The Balassa-Samuelson Effect in an Imperfectly Competitive Economy: Empirical Evidence for G7 Countries.*

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Abstract

In this paper we consider the role of imperfect competition to explain the relative price of non-traded to traded goods within the Balassa-Samuelson framework. Under imperfect competition in the two sectors, relative prices depend on both productivity and mark-ups. We test this implication using a panel of sectors for the seven major OECD countries. The empirical evidence suggests that relative price movements are well explained by relative productivity and variations in mark ups. Unlike the original Balassa-Samuelson model, aggregate demand could affect the real exchange rate by changing the mark ups. Empirical results show that aggregate demand fluctuations lead to changes on the mark ups.

Keywords: Balassa-Samuelson hypothesis, Relative prices, imperfect competition.

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1 Introduction

Relative prices between nontradable and tradable goods are important in explaining real exchange rate movements and price convergence among countries. In this paper, we study the determinants of those relative prices in an economy with imperfect competition. The existing theory on this topic is based on Balassa (1964) and Samuelson (1964). In the Balassa-Samuelson framework, prices are determined only by marginal costs under perfect competition assumption; so, variations in the relative price of the nontraded goods had to be explained by differences in productivity between sectors. At the same time, variations in aggregate demand, for instance due to fiscal policy, would not affect the relative price of nontraded goods.

In this paper, we take a closer look at the determinants of relative prices by considering the presence of market power in both traded and non-traded sectors. Unlike the Balassa-Samuelson model, in an economy with imperfect competition, prices are determined both by marginal costs and mark-ups. Hence, variations in mark ups could amplify or dampen the effect of the variation in productivity on prices. Besides, the mark-ups provide a channel through which aggregate demand fluctuations could affect the relative prices of the traded and nontraded goods. Different authors have shown that variations in aggregate demand lead to variations in mark ups (e.g., Schmitt-Grohé (1997) and Rotermberg and Woodford (1999)).

Empirical research (e.g., De Gregorio, Giovannini and Wolf (1994) De Gregorio, Giovannini and Krueger (1994), Froot and Rogoff (1991, 1995) and Canzoneri et. al. (1999)) has corroborated that changes in productivity in the non-tradable and tradable sectors are correlated with relative price variations. However, the empirical evidence has also indicated that variations in aggregate demand, like changes in public expenditure, are an important determinant of relative price variations. However, this empirical finding can not be explained within the Balassa-Samuelson hypothesis. In our model, movements in relative prices may be generated by changes in relative productivity and/or in relative mark-up. Thus, the effect of a shift in aggregate demand on relative price could be explained by the variations in mark-ups[1].

To account for the empirical relevance of imperfect competition in explaining relative price movements, we study relative prices using a panel data for the G-7 economies during the period 1970-90. Empirical results indicate that there exists a positive correlation between relative prices and relative mark-ups in the non-traded and traded sectors. An increase in the non-traded sector mark-up relative to the mark up in the traded sector raises the relative price of the nontraded goods. Also, as in the previous literature (e.g., Bergstand (1991), De Gregorio, Giovannini and Wolf (1994), Muscatelli and F. Spinelli (1999) and DeLoach (2001)), we find evidence of the Balassa-Samuelson effect, an increase in the difference between productivity in the traded and nontraded sectors increases the relative price of the nontraded sector.

Finally, we also analyze the role of different macroeconomic variables that

[1] The existence of inflation differentials in the European Monetary Union has highlighted the relevance of the different evolution of prices in traded and nontraded sector (see European Central Bank (1999)). Inflation in the traded sector (manufacturing) tends to converge in consequence of the introduction of the Euro and the single market. Inflation in the nontraded sector (services) tends to be different among countries. This phenomenon was studied by Blanchard (2001) and Sinn and Ruetter (2001).

could change relative prices through variations in mark-ups. We show that relative productivity is correlated with relative mark-ups, thus the evolution of the mark-ups amplifies the Balassa-Samuelson effect. Moreover, aggregate demand proxies, like inflation and public spending, have a positive effect on relative mark-ups, so aggregate demand affects relative prices by changing relative mark-ups. These results support our hypothesis about the relevance of mark-ups to explain the effect of aggregate demand on relative prices.

The paper proceeds as follows. In Section 2, we introduce imperfect competition in the Balassa-Samuelson framework and discuss the effect of variations in productivity and mark ups on the real exchange rate. In Sections 3 and 4, we describe the data and the empirical framework underlying our later empirical results. In Section 5, we report regression results for relative prices, productivity and market power, and the macroeconomic effects of fiscal expenditure and output fluctuations on the mark-ups. Finally, Section 6 concludes the paper.

2 Relative prices, productivity and mark-ups

We consider a small open economy that produces traded (T) and non-traded goods (N). Movements in the real exchange rate (q) can be decomposed into two components: deviation in the law of one price in the traded sector and variation in the relative price of the nontraded goods. Consider the log of the real exchange rate

$$\log q = s + p^{*} - p$$

where s is the log of the nominal exchange rate, p is the log of the price index, and "$*$" refers to foreign variables. We define the price index as a weighted average of traded and nontraded good prices: $p = (1-\phi)\log P_T + \phi \log P_N$. Thus, the real exchange rate is divided in two components:

$$\log q = s + \log P_T^* - \log P_T + \phi^*(\log P_N^* - \log P_T^*) - \phi\,(\log P_N - \log P_T)$$

In the paper, we focus on the determinants of variations in the relative price of nontraded goods. In the existing literature, some authors tested the Balassa-Samuelson effect on real exchange rates (e.g., Canzoneri, Cumby, Diba (1999), while other authors consider only the relative price for non-traded goods (e.g., Bergstrand (1991), De Gregorio, Giovannini and Wolf (1994)). We prefer this second approach since the relationship between mark up, productivity and relative prices could be obscured by other factors that affect the real exchange rate, like fluctuations in the nominal exchange rate.

According to Balassa (1964) and Samuelson (1964), the relative price of nontraded goods is only explained by variations in the relative marginal cost, generated by variations in productivity. Here, we keep the basic Balassa-Samuelson assumptions, but we introduce imperfect competition in both sectors. Our results do not depend on the way in which imperfect competition is introduced. We use a general model of imperfect competition, where firms in both sectors have market power to fix prices over marginal cost. The mark ups could be affected by different factors: changes in the concentration in the market, elasticity of demand, etc. However, the key point is that firms in the nontraded sector only face demand from the domestic market and they are sheltered from international competition, while firms in the traded sector also face demand from abroad and they suffer international competition. Thus, we should expect mark-ups to evolve differently in each sector. At the same time, mark-ups will react differently to macroeconomic shocks. For instance, in the case of an increase in aggregate demand, it is going to be easier for firms in the nontraded sector to collude in order to raise prices.

Like in the original Balassa-Samuelson model, firms in both sectors produce output through a constant return to scale production function

$$y_i = A_i F_i(K_i, l_i), \qquad i = T, N,$$

where the subindex T refers to the traded sector, and N refers to the nontraded sector. The term A_i represents the total factor productivity. Capital (K) and labour (l) can move freely across sectors. Therefore, firms across sectors pay the same wage to workers, w. Finally, the real interest rate, r, is determined in the international capital market, given that the economy is small and there is international capital mobility. However, we depart from the basic Balassa-Samuelson conditions since firms in each sector have market power to fix their prices. Firms set their prices, p_j, over marginal cost, $C(w, r)$.

$$p_i = \mu_i C(w, r). \tag{1}$$

The mark up μ_i is defined as the ratio of price over marginal cost[2]. Since

[2]For instance, if we consider monopolistic competition, following Dixit-Stiglitz (1977), where each industry consists of many monopolistic competitors, which produce symmetric

firms use a constant returns technology, the marginal cost is independent of the level of production. Using cost minimization it can be represented as a function of input costs and the marginal productivity of capital and labour.

$$C(w,r) = \frac{r}{f_i'(k_i)} = \frac{w}{\left(f(k_i) - k_i f_i'(k_i)\right)} \tag{2}$$

Here, we have used the constant return to scale property of the production function to write the marginal productivity of capital and labour in terms of the capital labour ratio k_i and per worker production function $f(k_i)$.Then, we use the profits maximization condition, equation (1), to derive the factor market equilibrium in the economy:

$$p_N A_N f_N'(k_N) = \mu_{_N} r, \tag{3}$$

$$p_N A_N \left(f_N(k_N) - k_N f_N'(k_N)\right) = \mu_{_N} w, \tag{4}$$

$$A_T f_T'(k_T) = \mu_{_T} r, \tag{5}$$

$$A_T \left(f_T(k_T) - k_T f_T'(k_T)\right) = \mu_{_T} w. \tag{6}$$

We have normalized the price of the traded sector good $p_T = 1$, so that p_N measures the relative price of the nontraded sector with respect to the traded sector. This set of equations ((3), (4), (5) and (6)) alone determines the relative price in the nontraded sector p_N. Therefore, the relative price of the nontraded good is only determined by the mark-ups and the marginal

varieties, the mark-up would be determined by the elasticity of demand.

costs. The proof is simple, from equation (5) we solve the capital labour ratio in the traded sector, k_T, as a function of the international interest rate and the mark-up in this sector. After that, we compute the wage w as function of the international interest rate and mark-up in the traded sector by substituting k_T in equation (6). Given the wage as a function of r and μ_T, we can solve for k_N and p_N from equations (3) and (4). Thus, we express p_N as a function of the mark-ups in the traded and nontraded sector. In the case of perfect competition ($\mu_N = \mu_T = 1$) this result was obtained by Balassa (1964) and Samuelson (1964). Under perfect competition, observed changes in the relative price of nontraded goods should be explained by variations in total factor productivity. However, under imperfect competition variation of the mark up is an important determinant of the real exchange rate. From the above equilibrium conditions (equations (3), (4), (5) and (6)), we can compute the effect of variation in the mark ups and productivity on relative price of the nontraded good as

$$\frac{\Delta p_N}{p_N} = \left(\frac{\alpha_N}{\alpha_T}\frac{\Delta A_T}{A_T} - \frac{\Delta A_N}{A_N}\right) - \left(\frac{\alpha_N}{\alpha_T}\frac{\Delta \mu_T}{\mu_T} - \frac{\Delta \mu_N}{\mu_N}\right), \tag{7}$$

where $\alpha = \frac{F_L L}{F}$ denotes the labour-output elasticity in each sector. Note that variations in mark-ups and productivity have an opposite effect on the relative price of the nontraded sector. An increase in the mark-up in the nontraded sector increases the price of the nontraded good. We have to take into account that variations in markups produce changes in prices as long as the movement in mark-up in one sector is not offset by the movement in the markup in the other sector. The effect of an increase in the mark-up in the traded sector depends on the capital labour ratio in each sector.

Since an increase in traded sector mark-up reduces real wages, the effect on the relative price is going to be bigger when the nontraded sector is labour intensive.

In the original Samuelson-Balassa framework ($\mu_N = \mu_T = 1$), as productivity grows faster in the tradable sector, relative prices increase, since greater wages raise marginal costs in the non-tradable sector over the ones in the tradable sector that simply match productivity growth with wage growth. At the same time, variations in aggregate demand (like changes in fiscal policy) cannot affect relative prices. However, in our model, relative prices also depend on the different evolution in mark-ups in each sector. Therefore, variations in demand can affect the relative price of nontraded goods by changing the mark-ups.

A satisfactory theory to explain the evolution of the relative price of the nontraded good cannot neglect the effect of the variation in mark up on prices. At the same time, it has to distinguish between the effect of a variation in productivity and a variation in the mark up on prices. Our first objective is the estimation of equation (7), so that we can distinguish between the effects of variation in productivity and mark ups in the relative prices. Secondly, as we can see in this equation, changes in mark ups only change relative prices when they follow different paths in each sector. Then, we must analyze the reasons that could explain the different evolution in the mark-up in the traded and nontraded sector.

There are several reasons why mark-ups can change as a consequence of demand or productivity shocks[3], for instance, an increase in aggregate

[3]Rotermberg and Woodford (1999) summarize the recent empirical literature about

demand can induce firm entry, therefore increasing competition. Moreover, since firms in the traded sector have to compete in the international market, we should expect different types of shocks to have different effects on traded and nontraded sector mark-ups. Thus, mark-ups in the traded sector are more affected by the external demand and the competition in international market than by domestic factors. Finally, our model offers an alternative explanation for the observed positive relation between the increase in public spending and nontraded sector prices (e.g., De Gregorio, Giovanni and Wolf (1994), Froot and Rogoff (1991) and Chinn and Johnston (1997), Strauss (1999)). Variations in mark-ups generated by a fiscal expansion can cause a real appreciation .

3 Data

The data used in the empirical analysis come from the OECD International Sectorial Database for G-7 countries from 1970 to 1990. The dataset includes output in nominal and real terms, gross capital stock at constant prices in home currency and in dollars, and the number of labour hours for a set of sectors. Sectorial prices are computed as implicit deflators. We follow De Gregorio, Giovannini and Wolf (1994) and Canzoneri et. al. (1999) to group manufacturing and agriculture into the traded category and service sectors into the non-traded category. Also, the data set includes information about public spending and inflation coming from OECD Annual National Accounts.

mark-ups. These authors show that mark-ups in US tend to be procyclical.

4 Empirical framework

In order to consider the empirical relevance of market structure and productivity in explaining relative prices, we have first to specify how changes in productivity and mark-ups are calculated for tradable and non tradable goods. Hall (1988) showed that under imperfect competition, we cannot use the Solow residual to measure productivity. The reason is that marginal productivity is not equal to wages (see equation (4)), therefore, we can not use the labour share in income to compute the labour-output elasticity[4]. Then, to estimate mark up and productivity, we first specify a constant returns Cobb-Douglas production function for any sector producing tradable or non tradable goods at time t as

$$Y_{j,t} = A_{j,t} L_{j,t}^{\alpha_i} K_{j,t}^{(1-\alpha_i)} \qquad 0 < \alpha_i < 1, \tag{8}$$

the subindex j refers to the different sectors within the tradable or nontradables group, and $Y_{j,t}$, $K_{j,t}$, $L_{j,t}$ denote, respectively, real output, real value of capital stock, and labour hours. $A_{j,t}$ represents total factor productivity for sector j at period t,. α_i denotes the elasticity of output with respect to labour for tradable or non tradable goods if $i = T$ or $i = N$, respectively[5].

Changes in the productivity of sector j at time t can be easily obtained from the production function

[4]Moreover, the Solow residual, under imperfect competition is affected by variations in output generated by variations in demand. Therefore, the Solow residual is not suitable to test the Balassa-Samuelson effect since it cannot be used to distinguish the effect of variations in demand or productivity on prices.

[5]The output elasticity is assumed constant over sectors included in the same category (tradables or nontradables) because of short length of time series available for each sector.

$$\Delta a_{j,t} = \Delta y_{j,t} - \alpha_i \Delta l_{j,t}, \tag{9}$$

where $y_{j,t} = \ln\left(\frac{Y_{j,t}}{K_{j,t}}\right)$, $a_{j,t} = \ln(A_{j,t})$ and $l_{j,t} = \ln\left(\frac{L_{j,t}}{K_{j,t}}\right)$. However, before constructing changes in productivity from equation (9), it is necessary to have an estimation of the output-labour elasticity for tradable and non tradable goods, α_i. We estimate the output-labour elasticity from the production function instead of using labour share to compute total factor productivity. The production function is estimated for tradable and non tradable goods from a panel data of sectors included in each of the two categories. Moreover, as in Kang et. al. (1998), we assume that the log form of total factor productivity for any sector j at time t follows the following AR(1) process

$$\ln(A_{j,t}) = \delta_j + u_{j,t}, \tag{10}$$

$$u_{j,t} = \rho u_{j,t-1} + \varepsilon_{j,t} \quad 0 < \rho \leq 1, \varepsilon_{j,t} : i.i.d. \tag{11}$$

where δ_j is a specific effect on productivity for a sector j included in anyone of the two categories.

In order to compute the mark-ups, we use the firms' profit maximization condition (equation (4)) for the Cobb-Douglas production function[6]

$$P_{j,t}\alpha_i \left(\frac{Y_{j,t}}{L_{j,t}}\right) = \mu_{j,t} w_{j,t}, \tag{12}$$

[6] Note that the other equilibrium condition states that the value of marginal product of capital equals the mark-up multiplied by the cost of capital. We do not use this second condition because the estimation of the cost of capital for each sector is more inaccurate than the wage estimation, which is given by the data.

where $P_{j,t}$, $\mu_{j,t}$, and $w_{j,t}$ are respectively the price, the markup and the wage level for sector j at time t. From this equilibrium condition we can calculate how markups change over time for sector j

$$\Delta \ln \mu_{j,t} = \Delta \ln(P_{j,t}) + \Delta \ln \left(\frac{Y_{j,t}}{L_{j,t}} \right) - \Delta \ln(w_{j,t}). \tag{13}$$

In order to proceed with our estimation, we need to construct an aggregate series of productivity, prices and mark-ups in traded and nontraded sectors. We use the same aggregation criteria in these three variables which are based on the output share $s_{j,t}$

$$s_{j,t} = \frac{Y_{j,t}}{\sum_{j=1}^{H} Y_{j,t}}, \tag{14}$$

here, H is the number of sectors producing tradable or non tradable goods. For instance, changes in productivity level for tradable and non tradable goods can be constructed simply by aggregating the sectorial changes in productivity as

$$\Delta a_t^i = \sum_{j=1}^{H} s_{j,t} \Delta a_{j,t}, \tag{15}$$

With these series at hand, the Samuelson-Balassa hypothesis under imperfect competition is tested for the G-7 economies (equation (7)). With this aim, we use the following panel data model

$$Z_{k,t} = \lambda_k + \beta_1 R_{k,t} + \beta_2 M_{k,t} + \xi_{k,t} \tag{16}$$

where k denotes country and $Z_{k,t} = \Delta \ln(P_t^N) - \Delta \ln(P_t^T)$, $R_{k,t} = \frac{\alpha_N}{\alpha_T} \Delta a_{j,t}^T - \Delta a_{j,t}^N$, $M_{k,t} = \frac{\alpha_N}{\alpha_T} \Delta \mu_{j,t}^T - \Delta \mu_{j,t}^N$, for country k. $\xi_{k,t}$ is a stochastic i.i.d. term and λ_k is a country specific effect on relative prices. The empirical significance of the β_1 and β_2 coefficients could support or not the Samuelson-Balassa hypothesis under imperfect competition.

One concern in the estimation of equation (16) is that variations in mark-ups are correlated with price changes at the sector level by construction of equation (13). This problem of simultaneity would mean that OLS estimates would be biased. To address this problem we have used a GMM estimator using the set of instruments suggested by Arellano and Bond (1991, 1998). The results of these estimations are presented in the following section.

5 Results

Estimates of the output labour elasticities (α_i) from the production function (8) for tradable and non-tradable sectors in each country are presented in the first two columns of Table 1. Both coefficients are significant and indicate that non-traded output labour elasticity is for most of the countries above the traded output labour elasticity, which reflects the relatively well known fact that service industries are more labour intensive than manufacturing industries. From these elasticities, we can obtain the changes in productivity for the two sectors and the relative productivity changes. Average values for relative changes in productivity, mark-ups and prices are presented in columns (3)-(5) of Table 1.

INSERT TABLE 1 HERE

In Table 2 we report the estimates for the relative prices equation (16). The results in columns (1)-(3) are obtained using OLS and assuming that

λ_k remains constant for all countries. The estimates indicate that both relative changes in productivity and demand are important in explaining relative price movements and have the expected sign. The effect of relative productivity, taking it independently of demand conditions, regression in column (3), has a similar size to that in De Gregorio, Giovannini and Wolf (1994). Likewise, the coefficient on productivity and on mark-up differentials increases when the two effects on relative prices are taken together. Moreover, the serial correlation tests suggest that the estimates in columns (1) and (3) are well specified. Assuming that λ_k takes a different value for each country, we reach similar conclusions using the within-groups estimator in column (4).

On the other hand, columns (5) and (6) report GMM estimates of the relative prices equation corresponding to the one-step Arellano-Bond (1991,1998) procedure. We treat the two explicative variables as endogenous and instrument them using t-1 and t-1 to t-3 lags of these variables to address the simultaneity problem. Comparing GMM with OLS results in column (1) we can check that the estimated coefficients are quite similar, even though the OLS estimates of the coefficients are a little biased upwards. The Sargan and serial correlation test provide no evidence of bad specification. Similarly, estimates of the relative prices equation in first differences using OLS and GMM are presented in columns (7)-(9) for comparison. Column (7) reports OLS estimates of the equation in differences which are very similar to the ones in column (1), except for the productivity coefficient which is larger, while columns (8) and (9) report GMM estimates which are in agreement with those of the OLS estimator.

To summarize, the results of the empirical application of the Samuelson-Balassa hypothesis under imperfect competition for G-7 countries suggest that relative prices of non-tradable to tradable goods are explained by both productivity and mark-ups. Increases in tradable sector relative to non-tradable sector productivity increase the relative prices of non-tradables. Also, increases in non-traded relative to traded sector mark-ups increase the relative prices of non-tradables, although in a lower proportion than an increase in relative productivity.

INSERT TABLE 2 HERE

5.1 Mark up fluctuations

In this section, we study the empirical determinants of relative mark ups ($M_{k,t} = \frac{\alpha_N}{\alpha_T}\Delta\mu^T_{j,t} - \Delta\mu^N_{j,t}$) for each country. The Balassa-Samuelson hypothesis implies that variation in aggregate demand cannot affect relative prices. However, under imperfect competition, since aggregate demand can affect the mark-ups, variations in aggregate demand can affect the relative price. We focus our analysis mainly in macroeconomic variables that could affect the relative price of the nontraded sector through variations in mark ups. With this aim, we use the following panel data model

$$M_{k,t} = \omega_k + \theta_1 R_{k,t} + \theta_2 \Pi_{k,t} + \theta_3 (G/Y)_{k,t} + \epsilon_{k,t} \quad (17)$$

where k denotes country, $R_{k,t} = \frac{\alpha_N}{\alpha_T}\Delta a^T_{j,t} - \Delta a^N_{j,t}$ is the relative productivity, $\Pi_{k,t}$ is the rate of inflation, $(G/Y)_{k,t}$ represents the ratio of public spending relative to GDP and $\epsilon_{k,t}$ is a stochastic i.i.d. term. The empirical results are presented in Table 3.

INSERT TABLE 3 HERE

First, we consider the effect of productivity on the mark up in each sector. Under imperfect competition, firms will not always pass all reductions in costs, as a result of higher productivity, into prices. Therefore, the evolution of mark-ups could reinforce or compensate the Balassa-Samuelson effect. We have observed that differences in productivity have a negative and significant effect on the differences in mark-ups between sectors. Thus, evolution in the mark up reinforces the effect of differences in productivity on prices. The reason is that large differences in productivity between sectors are associated with large differences in the rate of variation of the mark-ups between these sectors.

The inflation rate could be considered as a proxy for the evolution of aggregate demand (De Gregorio, Gionannini and Wolf (1994) show that there is positive correlation between inflation and the relative price of nontradables). We find that inflation has a negative and significant effect on the relative mark-up. This result implies that expansions in aggregate demand have different effects on the mark up in each sector. Several authors have shown that inflation itself affects the mark ups. Bénabou (1992) argues that inflation lowers the mark up, since inflation leads to greater consumer search that increases competition. Also, empirical studies show that there is a negative relationship between mark up and inflation (e.g., Bénabou (1992) and Banerjee and Russell (2000)). Our results indicate that this effect is different in the traded and nontraded sector, thus, inflation generates increases in the relative price of nontraded goods by reducing the differences in mark-ups between tradable and non tradable sectors.

Also, we consider the effect of fiscal policy on the relative mark up. Different authors have shown that an increase public spending raises prices in the nontraded sector relative to the traded sector. (e.g., Froot and Rogoff (1991) and De Gregorio, Gionannini and Wolf (1994)). As we have said, this effect cannot be explained within the original Balassa-Samuelson framework; however our model suggests that variations in public spending could affect prices by changing mark-ups. Our empirical results support this last intuition, public spending tends to reduce the difference in mark-ups between the traded and nontraded sectors, and thus increase relative prices. However, as we consider inflation and public spending (regression (3)) the public spending reduces its significance.

6 Conclusion

In this paper we have introduced imperfect competition in the standard Balassa-Samuelson framework. We have shown that relative price of traded to non-traded sectors is determined by both productivity and the mark ups.

We have also estimated the effect of variation in productivity and mark-ups on the relative prices. We have shown that differences in productivity and mark-ups have significant and opposing effects on the relative price of the nontraded sector. Faster growth in productivity in the traded sector, relative to productivity growth in the nontraded sector, increases the relative price in the nontraded good. At the same time, our results support the hypothesis that the mark-ups in traded and nontraded sectors follow a different paths, generating variations in the nontraded sector relative prices.

Besides, we have analyzed the reasons for the variation in mark-ups in each sector. Variations in mark-ups constitute a new channel through which variations in aggregate demand could affect the real exchange rate. Variations in mark-ups generated by variations in aggregate demand can cause a real appreciation. We have shown that demand side variables; like inflation, government spending; have significant effects on mark-ups in the traded and nontraded sector. Moreover, changes in mark-ups amplify the effect of a variation in productivity on prices since a higher difference in productivity is associated with a higher difference in mark-ups.

These results suggest a number of future lines of research. It could be interesting to study the role of the mark-ups in the propagation of business cycle fluctuations since the mark-ups could amplify or reduce the effect of shocks in productivity on prices. It would also be interesting to analyze the reasons for the variation in mark-ups in each sector in more detail. In addition, one could consider different measures for the variation in fiscal policy. Finally, one could study if the evolution in the mark up explains how different inflation rates in the service sector explains differential inflation rates among countries in Euroland.

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