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Economic Analysis

Product Market Competition and Inflation Dynamics: Evidence from a Panel of OECD Countries

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Abstract

We analyse the impact of product market competition on the responsiveness of inflation to macroeconomic imbalances. Results based on a 20-country OECD panel estimated for the period 1961-2006 show that if product market competition is high the response of inflation to lagged inflation and unemployment is reduced, while inflation is more responsive to changes in productivity growth in countries in which competition is above the OECD average. When product market competition is measured by barriers to firms' entry, we also find that low entry barriers dampen the effect on inflation of movements in import prices. These results are attributed to temporary mark-up changes after demand- and supply-side shocks.

Keywords: Inflation dynamics; Product market competition; Labour market coordination; Trade union density.

JEL Classification: E02; E31; J51.

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1. Introduction

Understanding the determinants of the inflation process remains a key subject of research in macroeconomics. Following the oil and raw materials price hikes of the 1970s a large literature has investigated the role of institutions in explaining cross-country differences in inflation rates. The institutions considered by the literature are varied and include, amongst others, labour market institutions, such as coordination in wage-setting and unionisation, monetary institutions, such as central bank independence, and exchange rate arrangements[5].

Basic theory suggests that competition in the product market is an important determinant of the price level - in imperfectly competitive markets firms set prices as a mark-up over the marginal cost - and thus of the inflation rate. In terms of recent policy efforts the ongoing implementation of the Services Directive by the European Union member states intends to have a large beneficial impact on the competitive environment in which the single market operates. In this paper we investigate empirically the relationship between product market competition and inflation dynamics and show that competition has a significant impact on the response of inflation to macroeconomic shocks.

The inflation process has been often modelled by means of reduced-form specifications in which inflation is typically influenced by its own lag or lags, as a proxy of backward-looking inflation expectations and of fixed-duration of wage and price contracts, the unemployment gap, as a proxy of cyclical position or excess demand, and productivity growth, import price inflation and tax changes, all of them as proxies of the evolution of production costs or unanticipated cost shocks. The theoretical underpinning of these equations is usually found in extended price-setting and wage-setting rules that would capture the structural characteristics of the economy in question, such as exogenous wage-push factors that would be eventually collected in the natural rate of unemployment[6].

The empirical literature in the field has established that the demand- and cost-side variables determining inflation dynamics in the post-war period are indeed similar across OECD economies. It has also shown that the presence of cross-country heterogeneity in the size of the impacts of those macroeconomic determinants is expected, namely as a result of the underlying structural differences that prevail across countries. In Burdekin and Siklos (1999), Boschen and Weise (2004) and Bowdler and Nunziata (2007), the empirical analysis sets the hypothesis that inflation adjustment to common macroeconomic shocks depends upon the institutional environment that characterises each economy. In this spirit, Bowdler and Nunziata (2007) show that the heterogeneity that governed the inflation adjustments to the common macroeconomic imbalances of the 1960-1995 period across the OECD can be explained, at least in part, by the degree of coordination among labour organisations in the wage-setting process and by the percentage unionisation of the labour force. In this paper we explore the impact that institutional features of the product market have on the response of inflation to its reduced-form determinants. By so doing we further explain the heterogeneity that has characterised inflation processes across the OECD since the early 1960s.

The empirical analysis is based on the estimation of a panel data model of 20 OECD countries constructed yearly for the period 1960-2006. The panel controls for the degree of product market competition as a novel institutional characteristic that may determine the response of inflation to macroeconomic shocks. More specifically, the analysis finds that the response of inflation to lagged inflation and unemployment is a decreasing function of the degree of product market competition, while inflation is more responsive to changes in productivity growth in countries in which competition is above the OECD average. In addition, when the degree of product market competition is solely proxied by a measure of barriers to firms' entry, we find that low entry barriers dampen the response of inflation to import price inflation. The empirical evidence that we present also confirms the earlier results reported in Bowdler and Nunziata (2007). Thus, high coordination in the labour market reduces the effect on inflation of movements in unemployment, productivity and import prices, both on impact and dynamically.

5: See, among others, Flanagan *et al*. (1983), Bruno and Sachs (1985), Alogoskoufis and Smith (1991), Burdekin and Siklos (1999), Boschen and Weise (2004) and Bowdler and Nunziata (2007). Comparatively, the recent literature in this subject is less extensive than the literature addressing the role of institutions in explaining cross-country variation in unemployment rates (see, for example, Blanchard and Wolfers (2000), Nickell *et al.* (2005), Griffith *et al*. (2007) and Fiori *et al.* (2008)).
6: For the case of the U.S economy, Gordon (2009) argues that the triangle approach to model inflation, which reflects its dependence on demand, supply and inertia, is more suited to explain the post-war inflation process while the New Keynesian Phillips Curve, which emphasises the forward-looking nature of inflation expectations and thus the ability to respond to anticipated policy changes, is essential for understanding big inflation episodes (e.g. the end of hyperinflations).

In contrast, high unionisation increases the response of inflation to changes in productivity, import prices and indirect taxation. For a given path of each macroeconomic determinant, the trajectory of inflation would be more stable in countries with an institutional scenario that combines high product market competition, high coordination and low unionisation. The results are generally robust to the inclusion of other explanatory macroeconomic variables, such as money supply growth, to additional institutional controls, such as policy regimes (i.e. money supply target, inflation targeting and exchange rate regime), and to the adoption of alternative estimation methods. Our dynamic simulations suggest that product market competition has exerted a large impact on inflation performance after 1990, more particularly, in the absence of product market reform annual inflation across the OECD would have been 33 percent higher on average.

The remainder of the paper is organised as follows. Section 2 briefly revises the literature on inflation adjustment in OECD countries and presents the relevant stylized features of the product and the labour markets across the 20 country sample. Section 3 describes the panel dataset that has been constructed and discusses the econometric methodology and issues relevant to the estimation approach. Section 4 presents the empirical results and it also carries out robustness tests. Section 5 applies the estimation results to illustrate the relevance of heterogeneity in inflation dynamics. Section 6 presents a set of dynamic simulations performed in order to show the relative importance of labour and product market institutional changes in the determination of inflation since the early 1990s. Section 7 concludes.

2. Product and Labour Markets Institutions and Inflation Adjustment

2.1. Institutions and inflation adjustment

The relationship between institutions and inflation performance has attracted renewed interest in the macroeconomics literature. The argument goes back to the 1980s, when the focus of attention was on the interplay between labour market institutions and inflation performance. The literature has argued that the corporatist model of wage bargaining, in which an economy-wide agreement among labour unions, employers confederations and the government facilitated wage restraint, allowed countries such as Austria, Germany and the Netherlands to stave off the worst inflation episodes after the oil and raw materials price hikes of the 1970s (see, for example, Flanagan *et al.* (1983) and Bruno and Sachs (1985)). More recently, Burdekin and Siklos (1999) identify the shifts in inflation persistence that took place in the U.S, U.K, Canada and Sweden over the XXth century and account for them in terms of the onset of wars, the oil price shocks of the 1970s and institutional shifts in monetary policy, as opposed to the changes in exchange rate regime that were emphasised earlier in Alogoskoufis and Smith (1991). Franzese and Hall (2000) argue that the low inflation experience in post-war Germany was the result of a successful combination of central bank independence and high coordination in the labour market. Boschen and Weise (2004) reach a similar conclusion with regard to the cross-country differences in the inflation effect of the oil and raw material price shocks of the 1970s recorded across the OECD. Boschen and Weise (2004) explain these differences using a measure of political support for low inflation. These empirical studies, namely Burdekin and Siklos (1999) and Boschen and Weise (2004), note that labour market institutions may account for, at least, part of the cross-country heterogeneity governing inflation responses to macroeconomic shocks in the OECD, an observation recently confirmed in Bowdler and Nunziata (2007). In particular, Bowdler and Nunziata (2007) emphasise the roles of both the extent of coordination in the labour market and the percentage unionisation of the workforce as two independent channels through which institutions may determine inflation adjustment. Finally, Przybyla and Roma (2005) explore the role that product market competition may have in explaining long-term average inflation rates for a panel of EU countries and sectors, and find that higher product market competition reduces average inflation rates for long periods of time.

A labour market in which coordination is high is characterised by increased information flows among trade unions that represent different groups of workers as well as by high synchronisation in the timing of their respective wage bargaining processes with employers. In this institutional environment, wage-setters are more aware of the aggregate price effects of their individual wage demands (see, for example, Cukierman and Lippi (1999, 2001), Grüner and Hefeker (1999), Franzese and Hall (2000), Soskice and Iversen (2000), Coricelli *et al*. (2004))[7]. Hence, in the event of a changing macroeconomic environment, unions coordinate to restrain wages and thus limit the price effects of macroeconomic shocks[8]. Thus, the first hypothesis that the empirical model of inflation tests is that more (respectively, less) coordination makes inflation less (respectively, more) responsive to macroeconomic imbalances, such as unemployment below the natural rate.

A labour market in which unionisation rates are high is likely to imply that the bargaining power in the hands of unions in wage-setting is also high. That is, high unionisation rates reflect the extent of monopoly power over the labour supply. A labour market with a high percentage of unionised workers may thus deliver higher wage increases after macroeconomic shocks, as workers may be able to extract greater labour rents in the face of labour shortages or raised living costs. Hence, in line with Bowdler and Nunziata (2007), the second hypothesis that we test is that more (respectively, less) unionisation causes a larger (respectively, smaller) response of inflation to macroeconomic imbalances.

The response of inflation to supply and demand-side pressures may be potentially affected by institutional features of the product market. A channel through which the degree of product market competition may have an effect on inflation adjustment is via temporary variations in the mark-up.

7: The theoretical modelling of labour unions' perception of the inflationary consequences of their individual wage strategies typically involves a union objective function that reflects some sort of inflation aversion

8: The institutional environment must be such that labour unions in highly coordinated markets must find coordination optimal. That is, no individual labour union has the incentive to deviate from the coordinated strategy in order to favour its group of workers.

That is, a more competitive product market environment may imply that firms adjust their mark-ups down in response to excess demand imbalances, i.e. unemployment below the natural rate, and shocks that raise the cost of production. By so doing, price-setters would reduce the aggregate price change that follows these macroeconomic pressures. Thus, we test for weaker (respectively, stronger) responses of inflation to macroeconomic variables when the degree of product market competition is above (respectively, below) the OECD average[9].

The presence of interaction terms between the backward-looking inflation component and institutions in the inflation equation accounts for the possibility that macroeconomic shocks take effect, not only contemporaneously, but over time as well. Therefore, we finally test for the role that product and labour market institutions have on the response of inflation to its backward-looking component, quantifying the extent of heterogeneity in the (conditional) persistence parameter.

2.2. The product and labour markets institutions across the OECD

The sample of OECD countries that we consider includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, Switzerland, the UK and the US. A key feature of this sample is its heterogeneous institutional mix[10]. Figures 1, 2 and 3 show the variety of prevailing institutional arrangements of the product and the labour markets that, on average, have characterised the OECD during the post-war period[11].

Thus, Figures 1, 2 and 3 show distinctive institutional mixes such as those of Denmark, Finland, Norway and Sweden -- i.e. the Scandinavian countries -- which have exhibited both more coordination and unionisation than average and less product market competition, the latter with the exception of Sweden. On the other hand, the Anglo-Saxon economies of Australia, Canada, U.K, and U.S appear to have moved together in the extent of improved competition in their goods markets. Germany and Austria had the highest level of coordination over the sample period and slightly less product market competition than average. Spain is placed at an intermediate level in terms of both coordination and competition; however, average unionisation is the weakest in the sample[12]. Ireland, on the other hand, is above average in coordination and unionisation, showing also a much worse position in the extent of product market competition if compared to most other countries. This latter feature is also shared by Portugal which, in addition, has lower coordination and higher unionisation than average.

The next sections explore the potential effects on inflation adjustment of such heterogeneity in product and labour markets structures, identifying which countries might have fared relatively better after the common macroeconomic shocks of the past fifty years.

9: The analysis in this paper is confined to the impact of institutions on the response of inflation to macroeconomic shocks. Hence, it does not address whether product market competition may exert permanent effects on inflation. A direct effect of competition on equilibrium, or average, inflation has been associated to the time inconsistency argument of monetary policy (Kydland and Prescott (1977), Barro and Gordon (1983)). Thus, in Neiss (2001), the difference in average inflation rates across OECD economies can be explained by the greater incentive on the part of the monetary authority to create surprise inflation in those economies with a level of equilibrium employment far below the social optimum or perfectly competitive level. In a monopolistically competitive model in which both labour unions and an independent central bank are inflation averse, Coricelli *et al*. (2006) show that equilibrium inflation is a decreasing function of the degree of competition in product markets.
10: See below and the Appendix for a detailed description of the measures of institutions that are used
11: Note that, in Figures 1, 2 and 3, AUST stands for Australia and AT for Austria.
12: For the cases of France and Spain, it is worth noting that union membership is likely to underestimate the degree of union power over the labour supply. An index adjusted by the extent of bargaining coverage would, probably, be more accurate in capturing this effect for these two countries. More particularly, union coverage measures the proportion of employees covered by collective agreements and, albeit it constitutes an important feature to fully account for the degree of union bargaining power in the labour market, the data on union coverage is generally limited to a number of years (see Nickell *et al*. (2005)).

Figure 1

Average degree of labour market coordination (in deviation from the sample mean, 1960-2007)

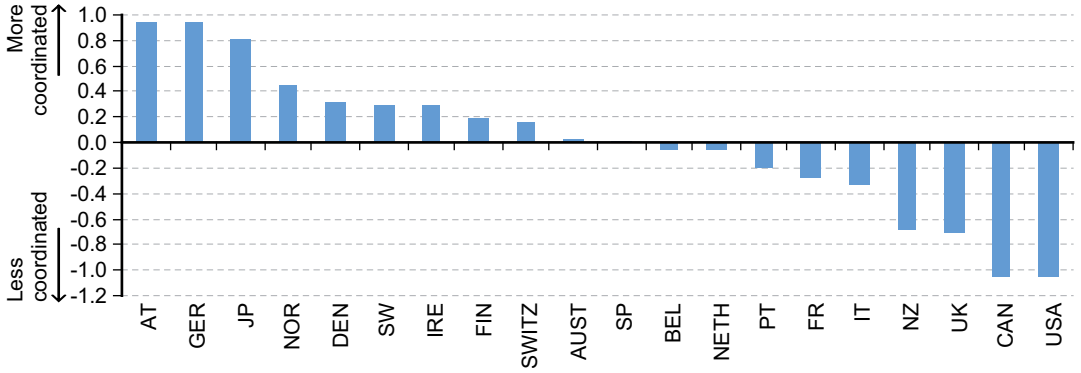


Figure 2

Average degree of unionisation (in deviation from the sample mean, 1960-2006)

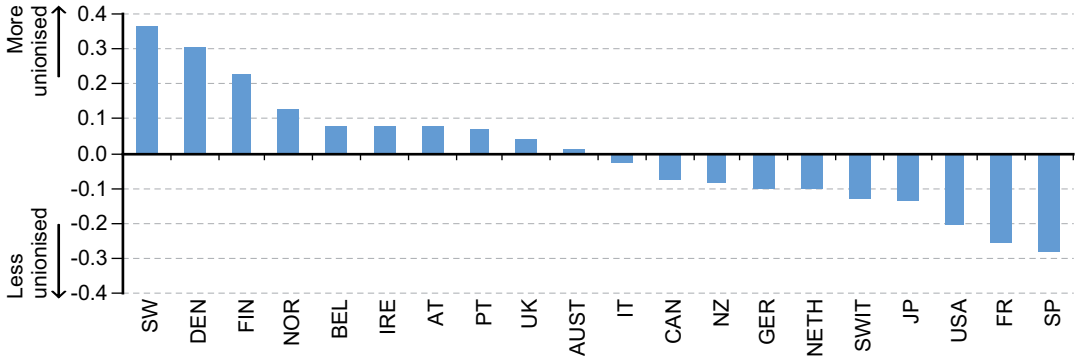
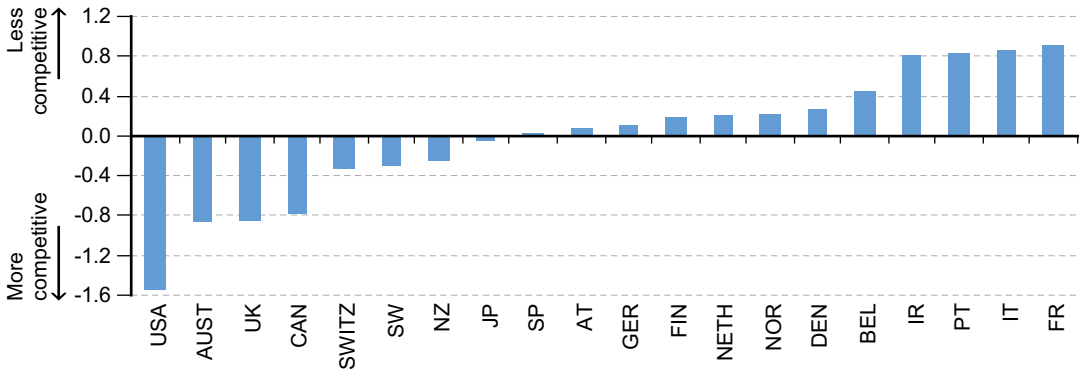


Figure 3

Average degree of product market competition (in deviation from the sample mean, 1960-2007)



3. Econometric Strategy

From an econometric viewpoint, the empirical model of inflation is estimated in a panel of 20 OECD countries constructed annually for the period 1960-2006. In the reduced-form model, inflation is explained by its own lag, which serves as a proxy for backward-looking inflation expectations, a macroeconomic measure of excess demand, that is the unemployment gap, and the evolution of input costs, namely of labour productivity, import prices, and taxation. As in Bowdler and Nunziata (2007), the estimated inflation equations typically take the form:

$$\pi_{it} = \gamma_0 + \gamma_1' x_1 + \gamma_2' x_2 + \mu_i + \lambda_t + \varepsilon_{it}, \quad (1)$$

where, on the left hand side, π denotes inflation, subscript i refers to the country and subscript t refers to the year. In Eq. (1), inflation is explained by the vector x_1 of macroeconomic variables, the vector x_2 of interaction effects between the macroeconomic determinants in x_1 and the institutional characteristics considered, namely the degree of coordination in wage bargaining ($COORD_{it}$), the percentage unionisation of the labour force (TU_{it}), and the degree of competition in goods markets (PMR_{it}). The model in Eq. (1) allows for cross-country variation in the intercept term γ_0' via the individual fixed effects, μ_i, and it controls for common movements in inflation caused by major events, such as oil and raw materials price hikes, via the introduction of time dummies, λ_t. The definitions of the macroeconomic variables and the institutional characteristics as well as the discussion of the properties of the error term are provided below.

In Eq. (1) it shall be noted that the response of inflation to a macroeconomic variable is calculated as the direct effect on inflation of the macroeconomic variable, which is collected by the corresponding coefficient in γ_1', plus the sum of the indirect effects on inflation of the interaction terms between the macroeconomic variable and each institutional characteristic, which can be calculated from the coefficients in γ_2'. Thus, the estimated coefficients in $\{\gamma_1', \gamma_2'\}$ will account for cross-country and temporal variation in the relationship between inflation adjustment and macroeconomic variables.

3.1. Macroeconomic Variables

The description of the macroeconomic determinants is provided next. Further details on the construction of the database is found in the Appendix.

π_{it} is the annual rate of inflation for the consumer price index (CPI). As the rest of the variables, it is measured in decimal form (thus 0.01 should be read as 1%), and it is constructed using the proportional rate of change.

$$\pi_{it} = \frac{CPI_t - CPI_{t-1}}{CPI_{t-1}}$$

such that π_{it-1} is the lagged inflation rate, often referred in the tables as inf(-1).

$unemp_{it}$ is the unemployment gap, i.e. the deviation of the unemployment rate from its trend value. The trend value is country-specific and is calculated by applying a Hodrick-Prescott filter, with a smoothing parameter equal to 400, to the unemployment series.

$import_{it}$ is the rate of import price inflation multiplied by the average degree of openness of the country in question over the whole sample period. Openness is calculated as the ratio of nominal import expenditures in goods and services to nominal GDP. It is expected that the CPI-based inflation rate will be more responsive to import price inflation in a more open economy, thus this adjustment controls for a potential source of cross-country heterogeneity in the coefficients.

$prod_{it}$ is the rate of labour productivity growth multiplied by one minus the average degree of openness (the latter is calculated as above). The growth rate of labour productivity is the percentage change in GDP per person employed. Scaling productivity growth by one minus average openness controls for the fact that domestic productivity growth may be less effective in containing inflationary pressures in more open economies.

$itax_{it}$ is the percentage growth rate of the indirect tax wedge, which is defined as the share in households final expenditures of the difference between total indirect taxes and total subsidies.

$dtax_{it}$ is the rate of growth of the ratio of direct taxes to households' current receipts multiplied by one minus the average degree of openness. Direct taxes are calculated as income tax plus households' social security contributions net of the employers' social security contributions. Households' current receipts is the sum of compensation of employees, property income, social contributions, and benefits and other current transfers. A scaling factor based on openness is applied since the effect of direct taxation on inflation is larger in relatively closed economies.

3.2. Institutional Variables: Labour and Product Markets Features

The description of the set of institutional characteristics figures next. As indicated previously, further details on the construction of the database is in the Appendix.

$COORD_{it}$ is a measure that captures the extent to which wage bargaining parties are able to internalise the macroeconomic effects of their individual wage-setting strategies. It combines two distinctive features of the prevailing wage bargaining regime. First, the level at which wage negotiating rounds take place, i.e. at the national, industry, or firm levels. Second, the extent of consensus among the actors in the bargaining system, namely employers' associations and labour unions on the one hand, and the role of the government in coordinating wage negotiations, on the other. The index takes values between 1 and 3, such that a higher value of the index indicates a higher degree of coordination.

TU_{it} is net union membership written as a proportion of wage and salary earners in employment. Following Nickell *et al*. (2002) and Visser (2009), net union membership is defined as gross membership, i.e. total membership of unions confederations plus membership of independent unions, minus those union members that are outside the active, dependent and employed labour force, i.e. retired workers, independent workers, students and unemployed. The index takes values between 0 and 1, where 1 would indicate complete unionisation.

PMR_{it} is the aggregate indicator that measures the regulatory conditions in the product market constructed by Conway and Nicoletti (2006). The index is based on information collected from seven non-manufacturing sectors, namely gas, electricity, post, telecommunications, air transport, rail transport and road freight. The indicator gathers information regarding public ownership of business sector firms, legal barriers that restrict access to markets, and other barriers to entry related to market or industry structure (e.g. market dominance and vertical integration in network industries)[13]. As non-manufacturing sectors represent around two thirds of economic activity, are typically non-tradable sectors, and concentrate most of the existing economic regulation, the PMR_{it} indicator serves as a good proxy of the degree of product market competition prevailing in the whole economy.

The PMR_{it} index is available for the period 1975-2007, on an annual basis, and it is assumed constant at the 1975 value for the period 1960-1974. Constancy of the index for the pre-1975 period is assumed since most of the important reforms in the regulatory environment of product markets across the OECD took place from 1980 onwards (see Nicoletti *et al*. (1999)). The index takes values between 0 and 6, scaled from *the least to the most restrictive of competition*, such that *a high value of the index reflects a low degree of competition* in goods markets.

The empirical analysis assumes that the variables *COORD*, *TU* and *PMR* are institutional features of the labour and product markets set exogenously and independently from one another. Coordination and unionisation may be related in so far as highly unionised labour markets may be more prone to produce larger unions with a greater incentive to coordinate. The correlation coefficient between these two labour market characteristics is 0.29 with a diverse range of country experiences. For example, the unionisation rate in Japan and New Zealand in 1999 stood at 21.6% and 19.2% respectively, while the level of coordination was high in Japan (2.7) and low in New Zealand (1.2). In the second half of the 1970s, the UK had a high unionisation rate (56% on average) yet high coordination did not succeed as a wage bargaining system (the index never exceeded the value of 1.5) as it did in Scandinavia. In addition, there may be political economy linkages between product and labour market policies such that product market deregulation may lead to labour market deregulation, thus making both policies complementary (Blanchard and Giavazzi (2003), Fiori *et al*. (2008)). We do not address issues of policy complementarity and consider the variables as exogenous, yet the simple correlations between product and labour market institutions reveal a correlation coefficient of 0.4 between *PMR* and *COORD* and of 0.15 between *PMR* and *TU*, thus indicating a positive relationship between deregulation in both markets.

13: The *PMR* indicator is an aggregate of indicators constructed under the categories of public ownership, legal entry barriers, market structure, vertical integration, and price controls, whenever relevant.

3.3. Steps to Estimation

We work under the assumption that the error process in Eq. (1) is heteroskedastic and that individual errors ε_{it} exhibit neither serial nor spatial correlation. The unbalanced panel data model can thus be estimated by pooled OLS, with a total of 915 observations and 5 observations missing. The t-ratios are obtained using the heteroskedasticity-consistent standard errors due to White (1980). The robustness of the results to alternative estimation methods will be addressed in the following section.

The second moments of the OLS estimator depend on the order of integration of the variables. If the time series are non-stationarity, i.e. they have unit root properties, results based on panel regression analysis would be subject to spurious correlation. To address this issue, we have conducted several unit root tests. As the macroeconomic variables are formulated in first differences of prices, taxes, or production variables, with the exception of the unemployment gap, they should be *I*(0) processes. We firstly conduct augmented Dickey-Fuller (*ADF*) tests separately for each series of each country. The tests results yield that the null hypothesis is not always rejected, mainly due to the fact that the *ADF* test often has low power in samples of the size that we are using, yet it may also be the case that there are potential structural breaks in the series, as they start in 1960.

Thus, we carry out unit root testing for panel data, which captures country specific effects and allows for heterogeneity in the direction and magnitude of the parameters across the selected panel. In addition, it permits a greater degree of flexibility in terms of model selection. The alternatives for model choice range from a model with heterogeneous intercepts and heterogeneous trends to a model with no intercepts and no trends. Therefore, we test for both mean stationarity and trend stationarity in each macroeconomic variable, while we also control for time effects common to all countries within each model. We test the null of non-stationarity in each variable against the alternative of stationarity by taking each of the models at a time. The test is a residual-based test that evaluates four different statistics for the variables included in Eq. (1). These four statistics represent a combination of the tests used by Levin *et al*. (2002) and Im *et al*. (2003). The Appendix reports the set of these four statistics for each of the models considered. In summary, the results suggest that the macroeconomic variables used in Eq. (1) are stationary and, therefore, they will not be subject to spurious correlation. Finally, note that institutional variables are not amenable for unit root testing - as they are often constant or they evolve very slowly over time - yet, since they are bounded processes, they will not introduce spurious non-stationarity in the estimation.

The time dimension of the panel, $T = 46$, is sufficiently large so that the biasedness affecting the OLS estimation of a panel data model with individual fixed effects and a term on the lagged dependent variable is bound to be extremely small. See Nickell (1981) for the original discussion and Judson and Owen (1999) for a recent demonstration of the good performance of the OLS estimator when the time dimension of the panel is sufficiently large, i.e. $T \geq 30$.

The panel data model in Eq. (1) assumes cross-country homogeneity of the slope coefficients collected in γ_1'. As in Bowdler and Nunziata (2007), a source of heterogeneity in γ_1' is accounted for by scaling the macroeconomic determinants in x_1 with the respective country´s average degree of openness. Further heterogeneity in γ_1' is controlled for by the introduction of interaction terms between the macroeconomic variables in x_1 and the set of country-specific labour market features, as Bowdler and Nunziata (2007) do. Thus, the new interactive terms between the macroeconomic variables and the degree of product market competition address the presence of a further source of heterogeneity not previously accounted for. That is, the parameters collected in γ_2' of Eq. (1) provide a more extensive account of cross-country diversity[14].

14: We produce some empirical evidence of cross-sectional parameter stability at the end of next section, where the model is estimated deleting a particular group of countries.

4. Estimation Results

This section presents the estimates of the empirical model of inflation. All estimated equations include nine impulse dummies which control for special events in inflation data. The nine impulse dummies were identified by estimating an AR(1) model that included individual fixed effects and time dummies. The selection criterion consisted of identifying residuals more than four times larger, in absolute terms, than the residual standard deviation[15]. On the other hand, the observations of institutional variables are normalized, more particularly, they are demeaned from the respective sample mean. Thus, a value equal to zero corresponds to the sample average country. Unless otherwise stated, the tables report specifications obtained from an iterative process in which the least significant variable is deleted and the model is re-estimated until all variables are significant at either the 1%, 5%, or 10% levels[16].

Table 1 presents the results of the basic estimations. The first column corresponds to the preferred model estimated in Bowdler and Nunziata (2007) and the second column reports the estimates that replicate Bowdler and Nunziata's (2007) model using our sample for the period 1961-2006. The results on the temporal update of Bowdler and Nunziata's (2007) preferred specification suggest that the sign and the significance of the macroeconomic determinants of inflation as well as the interaction terms remain unchanged, with the exception of the direct taxation variable whose significance falls in the extended sample. The size of the coefficients remain roughly stable, although the effect of the evolution of taxes on inflation appears somewhat smaller.

The third column of Table 1 adds to the macroeconomic determinants all the possible interaction effects between the macroeconomic variables and the product and labour market characteristics. The fourth column of Table 1 is our preferred specification, obtained by testing down iteratively the complete model reported in the third column. Notice that the error autocorrelation tests that figure at the bottom of the table indicate that the model is well specified. The results in column (4) show that the coefficients of macroeconomic variables have the expected sign. They are usually significant at the 5% level, the exception being changes in direct taxation that may turn insignificant, or if found significant it is at the 10% level. Therefore, inflation is positively influenced by its own lag, with a (conditional) persistence parameter of 0.54, import price movements, and tax changes. It is however negatively influenced by unemployment and by productivity growth.

The coefficients on the interaction terms imply that more coordination in the labour market decreases the responsiveness of inflation to lagged inflation, the unemployment gap, import price movements, and productivity growth. The presence of these interaction effects is explained by the adjustment of wages following a macroeconomic shock. Hence, in the event of unemployment raising above the natural rate, high coordination in the labour market may imply that the parties involved in wage-setting react by restraining real wage growth (see Nunziata (2005)). On the other hand, oil and raw materials price shocks are more likely to be accommodated via wage restraint when the degree of coordination in the labour market is high (see Bruno and Sachs (1985)). The positively signed interaction effect between productivity growth and coordination indicates that productivity growth may be less effective in containing inflationary pressures in economies with high labour market coordination. This result may reflect the fact that coordinated labour unions are able to extract higher nominal wage increases when productivity growth is high as a compensation mechanism for wage restraint in periods of adverse macroeconomic pressures (see Bowdler and Nunziata (2007)). The (conditional) persistence parameter decreases with the degree of coordination in the labour market, thus reflecting that high labour market coordination moderates the dynamic adjustment of inflation to macroeconomic shocks. Lastly, albeit the significance level is smaller, the results reported in column (4) indicate that more coordination in the labour market increases the response of inflation to changes in direct taxation, possibly reflecting the fact that coordinated labour unions are better able to negotiate higher wage increases in the event of tax policy changes that directly diminish the purchasing power of wages.

15: The impulse dummies were identified for the following observations: Japan 1974 and 1975, New Zealand 1985, Portugal 1974, 1977, 1983, 1984, Spain 1977 and United Kingdom 1975.
16: The results were obtained using OxMetrics 5, unless otherwise specified.

Table 1

Inflation regressions for a panel of 20 OECD countries (annual data 1961-2006)

Regression	(1)		(2)		(3)		(4)	
inf(-1)	0.52	***(12.9)	0.59	***(21.9)	0.54	***(16.0)	0.54	***(15.8)
unemp	-0.40	***(-5.51)	-0.37	***(-6.66)	-0.35	***(-5.53)	-0.36	***(-6.43)
import	0.33	***(4.48)	0.22	***(4.17)	0.19	***(3.41)	0.21	***(4.18)
prod	-0.16	***(-3.22)	-0.10	*(-1.80)	-0.16	***(-4.22)	-0.15	***(-3.61)
itax	0.04	***(6.31)	0.02	***(3.15)	0.02	***(2.85)	0.02	**(2.54)
dtax	0.04	**(2.07)	0.02	(1.43)	0.03	*(1.71)	0.03	*(1.70)
inf(-1)×zcoord	-0.09	***(-3.20)	-0.05	*(-1.88)	-0.05	*(-1.93)	-0.06	**(-2.28)
unemp×zcoord	0.27	***(2.59)	0.19	**(2.18)	0.20	*(1.80)	0.21	**(2.03)
import×zcoord	-0.24	***(-2.60)	-0.18	**(-2.36)	-0.17	**(-2.41)	-0.16	**(-2.25)
prod×zcoord	0.20	***(2.80)	0.17	***(2.59)	0.17	***(2.78)	0.18	***(2.77)
itax×zcoord					-0.01	(-0.49)		
dtax×zcoord					0.03	(1.40)	0.03	*(1.67)
inf(-1)×ztu					-0.10	(-1.13)		
unemp×ztu					0.00	(0.01)		
import×ztu	0.55	**(2.20)	0.47	***(2.84)	0.46	***(2.68)	0.42	***(2.70)
prod×ztu	-0.54	***(-2.84)	-0.62	***(-3.00)	-0.68	***(-4.10)	-0.69	***(-4.13)
itax×ztu	0.10	***(3.64)	0.11	***(3.53)	0.10	***(2.63)	0.10	***(2.89)
dtax×ztu					0.03	(0.24)		
inf(-1)×zpmr					0.05	***(2.72)	0.05	***(2.81)
unemp×zpmr					-0.05	(-1.47)	-0.05	*(-1.80)
import×zpmr					0.03	(0.68)		
prod×zpmr					0.10	***(3.22)	0.10	***(3.21)
itax×zpmr					0.00	w(-0.09)		
dtax×zpmr					0.00	(-0.29)		
Observations	644		915		915		915	
Standard error	1.56%		1.40%		1.39%		1.39%	
R-squared	/		0.92		0.92		0.92	
AR(1)	-0.22 [0.83]		-1.46 [0.14]		-1.33 [0.18]		-1.36 [0.17]	
AR(2)	-0.09 [0.93]		-0.79 [0.43]		-0.71 [0.48]		-0.69 [0.49]	

	(5)		(6) Entry Barriers		(7) Public Ownership		(8) Mean Tariff Rate	
inf(-1)	0.53	***(14.8)	0.53	***(16.1)	0.59	***(21.4)	0.58	***(16.6)
unemp	-0.36	***(-6.40)	-0.36	***(-6.40)	-0.38	***(-6.92)	-0.34	***(-5.43)
import	0.20	***(4.02)	0.18	***(3.69)	0.22	***(4.15)	0.17	***(3.62)
prod	-0.16	***(-3.77)	-0.16	***(-4.01)	-0.11	*(-1.92)	-0.14	*(-1.82)
itax	0.02	***(2.54)	0.02	***(2.86)	0.02	***(3.15)	0.02	***(3.91)
dtax	0.03	*(1.68)						
inf(-1)×zcoord	-0.06	*(-1.71)	-0.07	**(-2.44)	-0.05	**(-1.92)	-0.08	**(-2.45)
unemp×zcoord	0.20	*(1.90)	0.18	*(1.87)	0.20	**(2.24)	0.19	*(1.85)
import×zcoord	-0.16	**(-2.24)	-0.15	**(-2.16)	-0.17	**(-2.25)		
prod×zcoord	0.19	***(2.95)	0.17	***(3.07)	0.18	***(2.63)		
dtax×zcoord	0.03	*(1.66)					-0.05	**(-1.98)
import×ztu	0.42	***(2.70)	0.38	**(2.46)	0.45	***(2.70)	0.32	**(2.35)
prod×ztu	-0.71	***(-3.62)	-0.64	***(-3.58)	-0.64	***(-3.24)	-0.97	**(-2.31)
itax×ztu	0.10	***(2.88)	0.11	***(3.12)	0.12	***(3.72)	0.10	***(3.20)

Continues on next page

Table 1 (cont.)

Inflation regressions for a panel of 20 OECD countries (annual data 1961-2006)

	(5)		(6) Entry Barriers		(7) Public Ownership	(8) Mean Tariff Rate	
inf(-1)×zpmr	0.06	***(2.57)	0.05	***(3.04)			
unemp×zpmr	-0.05	*(-1.89)	-0.05	**(-2.07)			
import×zpmr			0.06	**(1.97)			
prod×zpmr	0.12	***(3.32)	0.08	***(2.83)			
coord	-0.001	(0.73)					
tu	0.001	(0.93)					
pmr	-0.002	(0.31)					
unemp×zmtr						0.22	**(2.33)
import×zmtr						-0.10	***(-4.54)
prod×zmtr						-0.10	**(-2.03)
dtax×zmtr						-0.05	***(-3.09)
Observations	915		920		920	625	
Standard error	1.39%		1.39%		1.40%	1.23%	
R-squared	0.92		0.92		0.92	0.93	
AR(1)	-1.43 [0.15]		-1.51 [0.13]		-1.50 [0.13]	-0.26 [0.80]	
AR(2)	-0.74 [0.46]		-0.61 [0.54]		-0.65 [0.51]	-0.77 [0.44]	

Notes: All models include a constant, fixed effects, time dummies, and, unless otherwise specified, nine impulse dummies. In parentheses, t-ratios based on heteroskedasticity consistent standard errors. Superscript: * denotes p<0.10, ** denotes p<0.05, and *** denotes p<0.01, where p is the marginal probability level. AR(1) and AR(2) are test statistics for error autocorrelation up to orders one and two, respectively; p-values are in square brackets. Institutional variables are preceded by z, indicating that they are normalised with respect to their sample mean. Model (1) includes six im-pulse dummies, as identified in Bowdler and Nunziata (2007). Model (8) includes four impulse dummies as the estimation period is 1975-2006 and the MTR data for Portugal starts in 1990.

Turning to the second labour market institution, the estimates in column (4) show that more unionisation increases the response of inflation to import price movements and indirect tax changes. The high monopoly power over the labour supply that is associated with high unionisation rates may imply that wage increases are higher following adverse shocks to the cost of living. A surprising result reported in column (4), and that is also found in Bowdler and Nunziata (2007), refers to the reinforced inflation-decreasing effect of productivity growth when the level of union membership is high. Intuitively, we would have expected that more powerful labour unions are able to extract higher rents from high productivity growth, thus reducing the inflation-decreasing effect of productivity gains. As Bowdler and Nunziata (2007) argue, this surprising finding may be the result of negative observations for productivity growth. In this scenario, labour unions with a high degree of monopoly power may resist downward nominal wage adjustments in the event of productivity reversals, thus increasing the upturn in inflation. However, testing the model of column (4) by entering positive and negative observations for productivity separately yields a coefficient for $prod^{+}$ x *ztu* still negative and significant at 1% level, and a coefficient for $prod^{-}$ x *ztu* that turns positive and insignificant, thus rendering no support for this idea[17].

The results in column (4) of Table 1 show that the response of inflation to macroeconomic shocks is affected by institutional features of the product market. In particular, more competition in product markets decreases the responsiveness of inflation to lagged inflation and to movements in unemployment, while it increases the responsiveness of inflation to productivity growth. The presence of these interaction terms can be explained by temporary variations in the mark-up. Thus, in the event of unemployment falling below the natural rate, a more competitive product market environment may induce firms to temporarily adjust their mark-ups down in order to contain the inflation upturn. On the other hand, the inflation-decreasing effect of productivity growth is larger in a more competitive product market environment. Firms operating in a highly competitive product market environment may be more prone to temporarily adjust their mark-ups down in an attempt to gain market share and thus exploit the cost-reducing effect of the productivity shock. Lastly, the (conditional) persistence parameter decreases with the degree of product market competition, capturing that high competition in goods markets dampens the dynamic adjustment of inflation to macroeconomic shocks.

17: Results for these estimations are available from the authors upon request.

In column (5) of Table 1 the levels of labour market coordination, union membership, and product market competition are added to the preferred specification in order to check that the significance of the interaction terms does not simply capture the absence of institutional variables in levels. Indeed, the results in column (5) show that institutions in levels are insignificant while all interaction terms are robust.

In columns (6) and (7) of Table 1, we report regression results based on disaggregated categories of the *PMR* variable. The results in column (6) use the entry barriers indicator and the results in column (7) use the public ownership indicator due to Conway and Nicoletti (2006). Starting from the complete specification, the model was tested down such that columns (6) and (7) report those terms that were found significant at either the 1%, 5%, or 10% levels. In addition to the significance of the interaction terms between macroeconomic variables and product market competition found in the model of column (4), the results in column (6) show that, when the measure of entry barriers is used, more competition in goods markets reduces the responsiveness of inflation to import price inflation. Thus, in the event of rising import prices, a more competitive product market environment may imply that firms temporarily reduce their mark-ups in order to contain the inflation upturn induced by the adverse cost shock. From the results in column (6), we also note that the coefficients on direct taxation that are present in column (4) become insignificant. On the other hand, column (7) shows that, when the measure of public ownership is used, the interaction terms between macroeconomic variables and competition lose all their significance, suggesting that the most relevant aspect of competition that concerns inflation adjustment relates to the existing barriers that prevent businesses from entering a market. In this spirit, a more competitive environment is associated with easier entry, higher survival rates and, as a result, less concentrated markets, a definition that is very much in line with the one in Geroski (1995, p. 436) whereby barriers to entry are thought of as an obstacle which prevents new firms from surviving long in a market.

In column (8) we report the estimation of the inflation equation using Fraser Institute's mean tariff rate (*MTR*) as the measure of the extent of competition in product markets. The *MTR* indicator takes values between 1 and 10, where 1 indicates very high tariffs and 10 indicates none at all. Thus, *a high degree of product market competition corresponds to a high value of the indicator*. The model is estimated for the period 1975-2006 and the data for Portugal starts in 1990.[18] The main differences between this set of results and the results reported in columns (4) and (6) are that the interaction terms *import* x *zcoord* and *prood* x *zcoord* lose significance, that *dtax* x *zcoord* retains significance, albeit with the opposite sign to that of column (4), and that *dtax* becomes insignificant. When the measure of product market competition is based on an open economy indicator as *MRT*, we find that more competition in product markets decreases the responsiveness of inflation to movements in unemployment, import price inflation and direct taxation, while it increases the responsiveness of inflation to productivity growth. These results point towards similar effects to the ones identified so far with regard to the impact of product market competition on inflation adjustment.

4.1. Robustness and Additional Determinants of Inflation Dynamics

As a first robustness check, the inflation model is estimated using alternative methods. The estimation of the pooled time-series model by a feasible generalised least squares method can lead to estimators of the parameters that are more efficient than OLS estimators. In columns (1) and (2) of Table 2, we present estimates for the preferred specifications (4) and (6) of Table 1 that allow for heteroskedasticity and an AR(1) error structure. Similarly, columns (3) and (4) of Table 2 report coefficient estimates obtained by pooled OLS estimation and standard errors computed following Driscoll and Kraay (1998). The Driscoll-Kraay standard errors estimates are heteroskedasticity consistent and robust to very general forms of spatial and temporal dependence in the residuals when the time dimension of the panel is large. Note that erroneously ignoring spatial correlation in panel data estimation can produce severe biasedness in the estimates. In practice, spatial correlation in the residuals may be the result of a common shock to inflation that is not captured by either the time dummies or the macroeconomic determinants. The results reported in Table 2 show that the relationship between product and labour market institutions and inflation adjustment is generally robust in all cases, such that *dtax* * *zcoord* is the only term that becomes insignificant[19].

18: Further details on the data source of the mean tariff rate indicator can be found in the Appendix.
19: The results were obtained using STATA 10. Note that the Driscoll-Kraay standard errors are computed using the xtscc command.

Table 2

Robustness to estimation methods and macroeconomic variables (annual data 1961-2006)

Regression	(1) FGLS		(2) FGLS		(3) OLS-DK		(4) OLS-DK	
PMR measure	Aggregate		Entry Barriers		Aggregate		Entry Barriers	
inf(-1)	0.57	***(17.3)	0.56	***(17.4)	0.54	***(23.4)	0.53	***(23.0)
unemp	-0.35	***(-6.27)	-0.35	***(-6.24)	-0.36	***(-10.3)	-0.36	***(-9.02)
import	0.21	***(4.22)	0.18	***(3.74)	0.21	***(6.62)	0.18	***(5.93)
prod	-0.15	***(-3.25)	-0.16	***(-3.59)	-0.15	***(-4.19)	-0.16	***(-2.91)
itax	0.02	**(2.52)	0.02	***(2.80)	0.02	***(5.37)	0.02	***(3.16)
dtax	0.03	*(1.67)			0.03	***(5.59)		
inf(-1)×zcoord	-0.05	**(-2.06)	-0.06	**(-2.26)	-0.06	***(-3.45)	-0.07	**(-2.24)
unemp×zcoord	0.20	**(2.01)	0.17	*(1.88)	0.21	***(5.36)	0.18	**(2.53)
import×zcoord	-0.16	**(-2.23)	-0.15	**(-2.17)	-0.16	***(-7.66)	-0.15	***(-3.48)
prod×zcoord	0.18	***(2.78)	0.17	***(3.01)	0.18	***(7.27)	0.17	***(3.61)
dtax×zcoord	0.03	(1.30)			0.03	(1.55)		
import×ztu	0.41	***(2.58)	0.36	**(2.32)	0.42	***(19.2)	0.38	***(8.82)
prod×ztu	-0.68	***(-3.82)	-0.63	***(-3.31)	-0.69	***(-7.30)	-0.64	***(-3.05)
itax×ztu	0.10	***(2.75)	0.11	***(2.98)	0.10	***(3.85)	0.11	**(2.79)
inf(-1)×zpmr	0.05	**(2.55)	0.04	***(2.80)	0.05	***(4.77)	0.05	**(2.69)
unemp×zpmr	-0.05	*(-1.80)	-0.05	**(-1.98)	-0.05	*(-1.77)	-0.05	*(-1.95)
import×zpmr			0.06	*(1.89)			0.06	***(3.48)
prod×zpmr	0.11	***(3.13)	0.08	***(2.76)	0.10	***(5.24)	0.08	**(2.45)
Observations	915		920		915		920	
Standard error	1.32%		1.32%		1.46%		1.46%	

	(5)		(6)		(7)		(8)	
PMR measure	Aggregate		Entry Barriers		Aggregate		Entry Barriers	
inf(-1)	0.53	***(16.6)	0.52	***(16.5)	0.53	***(15.7)	0.52	***(15.6)
unemp	-0.35	***(-6.29)	-0.34	***(-6.30)	-0.35	***(-6.47)	-0.35	***(-6.45)
import	0.20	***(4.21)	0.17	***(3.81)	0.21	***(4.40)	0.19	***(3.94)
prod	-0.16	***(-3.89)	-0.17	***(-4.15)	-0.20	***(-3.79)	-0.22	***(-4.56)
itax	0.02	**(2.56)	0.02	***(2.81)	0.02	**(2.40)	0.02	***(2.64)
dtax	0.03	(1.46)			0.03	*(1.82)		
inf(-1)×zcoord	-0.06	**(-2.01)	-0.07	**(-2.16)	-0.06	**(-2.02)	-0.06	**(-2.15)
unemp×zcoord	0.21	**(2.08)	0.18	**(1.99)	0.20	*(1.93)	0.17	*(1.81)
import×zcoord	-0.15	**(-2.18)	-0.14	**(-2.13)	-0.17	**(-2.33)	-0.15	**(-2.26)
prod×zcoord	0.18	***(2.92)	0.16	***(2.90)	0.16	***(3.01)	0.15	***(3.28)
dtax×zcoord	0.02	(1.06)			0.02	(1.01)		
import×ztu	0.39	**(2.47)	0.34	**(2.19)	0.37	**(2.28)	0.31	**(2.01)
prod×ztu	-0.78	***(-4.09)	-0.76	***(-3.66)	-0.71	***(-4.94)	-0.67	***(-5.10)
itax×ztu	0.11	***(3.06)	0.12	***(3.26)	0.09	***(2.57)	0.09	***(2.64)
inf(-1)×zpmr	0.04	**(2.18)	0.04	**(2.44)	0.05	**(2.40)	0.05	***(2.85)
unemp×zpmr	-0.04	(-1.48)	-0.04	*(-1.71)	-0.05	(-1.56)	-0.05	*(-1.96)
import×zpmr			0.06	*(1.92)	0.09	**(2.37)	0.06	*(1.87)
prod×zpmr	0.09	***(2.81)	0.07	**(2.48)			0.07	**(2.27)
money(-1)	0.02	***(3.62)	0.02	***(2.97)				
money(-1)×zcoord	-0.01	(-0.47)	0.00	(-0.25)				
money(-1)×ztu	0.04	(0.89)	0.05	(1.28)				
money(-1)×zpmr	0.01	(1.29)	0.01	(1.17)				
levelprod(-1)					-0.01	(-1.40)	-0.02	*(-1.80)
realimport(-1)					0.03	***(4.51)	0.03	***(5.16)
Observations	899		903		915		920	
Standard error	1.39%		1.39%		1.38%		1.37%	
R-squared	0.92		0.92		0.92		0.92	
AR(1)	-1.45 [0.15]		-1.58 [0.12]		-1.23 [0.22]		-1.34 [0.18]	
AR(2)	-0.61 [0.54]		-0.53 [0.60]		-0.52 [0.60]		-0.41 [0.68]	

Notes: See notes to Table 1. FGLS stands for feasible generalised least squares; OLS-DK refers to OLS with Driscoll-Kraay standard errors; see text for further details. Models (5) and (6) are estimated for the period 1961-2006.

The second robustness test consists of allowing for a direct effect of monetary policy on inflation dynamics by introducing the lagged growth rate of the money supply (*money*) as an additional macroeconomic determinant[20]. As pointed out in Bowdler and Nunziata (2007), the effects of monetary policy on inflation are channelled through the macroeconomic variables in Eq. (1). That is, a tightened monetary policy may reduce inflation via an increase in unemployment and a reduction in imported inflation (due to exchange rate appreciation), and vice versa. In columns (5) and (6) of Table 2, we report the results of estimating the preferred specifications extended with the lagged rate of money supply growth and its interactions with product and labour market variables. The results indicate that money supply growth exerts a positive and statistically significant impact on inflation adjustment, while none of its product and labour market interaction terms is significant. The relationship between product and labour market institutions and inflation dynamics is robust in the model of column (6), while the results in column (5) show that *dtax*, *dtax* x *zcoord* and *unemp* * *zpmr* lose significance when money supply growth is included as a regressor.

The empirical specification laid out in Eq. (1) is not a characteristic error correction specification of inflation, as it does not include a term on the deviation of the lag of the log price level from its long-run equilibrium solution. In this framework, a possible long-run equilibrium solution for prices would consist of a combination of terms in the mark-up, unit labour costs and import prices. However, as the channel through which institutions may have an impact on inflation works through both mark-ups and wages, we cannot condition inflation upon either of these variables. In other words, a correct long-run solution for prices cannot be written solely with the variables featured in Eq. (1). Yet, in columns (7) and (8) of Table 2, we estimate inflation models that add error-correction-type of terms to the preferred specifications. In particular, *levelprod*(-1) is the lagged value of the log of productivity multiplied by one minus average openness, and *realimport*(-1) is the lagged value of the log ratio of import prices to consumer prices multiplied by average openness. The results show that the coefficients on *import* and *prod* become slightly larger, in absolute terms, once error-correction-type of terms are included. In both models, the relationship between product and labour market institutions and inflation dynamics is robust, albeit two terms in the model of column (7), *dtax* * *zcoord* and *unemp* * *zcoord*, lose significance.

We next evaluate whether various post-war policy regimes may have exerted systematic effects on inflation dynamics. We consider three alternative policy regimes that might have an impact on the response of inflation to its macroeconomic determinants, in particular, a policy regime that targets the growth rate of the money supply, an inflation targeting regime, and the exchange rate regime. The policy regime indicators are interacted with the macroeconomic variables and added to the preferred specifications of columns (4) and (6) of Table 1, such that the extra terms are tested down and reported, in Table 3, if they are found significant.

mstarget is a dummy variable set to unity for those countries and years in which a policy of targeting the growth rate of the money supply was adopted. It takes the value of one for Germany in the period 1974-1998, U.S in the period 1980-1981 and U.K in the period 1981-1984; see Bernanke and Mihov (1997).

inftarget is a dummy variable set to unity for those countries and years in which an inflation targeting regime was in place for more than half of the year. The indicator takes the value of one for Australia 1994-2006, Canada 1992-2006, Finland 1994-1998, New Zealand 1990-2006, Norway 2000-2006, Spain 1995-1998, Sweden 1995-2006, U.K 1993-2006 and Switzerland 1999-2006; see Ball and Sheridan (2003) for the dating of regimes and Rose (2007) for a discussion regarding the definition of an inflation targeting regime.

err is the exchange rate regime indicator taken from Reinhart *et al*. (2009). The de facto fine classification indicator takes values between 1 and 15, ranging from no separate legal tender or a strict peg (lower values of the indicator) to freely falling or dual market (higher values of the indicator). The fine classification is favoured to the coarse one as it distinguishes between hard peggers and monetary union members. Note that the *err* index is normalized, i.e. it is demeaned from its sample mean as denoted by z*err*.

In columns (1) and (2) of Table 3, we report the results of the extended regression specifications that control for the effects of a money supply growth target. The results indicate that targeting the growth rate of the money supply makes inflation more responsive to unemployment and less responsive to tax movements. On the other hand, the results reported in Table 3 suggest that an inflation targeting regime reduces the (conditional) persistence parameter, with an impact that ranges from -0.08 in the model of column (3) to -0.14 in the model of column (4). The results also suggest that inflation targeting may reduce the responsiveness of inflation to movements in productivity growth. With regard to the exchange rate regime, columns (5) and (6) of Table 3 show that inflation is more responsive to both unemployment and import price movements and less responsive to productivity growth under a more flexible exchange rate system. Most importantly, all the models reported in Table 3 show that the relationship between product and labour market institutions and inflation dynamics is robust once we control for the effects of policy regimes.

20: See the Appendix for details on the definition of money supply and the sources used to construct the series.

Table 3

Policy Regimes and Inflation Dynamics (annual data 1961-2006)

Regression	(1) Money supply target	(2) Money supply target	(3) Inflation targeting	(4) Inflation targeting	(5) Exchange rate regime	(6) Exchange rate regime
PMR measure	**Aggregate**	**Entry Barriers**	**Aggregate**	**Entry Barriers**	**Aggregate**	**Entry Barriers**
inf(-1)	0.54 ***(15.9)	0.53 ***(16.4)	0.54 ***(16.0)	0.53 ***(16.4)	0.54 ***(15.8)	0.53 ***(16.0)
unemp	-0.35 ***(-6.46)	-0.36 ***(-6.50)	-0.36 ***(-6.30)	-0.35 ***(-6.40)	-0.36 ***(-6.97)	-0.36 ***(-6.81)
import	0.20 ***(4.08)	0.18 ***(3.67)	0.20 ***(4.16)	0.18 ***(3.68)	0.23 ***(5.44)	0.20 ***(5.06)
prod	-0.15 ***(-3.62)	-0.17 ***(-4.03)	-0.15 ***(-3.58)	-0.19 ***(-4.45)	-0.15 ***(-3.57)	-0.16 ***(-4.01)
itax	0.02 **(2.50)	0.02 ***(2.90)	0.02 **(2.52)	0.02 ***(2.81)	0.02 ***(2.60)	0.02 ***(2.81)
dtax	0.03 *(1.82)		0.03 *(1.69)		0.03 *(1.73)	
inf(-1)×zcoord	-0.06 **(-2.47)	-0.07 ***(-2.65)	-0.06 **(-2.33)	-0.07 **(-2.55)	-0.06 **(-2.24)	-0.06 **(-2.47)
unemp×zcoord	0.23 **(2.39)	0.18 *(1.93)	0.21 **(2.01)	0.17 *(1.79)	0.18 **(2.00)	0.16 *(1.75)
import×zcoord	-0.17 **(-2.26)	-0.15 **(-2.15)	-0.16 **(-2.17)	-0.14 **(-1.99)	-0.16 **(-2.29)	-0.15 **(-2.25)
prod×zcoord	0.17 ***(2.76)	0.17 ***(3.07)	0.17 ***(2.70	0.17 ***(3.15)	0.17 ***(2.74)	0.17 ***(2.99)
dtax×zcoord	0.04 *(1.84)		0.04 *(1.75)		0.03 (1.48)	
import×ztu	0.43 ***(2.77)	0.38 **(2.47)	0.42 ***(2.72)	0.38 **(2.48)	0.45 ***(3.04)	0.41 ***(2.85)
prod×ztu	-0.69 ***(-4.22)	-0.64 ***(-3.60)	-0.69 ***(-4.07)	-0.65 ***(-3.64)	-0.65 ***(-4.20)	-0.63 ***(-3.70)
itax×ztu	0.10 ***(2.87)	0.11 ***(3.04)	0.10 ***(2.98)	0.11 ***(3.17)	0.10 ***(2.,86)	0.10 ***(3.13)
inf(-1)×zpmr	0.05 ***(2.74)	0.05 ***(2.95)	0.05 ***(2.86)	0.04 ***(2.85)	0.04 **(2.37)	0.04 **(2.46)
unemp×zpmr	-0.05 *(-1.86)	-0.05 **(-2.10)	-0.05 *(-1.91)	-0.04 **(-1.97)	-0.05 **(-2.02)	-0.05 *(-1.85)
import×zpmr		0.06 *(1.95)		0.07 **(2.17)		0.06 *(1.77)
prod×zpmr	0.11 ***(3.33)	0.08 ***(2.90)	0.10 ***(3.17)	0.10 ***(3.22)	0.09 ***(2.90)	0.08 **(2.49)
unemp×mstarget	-0.35 ***(-3.56)					
itax×mstarget		-0.08 **(-2.03)				
dtax×mstarget	-0.14 **(-1.98)					
inf(-1)×inftarget			-0.08 *(-1.65)	-0.14 ***(-2.85)		
prod×inftarget				0.22 **(2.09)		
unemp×zerr					-0.02 **(-2.22)	-0.02 **(-2.17)
import×zerr					0.01 **(2.15)	0.01 **(2.35)
prod×zerr						0.01 *(1.95)
Observations	915	920	915	920	915	920
Standard error	1.39%	1.39%	1.39%	1.39%	1.38%	1.38%
R-squared	0.92	0.92	0.92	0.92	0.92	0.92
AR(1)	-1.46 [0.14]	-1.57 [0.12]	-1.31 [0.19]	-1.46 [0.14]	-1.15 [0.25]	-1.23 [0.22]
AR(2)	-0.70 [0.48]	-0.57 [0.57]	-0.77 [0.44]	-0.68 [0.50]	-0.51 [0.61]	-0.37 [0.71]

Notes: See notes to Table 1 and see the text for further details.

The last robustness check is concerned with the cross-sectional stability of the model. Albeit it is not an exhaustive exercise, we have estimated the preferred specification in column (4) of Table 1 excluding Australia, New Zealand, U. K and U.S from the sample. This is due to the fact that their definition of the consumer price index may have differed, for a period of time, from the definition adopted by the rest, for example, by including mortgage interest payments. In the results, two interaction terms, namely *unemp* * *zcoord* and *import* * *zcoord*, become insignificant with the coefficients falling substantially to -0.03 (t-ratio of -0.23) and -0.16 (t-ratio of -1.60), respectively. Yet, other terms become larger and more significant, such as inf (-1) * *zcoord* that produces a point estimate of -0.10 (t-ratio of -3.39).[21]

21: The detailed estimates are available from the authors upon request.

5. Heterogeneity in Inflation Dynamics: A Quantitative Assessment

The evidence presented above suggests that both, labour markets agents that are highly coordinated and firms with strong wage bargaining power - a by-product of low unionisation rates - are institutional actors of the wage-setting process that dislike large price movements in response to macroeconomic imbalances. Similarly, firms operating in a highly competitive product market environment dislike large price changes as an adjustment mechanism following a macroeconomic shock. Thus, as a result of the role played by the aforementioned institutions, we find large cross-country variation in inflation dynamics. In Table 4, we use the estimation results of columns (4) and (6), Table 1, to illustrate the quantitative importance of product and labour market features in shaping the dynamics of inflation across the OECD. The first column reports the direct effect on inflation of each macroeconomic variable. The direct effect is homogenous to all countries or, in other words, it represents the total effect that would prevail in a country if it had, on average, an identical institutional structure to the sample average. The second and third columns report the maximum and the minimum values observed for the total effect on inflation of each macroeconomic variable. The total effect is calculated for each country as the sum of the direct effect plus the sum of those indirect effects that are significant, the latter adjusted by the corresponding institutional variable {COORD, TU, PMR} whose respective value is set equal to the country's time average. Beneath the coefficients in Table 4, we indicate the name of those countries that register the maximum and the minimum values, while the rest will have a total effect located between the maximum and the minimum. To provide more information regarding the extent of heterogeneity, we also report standard deviations.

Table 4

Cross-Country Variation in Inflation Dynamics
(Total derivatives for inflation with respect to each macroeconomic variable)

PMR measure	Aggregate				Entry Barriers			
Variable	**Coefficient**	**Absolute max.**	**Absolute min.**	**S.D**	**Coefficient**	**Absolute max.**	**Absolute min.**	**S.D**
inf (-1)	0.54	0.60 (France, Italy)	0.49 (Australia, Austria, Germany,Japan)	0.04	0.53	0.59 (Italy)	0.46 (Austria)	0.04
unemp	-0.36	-0.54 (Canada)	-0.17 (Austria, Germany)	0.11	-0.36	-0.53 (Canada)	-0.19 (Austria)	0.10
import	0.21	0.35 (Canada)	0.01 (Germany, Japan)	0.10	0.18	0.30 (U.K)	0.01 (Germany)	0.09
prod	-0.15	-0.39 (U.K)	0.09 (Germany)	0.16	-0.16	-0.40 (Sweden)	0.10 (Japan)	0.15
itax	0.02	0.05 (Denmark, Sweden)	-0.01 (France, Spain)	0.02	0.02	0.06 (Sweden)	-0.01 (France, Spain)	0.02
dtax	0.03	0.06 (Austria, Germany)	-0.01 (Canada, U.S)	0.02				

Notes: The estimates listed above correspond to the preferred estimations in columns (4) and (6) of Table 1. COORD, TU, aggregate PMR, and Entry Barriers are set at their time average value for each country and then demeaned with the sample average. Absolute max refers to the largest absolute value of each coefficient. Absolute min refers to the smallest absolute value. Countries listed below correspond to the observations for which the maxima and minima occur.

In Table 4, we note that France and Italy show the greatest degree of (conditional) persistence, with a coefficient of 0.6, while Germany and Austria are among those countries with the lowest, with a coefficient of 0.49.[22] Similarly, German and Austrian inflation rates are both much less responsive to the economic cycle, with a coefficient of -0.17, while Canada exhibits the largest response, with a coefficient of -0.54. On the other hand, note that if all countries experience a 10% rise in import prices, consumer price inflation would increase contemporaneously by 1.1% in Ireland (10 x 0.19 x 0.57, where 0.19 measures the total effect on Irish inflation of import price changes and where 0.57 is the average degree of openness of the Irish economy) and 0.9% in Portugal, UK or Canada (10 x 0.35 x 0.26 where 0.26 is the average degree of openness of the Canadian economy). Simultaneously,

22: These figures correspond to the estimates of the specification in column (4), Table 1.

German consumer price inflation would barely change while the Spanish one would increase by just 0.2%. The difference in these impact effects would propagate over time since the estimated persistence parameters are different. Therefore, the cumulative effect of the shock would increase inflation in Ireland by a total of 2.5% and in Portugal by 2.3%, while German domestic inflation would be barely affected by the acceleration in import prices. It is important to note that, although the cumulated impact on inflation should be larger than the contemporaneous effect, basically due to persistence mechanisms, the shock is temporary in the sense that it would be soon reverted by another shock in the opposite direction. For this reason, the macroeconomic determinants considered here exert temporary effects on inflation without affecting its equilibrium rate. Finally, note that the largest cross-country variation is recorded, for both specifications, in the productivity parameters, such that U.K inflation reaches the largest response to productivity movements (-0.39). Indeed, the total effect of productivity growth changes sign in a few instances, yet the value is not too large to render it important.[23] The lowest cross-country variation corresponds to the tax-related parameters where, once again, a few cases show a sign reversal, although very close to zero.

23: Note that the change in sign is also influenced by the time average of the institutional variables.

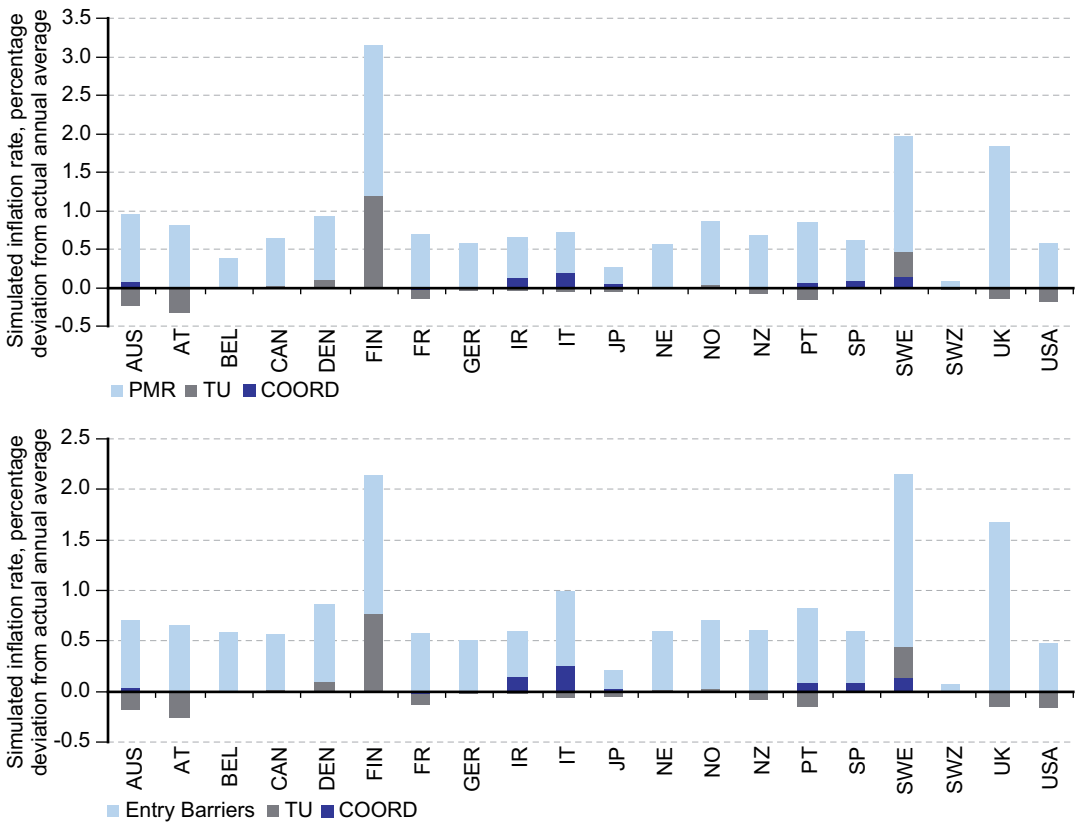
6. Dynamic Simulations: Institutions and Inflation in the 1990s

In this section, we first present a set of dynamic simulations carried out using, alternatively, the two preferred specifications of the inflation model in order to illustrate the *relative* effect of product and labour market institutions on inflation performance across the OECD. For each specification, we obtain simulated series of inflation for each country through a recursive procedure that substitutes the lagged dependent variable with the previous year's prediction of the model. The simulated inflation series for a particular country is then compared against three alternative inflation series obtained, one at a time, using the same procedure as described above but setting, from 1970 onwards, each of the three institutional variables equal to their respective 1960 annual average value for that country. Therefore, we can calculate, for each country, the variation in the simulated inflation rate that can be attributed to the post-1970 time path of each institution and, hence, apply that variation to the actual inflation series to illustrate the impact of institutional change on inflation. It is important to emphasise that, in a study of inflation adjustment like this, the impact of institutions on inflation outcomes is shaped by the evolution of the macroeconomic determinants that interact with institutions and, in addition, by the persistence mechanisms that, once set in, operate through all interaction terms that feature lagged inflation.

Figure 4 plots the results of the dynamic simulations for the annual average inflation rate of the period 1990-2006. We focus on the post-1990 period due to its distinctive record of low inflation rates. In Figure 4, the vertical distance of each bar indicates the amount by which inflation would have deviated from its actual value if the corresponding institution, in the country in question, would have remained unchanged from its average value of the 1960s. If positive (respectively, negative), the institutional evolution that took place after 1970 reduced (respectively, increased) inflation on average. Note that a vertical distance close to zero indicates either that, given the evolution of the macroeconomic determinants, there was, on average, no impact of the specific institution or that, indeed, no institutional change took place over the whole sample period.

Figure 4

Dynamic Simulations with Institutions Fixed at 1960s Average Values: Annual Average Infation Outcomes for the 1990-2006 Period



The results in Figure 4 indicate that the degree of product market competition exerted the major impact on inflation performance across the OECD. Our dynamic simulations suggest that, in the absence of a change towards a more competitive product market environment, annual average inflation in the post-1990 period would have been between 0.08 percent (Switzerland) and 1.9 percent (Finland) higher across the OECD sample or, in other words, annual inflation would have been 33 percent higher on average.[24] The cross-country experience is very diverse. Finland started a deregulatory path in 1975 followed, immediately, by Austria and the U.S and, at the start of the 1980s, by the U.K, albeit the U.S departed from a much more competitive product market environment than the rest. Many countries did not embark on a deregulatory path until the mid-1980s, such as Sweden and France, and some delayed product market reforms until the 1990s, such as Ireland, Italy and Switzerland. Therefore, given the corresponding evolution of macroeconomic variables, the impact of product market reforms on inflation outcomes tended to be larger in those countries that started to reform earlier and were more aggressive in the extent of reform.

With regard to the role played by labour market institutions, the results suggest that changes in the degree of coordination did not have a large effect on inflation performance across the OECD sample in the post-1990 period. A similar conclusion applies to the extent of unionisation of the labour force, where Finland and Sweden constitute an exception. Starting in the 1960s, Finland and Sweden increased their unionisation figures reaching the highest unionisation rates in the 1990s. During the 1990s, this institutional development exacerbated the disinflationary pressure associated to negative observations of import price inflation, thus partly explaining the effects of unionisation that we observe in the results of Figure 4.

Next, we present the results of a simulation exercise that uses the estimates of the preferred specification in column (4) of Table 1 to obtain the inflation paths fitted by the model in the context of a different product and labour markets institutional mix for a certain group of countries. In particular, Figures 5 and 6 show the inflation rates fitted by the preferred specification had the high-inflation EMU countries, namely Ireland and Spain, exhibited the best possible combination of institutional features since the establishment of the monetary union. The best institutional mix for the period corresponds to the high coordination of Germany, the low unionisation of France and the high competition of the U.K.

Figure 5

Inflation Performance under the Best Institutional Structure. Inflation in Ireland (in unitary percentage terms)

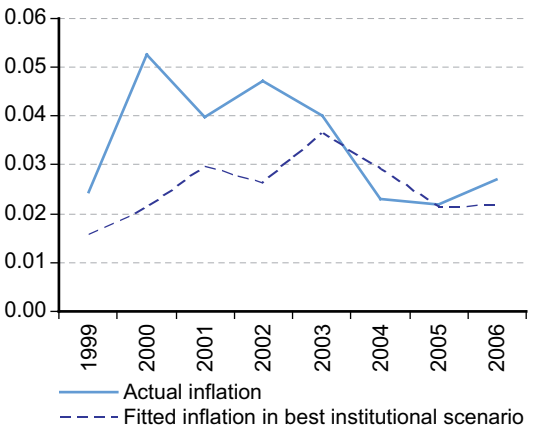
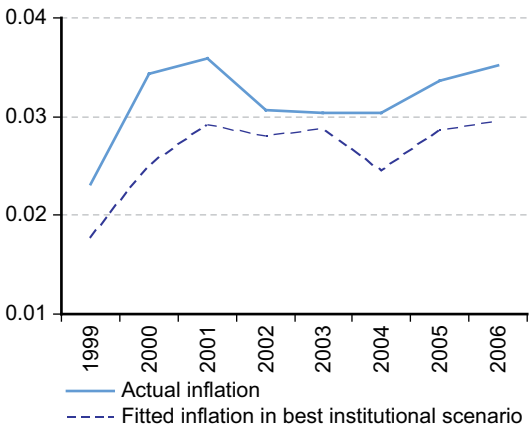


Figure 6

Inflation Performance under the Best Institutional Structure. Inflation in Spain (in unitary percentage terms)



The results of the simulation suggest that the two countries would have recorded an annual average inflation rate 0.6 to 0.8 percentage points below their actual values. Given the evolution of the macroeconomic variables, the euro area-wide inflation differential would have been significantly reduced.

24: These figures correspond to the simulation of the model that uses the aggregate *PMR* measure, namely the specification in column (4) of Table 1.

7. Conclusion

We have analysed the impact of product market competition on the responsiveness of inflation to macroeconomic imbalances. The empirical analysis has been based on the estimation of a panel data model of 20 OECD countries for the period 1961-2006. Specifically, the analysis finds that the response of inflation to lagged inflation and unemployment is a decreasing function of the degree of product market competition, while inflation is more responsive to changes in productivity growth in countries in which competition is above the OECD average. In addition, when the degree of product market competition is solely proxied by a measure of barriers to firms' entry, we find that low entry barriers dampen the response of inflation to import price inflation. These results are attributed to temporary mark-up variation following demand- and supply-side shocks. Our dynamic simulations suggest that product market competition has exerted a large impact on inflation performance after 1990, in the absence of product market reform annual average inflation would have been between 0.08 percent and 1.9 percent higher across the OECD.

The evidence presented here suggests that an institutional environment that combines high competition in the product market with high coordination and low unionisation in the labour market might be the most successful in achieving price stability in the event of either common or idiosyncratic macroeconomic shocks. Had the high-inflation EMU countries exhibited the best observed institutional scenario, their annual average inflation rate would have been significantly closer to the EMU average.

Appendix

Data Sources

The database contains information of 20 OECD countries for the period 1960-2006. The countries in the sample are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States.

Macroeconomic variables

inf is the annual rate of inflation for the CPI. The data for all countries have been obtained from the International Financial Statistics (IFS) database maintained by the International Monetary Fund (IMF).

unemp is based on unemployment data taken from Layard *et al*. (1991) that have been updated using the standardised unemployment rate from the OECD Employment Outlook, with the following exceptions:

Belgium, *France*, *Germany* and *Sweden* are updated with the London School of Economics CEP-OECD database until 2004 (unemployment/labour force), and thereafter with the OECD Employment Outlook.

The *Portuguese* data are taken from the London School of Economics CEP-OECD database from 1974 to 2004. Between 1960 and 1973, the data have been constructed using the percentage growth of the unemployment rate taken from AMECO. Like for the rest of the countries, the series is updated with the OECD Employment Outlook.

The data for *Italy* are taken from the US Bureau of Labor Statistics series Unemployment rate on U.S Concepts.

import is constructed by using import price indices and the degree of openness. The main source of the import price series is the International Financial Statistics (IFS) database maintained by the International Monetary Fund (IMF), except for the case of *France* where the import price series is taken from AMECO. For the cases of *Finland*, *Ireland* and *Italy*, the IFS series is updated with the OECD Economic Outlook from 2005 onwards; and for *Portugal* the IFS series is updated with the OECD Economic Outlook from 2003 onwards. For *Finland* and the *United Kingdom*, the series is extrapolated backwards for the period 1960-1963 with import price indices taken from the OECD Economic Outlook.

openess is an indicator constructed from nominal import expenditures and nominal GDP, all taken from the International Financial Statistics (IFS) database maintained by the International Monetary Fund (IMF). For the case of *Germany*, we have used the growth rate of imports of goods and services from the OECD Economic Outlook in order to extrapolate the series backwards for the period 1960-1978; the data of nominal import expenditures for 2006 is also taken from the OECD Economic Outlook.

prod is constructed using data for GDP at constant prices and total employment. The real GDP series are taken from the National Accounts published by the OECD. From 1960 through to 1970, the GDP data have been constructed by using the growth rate of GDP, in volume indices, taken from the aforementioned source, in all cases with the exception of *Australia*, for which we use the OECD Factbook 2009. The total employment series are taken from the OECD Economic Outlook. For the case of the *U.S*, the employment series is updated for 2005-2006 with the employment growth rate taken from National Accounts of the OECD.

itax is taken from the London School of Economics CEP-OECD database. It is updated using data on total indirect taxes, total subsidies, and total private final expenditures from the OECD National Accounts, with the following exceptions:

Switzerland is updated, from 2003 onwards, with data taken from AMECO.

New Zealand is updated, from 1987 onwards, with data taken from domestic National Accounts sources.

dtax is taken from the London School of Economics CEP--OECD database for the period starting in 1960 through to 2003 or whenever available. Thereafter, it is updated with the series on income tax, employees' social security contributions, and household current receipts. In particular, the first two series are taken from the OECD Revenue Statistics and the third series is constructed with data from the OECD National Accounts. A number of exceptions figure next:

Australia has been updated since 1991 and *Denmark* and *Portugal* since 2003.

Ireland has been updated since 1987 using the growth rate of the labour tax rate taken from Doménech and García (2008) for the period 1988-2001 and the OECD National Accounts thereafter.

Switzerland´s (1996 onwards) and *U.K´s* (2001 onwards) household current receipts have been constructed with data taken from AMECO. For the case of *Switzerland*, the data between 1990 and 1995 have been linearly interpolated.

New Zealand´s data has been taken from domestic National Accounts starting in 1987, extrapolated backwards with the growth rate of the labour tax rate taken from Doménech and García (2008).

From 1960 to 1964, data for *Norway* are missing.

money is the growth rate of the broad money supply taken from the OECD Economic Outlook database. The following exceptions apply:

Germany´s series has been provided by the national Central Bank; *Sweden´s* series is taken from the International Financial Statistics (IFS) database maintained by the International Monetary Fund (IMF).

Switzerland´s series for the period 1971-2003 is taken from OECD Main Economic Indicators, thereafter from the International Financial Statistics (IFS) database maintained by the International Monetary Fund (IMF).

Austria, Belgium, Netherlands and *Portugal* are updated since 1999 and *Denmark* for 2006 with data provided by national Central Banks.

Finland, France, Ireland, Italy and *Spain* are updated since 1999 with data taken from the International Financial Statistics (IFS) database maintained by the International Monetary Fund (IMF).

Institutional Features

COORD is an index of labour market coordination taken from Belot and van Ours (2000) until 1995 (see Nickell *et al*. (2002)). The labour market coordination series is offered at five year intervals and it has been linearly interpolated in order to obtain annual observations. After 1995, the data have been updated using the growth rate of the labour market coordination series taken from Visser (2009), whose index has been adjusted to the range in Belot and van Ours (2000). For the case of *Italy*, the updated series starts in 1987.

TU is net union membership taken from Nickell and Nunziata (2001) for the period 1960-1995. The series has been updated, from 1996 onwards, using the growth rate of the union density series in Visser (2009), with the exception of *Canada* that is updated from 1993 onwards. For the cases of *Portugal* and *Spain*, net union density data are taken from Nickell *et al*. (2005) for the period 1960-1964.

PMR measures the regulatory conditions in the product market. The aggregate indicator, as well as the disaggregated indicators covering Entry Barriers and Public Ownership, are taken from Conway and Nicoletti (2006). For the period 1960-1975 the indicators are assumed constant at their respective 1975 value.

MTR is the mean tariff rate taken from Gwartney *et al*. (2009), The Fraser Institute. The data is available at five-year intervals starting in 1975 through 2000, and at an annual basis from 2000 onwards. For the period 1975-2000, the *MTR* data has been linearly interpolated in order to obtain annual observations.

Testing for Unit Roots in Panel Data

The results of the test are presented in the table below. Given that the left-tail of the normal distribution is used to reject the null of non-stationarity, note that large negative values for the statistics indicate rejection of the null of non-stationarity, at the 1 percent level for all models.

Table A.1

Full Panel Unit Root Test

Ho: Variables are non-statinary

Variable	Levin *et al.* Rho-stat	Levin *et al.* t-rho-stat	Levin *et al.* ADF-stat	Im *et al.* ADF-stat	Decission on Ho
Model 1: Heterogeneous intercepts with no common time effects					
Inflation	-5.9167	-1.9465	-2.2851	-3.0202	Reject
Unemployment	-6.9889	-2.3790	-3.5402	-4.6855	Reject
Import prices	-9.4579	-3.3634	-3.3414	-4.4217	Reject
Productivity	-12.2822	-4.6887	-4.6593	-6.1703	Reject
Indirect tax	-10.0135	-3.7163	-3.7585	-4.9751	Reject
Direc tax	-14.1532	-5.5095	-5.4036	-7.1579	Reject
Model 2: Heterogeneous intercepts with common time effects					
Inflation	-1.2882	-0.3535	-0.2609	-0.3343	Accept
Unemployment	-5.2401	-1.7110	-3.0145	-3.9880	Reject
Import prices	-8.2681	-2.5848	-0.5659	-0.7391	-
Productivity	-11.7321	-4.3397	-4.3548	-5.7663	Reject
Indirect tax	-11.2816	-4.3688	-4.3549	-5.7665	Reject
Direc tax	-14.0960	-4.8249	-4.8240	-6.3889	Reject
Model 3: Heterogeneous intercepts and heterogeneous trends with no common time effects					
Inflation	-7.3992	-1.7768	-2.2150	-3.4467	Reject
Unemployment	-7.4176	-1.7651	-2.7931	-4.4299	Reject
Import prices	-10.7134	-2.6736	-2.6865	-4.2486	Reject
Productivity	-14.3147	-4.0672	-2.8115	-4.4611	Reject
Indirect tax	-11.4243	-3.0169	-3.0488	-4.8648	Reject
Direc tax	-16.9042	-4.5540	-4.4481	-7.2448	Reject
Model 4: Heterogeneous intercepts and heterogeneous trends with common time effects					
Inflation	0.0025	-0.0619	0.0126	0.3422	Accept
Unemployment	-5.0910	-1.1795	-1.1795	-3.6536	-
Import prices	-9.6247	-2.1061	-2.0706	-3.2011	Reject
Productivity	-14.0159	-3.7794	-2.7310	-4.3243	Reject
Indirect tax	-13.1095	-3.5373	-3.5209	-5.6679	Reject
Direc tax	-16.5978	-4.4531	-4.3586	-7.0926	Reject

Note: All reported values are distributed according to N(0,1) under the null hypothesis of a unit root.

References

Alogoskoufis, G. and Smith, R. (1991), The Phillips Curve, the Persistence of Inflation, and the Lucas Critique: Evidence from Exchange-Rate Regimes, *American Economic Review* 81, 1254-1275.

Bernanke, B. and Mihov, I. (1997), What Does the Bundesbank Target?, *European Economic Review* 41, 1025-1053

Ball, L. and and Sheridan, N. (2003), Does Inflation Targeting Matter?, NBER Working Paper No. 9577.

Barro, R. and Gordon D. (1983), A Positive Theory of Monetary Policy in a Natural Rate Model, *Journal of Political Economy* 91, 589-610.

Blanchard, O. and Wolfers, J. (2000), The Role of Shocks and Institutions in the Rise of European Unemployment: the Aggregate Evidence, *Economic Journal* 113, C1--C33.

Blanchard, O. and Giavazzi, F. (2003), Macroeconomic Effects of Regulation and Deregulation in Goods and Labor Markets, *Quarterly Journal of Economics* 118, 879-907.

Belot, M. and van Ours, J. (2000), Does the Recent Success of Some OECD Countries in Lowering their Unemployment Rates Lie in the Clever Design of their Labour Market Reforms?, IZA Discussion Paper no. 147, Bonn.

Boschen, J. and Weise, C. (2004), Does the Dynamic Time Consistency Model of Inflation Explain Cross-country Differences in Inflation Dynamics?, *Journal of International Money and Finance* 23, 735--759.

Bowdler, C. and Nunziata, L. (2007), Inflation Adjustment and Labour Market Structures: Evidence from a Multi-country Study, *Scandinavian Journal of Economics* 109, 619--642.

Bruno, M. and Sachs, J. (1985), *Economics of Worldwide Stagflation*, Harvard University Press, Cambridge, MA.

Burdekin, R. and Siklos, P. (1999), Exchange Rate Regimes and Shifts in Inflation Persistence: Does Nothing Else Matter?, *Journal of Money, Credit, and Banking* 31, 235--247.

Conway, P. and Nicoletti, G. (2006), Product Market Regulation in the Non-manufacturing Sectors of OECD Countries: Measurement and Highlights, Working Paper 58, Economics Department OECD.

Coricelli, F., Cukierman, A. and Dalmazzo, A. (2004), Economic Performance and Stabilization Policy in a Monetary Union with Imperfect Labor and Goods' Markets, in: Sinn H. W., M. Widgren and M. Kothenburger (eds.), *European Monetary Integration*, MIT Press.

Coricelli, F., Cukierman, A. and Dalmazzo, A. (2006), Monetary Institutions, Monopolistic Competition, Unionized Labor Markets and Economic Performance, *Scandinavian Journal of Economics* 108, 39-63.

Cukierman, A. and Lippi, F. (1999), Central Bank Independence, Centralization of Wage Bargaining, Inflation and Unemployment: Theory and Some Evidence, *European Economic Review* 43, 1395--1434.

Cukierman, A. and Lippi, F. (2001), Labour Markets and Monetary Union: A Strategic Analysis, *Economic Journal* 111, 541-565.

Doménech, R. and García, J. R. (2008), Unemployment, Taxation and Public Expenditure in OECD Economies, *European Journal of Political Economy* 24, 202--217.

Driscoll, J. C. and Kraay, A. C. (1998), Consistent Covariance Matrix Estimation with Spatially Dependent Panel Data, *Review of Economics and Statistics* 80, 549--560.

Fiori, G., Nicoletti, G., Scarpetta, S. and Schiantarelli, F. (2008), Employment Outcomes and the Interaction Between Product and Labor Market Deregulation: Are They Substitutes or Complements?, Boston College Working Papers in Economics 663.

Flanagan, R., Soskice, D., and Ulman, L. (1983), *Unionism, Economic Stabilisation and Incomes Policies: European Experience*, Brookings Institution, Washington.

Franzese, R. J., Jr., and Hall, P. A., (2000), Institutional Dimensions of Coordinating Wage Bargaining and Monetary Policy, in T. Iversen, J. Pontusson and D. Soskice (eds.), *Unions, Employers and Central Banks: Macroeconomic Coordination and Institutional Change in Social Market Economies*, Cambridge: Cambridge University Press.

Geroski, P. A. (1995), What Do We Know About Entry?, *International Journal of Industrial Organization* 13, 421-440.

Gordon, R. J. (2009), The History of the Phillips Curve: Consensus and Bifurcation, *Economica*, forthcoming.

Griffith, R., Harrison, R. and Macartney, G. (2007), Product Market Reforms, Labour Market Institutions and Unemployment, *Economic Journal* 117, C142-C166.

Grüner, H. P. and Hefeker, C. (1999), How Will EMU Affect Inflation and Unemployment in Europe?, *Scandinavian Journal of Economics* 101, 33-47.

Gwartney, J., Lawson, R, Grubel, H., Haan, H., Sturm, J., and Zandberg, E. (2009), Economic Freedom of the World: 2009 Annual Report, Vancouver, BC: The Fraser Institute.

Judson, R. A. and Owen, A. L. (1999), Estimating dynamic panel data models: a guide for macroeconomists, *Economic Letters* 65, 9--15.

Layard, R., Nickell, S. and Jackman, R. (1991), *Unemployment: Macroeconomic Performance and the Labour Market*, Oxford University Press: London.

Neiss, K. S. (2001), The Markup and Inflation: Evidence in OECD Countries, *Canadian Journal of Economics* 34, 570-587.

Nickell, S. J. (1981), Biases in Dynamic Models with Fixed Effects, *Econometrica* 49, 1417--1426.

Nickell, S. J. (1999), Product Markets and Labour Markets, *Labour Economics* 6, 1--20.

Nickell, S. J. and Nunziata, L. (2001), Labour Market Institutions Database, version 2.00, 1960-1995, CEP-LSE.

Nickell, S. J., Nunziata, L., Ochel, W. and Quintini, G. (2002), The Beveridge Curve, Unemployment and Wages in the OECD from the 1960s to the 1990s, Centre for Economic Performance, London School of Economics and Political Science.

Nickell, S. J., Nunziata, L. and Ochel, W. (2005), Unemployment in the OECD since the 1960s. What do we know?, *Economic Journal* 115, 1-27.

Nicoletti, G., Scarpetta, S. and Boylaud, O. (1999), Summary Indicators of Product Market Regulation with an Extension to Employment Protection Legislation, OECD Economic Department Working Paper 226.

Nunziata, L. (2005), Institutions and Wage Determination: A Multi-country Approach, *Oxford Bulletin of Economics and Statistics* 67, 435-466.

Przybyla, M. and Roma, M. (2005), Does Product Market Competition Reduce Inflation? Evidence from EU Countries and Sectors, European Central Bank Working Paper Series No. 453.

Reinhart, C., Rogoff, K. and Ilzetki, E. (2009), Exchange Rate Arrangements Entering the 21st Century: Which Anchor Will Hold?, database available at http://terpconnect.umd.edu/~creinhar/Papers.html.

Rose, A. K. (2007), A Stable International Monetary System Emerges: Inflation Targeting is Bretton Woods, Reversed, *Journal of International Money and Finance* 26, 663-681.

Soskice, D. and Iversen, T. (2000), The Non-Neutrality of Monetary Policy with Large Wage and Price Setters, *Quarterly Journal of Economics* 115, 265-284.

Visser, J. (2009), ICTWSS Database, Database on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts in 34 countries between 1960 and 2007, Institute for Advanced Labour Studies, AIAS, University of Amsterdam, Amsterdam.

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