

The real exchange rate and the Balassa Samuelson Effect:

The Role of the Distribution Sector

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Abstract

This paper investigates the impact of the distribution sector on the real exchange rate, controlling for the Balassa-Samuelson effect, as well as other macro variables. Long-run coefficients are estimated using a panel dynamic OLS estimator. The main result is that an increase in the productivity and product market competition of the distribution sector with respect to foreign countries leads to an appreciation of the real exchange rate, similarly to what a relative increase in the domestic productivity of tradables does. This contrasts with the result that one would expect by considering the distribution sector as belonging to the non-tradable sector. One explanation may lie in the use of the services from the distribution sector in the tradable sector. Our results also contribute to explaining the so-called PPP puzzle.

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Introduction

Very few authors discuss the importance of the distribution sector in influencing the real exchange rate. When this sector is analyzed, it is normally considered—either explicitly or implicitly—as non-tradable. This paper investigates, both theoretically and empirically, the long-run impact of the distribution sector on the real exchange rate (RER) and shows that the common intuition that such a sector behaves as a non-tradable is not consistent with the empirical evidence.

The issue is important, given the size of the distribution sector (wholesale and retail trade) in the economy, which in industrial countries often reaches 20 percent of industrial activity both in terms of value added and of employment (see Table 1), and might therefore account for a large component of prices. For example, using US input-output data, Burstein, Neves, and Rebelo (2000) show that consumption goods in the U.S. contain distribution services accounting for about 47% of the final price in the agricultural sector and 42% in manufacturing. Dornbusch (1989) mentions the importance of the distribution sector in influencing the RER via “the service content of the consumer prices of goods”. Recent studies of the Balassa-Samuelson effect, which use sectoral data to derive measures of relative productivity of tradables and non-tradables, include the distribution sector in the non-tradable sector (De Gregorio, Giovannini, and Wolf, 1994; De Gregorio and Wolf, 1994; Chinn and Johnston, 1999).² Both Devereux (1999) and Burstein, Neves, and Rebelo (2000) explicitly discuss the role of the distribution sector in explaining the RER, but still treat the sector as a non-tradable

² The Balassa-Samuelson effect states that an increase in the relative productivity of tradables versus non-tradables of one country versus foreign countries raises its relative wage, thus increasing its relative price of non-tradables and its relative average price, and inducing an appreciation of the real exchange rate (RER). For the original analysis, see Balassa (1964) and Samuelson (1964).

(in both papers it is assumed to influence the domestic consumption price of tradables, after international price equalization). Obstfeld and Rogoff (2000) briefly mention, but do not pursue, the role of the distribution sector as an alternative explanation for the relatively slow mean reversion in RERs. Engel (1999) has suggested the distribution sector as one explanation for the variability of the relative price of non-traded goods in explaining US CPI-based RER movements.

The view that the distribution sector influences the RER through the non-tradable sector stems directly from the observation that arbitrage in the goods market does not occur at the consumer level but at the producer level.³ Even abstracting from transportation costs and market pricing, and even if global market integration equalizes prices at the producer level, the consumer prices for the same good may still differ across countries. For example, if one country has a more efficient distribution sector (say large retail outlets in the USA) than other countries (say small shops in some European countries), it will enjoy lower prices for the distribution services and a lower consumer price index than its foreign counterpart, as both prices of tradables and non-tradables would, *ceteris paribus*, be lower. This would, in turn, be reflected in a more depreciated RER. To the extent that differences in the efficiency of the distribution sector across countries remain constant over time, they would simply generate constant gaps in consumer price levels across countries. In other words they would affect absolute PPP. Of course, this cannot be tested with the aggregate price series usually exploited in PPP-based studies, since these series are in index form. However, to the extent that these differences change over time (for example, because of productivity growth or changes in

the market structure of the retail sector) they would induce converging or diverging trends in relative prices and hence could explain systematic movements in RERs. In the previous example, an empirically testable implication would be the following: an increase (decrease) in the relative efficiency of the distribution sector with respect to the foreign country induces a depreciation (appreciation) of the RER. But is this, in fact, the case?

This paper addresses the issue by examining the importance of the distribution sector in explaining deviations of the RER from purchasing power parity (PPP) and by assessing how the sector influences the RER. The remainder of the paper is organized as follows. Section 1 provides a comparative description of our analysis versus the existing literature. Section 2 develops a simple theoretical model to explore the main intuition behind the influence of the distribution sector on the RER in the long-run. Sections 3 and 4 empirically investigate the long-run relations between the RER and a measure of efficiency of the distribution sector, by applying a dynamic panel methodology to data for nine countries over a 20-year period. Section 5 draws conclusions.

1. Our Analysis and the Related Literature

A natural framework for our investigation is the one that features the Balassa-Samuelson analysis. Most empirical studies of the Balassa-Samuelson effect on the RER compare aggregate measures of productivity across countries, such as GDP per capita, GDP per worker, or labor productivity in the manufacturing sector. Ito, Isard and Symansky (1997) report a statistically significant relationship between the RER change and the change in per capita GDP, their proxy for the Balassa-Samuelson effect, for a

³ It is interesting to note that when internet trade, or other forms of direct producer-consumer trade, will have developed internationally, goods arbitrage will tend to occur also at the consumer level, controlling

group of Asian currencies. They do not find an association between the per capita differential and the relative price of non-traded to traded goods, and suggest that one explanation for this latter result is that per capita GDP is not a good proxy for productivity differences. However, there are a number of existing studies that test the Balassa-Samuelson hypothesis directly, via the effect of productivity in the tradable and non-tradable sectors on CPI-based RERs, rather than using proxies. For example, Hsieh (1982), Marston (1990), and DeGregorio and Wolf (1994) examine the relationship in growth terms and report evidence which is favorable to the Balassa-Samuelson hypothesis, in the sense that the coefficients on productivity in the two sectors are statistically significant and correctly signed. As Chinn and Johnston (1999) point out, however, the use of growth rates in these papers allows for permanent shocks to the relationship in levels, which is perhaps undesirable. By applying cointegration analysis and employing OECD sectoral total factor productivity data, the authors find significant long-run relationships between the CPI-based RERs and the relative price of non-traded to traded goods as well as between the RERs and productivity differentials, thus again supporting the Balassa-Samuelson proposition. Similar results are derived by Canzoneri, Cumby and Diba (1999), who find—using panel cointegration methods—a significant long-run relationship between the relative price of non-traded to traded goods and relative labor productivity in the traded to non-traded sectors

Section 2 provides a very simple framework to illustrate the role the distribution sector has in the context of a standard Balassa-Samuelson setting with tradable and non-tradable sectors (the model shares some features with Devereux, 1999, as discussed later). Our motivation is to minimize the assumption changes in the basic Balassa-

Samuelson framework in order to highlight the likely role the distribution sector will have on the RER.

One key assumption in the standard Balassa-Samuelson model is that the law of one price (LOOP) holds and therefore systematic movements in RERs arises from movements in the relative price of non-traded to traded goods. However, using disaggregate CPI data Engel (1993, 1999) has demonstrated that the vast majority of the variation in RERs is attributable to variations in the relative price of traded goods, rather than the relative price of non-traded to traded goods. This finding has been confirmed using more finely disaggregated prices by Rogers and Jenkins (1995) and Betts and Kehoe (2001).⁴

In our empirical testing of the effect of the distribution sector on the RER we do not require the LOOP to hold and, indeed, our empirical results are consistent with those researchers who have reported violations of the LOOP at the wholesale level. In particular, by following MacDonald and Ricci (2002), we will introduce, in some specifications, the wage into our regressions as an extra conditioning variable in order to determine the channel of influence of the productivities in the various sectors and the importance of violations of the LOOP. If the LOOP holds, productivity shocks get transmitted into the RER via the wage, and the significance of productivity in the tradable sector should disappear once the wage is introduced into the regression.

In addition to the Balassa-Samuelson effect, other variables have been shown to be related to the RER in the long run, both in theoretical and empirical contributions (see for example: Obstfeld and Rogoff, 1996; Devereux, 1999; Lane and Milesi-Ferretti, 2000;

⁴ Terms of trade fluctuations have also been considered an important determinant of the real exchange rate, but especially for developing countries.

MacDonald, 1995). In order to ensure that our results with respect to productivity and distribution are not spurious, we include net foreign assets and the real interest differential in our empirical analysis.

Our work also has a bearing on the recent PPP literature which has produced the so-called PPP puzzle (Rogoff, 1996), which indicates that the mean reversion in RERs is too slow to be consistent with a traditional form of PPP. In particular, studies which use long historical time spans on a single currency to estimate PPP (see Edison, 1987; Frankel, 1988; and Diebold, Husted, and Rush, 1991), and those applying panel estimators to data for the recent floating period (see Frankel and Rose, 1995; MacDonald, 1995; and Oh, 1996) have shown that the half-life in RERs is between 3 and 5 years. A variety of avenues have been explored to try to explain the 'PPP puzzle'. One of these simply involves explicitly recognizing the role of macroeconomic factors, such as the Balassa-Samuelson effect, net foreign assets, and interest rate differentials, in driving RERs.⁵ We will show that taking into account these effects, as well as the one of the distribution sector, brings the estimated half-life of deviations close to 1 year.

⁵ An alternative approach has capitalized on the evident failure of the LOOP and focuses on the relative price of traded goods, rather than the relative price of non-traded to traded goods. For example, one such explanation lies in the pricing to market behavior of exporters, which effectively prevents traditional arbitrage forcing PPP (see Feenstra and Kendall, 1997; Cheung, Chinn, and Fujii, 1999). A second explanation stresses the importance of transaction costs, relating to the distance between trading centers, in preventing arbitrage between trading centers. Such costs are usually captured in a non-linear framework, such as a threshold autoregressive model, and the application of these models indicates adjustment speeds for real exchange rates which are consistent with a traditional form of PPP (see, for example, Obstfeld and Taylor, 1997). However, transaction costs are only a small proportion of traded goods prices and therefore seem insufficient on their own to explain the large observed deviations from PPP. For example, Hummels (1999) estimates the average trade-weighted freight cost in the US in 1994 to be 3.8%, which is clearly very small compared to the effects of distribution costs referred to above. A much more significant set of costs relates to the distribution of goods, which can affect the real exchange rate through both the relative price of traded goods and the relative price of non-traded to traded goods.

2. A Simple Motivational Model

The model assumes constant returns to labor in all primary activities, i.e. production of intermediate inputs (I), of distribution services (D), of non-tradables goods (N), and of the aggregation services (A) necessary to manufacture tradables from intermediate inputs.^{6,7} The technology for secondary activities are Cobb-Douglas: in goods I, D and A, for the production of tradables (T); and in goods T and D in order to make tradables available to consumers (TC). The model is then completed by assuming different technologies in the primary activities across countries, identical Cobb-Douglas preferences in tradables and non-tradables across countries, wage equalization within countries, international price equalization for tradables, and non-tradability of intermediate inputs. In formulas, for country i ($i=1, 2$):

$$Y_{ki} = \frac{L_{ki}}{\beta_{ki}}, \quad k = I, D, N, A$$

$$Y_{Ti} = \frac{Y_{Ii}^{\gamma\eta} Y_{Di}^{1-\gamma} Y_{Ai}^{\gamma(1-\eta)}}{(\gamma\eta)^{\gamma\eta} (1-\gamma)^{1-\gamma} (\gamma(1-\eta))^{\gamma(1-\eta)}},$$

$$Y_{TCi} = \frac{Y_{Ti}^{1-\phi} Y_{Di}^{\phi}}{\phi^{\phi} (1-\phi)^{1-\phi}},$$

$$U_i = \frac{y_{Ni}^{\alpha} y_{TCi}^{1-\alpha}}{\alpha^{\alpha} (1-\alpha)^{1-\alpha}}$$

⁶ In reality, the distribution sector delivers both intermediate inputs to the firms that use them in the final stage of production and final goods to consumers. For the sake of simplicity, we assume that intermediate inputs are used only in the tradable sector and that distribution of final goods is necessary only in the tradable sector; relaxation of these assumptions would deliver qualitatively identical results. This choice of assumptions is also in line with the fact that most non-tradable activities (utilities, social services) have a vertically integrated distribution sector.

⁷ Our model is similar to that of Devereux (1999), which we discuss below.

where L_{ki} and β_{ki} represent, respectively, employment and unit labor input requirement prevailing in sector k and country i (for $k=I, D, N, A$), and Y_{ki} is the output in sector k of country i (for $k=I, D, N, A, T, TC$); U_i and y_{ki} stand for, respectively, the utility of one individual of country i and her/his demand for good k (for $k=N, TC$).

In equilibrium, given firms and consumer maximization problems and goods market clearing, the following equations for the price of the various goods and services of the two countries must hold:

$$p_{ki} = \beta_{ki} w_i, \quad k = I, D, N, A,$$

$$p_{Ti} = p_{Li}^{\gamma\eta} p_{Di}^{1-\gamma} p_{Ai}^{\gamma(1-\eta)} = w_i \beta_{Li}^{\gamma\eta} \beta_{Di}^{1-\gamma} \beta_{Ai}^{\gamma(1-\eta)} \equiv w_i \beta_{Ti}^{\gamma} \beta_{Di}^{1-\gamma},$$

$$p_{TCi} = p_{Ti}^{1-\phi} p_{Di}^{\phi},$$

$$p_{T1} = e p_{T2},$$

$$p_i = p_{Ni}^{\alpha} p_{TCi}^{1-\alpha},$$

$$RER \equiv \frac{p_1}{e p_2} = \frac{p_{N1}^{\alpha} p_{TC1}^{1-\alpha}}{e p_{N2}^{\alpha} p_{TC2}^{1-\alpha}},$$

where w_i is the wage prevailing in country i , $\beta_{Ti} \equiv \beta_{Li}^{\eta} \beta_{Ai}^{1-\eta}$ is the average productivity of the two stages of production of tradable goods in country i , and e is the nominal exchange rate (units of currency 1 for one unit of currency 2).

Price equalization of tradable goods (we discuss this assumption further below) determines relative wages and provides the familiar relation for the RER, which is now augmented for the distribution sector:

$$\frac{w_1}{e w_2} = \left(\frac{\beta_{T2}}{\beta_{T1}} \right)^{\gamma} \left(\frac{\beta_{D2}}{\beta_{D1}} \right)^{1-\gamma},$$

$$RER = \left(\frac{w_1}{ew_2} \right)^{\alpha+(1-\alpha)\phi} \left(\frac{\beta_{N1}}{\beta_{N2}} \right)^\alpha \left(\frac{\beta_{D1}}{\beta_{D2}} \right)^{(1-\alpha)\phi} = \left(\frac{\beta_{T2}}{\beta_{T1}} \right)^{\alpha\gamma+(1-\alpha)\phi\gamma} \left(\frac{\beta_{N2}}{\beta_{N1}} \right)^{-\alpha} \left(\frac{\beta_{D2}}{\beta_{D1}} \right)^{(1-\gamma)\alpha-(1-\alpha)\phi\gamma}$$

Hence, the RER of country 1 versus 2 will appreciate with the relative productivity of tradables (β_{T2}/β_{T1}) and will depreciate with the relative productivity of non-tradables (β_{N2}/β_{N1}). It will also appreciate with the relative productivity of the distribution sector (β_{D2}/β_{D1}), if this sector plays a bigger role in delivering goods in the tradable industry rather than to consumers. This is because the productivity of the distribution sector has two effects: on the one hand, it tends to lower the price of tradables (by lowering the cost of distributing intermediate inputs), thus raising the relative wage and appreciating the RER (similar to the effect of the productivity of tradables); on the other hand, it lowers the consumer price of tradables, depreciating the RER (similar to the effect of the productivity of non-tradables).^{8,9}

Our model is similar in spirit to that presented in Devereux (1999), who also analyses the effect of the distribution sector on the RER in the context of a Balassa-Samuelson framework. In particular, Devereux (1999) presents a general equilibrium model in which productivity in the traded sector, by raising consumption, leads to growth in the size of the distribution sector. This, in turn, generates an endogenous increase in productivity in the distribution sector, pushing the price of distribution services down. The latter effect,

⁸ The net effect of the distribution sector would be positive if $\phi < (1-\gamma)\alpha / ((1-\alpha)\gamma)$. Note that if $\phi=0$ and $\gamma=1$, the distribution sector would disappear from the model and we would obtain the usual Balassa-Samuelson framework, where the exponent of the relative productivity of both tradables and non-tradables is α and $-\alpha$. In our model, the relative productivity of the tradable sector presents two differences with respect to a basic Balassa-Samuelson model: on the one hand, it has a smaller effect, as its impact on wages is less than proportional; on the other hand it has an additional positive effect, as its impact on wages also raises the consumption price of tradables via the employment cost of the distribution sector. Note also that the sum of all the exponents in the RER expression is zero. Allowing for intermediate inputs in the non-tradable sector would lower the exponents (and hence the impact) of the productivities in both tradable and non-tradable sectors.

consequently, reduces the traded goods prices facing consumers which, in turn, can generate a depreciation of the RER. As in our model, Devereux (1999) assumes that the LOOP holds at the producer price level but not at the CPI level. A key difference is that an autonomous increase in the productivity of the distribution sector would depreciate the RER in Devereux's model, while it could either depreciate or appreciate the RER (depending on parameter values) in our model.

In the presence of violations of the LOOP at the producer price level, the effect of both the Balassa-Samuelson and distribution effects on the RER would be less clear-cut. The productivity shocks would be transmitted to the RER also via the relative price of traded goods. Our empirical work will allow for failure of the LOOP, which has been chosen at the theoretical level simply for presentation of the main intuition behind the effect.

3. Data Sources, Variable Definitions, and Econometric Methods

This Section presents a brief discussion of the construction of the data set, relegating a more complete description of the construction of the variables to the data appendix. Ten countries feature in our analysis: Belgium (BEL), Denmark (DNK), Finland (FIN), France (FRA), Italy (ITA), Japan (JPN), Norway (NOR), Sweden (SWE), West Germany (WGR), and the United States (USA).¹⁰ Variables for each of the first nine countries are defined relative to the USA, bringing the cross sectional dimension of our panel to nine. Annual data are used for the period 1970 to 1991. Both the cross sectional and the time series dimension of the panel were determined by the availability of consistent data,

⁹ Our model does not feature policy or preference shocks, which can have an independent effect on the relative price of traded to non-traded goods in the short-run.

especially for the distribution sector variables, and by the need to balance the panel for the panel unit root test employed. All variables, apart from the Balassa-Samuelson terms, are from the IFS, OECD, World Bank, and WEO macroeconomic data bases.

The key dependent variable in our study is the logarithm of the RER (LRER), which is CPI-based: an increase in LRER of country j corresponds to an appreciation of the real exchange of j versus the USA. The relative productivity in tradables and non-tradables are calculated by drawing from the OECD International Sectoral data base. Similar to De Gregorio, Giovannini, and Wolf (1994) and Cheung, Chinn, and Fujii (2001) we classify agriculture, manufacturing and transportation sectors as tradables; and utilities, construction, and social services sectors as non-tradables.¹¹ Notably, we exclude the distribution sector from the non-tradables, in order to focus on this sector separately.¹²

We then sequentially introduce into the regressions variables capturing the relative efficiency in the distribution sector with respect to the USA (our proxies for β_{D2}/β_{D1}), calculated from the OECD International Sectoral database. The most obvious measure of efficiency is the relative total factor productivity in this sector. The database however allows the calculation of another proxy for efficiency: the ratio of the number of employees to total employment (E) in the distribution sector. This employment variable is designed to capture product market competition in the sector. For example, imagine a family owned retail store in the center of Rome with three members of the family hiring

¹⁰ Data refer to West Germany only, even for the period after German reunification.

¹¹ De Gregorio, Giovannini, and Wolf (1994) define as tradable those sectors for which the export share in total production is larger than 10 percent. A similar classification was used by Stockman and Tesar (1995). In the export content measurement exercise, the distribution sector is considered as part of services activity, as specific data within this activity is not available. Note that, in this classification, the services the distribution sector sells to the tradable sector would still be classified as non-tradable, inducing an undervaluation of the importance of the distribution sector as a tradable sector.

¹² Mining was not included in the tradable sector for lack of data for Belgium and Italy. The financial sector was not included in the non-tradable sector for lack of data for Belgium, Italy, and Netherlands.

three employees: the E variable would equal 1/2. Imagine now a Wal-Mart in the USA, with 10 managers (maybe even just 1!) and 100 employees: the E variable would equal 10/11 (if not 100/101). This employment structure is likely to be reflected in the markup charged: in particular, a change in the E variable would imply a change in the price of the distribution services.¹³ We therefore explore the empirical effect of each measure of efficiency in the distribution sector, both jointly and separately.

Finally, by introducing the aggregate wage in industrial activity (and in the tradable sector defined above) as well as measures of productivity and product market competition in the distribution sector (both series from the OECD International Sectoral database), we are able to analyze how the distribution effect gets transmitted into the RER.

The relatively small available time series samples for each country necessitates using panel methods to improve the power of our tests (data on productivity, for example, are only available at an annual frequency). In particular, we use a version of the panel DOLS estimator which allows for limited heterogeneity in the form of fixed effects is:

$$y_{it} = \theta_{1i} + \theta_{2t} + \theta_3 x_{it} + \sum_{j=-p}^{+n} \theta_{4j} \Delta x_{it+j} + \omega_{it} , \quad (1)$$

where y_{it} is a scalar, x_{it} is a vector with dimension k , θ_{1i} is an individual fixed effect, θ_{2t} is a time effect, θ_3 represents a cointegration vector, p is the maximum lag length, n is the maximum lead length and ω is a Gaussian vector error process. The leads and lags of the difference terms are included to ensure that the error term is orthogonalized. Our

¹³ This variable is motivated by a simple model of monopolistic competition a' la Dixit-Stiglitz, with CES utility function and a production function characterized by a fixed cost and a constant marginal cost, both costs being in terms of labor. In the equilibrium of this model, if one assumes that the fixed employment cost is given by the managers (the difference between total employment and number of employees) and the marginal cost by the employees, our E variable would equal the inverse of the markup. Hence, a lower markup could be interpreted as a more competitive sector. The framework presented above does not include imperfect competition or economies of scale for the sake of presentational simplicity.

representation of the Panel DOLS estimator assumes that the dynamics are the same across individuals. The estimator can address potential cross sectional dependence by the inclusion of time dummies, and that is accomplished here by removing the cross-sectional mean of each variable.¹⁴ As Pedroni (1997) notes, the residuals from an equation like (1) will have the same distribution as the raw data and hence it is possible to use a standard unit root test to check for the existence of cointegration amongst the variables in the vector of interest. We therefore use the Levin and Lin (1993) panel unit root statistic to test for cointegration:

$$\Delta\omega_{it} = \delta\omega_{it-1} + \sum_{j=1}^n \theta_{4i} \Delta\omega_{it-j} + u_{it}, \quad (2)$$

where $-\delta$ represents the adjustment speed¹⁵ and the t-ratio on this term, denoted “PUR test” in the empirical section of this paper, denotes the significance of the adjustment speed.¹⁶ The null hypothesis that each time series of residuals has a unit root is rejected if δ is significantly negative; that is, in the current application there is panel cointegration. As Levin and Lin demonstrate, under the null hypothesis that $\delta=0$ the PUR test diverges to minus infinity. However, they propose a simple adjustment to this statistic that produces a test statistic which has a standard normal distribution and it is the adjusted t-statistic which we use in this paper. We calculate the half-life mean reversion speed for

¹⁴ The inclusion of the time dummies neutralizes the role of the reference country (USA): measuring the real exchange rate with respect to different reference countries (say Germany as opposed to USA) would yield different coefficients in the absence of time dummies. Our results on the adjustment speed do not depend on time dummies, as discussed in Section 4.5.

¹⁵ Equation (1) represents the reparameterization of a levels autoregression for ω , and therefore δ represents the difference between the sum of the levels autoregressive coefficients and one.

¹⁶ Since fixed effects are included in our cointegrating regression, we use the adjustment proposed by Levin and Lin (1993) for the case of a constant term.

our panel of RERs using the formula: $\ln(0.5)/\ln(1-\hat{\delta})$, where $\hat{\delta}$ is the estimated value of δ in expression (2).

4. Results

This section discusses the empirical results. We first estimate a base line model for equation 1, which consists of a regression of the CPI-based RER on net foreign assets, a real interest differential and a Balassa-Samuelson term. We next proceed by investigating the role of the distribution sector, via the inclusion on the basic model of variables measuring the efficiency of this sector. We then discuss our implications for the “PPP puzzle”.

4.1. A basic Balassa-Samuelson model of the real exchange rate.

Table 2 presents the basic model of the RER, which is dependent on two macroeconomic control variables (relative net foreign assets, NFA, and relative real interest rates, INT), and on the Balassa-Samuelson effect or on its two components (the relative productivity of tradable and of non-tradables). Robustness tests are performed here by dropping variables from the regression. In the first column of Table 2, we present the panel unit root (PUR) test for our RER series, taking into account fixed effects.¹⁷ The RER appears to be non-stationary. However, given the limited power of the test with about 20 years of data, one may find it interesting that if the RER were indeed to be stationary, the implied a half-life of the deviations would be of approximately 3 years, which is in the range reported by other researchers using panel data sets (see section 1).

¹⁷ Implicitly we also account for time dummies, as our variables have the cross-sectional mean removed.

In the basic model specification, all of the variables enter with the correct sign and all are statistically significant. When the two productivity variables are entered separately, the control variables are no longer significant, suggesting that the macroeconomic variables are less important than the real variables capturing the Balassa-Samuelson effect. The PUR t-ratio is highly significant and we get a marked rise in the adjustment speed with the implied half-life of the real exchange rate, with respect to its equilibrium, now very close to the one year horizon. It is also worth noting that the two macroeconomic variables – net foreign assets and the real interest rate differential – on their own do not produce evidence of cointegration (see the final column of Table 2). It is only when the productivity and distribution effects are added in that we find evidence of cointegration and this would seem to underscore the importance of these variables in explaining systematic movements in RERs.

The magnitude of the coefficient on the Balassa-Samuelson term, as well as of the two components, are about the middle of the range of coefficient estimates of previous work (Chinn and Johnston, 1996, report a range of 0.1 to 1.6 for the absolute value of these coefficients) and particularly close to the estimates related to bilateral exchange rates (as opposed to multilateral). An estimate of approximately 0.8 (with a standard error of about 0.1) could appear to be somewhat high: in the neoclassical world of Balassa-Samuelson the theoretical prediction for this elasticity is that it should equal the expenditure share on non-tradables. However, our result is consistent with those of Chinn and Johnson (1999) who apply a similar methodology and discuss this empirical anomaly. Note also that the theoretical prediction for this elasticity would be higher than the one suggested by the Balassa-Samuelson framework, if tradables, in order to be

available for consumption, needed to be aggregated with non-tradables (see Burstein, Neves, and Rebelo, 2000).

Most empirical studies which include the Balassa-Samuelson effect either focus on aggregate measures of productivity (such as GDP per worker or labor productivity in manufacturing) or productivity in the tradable sector or the aggregate Balassa-Samuelson term. This is due partly to the lack of data for a large set of countries and/or extensive time series, but also to the presumption that all of the action should come from the tradable sector.¹⁸ Our data set facilitates entering the two components of the Balassa-Samuelson term separately and testing the constraint that the coefficients on the two terms are equal and opposite, as the basic Balassa-Samuelson theory would suggest. On the basis of the reported chi-squared test, this hypothesis is rejected in the basic model. Perhaps more interestingly, the larger coefficient (in absolute value) is the one on productivity in the non-traded sector. We note that dropping the control variables one at a time, as well as simultaneously, does not significantly affect the size nor alter the significance of the Balassa-Samuelson terms or components, nor the stationarity of the residuals.

4.2. The influence of the distribution sector on the real exchange rate.

Table 3 presents econometric evidence of the effects of the distribution sector on the RER. The two benchmark models (the one with the control variables and the Balassa-Samuelson term, and the one with the control variables and the productivity of tradable and of non-tradables separately) are expanded by adding, one at a time or simultaneously,

¹⁸ In many simple text book representations of the Balassa-Samuelson effect, productivity in the non-traded sector is even assumed to be fixed across countries.

the two measures of relative efficiency in the distribution sector (relative productivity and product market competition).

The distribution sector does not alter the sign, size, and significance of the coefficient on the Balassa-Samuelson variable. Note that when the two Balassa-Samuelson components are entered separately, however, their coefficients tend to be closer (in absolute value) than when the distribution sector is not in the regression.¹⁹ In terms of the control variables, the coefficient on the relative interest rate differential is correctly signed, of similar size, and more significant than without the distribution sector. The coefficient of the net foreign asset variable, instead, becomes insignificant. The coefficients on both productivity and product market competition in the distribution sector are strongly significant and positive (as one would expect, the size of these coefficients is reduced when they are both present in the regression, although they are both still largely significant).

These results suggest that the distribution sector influences the RER as a traded sector rather than as a non-traded sector, contrary to what the few earlier contributions speculating on the role of this sector have assumed. In terms of our simple theoretical model, this would suggest that the role of the distribution sector via the traded sector is stronger than via the non-traded sector. This plausibly reflects the fact that some components of the non-traded sector – such as utilities and social services – have

¹⁹ Indeed, one can actually accept the hypothesis that they are identical. However, our model suggests that once the distribution sector is taken into account, the relation among the coefficients should be different: more precisely, the coefficient of the productivity of non-tradables should equal (in absolute value) the sum of the coefficients of productivity of tradables and of the distribution sector. This new restriction hypothesis cannot properly be tested with our empirical result as we find two empirically useful measures of efficiency in the distribution sector. The reader may nonetheless be interested in knowing that if one ignores this problem (i.e. focuses on the productivity in the distribution sector) the new restriction hypothesis can be rejected in column 2 and accepted in column 6 of Table 2 at the 5 percent level of significance.

vertically integrated distribution sectors, while most of the services of the distribution sector gets imputed into the traded components of manufacturing and agriculture.

Note that all of the PUR statistics are statistically significant (which is evidence of the stationarity of the estimated residuals) in Table 3. In the model with both measures of efficiency in the distribution sector, the implied half-life in this regression falls to unity, exactly the number which is the starting point for the PPP puzzle. Note also that our results hold even if we were to drop the control variables NFA and INT (see MacDonald and Ricci, 2001).

4.3. Controlling for the wage: productivity effects and imperfect substitutability.

Following the approach adopted in MacDonald and Ricci (2002), this section attempts to further analyze the Balassa-Samuelson mechanism, in order to assess whether the distribution sector follows the same channel of influence on the RER. As we noted in section 2, the key variable in the Balassa-Samuelson effect is the wage rate. An increase in the productivity of tradables raises the domestic wage (as tradable prices are given) which, in turn, raises the price of non-tradables and induces an appreciation of the RER. Hence, in a standard Balassa-Samuelson framework one would expect the coefficient on the productivity of tradables to become zero (i.e. insignificant), when the wage enters the regression, as the wage would capture all of the effect of the productivity of tradables.

The first four columns of Table 4 introduce the wage in the basic model and in the benchmark model with the distribution sector. We use two measures for the wage rate: the wage rate in the overall industrial activity is the measure suggested by the theory; as a check, we employ also the average wage in the tradable sector (built similarly to the

productivity index - see the appendix). Not surprisingly, both measures yield similar results, given that wages are largely correlated across sectors within countries. The wage term is always positive and highly significant, with a plausible coefficient (theoretically it should equal the share of expenditure on non-tradables).

Note that the coefficient on the productivity of tradables becomes statistically negative after the introduction of the wage. MacDonald and Ricci (2002) document this result and discuss the theoretical underpinnings: while a standard Balassa-Samuelson approach cannot explain why the coefficient is significantly negative, imperfect substitutability across international goods produced in different countries may explain this finding. More specifically, in the presence of imperfect substitutability of tradables, productivity of tradables would not only directly and positively affect the aggregate wage, and hence indirectly and positively the overall price index and RER, but also directly and negatively the price of tradables, and hence indirectly and negatively the price index and the RER. The coefficient of productivity of tradables would thus be positive in a normal regression without the wage, but would be negative once we control for the wage effect. This result is consistent with the evidence presented by Engel (1993, 1999), Rogers and Jenkins (1995) and Betts and Kehoe (2001) that the majority of variation of RERs comes from the relative price of tradables across countries.

We now turn to the effect that the introduction of the wage has on the distribution sector. Unlike the coefficient on productivity in the tradable sector, both the coefficients of the two measures of efficiency in the distribution sector maintain their sign as in the regression without the wage, although their size is smaller in absolute terms (third and fourth column of Table 4). This suggests that although productivity and product market

competition in the distribution sector have a similar effect to the productivity of tradables on the RER, wages do not appear to be the only conduit which facilitates the effect of distribution sector efficiency.

Through which other channel could the distribution sector influence the RER? One potential channel is profits. In fact, as demonstrated in the last two columns of Table 4, the inclusion of operating profits in the regression for the distribution sector makes the coefficient on the productivity in the distribution sector insignificant, leaving unaltered the significance and sign of other variables. Note, however, that product market competition in the distribution sector remains positive and significant, perhaps suggesting that this variable also captures an externality in market structure, which should affect prices via game-theoretic incentives and would not show up in aggregate wages or sectoral operating profits.

One possible explanation for the role of profits is that international price equalization holds both for intermediate inputs and for final tradables. The equalization of prices of intermediate inputs determines wages and provides the channel for productivity of intermediate goods (part of tradables) to positively influence the RER, consistently with the Balassa-Samuelson effect. Then intermediate inputs are conveyed through the distribution sector to the production of a second stage of tradables. The price of this second stage of tradables, which includes the cost of distribution of such intermediate inputs, are also equalized internationally. If the distribution and the non-tradable sectors use a commonly specific factor such as land (or are similarly less competitive than tradables), and hence face similar operating profit margins, both sectors would see their

profit margins being affected by the productivity of the distribution sector.²⁰ In this case operating profit margins would be the channel for the effect of productivity of the distribution sector on the RER. Productivity in tradables and productivity in the distribution sector would both similarly affect the RER thanks to international price equalization, but one via wages and one via profits. A model consistent with such results is presented in the Appendix to MacDonald and Ricci (2001)²¹.

In passing, it is worth noting how our results relate to the literature which seeks to decompose the sources of the variance of the real exchange into demand, supply and nominal shocks. Starting with Clarida and Gali (1997), a number of researchers have used trivariate structural VARs (SVAR), comprising relative output, relative inflation and the RER, to show that demand and nominal shocks dominate the variability of RERs (this result has been confirmed in a number of other papers using such a trivariate structure). However, when the supply side is made richer in such SVAR models (see Weber, 1997, and Rogers, 1999) it is seen to play a significant role in explaining the variance of RERs. Since the supply side is, at least in part, attributable to a Balassa-Samuelson effect in such papers (see, for example, Weber, 1997) this would seem to be consistent with the results reported here for the level of the RER.

4.5 The PPP Puzzle.

Although the main focus of our paper is on the role played by the distribution sector on the RER, our econometric results would seem to have an important bearing on the PPP

²⁰ Note that in the OECD dataset, operating profit margins include, for example, land rent.

²¹ We checked the robustness of our results by using different panel estimators, different conditioning variables and different sample periods. These tests, reported in MacDonald and Ricci (2001), confirm the results reported in this section.

puzzle. As noted in section 1, this puzzle relates to the finding by a number of researchers that the mean reversion in RERs is too slow to be consistent with a traditional form of PPP. We now bring together the different mean reversion speeds mentioned at various places in the paper. First, we note that the half-life mean reversion speed for our RER series on its own is around three years (see Table 2), which is entirely consistent with the PPP puzzle. However, expanding the information set to include usual determinants of the RER raises significantly the speed: including only the relative net foreign asset position and the real interest differential reduces the half-life of the deviation of the real exchange rate to its equilibrium, to 2.1, while including only the Balassa-Samuelson term produces a real exchange rate half-life of 1.6-1.8 years. In the basic model encompassing all these variables, the half-life drops to around 1.2-1.3 years. Perhaps our most striking finding is that by adding our measures of efficiency in the distribution sector to the basic model produces a half-life of about one year (Table 3). It would seem therefore that at least one important explanation for the PPP puzzle (there may of course be others, as we noted in Section 1) is to be found in the fundamental determinants of RERs.

4.6. Robustness.

We perform various robustness tests on our benchmark specification identified in Table 3. First, similar to the exercise in Table 2, we eliminate the two control variables one at a time, as well as simultaneously, and these results are reported in Table 5. Then we exclude one country at a time from the benchmark regression (Table 6). Finally, again for the benchmark regression, we change the time span of the sample and we run plain static OLS (Table 7).

These experiments indicate that our original results are robust. The distribution sector as well as the Balassa-Samuelson variables maintain their sign and significance, with the size of the coefficients varying little. Only in one case does the coefficient of productivity in the distribution sector become insignificant, and this is when the sample period is shortened by four years; this result could simply reflect the fact that with only twelve years of data (given leads and lags), the long-run estimation becomes less accurate.

5. Conclusions

This paper finds that an increase in productivity and in product market competition of the distribution sector with respect to foreign countries leads in the long-run to an appreciation of the real exchange rate, similar to the effect a relative increase in the domestic productivity of tradables would have. This contrasts with the result that one would expect by considering the distribution sector as belonging to the non-tradable sector, as several authors have assumed. Notably, this effect is coexistent with the usual Balassa-Samuelson effect of the productivity in the other tradable and non-tradable sectors (and holds also when controlling for other macro-determinants of the real exchange rate, such as net foreign assets and real interest rates). One possible explanation offered for this result is that the use of the services from the distribution sector to deliver intermediate goods used in the production of tradables has a larger impact on the real exchange rate than the use of distribution services to deliver final goods to consumers.

Accurate estimates of the long-run relations are obtained by employing dynamic panel estimation methods (dynamic OLS). Panel unit root tests support the hypothesis of panel cointegration among the series. Accounting for our explanatory variables

(including the distribution sector) raises the speed of adjustment of temporary deviations of the real exchange rate from its long-run path, by lowering the half-life of such deviations to approximately one year and, as we have argued, this result would seem to contribute to solving the PPP puzzle. In other words, although the real exchange rate has a slow reversion to its average level (half-life of deviations of about 3 years), it has a reasonable speed of adjustment towards its equilibrium level (half-life of deviations of about 1 year), which depends on macroeconomic variables (such as net foreign assets position, real interest rate differential) but in particular on real variables measuring the Balassa-Samuelson effect and the efficiency in the distribution sector.

It is interesting to note that the channel of transmission of the distribution sector appears to be somewhat different from that predicted by the Balassa-Samuelson effect. The introduction of an aggregate wage variable does not crowd out the effect of the productivity and product market competition in the distribution sector. However, the introduction of operating profits in the distribution sector makes the productivity of this sector become insignificant. This would be consistent with a model which entails two stages of price equalization (of intermediate inputs and of final tradables, with the latter making use of these intermediate inputs once delivered by the distribution sector) and equalization of operating profits margins across the distribution sector and non-tradables.

Appendix 1. Variable definitions.

For brevity, OECD International sectoral Database will be referred to as OCDE ISD. The corresponding three letter sectoral code or variable name code is provided.

Real Exchange Rate: $LRER_j = \text{Log}(\text{CPI}_j / (e_j * \text{CPI}_{\text{usa}}))$, for CPI = Consumer price index, e = exchange rate (currency units of j per US\$) ; Source: IFS.

Relative Real Interest Rate: $\text{INT}_j = (i_j - \pi_j) - (i_{\text{usa}} - \pi_{\text{usa}})$; for i_j = nominal interest rate (long term government bond yield) π_j = CPI inflation rate; Source: IFS.

Relative Net Foreign Assets: $\text{NFA}_j = (\text{NFA}_j * e_j / \text{GDP}_j) - (\text{NFA}_{\text{usa}} / \text{GDP}_{\text{usa}})$, for NFA= Net foreign asset position, GDP = Gross Domestic Product, e = exchange rate (currency units of j per US\$). Source: IFS, OECD.

Relative public expenditure size: $\text{GOVY}_j = (\text{government expenditure}/\text{GDP})_j - (\text{government expenditure}/\text{GDP})_{\text{usa}}$; Source: World Bank, World Economic Outlook (IMF) database.

Relative Productivity in Tradables: $\text{LATRDWT}_j = \text{Log}(\sum_k(\omega_{kj} \text{TFP}_{kj}) / \sum_k(\omega_{k,\text{usa}} \text{TFP}_{\text{usa}}))$, for k = agricultural sector (AGR), manufacturing sector (MAN) and transport, storage and communication sector (TRS); the weights being the country-specific relative size of the sectoral value added, averaged over the sample period. Source: OECD ISD.

Relative Productivity in Non-Tradables: $\text{LANTRD}_j = \text{Log}(\sum_k(\omega_{kj} \text{TFP}_{kj}) / \sum_k(\omega_{k,\text{usa}} \text{TFP}_{\text{usa}}))$, for k = Community, social and personal services (SOC); Electricity, gas and water (EGW); Construction (CST); again the weights being the country-specific relative size of the sectoral value added, averaged over the sample period. Source: OECD ISD.

Balassa-Samuelson term: $\text{LBAL2WT}_j = \text{LATRDWT}_j - \text{LANTRD}_j$

Relative Productivity in Distribution Sector: $\text{LARWH}_j = \text{Log}(\text{TFP}_{kj} / \text{TFP}_{\text{usa}})$, for k= Wholesale and retail trade sector (RWH). Source: OECD ISD.

Relative Product market competition in Distribution Sector: $\text{LERWH}_j = \text{Log}((\text{EE}_{kj} / \text{ET}_{kj}) / (\text{EE}_{k,\text{usa}} / \text{ET}_{k,\text{usa}}))$, for k= Wholesale and retail trade sector (RWH), EE=Number of Employees, ET=Total Employment. Source: OECD ISD.

Relative Wage in Tradables: $\text{LWTRDWT}_j = \text{Log}(\sum_k(\omega_{kj} (\text{WSSS}_{kj} / (e_j * \text{EE}_{kj}))) / \sum_k(\omega_{k,\text{usa}} (\text{WSSS}_{k,\text{usa}} / \text{EE}_{k,\text{usa}})))$, for k = agricultural sector (AGR), manufacturing sector (MAN) and transport, storage and communication sector (TRS); WSSS = compensation of employees at current prices in national currency, EE= number of employees; e = exchange rate (currency units of j per US\$); the weights being the country-specific relative size of the sectoral value added, averaged over the sample period. Source: OECD ISD.

Relative Wage in Industrial Activity: $\text{LWTIN}_j = \text{Log}((\text{WSSS}_{kj} / (e_j * \text{EE}_{kj})) / (\text{WSSS}_{k,\text{usa}} / \text{EE}_{k,\text{usa}}))$, for k = Total Industry (TIN), WSSS = compensation of employees at current prices in national currency, EE= number of employees, e = exchange rate (currency units of j per US\$). Source: OECD ISD.

Relative Profit Margin in Distribution Sector: $\text{LORWH}_j = \text{Log}(\text{OP}_{kj} / \text{OP}_{\text{usa}})$, for k= Wholesale and retail trade sector (RWH), and OP = ratio of gross operating surplus to value added less indirect taxes. Source: OECD ISD.

Relative Wage in Distribution Sector: $\text{LWRWH}_j = \text{Log}((\text{WSSS}_{kj} / (e_j * \text{EE}_{kj})) / (\text{WSSS}_{k,\text{usa}} / \text{EE}_{k,\text{usa}}))$, for k= Wholesale and retail trade sector (RWH), WSSS = compensation of employees at current prices in national currency, EE= number of employees, e = exchange rate (currency units of j per US\$). Source: OECD ISD.

Relative Price in Distribution Sector: $\text{LDRWH}_j = \text{Log}((\text{GDP}_{kj} / (e_j * \text{GDPV}_{kj})) / (\text{GDP}_{k,\text{usa}} / \text{GDPV}_{k,\text{usa}}))$, for k= Wholesale and retail trade sector (RWH), GDP= value added at market prices and current prices in national currency, GDPV= value added at market prices and 1990 prices in national currency, e = exchange rate (currency units of j per US\$). Source: OECD ISD.

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Table 1: Sectoral Composition of Economic Activity
(1970-92 Average of 10 European Countries)

Sector	Sectoral Share in Industrial Activity		Sectoral Share in National GDP	
	Gross Domestic Value Added (GDP)	Total Employment (ET)	Gross Domestic Value Added (GDP)	Total Employment (ET)
Community, social & personal serv. (SOC)	10.15	11.34	8.71	9.18
Finance, ins., real est., bus. ser (FNI)	15.37	9.18	12.84	7.12
Transport, storage & communication (TRS)	8.51	8.10	7.15	6.36
Wholesale & retail trade (RWH)	15.21	18.68	12.87	14.91
Construction (CST)	8.21	9.73	6.92	7.73
Electricity, gas and water (EGW)	3.44	1.14	2.91	0.90
Manufacturing (MAN)	28.91	30.03	24.47	23.87
Mining and quarrying (MID)	1.85	0.67	1.57	0.54
Agriculture, hunt., for. & fishing (AGR)	5.24	10.15	4.40	8.16
Other	3.11	0.97	18.17	21.23
Total Industry (TIN)	100.00	100.00		
Total Economic Activity (TET)			100.00	100.00

Source: OECD International Sectoral Database; OECD datacode in parenthesis.

Table 2: Basic Model of RER and its Robustness
(Dynamic OLS)

	Basic model									
	LRER ¹	LRER	LRER	LRER	LRER	LRER	LRER	LRER	LRER	LRER
Net foreign assets (NFA)	-	0.004	0.001	0.004	0.001	-	-	-	-	0.005
	-	2.02	0.41	1.92	0.61	-	-	-	-	2.94
Real interest rates (INT)	-	0.013	0.007	-	-	0.014	0.012	-	-	0.03
	-	1.91	0.87	-	-	2.23	1.83	-	-	4.20
Balassa Samuelson (LBAL2WT)	-	0.769	-	0.815	-	0.760	-	0.785	-	-
	-	6.45	-	7.58	-	6.67	-	7.26	-	-
Productivity in tradables (LATRDWT)	-	-	0.418	-	0.425	-	0.271	-	0.315	-
	-	-	1.93	-	2.04	-	1.37	-	1.66	-
Productivity in non-tradables (LANTRD)	-	-	-0.948	-	-0.934	-	-0.909	-	-0.910	-
	-	-	-7.15	-	-7.95	-	-7.67	-	-8.07	-
Testing restrictions on balassa samuelson										
Chi-square			4.92		4.76		9.63		8.64	
Probability			0.03		0.03		0.00		0.00	
Panel Unit Root Analysis										
PUR test	-0.62	-3.81	-3.25	-4.28	-3.24	-3.47	-2.53	-2.95	-2.35	-0.87
Delta (from text)	-0.22	-0.44	-0.42	-0.44	-0.42	-0.38	-0.35	-0.32	-0.35	-0.28
Half-life time (years)	2.8	1.2	1.3	1.2	1.3	1.4	1.6	1.8	1.6	2.1
Number of observations	153	153	153	153	153	153	153	153	153	153

Absolute t-ratios below coefficients

Wald Test on restrictions. H0: LATRDWT=-LANTRD. Do not reject if p-value above desired alpha (0.05)

Panel Unit Root (PUR) test: 'adjusted' Levin and Lin (1996) t-ratios discussed in the text.

Half-life time of deviations of the real exchange rate from estimated relation (years): $\log(0.5)/(\log(1+\delta))$

¹ First column provides PUR test on residual of LRER on fixed effects.

Table 3: The Influence of the Distribution Sector on RER
(Dynamic OLS)

	LRER	LRER	LRER	LRER	Benchmark model	
					LRER	LRER
Net foreign assets (NFA)	-0.003	-0.003	-0.001	-0.002	-0.002	-0.002
	1.44	1.32	0.44	0.85	1.55	1.29
Real interest rates (INT)	0.012	0.011	0.018	0.018	0.016	0.017
	2.02	1.59	3.34	2.65	2.82	2.6
Balassa samuelson (LBAL2WT)	0.687	-	0.893	-	0.832	-
	6.59	-	9.41	-	8.45	-
Productivity in tradables (LATRDWT)	-	0.664	-	0.733	-	0.857
	-	3.36	-	3.98	-	4.58
Productivity in non-tradables (LANTRD)	-	-0.706	-	-0.934	-	-0.82
	-	5.79	-	8.63	-	7.22
Productivity in distribution (LARWH)	0.797	0.767	-	-	0.422	0.437
	7.92	6.43	-	-	3.63	3.39
Product market competition in distribution (LERWH)	-	-	2.043	1.979	1.482	1.518
	-	-	8.85	7.49	5.35	5.14
Testing restrictions on coefficients						
Chi-square		6.463				3.024
Probability		0.011				0.082
Panel Unit Root Analysis						
PUR test	-4.31	-3.79	-2.78	-2.69	-3.62	-3.74
Delta (from text)	-0.44	-0.44	-0.46	-0.45	-0.5	-0.51
Half-life time (years)	1.2	1.2	1.1	1.2	1.0	1.0
Number of observations	153	153	153	153	153	153

Absolute t-ratios below coefficients

Wald Test on restrictions. H0: LATRDWT+LANTRD+LARWH=0. Do not reject if p-value above desired alpha (0.05)

Panel Unit Root (PUR) test: 'adjusted' Levin and Lin (1996) t-ratios discussed in the text. Half-life time of deviations of the real exchange rate from estimated relation (years): $\log(0.5)/(\log(1+\delta))$

Table 4: The Influence of the Distribution Sector on RER: Controlling for the Wage Effect
(Dynamic OLS)

	LRER	LRER	LRER	LRER	LRER	LRER
Net foreign assets (NFA)	-0.002	-0.001	-0.003	-0.003	-0.003	-0.002
	2.37	1.65	3.97	4.00	3.42	3.29
Real interest rates (INT)	0.004	0.002	0.007	0.005	0.006	0.005
	1.58	1.02	2.74	2.53	2.54	2.71
Productivity in tradables (LATRDWT)	-0.587	-0.566	-0.253	-0.278	-0.120	-0.153
	6.67	7.30	2.78	3.60	1.37	2.13
Productivity in non-tradables (LANTRD)	-0.259	-0.221	-0.306	-0.283	-0.459	-0.393
	4.83	4.54	6.08	6.46	8.38	8.50
Productivity in distribution (LARWH)	-	-	0.230	0.182	-0.010	-0.021
	-	-	4.47	4.04	0.16	0.39
Product market competition in distribution (LERWH)	-	-	0.353	0.392	1.008	0.978
	-	-	2.69	3.46	5.91	6.96
Wage in tradables (LWTRDWT)	0.719	-	0.580	-	0.530	-
	22.06	-	16.45	-	16.29	-
Wage in industry (LWIND)	-	0.737	-	0.606	-	0.566
	-	25.09	-	19.71	-	20.44
Profits in distribution (ORWH)	-	-	-	-	0.104	0.095
	-	-	-	-	3.47	3.77
Panel Unit Root Analysis						
PUR test	-1.88	-2.31	-3.81	-2.38	-4.13	-5.01
Delta (from text)	-0.26	-0.28	-0.41	-0.38	-0.50	-0.60
Number of observations	153	153	153	153	153	153

Absolute t-ratios below coefficients

Panel Unit Root (PUR) test: 'adjusted' Levin and Lin (1996) t-ratios discussed in the text.

Table 5: Robustness: Dropping Control Variables
(Dynamic OLS)

	LRER	LRER	LRER	LRER	LRER	LRER
Net foreign assets (NFA)	-0.002	-0.001	-	-	-	-
	1.18	0.66	-	-	-	-
Real interest rates (INT)	-	-	0.018	0.018	-	-
	-	-	3.61	3.27	-	-
Balassa samuelson (LBAL2WT)	0.843	-	0.821	-	0.829	-
	8.52	-	8.71	-	8.52	-
Productivity in tradables (LATRDWT)	-	0.923	-	0.930	-	0.964
	-	4.68	-	5.33	-	5.34
Productivity in non-tradables (LANTRD)	-	-0.802	-	-0.795	-	-0.763
	-	7.26	-	7.64	-	7.11
Productivity in distribution (LARWH)	0.409	0.359	0.377	0.412	0.406	0.400
	3.30	2.68	3.45	3.36	3.48	3.12
Product market competition in distribution (LERWH)	1.170	1.128	1.489	1.528	1.174	1.144
	4.15	3.96	5.43	5.31	4.18	4.04
Panel Unit Root Analysis						
PUR test	-3.86	-3.59	-3.32	-3.46	-3.82	-3.68
Delta (from text)	-0.47	-0.48	-0.49	-0.5	-0.44	-0.46
Half-life time (years)	1.1	1.1	1.0	1.0	1.2	1.1
Number of observations	153	153	153	153	153	153

Absolute t-ratios below coefficients

Panel Unit Root (PUR) test: 'adjusted' Levin and Lin (1996) t-ratios discussed in the text.

Half-life time of deviations of the real exch. rate from estimated relation (years): $\log(0.5)/(\log(1+\delta))$

Table 6: Robustness: Excluding One Country at a Time
(*Dynamic OLS*)

	Benchmark LRER	Excluding					
		BEL LRER	DEN LRER	FIN LRER	FRA LRER	ITA LRER	JAP LRER
Net foreign assets (NFA)	-0.002	-0.005	-0.002	-0.002	0.000	-0.005	0.001
	1.30	2.32	0.99	1.39	0.16	2.38	0.83
Real interest rates (INT)	0.017	0.013	0.015	0.013	0.024	0.008	0.019
	2.61	1.96	2.03	2.01	2.98	1.20	2.96
Productivity in tradables (LATRDWT)	0.857	1.073	0.885	0.673	0.925	0.764	0.636
	4.59	5.47	4.66	3.24	4.58	3.63	3.39
Productivity in non-tradables (LANTRD)	-0.820	-0.926	-0.807	-0.979	-0.704	-0.685	-0.501
	7.22	7.88	6.75	7.65	5.16	5.02	3.81
Productivity in distribution (LARWH)	0.437	0.295	0.547	0.226	0.256	0.561	0.274
	3.40	1.97	4.02	1.46	1.53	4.12	2.10
Product market competition in distribution (LERWH)	1.518	1.508	1.481	1.664	2.114	1.743	0.812
	5.14	4.98	4.84	5.40	4.98	5.00	2.38
Panel Unit Root Analysis							
PUR Test	-3.74	-3.71	-4.12	-3.63	-3.01	-3.88	-3.02
Delta (from text)	-0.51	-0.54	-0.56	-0.50	-0.50	-0.55	-0.47
Half-life time (years)	0.97	0.89	0.84	1	1	0.87	1.09
Number of observations	153	136	136	136	136	136	136

Absolute t-ratios below coefficients

Table 7: Robustness: Changes in Time Span and Static OLS

	Benchmark				Static OLS 1973 - 89 LRER
	DOLS 1973 - 89 LRER	DOLS 1975 - 87 LRER	DOLS 1975 - 89 LRER	DOLS 1973 - 1987 LRER	
	Net foreign assets (NFA)	-0.002	0.002	0.000	
	1.30	0.94	0.09	0.24	0.74
Real interest rates (INT)	0.017	0.012	0.015	0.019	0.004
	2.61	1.33	1.92	2.61	1.53
Productivity in tradables (LATRDWT)	0.857	1.186	1.230	0.662	0.506
	4.59	4.02	5.03	3.16	3.59
Productivity in non-tradables (LANTRD)	-0.820	-1.064	-1.060	-0.795	-0.679
	7.22	6.11	7.92	5.82	7.37
Productivity in distribution (LARWH)	0.437	0.225	0.332	0.358	0.339
	3.40	1.22	2.21	2.37	3.72
Product market competition in distribution (LERWH)	1.518	1.757	1.527	1.541	1.089
	5.14	3.94	4.29	4.52	4.42
Panel Unit Root Analysis					
PUR test	-3.74	-4.37	-4.15	-3.60	-4.82
Delta (from text)	-0.51	-0.65	-0.53	-0.54	-0.46
Half-life time	0.97	0.69	0.90	0.89	1.13
Number of observations	153	117	135	135	153

Absolute t-ratios below coefficients