UNDERSTANDING SPANISH DUAL INFLATION

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Banco de España — Servicio de Estudios
Documento de Trabajo n.º 0205

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December 2001

Abstract

We explore the implications of the differential behavior of total factor productivity across sectors to understand the dynamics of the relative prices of services to manufacturing sectors. We find that contrary to the predictions of the Balassa-Samuelson hypothesis, the evolution of relative markups between services and manufacturing sectors has been a key determinant of recent Spanish dual inflation.

*At different stages of this project we have benefited from comments provided by José María Bonilla, Jordi Galí, Fernando Restoy and Javier Vallés, as well as seminar participants at the Banco de España. Notwithstanding, the views expressed in this paper are those of the authors and do not represent the view of the Banco de España. E-mails: ESTRADA@BDE.ES and DAVIDL@BDE.ES

1 Introduction

Recently there has been a growing debate on the sources of inflation differentials among countries that have decided to join the European Monetary Union.[1] Fixing the exchange rate and adopting a single monetary policy do not preclude inflation divergences, as they, in principle, can be caused by real factors which do not disappear in the new single monetary regime. Nowadays, the rationale for such a circumstance goes back to the extensively invoked Balassa-Samuelson hypothesis.[2] According to this hypothesis, under fairly general conditions, rapid increases in the productivity in the traded sectors in one country generate increases in the relative prices of non-traded sectors, so inducing positive inflation differentials in those countries relative to other members of the Union. Notwithstanding, those differentials do not represent losses of competitiveness as they reflect an efficient reallocation of resources typically related to a process of catching-up. In this respect, Spain is a particularly interesting case study since, in the last years it has consistently experienced positively inflation differentials vis-a-vis the EMU average accompanied by a considerable and lasting appreciation of the price of non-tradable relative to traded goods (i.e. a dual inflation problem). Not surprisingly, this phenomenom has been explained as a consequence of Balassa-Samuelson effect (i.e. Alberola and Tyrväinen (1998)).

In this paper we focus on an alternative explanation for the existence of relative price differentials. In particular, we depart from a perfectly competitive world and show that the evolution of relative markups is a key element of the dynamics of relative price, and hence of temporary inflation differentials.[3] Notice that our explanation has important policy implications. Hence, if the existence of dual inflation can be described as a result of the evolution of productivity (i.e. Balassa-Samuelson hypothesis), the increases in the relative prices result from an *efficient allocation* of resources across sectors. In our model, since inflation differentials are due to the lack of competition across sectors they can be hardly corrected by means of fiscal and/or monetary policies, but they would requiere changes in the supply conditions of the economy (i.e. by changing the way prices and wages are set up).

In this paper we focus on the recent evolution of relative prices in Spain and make use of a new data set that compiles information from National Accounts and some other sources on seventeen sectors, including manufacturing and services sectors, during the period 1980-1999. This data set makes it possible to compare the relative evolution of productivity growth distinguishing between the sector opened to external competence and the relatively closed services sectors. This dataset was described in

[1] See, e.g., Blanchard (2000), Alesina *et al.* (2001), Sinn and Reutter (2001), ECB(1999), and Alberola and Tyrvainen (1998).

[2] See Balassa (1964) and Samuelson (1964).

[3] For instance, the existence of wage pressures in the economy tends to put upward the wages in both sectors. In the non-traded goods sector, those movements can be translated to higher prices without reducing markups, because this sector is shielded from foreign competition. Nevertheless, in the traded sectors these movements might result in reduction of markups and so in profit squeezing.

detail in Estrada and Lopez-Salido (2001a).

In our empirical strategy we try to use an accurate measure of sectoral productivity. In a companion paper (Estrada and López-Salido (2001b)) we obtained a new index of technological progress that accounted for the presence of increasing returns, imperfect competition, unobserved input variation, external effects and sectorial reallocations. We showed that those factors contribute to explain why the Solow residual underestimates true technological progress. We also showed that, starting in the mid nineties, there has been a deceleration in the aggregate rate of technological growth. This is specially important in the manufacturing sector, while the services sectors have experienced higher growth rates. For the purpose of this paper we made use of those new estimates of technological progress in manufacturing and services sectors to explore its medium run implications alongside those of relative markups for the behavior of the relative prices of non-traded goods (i.e. services vs. manufacturing) in a non-competitive set up.

This paper is organized as follows: in the second section we introduce the baseline model used to explain the evolution of relative prices in terms of relative sectoral productivity (i.e. the Balassa-Samuelson framework.) By relaxing the assumption of zero relative markups we introduce a new source of dual inflation in the economy. Then, in the third section we present the empirical evidence on the explanatory power of both sources of dual inflation in the Spanish economy. Besides we perform a simple exercise to asses the response of the theoretical components of the inflation differential to an increase in the total factor productivity in the traded good sectors.The final section summarizes the main conclusions of this research.

2 The Model

2.1 The Competitive Balassa-Samuelson Set-up

Formally, under Cobb-Douglas technology, perfect mobility of inputs (the nominal price of inputs are equal across sectors) and perfect competition; profit maximization in the simplest two sector extension of the neoclassical growth model implies that the following two conditions will be satisfied:

$$\alpha_T \, A_t^T \left(K_t^T / N_t^T \right)^{1-\alpha_T} = \left(p_t^{NT} / p_t^T \right) \alpha_{NT} \, A_t^{NT} \left(K_t^{NT} / N_t^{NT} \right)^{1-\alpha_{NT}} \tag{1}$$

$$(1-\alpha_T) A_t^T \left(N_t^T / K_t^T \right)^{\alpha_T} = \left(p_t^{NT} / p_t^T \right) (1-\alpha_{NT}) A_t^{NT} \left(N_t^{NT} / K_t^{NT} \right)^{\alpha_{NT}} \tag{2}$$

where α_i $(i = T, \, NT)$[4] represents the elasticity of output to labor in the production function. Notice that, under Cobb-Douglas the term, $A_t^i \, (K_t^i / N_t^i)^{1-\alpha_i}$ in expression

[4]Notice that T stands for tradable sector while NT corresponds to the non-tradable one.

(1), corresponds to the labor productivity, i.e. Y_t^i/N_t^i; and, accordingly, $A_t^i\,(N_t^i/K_t^i)^{\alpha_i}$ is the ratio output-capital, Y_t^i/K_t^i.

In other words, these assumptions imply that the capital-labor ratio in the two sectors will be proportional:

$$\frac{\alpha_T}{1-\alpha_T}\left(K_t^T/N_t^T\right) = \frac{\alpha_{NT}}{1-\alpha_{NT}}\left(K_t^{NT}/N_t^{NT}\right)$$

This implies that the evolution of the relative prices between non-tradables and tradables is, in equilibrium, as follows:

$$\left(p_t^{NT}/p_t^T\right) = \left(A_t^T/A_t^{NT}\right)\left(K_t^T/N_t^T\right)^{\alpha_{NT}-\alpha_T} \tag{3}$$

Thus, the price of non-tradables in terms of tradables can be decompose into two components: first, the ratio of total factor productivity between the two sectors (A_t^T/A_t^{NT}), and, second, the capital-labor ratio in the tradable sector (K_t^T/N_t^T) power to the difference of the labor elasticities in the production of each sector (α_{NT} and α_T, respectively). This expression captures the basic insights of the Balassa-Samuelson idea. The relative price of non-tradables increases when there is an increase in total factor productivity in the tradable sector relative to non-tradable, and when there is an increase in the capital-labor ratio in the tradable sector provided that production in the latter sector is less labor intensive. Notice that, if $\alpha_{NT} = \alpha_T$, then the evolution of relative prices is completely exogenous, and it is driven by productivity shocks.

2.2 Relaxing Perfect Competion

Expression (3) can be generalized by allowing for some sort of imperfect competition in the good markets across sectors. In particular, simple algebra implies that, under fairly general conditions the relative price of non-tradables can be written as follows:

$$\left(p_t^{NT}/p_t^T\right) = \left(A_t^T/A_t^{NT}\right)\left(K_t^T/N_t^T\right)^{\alpha_{NT}-\alpha_T}\left(\mu_t^{NT}/\mu_t^T\right) \tag{4}$$

where (μ_t^{NT}/μ_t^T) represents the relative markup between the non-tradable sector and the tradable sector. The higher this ratio the higher the relative price of non-tradables. Notice also that this expression collapses to the previous one (3) when there is no time variation in these markups. Thus, it is possible that even with a similar evolution of productivity across sectors, there could be variations in the relative prices as a consequence of persistent differences in the relative markups.[5] Most studies tend to focus on the evolution of inflation rates, in addition to relative prices. The implications of previous expressions for inflation are straightforward. Thus, taking logs and first differences in expression (4) yields:

[5] A key element is then to explain why there can be persistent differences in the markup. This deserves future research that it is in our agenda.

$$\Delta(p_t^{NT} - p_t^T) = \Delta(a_t^T - a_t^{NT}) + (\alpha_{NT} - \alpha_T)\Delta(k_t^T - n_t^T) + \Delta(\mu_t^{NT} - \mu_t^T)$$

where Δ is the first differences operator. That is:

$$\pi_t^{NT} - \pi_t^T = \Delta(a_t^T - a_t^{NT}) + (\alpha_{NT} - \alpha_T)\Delta(k_t^T - n_t^T) + \Delta(\mu_t^{NT} - \mu_t^T) \qquad (5)$$

where $(\pi_t^{NT} - \pi_t^T)$ represents the inflation sectoral differentials. Notice that to have permanent (i.e. very long-lasting) differences in inflation which are not related to permanent differences in the rate growth of total factor productivity, we need a positive and constant growth rate of the capital-labor ratio in the tradable goods sector. But, even in this case, its implications for dual inflation depends upon $(\alpha_{NT} - \alpha_T)$, i.e. the intensity of labor in the closed sectors relative to the opened.[6] Besides, those two technological factors that are related to the traditional Balassa-Samuelson effect, we will need a positive and constant growth rate markup differential as to explain persistent inflation differences.

3 Results

3.1 Relative Prices

Starting with the evolution of relative prices, in Figure 1 (A) we show the evolution of the three variables of expression (3) during the period 1980-1999: (i) the relative price of non-tradables, p_t^{NT}/p_t^T, (ii) the ratio of total factor productivities A_t^T/A_t^{NT}, and (iii) the capital -labor ratio in the tradable sector, K_t^T/N_t^T.[7] First, it should be noticed there is clear evidence of a persistent process of price divergence between non-tradable and tradable sectors. This increase in the relative price has been coupled with an important increase in the capital-labor ratio in the manufacturing sector, specially until 1992. Second, it is also apparent the increase in the technological progress in the manufacturing sector relative to the service sector, although this is less intensive than the evolution of the capital-labor ratio, and it dissapears somewhere during the mid nineties. This suggests that Balassa-Samuelson effects might have been of some relevance to explain relative prices.

Figure 1 (B) displays how much of the evolution of relative prices can be explained by the traditional Balassa-Samuelson hypothesis, i.e. it shows the differences between relative prices, the ratio of technology indexes and the *adjusted* capital-labor ratio (dark line).[8] As can be seen, the simple Balassa-Samuelson story can not account for either the small price divergence of the eighties, or the real appreciation in the

[6] This aspect was emphasized by Rebelo (1992).

[7] All these series have been normalized to be 100 in 1980.

[8] In order to account for the evolution of the relative prices we have to adjust the evolution of the capital-labor ratio by the relative labor elasticities (see expression (3)). We have calibrated these

relative price of non-traded goods during the nineties (i.e. the line is negative during the eighties and positive during the nineties). In other words, if movements in relative prices would have reflected movements in relative productivities, they should have increased much more during the eighties and much less during the nineties, something clearly at odds with what we have observed.

Hence, as the expression (4) suggests, accounting for the evolution of relative markups, could potentially helps in explaining the long-lasting deviations of relative prices and relative productivities. As a first approximation, we have proxied these sectoral markups through the inverse of the real unit labor costs.[9] The grey line displayed in the panel B of Figure 1 corresponds to the deviations of relative prices with respect to its two main determinants according to expression (4): technologicals (i.e. $A_t^T/A_t^{NT}\left(K_t^T/N_t^T\right)^{\alpha_{NT}-\alpha_T}$), and markups ($\mu_t^{NT}/\mu_t^T$). Hence, as can be seen the grey line is very close to zero, so the consideration of markups mostly explain the persistent deviations between prices and its technological factors observed during our sample period.[10]

3.2 Implications for Inflation

In the previous section we have referred to the relative price levels of non-tradable and tradable goods. We now pursue a similar analysis in terms of price changes. Following expression (5) we can decompose relative price changes of non-tradable and tradable sectors into the relative technology growth, the capital-labor ratio in the tradable sectors (weighted by the difference in the labor intensity in both sectors) and the relative changes in the markups.

Before showing such a decomposition it is interesting to compare our aggregate measure of inflation corresponding to the sectors included in our sample (π^{ELS}) with

elasticities using information on the average labor income share in both sectors. Over that sample period we obtain that these shares are 65.9% and 66.4% for the tradable (manufacturing) and the non-tradable (services), respectively. Under imperfect competition there is a simple relationship between the labor intensity in the production function and these shares: i.e. $\alpha_j = \frac{Sj}{\mu_j}$, $j = NT, T$, where S represents the labor income share and μ the steady state markup. We have calculated these labor elasticities using that for our sample period the steady stata marups are $\mu_{NT} = 1.13$ and $\mu_T = 1.20$, respectively. This implies the following values for the labor elasticities: $\alpha_{NT} = 0.59$ and $\alpha_T = 0.55$, respectively.

[9] As discussed by Rotemberg and Woodford (1999), this constitutes a baseline definition of markups under Cobb-Douglas technology. Alternative definitions of technology (i.e.CES, overhead labor, or adjustment cost) will slightly modify the definition of the marginal cost. The exploration of how those definitions would affect the cyclical properties of sectoral markups is part of our ongoing research.

[10] Interestingly, the correlation between the deviation of relative prices from the Balassa-Samuelson hypothesis (i.e. $\left(p_t^{NT}/p_t^T\right) - \left(A_t^T/A_t^{NT}\right)\left(K_t^T/N_t^T\right)^{\alpha_{NT}-\alpha_T}$ in expression (3)) and the relative markups is positive and close to one. That is, runing an OLS regression of the deviation of relative prices from Balassa-Samuelson hypothesis on the relative markups we can not reject a slope coefficient equal to one.

two more usual measures of inflation: i.e. CPI inflation (π^{CPI}) and the inflation in the GDP deflator (π^{GDP}). As it can be seen in Table 1 and Figure 2(A), our measure of inflation tracks quite well both the CPI and the GDP inflation measures. The existence of discrepancies can be explained by the different scope and/or methodology of the indicators used to construct our price deflators.

In Figure 2(B) we have decomposed inflation between changes in the price of the non-tradable and tradable sectors. As it can be seen, for most of the sample period, inflation in non-tradables has been higher than in tradables (as shown in Table 1 the exceptions are the years 1984 and 1986). Another remark is that changes in relative price differentials are far from being constant: dual inflation was high (nearly 5%) at the begining of the eighties, reached a maximum value at the beginning of the nineties (nearly 6%), remaining almost constant and positive (3%) late in the nineties.

As it can be seen from Table 2 and Figure 2(C), at the beginning of the eighties, the inflation differentials between non-tradable and tradable sectors were mainly the result of a productivity growth rate in the tradable sectors well above the non-tradable sectors, with the markups counteracting this effect. At the begining of the nineties the dual inflation problem of the Spanish economy reached its maximum as the result of the high technology growth in the tradable sectors as well as a sustantial expansion of markups in the non-tradable sectors, where the latter effect was quantitavely stronger. This evolution of relative markups could be the result of the constraints faced by the tradable sectors seting their prices (specially in a context of currency appreciation), something not relevant for the non-tradable sectors, that, besides, could take advantage of the low degree of competition in domestic markets in expanding their markups. In the last part of the nineties the dual inflation phenomenon has been still present, although it has been smaller than in previous episodes. In this period the only responsible for that gap has been the relative evolution of markups in the non-tradable sectors, with relative productivity growth in the tradable sectors acting with a negative sign, just the opposite of the Balassa-Samuelson hypothesis.

3.3 Adjustment to Technology Improvements

In this section we try to answer the following question: what are the effects on relative prices, of an one percent permanent increase in the log-level of aggregate total factor productivity due to an increase in the productivity of tradable goods sectors? In other words we will try to analize the convergence to the new steady state of the relative prices, the capital-labor ratio in tradables and the relative markups, i.e. the components of expressions (4) and (5), in response to an exogenous movements in the total factor productivity differential.

To do that we run a simple three-variable VAR model using annual data from 1980-1999 on the first differences of: $(a_t^T - a_t^{NT})$, $(k_t^T - n_t^T)$, and $(p_t^{NT} - p_t^T)$. Notice that using expressions (4) and (5), we can also recover, the endogenous response of relative markups $(\mu_t^{NT} - \mu_t^T)$. The VAR is ordered as relative technology, capital-labor ratio in traded goods sectors, and relative prices of non-traded goods. Placing relative technology first reflects that technology is Wold causally prior of the rest of the variables, so exogenous movements in technology affect contemporaneously the variables but are not affected by movements in inputs and price movements. The lag-length of the VAR is one year, and we also report a ± 1.0 error confidence bands computed *via* 1000 RATS Monte Carlo simulations.[11] In Figures 3(A) and 3(B) we plot the adjustment of both the level and the first differences of the variables to a slightly above 2% permanent shock to the level in relative productivity of traded-goods sectors (up-left panel of Figure 3(A)). In our data set, the average weight of the tradable sectors on aggregate productivity is 0.45. Hence, a 2.2% increase in traded-goods productivity corresponds to a 1% increase in aggregate total factor productivity.

The up-left panels of Figures 3(A) and 3(B) represent the dynamic adjustment of both the level and the first differences of relative productivity. This shock leads to a slightly decrease in the capital-labor ratio in the traded-goods sectors,[12] while there is an increase in relative prices, as expected from expression (4). Nevertheless, the increase in productivity does not translate into a one-to-one increase in the relative price of non-traded goods as predicted by the frictionless Balassa-Samuelson story. On the contrary, there is lower response in prices resulting from the endogenous response of relative markups. In particular, the response of traded-good markups tends to be higher than the one of non-traded goods sectors, so partially reducing the effects of technology shocks on relative prices.

4 Conclusions

We have made use of *adjusted Solow residuals* estimated in our companion paper Estrada and López-Salido (2001b) to explain the sources of Spanish dual inflation. The adjustment attempts to correct for the bias associated with the potential presence of imperfect competition, increasing returns, variable input utilization, and specially sectorial reallocation of inputs across sectors. We have explored the medium run implications of the differential behavior of total factor productivity to understand the behavior of the relative prices of non-traded goods (i.e. services). Contrary to the predictions of the Balassa-Samuelson hypothesis we emphasize the evolution of relative markups between services and manufacturing sectors in the nineties as a key determinant of recent Spanish dual inflation.

Finally, we have analyzed the dynamic effects on relative prices, of an one percent permanent increase in the level of aggregate total factor productivity due to an

[11] In general, all the series can be well approximated by AR(1) processes at 5% significant level. The responses are very similar if we estimate the VAR in levels and/or adding more lags to the system. A RATS file to replicate the results is available from the authors upon request.

[12] This was one of the factors emphasized by Rebelo (1992), which does not apply to the Spanish case.

increase in the productivity of tradable goods sectors. We showed that the endogenous response of markups in tradable goods sectors is a key variable to understand the evolution of relative price differentials after the shock. In particular, our results point towards a procyclical movement of markups with sectoral output. All in all, the analysis of this issue requieres a complete model so deserving future research.

Table 1. Spanish Dual Inflation

Year	*Variables*				
	π^{CPI}	π^{GDP}	π^{ELS}	π^{T}	π^{NT}
1981	13.6	11.6	11.5	9.6	12.9
1982	13.5	12.7	13.5	10.6	15.5
1983	11.5	11.2	11.9	11.7	12.2
1984	10.7	10.3	9.3	13.5	7.5
1985	8.4	8.3	8.9	8.0	9.5
1986	8.4	10.3	9.7	10.6	9.3
1987	5.1	5.8	5.0	3.0	6.2
1988	4.7	5.8	5.7	4.4	6.5
1989	6.6	6.7	6.0	5.5	6.3
1990	6.5	7.1	6.6	2.8	8.7
1991	5.8	6.7	5.8	2.2	7.7
1992	5.8	6.5	5.9	2.0	7.7
1993	4.5	4.4	5.0	1.6	6.5
1994	4.6	3.8	3.6	1.8	4.3
1995	4.5	4.8	4.9	4.4	5.1
1996	3.5	3.5	3.7	2.9	4.0
1997	2.0	2.2	2.6	1.3	3.1
1998	1.8	2.2	2.3	1.0	2.8
1999	2.3	2.8	2.6	1.2	3.1

Table 2. Spanish Dual Inflation: A Decomposition

Year	*Variables*			
	$\pi^{NT}-\pi^{T}$	$\Delta(a_t^T-a_t^{NT})$	$\Delta(k_t^T-n_t^T)$	$\Delta(\mu_t^{NT}-\mu_t^T)$
1981	3.3	7.8	0.3	-0.7
1982	4.9	5.3	0.2	3.0
1983	0.4	4.1	0.1	-3.2
1984	-5.9	-5.6	0.1	-0.7
1985	1.4	2.1	0.1	-0.2
1986	-1.3	2.1	-0.1	-2.5
1987	3.2	0.2	0.0	0.9
1988	2.1	0.5	0.1	0.4
1989	0.8	-0.3	0.1	1.7
1990	5.9	0.9	0.1	6.7
1991	5.5	2.2	0.3	3.4
1992	5.6	0.4	0.3	5.9
1993	4.9	0.8	0.3	5.5
1994	2.5	1.5	0.0	-1.5
1995	0.7	3.1	-0.0	-3.4
1996	1.1	0.3	0.0	1.7
1997	1.8	0.2	-0.1	0.5
1998	1.8	-0.6	-0.1	0.5
1999	1.8	-0.9	0.1	1.1

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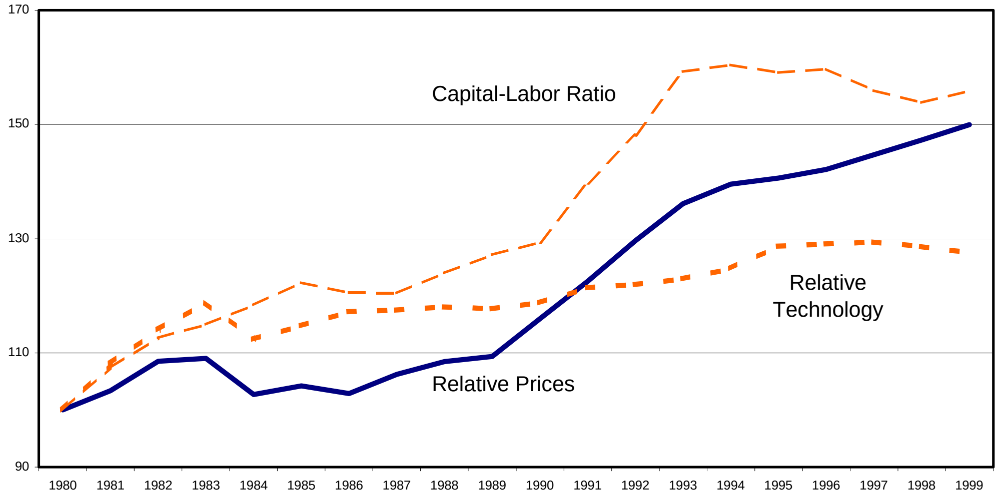
FIGURE 1. RELATIVE PRICES

(A) Relative Prices and Technology



(B) Deviation of Relative Prices from their Determinants

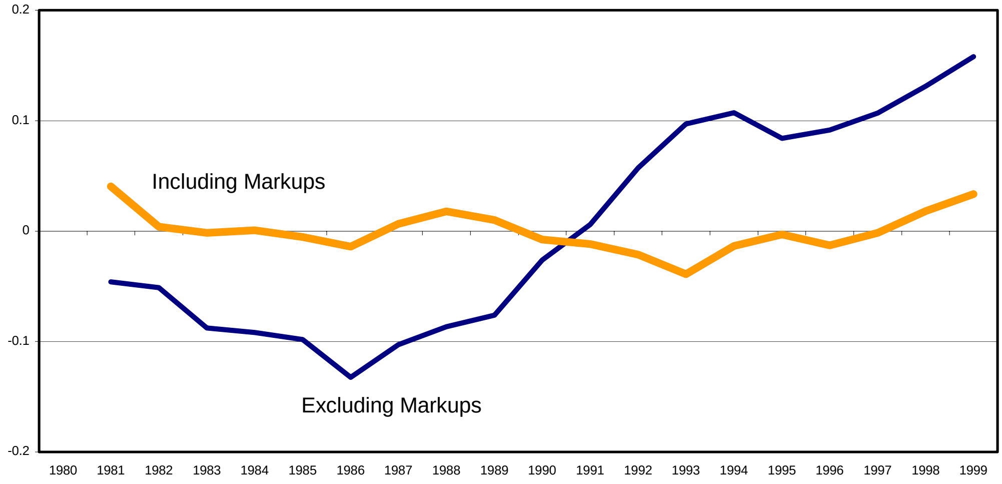
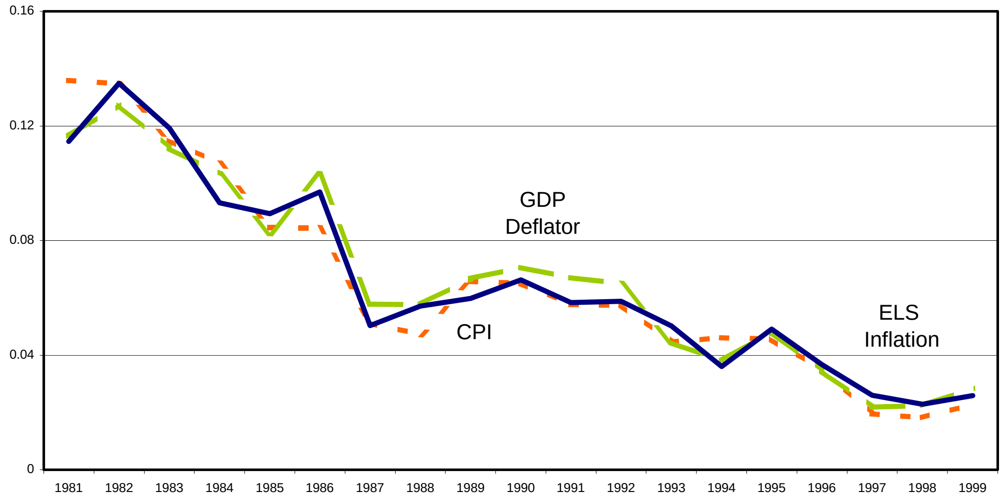
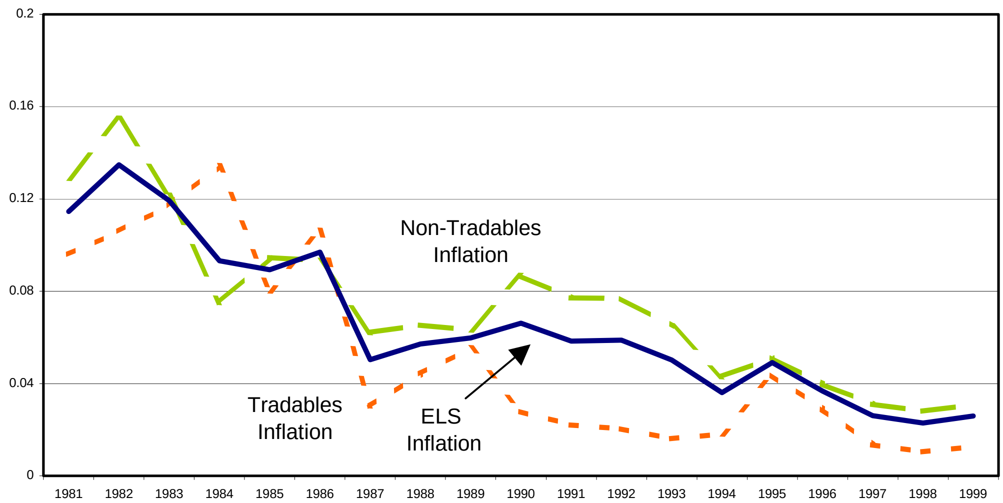


FIGURE 2. INFLATION DIFFERENTIALS

(A) DIFFERENT INFLATION MEASURES



(B) TRADABLES AND NON TRADABLES INFLATION



(C) INFLATION DIFFERENTIAL DECOMPOSITION

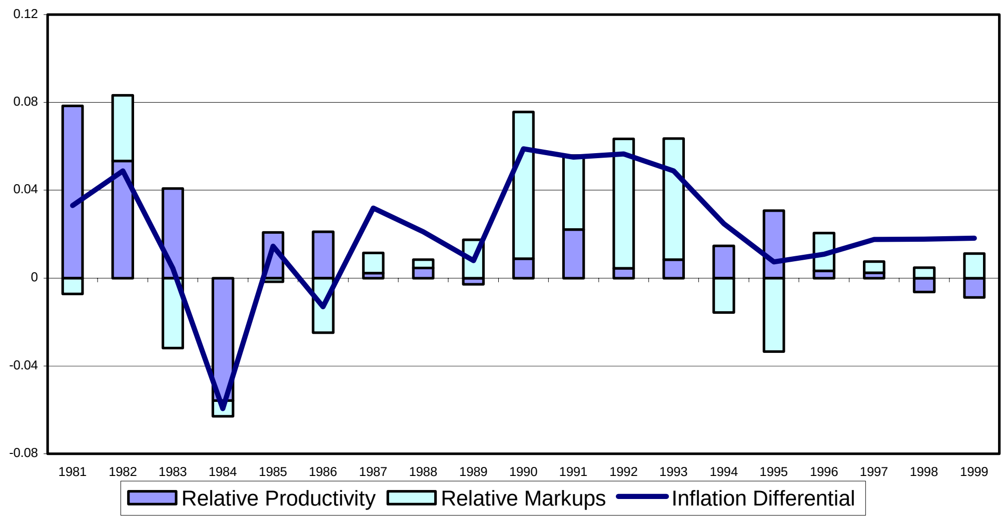


Figure 3(A). Adjustment to a Technology Improvement

Levels

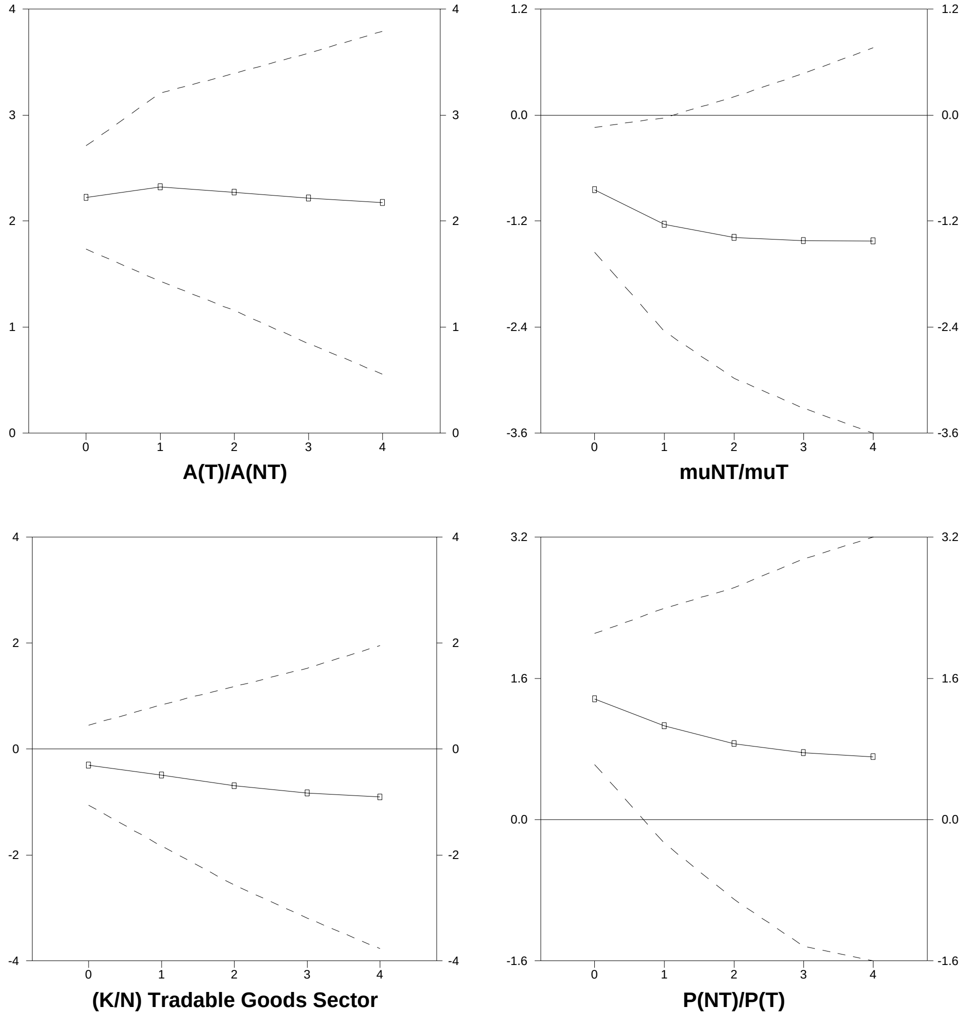


Figure 3(B). Adjustment to a Technology Improvement

First Differences