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UNDERSTANDING SPANISH DUAL INFLATION

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We explore the implications of the differential behavior of total factor productivity across sectors for understanding the dynamics of the relative prices of services and manufactures. We find that, in the second half of the nineties, contrary to the assumptions of the Balassa-Samuelson hypothesis, the relative evolution of the markups of the services and manufacturing sectors has been a key determinant of what we refer to as Spanish dual inflation.

Keywords: Inflation, productivity, markups.

(*JEL* E31, D24, D43)

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 does not preclude inflation divergences as, in principle, they can be caused by real factors which do not disappear in the new single monetary regime. Nowadays, the rationale for such a circumstance is based on the extensively invoked Balassa-Samuelson hypothesis.[2] According to this hypothesis, under fairly general conditions, rapid increases in productivity in the traded sectors of one country generate increases in relative prices in its non-traded sectors, so inducing positive inflation differentials in those countries relative to other members

At different stages of this project we have benefited from comments by Samuel Bentolila (the editor) and two referees of this Journal, as well as those provided by José María Bonilla, Jordi Galí, Fernando Restoy, and Javier Vallés. However, the views expressed in this paper are those of the authors and do not represent the view of the Banco de España.

[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).

of the Union. However, these differentials do not represent losses of competitiveness as they reflect an efficient reallocation of resources typically associated with a process of catching-up. In this respect, Spain is a particularly interesting case study since, in recent years it has consistently experienced positive inflation differentials vis-à-vis the euro area average accompanied by a considerable and lasting increase in the price of non-tradable relative to traded goods (i.e. a dual inflation problem). Not surprisingly, this phenomenom has often been interpreted as a reflection of the Balassa-Samuelson effect (i.e. Alberola and Tyrväinen (1998))[3].

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 relative evolution of markups is a key element of the dynamics of relative sectoral prices, and hence of temporary inflation differentials[4]. Notice that our explanation could have important policy implications. 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 relative prices result from an *efficient allocation* of resources across sectors. In our model, since inflation differentials are due to lack of competition they can hardly be corrected by means of fiscal and/or monetary policies, but require changes in the supply conditions of the economy (i.e. changes in the way prices and wages are set)[5].

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 various other sources on seventeen sectors, including the manufacturing and services sectors, during the period 1980-2000.

[3] Early contributions to the understanding of dual inflation from an international perspective are Giovannini *et al.* (1994, 1994a). Martín Moreno (1999) also develops a model where demand presures can translate into relative price differentials.

[4] For instance, the existence of wage pressures in the economy tends to push up wages in both sectors. In the non-traded goods sector, these rises can be passed through to higher prices without reducing markups, because this sector is shielded from foreign competition. Nevertheless, in the traded sectors these rises might result in lower markups and so in profit squeezing.

[5] The difference in policy implications is not so clear cut. Some papers have shown that higher competition is associated with higher productivity growth in Spain (see, for example, Hernando and Vallés (1994) or Martín and Jaumandreu (1998)), so perhaps the moderate evolution of productivity in the non-tradable sectors is again a reflection of low competition. Alternatively, the Balassa-Samuelson story can be thought as a reduced form reflecting not only the lack of competition in non-traded good, but the effects of trade on the productivity of tradable good sectors.

This data set makes it possible to compare the relative evolution of productivity growth distinguishing between the sector open to external competition and the relatively closed service sector.

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 accounts for the presence of increasing returns, imperfect competition, unobserved input variation, external effects and sectoral reallocations. We showed that these factors help to explain the differences between Solow residuals and true technological progress. We also showed that, from the mid-nineties, there has been a deceleration in the aggregate rate of technological growth. This has been especially significant in the manufacturing sector, while the services sector has experienced higher growth rates. This fact contrasts with the standard Balassa-Samuelson assumption. For the purposes of this paper we have made use of these new estimates of technological progress in manufacturing and services to explore their 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. The final section summarizes the main conclusions of this research.

2. The model

2.1. The competitive Balassa-Samuelson setup

Under Cobb-Douglas technology, perfect mobility of inputs (so that the prices of inputs are equal across sectors) and perfect competition, profit maximization in the simplest two sector extension of the neoclassical growth model implies the following two first order conditions for each sector (T, tradable; NT, non-tradable):

$$\alpha^i \; A_t^i \; \left(K_t^i/N_t^i\right)^{1-\alpha^i} = \left(W_t/P_t^i\right), \qquad i = T, NT \quad [1]$$

$$\left(1-\alpha^i\right) \; A_t^i \; \left(N_t^i/K_t^i\right)^{\alpha^i} = \left(UC_t/P_t^i\right), \qquad i = T, NT \quad [2]$$

where α represents the elasticity of output to labor in the production function, A is total factor productivity, K the capital stock, N labor, W the wage, P the price of output and UC the user cost of capital. Perfect input mobility across sectors implies that the wage rate and the user cost of capital are equal across sectors. Hence it is possible to combine the previous optimality conditions to obtain:

$$\alpha^T\ A_t^T\ \left(K_t^T/N_t^T\right)^{1-\alpha^T} = \left(P_t^{NT}/P_t^T\right)\ \alpha^{NT}\ A_t^{NT}\ \left(K_t^{NT}/N_t^{NT}\right)^{1-\alpha^{NT}} \quad [3]$$

$$(1-\alpha^T)A_t^T\left(N_t^T/K_t^T\right)^{\alpha^T} = \left(P_t^{NT}/P_t^T\right)(1-\alpha^{NT})A_t^{NT}\left(N_t^{NT}/K_t^{NT}\right)^{\alpha^{NT}} \quad [4]$$

Notice that, under Cobb-Douglas, the term, $A\ (K/N)^{1-\alpha}$ in expression [3], corresponds to labor productivity, i.e. Y/N; and, accordingly, $A\ (N/K)^{\alpha}$ is the output-capital ratio, Y/K. 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 of non-tradables and tradables is, in equilibrium, as follows:

$$\left(P_t^{NT}/P_t^T\right) = \Psi\ \left(A_t^T/A_t^{NT}\right)\left(K_t^T/N_t^T\right)^{\alpha^{NT}-\alpha^T} \quad [5]$$

where Ψ is a constant term that involves the capital shares of tradables and non-tradables, respectively.

Thus, the price of non-tradables in terms of tradables can be decomposed into two components: first, the ratio of total factor productivity between the two sectors (A^T/A^{NT}), and, second, the capital-labor ratio in the tradable sector (K^T/N^T) raised to the power of 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 the non-tradable one. In addition, the effect on the relative prices of the capital-labor ratio in the tradable sector depends upon the relative labor intensity across sectors. Notice that if $\alpha^{NT} = \alpha^T$, the evolution of relative prices is completely exogenous, as it is driven by productivity shocks.

2.2. Relaxing perfect competion

When allowing for imperfect competition, simple algebra leads expressions [1] and [2] to be modified as follows[6]:

$$\alpha^i \; A_t^i \; \left(K_t^i/N_t^i\right)^{1-\alpha^i} = \mu_t^i \left(W_t/P_t^i\right), \qquad i = T, NT \qquad [6]$$

$$\left(1-\alpha^i\right) \; A_t^i \; \left(N_t^i/K_t^i\right)^{\alpha^i} = \mu_t^i \left(UC_t/P_t^i\right), \qquad i = T, NT \qquad [7]$$

where μ captures the markup, or more generally any deviation from perfect competition. Substituting the production function in expression [6], the markup will be equal to:

$$\mu_t^i = \alpha^i \left(P_t^i Y_t^i / W_t N_t^i\right), \qquad i = T, NT \qquad [8]$$

the inverse of the labor income share, scaled by the elasticity of output to labor.

Using expressions [6] and [7] and the condition of proportionality among the capital-labor ratio across sectors, the relative price of non-tradables can be expressed as follows:

$$\left(P_t^{NT}/P_t^T\right) = \left(A_t^T/A_t^{NT}\right)\left(K_t^T/N_t^T\right)^{\alpha^{NT}-\alpha^T}\left(\mu_t^{NT}/\mu_t^T\right) \qquad [9]$$

where (μ_t^{NT}/μ_t^T) represents the relative markup of 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 is equivalent to the previous one [5] except for a constant 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 variations in the relative markups[7].

Most studies tend to focus on the evolution of inflation rates, in addition to relative prices. The implications of the previous expressions for inflation are straightforward. Thus, taking logs and first differences in expression [9] yields:

$$\pi_t^{NT} - \pi_t^T = \Delta(a_t^T - a_t^{NT}) + (\alpha^{NT} - \alpha^T)\Delta(k_t^T - n_t^T) + \Delta(\mu_t^{NT} - \mu_t^T) \quad [10]$$

[6] Even though the tradable sector is open to international trade, markups can vary over time if, for example, there is product differenciation and price stickiness.

[7] A key element is then to explain why there can be persistent variations in the markups. This is part of our current research agenda.

where $(\pi_t^{NT} - \pi_t^T)$ represents the sectoral inflation differential, Δ is the first difference operator, and finally the lower case letters represent the log of the corresponding variable. Notice that to have permanent (i.e. very long-lasting) differences in inflation which are not related to permanent differences in the growth rate of total factor productivity, we need a constant growth rate of the capital-labor ratio in the tradable goods sector. But, even in this case, the implications for dual inflation depend upon $(\alpha^{NT} - \alpha^T)$, i.e. the intensity of labor in the closed sectors relative to the more open ones[8]. Apart from changes in productivity and capital-labor ratios, only a positive change in the markup differential can 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 [5] during the period 1980-2000[9]: (i) the relative price of non-tradables, $\left(p_t^{NT}/p_t^T\right)$, (ii) the ratio of total factor productivities, $\left(A_t^T/A_t^{NT}\right)$, and (iii) the capital-labor ratio in the tradable sector, $\left(K_t^T/N_t^T\right)$[10]. First, 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, especially until 1992. Second, the increase in technological progress in the manufacturing sector relative to the service sector is also apparent, although this is less pronounced than the change in the capital-labor ratio, and it dissapears somewhere around the mid-nineties. This suggests that Balassa-Samuelson effects might have been of some relevance to explain relative prices.

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

[9] In the Appendix we describe the data set used in this paper. In particular, prices are approximated by value added deflators and labor by total hours.

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

FIGURE 1
Relative prices

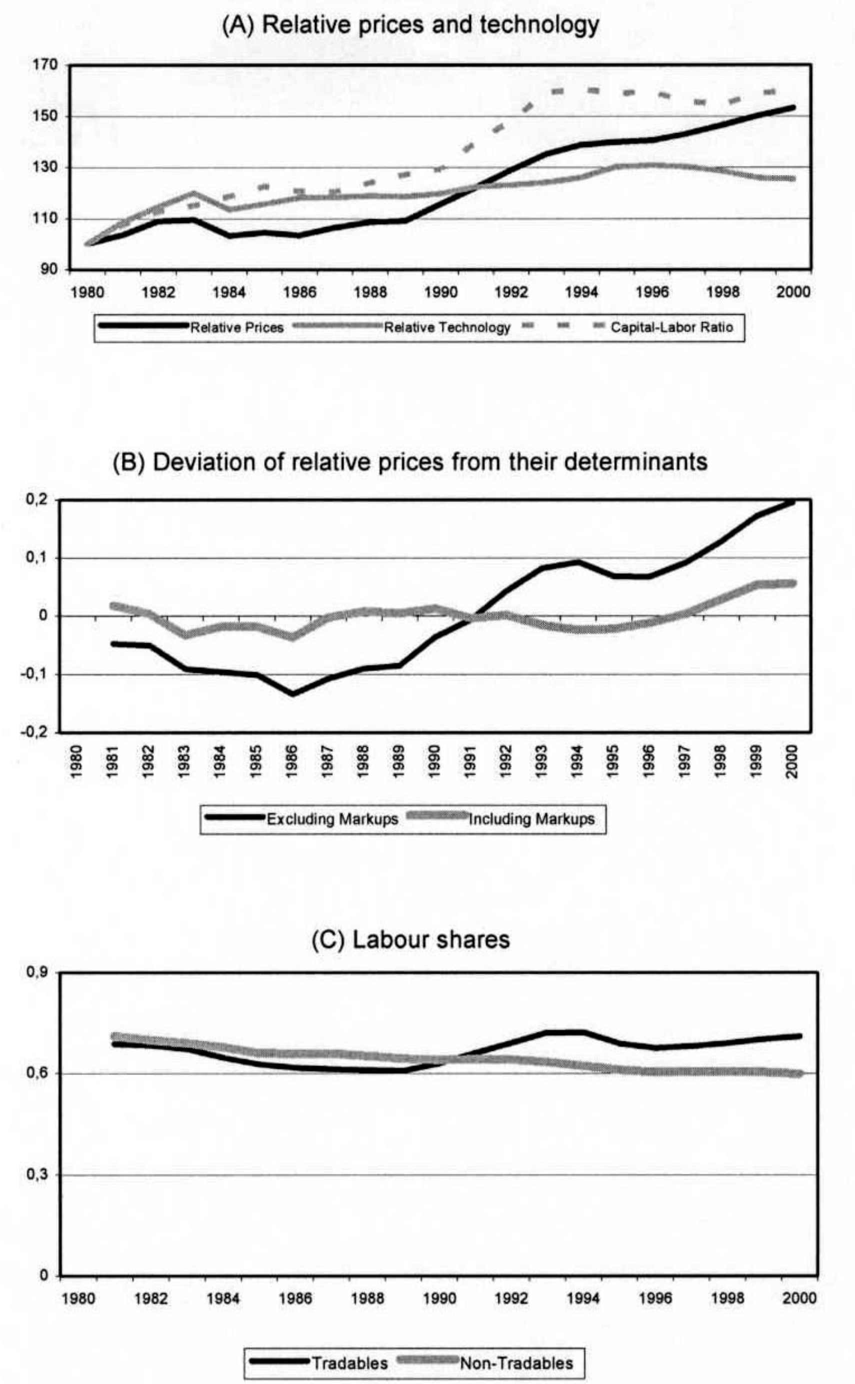


Figure 1(B) shows how much of the evolution of relative prices can be explained by the traditional Balassa-Samuelson hypothesis, i.e. it shows the differences between relative prices, the ratio of technology indices and the *adjusted* capital-labor ratio -dark line- (this corresponds to expression [5]). The grey line in panel B of Figure 1 depicts the deviations of relative prices with respect to their two main determinants according to expression [9]: technological progress (i.e. $\left(A_t^T/A_t^{NT}\right)\left(K_t^T/N_t^T\right)^{\alpha_{NT}-\alpha_T}$), and markups (μ_t^{NT}/μ_t^T).

In order to account for the path of relative prices we have to adjust the capital-labor ratio by the relative labor elasticities. We have calibrated these elasticities using information on the average labor income share in both sectors. Over the sample period we find that these shares are 66.6 % and 64.3 % for the tradable (manufacturing) and the non-tradable (services) sectors, respectively (see Figure 1(C)). Under imperfect competition there is a simple relationship between the labor intensity in the production function and these shares: i.e. $\alpha_j = \mu_j$ Sj, $for\ j = NT, T$, where S represents the labor income share and μ the steady state markup. We have calculated these labor elasticities using the fact that for our sample period the steady state markups are $\mu_{NT} = 1.12$ and $\mu_T = 1.18$, respectively (under the assumption of constant returns to scale, these figures were calculated from the results of Estrada and López-Salido (2001b)). This implies the following values for the labor elasticities: $\alpha_{NT} = 0.72$ and $\alpha_T = 0.79$, respectively. As can be seen, the simple Balassa-Samuelson story cannot account for either the small price divergence of the eighties, or the real increase in the 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, had movements in relative prices reflected movements in relative productivities, they would have increased much more during the eighties and much less during the nineties, which is clearly at odds with what we have observed. Hence, as expression [9] suggests, accounting for the evolution of relative markups, could potentially help explain the long-lasting deviations of relative prices and relative productivities. As a first approximation, we have proxied these sectoral markups through the inverse of real unit labor costs[11]. As can be seen

[11] 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, although without very significant effects on our empirical results.

the grey line is very close to zero, so the consideration of markups mostly enables us to explain most of the persistent deviations between prices and technological factors observed during our sample period.

3.2. Implications for inflation

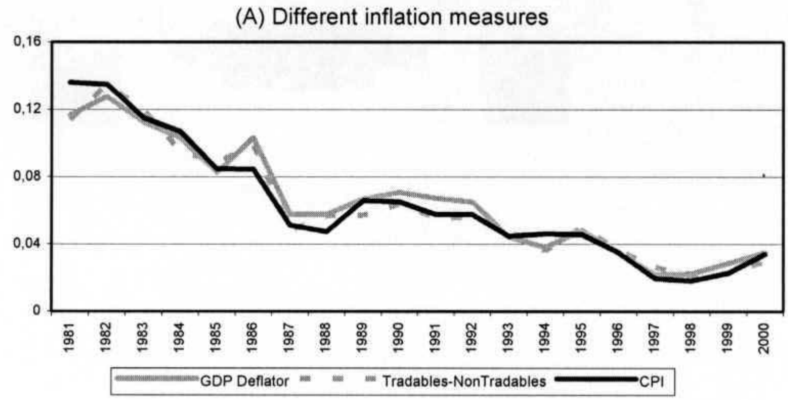
In the previous section we referred to the relative price levels of non-tradable and tradable goods. We now pursue a similar analysis in terms of price changes. Following expression [10], we can decompose the relative price changes of non-tradable and tradable sectors into the relative technology growth, the capital-labor ratio changes in the tradable sectors (weighted by the difference in the labor intensity between the two sectors) and the relative changes in the markups.

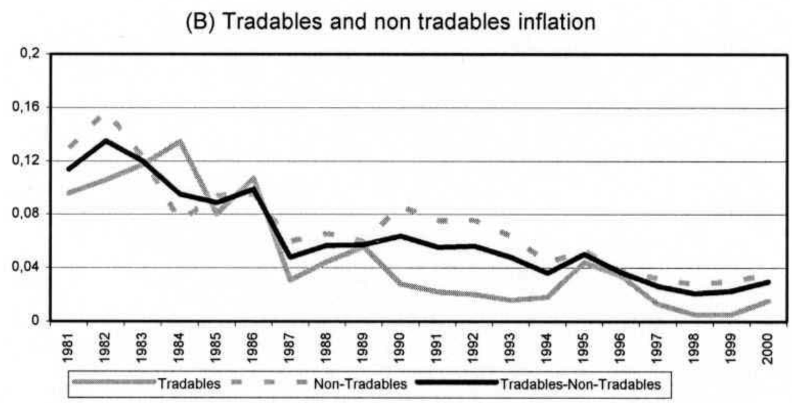
Before showing such a decomposition it is worth comparing our aggregate measure of inflation for the sectors included in our sample (π^{T-NT}) with two more usual measures of inflation: i.e. CPI inflation (π^{CPI}) and the inflation in the GDP deflator (π^{GDP}). As can be seen in Table 1 and Figure 2(A), our measure of inflation tracks rather 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.

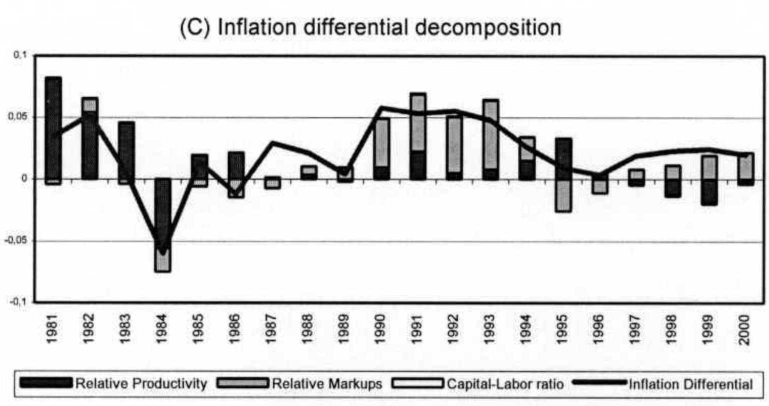
In Figure 2(B) we have decomposed aggregate inflation into the changes in the prices of the non-tradable and tradable sectors. As can be seen, for most of the sample period, inflation in non-tradables has been higher than in tradables (as shown in Table 1, the exceptions are 1984 and 1986). Another observation 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 %) and held almost constant and positive (3 %) in the late nineties.

As can be seen in 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 productivity growth in the tradable sectors being well above than in the non-tradable sectors, with the markups counteracting this effect. At the beginning of the nineties the dual inflation problem of the Spanish economy reached its maximum as a result of the higher technology growth in the tradable sectors as well as a substantial expansion of relative markups, the latter effect being

FIGURE 2
Inflation differentials







quantitavely stronger. This evolution of relative markups was the result of a reduction in markups in the tradable sectors due to the constraints faced by these sectors in setting their prices (in a context of currency appreciation). In the late nineties the dual inflation phenomenon was still present, although it was smaller than in the previous period. In this period the only factor responsible for this gap was the relative evolution of markups, with relative productivity growth in the tradable sectors acting with a negative sign, just the opposite of the Balassa-Samuelson hypothesis. In fact, the increase in relative markups was the result of both an expansion in the non-tradable sectors and a contraction in the tradable sectors[12].

4. Conclusions

We have made use of *adjusted Solow residuals* estimated in a 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 especially sectoral 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 relative evolution of the markups of the services and manufacturing sectors in the nineties as a key determinant of recent Spanish dual inflation.

[12] Notice that it is still possible to suspect that the behavior of relative markups could be explained by the evolution of land/housing prices. However, this explanation is not convincing: in the first half of the nineties relative markups increased substantially, while housing and land prices remained stable.

π

TABLE 1
Spanish dual inflation

Year	*Variables*				
	π^{CPI}	π^{GDP}	π^{T-NT}	π^{T}	π^{NT}
1981	13.6	11.6	11.3	9.6	13.0
1982	13.5	12.7	13.5	10.6	15.8
1983	11.5	11.2	12.0	11.7	12.2
1984	10.7	10.3	9.5	13.5	7.5
1985	8.4	8.2	8.9	8.0	9.4
1986	8.4	10.3	9.9	10.7	9.5
1987	5.1	5.8	4.8	3.1	6.0
1988	4.7	5.8	5.7	4.4	6.5
1989	6.6	6.7	5.7	5.5	5.9
1990	6.5	7.1	6.4	2.8	8.6
1991	5.8	6.7	5.5	2.2	7.5
1992	5.8	6.5	5.6	2.0	7.6
1993	4.5	4.4	4.8	1.6	6.3
1994	4.6	3.8	3.6	1.8	4.4
1995	4.5	4.8	5.0	4.4	5.3
1996	3.5	3.5	3.6	3.4	3.8
1997	2.0	2.2	2.6	1.3	3.2
1998	1.8	2.2	2.1	0.5	2.8
1999	2.3	2.8	2.3	0.5	3.0
2000	3.4	3.5	3.0	1.5	3.5
Memo Items (Averages)					
1981-1989	9.2	9.2	9.0	8.6	9.5
1990-1994	5.4	5.7	5.2	2.1	6.9
1995-2000	2.9	3.2	3.1	1.9	3.6
1981-2000	6.4	6.5	6.3	5.0	7.1

TABLE 2
Spanish dual inflation: A decomposition

Year	*Variables*			
	$\pi^{NT}-\pi^{T}$	$\Delta(\alpha_t^{T}-\alpha_t^{NT})$	$(\alpha_{NT}-\alpha_{T})\Delta(k_t^{T}-n_t^{T})$	$\Delta(\mu_t^{NT}-\mu_t^{T})$
1981	3.4	8.1	0.1	-0.4
1982	5.2	5.4	0.0	1.1
1983	0.5	4.6	0.0	-0.4
1984	-6.0	-5.6	0.0	-1.9
1985	1.4	1.9	0.0	-0.6
1986	-1.2	2.1	-0.0	-1.5
1987	2.9	0.2	-0.0	-0.7
1988	2.1	0.4	0.0	0.6
1989	0.4	-0.2	0.0	0.1
1990	5.8	1.0	0.0	4.0
1991	5.3	2.2	0.1	4.6
1992	5.5	0.5	0.1	4.5
1993	4.7	0.8	0.0	5.6
1994	2.6	1.5	0.0	1.9
1995	0.9	3.3	-0.0	-2.6
1996	0.4	0.4	0.0	-1.1
1997	1.9	-0.4	-0.0	0.8
1998	2.3	-1.3	-0.0	1.1
1999	2.4	-2.0	0.0	1.9
2000	2.0	-0.4	0.0	2.2
Memo Items (Averages)				
1981-1989	1.0	1.9	0.0	-0.3
1990-1994	4.8	1.2	0.0	4.1
1995-2000	1.6	-0.1	0.0	0.4
1981-2000	2.1	1.1	0.0	1.0

Appendix 1. The data set

Our data set consists of yearly information on seventeen productive branches over the period 1980-1997. These productive branches include ten manufacturing sectors, four market service sectors, and the Agricultural, Energy and Construction sectors, whose exact definitions are summarized in Table A.1. The aggregation of these sectors corresponds to the non-financial Spanish market economy. We exclude non-market services from the analysis because, as they are not traded on a market, their output and prices can be thought of as accounting conventions. In the case of the financial sector the problem lies in the difficulty of measuring its activity appropriately.

For each of these seventeen sectors we compile information for the following variables:

1. Gross production, defined as the sum of intermediate consumption and value added at factor cost.

2. Intermediate consumption. We distinguish between: energy and non-energy inputs and domestic and imported intermediate goods and services.

3. Value added at factor cost, defined as the sum of compensation of employees and the gross operating surplus.

These variables, in nominal terms, are taken from the National Accounts Statistics. One problem we encounter is that our sample period covers three different base years (1980, 1986 and 1995). To obtain homogeneous time series for the full period we proceed as follows: first, we aggregate the original (more disaggregated) sectors to obtain similar coverages for the three base years, and, second, we link together the three series. This last requirement is achieved using a statistical method similar to that proposed in Corrales and Taguas (1989). First we link aggregate gross production using the growth rates of the two earlier series. Then, sectoral gross production figures are generated, again using their corresponding growth rates, but now correcting their levels in order to match the aggregate gross production obtained in the previous step. Once we have the sectoral gross production, sectoral intermediate consumption and value added are extended backwards using growth rates and correcting their levels in order to match the previous sectoral gross production. The same is done with compensation of employees and the gross operating surplus[13].

The deflators of sectoral gross production are generated by combining different price indicators. In the case of the Agricultural, Energy and Manufacturing sectors, the deflator is a chained weighted index of agricultural and industrial domestic prices and unit value indices for exports, all of them corrected for indirect taxation. The weights are calculated using several Input-Output Tables. In the case of construction we use the deflator of gross capital formation, and for the market service sectors the corresponding categories of consumer prices (corrected for indirect taxation)[14]. Using these gross production deflators and unit value indices for imports, we are able to calculate chained weighted price indices for sectoral intermediate consumption. As in the previous case, the weights come from Input-Output Tables. Once we have calculated gross production and intermediate consumption in real terms it is straightforward to obtain sectoral value added in real terms and the corresponding deflators.

In addition, we obtain information for two other productive inputs.

4. Labor, including number of employees, total employment and hours per employee

5. Capital stock

The number of employees and total employment are taken from the National Accounts Statistics and, as in the previous case, a similar linking method is used to extend the sectoral figures backwards. Hours per employee are taken from the Wage Survey and homogenized to adjust for various methodological changes.

By dividing compensation of employees by the number of employees we obtain compensation per employee. This variable allows us to calculate what we have called compensation of total employment, as the sum of compensation of employees and the imputed compensation of self-employees. The latter is defined as the product of compensation per employee and the number of self-employees (i.e., the difference between total employment and the number of employees) corrected by a factor that captures the relative weight of the social contributions of employees and self-employees. Thus, we end up with a corrected

[13] The gross operating surplus of Other Market Services is corrected for the housing services imputed to home-owners that, again, are not traded.

[14] For a detailed description of the indicators used, see Estrada et. al (1998).

measure of the gross operating surplus (i.e., the difference between the value added and the compensation of total employment), which is free from the effects of differences in the relative importance of self-employment across sectors. In general, the wage concept that we use in this paper is compensation per total employment (per hour), that is, the ratio of compensation of total employment to total employment (total employment multiplied by hours per employee).

Finally, the capital stock is calculated using the permanent inventory method with sectoral investment series (see, for example, Hulten and Wykoff (1981)). These investment time series in real (and nominal) terms are taken from the BBVA Foundation Regional Data Base and adapted to ESA-95 requirements. In order to apply the permanent inventory method, we still need an initial condition for the capital stock and a depreciation rate. Both variables are also taken from the BBVA Foundation Regional Data Base. For each sector, the price of the capital stock is defined as a user cost (uc) as follows:

$$uc_s = P_{I_s}[i(1-\tau) + \delta_s - \ln(\frac{P_{I_s}}{P_{I_{s-1}}})]\frac{1-d-\tau z_s}{1-\tau}$$

where P_I is the investment deflator, i is the nominal interest rate (a weighted average of the interest rates of different credit instruments, see Cuenca (1994)), τ the marginal profit tax rate, δ_s the sectoral depreciation rate, d the investment allowances and z_s the fiscal savings associated with capital depreciation. The product of this user cost of capital and the capital stock is capital income, and, finally, the difference between the corrected gross operating surplus and the income of capital gives us an estimation of pure profits.

Finally, due to the delay in publication of the National Accounts sectoral estimates for output and inputs, we can not extend the data set using the same sources from 1997 onwards. Hence we have to resort to some other data sources to extend the original data base to 2000[15].

[15] To give just a few examples, gross production in real terms was enlarged using indicators of industrial production, transportation, hotels and catering, etc; intermediate consumption and sectoral investment using the *Encuesta Industrial*; employment using the Labour Force Survey; compensation per employee using the *Encuesta de Salarios*. All sectoral figures were made compatible with the figures estimated by the National Accounts for the market economy.

TABLE A1.1
Sectoral coverage

Sector Code	Sectors	*NACE, Rev 1 Code*
A	Agricultural, Forestry and Fishery	A, B
E	Fuel and Power Products	C, DF, E
M1	Ferric and Non-Ferric Industries plus Metals	DJ
M2	Non Metallic Minerals and Mineral Products	DI
M3	Chemical Products	DG
M4	Machinery	DK, DL
M5	Transport Equipment	DM
M6	Food, Beverages and Tobacco	DA
M7	Textiles and Clothing, Leather and Footwear	DB, DC
M8	Other Manufacturing Products	DD, DN
M9	Paper and Printing Products	DE
M10	Rubber and Plastic Products	DH
C	Building and Construction	F
S1	Repair Services, Wholesale and Retail Services	G, H
S2	Inland Transport, Maritime and Air Services	I60, I61, I62, I63
S3	Communication Services	I64
S4	Other Market Services	K, M, N, O

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Resumen

En este artículo se analizan las implicaciones que tiene la evolución diferencial de la productividad total de los factores en las distintas ramas de actividad para entender los cambios en los precios relativos de las manufacturas y los servicios de mercado. En el caso español y durante la segunda mitad de los años noventa, la mayor tasa de inflación registrada en la rama de servicios de mercado no parece estar justificada por la hipótesis de Balassa-Samuelson; en cambio, el comportamiento diferencial de los mark-ups en las ramas de servicios de mercado y las manufacturas es el factor clave para explicar lo que se ha denominado inflación dual de la economía española.

Palabras clave: Inflación, productividad, "mark-ups".

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