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Real Exchange Rates and the Prices of Nontradable Goods

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Abstract

This paper attempts to provide a perspective on real exchange rate developments following the inception of the EMS. The focus is on structural determinants of real exchange rates, notably the behavior of tradables and nontradable prices and productivity. It is found that changes in the relative price of tradable goods in terms of nontradables account for a sizable fraction of real exchange rate dynamics during the EMS period. Sectoral productivity growth differential help explain the behavior of the relative price of tradable goods, especially in the long run. There is also some evidence that the EMS has extended on relative price behavior.

JEL Classification Numbers:

F 31, F41

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Contents

I. Introduction

After several years of tranquillity and converging inflation performance across countries, the exchange rate mechanism (ERM) of the European Monetary System came under strong pressure starting in the Summer of 1992, and eventually broke down in August 1993 (although formally still in existence with 15 percent oscillation bands). In this paper we make an attempt at providing a perspective of real exchange rate developments following the inception of the EMS by focussing on some structural determinants of real exchange rates, notably the behavior of tradables and nontradables prices and productivity.

In the period between 1979 and 1987 the inflation rates in EMS countries showed remarkable convergence. High inflation countries like Italy were able to reduce considerably the inflation differential vis-à-vis more "virtuous" EMS countries by pegging the nominal exchange rate to the Deutsche Mark, with occasional realignments that failed to compensate fully for inflation differentials. The following period, known as the "hard EMS", was characterized by the absence of realignments and by a reduction in nominal interest rate differentials. The reduction of inflation differentials, however, came to a halt and in some cases started to widen again.

Incomplete convergence in inflation rates accompanied by fixed exchange rates lead to increasing divergence in price levels, as highlighted for example by De Grauwe (1992). Real effective exchange rate measures based on aggregate price indices such as CPI or GDP deflator show a substantial appreciation for high inflation countries, such as Italy and Spain (lower quadrant of Chart 1); Germany, Belgium, Denmark and the Netherlands, on the other hand, were able to reverse the large appreciation of the early seventies and enjoyed a strong competitive position through most of the EMS period, despite sizable nominal appreciation (Chart 1, upper quadrant). These facts, and the sizable depreciation of both the Lira and Peseta after September 1992, suggest that both currencies were "overvalued". Over-valuation can only be ascertained relative to some notion of equilibrium real exchange rate: however, in the presence of diverging productivity developments, the equilibrium real exchange rate changes over time, making any assessment of actual developments more difficult. 1/ Also, different measures of the real exchange rate seem to lead to different conclusions (compare Chart 1 with Chart 2, where real exchange rates are calculated on the basis of manufactured goods deflators). We have tried to throw some light on these issues by concentrating our attention on the interaction between (various measures of) the real exchange rate and relative price and productivity developments in manufacturing and services within EC member countries.

1/ Barro (1983) and Bergstrand (1991), among others, focus on structural determinants of real exchange rates.

Indeed, an interesting feature of the EMS area, fairly neglected until recently in the voluminous literature on the EMS and inflation, 1/ has been the sharply different behavior across countries of the relative price of manufactured goods in terms of services (Chart 3). These developments suggest that a sizable fraction of the change in intra-European real exchange rates may have been driven by changes in domestic relative prices between tradable and nontradable goods, rather than by changes in the price of tradable goods across countries. 2/ The distinction between tradable and nontradable goods has thus become the subject of a growing number of theoretical and empirical studies. 3/

The issue is important for two reasons. First, anti-inflation policy based solely on the exchange rate constraint may be less effective if the prices of services do not respond to exchange rate discipline (because services are not exposed to international competition). Second, if wages are equalized across sectors and their rate of increase is determined by productivity increases in manufacturing, then it is possible that productivity increases in manufacturing induced by exchange rate discipline may have inflationary effects on wages and prices in the service sector (where productivity increases are much lower). 4/

This paper is motivated by the desire to explain observed differences in the evolution of real exchange rate indicators over the years 1960-1991 for a group of eight countries: Belgium, Denmark, France, Germany, Italy, the

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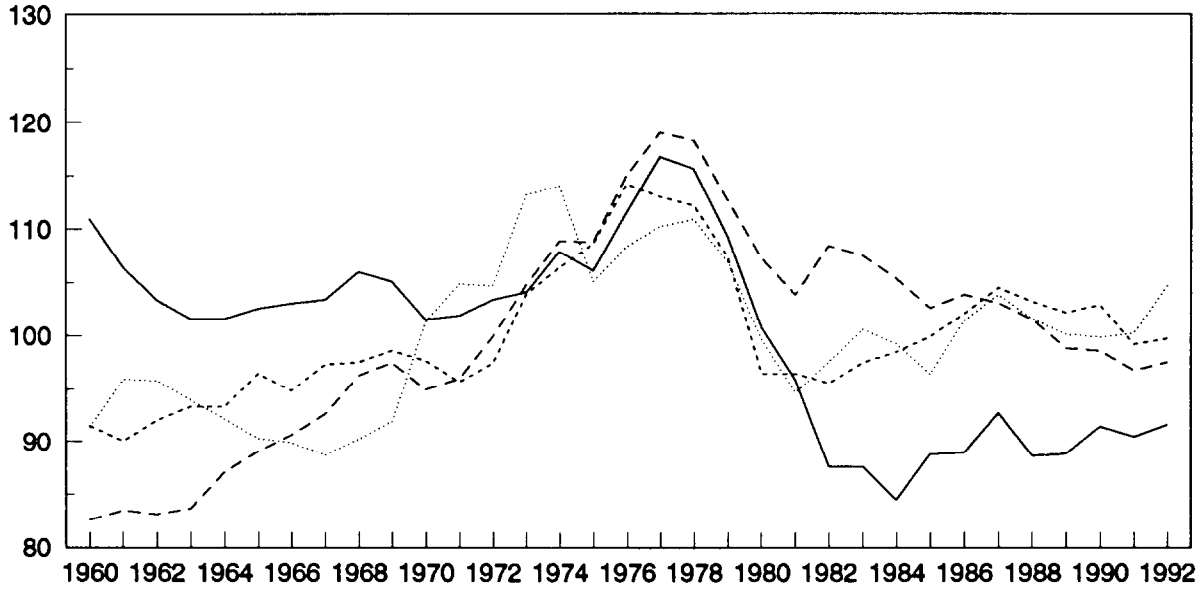
1/ See, for example, Giavazzi and Giovannini (1989) and the volumes edited by Giavazzi, Micossi and Miller (1988) and De Grauwe and Papademos (1990).

2/ Of course, if traded goods are perfect substitutes and there are no trade barriers then any real exchange rate change is necessarily driven by a change in the relative price of traded vs non traded goods.

3/ Recent papers using two-sector open economy models to study the dynamics of real exchange rates are Froot and Rogoff (1991), De Gregorio, Giovannini and Krueger (1992) and De Gregorio, Giovannini and Wolf (1993). See also Eichengreen and Wyplosz (1993). The literature on exchange rate-based stabilizations in Latin America has addressed similar questions for a number of years. See for example Calvo and Vegh (1991), Kiguel and Liviatan (1992). In that literature the relative price tradables/non tradables -- defined as the real exchange rate -- plays a key role.

4/ The relation between productivity differentials in different sectors and the value of the real exchange rate was studied by Balassa (1964) and Samuelson (1964). During the 1970s the "Scandinavian model" related inflation developments in a country with an "imported" and a "structural" component, where the latter depended on productivity differentials (see Lindbeck 1979). More recent intertemporal two-sector models with utility-maximizing consumers are presented, for example, in Obstfeld (1992, 1993) and De Gregorio, Giovannini and Krueger (1993). These models show how persistent differentials in the rate of productivity growth between tradable and non tradable goods can cause a fall over time of the relative price of traded goods.

CHART 1
Real effective intra-EC exchange rate
(avg 1960-1992 = 100)



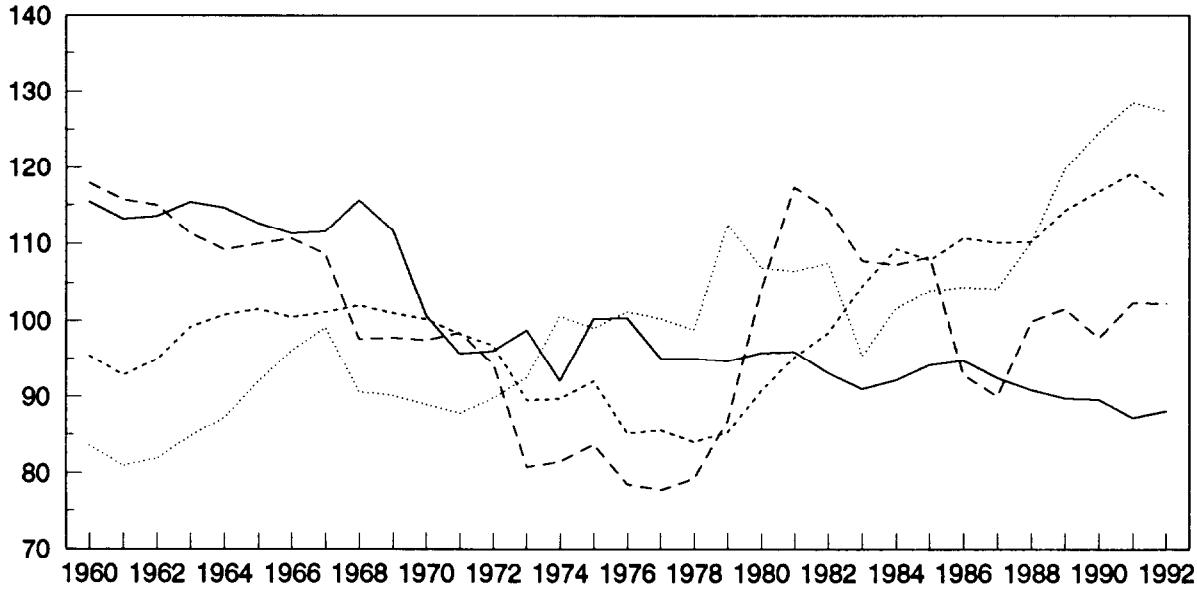
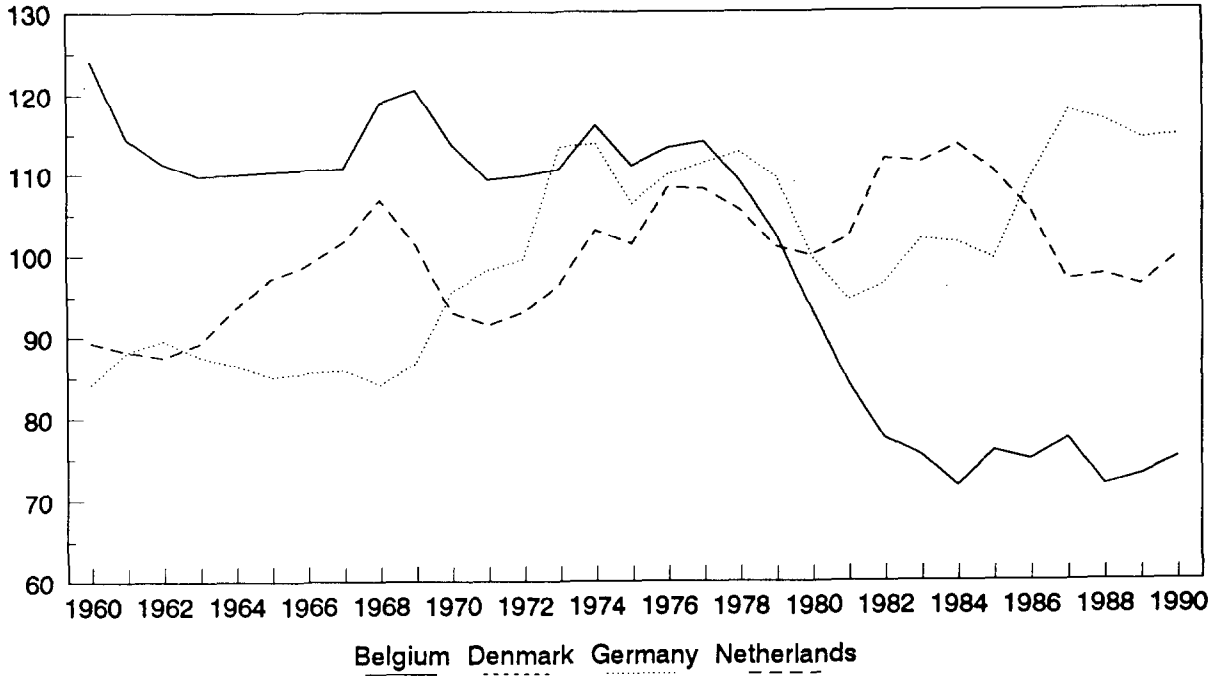


CHART 2

Real manufactures-based intra-EC exchange rate

(avg 1960-1990=100)



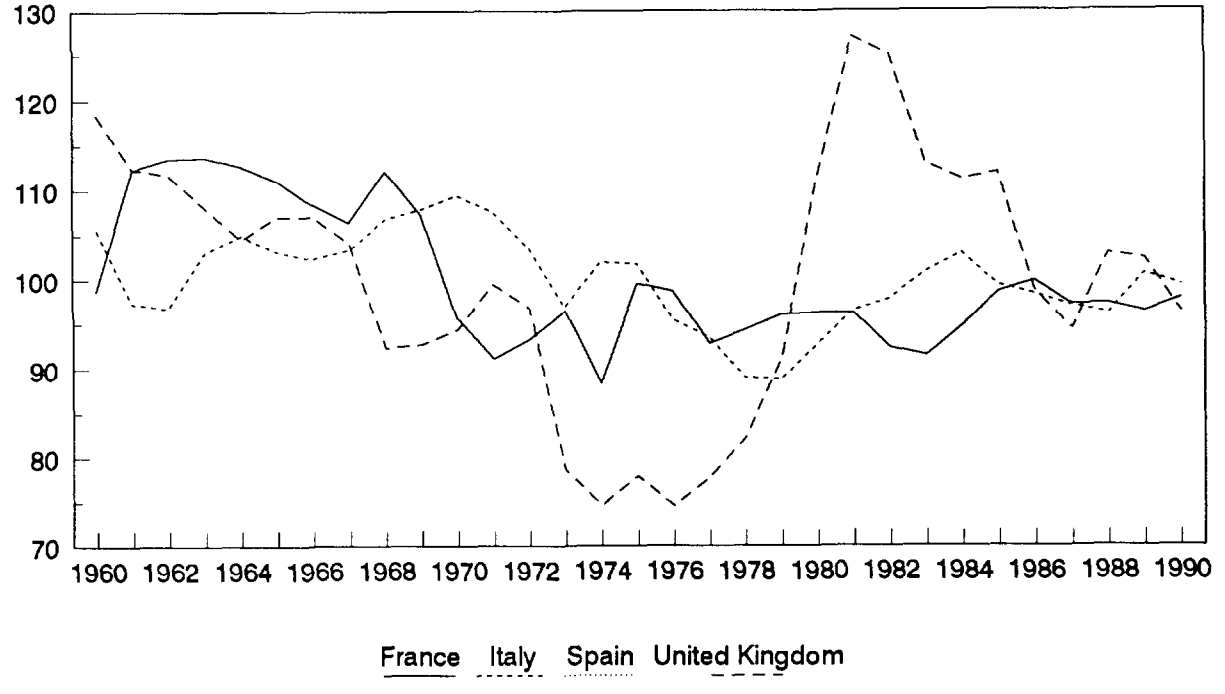
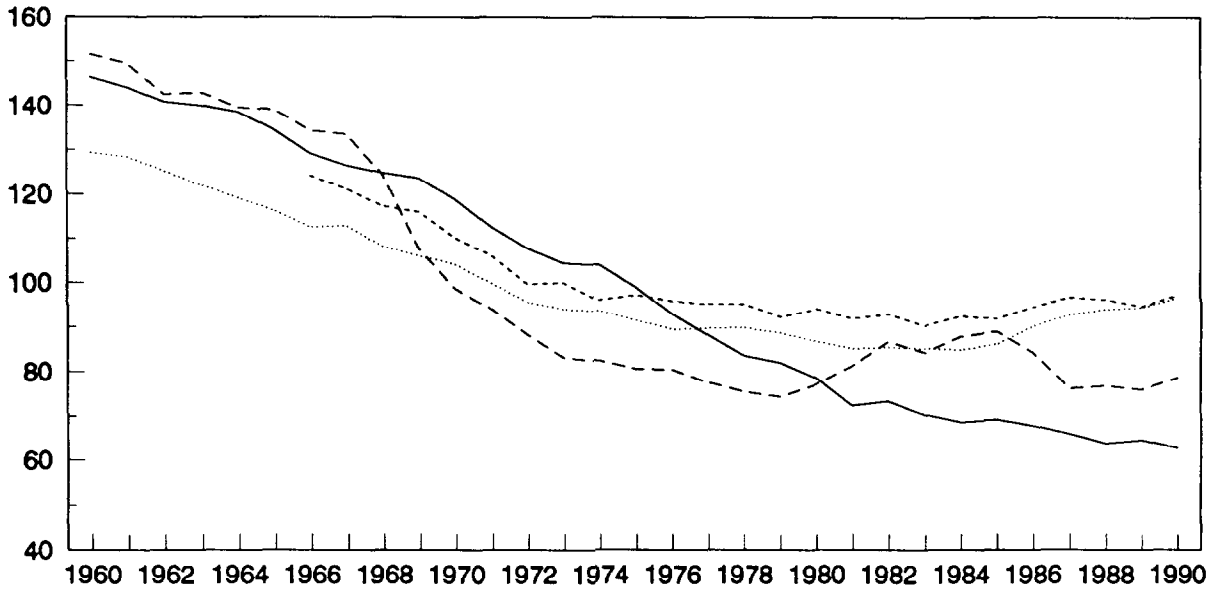


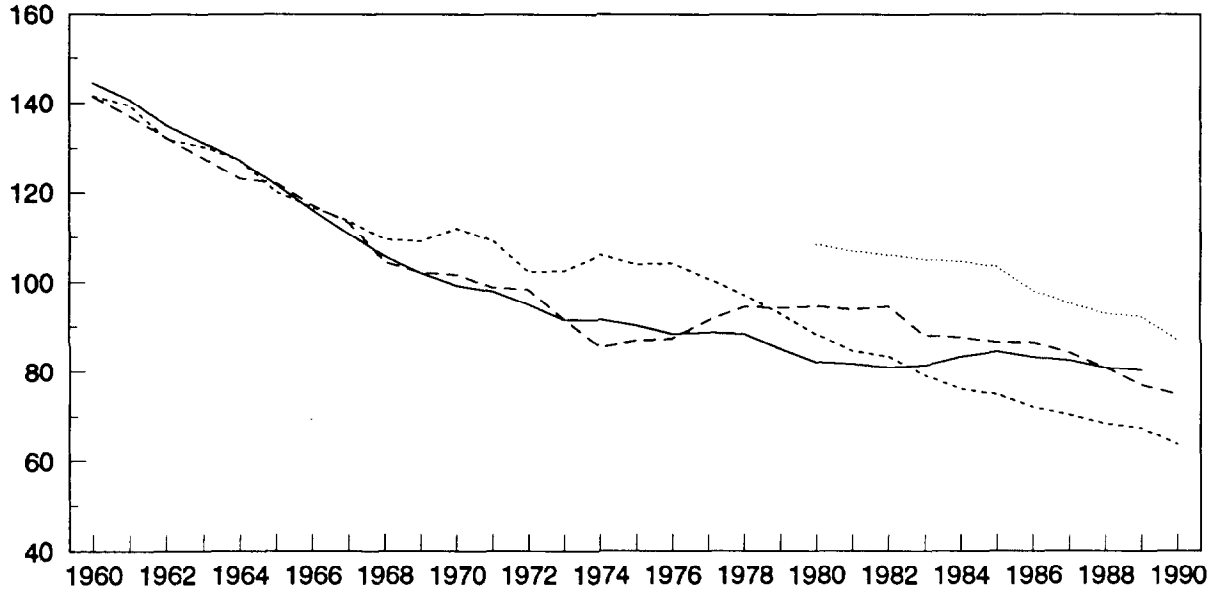
CHART 3

Relative price manufactures/services

(avg 1960-1990 = 100)



Belgium Denmark Germany Netherlands



France Italy Spain United Kingdom

Netherlands plus Spain and United Kingdom. 1/ The EMS period is contrasted with the period 1960-78. The length of the sample allows us to perform a comparison of the pre-EMS and EMS periods, complementing other studies, such as Froot and Rogoff (1991), De Gregorio, Giovannini and Krueger (1993) and De Gregorio, Giovannini and Wolf (1993) that were based on shorter time series.

The structure of the paper is as follows. Section II presents a simple accounting framework, taken from Marston (1987), that links together several definitions of the real exchange rate; Section III identifies some simple "stylized facts" concerning real exchange rates, productivity and relative price developments; Section IV presents empirical evidence on the determinants of real exchange rate behavior. Section V concludes.

II. The Model

We present below a simple accounting model that highlights the role of labor costs and productivity in determining real exchange rates; the model is a simplified version of Marston (1987). All variables are expressed in logarithmic terms. The equation for value added in each sector takes a Cobb-Douglas form, with exogenous technical progress:

$$V^i = (1 - c_i) L^i + c_i K^i + h^i t \qquad i = T, N \tag{1}$$

where V is value added, K is capital, L is labor, h^i is technical progress in sector i and c_i is the capital share in sector i. The superscripts T and N indicate the traded and non traded goods sector respectively; in what follows we identify traded goods with manufactures and non-traded goods with services. 2/ Our analysis will be based on sectoral value added and value added deflators, therefore excluding the effects of intermediate and imported inputs. 3/

Labor productivity is defined as follows:

$$H^i = V^i - L^i = c_i (K^i - L^i) + h^i t \qquad i = T, N \tag{2}$$

1/ For Spain we lack data on sectoral value added deflators and on productivity prior to 1980.

2/ See the discussion in Section III.

3/ This approach allows a more simplified treatment of the real exchange rate based on an aggregate index. If instead we focussed on the Consumer Price Index, we would have to take into account the role of the price of imports of final goods, as well as the role of intermediate and imported inputs in determining the final price of goods. See, for example, Marston (1987) and Lipschitz and McDonald (1992).

There are two possible sources of labor productivity growth: one is exogenous technical progress (h^T) and the other is capital deepening or labor shedding. Ideally we would like to focus on the behavior of total factor productivity, as De Gregorio, Giovannini and Krueger (1993) and De Gregorio, Giovannini and Wolf (1993). However, since consistent data on the evolution of the capital stock for the whole sample were not available, we focussed instead on labor productivity, following Hsieh (1982) and Marston (1987). Since our empirical analysis is conducted on rates of change of variables, we hope that labor productivity is a reasonable approximation for total factor productivity. Assuming a constant mark-up over labor costs, 1/ the relation between value-added deflator, wages and productivity in each sector is given by:

$$P^i = W^i - H^i \qquad i = T, N \tag{3}$$

With perfect labor mobility across sectors wages will be equalized, implying that the relative price of tradable goods in terms of non-tradables will depend on the productivity differential between the two sectors: 2/

$$P^T - P^N = H^T - H^N \tag{4}$$

The aggregate GDP deflator is defined as follows:

$$P^V \equiv \alpha P^N + (1-\alpha) P^T \tag{5}$$

where α is the share of tradables in total value added and the superscript V indicates the aggregate value added deflator.

Given these equations, we can relate the behavior of various definitions of the real exchange rate to variables such as productivity, wage behavior and the relative price of tradable and non-tradable goods. Marston (1987) argues that supply-side effects can be detected by looking at the differential behavior of various real exchange rate indicators. Consider the real exchange rate based on aggregate GDP and manufacturing deflators.

1/ Lipschitz and Mc Donald (1992) adopt a more elaborate model that allows for variability in profit margins. One of the advantages of their approach is that they are able to distinguish between the real exchange rate based on unit labor costs in the tradables sector and the one based on the value added deflator in the same sector. Using the Marston approach these two measures are equivalent (see below).

2/ A similar relation between the relative price of tradable goods and productivity is derived from a utility-maximizing model in recent papers such as Obstfeld (1993) and De Gregorio, Giovannini and Wolf (1993).

Let X be the nominal exchange rate between the home country and the rest of the world (defined as the foreign currency price of a unit of domestic currency), and $R^i = P^i + X - P^{*i}$ the real exchange rate based the price index i. We can then express the real exchange rate based on the aggregate GDP deflator as follows (a star indicates foreign variables):

$$R^V = (X + P^T - P^{T*}) - \alpha(P^T - P^N) + \alpha^*(P^{T*} - P^{N*}) \tag{6}$$

Clearly, when the domestic relative price of manufactured goods falls more than the foreign relative price, the real exchange-rate based on GDP deflators will appreciate relative to that defined in terms of tradable goods alone.

Because of the assumption of constant markups, the real exchange rate based on the value-added deflator in manufacturing, or services, is equal to the real exchange rate based on unit labor costs in the same sector. Define R^{ULC} as follows:

$$R^{ULC} = (W^T + X - W^{T*}) - (H^T - H^{T*}) \tag{7}$$

Equation (6) can then be expressed in terms of relative wages and productivity rates of change. Using (6) we obtain:

$$R^V = R^{ULC} + \alpha^*[(W^{T*} - W^{N*}) - (H^{T*} - H^{N*})] - \alpha[(W^T - W^N) - (H^T - H^N)] \tag{8}$$

If wage dynamics are the same in the tradable and non-tradable sectors, because of labor mobility across sectors, equation (8) simplifies to:

$$R^V = R^{ULC} + \alpha(H^T - H^N) - \alpha^*(H^{T*} - H^{N*}) \tag{9}$$

That is, if the differential in labor productivity between the tradables and the non-tradables sector is higher at home than abroad, then the real exchange rate based on value added deflators will appreciate relative to that based on unit labor costs in manufacturing. This happens because a higher productivity differential between traded and non-traded goods causes higher wage and price increases in the non-traded goods sector, and hence an appreciation of R^V. Equations (4), (6) and (7) present different definitions of the real exchange rate: the relative GDP deflators and the relative unit labor costs in manufacturing, expressed in common currency, and the relative price of tradables in terms of non-tradables. Together with (8) these relations highlight various factors that can account for the different behavior of these measures of real exchange rates.

III. Stylized Facts

Before turning to empirical analysis, it is useful to review some stylized facts in the data. As we mentioned, we take manufactured goods, excluding construction, as tradables, and services as non-tradables. This classification is often used in the literature. An alternative approach (for example, Hsieh (1982)) is to identify some appropriate notion of traded goods and then take the residual value added as non traded. This approach has the obvious advantage of complete coverage of the value added. We have preferred the former, however, because it allows a more accurate measure of productivity in services, a very important variable in our analysis, and because our approach excludes agricultural prices that are heavily distorted. As stated in the previous section, we have focussed on GDP deflators rather than consumer price indices, because the latter are influenced also by import prices.

1. Relative price tradables/nontradables

As can be seen in Table 1 and Chart 3, during the eighties the relative price of manufactures in terms of services fell considerably in Belgium, Italy, Spain and the UK, while it was stable or rising in Denmark, France, Germany and the Netherlands. During the sixties and the seventies the relative price of manufactured goods in terms of services shows instead a clear declining trend in all countries. The average inflation differential between the manufactures' and the services' sector between 1961 and 1980 varies between a minimum of 2 percent in Germany and a maximum of 3.5 percent in the Netherlands. This trend stops in "core" countries during the eighties (the inflation differential even changes sign in Denmark, Germany and the Netherlands), while it continues unabated in Italy, Spain and the United Kingdom.

2. Productivity

Data on productivity growth rates across countries and sectors are presented in Table 2. In the 1980s, labor productivity growth in manufacturing outstripped that of services by more than two and a half percentage points in Belgium, Italy, Spain and the United Kingdom. In Italy, the average growth rate of productivity in manufacturing was one of the highest among the countries in our sample, while productivity in services was the second lowest. Productivity growth differentials between manufactured goods and services were much lower (or negative) in Denmark, France, Germany and the Netherlands. Interestingly, productivity growth in manufacturing slowed down in the eighties with respect to the seventies for all countries except the United Kingdom. This slowdown is particularly large in Denmark and the Netherlands (more than 3%). These two countries, as well as France, showed rapid productivity growth in manufacturing in the sixties and seventies, with large differentials in productivity growth rates between manufacturing and services.

Table 1. Price Increases in EC Countries, 1961-90
(Value added deflators, Average yearly percentage changes)

Countries	1961-70	1971-80	1980-90	1987-90
		Total VA Deflator		
Belgium	3.4	7.1	4.4	2.8
Denmark	5.9	9.7	5.7	3.6
France	4.4	9.5	6.3	3.0
Germany	3.8	5.2	2.9	2.4
Italy	4.9	15.5	10.1	5.9
The Netherlands	5.2	7.6	2.3	1.5
Spain	6.4	15.2	9.5	6.5
United Kingdom	4.2	14.0	6.3	6.3
EC	4.7	11.3	6.1	4.2
Standard dev.	3.8	22.5	25.8	9.3
		VA Manufacturing		
Belgium	1.7	3.9	2.7	0.9
Denmark	-	8.1	6.2	4.3
France	3.6	8.5	6.2	2.3
Germany	2.1	4.2	3.1	2.2
Italy	3.1	13.4	7.8	3.7
The Netherlands	2.5	5.8	2.5	0.1
Spain	-	-	7.6	4.1
United Kingdom	2.2	13.4	4.8	3.2
		VA Services		
Belgium	3.8	8.3	5.0	2.9
Denmark	-	9.8	5.9	3.6
France	5.9	10.4	6.8	3.7
Germany	4.3	6.2	2.0	0.5
Italy	5.6	16.1	11.3	7.0
The Netherlands	7.0	8.4	2.3	1.9
Spain	-	16.3	10.0	7.3
United Kingdom	5.6	14.2	7.3	7.0

Table 2. Labor Productivity, 1961-90
(Average yearly percentage changes)

Countries	1961-70	1971-80	1981-90	1987-90
		Total		
Belgium	4.3	3.2	1.8	2.4
Denmark	3.9	1.6	1.6	1.2
France	4.9	3.2	2.2	2.5
Germany	4.0	2.6	1.7	2.4
Italy	6.1	2.6	1.7	2.6
The Netherlands	3.9	2.7	1.4	1.2
Spain	6.7	4.2	1.8	1.2
United Kingdom	2.7	1.7	1.9	0.5
		Manufacturing		
Belgium	5.9	6.4	4.5	4.6
Denmark	-	4.2	0.7	0.3
France	7.1	3.9	2.9	3.3
Germany	4.3	3.2	2.0	2.9
Italy	6.5	4.8	4.1	4.1
The Netherlands	6.0	5.4	2.0	1.6
Spain	-	-	2.3	0.7
United Kingdom	3.1	1.4	4.9	3.7
		Services		
Belgium	3.1	1.7	0.9	1.5
Denmark	-	0.4	1.3	0.8
France	2.6	2.0	1.6	1.9
Germany	4.9	1.7	1.9	2.8
Italy	3.7	1.3	0.2	1.6
The Netherlands	2.4	1.8	0.9	0.6
Spain	-	-	-0.6	-2.6
United Kingdom	1.4	1.0	1.0	0.3

We must also consider the possibility that quality changes may not be appropriately accounted for in aggregate price indices, thus underestimating productivity growth.

3. Real exchange rates

In the EMS years GDP-deflator-based RERs show depreciation or stability, relative to the seventies, for the DM-area countries, France and the United Kingdom, appreciation for Italy and Spain (Chart 1 and Table 3). Manufactures-deflator-based RERs, on the other hand, show a strong depreciation for the Belgian Franc, appreciation for the Deutschemark (some 9 percent), relative stability for the other countries, with high variability for the United Kingdom (Chart 2).

For most countries, cumulative changes in the manufactures deflator-based RER were smaller than in the total deflator-based RER (Germany and Belgium stand as the exceptions).

4. Shares in value added and real trade developments

The observed changes in sector shares in value added and real trade balance can in principle offer a clue as to the real nature of observed changes in real exchange rates: one could argue, for example, that a constant or increasing share of manufacturing could be taken as evidence against overvaluation of a country's currency, and the same would be true for improving trade balances. However, the picture that emerges from the data is far from clear. As can be seen from table 4, the real share of manufacturing in total GDP in 1980-90 rose in Italy and fell in Spain, that were both apparently appreciating and experiencing a large decline in the relative price of manufactured goods. The share also rose in Belgium, where relative prices of manufactures declined, but fell in France (fairly stable real exchange rate and relative price of manufactures), Germany and Denmark (rising relative price of manufactures) and the Netherlands (real depreciation, falling relative price of manufactures after 1983). Germany, on the other hand, show a large improvement in its trade balance (Table 4), and so do Belgium, Denmark and the Netherlands; Italy and Spain show wider deficits.

In sum, while trade balance data would seem to confirm roughly the picture of real exchange rate changes described above, developments in sectoral shares would point to more complex interpretations.

Table 3. Real Exchange Rates of EC Countries (*)

Countries	1960-78 Mean	1960-78 Coeff. of Variation	1979-92 Mean	1979-92 Coeff. of Variation
		Global		
Belgium	105.3	0.05	92.2	0.10
Denmark	99.5	0.08	100.7	0.05
France	105.2	0.07	92.4	0.05
Germany	100.5	0.08	99.3	0.06
Italy	96.1	0.06	105.7	0.09
The Netherlands	97.3	0.13	103.9	0.06
Spain	92.7	0.08	110.7	0.11
United Kingdom	97.9	0.11	103.1	0.08
		Intra EC		
Belgium	105.7	0.05	91.7	0.07
Denmark	99.8	0.08	100.3	0.04
France	105.5	0.08	92.0	0.03
Germany	99.9	0.09	100.0	0.03
Italy	95.8	0.06	106.1	0.10
The Netherlands	97.6	0.13	103.6	0.04
Spain	92.8	0.07	110.5	0.09
United Kingdom	98.4	0.14	102.3	0.09
		Intra EC, Manufacturing		
Belgium	112.5	0.03	79.3	0.12
France	102.7	0.09	96.1	0.02
Germany	96.7	0.12	106.3	0.08
Italy	101.4	0.05	97.5	0.04
The Netherlands	98.1	0.07	103.8	0.06
United Kingdom	94.3	0.14	107.1	0.11

(*) Exchange rate indices with base 100 = average 1960-92.

Table 4. Shares of Manufacturing in Value added and Trade Balance

	1970 - 72		1979 - 82		1989 - 91	
	(A)	(B)	(A)	(B)	(A)	(B)
	Shares of manufacturing (value added) in GDP					
Belgium	33.2	19.4	26.4	20.4	24.8	22.0
Denmark	18.1	16.1	16.6	16.7	16.0	15.7
France	29.4	26.4	23.9	24.0	21.2	20.9
Germany	37.2	29.2	32.6	27.7	31.3	25.8
Italy	25.5	20.2	26.9	24.0	22.6	25.2
Netherlands	25.3	25.6	17.9	25.5	20.3	25.1
Spain	-	-	25.4	-	21.0	22.0
United Kingdom	32.9	29.1	25.2	23.7	21.6	23.1
	Trade balances, percentage ratios to GDP					
Belgium	0.7	0.3	-5.9	-4.6	-0.4	-0.5
Denmark	-5.0	-1.5	-3.6	-2.5	2.1	2.5
France	-0.4	-0.1	-2.5	-1.8	-2.9	-3.4
Germany	2.3	1.3	1.8	1.6	3.7	1.1
Italy	-1.0	-0.1	-3.5	-2.0	-1.2	-1.7
Netherlands	-5.2	-2.2	0.0	0.1	1.9	2.1
Spain	-5.6	-0.9	-5.6	-3.5	-6.6	-9.3
United Kingdom	-1.8	-0.4	-1.2	-0.8	-4.0	-5.2

(A) Current prices.
(B) Constant (1985) prices.

IV. Empirical Evidence

1. Real exchange rates based on GDP deflators

We first examine real effective exchange rates constructed using GDP deflators in a group of EC countries. We have used a "global" exchange rate, constructed with world trade weights, and a "EC" based on intra-EC trade weights. For reasons of data availability, the countries considered are: Belgium, Denmark, France, Germany, Italy, the Netherlands, Spain and the United Kingdom. A glance at Chart 1 suggests the existence of a high correlation between real exchange rate movements in Germany and those of the three small economies--Belgium, Denmark and the Netherlands, also in the period 1960-78.

Table 5 presents the correlation matrix between global real exchange rates at yearly frequency, both for the pre-EMS and the EMS period; Spain and the United Kingdom are also included, even though these two countries joined the exchange rate mechanism of the EMS only in 1990. In the pre-EMS period, the French franc and the Italian Lira have a high negative correlation with the DM; for the French franc this becomes positive during the EMS period (0.74). For the Italian Lira the negative correlation drops from -0.74 to -0.15. The correlation with the German real exchange rate also increases in the EMS period for Belgium, Denmark and the United Kingdom, while it remained more or less constant for the Netherlands and Spain. The variability of real effective exchange rates at yearly frequency, measured with the coefficient of variation, 1/ fell during the EMS period for Denmark, France, Germany, the Netherlands and the United Kingdom; it increased for Italy, Belgium and Spain. The variability of inter-European real exchange rates shows similar behaviour.

We also performed a simple time-series analysis with the purpose of identifying trends and structural breaks in inter-European real exchange rates. For all countries we were unable to reject the null hypothesis that the real exchange rate follows a random walk, using standard Dickey-Fuller and Augmented Dickey-Fuller tests. This is a well-known result; one must however take into account that in such a short sample (1960-92) unit root tests have very limited power against alternative hypotheses with highly persistent autoregressive processes.

Visual inspection suggests a change in behavior since the inception of the EMS in 1979. Following Perron (1989) (see also Campbell and Perron 1991) we allowed for a possible structural break, in the form of a change in the intercept, following the inception of the EMS. 2/ At the 5 percent confidence level, we were able to reject the random walk hypothesis only for

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1/ We focus on the coefficient of variation, rather than he standard error, because there are differences in the mean of the variables between the two subperiods.

2/ Test statistics and significance levels are tabulated in Perron (1989).

Table 5. Real Effective Exchange Rates Correlations

	Belgium	Denmark	France	Germany	Italy	Netherlands	Spain
			1960-78				
Denmark	0.810						
France	-0.487	-0.694					
Germany	0.621	0.813	-0.885				
Italy	-0.874	-0.729	0.538	-0.746			
Netherlands	0.802	0.976	-0.775	0.827	-0.705		
Spain	0.630	0.876	-0.555	0.578	-0.444	0.854	
United Kingdom	-0.655	-0.895	0.797	-0.827	0.629	-0.941	-0.729
			1979-92				
Denmark	0.786						
France	0.901	0.575					
Germany	0.900	0.913	0.746				
Italy	-0.407	0.035	-0.563	-0.156			
Netherlands	0.870	0.600	0.869	0.815	-0.671		
Spain	0.508	0.593	0.267	0.571	0.453	0.176	
United Kingdom	-0.183	-0.320	0.313	-0.041	-0.273	0.212	0.187

two of the smaller "core" countries (Belgium and Denmark), and only for the intra-EC real exchange rate. 1/ Thus, the evidence of a break based on this simple time series analysis is weak.

2. Real exchange rates based on manufactured goods' prices

The analysis of the variability of intra-European real exchange rates based on manufacturing deflators for the pre-EMS and EMS periods yields results similar to those described above. Table 3 reports means and coefficients of variation for this real exchange rate measure for the periods 1960-78 and 1979-90. Interestingly, we find that in Italy the variability of this real exchange rate measure drops from 5.4 percent to 3.8 percent. Only for Belgium there is an increase in the variability of this real exchange rate measure. This suggests that the behaviour of services' prices may account for the increased volatility of the Lira real exchange rate during the 1980s. We also performed standard non-stationarity tests, allowing for the possibility of a structural break following the inception of the EMS. The results of the tests, not reported, can be summarized as follows. Only for Belgium can one reject the unit root in favor of a trend-stationary autoregressive specification with a break in 1980. For all the other countries the EMS dummy is insignificant at standard confidence levels. This evidence, admittedly based on tests with low power, seems to suggest that the impact of the EMS has mainly affected the relative price of tradable goods in each country.

3. Decomposition of real exchange rate changes

In order to disentangle the impact of changes in the relative price of tradables in each country from that of changes in tradables' prices across countries we have decomposed the changes in the real effective exchange rate (measured with aggregate GDP deflators) during the eighties into changes in the real exchange rate based on tradable goods' prices and changes in the relative price of tradable goods in the home country and "abroad", based on equation (6). The results are reported in Table 6. 2/ The fourth column of the Table ("residual") is the percentage change in the real exchange rate that is accounted for by changes in the relative price of manufactured goods in terms of services at home and abroad. 3/ As can be seen by comparing columns 1 and 4, the appreciation of the Italian Lira and the Spanish Peseta is explained almost entirely by changes in the relative price of manufactured goods in terms of services, rather than by changes in the relative price of manufactured goods across countries (RER based on

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1/ The EMS dummy is generally significant in first-difference regressions. Tests, not reported for reasons of space, are available from the authors.

2/ One should remember, here, that our definition of tradable goods (manufactured goods) and non tradable goods (services) are not exhaustive since the sum of the two sectors does not add up to total value added.

3/ The exchange rate index is constructed so that an increase in its value corresponds to an appreciation of the currency.

Table 6. Decomposition of Exchange Rate Changes
(Percentage terms, 1980-90)

	q (1)	e (2)	(p_T/p_T^*) (3)	residual (4)	(p_N/p_T) (5)	(p_N^*/p_T^*) (6)
Belgium						
intra-EC	-9.6	-3.2	-18.7	14.9	25.1	8.1
v. DM	-9.8	-21.6	-4.1	20.0	-	-10.0
Denmark						
intra-EC	6.3	-12.1	18.4	2.1	-3.0	9.5
v. DM	5.9	-19.0	34.5	1.0	-	-10.0
France						
intra-EC	-7.1	-16.1	17.1	-5.5	5.9	14.2
v. DM	-4.8	-30.9	35.6	1.6	-	-10.0
Germany						
intra-EC	-0.6	36.3	-19.9	-9.0	-3.0	18.9
v. DM	-	-	-	-	-	-
Italy						
intra-EC	28.6	-24.0	37.6	22.9	38.6	3.8
v. DM	25.2	-36.6	55.7	26.8	-	-10.0
Netherlands						
intra-EC	-8.5	20.1	-19.1	-6.4	-1.9	10.2
v. DM	-8.2	-2.9	-5.9	0.5	-	-10.0
Spain						
intra-EC	15.9	-20.9	28.1	14.3	24.6	9.6
v. DM	16.1	-37.5	53.5	21.0	-	-10.0
United Kingdom						
intra-EC	-6.8	-16.1	-0.2	11.3	26.3	9.6
v. DM	-5.6	-31.8	17.7	17.6	-	-10.0

Source: OECD
(1) Real exchange rate based on total value added deflator.
(2) Nominal exchange rate.
(3) Relative deflator of manufacturing.
(4) [1+(1)/100]/{[1+(2)/100]*[1+(3)/100]} - 1
(5) Relative deflator: non-tradables versus tradables, domestic.
(6) Relative deflator: non-tradables versus tradables, foreign.

manufactured goods' deflators). The large positive "residuals" for Belgium and the United Kingdom indicate that for both countries the large depreciation of the real exchange rate based on manufacturing deflators has been mitigated by changes in the relative price of manufactures in terms of services. In Germany the RER based on manufactures' deflators appreciated by over 9 percent, but this was offset by a sharp fall in the relative price of manufactured goods in terms of services abroad. 1/ Overall, the Table highlights the importance of domestic relative price developments for the evolution of real exchange rates. In the following section we focus directly on the relative price of traded goods and on productivity.

4. The relative price of tradable goods

It appears that a main reason of divergence between manufactures-deflator-based and GDP-deflator-based real exchange rate is the behaviour of the relative price of tradables versus non-tradables. 2/ For this reason, we first performed a simple time-series analysis of the relative price of tradable goods: for the whole sample (1961-90), one cannot reject the null hypothesis that the relative price p_T/p_N follows a random walk with a negative drift. Since the level series shows non stationarity, we focussed our attention on rates of change in this relative price over time.

According to equation (5), differences in productivity growth between the tradables and non-tradables sector will cause changes in the relative price of tradable goods. Following De Gregorio, Giovannini and Wolf (1993), we took into account two additional variables that may affect the behaviour of the relative price of tradable goods, namely the change in (GDP deflator) inflation and the GDP growth rate. The former variable is there to "capture" possible inertial factors that may cause inflation to decelerate more slowly in the non-tradables sector during a disinflation; it may also account for some of the effects of oil shocks--an increase in the price of oil raises overall inflation but has a stronger impact on the price of tradable goods. More generally, this variable can capture cyclical influences on the behaviour of the relative price of tradable goods. 3/ As for the GDP growth rate, if the elasticity of services' consumption with respect to income is larger than one, then high income growth would be associated with a more than proportional increase in the demand for nontradable goods, thus causing an increase in their relative price. 4/

1/ Giuseppe Tullio sguggested to us that the appreciation of the manufactures' deflator-based RER for Germany in the 1980s may be in part caused by quality changes, especially for capital goods.

2/ See also Kravis and Lipsey (1983), and De Gregorio, Giovannini and Wolf for evidence on OECD countries.

3/ The latter interpretation is consistent with Sommariva and Tullio (1987).

4/ Froot and Rogoff (1991) argue that government spending is an important determinant of the relative price of tradable goods since it falls mainly on non tradable goods, and present some empirical evidence in support of their view. De Gregorio, Giovannini and Krueger (1993) find instead little evidence

A shortcoming with using these variables is that they can hardly be taken as exogenous; on the other hand, we lacked appropriate instruments for instrumental variable correction. As these countries are relatively similar and highly integrated, it is possible that exogenous shocks hitting the EC may be responsible for common changes in the relative price of tradables. We ended up estimating single-country regressions with seemingly unrelated regressions (SUR) to allow for the covariance between error terms in the relative price equations. For each country, the regression equation is:

$$(\hat{p}^T_{it} - \hat{p}^N_{it}) = \beta_{0i}(\hat{H}^T_{it} - \hat{H}^N_{it}) + \beta_{1i} EMS + \beta_{2i}(\hat{P}^V_{it} - \hat{P}^V_{i,t-1}) + \beta_{3i} GROWTH_{it} + \epsilon_{it} \quad (10)$$

The variable EMS takes value equal to unity in the years 1979-90, and is introduced in order to capture potential effects of the nominal exchange rate regime on relative price developments. According to our simple accounting framework, the coefficient β_{0i} should be equal to unity. If inertial factors are present in the determination of non-tradables' prices the coefficient β_{2i} should have a positive sign; if the elasticity of demand for non-tradables with respect to income is larger than one, we would expect the coefficient β_{3i} to be negative.

The results are presented in Table 7. 1/ The coefficient of the productivity differential is significant for most countries, and has the right sign. It is, however, significantly smaller than one: indeed, it is higher than 0.5 only for the United Kingdom. For Italy and Belgium we find that the coefficient of the change in the inflation rate is significant and has a positive sign: this means that indeed when inflation slows down (accelerates) the inflation differential between the two sectors widens (shrinks). The coefficient is insignificant for Denmark, France, Germany and the Netherlands, and has a negative sign for the United Kingdom.

Higher growth rates are associated with a widening inflation differential between tradable and nontradable goods in Belgium, Denmark and especially the Netherlands. The EMS dummy is significant and positive for Belgium, Germany and France. In this last case, the dummy takes the value of one from 1983 onwards, which implies that the rate of decline of the relative price of tradable goods slowed during the EMS period. There is instead some evidence of an *acceleration* in the decline of the relative price of tradable goods in Italy, while for the remaining countries the dummy is insignificant. The country-specific constants are significant and

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of an impact of government spending on the relative price of tradables. See also Dornbusch (1991).

1/ The SUR regressions were also performed for a longer time period (1961-90) excluding Denmark (for which productivity data are available starting 1966). Results were in line with those presented in Table 7.

Table 7. Determinants of Relative Price Changes
Dependent Variable: Relative Price of Manufactures in Terms of Services (Rates of Change)
1966-1990, Seemingly Unrelated Regressions (t-statistics in parenthesis)

	Constant	Prod. diff.	EMS	Inflation	Growth	$\bar{R}^2$
Belgium	-2.13 (-2.32)**	-0.33 (-2.33)**	1.15 (1.35)			0.07
	-2.65 (-3.21)**	-0.22 (-1.62)	1.21 (1.59)	0.66 (3.72)**		0.25
	-3.93 (-4.13)**	-0.17 (-1.36)	1.70 (2.24)**	0.73 (4.37)**	0.29 (1.77)*	0.28
Denmark	-1.35 (-2.14)**	-0.26 (-2.46)**	1.54 (1.90)*			0.35
	-1.26 (-2.00)**	-0.26 (-2.46)**	1.36 (1.66)*	-0.13 (-0.55)		0.32
	-0.77 (0.81)	-0.41 (-3.86)**	0.32 (0.37)	-0.30 (-1.36)	-0.51(-2.70)**	0.40
France	-1.74 (-3.67)**	-0.30 (-2.73)**	2.00 (3.73)**			0.30
	-1.41 (-2.70)**	-0.35 (-2.64)**	1.18 (1.83)*	-0.289(-1.41)		0.35
	-0.77 (-1.18)	-0.32 (-1.97)**	0.89 (1.41)	-0.238(-1.07)	-0.19(-0.95)	0.33
Germany	-1.64 (-3.15)**	-0.17 (-1.39)	2.26 (3.18)**			0.32
	-1.41 (-2.70)**	-0.31 (-2.48)**	2.01 (2.84)**	-0.22 (-0.90)		0.27
	-1.46 (-2.09)**	-0.37 (-2.45)**	1.95 (2.74)**	-0.20 (-0.68)	0.04 (0.27)	0.23
Italy	-1.65 (-2.27)**	0.01 (0.10)	-1.83 (-2.12)**			0.09
	-1.85 (-2.60)**	0.01 (0.08)	-1.51 (-1.77)*	0.29 (2.00)**		0.16
	-1.11 (0.27)	0.14 (0.90)	-1.98 (-2.14)**	0.41 (2.57)**	-0.30(-1.27)	0.08
Netherlands	-2.50 (-1.41)	-0.45 (-1.69)*	3.26 (1.67)*			0.27
	-2.53 (-1.44)	-0.46 (-1.70)*	3.35 (1.70)*	0.29 (0.04)		0.23
	0.87 (0.50)	0.57 (0.21)	2.17 (1.31)	0.49 (1.03)	-1.31(-3.74)**	0.43
UK	-1.02 (-1.54)	-0.43 (-3.02)**				0.16
	-1.54 (0.91)	-0.65 (-4.22)**		-0.41 (-3.49)**		0.30
	0.23 (0.31)	-0.57 (-3.26)**		-0.42 (-3.40)**	-0.40(-1.73)*	0.24

* Significant at the 10% confidence level.
** Significant at the 5% confidence level.

negative for Belgium, Germany and Italy, indicating a trend depreciation which is unaccounted for by productivity developments.

Overall, the empirical evidence confirms the importance of productivity differentials in explaining the behaviour of the relative price of traded goods. At yearly frequency, however, productivity differentials are not reflected one-to-one into changes in the relative price of tradable goods, as our accounting model would suggest. Indeed, if we constrain the coefficient on productivity growth differentials to be equal across countries, it takes the value 0.26 and is highly significant (regression not reported). Furthermore, for some countries there is a significant drift term in the relative price of tradable goods that is unrelated to productivity. One possible explanation is that our results are contaminated by short-run demand effects, not captured by the growth and change in inflation variables.

In order to focus more clearly on the long run determinants of the relative price of tradable goods we also plotted took the (average) inflation and productivity growth differentials between manufactured goods and services over 10-year periods (1961-70, 1971-80 and 1981-90; see Chart 4); the 45 degree line is also shown in the Chart. The scatter plot seems to show a high correlation between inflation and productivity differentials over the long term. For the case of Italy, for example, the average productivity growth differential over each decade is very close to the average inflation differential, even though at yearly frequency productivity growth differentials do not "explain" inflation differentials very well. Using pooled data on decade-long averages, we regressed the average change in the relative price of traded goods on the average productivity differential, average growth rates and a dummy for the 1980s. The results are reported below (t-statistics in parenthesis):

$$\underset{}{\hat{p}_{it}^{T} - \hat{p}_{it}^{N}} = \underset{(-5.4)}{-0.7}(\hat{H}_{it}^{T} - \hat{H}_{it}^{N}) \underset{(-2.36)}{-0.23}\, GROWTH + \underset{(2.36)}{0.706}\, DUM80 \qquad (11)$$

$$R^2 = 0.76$$

As can be seen, the coefficient of productivity differentials is higher than in the SUR regressions; also, the coefficient on growth is significant, and so is the dummy for the 1980s, indicating a slowdown or reversal in the decline of the relative price of tradable goods. Analogous results are obtained if one replaces the 1980s dummy with an EMS dummy. 1/ Overall,

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1/ The difference between the two dummies is the value of the coefficient for Spain and the UK, which did not belong to the EMS until 1990. Focussing on a larger sample of countries may allow to establish whether the change in relative price developments during the last decade is exclusively a feature of EMS countries.

the evidence is consistent with a large long-run impact of productivity differentials on sectoral inflation differentials. There is also some evidence that countries that grow faster tend to have higher intersectoral inflation differentials, and that the 1980s were characterized by a

reduction in inflation differentials between sectors, even after controlling for productivity developments and growth. 1/

5. Unit labor costs and productivity differentials

The evidence in the previous sections seems to confirm that relative price changes and productivity differentials can account for a good deal of the observed divergence between different real exchange rate measures. We now want to examine the behaviour of the real exchange rate based on unit labor costs in manufacturing (see Chart 5). For Italy, this measure of the real exchange rate shows a less pronounced appreciation than the real exchange rate based on the aggregate GDP deflator. Our theoretical framework of Section II suggests that productivity differentials between tradables and nontradables may account for this difference in behavior. For each country, we regressed the change in the real exchange rate measured with the aggregate GDP deflators on the change of the real exchange rate measured with unit labor costs in manufacturing and on the productivity growth differential between sectors at home and "abroad":

$$\hat{R}^{V}_{it} = \beta_{0i}\hat{R}^{ULC}_{it} + \beta_{1i}(\hat{H}^{T}_{it} - \hat{H}^{N}_{it}) + \beta_{2i}(\hat{H}^{T*}_{it} - \hat{H}^{N*}_{it}) \qquad (12)$$

With this regression we try to determine what fraction of the difference between the dynamic behaviour of R^V and R^{ULC} can be "explained" by productivity differentials. A similar approach was followed by earlier studies on the impact of productivity differentials and relative price changes on real exchange rate behaviour, such as Hsieh (1982) and Marston (1987). 2/ The productivity differentials for the "foreign" country were constructed with the same weights used for the construction of the real exchange rate. The sample we consider is shorter (1970-90) because of data availability. Our simple model would imply that β_{0i} is equal to unity and that the coefficients on the productivity differentials, in absolute terms, are equal to the shares of nontradable goods in value added (see equation (9)).

1/ De Gregorio, Giovannini and Wolf (1993) using a sample with more countries, find that the average productivity growth differential over the period 1970-85 has a coefficient insignificantly different from unity in a cross-section regression. They also find that growth is insignificant.

2/ Hsieh defines non tradables as the GDP complement to manufacturing.

CHART 4
Relative prices and productivity
average change, 1961-70, 1971-80, 1981-90

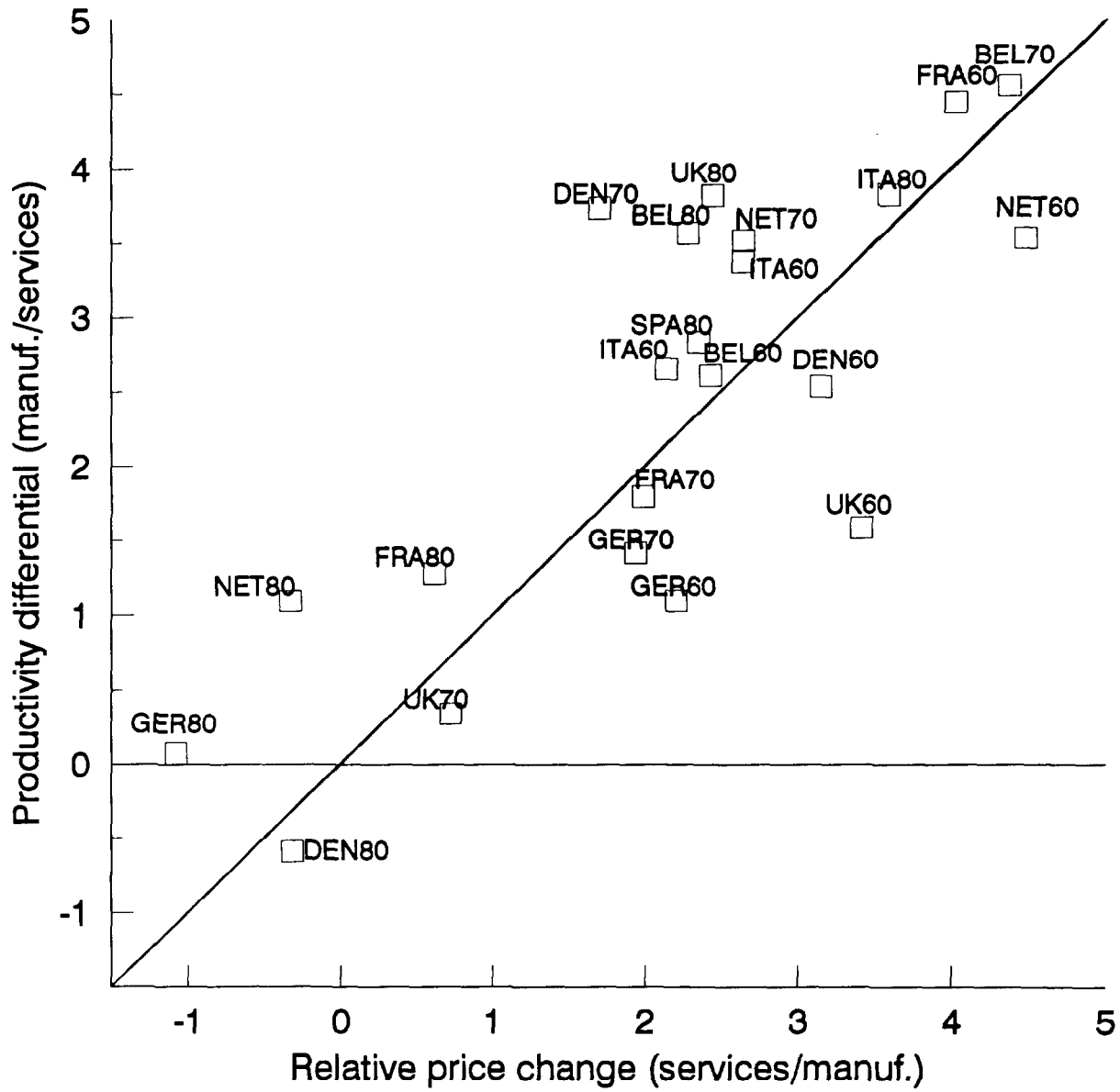
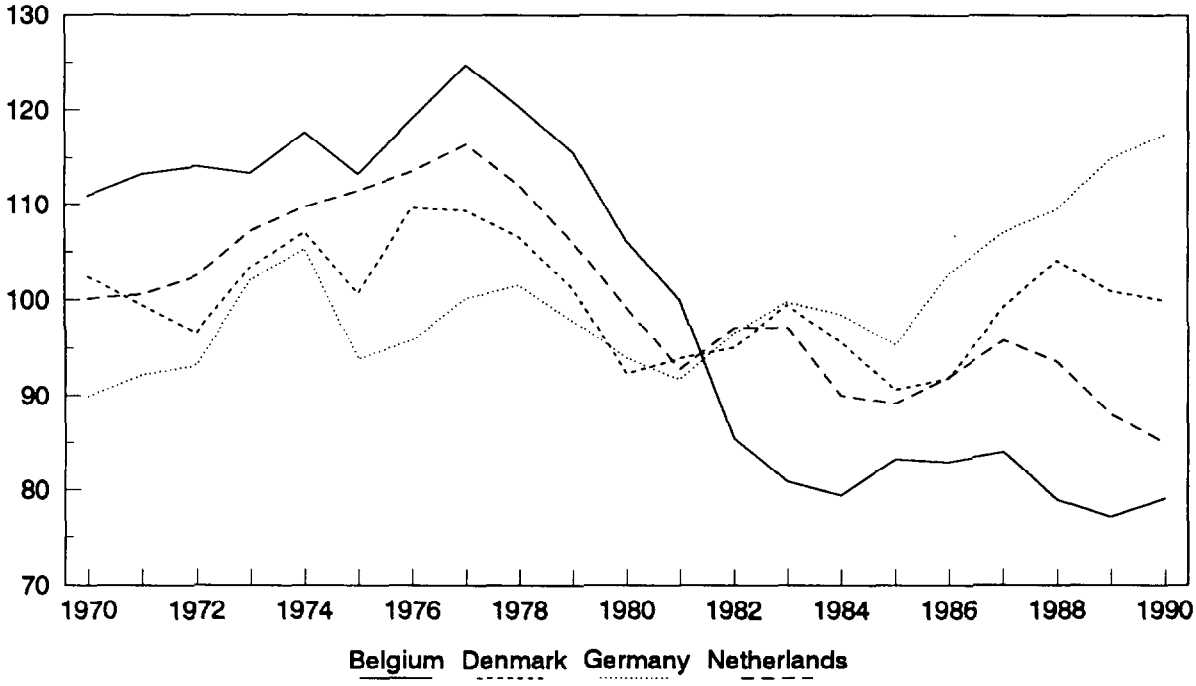
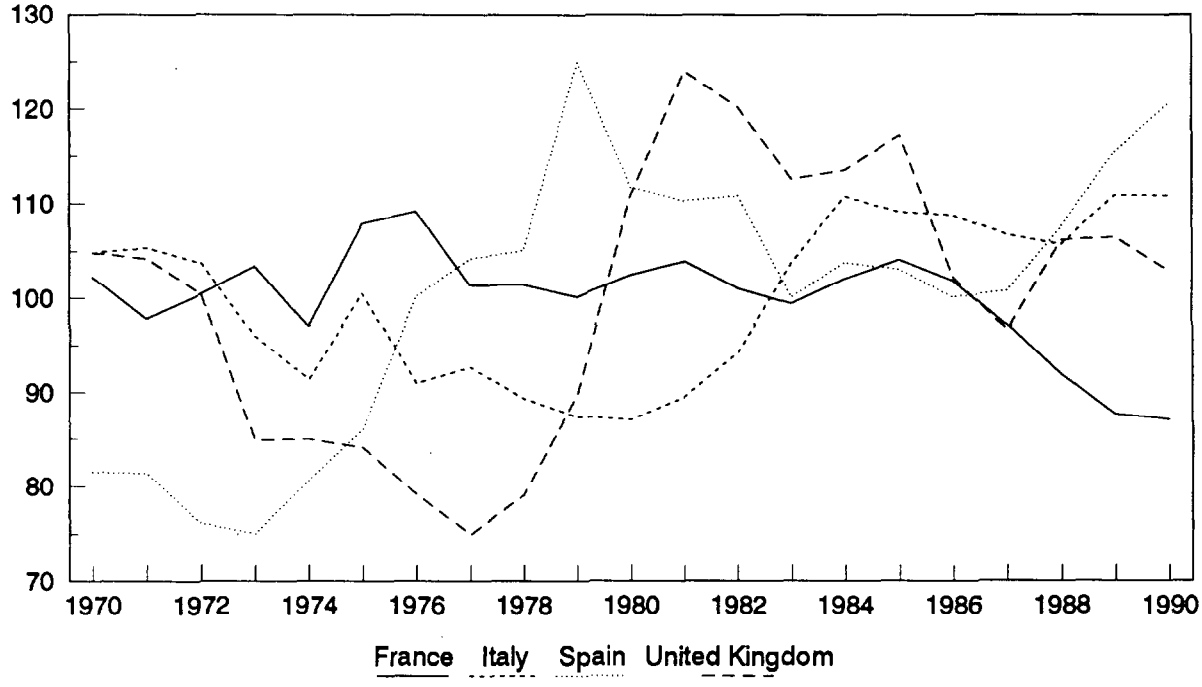


CHART 5

Real inter-EC exchange rate (unit labour costs in manufacturing)
(avg 1970-90 = 100)





The results are presented in Table 8; for reference, Table 2 shows labor productivity growth rates in the manufactures and services sectors. The point estimate for the coefficient β_{0i} is smaller than one for all countries; consistently with the results obtained in the studies by Hsieh and Marston. A larger differential in productivity growth rates between manufactures and services should cause the real exchange rate based on GDP deflators to appreciate with respect to the one based on unit labor costs in manufacturing because it raises wage inflation in the non-tradable goods sector. For most countries, results are consistent with the theory. The exception is Denmark, where productivity differentials do not explain the different behaviour of the two deflators. Overall, Table 8 highlights the important role of productivity developments in explaining divergences between different real exchange rate indicators.

V. Concluding Remarks

This paper has highlighted some interesting facts in the behavior of various real exchange rate indicators in countries belonging to the European Community, and provided some evidence on the role of productivity in driving real exchange rate developments in EEC countries, especially in the longer run. Differences in productivity growth rates between manufactures and services and between countries help explain real exchange rate behaviour and account for the "puzzle" of the different behaviour of different real exchange rate measures. The behavior of relative prices seem to have been affected by the exchange rate regime, at least in some of the countries, although the channel through which this occurred is unclear. We also provided some evidence of inertial factors in the non traded goods sector (widening inflation differential between sectors when inflation falls and viceversa) in Belgium and in Italy.

Regarding productivity developments, we are unable to infer whether productivity growth was spurred by the exchange rate regime (the increases in productivity in the tradables sector were dictated by the need to remain competitive in the absence of any accommodation of higher inflation through devaluation) or whether productivity growth caused the appreciation of the real exchange rate, regardless of the exchange rate regime. In other words, an alternative explanation of our finding is that the discipline provided by a (semi-) fixed exchange rate has forced the manufacturing sectors of weak-currency countries into large restructuring and productivity increases. The fact that productivity growth in manufacturing in Italy did not accelerate during the EMS period (although productivity differentials widened) may be interpreted as supporting the "productivity to real exchange rate" nexus. However, the eighties were characterized by a generalized decline in productivity growth in industrialized economies. The widening of the productivity differential between tradables and nontradables in Italy may also suggest that the exchange rate regime and the Lira's appreciation have raised productivity in the manufacturing sector. 1/

1/ We are grateful to Paul de Grauwe for this suggestion.

Table 8. Real Exchange Rate Measures and Productivity Differentials, 1970-90
Dependent Variable: real effective exchange rate (rate of change)
(GDP deflators, EC weights*)

	R^{ULC}	Prod. differ.	For. prod. differ.	R^2
Belgium	0.698 (11.67)	0.40 (3.02)	-0.53 (-2.09)	0.89
Denmark	0.561 (5.17)	0.10 (0.73)	0.29 (1.60)	0.76
France	0.751 (9.98)	0.29 (1.24)	-0.24 (-1.47)	0.86
Germany	0.744 (10.80)	0.60 (3.52)	-0.60 (-3.90)	0.88
Italy	0.717 (8.88)	0.76 (6.12)	-1.10 (-4.42)	0.85
Netherlands	0.693 (7.18)	0.51 (3.22)	-0.05 (0.84)	0.78
United Kingdom	0.936 (12.90)	0.62 (2.67)	-0.62 (-2.30)	0.92

(*) Ordinary Least Squares, t-Statistics in brackets.

Appendix

Data Sources and Definitions

Gross Domestic Product: OECD, National Income Accounts.

Value Added and Deflators, Manufacturing and Services: OECD, National Income Accounts

Total Employment, Manufacturing and Services: OECD, National Income Accounts.

Total Income, Manufacturing and Services: OECD, National Income Accounts.

Exchange Rates: IMF, International Finance Statistics.

Exports and Imports: IMF, International Finance Statistics.

"Services" defined as "Market Services" (excluding Public Administration).

"Manufacturing" defined as Industry minus Construction.

"Unit Labor Costs in Manufacturing" defined as income per worker over unit of output per worker in the manufacturing sector.

The OECD series have been integrated with elaborations by the Centro Studi Confindustria, Rome.

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