except (2), which does not include country fixed effects).

Table 5. Determinants of Inflation: Additional Robustness Tests for One Structural Variable at a Time

	(1) Union density	(2) EPL	(3) Coordination	(4) PMR
Lag inflation	0.636***	0.611***	0.608***	0.557***
	(0.0548)	(0.0478)	(0.0694)	(0.0865)
Output gap	0.372***	0.335***	0.332***	0.334***
	(0.0963)	(0.0773)	(0.0861)	(0.0758)
Lag relative price level	-4.541***	-2.851**	-3.431**	-4.404***
	(1.622)	(1.249)	(1.466)	(1.502)
Change of NEER	-0.137***	-0.115***	-0.120***	-0.138***
	(0.0384)	(0.0286)	(0.0296)	(0.0347)
Lag change of NEER	-0.0295	-0.0358**	-0.0318*	-0.0335*
	(0.0192)	(0.0177)	(0.0182)	(0.0187)
Lag infl*union density	0.0000924			
	(0.0299)			
Output gap*union density	-0.00890			
	(0.0267)			
Lag inflation*EPL		0.0574***		
		(0.0196)		
Output gap*EPL		0.0394		
		(0.0329)		
Lag infl*interm coord			0.0540	
			(0.0380)	
Lag infl*low coord			-0.00368	
			(0.0172)	
Output gap*interm coord			0.00760	
			(0.0366)	
Output gap*low coord			-0.0537	
			(0.103)	
Lag infl*PMR				0.0459
				(0.0648)
Output gap*PMR				0.132**
				(0.0623)
Observations	242	242	242	242
Adjusted R^2	0.90	0.91	0.90	0.90

Notes: Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All equations are estimated using instrumental variables, and include country and time fixed effects.

Table 6. Determinants of Inflation: Additional Robustness Tests with Rolling Regressions

	(1) 1980-2000	(2) 1981-2001	(3) 1982-2002	(4) 1983-2003	(5) 1984-2004	(6) 1985-2005	(7) 1986-2006	(8) 1987-2007
Lag inflation	0.440***	0.450***	0.487***	0.476***	0.543***	0.561***	0.493***	0.548***
	(0.106)	(0.101)	(0.0993)	(0.0819)	(0.103)	(0.112)	(0.0942)	(0.114)
Output gap	0.247**	0.256**	0.267***	0.275***	0.232***	0.168**	0.275***	0.145
	(0.113)	(0.106)	(0.102)	(0.0937)	(0.0847)	(0.0690)	(0.0766)	(0.195)
Lag relative price level	-3.420*	-2.687	-1.219	-0.691	-1.871	-1.770	-2.510	-3.003*
	(1.982)	(1.922)	(1.728)	(1.603)	(1.713)	(1.679)	(1.726)	(1.786)
Change of NEER	-0.0849***	-0.0813***	-0.0669***	-0.0597***	-0.0672***	-0.0706***	-0.0810***	-0.0657**
	(0.0239)	(0.0235)	(0.0224)	(0.0216)	(0.0243)	(0.0245)	(0.0235)	(0.0266)
Lag change of NEER	-0.0318*	-0.0349*	-0.0381**	-0.0382**	-0.0290	-0.0239	-0.0273	-0.0182
	(0.0185)	(0.0187)	(0.0179)	(0.0179)	(0.0180)	(0.0180)	(0.0169)	(0.0194)
Lag infl*union density	0.133***	0.128***	0.139***	0.143***	0.0486	-0.0232	0.0792	0.142**
	(0.0400)	(0.0408)	(0.0413)	(0.0394)	(0.0621)	(0.0522)	(0.0575)	(0.0646)
Lag inflation*EPL	0.103***	0.105***	0.108***	0.109***	0.0540	0.0410	0.0255	0.0313
	(0.0248)	(0.0251)	(0.0255)	(0.0252)	(0.0399)	(0.0449)	(0.0690)	(0.0863)
Lag infl*interm coord	0.123**	0.122**	0.140**	0.146***	0.0714	-0.0217	0.105	0.129*
	(0.0594)	(0.0590)	(0.0565)	(0.0536)	(0.0701)	(0.0614)	(0.0703)	(0.0662)
Lag infl*low coord	0.0163	0.0188	0.0202	0.0188	0.00845	-0.00126	0.0413	0.236
	(0.0194)	(0.0189)	(0.0179)	(0.0176)	(0.0154)	(0.0169)	(0.0278)	(0.263)
Lag infl*PMR	-0.0526	-0.0652	-0.104	-0.0998	-0.0825	0.0173	-0.0705	-0.0648
	(0.112)	(0.108)	(0.102)	(0.0886)	(0.0959)	(0.0919)	(0.0987)	(0.118)
Output gap*union density	-0.00323	-0.0101	-0.0262	-0.0401	-0.0259	-0.00454	-0.0237	-0.0479
	(0.0718)	(0.0664)	(0.0634)	(0.0597)	(0.0476)	(0.0373)	(0.0408)	(0.0443)
Output gap*EPL	0.0788	0.0669	0.0505	0.0409	0.0303	0.00809	0.0283	0.00863
	(0.0678)	(0.0608)	(0.0551)	(0.0524)	(0.0551)	(0.0492)	(0.0501)	(0.0494)
Output gap*interm coord	-0.134	-0.129	-0.126	-0.138	-0.101	-0.0440	-0.0750	-0.0691
	(0.0953)	(0.0862)	(0.0850)	(0.0839)	(0.0885)	(0.0748)	(0.0755)	(0.0690)
Output gap*low coord	-0.0776	-0.0720	-0.0702	-0.0810	-0.0792	-0.0866	-0.122	-0.749
	(0.0977)	(0.0930)	(0.0876)	(0.0870)	(0.0932)	(0.0818)	(0.111)	(0.840)
Output gap*PMR	0.127	0.123	0.112	0.103	0.104	0.0926*	0.0721	0.0473
	(0.122)	(0.120)	(0.118)	(0.106)	(0.0783)	(0.0536)	(0.0531)	(0.0561)
Observations	176	185	194	204	203	204	203	205
Adjusted R^2	0.91	0.91	0.92	0.92	0.86	0.85	0.84	0.76

Notes: Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All equations are estimated using instrumental variables, and include country and time fixed effects.

Table 7. Determinants of Inflation: Additional Robustness Tests Dropping One Country At a Time

	(1) Austria	(2) Belgium	(3) France	(4) Germany	(5) Italy	(6) Netherlands	(7) Finland	(8) Ireland	(9) Portugal	(10) Spain
Lag inflation	0.430***	0.424***	0.444***	0.476***	0.623***	0.409***	0.310***	0.486***	0.474***	0.419***
	(0.0740)	(0.0795)	(0.0788)	(0.0737)	(0.0894)	(0.0927)	(0.0931)	(0.0780)	(0.0807)	(0.0791)
Output gap	0.243***	0.292***	0.264***	0.336***	0.193***	0.285***	0.380***	0.318***	0.281***	0.261***
	(0.0719)	(0.0726)	(0.0720)	(0.0777)	(0.0647)	(0.0819)	(0.125)	(0.0689)	(0.0791)	(0.0769)
Lag relative price level	-0.234	-1.337	-1.756	-0.738	-1.595	-0.575	-2.203	-4.449***	-0.525	-1.105
	(1.494)	(1.424)	(1.602)	(1.457)	(1.453)	(1.506)	(2.248)	(1.698)	(1.458)	(1.507)
Change of NEER	-0.0617***	-0.0700***	-0.0686***	-0.0758***	-0.0692**	-0.0593***	-0.0582***	-0.0922***	-0.0510***	-0.0799***
	(0.0197)	(0.0187)	(0.0208)	(0.0178)	(0.0277)	(0.0206)	(0.0219)	(0.0201)	(0.0187)	(0.0210)
Lag change of NEER	-0.0479***	-0.0417**	-0.0383**	-0.0332**	-0.0329	-0.0454***	-0.0390**	-0.0342*	-0.0331**	-0.0438***
	(0.0163)	(0.0177)	(0.0177)	(0.0164)	(0.0221)	(0.0160)	(0.0192)	(0.0177)	(0.0153)	(0.0161)
Lag infl*union density	0.141***	0.149***	0.186***	0.129***	0.0489	0.162***	0.145***	0.169***	0.167**	0.151***
	(0.0302)	(0.0317)	(0.0428)	(0.0306)	(0.0545)	(0.0299)	(0.0324)	(0.0313)	(0.0749)	(0.0328)
Lag inflation*EPL	0.111***	0.116***	0.140***	0.121***	0.0373	0.120***	0.115***	0.0391	0.115***	0.110***
	(0.0223)	(0.0237)	(0.0327)	(0.0234)	(0.0371)	(0.0220)	(0.0267)	(0.0324)	(0.0317)	(0.0244)
Lag infl*interm coord	0.138***	0.135***	0.159***	0.104**	0.0754	0.165***	0.175***	0.193***	0.181**	0.143***
	(0.0438)	(0.0467)	(0.0445)	(0.0434)	(0.0730)	(0.0428)	(0.0519)	(0.0450)	(0.0848)	(0.0477)
Lag infl*low coord	0.0168	0.0165	0.0290	0.00834	-0.00628	0.0246	0.0303	0.0493**	0.0157	0.0199
	(0.0166)	(0.0172)	(0.0189)	(0.0162)	(0.0218)	(0.0159)	(0.0228)	(0.0194)	(0.0170)	(0.0192)
Lag infl*PMR	-0.0689	-0.103	-0.186*	-0.0857	-0.0976	-0.117	-0.0716	-0.128*	-0.0652	-0.0984
	(0.0756)	(0.0730)	(0.0960)	(0.0701)	(0.0772)	(0.0749)	(0.0750)	(0.0741)	(0.0702)	(0.0938)
Output gap*union density	-0.0318	-0.0377	-0.0254	-0.0742	0.00531	-0.0352	-0.0321	0.0141	-0.0459	-0.0223
	(0.0444)	(0.0450)	(0.0485)	(0.0478)	(0.0348)	(0.0574)	(0.102)	(0.0529)	(0.0380)	(0.0430)
Output gap*EPL	0.0478	0.0560	0.0362	0.101*	0.0380	0.0563	0.0480	0.0295	0.0321	0.0484
	(0.0473)	(0.0545)	(0.0579)	(0.0557)	(0.0401)	(0.0511)	(0.0620)	(0.0931)	(0.0497)	(0.0509)
Output gap*interm coord	-0.121*	-0.156**	-0.122	-0.221***	-0.0350	-0.144	-0.169*	-0.0639	-0.113	-0.141*
	(0.0714)	(0.0771)	(0.0811)	(0.0818)	(0.0569)	(0.0930)	(0.0898)	(0.0717)	(0.0702)	(0.0756)
Output gap*low coord	-0.0902	-0.0981	-0.109	-0.0992	-0.0504	-0.0834	-0.122	0.0192	-0.0788	-0.0895
	(0.0799)	(0.0886)	(0.0984)	(0.0855)	(0.0512)	(0.0797)	(0.105)	(0.0538)	(0.0841)	(0.0824)
Output gap*PMR	0.129**	0.148**	0.176***	0.131**	0.0688	0.125**	0.143**	0.153***	0.0863*	0.152**
	(0.0570)	(0.0554)	(0.0587)	(0.0605)	(0.0444)	(0.0602)	(0.0677)	(0.0548)	(0.0498)	(0.0615)
Observations	218	217	217	217	209	218	217	217	221	219
Adjusted R^2	0.93	0.93	0.92	0.94	0.86	0.93	0.92	0.93	0.89	0.92

Notes: Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All equations are estimated using instrumental variables, and include country and time fixed effects.

Table 8. Determinants of Inflation: Additional Robustness Tests for Role of Productivity Levels and Anchoring of Inflation Expectations

	(1) Productivity levels with fixed effects	(2) Productivity levels without fixed effects	(3) Anchoring time trend since 1980	(4) Anchoring euro time trend
Lag inflation	0.432***	0.567***	0.761***	0.420***
	(0.0771)	(0.0706)	(0.157)	(0.0820)
Output gap	0.281***	0.243***	0.522	0.281***
	(0.0719)	(0.0564)	(0.319)	(0.0928)
Lag relative price level	-1.057	-2.236***	-0.628	-0.824
	(1.425)	(0.866)	(1.585)	(1.521)
Change of NEER	-0.0677***	-0.0965***	-0.0570***	-0.0641***
	(0.0188)	(0.0179)	(0.0209)	(0.0198)
Lag change of NEER	-0.0407**	-0.0302*	-0.0433***	-0.0397**
	(0.0163)	(0.0156)	(0.0156)	(0.0166)
Lag infl*union density	0.164***	0.0765**	0.131***	0.150***
	(0.0328)	(0.0390)	(0.0304)	(0.0331)
Lag inflation*EPL	0.114***	0.0670***	0.102***	0.113***
	(0.0230)	(0.0231)	(0.0255)	(0.0231)
Lag infl*interm coord	0.149***	0.0521	0.138***	0.144***
	(0.0423)	(0.0424)	(0.0507)	(0.0494)
Lag infl*low coord	0.0161	0.000935	0.0175	0.0172
	(0.0169)	(0.0160)	(0.0221)	(0.0180)
Lag infl*PMR	-0.0999	-0.0248	-0.200**	-0.0827
	(0.0706)	(0.0453)	(0.0865)	(0.0944)
Output gap*union density	-0.0413	-0.00366	-0.0314	-0.0475
	(0.0443)	(0.0383)	(0.0430)	(0.0455)
Output gap*EPL	0.0614	0.0453	0.00951	0.0532
	(0.0535)	(0.0545)	(0.0725)	(0.0565)
Output gap*interm coord	-0.154**	-0.0564	-0.0642	-0.155**
	(0.0747)	(0.0655)	(0.0913)	(0.0735)
Output gap*low coord	-0.102	-0.0891	-0.0399	-0.0933
	(0.0873)	(0.0890)	(0.101)	(0.0852)
Output gap*PMR	0.141**	0.0818	0.0260	0.131
	(0.0547)	(0.0516)	(0.113)	(0.0908)
Log of labor productivity	1.371	0.843*		
	(1.368)	(0.430)		
Lag infl*trend1980			-0.0232**	
			(0.00948)	
Output gap*trend1980			-0.0131	
			(0.0182)	
Lag infl*euro trend				-0.00411
				(0.0373)
Output gap*euro trend				0.00569
				(0.0221)
Observations	242	242	242	242
Adjusted R^2	0.92	0.93	0.93	0.92

Notes: Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All equations are estimated using instrumental variables, and include country and time fixed effects.