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The Behavior of Nontradable Goods Prices in Europe: Evidence and Interpretation

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Abstract

This paper examines the evolution of the relative price between tradable and nontradable goods in a group of European countries. A model of an open economy is used to analyze different factors that can account for an increase in the relative price of nontradable goods. These factors are: (a) faster technological progress in the tradable goods sector; (b) demand shifts toward nontradable goods; and (c) real wage pressures. The relevance of these factors is analyzed empirically for France, Germany, Italy, Spain and the United Kingdom.

JEL Classification Nos.
F3, F4

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Contents

I. Introduction

The recent disruptions in the Exchange Rate Mechanism (ERM) of the European Monetary System (EMS) have raised questions about the feasibility of a strategy for monetary union based on gradualism and convergence of inflation rates and of other macroeconomic indicators. Indeed, one of the main problems that several European countries are facing is the achievement of inflation convergence: persistent inflation differentials continue to be among the major economic concerns in Europe.

In particular, countries experiencing a real appreciation (an increase in their price level relative to foreign price levels) have had persistent inflation differentials between nontradable and tradable goods. This phenomenon--the decline in the price of tradable goods relative to nontradable goods--may be caused by a number of factors, each of them leading to different implications for policy. The recent experience of European countries has also been subject of different interpretations. According to some observers the recent European experience is the result of exchange-rate misalignment, which in turn caused the crisis of the ERM. According to other observers, the evolution of the relative price of tradables and nontradables is the equilibrium response to shocks originating in the real sector of the economy and as such, do not warrant monetary policy interventions, let alone exchange-rate realignments.

This paper addresses the problem of identifying the causes of fluctuations of the relative price of tradable in terms of nontradable goods. It uses a model of an open economy to analyze the evidence on the five largest European economies: France, Germany, Italy, Spain, and the United Kingdom. The model is an extension of the classic two-sector economy in the Australian tradition, where labor is assumed to be the only input (see Salter (1959), Swan (1960), and the illustration in Dornbusch (1980)). The nontradable goods sector is imperfectly competitive with free entry. Spending and income of consumers are the outcome of a dynamic optimization problem.

A crucial role in the economy is played by the labor market, which transmits shocks to the real wage and the real exchange rate. We postulate a centralized bargaining arrangement, where unions act as monopolists by setting the wage rate, and employers decide the level of employment. The key element of this market is that the unions' target real wage and target level of employment are above the labor demand schedule. The target real wage could be determined, for example, by expectations of an unsustainable real exchange rate (Giovannini (1990)). 1/ We also allow for a government that finances spending on nontradable goods through lump-sum taxation.

1/ The real wage pressure could alternatively be generated, in the context of a disinflation, by staggered price setting and indexation, studied by Fischer (1977) and Taylor (1980).

The model points to several causes of the increase in the relative price of nontradables. 1/ They are: (a) faster technological progress (total factor productivity growth) in the traded goods sector; (b) demand shifts toward nontradable goods; and (c) real wage pressures. Each of these exogenous shocks has implications for labor productivity, the current account, and the sectoral composition of aggregate output.

Consistent with the Balassa-Samuelson hypothesis (Balassa (1964), and Samuelson (1964)), in our model technological progress in the tradable goods sector leads to an increase in labor demand, an increase in the real wage (due to demand pressures in the labor market), and as a result to an increase in the relative price of nontradable goods. In this case, average labor productivity and the share of the traded goods in total output increase.

A temporary increase in government purchases of nontraded goods leads to a temporary increase in total spending. As a result, employers in the tradable goods sector layoff workers, and average labor productivity increases. The increase in spending leads to a current account deficit and a reduction in the share of the tradable goods sector. Similar effects are caused by a shift in preferences of the private sector toward consuming more nontradable goods.

Finally, an increase in the target real wage leads to a worsening of the current account, a fall in the output of tradables, an increase in the average labor productivity in the tradable goods sector and in the relative price of nontradables.

We apply the model to the data, by analyzing the joint behavior of the current account, the relative price of nontradable goods, average labor productivity across sectors, government spending, and the sectoral composition of aggregate output. In addition we provide econometric evidence on the determinants of the real exchange rate. Our broad findings reveal that demand shifts in the private sector as well as faster productivity growth in the tradable goods sector were important factors underlying the appreciation of the real exchange rates in Europe. In addition, the slow adjustment of nontradable goods prices, interpreted in this paper as a lack of credibility that places pressure on target real wages, may have played an important role in France during the second half of the 1970s and early 1980s, in Italy since the late 1970s, and in Spain and the United Kingdom during the second half of the 1980s. In contrast, government expenditure does not appear to have played a major role, through its impact on the demand for nontradable goods, in the evolution of the real exchange rate.

The rest of the paper is divided into four sections. Section II illustrates the problem, and the striking trend of the relative price of

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1/ See also Froot and Rogoff (1991a).

nontradable goods in most of the European countries we analyze. Section III develops the theoretical framework. Section IV discusses the application of the model to the data. Finally, Section V contains a few concluding remarks.

II. The Evolution of Real Exchange Rates in Europe

This section compares the evolution of two alternative definitions of the real exchange rate in our set of countries. 1/ They are shown in Figure 1. The first measure of the real exchange rate, which will be the focus of the rest of the paper, corresponds to the relative price of tradable goods with respect to nontradable goods. The tradable goods sector is defined as industry and the nontradable goods sector as services. Although some sectors are not included (and in industry there are products that are not traded internationally as in services there are some traded goods) this simplification facilitates cross-country comparisons by providing homogeneity in the construction of the variables. We will denote this (internal) real exchange rate by q_1, defined by:

$$q_1 = \frac{p^T}{p^N},$$

where p^T and p^N are the value added deflators of tradable and nontradable goods, respectively.

The other, more conventional, measure of the real exchange rate is the ratio between the foreign price level and the domestic price level (the rest of the discussion normalizes the nominal exchange rate to one). To measure price levels we use GDP deflators. To compute the foreign price index we consider the five largest European economies (France, Germany, Italy, Spain and the UK). This index is computed as a geometric average of the other countries using the weights derived from the multilateral exchange rate model (MERM) (Artus and McGuirk (1981)). This index is denoted by q_2,

$$q_2 = \frac{p^*}{p},$$

where p^* is the foreign aggregate price and p is the domestic aggregate price. Note that a rise in the index indicates a depreciation of the real exchange rate.

An important difference between the two measures of the real exchange rate is that while q_1 can have the same trend across countries, the trends in q_2 have to offset worldwide. The reason is that q_1 measures a relative

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1/ See Lipschitz and McDonald (1991) for a discussion of different measures of real exchange rates and competitiveness.

price between two domestic goods and, in contrast, q_2 measures a relative price between domestic and foreign goods.

Two important features from Figure 1 are worth to note. First, the relative price between tradable and nontradable goods has a negative trend in France, and especially in Italy, Spain and the UK. In France, the decline between 1975 and 1990 is about 14 percent, in Italy 29 percent, in Spain 24 percent, and in the UK it is 28 percent. In Germany, the relative price of tradables declined slightly until 1984 and subsequently increased 4 percent until 1987. 1/

Second, in contrast to the evolution of the relative price of tradable with respect to nontradable goods, relative GDP deflators appear to display larger fluctuations and no clear long-run trend. In particular, the behavior of q_1 and q_2 in France, Germany and the UK are quite different. In France, for example, the relative GDP deflators shows an upward trend, i.e., a real depreciation. Nevertheless, the two measures of the real exchange rate exhibit similar patterns in Italy and Spain.

To explain the remarkable differences between the two measures of the real exchange rate it is useful to show the relationship between them. Since aggregate prices are an average of tradable and nontradable goods we have that:

$$p = p^{N\gamma} p^{T(1-\gamma)} \tag{1}$$

and

$$p^* = p^{N*\gamma^*} p^{T*(1-\gamma^*)} . \tag{2}$$

Assuming the same weights for tradable and nontradable goods across countries ($\gamma=\gamma^*$), it is easy to show that the relationship between the two measures of the real exchange rate is given by:

$$\log q_2 = \gamma(\log q_1 - \log q_1^*) + \log \frac{p^{T*}}{p^T} .$$

As equation (3) shows, an increase in q_1 will result also in an increase in q_2 as long as q^*_1 and the ratio p^{T*}/p^T do not change too much. However, if the relative price of tradable goods in the home country declines less than the relative price of tradable goods in the foreign country a real appreciation in q_1 could occur simultaneously with a real depreciation in

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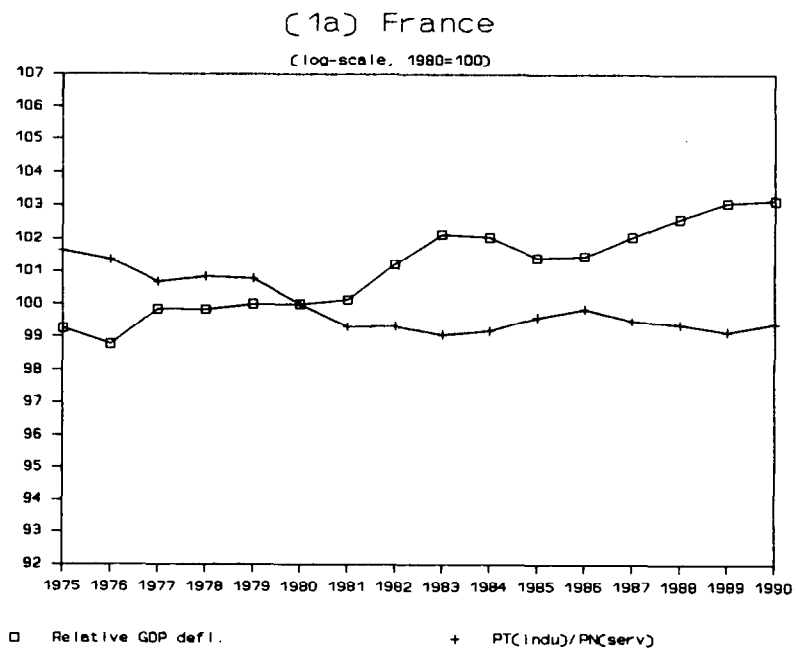
1/ Between 1968, the first year for which data for Germany were available, and 1990 the relative price of tradeable goods had declined by 12 percent less. Most of this decline occurred during 1968 and 1976.

Figure 1: Real Exchange Rates



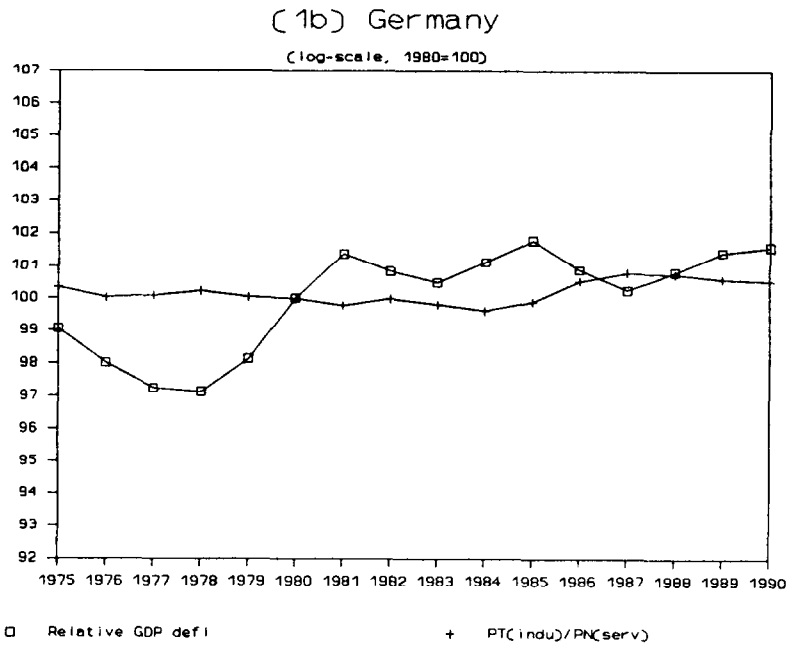
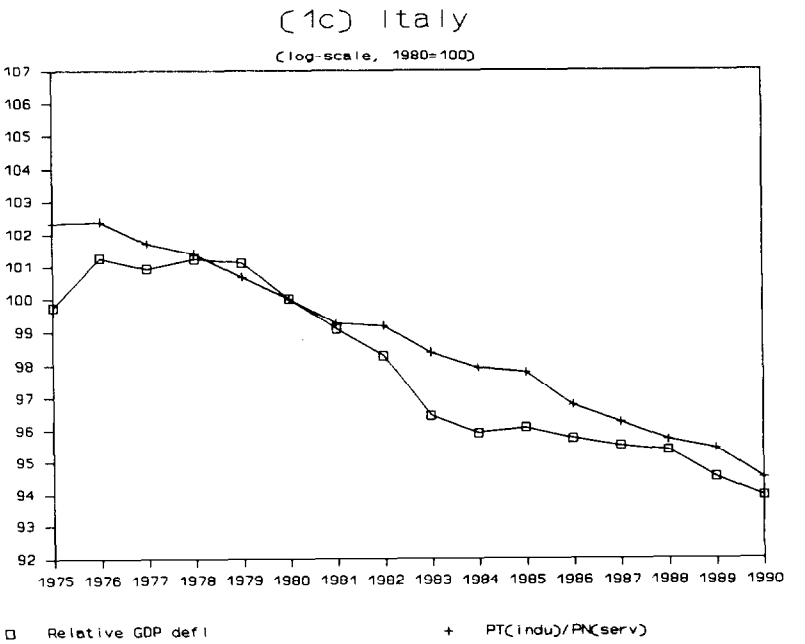


Figure 1 (contd.): Real Exchange Rates



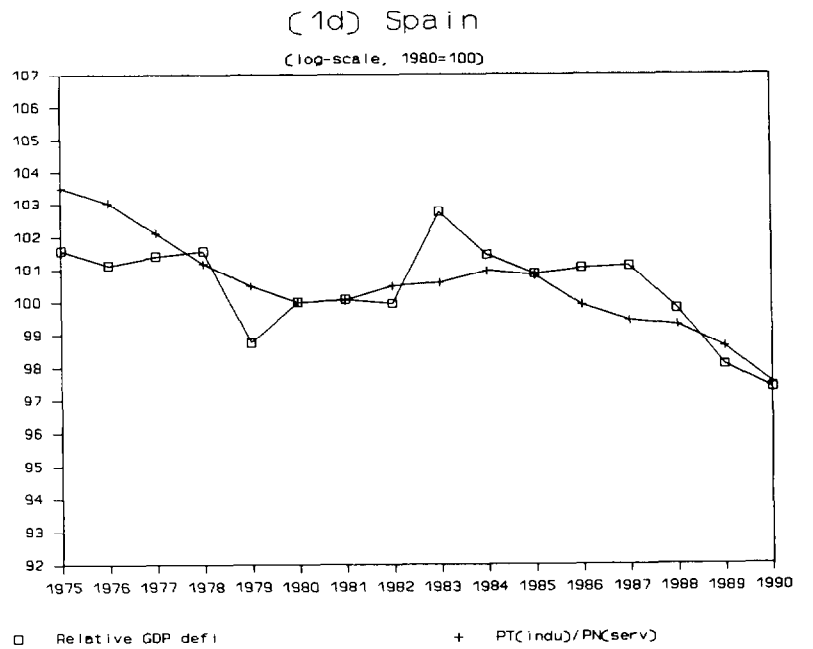
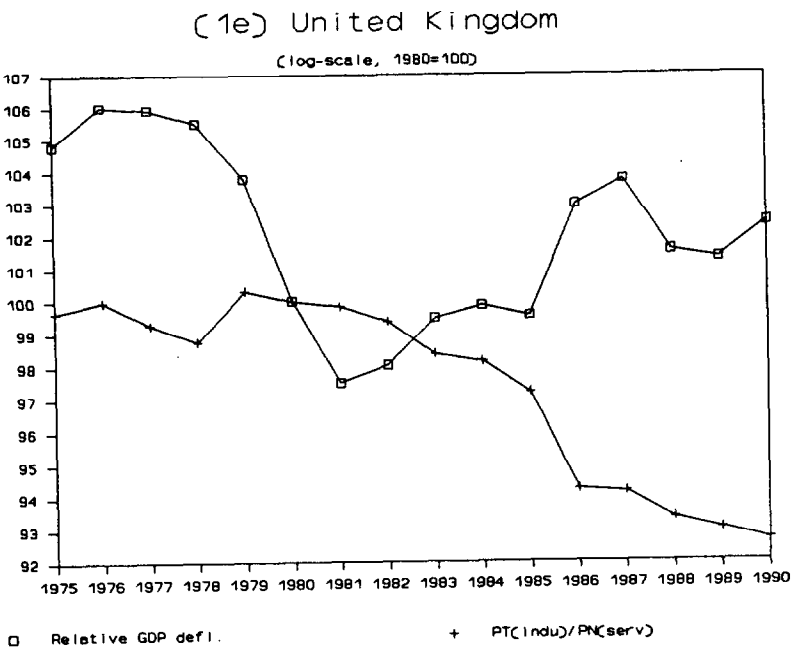


Figure 1 (contd.): Real Exchange Rates



q_2. This seems to be the case in France and Germany, where the large fall in q_1^* (Italy, Spain, and the UK) dominates the fluctuations in the domestic relative price between tradable and nontradable goods. In contrast, the similar patterns of q_1 and q_2 in Italy and Spain (at least from a long run point of view) show that the large real appreciation experienced by q_1 in those countries is not offset by the other terms in the right hand side of (3).

In addition, equation (3) indicates that changes in the terms of trade, p^{T*}/p^T, could also be responsible for a negative relationship between q_1 and q_2. For example, a real appreciation in domestic tradable prices (i.e., a rise in q_1) could occur simultaneously with a fall in q_2 if there were a strong rise in the terms of trade (decline in p^{T*}/p^T). Those changes in the terms of trade could occur because of a failure in the law of one price, or because the composition of tradable goods is different across countries. This is perhaps the case for the UK, where since 1981 q_1 and q_2 have displayed remarkable differences.

Overall, we can conclude that the relative price of tradable goods with respect to nontradable goods has exhibited, broadly, a downward trend. That is, the rate of inflation of nontradable goods prices has been larger than that of tradable goods prices. The magnitude of this inflation differential across countries is, however, very different, and thus may have contributed to the different behavior of measures of the external real exchange rate, such as q_2. The rest of our discussion will focus on explaining the sources of the internal relative inflation differential.

III. A Model of the Real Exchange Rate

To discuss the comovements of relative prices, wages, and the external sector it is useful to set up a simple two-sector model of an open economy. The model is intertemporal to discuss the behavior of the current account 1/ and, for tractability, we assume that the economy lasts for two periods. The model economy studied here is characterized by non-competitive goods and labor markets. In particular, we assume that while the tradable goods sector takes international prices as given, the nontradable goods sector is monopolistically competitive similar to Dixit and Stiglitz (1977). 2/ In the labor market, in turn, we postulate a centralized bargaining arrangement between employers in the two sectors and trade unions.

1/ See, for example, Dornbusch (1983), Cuddington and Viñals (1986), Frenkel and Razin (1992), Ostry (1988), Edwards (1989), and Froot and Rogoff (1991a).

2/ Our formulation of the utility function is, however, closer to that of Blanchard and Kiyotaki (1987). See also Aizenman (1989) for a model of a small open economy with imperfect competition and sticky prices.

1. Income, Spending and the Current Account

The representative consumer solves the following maximization problem:

$$\max_{\{c_t^T,\, c_t^N\}_{t=1}^{2}} \log\left[c_1^{T(1-\phi)}\, c_1^{N\phi}\right] + \beta \log\left[c_2^{T(1-\phi)}\, c_2^{N\phi}\right] \tag{4}$$

subject to:

$$p_1^T c_1^T + p_1^N c_1^N + \frac{p_2^T}{1+r} c_2^T + \frac{p_2^N}{1+r} c_2^N = E. \tag{5}$$

The notation of the problem (4)-(5) is straightforward. The consumer derives utility from the consumption of a basket of nontraded goods (c^N) and of a single traded good (c^T). He faces a budget constraint that limits the present discounted value (at the world interest rate r) of his consumption to his wealth (E). For simplicity, the representative consumer holds initially no financial assets and his wealth equals the present discounted value of income derived from the production in the two sectors (which is the value of output in the absence of intermediate inputs), minus the present discounted value of taxes: 1/

$$E = p_1^T y_1^T + p_1^n y_1^N + \frac{p_2^T}{1+r} y_2^T + \frac{p_2^n}{1+r} y_2^N - \tau_1 - \frac{\tau_2}{1+r}. \tag{6}$$

The familiar first-order conditions for this maximization problem describe the optimal intratemporal and intertemporal consumption choices:

$$\frac{c_2^T}{c_1^T} = \beta(1+r)\frac{p_1^T}{p_2^T}, \tag{7}$$

$$\phi p_t^T c_t^T = (1-\phi) p_t^N c_t^N, \qquad \forall t = 1,2. \tag{8}$$

The government uses tax revenues to finance spending on nontradable goods. In this setup Ricardian equivalence holds, so debt policies and the timing of taxes do not matter, and we shall assume that the budget is

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1/ As will be clear later, the average producer price (p^n) differs from the consumer price (p^N), because the price paid by private consumers is not the same as the price paid by the government. This assumption facilitates the algebra without changing the main results of the model.

balanced on a period-by-period basis. Hence, equilibrium in the market for nontraded goods and the government budget constraint imply:

$$p_1^n y_1^N = p_1^N c_1^N + \tau_1, \tag{9}$$

$$p_2^n y_2^N = p_2^N c_2^N + \tau_2. \tag{10}$$

Substituting these equations into (5) and (6) we obtain the condition that the present discounted value of tradable consumption equals the present discounted value of tradable production. With logarithmic preferences, however, the present discounted value of tradable consumption equals $(1-\phi)$ times wealth. Hence we can find a convenient expression for total wealth in terms of tradable goods output:

$$E = \frac{1}{1-\phi}\left[p_1^T y_1^T + \frac{1}{1+r} p_2^T y_2^T\right].$$

Call the present-discounted value of tradable production Y^T:

$$Y^T = p_1^T y_1^T + \frac{1}{1+r} p_2^T y_2^T. \tag{11}$$

The Euler equation can be used to derive the value of total spending for each period:

$$I_1 = \frac{E}{1+\beta} = \frac{Y^T}{(1-\phi)(1+\beta)}, \tag{12}$$

$$I_2 = \frac{E\,\beta(1+r)}{1+\beta} = \frac{Y^T\,\beta(1+r)}{(1-\phi)(1+\beta)}. \tag{13}$$

In this model, the current account balance in the first period is equal to the excess supply of tradable goods (there is no initial stock of external assets or liabilities). Since tradable consumption is a fraction $(1-\phi)$ of total consumption, we have:

$$c_1^T = \frac{Y^T}{p_1^T(1+\beta)}.$$

The first-period current account balance in terms of the tradable good is thus:

$$y_1^T - c_1^T = \frac{\beta}{1+\beta}\left[y_1^T + \frac{p_2^T}{p_1^T}\,\frac{1}{1+r}\,y_2^T\right]. \tag{14}$$

If the price of tradable goods, which is determined exogenously, does not change over the two periods, and if the utility discount rate equals the world interest rate, the balance of the current account in the first period is determined exclusively by the difference in the level of output of tradable goods in the two periods.

2. Firms and Goods Markets

As pointed out above, the nontraded goods sector is monopolistically competitive. To describe the determination of equilibrium prices, we need more detail on the decision problem of the representative consumer. Note that with a utility function as described in equation (4), the consumer's two-period problem can be separated into two stages. First, the consumer allocates wealth between the two periods, and, second, the wealth apportioned to a single period is allocated among the different consumption goods. This section focusses on the last problem, the intra-period allocation. For convenience, we shall omit time subscripts whenever they are inessential.

The consumption bundle of nontradables described in the previous section consists of different nontradable goods. The optimal composition of the consumption bundle is the solution to the following problem:

$$\min_{\{c^N(i)\}_{i=1}^n} \sum_{i=1}^n c^N(i)\, p^N(i) \tag{15}$$

subject to:

$$c^N = \left[n^{-\frac{1}{\theta}} \sum_{i=1}^n c^N(i)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}} \geq \bar{c}^N. \tag{16}$$

The solution of the joint problem (4)-(5) and (15)-(16) leads to the following demand functions:

$$c^N(i) = \frac{\phi I}{n\, p^N}\left(\frac{p^N(i)}{p^N}\right)^{-\theta}, \tag{17}$$

where:

$$p^N \equiv \left[\frac{1}{n}\sum_{i=1}^{n} p^N(i)^{1-\theta}\right]^{\frac{1}{1-\theta}}. \tag{18}$$

The production function for a single firm that produces $y^N(i)$ units of the nontraded good i employing $\ell^N(i)$ units of labor is:

$$y^N(i) = a_N\left(\ell^N(i) - F\right), \quad \ell^N \geq F. \tag{19}$$

As is well known, the presence of the fixed cost, $a_N F$ in terms of labor inputs, insures that each variety is produced by a single firm and that the total number of varieties produced in equilibrium, equal to the number of firms, is finite. Each firm behaves as a monopolist in its own sector. We assume that it does not take into account government demand when setting prices, because government demand is price inelastic. It is assumed instead that sales to the government are priced at marginal cost. Furthermore, firms take wages as given and do not incorporate the spillover effects on prices charged by other companies. With these assumptions, the familiar markup formula implies the following pricing condition for the private sector:

$$p^N(i) = \frac{\theta}{\theta - 1}\,\frac{W}{a_N}, \tag{20}$$

where W is the nominal wage rate. Since the problem is identical for all firms, all goods prices in the nontraded sector are identical and the aggregate nontraded goods price level, defined by equation (18), equals the price of the individual goods. Hence, from the private demand function for each nontradable good we have:

$$c^N(i) = \phi I\,\frac{\theta - 1}{\theta}\,\frac{a_N}{n W}.$$

Total private consumption is thus:

$$c^N = \phi I\,\frac{\theta - 1}{\theta}\,\frac{a_N}{W}.$$

The equilibrium number of firms is computed by setting profits equal to zero. Note that firms in this model allocate the entire overhead to private sales:

$$0 = \frac{W}{a_N}\left[\frac{\theta}{\theta - 1} - 1\right]\phi I\,\frac{\theta - 1}{\theta}\,\frac{a_N}{n W} - W F. \tag{21}$$

After some simplification we obtain:

$$0 = \frac{\phi I}{\theta n} - W F \quad \rightarrow \quad n = \frac{\phi I}{\theta W F}. \tag{22}$$

To compute equilibrium aggregate output of nontradable we have to sum private and government demand:

$$y^N = \frac{\phi Y^T}{p^N(1-\phi)(1+\beta)} + g.$$

Substituting for the equilibrium price yields:

$$y^N = \frac{\phi Y^T(\theta-1)a_N}{(1-\phi)\theta(1+\beta)W} + g. \tag{23}$$

In the tradable goods sector, we postulate a single firm, with a decreasing-returns technology. The production function is:

$$y^T = a_T \ell^{T\,\alpha}, \quad \alpha < 1. \tag{24}$$

The price of the tradable good is given exogenously. Setting the marginal productivity of labor equal to the product wage, we obtain the equilibrium output supply for tradable goods:

$$y^T = a_T^{\frac{1}{1-\alpha}} \left(\frac{\alpha p^T}{W}\right)^{\frac{\alpha}{1-\alpha}}. \tag{25}$$

3. Labor Market

Aggregate labor demand is the sum of the demands for labor in the tradable and nontradable goods sectors (time subscripts are again omitted when they are not essential):

$$L^d = \ell^N + \ell^T = n\,\ell^N(i) + \ell^T. \tag{26}$$

Labor demand in the nontradable sector is obtained by substituting the expression for output (23), into the equation describing the production technology (19) and solving for ℓ^N:

$$\ell^N = \frac{\phi Y^T(\theta-1)}{(1-\phi)\theta(1+\beta)W} + \frac{g}{a_N} + n F.$$

Substituting for the equilibrium number of firms yields:

$$\ell^N = \frac{\phi\, Y^T}{(1-\phi)(1+\beta)W} + \frac{g}{a_N} \,. \tag{27}$$

In the tradable goods sector, labor demand is obtained by substituting the optimal output supply into the production function, and solving:

$$\ell^T = \left[\frac{\alpha\, a_T\, p^T}{W}\right]^{\frac{1}{1-\alpha}} \,. \tag{28}$$

The labor demand function in the tradable goods sector is decreasing in W and increasing in a_T. The comparative statics of the labor demand for the nontradable sector will be discussed below after we specify the wage bargaining process.

We consider wages as being determined by a centralized labor union. The labor union's objective is to minimize a quadratic loss function of the deviations of employment and real consumption wages from their targets. In turn, the level of employment is decided by firms according to their labor demand schedules. 1/ Hence, the union solves the following decision problem:

$$\min_{w} \; (L - \bar{L})^2 + \sigma\,(w - \bar{w})^2 \tag{29}$$

subject to:

$$L = L^d(w), \tag{30}$$

where w is the consumption based real wage. The parameters $\bar{L}$ and $\bar{w}$ are the union's target employment and real wage, respectively. The parameter σ reflects the relative importance that the union attaches to real wage deviations vis-à-vis employment deviations. It is assumed that a union bargains only over the wage rate in a single period. Bargaining in the first and second period would be undertaken by different labor representatives and the negotiators in the first period can not commit for the second period.

It is assumed that $L^d(\bar{w})<\bar{L}$ and, therefore, the trade-off between the real wage and the level of employment for the union arises because the union's optimal outcome ($L=\bar{L}$ and $w=\bar{w}$) is inconsistent with the labor demand

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1/ For further discussions on this type of union behavior see, for example, Oswald (1985) and Alogoskoufis and Manning (1988).

schedule. This is the key feature that makes the labor market non-competitive. In a competitive labor market one could expect the target real wage to be consistent with full employment at $\bar{L}$. In contrast, if the union leaders are more protected from unemployment than the rest of the labor force, or they assign different weights to different groups of workers, they will have an incentive to demand higher real wages than those of the competitive case. Wage claims will be restricted to some extent by the possibility that union leaders are replaced and, thus, become outsiders in the wage determination process and more exposed to unemployment. Therefore, the level of $\bar{w}$ can be considered an indicator of the labor market imperfections, or in other words, the relative power of insiders vis-à-vis outsiders and firms (Lindbeck and Snower (1989)).

As can be seen from equations (27) and (28), the expression for the labor demand is highly non-linear in W, and consequently in w. Since the real consumption wage is equal to $W/p^{T(1-\phi)}p^{N\phi}$, the relationship between the consumption and the nominal wage is give by: 1/

$$W = w^{\frac{1}{1-\phi}} p^{T} \left[\frac{\theta}{(\theta-1)a_N}\right]^{\frac{\phi}{1-\phi}} . \tag{31}$$

Therefore, labor demand as a function of the real consumption wage can be written as (variables without time subscript refer to period 1):

$$L^{d}(w) = \left[\left(\frac{\alpha a_T}{w^{\frac{1}{1-\phi}}}\right)^{\frac{\alpha}{1-\alpha}} + \phi \frac{\alpha^{\frac{\alpha}{1-\alpha}}}{w^{\frac{1}{1-\phi}} p^{T(1-\phi)(1+\beta)}} \left(\frac{a_T^{\frac{1}{1-\alpha}} p^{T}}{w^{\frac{1}{(1-\phi)(1-\alpha)}}} + \frac{a_{T_2}^{\frac{1}{1-\alpha}} p_2^{T}}{(1+r) w_2^{\frac{\alpha}{(1-\phi)(1-\alpha)}}}\right)\right]$$

$$\times \left[\frac{a_N(\theta-1)}{\theta}\right]^{\frac{\phi}{(1-\phi)(1-\alpha)}} + \frac{g}{a_N} . \tag{32}$$

1/ Note that in equation (31) it is implicitly assumed that the union, since bargaining is centralized, incorporates the effects of wages on the price of non-traded goods.

For simplicity, we consider the following linear approximation of the demand for labor:

$$L^d(w) = \frac{g}{a_N} + L_0 - \epsilon w \ . \tag{33}$$

The first term is the demand for labor arising from government expenditure in nontraded goods, and the rest corresponds to the labor demand arising from private demand for goods. The parameters (a_{Tt}, a_N, $p^T{}_t$) are assumed to affect only L_0 with the same sign as they affect the labor demand and ϵ is assumed to be independent of those parameters. 1/ Solving the union's problem, the following expression is obtained for the equilibrium real wage:

$$w = \frac{\sigma}{\sigma+\epsilon^2}\bar{w} + \frac{\epsilon}{\sigma+\epsilon^2}(L_0 + \frac{g}{a_N} - \bar{L}) \ . \tag{34}$$

This expression shows that the real wage is increasing in the target real wage and positive exogenous shifts in the demand for labor.

If unions would only care about real wages, the real wage would be equal to $\bar{w}$ and it would be insensitive to labor demand conditions. It is easy to verify, using (34), (31) and the expressions for labor demand, that the equilibrium nominal wage will be an increasing function of $\bar{w}$, a_T and g. On the other hand, equilibrium employment will be increasing in g and a_T and decreasing in $\bar{w}$. Wages will also be an increasing function of $p_1{}^T$ and $p_2{}^T$ and an equiproportional increase in $p_1{}^T$ and $p_2{}^T$ increases W equiproportionately, because of the homogeneity property. The effects of a_N on wages, on the other hand, are ambiguous, because an increase in productivity has an ambiguous effect on total labor demand. Although the demand for labor to satisfy government purchases declines, equation (32) shows that an increase in a_N increases the demand for labor to satisfy private sector demand in the traded and nontraded sectors.

1/ If the linear approximation (33) is a first-order Taylor approximation, that is $L^d(w)=L^d(w_0)+(w-w_0)dL^d(w_0)/dw$, not only L_0 but also $\epsilon(=dL^d(w_0)/dw_0)$ would be affected by the parameters. However, our assumption is that the effects of changes in ϵ do not change the qualitative impact (sign) of changes in the other labor demand parameters.

To summarize the discussion on the labor market, we can write the following reduced form for period-1 wages, where the signs below each variable correspond to the sign of the partial derivative: 1/

$$W = W(\bar{w}, a_{T_1}, a_{T_2}, a_N, p_1^T, p_2^T, g). \qquad (35)$$
$$\quad + \quad + \quad + \quad ? \quad + \quad + \quad +$$

Note that an increase in productivity could cause a more than proportional increase in nominal wages, having negative effects on labor demand and output in the traded goods sector. Thus, one could have the counterintuitive result that productivity growth in the traded goods sector may cause this sector to shrink. By a simple contradiction it can be shown that this is not the case: consider an increase in a_T that leads to a more than proportional increase in W. It follows from equation (28) that the demand for labor in the tradable goods sector will fall. In the nontradable goods sector demand will also fall since (see equation (27)) Y^T decreases and W increases. Hence, labor demand would fall, leading to a reduction of wages, which is a contradiction.

After having analyzed the equilibrium in the goods and labor market we turn to the discussion of the effects of changes in the main exogenous variables.

4. Determinants of the Real Exchange Rate and of Labor Productivity

In this section we discuss the effects of a variety of shocks in the economy that was described above. The focus of our discussion is the extent to which the model allows us to identify the fluctuations of prices, productivity, and sectoral output shares observed in European economies. Our analysis focuses on the effects that a change in a parameter in period 1 has over the contemporaneous endogenous variables. In most cases, the qualitative effects of shocks that are only transitory (last only during period 1) are the same as in the case of permanent shocks (last also during period 2), and we shall discuss both permanent and transitory shocks only

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1/ The same reduced form could be obtained by considering a more general form of bargaining. For example, while allowing firms to choose employment by the "right to manage", the determination of wages could be the result of a bargaining process between the labor union and a representative of firms (see Layard, Nickell and Jackman (1991)). The two key ingredients are the existence of $\bar{w}$ and that any exogenous upward shift in the labor demand schedule results in higher equilibrium real wages. This process could be formalized by assuming that there exists an upward sloping wage setting schedule $L^S(w,\bar{w})$ that together with the labor demand determines wages (see Alogoskoufis and Manning (1988)).

for one of the exogenous variables, i.e., for a_T. The equations we use in this discussion are: 1/

$$\frac{p^T}{p^N} = \frac{\theta - 1}{\theta} \frac{a_N p^T}{W},$$

$$CA = \frac{\beta}{1+\beta} \left[y_1^T - \frac{p_2^T}{p_1^T} y_2^T \right],$$

$$\frac{y^T}{l^T} = \frac{W}{\alpha p^T},$$

$$\frac{y^N}{l^N} = \frac{\theta - 1}{\theta} a_N,$$

$$y^T = a_T^{\frac{1}{1-\alpha}} \left(\frac{\alpha p^T}{W} \right)^{\frac{\alpha}{1-\alpha}},$$

$$W = W(\bar{w}, a_{T1}, a_{T2}, a_N, p_1^T, p_2^T, g).$$

In addition to the above variables we are also interested in extracting relevant information from the evolution of sectoral shares. Define s^T as the share of tradable goods in total output. Since s^T is computed at constant relative prices (at a given period 0), it can be written as:

$$s^T = \frac{y^T}{y^T + p_0^n y^N / p_0^T}.$$

All of the expressions for the comparative statics exercises are functions of the exogenous parameters and W, $y^T{}_1$, $y^T{}_2$, and y^N, which can be

---

1/ Note that we define the real exchange rate as p^T/p^N. Using, instead, p^T/p^n does not change the comparative statics results.

substituted by equations (31), (25) and (23), to obtain the final reduced forms. The qualitative results of these comparative statics exercises are summarized in Table 1. The maintained assumption in the table, as well as in the algebra above, is that initial external debt holdings are zero. It is also assumed that g is relatively small compared to private spending on nontradable goods.

Private (nominal) spending shares are constant because of the unitary elasticity of substitution across goods assumed in the specification of consumer preferences. Therefore, changes in preferences can be analyzed as changes in ϕ (the share of private expenditures in nontradable goods). 1/ An increase in ϕ corresponds to a change in preferences toward nontradable goods. The parameter ϕ only affects the main endogenous variables through its effects on wages. To examine these effects it is sufficient to verify that an increase in ϕ increases aggregate labor demand, with the consequent increase in wages. The reason for this result is that labor demand from the nontradable goods sector increases as the result of the increase in demand, while labor demand from the tradable goods sector remains the same since it is independent of domestic demand. Thus, as in the case of government expenditure, taste shocks affect the real exchange rate, the current account and labor productivity, through labor demand and its impact on wages. Finally note that even when ϕ is constant, total nominal spending shares change because government spending can change and its composition differs from that of the private sector (the government only spends in nontradable goods).

Traditional models of the real exchange rate in the spirit of Balassa-Samuelson interpret the large observed changes in the relative price of nontradable goods in terms of an increase in relative total factor productivity in the tradable good sector. These effects, as the table confirms, occur also in our model. The table, however, shows that increases in government spending, the private expenditure-share in nontradable goods, and the unions' real-wage target have qualitatively identical effects on labor productivity and the relative price of nontradable goods. In fact, in all of those cases, it would be observed that labor productivity in the traded goods sector outpaces labor productivity in the nontraded goods sector, and that the real exchange rate appreciates. However, while the positive impact of a_T on labor productivity in the traded goods sector is the result of an expansion of output with a less than proportional expansion of employment, the positive impact of g and $\bar{w}$ on labor productivity in the traded goods sector is the result of labor shedding and a contraction of this sector.

A major difference between the effects of a_T and the effects of g, ϕ and $\bar{w}$ lies in the impact on the current account and sectoral shares. For

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1/ Another way to study the effects of demand changes on the real exchange rate would be to assume non-homothetic preferences so that sectoral demands would be correlated with the level of income, see Bergstrand (1991).

Table 1. Summary of Comparative Statics Results

	a_T Permanent	a_T Transitory	a_N	g	ϖ	ϕ
p^T/p^N	-	-	+	-	-	-
CA	?	+	?	-	-	-
y^T/l^T	+	+	?	+	+	+
s^T	+	+	-	-	-	-

transitory shocks, the effects on the current account and sectoral shares are unambiguous. An increase in tradable goods productivity improves the current account and raises the sectoral share of tradable goods. On the other hand, an increase in government spending as well as an increase in the real-wage target, result in a deterioration of the current account and reduce the share of tradable goods.

A permanent increase in tradable goods productivity has an ambiguous effect on the current account and increases the share of tradable goods. The reason for the ambiguity of the effects of a permanent productivity shock in the tradable goods sector is that its sign depends on the effects of productivity on the path of wages and on the initial sign of the current account. According to (31), a permanent increase in a_T increases wages in the two periods and this can change the current account balance. Secondly, the current account response depends also on the initial sign of the current account. A permanent increase in a_T increases both, y^T_1 and y^T_2. If both levels of production are equally affected, the final effect will be positive (negative) if the current account in the absence of productivity growth would have been a surplus (deficit).

The effects of total labor productivity in the nontradable goods sector (a_N) on the main variables of interest is in many cases ambiguous, since the main channel through which a_N affects the rest of the variables is its impact on wages, which, as we showed before, cannot be unambiguously signed. We can presume, however, that an increase in productivity in the nontraded goods sector increases the output of this sector. That is, in the event that nominal wages increase with a_N, this increase in wages will not be enough to offset the direct effect that a_N has on output in the nontraded goods sector. This is the assumption implicit in the column for a_N in Table 1.

IV. Interpretation

In this section we provide a broad interpretation for the evolution of the real exchange rate across countries, using the main results from the model developed in the previous section. Although the effects of different shocks are difficult to separate, the joint examination of all the variables can shed light on the main causes for the actual evolution of the price of nontradable goods vis-à-vis tradable goods.

1. An Informal Examination of the Evidence

For each country we present four figures. They contain the real exchange rate (relative price of tradable goods), an index of the difference in labor and the difference in total factor productivity across sectors, sectoral shares in real GDP, and the current account and trade balance. In Figure 7 we also present the evolution of government consumption for all countries. After an informal discussion of the figures, we present

econometric evidence on the determination of the real exchange rate. The description of the data is contained in Appendix.

The evolution of the difference in labor productivity and total factor productivity across sectors show remarkable variations in most of the countries. Only in Italy both indices move relatively close together. In Germany, by contrast, the growth of total factor productivity in the tradable goods relative to nontradable goods sector has been faster than the growth of labor productivity. In fact, Figure 3 shows that labor productivity has grown in both sectors at a similar rate. At the other extreme are France and the UK, where relative labor productivity in the tradable goods sector displays faster growth than total factor productivity over the period 1975-91. Although the reasons for these discrepancies may vary across countries it is interesting to note that the interpretation of the evolution of the real exchange rates using labor productivity rather than total factor productivity may lead to wrong conclusions.

An element that is common across countries, with the exception again of Italy, is that the share of total output in the tradable (nontradable) goods sector has displayed a downward (upward) trend. 1/ This trend has been more pronounced in the cases of France and Germany. As was shown in the previous section, if the growth of productivity in the tradable goods sector were the main cause for the real appreciation, one would expect the share of tradable goods to increase. That this was not the case and, on the contrary, real tradable goods share generally decreased, suggested that demand factors (private and public) as well as wage pressures may have played an important role in explaining the evolution of real exchange rates. 2/

After the second oil shock all countries, except the UK, show a deterioration in the current account and the trade balance that continued until the early 1980s. Subsequently, the external accounts improve, except for the UK. But in Italy, and specially in Spain and the UK, external balances deteriorate in during the second half of the 1980s. The evidence is consistent with the implications of the evolution of output shares in the sense that other factors than productivity developments may have played an important role.

1/ The non-conformity of the Italian data with this general trend is in part a base year problem. When the first half of the 1970s is included, tradeables (non-tradeables) also display a falling (rising) trend, albeit more gradual than in other countries.

2/ The decline in the share of tradeable goods in output is one of the most important inconsistencies in the productivity-based explanations of the evolution of the real exchange rate. We suspect, for example, that Rebelo's (1992) simulations for Portugal do not explain the "shares differentials", although they seem to explain the inflation differential.

Regarding real government spending, Figure 7 shows that there is no strong trend that could account for the significant decline of the relative price of tradable goods, specially in Italy and the UK. The share of government spending in GDP increased steadily only in Spain, from 11 percent in 1975 to 14 percent in 1990.

The case of Germany is interesting to highlight since the evolution of total factor productivity and output shares (indicating a shift in demand toward nontradable goods) would suggest that the real exchange rate should have appreciated instead of depreciated as Figure 3 shows. This evidence could suggest that wage pressures declined enough to prevent a real appreciation. This may reflect in part the fact that Germany performed a role of a credible nominal anchor during this period. With tradable prices coming closer in line under increasingly fixed exchange rates, the leadership role on the inflation front was only achievable through relatively low inflation in the service sector, achieved through a containment of wage costs.

2. Determinants of the Real Exchange Rate

The data we have collected can be subject to a more systematic statistical analysis to uncover the determinants of the relative price of tradable goods. This analysis, however, is necessarily exploratory, because the availability of consistent annual data over a short period of time limits severely the size of our sample.

The main difference between our analysis and previous empirical work on real exchange rates (see, for example, Hsieh (1982) and Froot and Rogoff (1991a, b)) is that the explanatory variables in the dataset we have constructed are closer to the variables suggested by theoretical models. In particular, we employ total factor productivity instead of labor productivity for all countries (except for Spain, where we did not have reliable estimates of sectoral capital stocks for our sample period). Such total factor productivities, calculated for both tradables and nontradables, are noticeably different from average labor productivity, as pointed out in the previous subsection. In contrast to Froot and Rogoff (1991a, b), we also use the *real* share of government spending, which is the relevant variable according to the theory, while they use the nominal share. Since government expenditure falls more heavily on nontradable goods, nominal government expenditure over nominal GDP is by construction correlated with the real exchange rate. 1/ An interesting example is the case of Italy, where according to Froot and Rogoff (1991a) government expenditure over GDP has grown by 2.9 percentage points between 1979 and 1989. In real terms, however, it has increased only 0.3 percentage points. Finally, we include a variable to proxy for the preference parameter ϕ of our model. Assuming intratemporal Cobb-Douglas preferences, we know that the nominal private-expenditure shares are constant across goods. Instead, we can construct a

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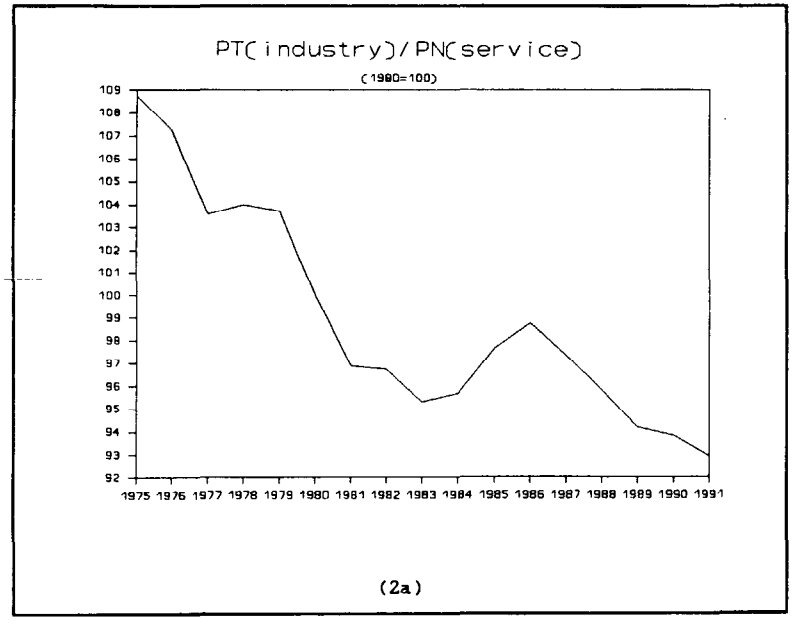
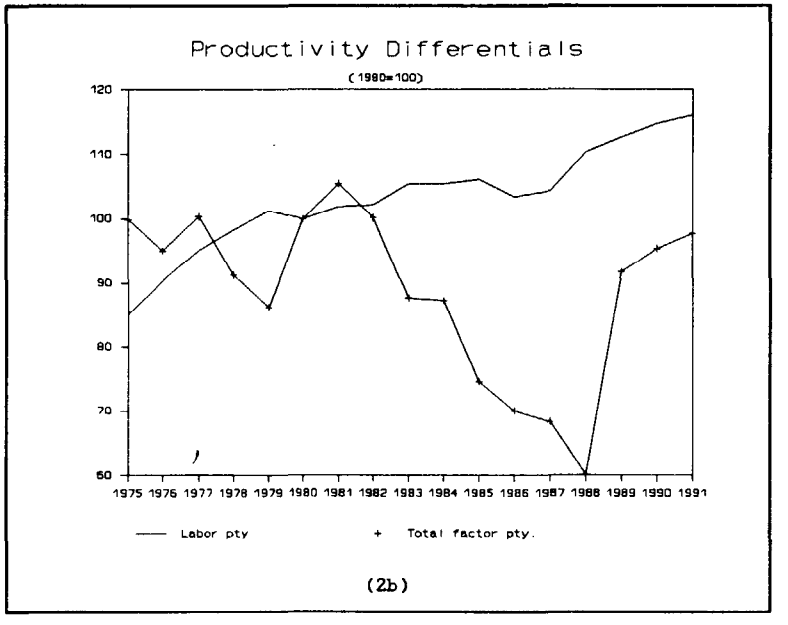
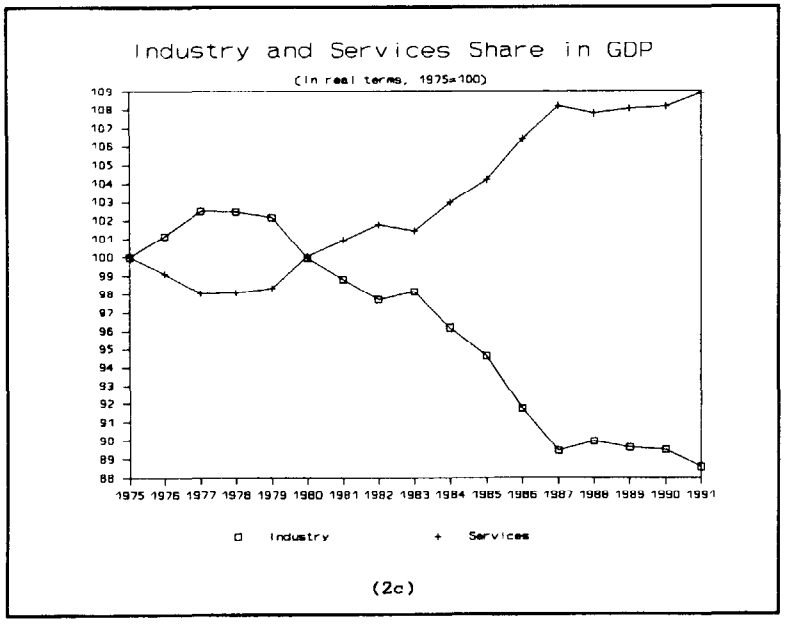
1/ See Dornbusch (1991) for additional discussion of this point.







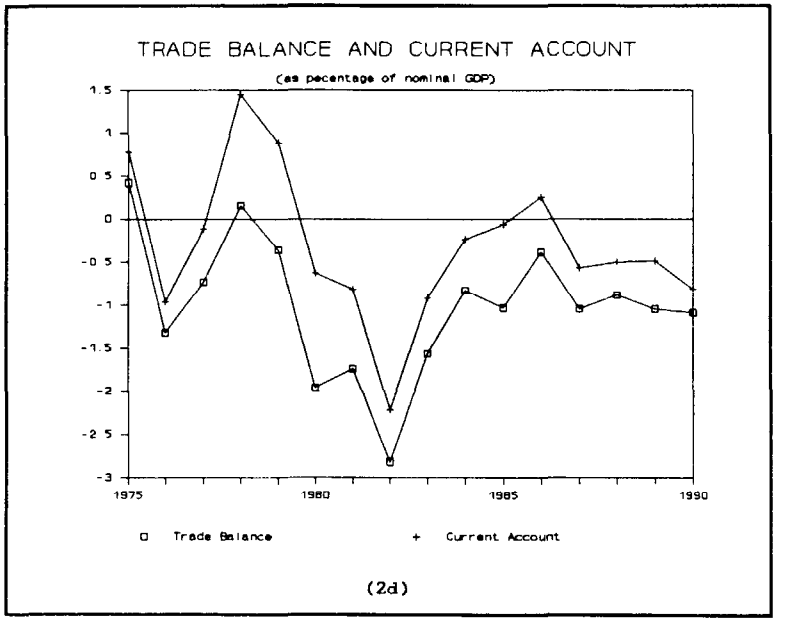
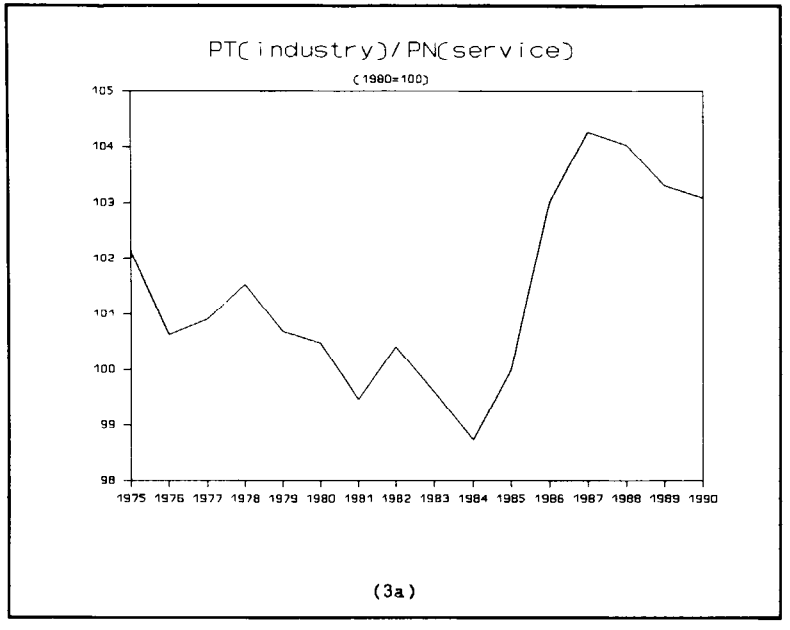
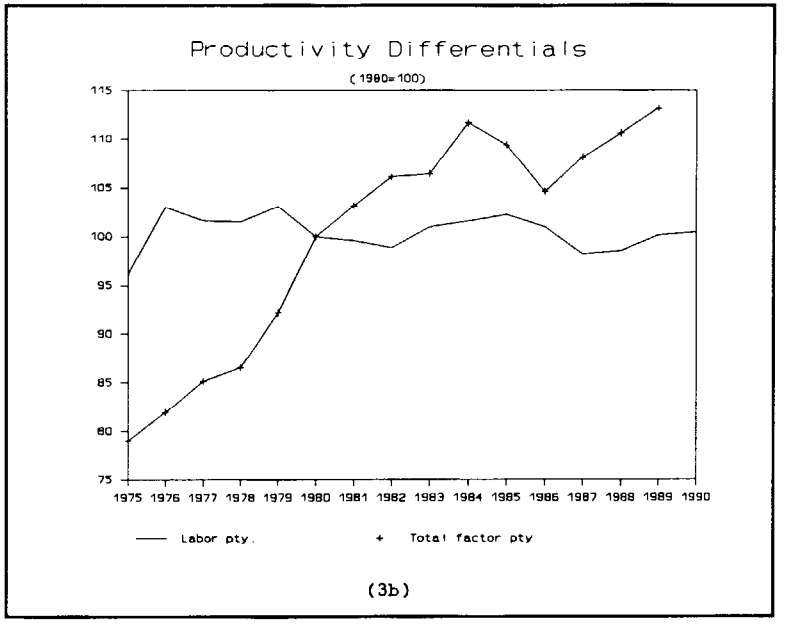
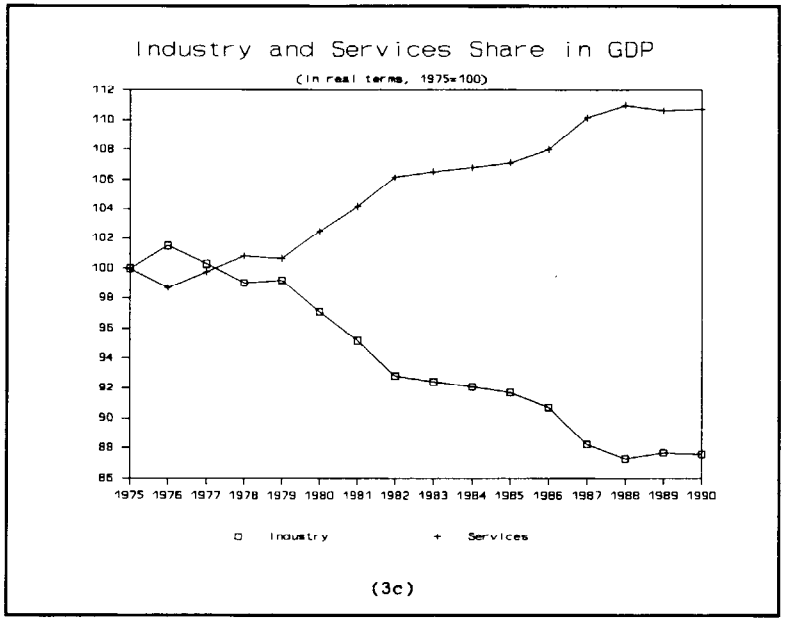


Figure 2. France







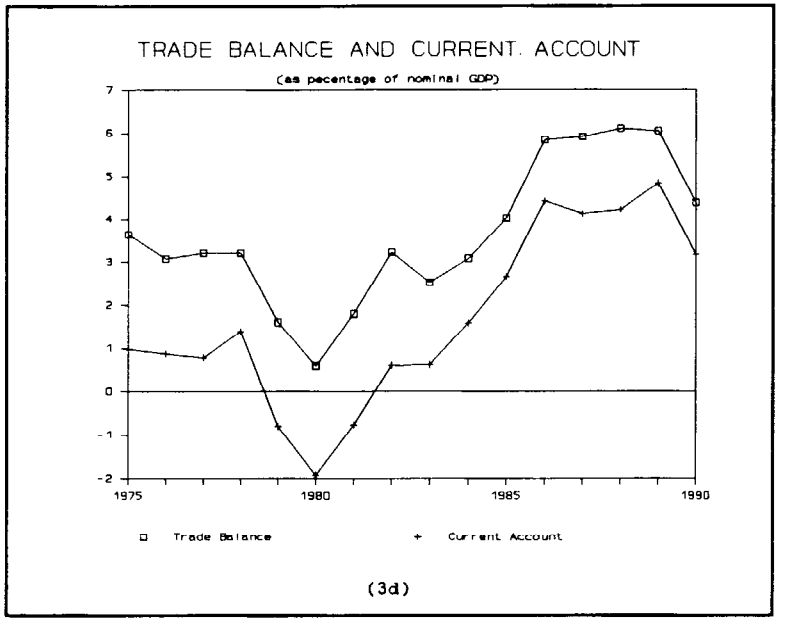
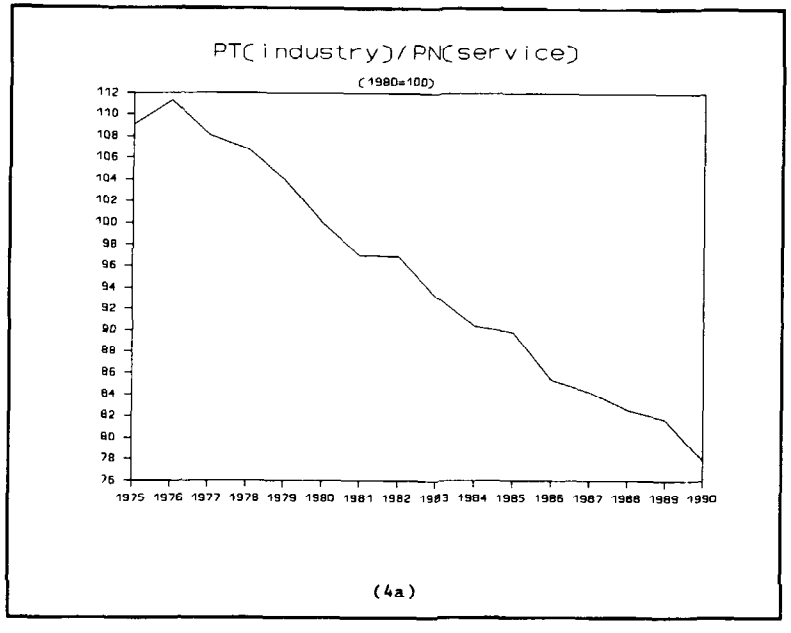
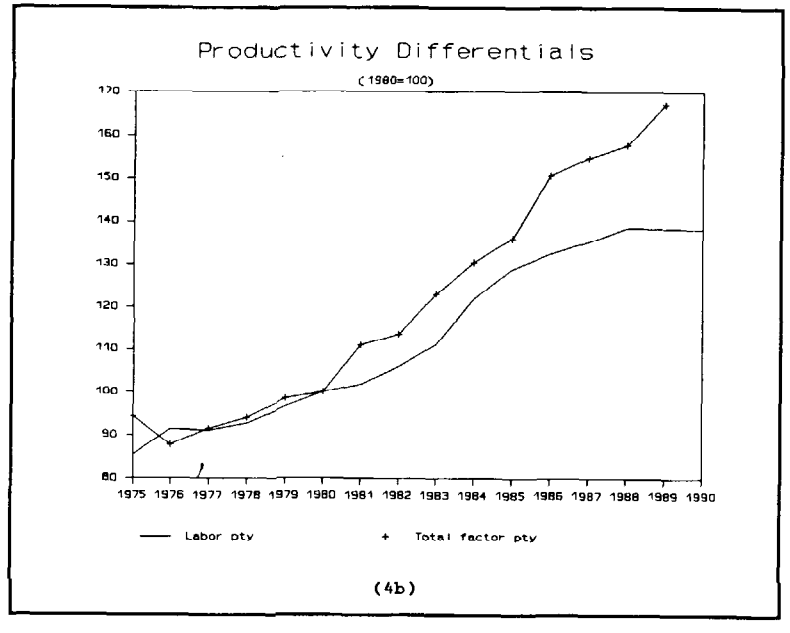
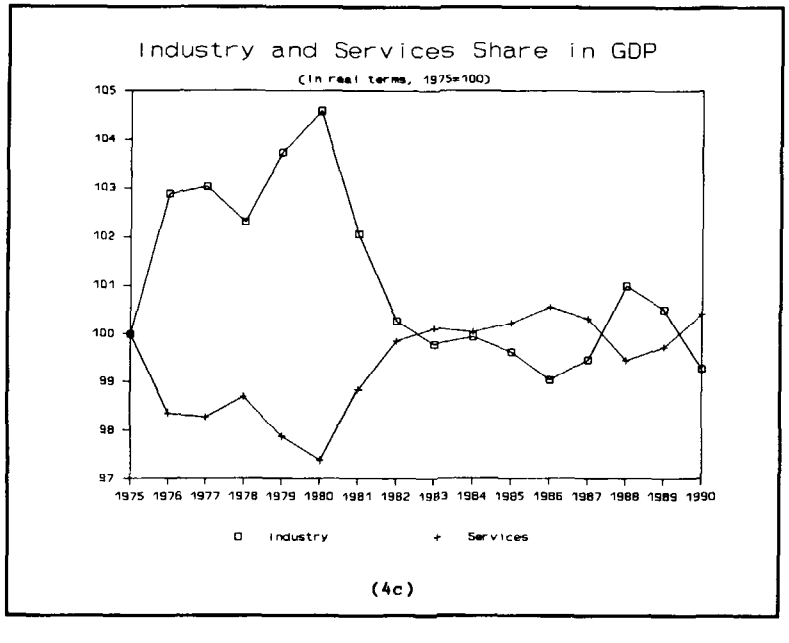


Figure 3. Germany







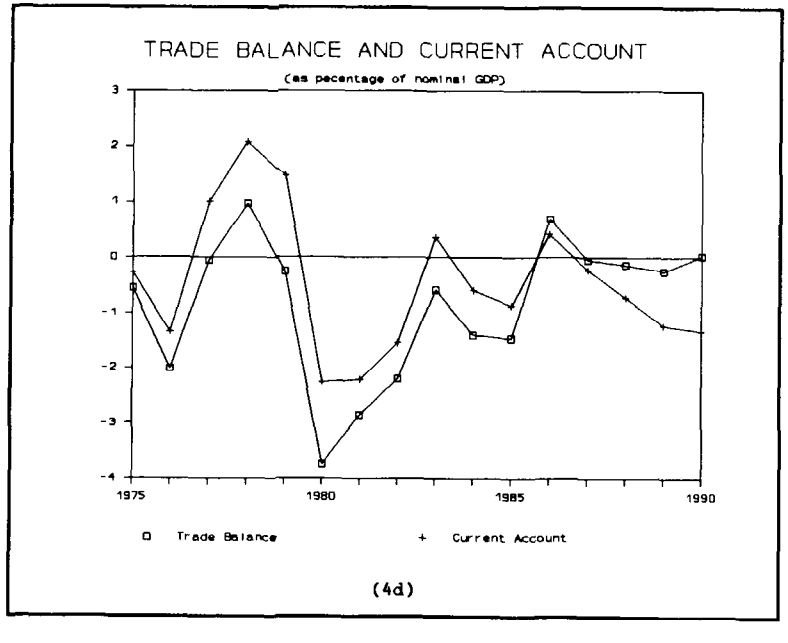
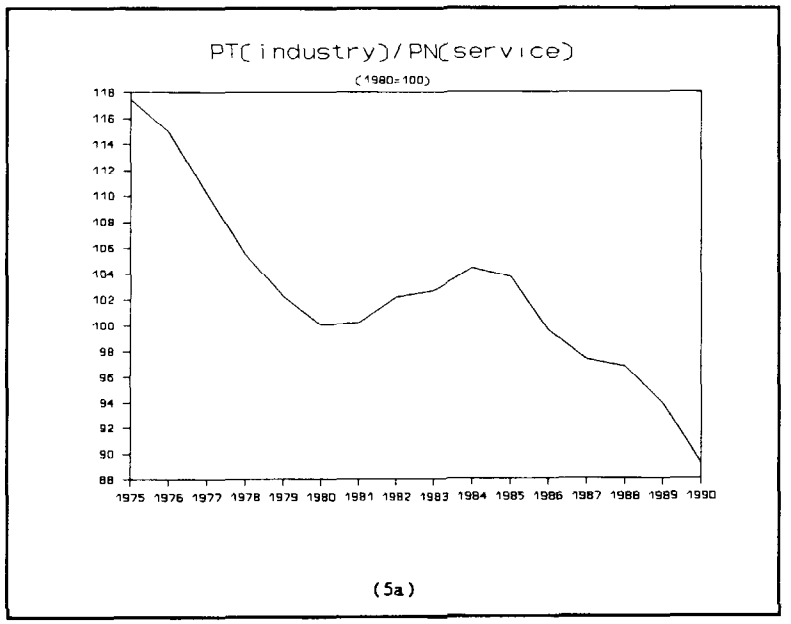
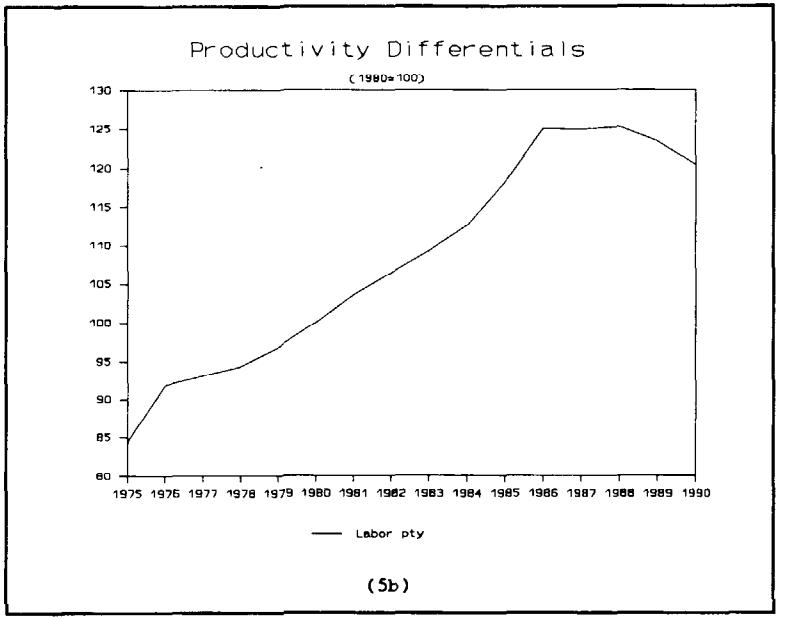


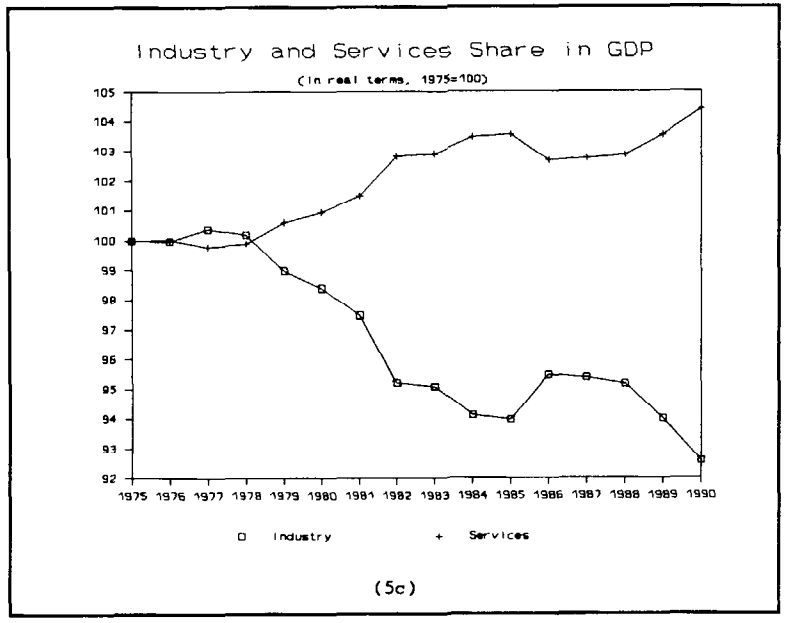
Figure 4. Italy



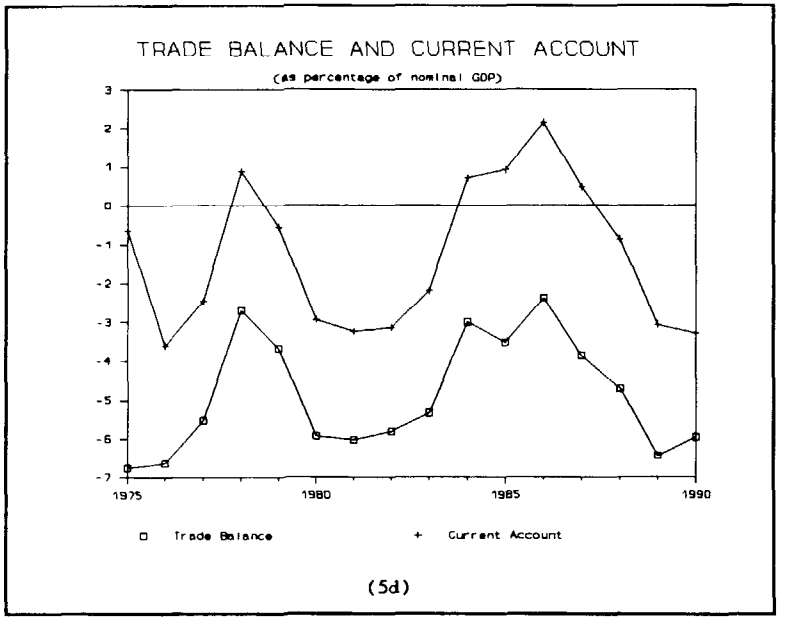
(5a)



(5b)

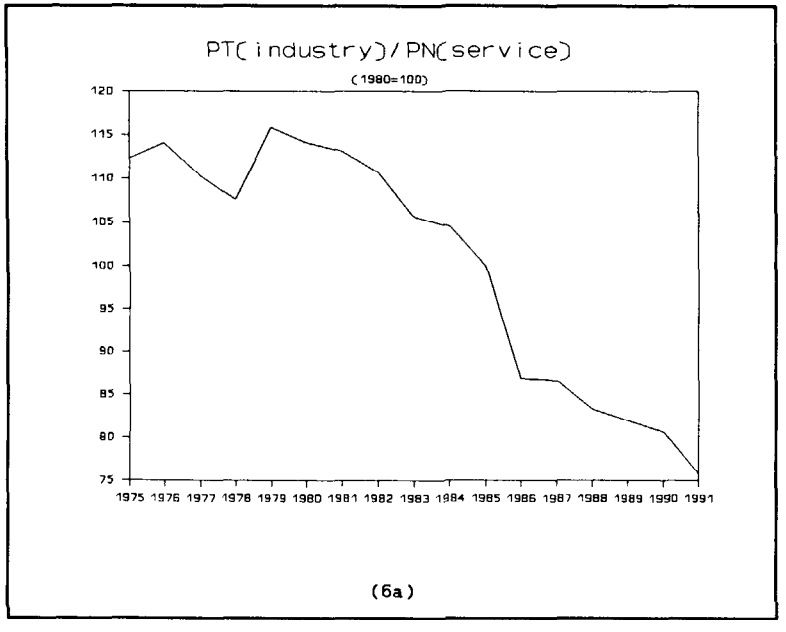


(5c)

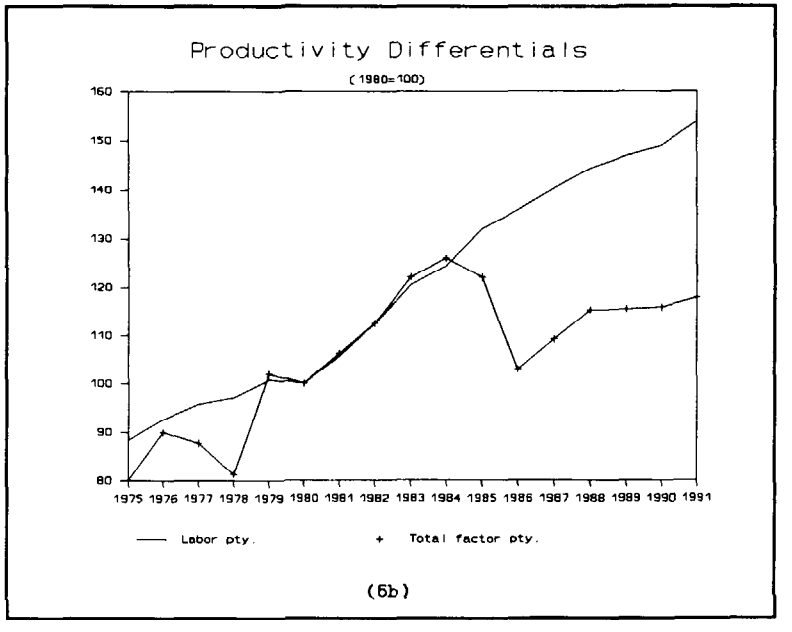


(5d)

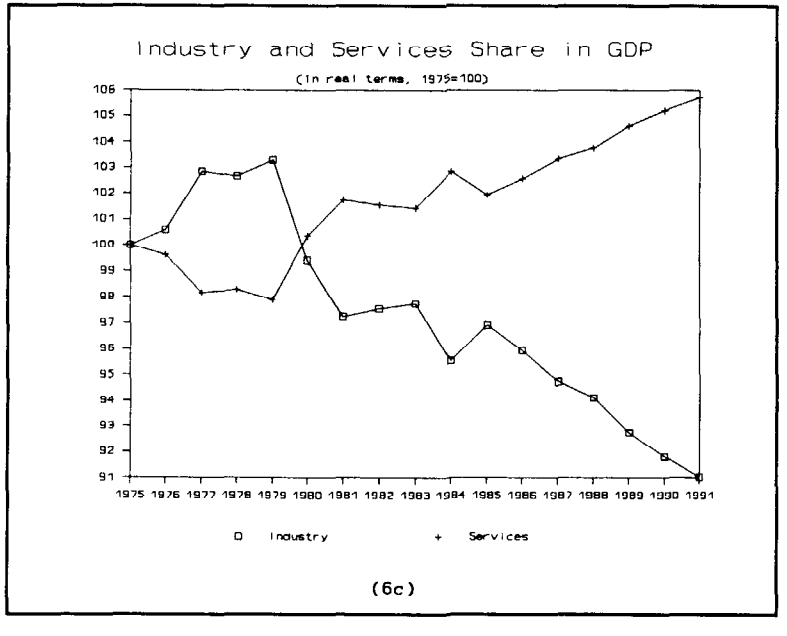
Figure 5. Spain



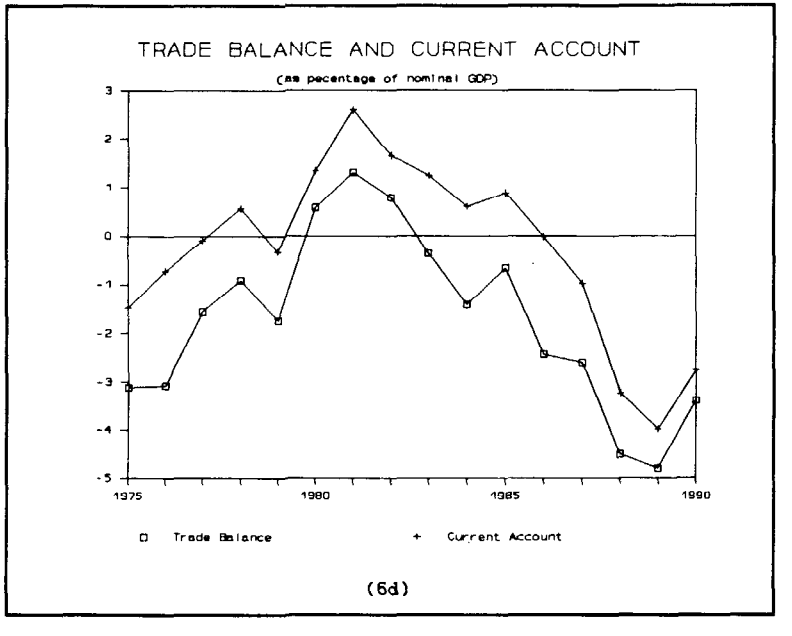
(6a)



(6b)



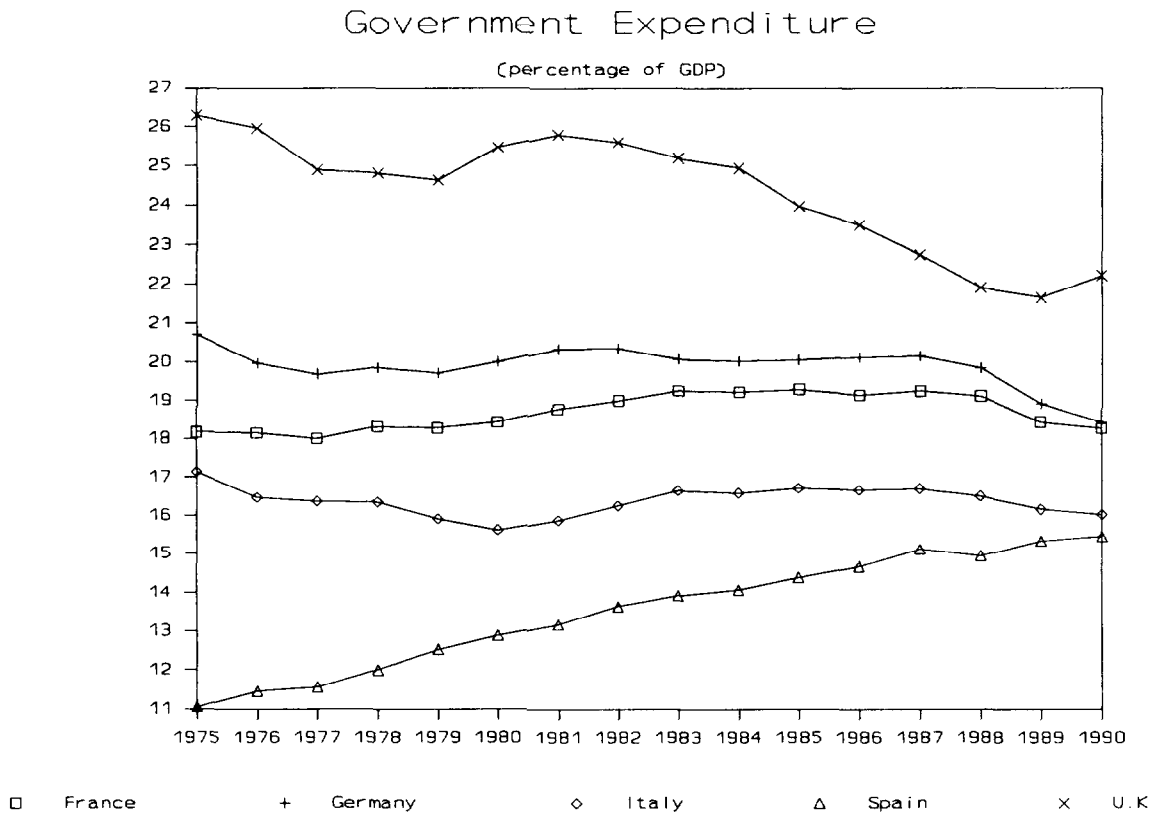
(6c)



(6d)

Figure 6. United Kingdom

Figure 7


Government Expenditure
(percentage of GDP)
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990
□ France
+ Germany
◇ Italy
△ Spain
× U.K

time-varying proxy for this variable from the data on private expenditure (see Appendix for the details on the construction of this variable).

Our regression equation has, as a dependent variable, the logarithm of the real exchange rate, defined as the relative price of tradable goods. The explanatory variables are, besides a constant term, the log-difference between total factor productivity in the tradable goods and nontradable goods sectors, the share of government purchases of goods and services in GDP, and the private expenditure shift variable described above. 1/

Tables 2 and 3 contain regression results on a number of different specifications of the basic equation. We employ both ordinary least squares (OLS) and the seemingly unrelated regression (SUR) technique. Furthermore, the regressions have been run both in levels and first differences. The choice of the levels versus first differences should be based on statistical tests of nonstationarity, which however would need a much larger sample than what is available. Given data limitations, we compare the results from regressions run for levels with regressions in the first differences.

Consider first Table 2, which reports the results from SUR regressions. The differential in productivity in the tradables and nontradables sectors has the expected sign (negative) in the cases of France, Germany and Italy, but not in the case of Spain (for which the data is actually average labor productivity, and not total factor productivity) and of the United Kingdom. For the cases where the coefficients have the expected signs, the estimated parameter values in the levels and differences specifications are the highest in Italy and considerably smaller in France.

The other two variables in the regression--government expenditure and the share of nontradables in private spending--have less consistent explanatory power. In the case of France the two variables have the correct sign (negative) and low standard errors, although the size of the estimated coefficient changes substantially with the levels versus first differences specification. Such differences across specifications are more marked for the other countries. Government expenditure is of the expected sign and significant only in the case of Germany (regression in the levels) and Spain (regression in the levels), where it becomes insignificant in the first-difference regressions. In the case of the United Kingdom, both the levels and the first-differences regression yield significant coefficients of similar size, but with a positive sign. The private spending share in nontradables has the correct sign in the case of France, Spain (where, however, it is insignificant) and the United Kingdom (levels regression).

Table 3 reports the results for several alternative specifications: SUR estimates that exclude the variable representing taste shocks or government spending, and OLS estimates. Significance levels are indicated by

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1/ We also included the measures of sectoral total factor productivity separately, but the results were less satisfactory.

Table 2. Unconstrained SUR Regressions
(1971-1989)

	Constant	Productivity Differentials	Government Expenditure	Private Spending Share in Nontradables	R^2 DW	Method
France	1.636	-0.094	-5.631	-1.073	0.93	SUR
	(0.136)	(0.022)	(0.811)	(0.119)	0.90	
	-0.007	-0.082	-2.279	-0.389	0.40	ΔSUR
	(0.004)	(0.022)	(0.989)	(0.276)	2.23	
Germany	4.761	-0.215	-1.829	0.579	0.58	SUR
	(0.137)	(0.052)	(0.613)	(0.185)	0.65	
	0.004	-0.322	0.013	0.050	0.22	ΔSUR
	(0.005)	(0.088)	(0.612)	(0.365)	1.07	
Italy	4.013	-0.598	-0.153	0.811	0.98	SUR
	(0.244)	(0.093)	(1.023)	(0.493)	1.12	
	0.005	-0.653	2.526	0.743	0.54	ΔSUR
	(0.005)	(0.119)	(1.227)	(0.402)	1.83	
Spain	0.979	0.116	-5.279	-0.362	0.85	SUR
	(0.310)	(0.206)	(2.116)	(0.656)	0.48	
	-0.029	0.019	1.370	-0.361	0.04	ΔSUR
	(0.008)	(0.147)	(2.051)	(0.470)	1.00	
United Kingdom	-0.451	0.079	4.640	-1.453	0.94	SUR
	(0.266)	(0.032)	(0.724)	(0.229)	0.48	
	-0.009	0.200	3.242	1.272	0.77	ΔSUR
	(0.008)	(0.094)	(0.711)	(0.496)	1.84	

The dependent variable is the logarithm of the real exchange rate, and the regressors are the real share of government expenditure on GDP, the logarithm of the differential in total factor productivity (total factor productivity in the tradeable goods sector minus total factor productivity in the non-tradeable goods sector), and the (nominal) share of private expenditure in non-tradeable goods in total private expenditure. See Appendix for sources, data definitions and sample periods. Standard errors in parentheses. SUR: seemingly unrelated regressions in levels. ΔSUR: SUR in first-differences.

Table 3. Additional Regressions

	Productivity Differentials	Government Expenditure	Private Spending Share in Nontradables	R^2	DW	Method
France	-0.061	-10.717**		0.93	0.90	SUR
(1970-1991)	-0.125**	-4.936**	-1.214**	0.95	1.08	OLS
	-0.066**	-1.995**	-0.428	0.40	2.02	ΔOLS
		-3.288**	-1.221**	0.91	0.46	OLS
Germany	-0.045	-2.624**		0.71	0.87	SUR
(1968-1989)	-0.256**	-3.909**	0.472	0.95	0.58	OLS
	-0.205	-0.186	-0.120	0.12	1.32	ΔOLS
	-0.132**	-3.855**		0.69	0.59	OLS
Italy	-0.445**	0.641		0.97	1.24	SUR
(1960-1989)	-0.232**	1.714**	-1.128**	0.98	1.14	OLS
	-0.236**	2.072*	-0.559*	0.40	1.39	ΔOLS
	-0.307**		-0.855**	0.98	1.09	OLS
Spain	0.156	-5.812**		0.91	0.48	SUR
(1965-1990)	-0.811**	4.343**	-2.792**	0.92	0.48	OLS
	0.071	2.072**	0.559**	0.35	1.32	ΔOLS
	-0.477**		-2.468**	0.87	0.21	OLS
United Kingdom	-0.098**	7.467**		0.86	1.85	SUR
(1971-1991)	0.107	3.275**	-1.954**	0.96	0.89	OLS
	0.151	2.552**	1.571**	0.70	1.73	ΔOLS
			-2.333**	0.89	0.50	OLS

See notes to table 2. The period under each country name corresponds to the period for which the data are available. Since SUR requires the same period, all SUR were performed for the period 1971-1989. OLS: ordinary least squares. ΔOLS: OLS in first-differences. Standard errors not reported. *: significant at 10 percent. **: significant at 5 percent.

asterisks. The results of the previous table are broadly confirmed: the variable that tends to be consistently significant with the expected sign is the productivity differential. In several cases, government expenditure takes on a positive coefficient. The table also indicates that residuals in the level equations appear to be highly serially correlated, and that such correlation decreases, as expected, with first differentiation.

Because the size of our sample makes the discussion of the statistical significance of the estimates of Tables 2 and 3 difficult, we have also estimated the equations with the SUR technique, constraining the coefficients on all variables except the constant terms to be equal across countries. We also restrict the sample to France, Germany and Italy, because of the poor results obtained for Spain and the UK. The results are reported in Table 4. The variable that has consistently high explanatory power is the share of private spending in nontradables. For the whole sample, and in contrast with the results of the previous tables, productivity differentials become insignificant in the first difference equation, while the opposite happens to government spending. More encouraging are the results for the smaller sample. In particular, the level equation has the expected signs and small standard errors. In the difference equation the coefficients still have the expected sign, but only the estimate for the productivity differential is significant. We ascribe the different behavior of parameter estimates across samples to the difference across countries that are detectable from the previous two tables.

In order to assess the relative importance of the different factors affecting the evolution of the real exchange rate, Table 5 presents several estimates of the impact that the change in each variable had on the real exchange rate during 1979--89. Three estimates are provided for each country. The first one corresponds to the first regression of each country from Table 2. The second one corresponds to the SUR estimations that assumes the same coefficients (first regression in Table 4). The third one corresponds to other estimates where the parameters are in line with the theoretical predictions and the overall fit is reasonably good: for France it is the second regression of Table 2, for Germany the first regression of Table 3, and for Italy, Spain, and the United Kingdom the last regression of each country reported in Table 3. In addition the first column of Table 5 presents the actual change of the real exchange rate during 1979--89 and the last line for each country (figures in square brackets) corresponds to the actual change of each of the explanatory variables during the same period.

The results in Table 5 illustrate several interesting features. First, except for Spain, the effects of government spending in explaining the real appreciation are relatively small. As Figure 7 reveals, the share of real government expenditure in GDP has been relatively stable, and hence, its effects are in general quantitatively unimportant for the estimated coefficient values. The exception is possibly Spain, where the share of

Table 4. Constrained SUR Regressions
(1971-1989)

Productivity Differentials	Government Expenditure	Private Spending Share in Nontradables	Method
Five-country sample			
-0.032	0.051	-1.571	SUR
(0.018)	(0.328)	(0.054)	
0.024	-1.366	0.993	ΔSUR
(0.027)	(0.470)	(0.195)	
Three-country sample (France, Germany and Italy)			
-0.137	-2.400	-0.881	SUR
(0.022)	(0.811)	(0.103)	
-0.076	-0.481	-0.166	ΔSUR
(0.026)	(0.565)	(0.210)	

See notes to table 2. Only the constant (not-reported) was allowed to vary across countries.

Table 5. Change in the Real Exchange Rate (p^T/p^N) during 1979-89
(percent)

	Actual Change	Change Explained by		
		Productivity Differentials	Government Expenditure	Private Spending Share in nontradables
France	-9.7	-0.6	-0.9	-10.2
	-9.7	-0.2	0.0	-15.0
	-9.7	-0.5	-0.4	-3.7
		[6.3]	[0.2]	[9.5]
Germany	2.6	-4.4	1.5	5.6
	2.6	-0.7	0.0	-15.2
	2.6	-0.9	2.12	
		[20.5]	[-0.8]	[9.7]
Italy	-24.2	-31.6	0.0	7.6
	-24.2	-1.7	0.0	-14.6
	-24.2	-16.2		-8.0
		[52.8]	[0.3]	[9.3]
Spain	-8.6	2.8	-14.9	-0.2
	-8.6	-0.8	0.1	-0.7
	-8.6	-11.6		-1.1
			[2.8]	[0.4]
United Kingdom	-34.6	1.0	-13.9	-19.2
	-34.6	-0.4	-0.2	-20.8
	-34.6			-30.8
		[12.5]	[-3.0]	[13.2]

See text.

government spending in GDP grew by almost 3 percentage points between 1979 and 1989, and could explain a 15 percent real appreciation. 1/

The Balassa-Samuelson effect appears to be very important in Italy, and less in Spain. In France, the importance of this effect is small due to the relative similar growth rates of total factor productivity in the tradable and nontradable goods sector. In the case of Germany, the relatively faster growth of productivity in industry in itself would have implied an appreciation of the real exchange rate.

The other explanatory factor, shifts in private demand for nontradable goods, appears also to be an important cause of the real appreciation in some countries. In France, Germany and Italy, the change in the private nominal share of nontradable goods was about 10 percentage points during 1979--89, and in the United Kingdom it grew by 13 percentage points.

Real wage shocks are not included in the regressions, but we can extract some information from the residuals of the regressions. The estimated residual represents the sum of two variables: the autonomous real wage disturbance discussed in the previous sections, and additional orthogonal errors. Therefore, the autonomous real wage shock, while not observable, could be inferred from the estimated residuals, under the maintained assumption that the regression equations are otherwise well-specified. Because the unobserved real wage shock is likely to be highly persistent one should look at the implicit disturbance for the specification in levels.

Figures (8a) to (8e) plot the residuals estimated the level equation of Table 4. 2/ Taking the regression residuals to represent a noisy estimate of the exogenous components of the real wage, we note that in the case of Germany such autonomous component of the real wage tended to increase the relative price of tradables after 1980, while in Italy the opposite occurred after 1979. In France and the United Kingdom we observe two cycles, again of opposite sign. In France the autonomous component of the real wage tended to lower the relative price of tradables between 1977 and 1983, while in the UK there was an increase in the exogenous real wage component before 1975 and after 1985.

It is, of course, tempting to relate these patterns to the stance of monetary policy. In the presence of wage contracts, an imperfectly credible

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1/ For the United Kingdom, government spending can also "explain" part of the real appreciation, but in a regression that has the wrong sign, since government expenditure as a share of GDP actually fell during the period.

2/ The broad time profile of the residuals does not change substantially when other regressions are used, in particular the SUR regressions of table 2. The figures are also not very different when the residuals of the regressions in first differences are used to estimate the residuals from the equation in levels.

disinflation can produce the equivalent of a wage shock leading to a fall of the relative price of tradables. The pattern observed for Italy and Spain seems to match that description. Similarly, the case of France would suggest that the policy of fixing the franc to the Deutsche mark, started in March 1979, was initially not credible, but gained credibility only after the large devaluation of 1983. The case of Germany is also interesting. The credibility of its monetary policy, which has been the anchor of the EMS, may explain why the real wage shock reverted the pressures for a real appreciation. We think that the analysis of these regression residuals might be illuminating. However, the strong upward trend obtained for the last part of the period suggests that there are factors other than the stance of monetary policy behind the progressive increase in the relative price of tradable goods.

V. Concluding Remarks

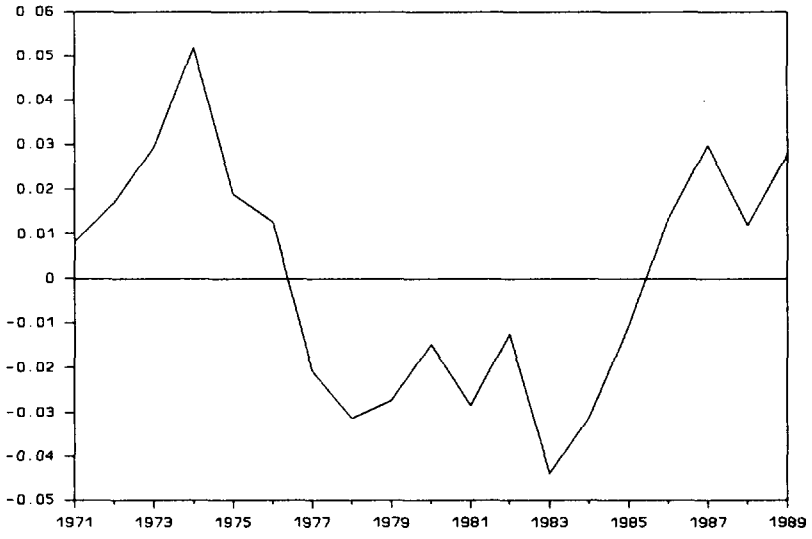
In this concluding comments we focus our discussion on some important aspects not discussed previously in the paper. First, the model assumes that there is free entry in the nontradable goods sector, so profits are equal to zero. A relevant extension would be to analyze the effects of fixing the number of firms, and deriving the implications for the real exchange rate and wages. In particular, we presume that it may provide a clearer description of the effects of productivity growth in the nontradable goods sector. An increase in productivity would lead to an increase in profits of existing firms. This increase in profits could be shared (through bargaining) with workers, exerting upward pressures on wages.

Second, the role of nominal exchange rate policy has not been explicitly considered, since our framework models only the real side of the economy. More precisely, the effectiveness--and magnitude--of a nominal devaluation in helping to recover competitiveness and adjusting the real exchange rate has not been analyzed. Although a devaluation may help to correct relative prices, it can start inflation through its effects on imported intermediate and consumption goods and from there affect also the rate of growth of wages and other prices. A devaluation may also delay the need for the solution to other fundamental economic problems--for example, correction of large fiscal imbalances, and labor and goods market reforms. At the end, the effects of a devaluation will depend on the degree of wage and price stickiness. At the empirical level, more work needs to be done to establish the role of nominal exchange rate policy on the evolution of the real exchange rate.

This brings us to our third remark. Although our model assumes lack of perfect competition in goods and labor markets, it does not provide clear answers on the extent to which these imperfections affect the inflation differential across sectors and countries. For the labor market, one can presume that the degree to which an increase in the target wage affects equilibrium wages depends on the degree of labor market imperfections. For example, the parameter σ in the unions' loss function may depend on the

Figure 8: Residuals of Real Exchange Rate Regressions

(8a) France



(8b) Germany

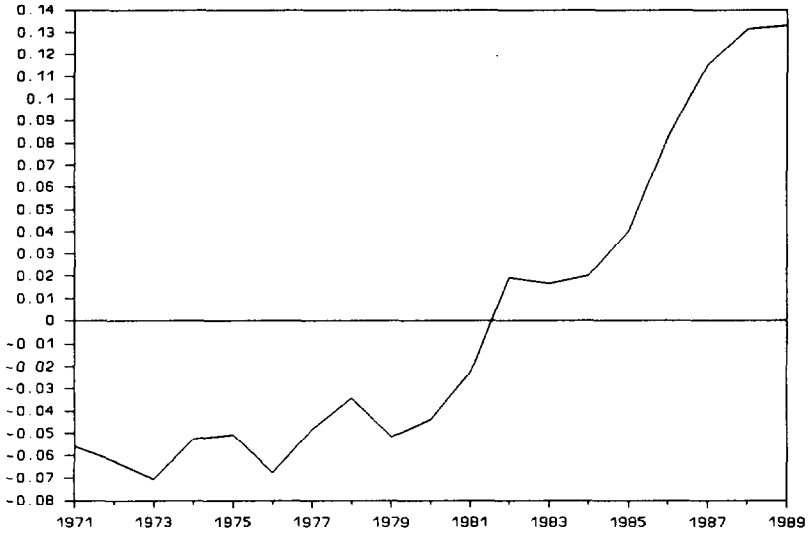
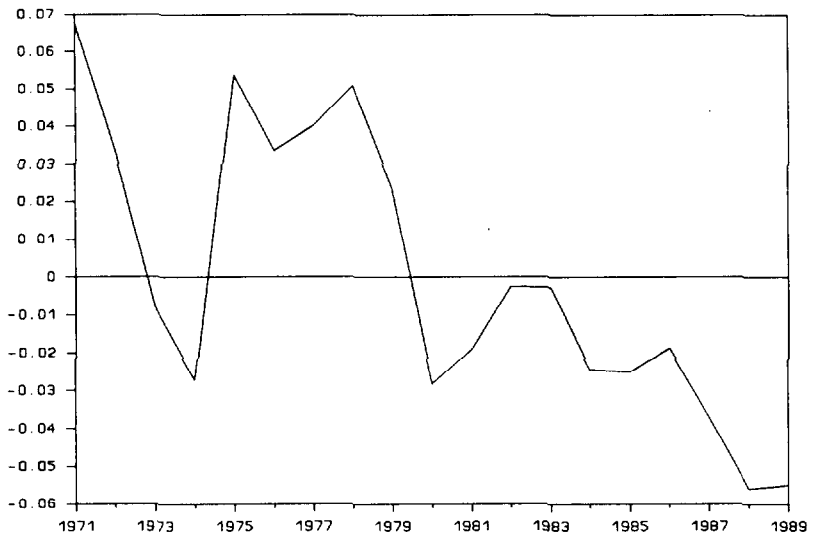


Figure 8 (contd.): Residuals of Real Exchange Rate Regressions

(8c) Italy



(8d) Spain

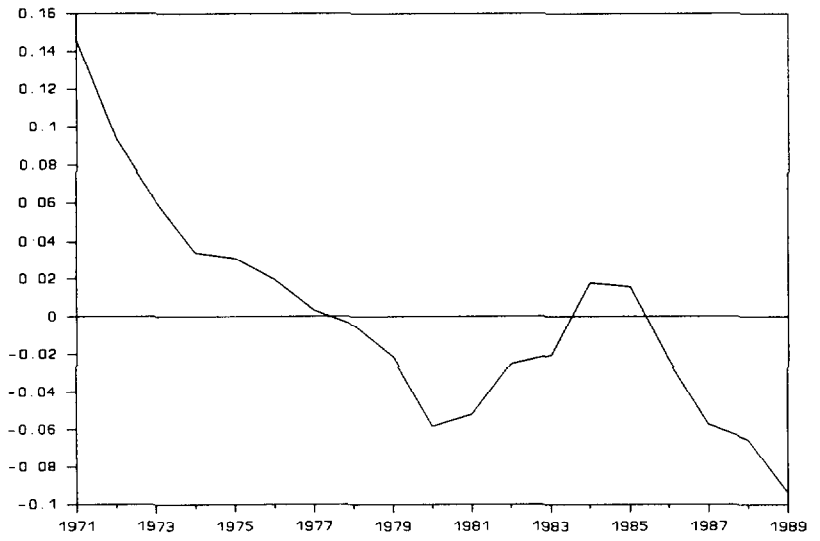
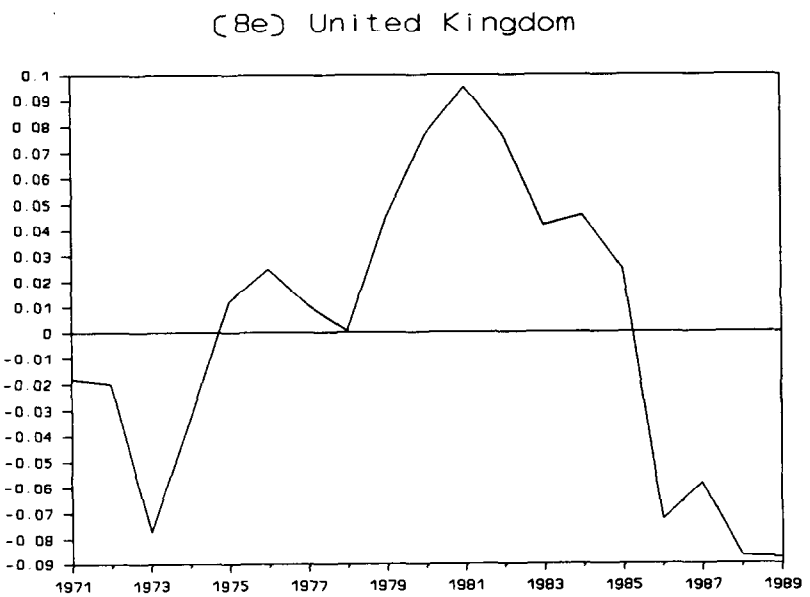


Figure 8 (contd.): Residuals of Real Exchange Rate Regressions



ability that they have to set wages. A low value of α may reflect a union with low monopoly power, and consequently, according to equation (34), the effects of an increase in $\bar{w}$ on equilibrium wages would be small. Nevertheless, further work in studying the role, and the relative importance, of labor and goods market imperfections in preventing inflation convergence is warranted.

Fourth, we have argued that the moderate increase in the share of government expenditure in GDP has little importance in explaining the recent decline of the relative price of tradable goods. Although a reduction of government expenditure can result in a real depreciation, the magnitudes required appear to be too large to rely only on this policy to recover competitiveness. The question is then which policy can help to achieve inflation convergence, or in other words, does this imply that fiscal policy has no role in helping inflation convergence? We think fiscal policy has played a role and can help in recovering competitiveness and speeding inflation convergence, but by channels different from the demand push in the nontradable goods sector.

Fiscal policy could affect the real exchange rate by inducing a wage push. Indeed, if the public perceives that the fiscal position is unsustainable, the wage push will be the result of expectations of higher inflation in the future to solve the fiscal problem (Sargent and Wallace (1981), and Drazen and Helpman (1990)).

In our model, given that prices in the tradable goods sector are constrained by external competition, the inflationary pressures of expansionary fiscal policy will mainly affect the rate of inflation in the nontradable goods sector and consequently will appreciate the real exchange rate. In traditional sticky-prices analysis, fiscal policy affects the rate of inflation in the short run by affecting aggregate demand. The effects on the real exchange rate would be similar to ours, but the general impact of fiscal policy on aggregate demand, rather than only the level of government expenditure, would be the relevant variable for the evolution of the real exchange rate.

Another important channel through which government policy may affect the real exchange rate is via regulation and support of inefficient firms. These activities may also fuel inflation in the nontradable goods sector (Giovannini (1992)). In this case, the relevant measure for the effects government policy on the real exchange rate is not government expenditure, and government actions to induce efficiency and competition in the nontradable goods sector can serve to improve competitiveness.

Data Definitions and Sources

The selection of the variables was largely determined by the availability of data and attempts were made to measure the variables in a consistent way across countries. Most of the series were taken from the national income accounts of each country. For tradable goods sector we used industry (manufacturing and energy), and for Germany it also included construction. Nontradable goods were defined as services. In two cases we excluded non-market services (France and Italy). In France and the UK we also excluded rents for ownership of dwellings. Some preliminary experiments with other classifications revealed that the main results are robust to the inclusion or exclusion of the smaller sectors.

- **Definition of Main Variables**

Real exchange rate. It was defined as the ratio between the implicit deflators in the tradable and nontradable goods sector.

Output Shares. The share of output in the tradable (nontradable) goods sector was defined as the ratio between real value added in the tradable (nontradables) goods sector and the total real value added in those two sectors.

Productivity. Total factor productivity by sector was computed as a Solow residual from a Cobb-Douglas production function with capital and labor as the only factors of production. The stock of capital was taken at the beginning of each year, and the factor shares were obtained directly from national accounts. Average labor productivity is the ratio between value added and employment. The indices of differential total factor productivity were constructed as the ratio between total factor productivity in the tradable goods sector and total factor productivity in the nontradable goods sector. The same procedure was used to construct the indices for the differential of labor productivity.

Nominal private expenditure in tradable and nontradable goods. It was assumed that private expenditure in tradable goods is equal to nominal value added in tradable goods plus the deficit in the trade balance. Government expenditure was assumed to fall only in nontradable goods, and therefore, private expenditure in nontradable goods was assumed to be equal to value added in nontradables minus government expenditure. The actual calculation assumes that the share of government expenditure on real GDP is equal to the share of government expenditure on real value added of industry plus services. To convert the resulting real value of government expenditure to nominal terms, the implicit deflator of the services sector was used. Similarly, it was assumed that the trade balance is composed exclusively of industrial goods and its share over total production of industry and services is the same as the actual figures for the ratio between the trade balance and GDP.

Share of Government Consumption on GDP. Based on values at constant prices of government consumption and GDP.

Current Account and Trade Balance as Share of GDP. It was based on values at current prices of the current account, trade balance and GDP.

- **Basic Variables**

NVAS and RVAS: Nominal and real value added by sectors, respectively.

EMPS: Employment by sector.

WCOMS: Labor compensation by sector.

KS: Capital stock by sector.

GY, CAY and TBY: Government consumption, current account, and trade balance as a proportion of GDP, respectively.

- **Sources by Country**

France (1970-91)
NVAS, RVAS, EMPS, WCOMS, and KS (end of year net capital stock, excludes dwellings) are from INSEE, "Comptes and Indicateurs Economiques, Raport sur les Comptes de la Nation," several issues. The data on KS are only available since 1980 and they were constructed backwards until 1970 using gross fixed capital formation by sectors and the implicit average rate of depreciation for the 1980s. GY, CAY and TBY from OECD, "Main Economic Indicators," and OECD, "Quarterly National Accounts."

Germany (1968-90)
All variables refer to Western Germany. NVAS, RVAS, EMPS, WCOMS, KS and GY are from Statistisches Bundesamt, "Volkswirtschaftliche Gesamtrechnungen," Fachserie 18. CAY and TBY from IMF, "International Financial Statistics," OECD, "Main Economic Indicators," and OECD, "Quarterly National Accounts."

Italy (1960-89)
NVAS, RVAS, EMPS and WCOMS have been constructed from a set of national income accounts built by Prometeia to reconcile the pre-and post-1970 data. WCOMS is only available for dependent employment. For independent employment was assumed the same average compensation. KS corresponds to net capital of machinery as reported in P. Annunziato, P. Manfroni, and G. Rosa, "La Stima del Capitale per Settore e Area Geografica e alcuni Indici de Produttivita," mimeo, 1992. The data are available until 1988. GY, CAY and TBY from IMF, "International Financial Statistics," OECD, "Main Economic Indicators," and OECD, "Quarterly National Accounts."

Spain (1965-90)
NVAS, RVAS, GY, CAY and TBY from Ministerio de Economía y Hacienda,"Economía Española: Series Históricas," Apuntes y Documentos Económicos, March 1991. EMPS from OECD, "Quarterly Labor Statistics." There are no data on KS and WCOMS.

United Kingdom (1970-90)
NVAS, RVAS, EMPS (industry), WCOMS, KS (gross capital stock end of year, excludes dwellings) and GY from Central Statistical Office, "United Kingdom National Accounts, the CSO Blue Book." The data on employment in the service sector are from OECD, "Quarterly Labor Statistics". CAY and TBY from OECD, "Main Economic Indicators," and OECD, "Quarterly National Accounts."

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