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Regional Price Adjustment in a Monetary Union:
The Case of EMU

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REGIONAL PRICE ADJUSTMENT IN A MONETARY UNION
THE CASE OF EMU *

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Abstract

Using a New-Keynesian framework, we investigate how far the inflationary processes in member states of EMU cause regional price levels to converge. We fail to produce hard evidence of the present existence of such an adjustment mechanism, notwithstanding that inflation in some countries tends to converge towards the euro area level. Overall, inflation persistence has declined significantly over the years, but there are still marked differences between countries on this score. We conclude that the euro area is not an optimal currency area yet, lending support to the quest for further structural reforms in European labour and product markets.

Jel Classification: E31; F02; E58

Keywords: Inflation; EMU; Monetary policy

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1. Introduction

On January 1, 1999, the currencies of **eleven** member states of Economic and Monetary Union (EMU) became irrevocably fixed. As a **consequence**, the nominal exchange **rate** Channel as a propagation **mechanism** of **asymmetric** shocks within the euro area was shutdown. Since then, **mean-reversion** of **real** exchange **rates** (or international competitiveness) across the euro area **relies** exclusively on **convergence** of regional price levels. This paper **addresses** the empirical question whether or not **such convergence** is inherent in the inflationary **processes** of member states, and if so, **how** fast it occurs.

A related issue is the extent to which price dynamics differ between **countries** as regards inflation **persistence** and the pass-through of **changes** in the **real** exchange **rate** and domestic **demand** pressure. **Such** heterogeneity **may** **render** the common monetary policy conducted by the European Central Bank (ECB) suboptimal for (some) individual countries and is thereby a potential **cause** of **tension** among Governing Council members of the ECB (Aksoy *et al.*, 2002). This imposes constraints on **fiscal** policies, which are still in **place** to **cope** with regional inflation divergences. **However**, differences in national preferences **may** seriously **hamper** that kind of **accommodating** behaviour by sovereign governments (Hughes Hallett and Weymark, 2001), notwithstanding the requirements of the Maastricht Treaty, the **Stability & Growth Pact**, and the **Broad Economic Policy Guidelines**.

Of course, **such** coordination failure **will** become less pressing as the **real** **economies** of member states of EMU get more integrated. This **stresses** the **importance** of completing the Internal Market by ongoing efforts at **harmonizing** tax and **benefit** systems across national borders, at structurally **reforming** labour and product **markets**, etc. While this is clearly a long-term challenge, some progress has been made during the past two decades, which we try to **detect** empirically by assessing regional inflation dynamics in the euro area over different **time** spans. This **also** allows us to test the **proposition** put forward by Taylor (2000) and others that the shape of the Phillips curve **tends** to vary with the inflationary environment.

Our empirical analysis is embedded in a simple New-Keynesian framework, incorporating inertia — which are commonly seen as characteristic of European labour and product markets (Gonenc et al., 2000) — and forward-looking behaviour in the determination of inflation. The focus on regional price adjustment within a monetary union is fairly novel, as most of the existing literature on inflation dynamics concentrates on monetarily sovereign countries (e.g., in the context of assessing different strategies of monetary policy). A further innovative aspect of our approach is that we allow and test for convergence of expectations to the rate of inflation in the euro area as a whole. Our evidence on this score is rather tentative, though, due to some restrictive assumptions on expectation formation (especially prior to the establishment of EMU).

The remainder of the paper is organized as follows. The next section contains our conceptual framework, which is put to the test empirically in section 4, after a discussion of data issues in section 3. Section 5 concludes.

2. Conceptual framework

Our starting point is an expectations-augmented Phillips curve as contained in the work of Svensson (1998) and Leitemo and Söderström (2001), with domestic inflation predetermined one period:

$$\pi_t = \alpha \pi_{t-1} + (1 - \alpha) E_{t-1}(\pi_{t,1}) + \beta E_{t-1}(y_t) - \gamma E_{t-1}(e_t) + \delta + \varepsilon_t \quad (1)$$
$$0 \leq \alpha \leq 1 ; \quad \beta > 0 ; \quad \gamma < 0$$

where π_t is the annualized domestic rate of inflation, measured as the difference of the (log) gdp-deflator (p), y_t is the output gap, e_t is the (log) real exchange rate, ε_t is a white-noise supply shock, and E is an expectations operator. The suffix t indicates the (quarterly) time period. The expectations of y_t and e_t , formed in period $t-1$, should be regarded as deviations from their steady-state levels, which are assumed to be constant and to be captured by the intercept δ for convenience. The real exchange rate is defined as:

$$e_t = s_t + p_t - p_t^* \quad (2)$$

where s_t is the (log) spot exchange rate (in units of foreign currency per unit of domestic currency), and p_t^* is the foreign (log) gdp-deflator. The parameters α , β , γ and δ may differ across countries. Of course, they may also change over time due to shifts in wage negotiation models, opening-up of product markets (both domestically and across borders), and so on.

For a theoretical underpinning of eq. (1), we refer to Svensson (1998, Appendix C). He derives a macroeconomic supply function from a first-order condition of an optimization problem for an open economy, adding inflation persistence along the lines of Fuhrer and Moore (1995). This last extension gives the equation its 'Keynesian' flavour of price-staggering, which has recently been worked out by Taylor (2000) and Choudri and Hakura (2001) in the context of marginal cost and exchange rate pass-through.

To see what EMU implies, consider the more extreme case in which s is completely fixed. Then, the real exchange rate in eq. (1) acts as an equilibrating mechanism in that it incites inflation as long as the domestic price level is expected to lag behind the foreign price level (provided, of course, that $\gamma < 0$).¹ As a consequence, international price level differences are only temporary. Clearly, it depends on the strength of the real exchange rate channel (i.e., on γ) and on domestic inflation dynamics (notably α) how long that adjustment process takes. The more integrated and dynamic the real economies of countries are as regards product market competition, wage rate determination and so on, the sooner equilibrium will be restored.

We intend to shed some light on this issue in the context of EMU by estimating eq. (1) for five larger member states. This requires that certain assumptions be made on the formation of expectations about future inflation, the output gap and the real exchange rate. We assume that y_t and e_t are expected to converge to their constant steady-state levels (\bar{y} and \bar{e}) according to the adaptive mechanisms:

¹ Note that the real exchange rates of member states of EMU (e) are still subject to changes in nominal exchange rates vis-a-vis the currencies of countries outside the euro area.

$$E_{t-1}(y_t) = \kappa y_{t-1} + (1 - \kappa)\bar{y} \quad (0 \leq \kappa \leq 1) \quad (3)$$

$$E_{t-1}(e_t) = \lambda e_{t-1} + (1 - \lambda)\bar{e} \quad (0 \leq \lambda \leq 1) \quad (4)$$

Note that expectations are **static** in case $\kappa = \lambda = 1$.² The expectation of **one-**period ahead inflation in **each** member **state** of EMU is assumed to converge to the expectation of one-period ahead **inflation** in the euro area as a **whole**, $E_{t-1}(\Pi_{t+1})$, according to:

$$E_{t-1}(\pi_{t+1}) = \mu \pi_{t-1} + (1 - \mu) E_{t-1}(\Pi_{t+1}) \quad (0 \leq \mu \leq 1) \quad (5)$$

This is asymptotically consistent with the aforementioned hypothesis that **re-**gional price level differences within EMU tend to disappear in the long run. The **persistence coefficients** κ , λ and μ may differ **across** countries, just **like** (or **rather** in conjunction with) the parameters in eq. (1). Finally, we assume that one-period ahead inflation in the euro area as a **whole** is expected to converge to the constant **rate** Π^* , representing the **rate** of inflation the **Euro-**pean (system of) central banks consider(s) to be consistent with **medium-**term price stability:

$$E_{t-1}(\Pi_{t+1}) = v \Pi_{t-1} + (1 - v)\Pi^* \quad (0 \leq v \leq 1) \quad (6)$$

Upon substituting eqs. (3) to (6) into eq. (1), we arrive at the **final** estimating form:

$$\pi_t = \alpha_1 \pi_{t-1} + \alpha_2 \Pi_{t-1} + \beta' y_{t-1} + \gamma' e_{t-1} + \delta' + \varepsilon_t \quad (7)$$

$$0 \leq \alpha_1 = a + \mu - \alpha\mu \leq 1 ; 0 \leq \alpha_2 = (1 - \alpha_1)v \leq 1 ; \beta' = \beta\kappa ;$$

$$\gamma' = \gamma\lambda ; \delta' = \delta + \beta(1 - \kappa)\bar{y} + \gamma(1 - \lambda)\bar{e} + (1 - \alpha_1)(1 - v)\Pi^*$$

From the parameter restrictions, it follows that $\alpha_1 + \alpha_2 \leq 1$. The larger a , (hence, the smaller α_2) and the smaller γ' are, the more persistent domestic

² We have explored more complicated schemes by adding several lagged difference terms to the equations (Δy_{t-i} and Δe_{t-i} , respectively), but on the **whole**, this gave inferior estimation results.

inflation is, and the **longer** it takes until the **country's** price competitiveness is at par vis-a-vis other member states **after** it has been hit by an **asymmetric** supply shock (E). **Thus**, the estimates of α_1 , α_2 and γ , taken in conjunction, **tell** US to what extent national **economies** in EMU have really integrated. Incidentally, the **significance** of the domestic output gap (i.e., the parameter β') is **also** indicative of the degree of **economic** regionalism in inflation dynamics.

3. Data issues

We have obtained quarterly data from Datastream, **covering** the period 1980-2000, for **France**, Germany, Italy, the Netherlands and **Spain**. **Lack** of consistent data over a **sufficiently** long period prevented US from considering other member states of EMU as well. Inflation in the euro area is a weighted **average** of the gdp-deflators for the constituent countries, with the euro area prior to the establishment of EMU represented by the group of countries participating in the European Exchange Rate Mechanism.³ We have **experimented** with several indicators of the output gap: deviations of **real** gdp from trend, constructed by a HP(1600) filter, the **rate** of capacity utilization, the unemployment **rate** and its inverse. The last proxy, implying a hyperbolic Phillips curve, **tuned out** to be superior throughout the sample of countries. **Forced** by the (un)availability of data, we had to measure the **real** exchange **rate** in terms of either **consumer** price deflators or unit labour **costs**, where we would have preferred gdp-deflators.

Unit-root tests (both Augmented **Dickey-Fuller** and Phillips-Perron) **showed** for **each** country that **all** but one series are stationary. The exception is the **real** exchange **rate** based on unit labour **costs**, which led US to choose the **real** exchange **rate** based on **consumer** price deflators as our measure of international competitiveness. So, the preferred data set is consistent with Svensson's (2001) prior that **all** variables in eq. (1) are stationary.

³ The obvious alternative is to identify Π prior to 1999 with German inflation, but this gave implausible estimation results.

Studies by Gonenc *et al.* (2000) and Rich and Tracey (2000) suggest that the **persistence** of domestic inflation is not **fully captured** by simply **including** the quarterly lagged **rate** of inflation (π_{t-1}) as a regressor. The reason is that wage developments (especially in Europe) are largely governed by **collective** labour agreements that are **effective** during a relatively long period of **time**. Following Rudebusch (2000), we have experimented with more complicated lag **structures**, and established that using lags of up to and **including** eight quarters fits best for the countries **considered**.⁴ This confirms the notion of Fuhrer and Moore (1995), elaborating on Taylor (1980), that wage **inertia** extending over several quarters tend to translate into equally severe inflation **persistence**.

4. Estimation results

Eq. (7) was fitted over the entire sample period (1980-2000) and over the subperiod 1990-2000, for **each** country separately and for a panel of the five countries. We used OLS (and SUR for the panels), with the covariance matrix estimated by the method suggested by Newey and West (1987) to allow for ARCH **effects** found in some equations. The results are **recorded** in table 1, together with some summary **statistics**.

As it turns **out**, inflation in most countries considered is primarily driven by past inflation **rates**, with the **real** exchange **rate** playing a **very** limited role (if **any**). This conclusion **holds** for both sample **periods**.⁵ As revealed by the results of the pooled regressions (with only δ' allowed to vary **across** countries), the pass-through of **changes** in the **real** exchange **rate** to domestic inflation has even declined over **time** (though not significantly). Recent research by Taylor (2000) and others (Choudry and Hakura, 2001; Gagnon and Ihrig, 2001) suggests that this is due to a shift towards an environment of lower inflation, whether or not induced by monetary policy. The argument

⁴ All pre-testing results are available from the authors **upon** request.

⁵ In the longer sample, γ is significant for **France**, but it has the wrong sign.

runs as follows. The extent to which firms pass through **cost** increases as **well** as price increases at competing firms depends on their expectations about the **persistence** of **such** increases. This perceived **persistence** is **associ-**ated with the overall level of inflation, which is assumed to be **indicative** of the pricing power of firms. And **indeed**, as appears from the last column of table 1, **average** inflation has decreased markedly in most countries **consid-**ered. Moreover, we find that the influence of domestic **demand** pressure on inflation (i.e., the parameter β') has declined significantly over the years in France, Italy and the Netherlands, which **also** supports Taylor's hypothesis. Remarkably, this is not revealed by the results of the pooled regressions, suggesting that the assumption of constant slope **coefficients across** countries is not entirely appropriate. It follows that national **economies** in EMU are not perfectly integrated as regards price (and wage) formation, which **cor-**roborates recent findings by Aksoy et al. (2002).

Notwithstanding this last conclusion, inflationary expectations in some countries — Germany in particular — were based more and more on **aver-**age European inflation as EMU got nearer. This emerges from a comparison of the estimates of α_1 and α_2 between the two **samples**.⁶ Spain is found to be most oriented towards Europe in this **regard**, **already** from the 1980s onward, which is probably due to the **fact** that this country has the strongest trade links with the rest of the euro area. Inflation **persistence** in France and Italy has remained **considerable** through the years. It is beyond the scope of this paper to go deeply into the possible **causes** behind this **finding**. We do note, **however**, that those countries have the highest scores on product **mar-**ket regulation in our sample, according to a recent study by the OECD (Ni-coletti et **al.**, 2001, pp. 43-44). This **may** have a bearing on the viability of indexation and, hence, on price staggering. The Netherlands, on the other hand, seems to have moved towards pretty sound inflation **dynamics**. The

⁶ Although the sum of these parameters exceeds **unity** in some cases, thereby breaching the theoretical restriction, it does only significantly so in the case of **Spain** in the **longer** sample (according to a Wald test). Furthermore, we had to **re-**ject the hypothesis that v in eq. (6) is uniform **across** countries.

most recent estimates of α_1 and α_2 for the Netherlands imply that Dutch inflation is largely governed by the perception of medium-term price stability in the euro area (i.e., by Π^*). Hence, the effects of exogenous price shocks on inflation tend to be short-lived in the Netherlands.

5. Concluding remarks

This study was primarily inspired by curiosity about the degree and speed of price level convergence across EMU, after a member state has been hit by an asymmetric supply shock. Our finding that regional inflation rates in the euro area are not significantly affected by deviations of real exchange rates from their steady-state levels does not bode well for a spontaneous — let alone rapid — convergence. It follows that stationarity of real exchange rates in our sample of countries is conditional on the possibility of adjustments in nominal exchange rates. Since this flexibility does not exist within EMU, differences in price competitiveness between member states may last for quite a long time. This is the more so as there are still marked differences in inflationary dynamics — hence, in the propagation of shocks — between member states of EMU, which further complicate the pursuit of a common monetary policy. These findings lead us to conclude that the euro area is not an optimal currency area yet, lending support to the quest for continued structural reforms in European labour and product markets.⁷

We acknowledge that our findings are based on a simple model of inflation dynamics, especially where the formation of expectations is concerned. The results are also prone to the Lucas critique. Indeed, the empirical evidence produced in this paper supports the view of Taylor (2000) and others that the inflationary environment tends to alter the shape of the Phillips curve. It may well be, therefore, that the influence of real exchange rates (and other factors) on regional inflation levels will increase in the unlikely event that the euro area runs into persistently higher inflation zones.

⁷ See Hughes Hallett and Weymark (2001) for a theoretical underpinning of this proposition.

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Table 1
Estimation results^a

	α_1	α_2	β'	γ	δ'	\bar{R}^2	\bar{S}_e	$\bar{\pi}$
<i>Sample 1980-2000</i>								
France	0.90 (20.3)	0.02 (0.4)	0.11 (2.2)	0.03 (1.9)	-3.83 (2.7)	0.98	0.51	3.89
Germany	0.78 (8.7)	0.09 (1.2)	0.03 (1.6)	-0.00 (0.1)	-0.04 (0.0)	0.91	0.47	2.44
Italy	0.94 (15.7)	-0.01 (0.1)	0.28 (2.1)	-0.00 (0.2)	-1.89 (0.8)	0.98	0.80	7.33
Netherlands	0.76 (6.7)	0.11 (1.5)	0.05 (3.4)	-0.02 (0.6)	0.85 (0.3)	0.78	0.80	2.06
Spain	0.51 (3.8)	0.80 (3.3)	0.28 (1.3)	-0.04 (1.6)	2.63 (0.9)	0.85	1.21	6.80
Pooled	0.91 (52.2)	0.08 (3.0)	0.02 (2.6)	-0.01 (1.5)	- ^b	0.96	0.86	4.75
<i>Sample 1990-2000</i>								
France	0.87 (3.5)	0.00 (0.0)	0.07 (1.0)	0.02 (0.5)	-2.14 (0.6)	0.87	0.32	1.67
Germany	0.57 (5.2)	0.47 (2.8)	0.02 (0.3)	0.03 (1.2)	-3.09 (1.3)	0.92	0.48	2.17
Italy	0.91 (8.7)	0.27 (1.1)	-0.19 (0.8)	-0.02 (0.9)	3.93 (1.0)	0.91	0.67	4.29
Netherlands	0.14 (0.8)	0.14 (2.5)	0.02 (1.4)	-0.05 (1.6)	5.65 (1.9)	0.55	0.43	2.12
Spain	0.42 (1.4)	0.81 (2.0)	0.31 (1.0)	-0.03 (0.7)	2.04 (0.4)	0.63	1.25	4.45
Pooled	0.72 (12.8)	0.23 (6.0)	0.03 (2.6)	0.00 (0.2)	- ^c	0.84	0.80	2.94

^a T-ratios in brackets; \bar{R}^2 is the coefficient of determination and \bar{S}_e is the standard error of estimate, both adjusted for degrees of freedom; $\bar{\pi}$ is the sample mean of gdp-inflation.

^b Varies across countries (Fr: 0.65; Ge: 0.41; It: 1.10; NI: 0.42; Sp: 0.99).

^c Varies across countries (Fr: -0.61; Ge: -0.58; It: 0.07; NI: -0.70; Sp: 0.26).