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Trade Costs, Trade Balances and Current Accounts :
An Application of Gravity to Multilateral Trade

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Abstract

In this paper we test the well-known hypothesis of Obstfeld and Rogoff (2000) that trade costs are the key to explaining the so-called Feldstein-Horioka puzzle. Using a gravity framework in an intertemporal context, we provide strong support for the hypothesis and we reconcile our results with the so-called home bias puzzle. Interestingly, this requires a fundamental revision of Obstfeld and Rogoff's argument. A further novelty of our work is in tying bilateral trade behavior to desired aggregate trade balances and desired intertemporal trade.

Journal of Economic Literature Classification: F10, F32

Keywords: Feldstein-Horioka puzzle; trade costs; gravity model; home bias puzzle; current account; trade balance.

Résumé

Dans ce papier nous testons la célèbre hypothèse de Obstfeld et Rogoff (2000) que les coûts commerciaux sont la clef de la résolution du soi-disant Feldstein-Horioka puzzle. En transposant le modèle de gravité dans un contexte intertemporel, nous arrivons à fournir un support important pour cette hypothèse et nous réconcilions nos résultats avec le puzzle du « home bias ». De façon intéressante, cela nécessite une révision fondamentale du raisonnement de Obstfeld et Rogoff. Une autre nouveauté de notre travail consiste à relier le comportement des échanges bilatéraux aux balances commerciales désirées dans l'agrégat et aux échanges intertemporels désirés.

Journal of Economic Literature Classification: F10, F32

Mot-clefs: Feldstein-Horioka puzzle; coûts commerciaux; modèle de gravité; home bias puzzle; balance courante; balance commerciale.

A large body of work seeks to explain the so-called Feldstein–Horioka (FH) puzzle; the phenomenon of excessive reliance on domestic saving in order to finance domestic investment in a world of high capital mobility. In a recent provocative paper, Obstfeld and Rogoff (2000) propose trade costs as the explanation for not only this puzzle but also five other major puzzles in international macroeconomics. Although there are now a large number of competing explanations for the FH puzzle (see, for example, Obstfeld (1986), Dooley, Frankel and Mathieson (1987), Gordon and Bovenberg (1996) and Taylor (2002)), Obstfeld and Rogoff (OR) emphasize that the alternative explanations often suffer from other problems. In this paper, we test OR's key emphasis on the role of trade costs in explaining the FH puzzle. We provide strong support for their hypothesis and we reconcile our results with the so-called home bias puzzle. Additionally, we shed light on the importance of national plans to borrow and lend in explaining bilateral. Our approach is perhaps best understood against the backdrop of OR's interpretation of the FH puzzle.

The OR story runs as follows. First, any shift in a country's trade balance requires some movement between import prices inclusive of trade costs and prices of home goods exclusive of trade costs. A real exchange rate change is thus required to alter trade balances because of trade costs alone. Pressures to resist such changes may then explain the observed sluggishness of trade balances. In developing their argument, OR rely heavily on the intertemporal budget constraint. For example, in the current period, a country with a large negative trade balance will face higher prices inclusive of customs, insurance and freight (CIF) and those exclusive of these, or free on board (FOB), and thereby less favorable terms of trade. In the next period, however, there will be a resulting need to pay the added obligations on foreign debt and this will imply an opposite movement in the terms of trade. Thus, negative trade balances today mean lower expected future consumer prices relative to present consumer prices and therefore imply higher expected real interest rates. As a result of this direct link between trade costs in goods markets and foreign borrowing, OR make the current account the focus of their discussion in addressing the FH puzzle. In support of their hypothesis, OR demonstrate the presence of a negative correlation between the average values of real in-

terest rates and current account surpluses over the period 1990 to 1997 for 24 OECD countries and up to 32 others. Since then Bergin and Glick (2003) have reached the same conclusion in a related empirical test and with similar reasoning.

In this paper, we use a gravity model to capture the effects of trade costs on bilateral trade. In contrast to other gravity studies, however, we admit intertemporal substitution in the usual general equilibrium form of the model. We also impose an intertemporal objective. It turns out that this objective plays an important role in enabling us to assess the significance of trade costs in explaining aggregate trade and the FH puzzle. Our measure of trade costs relies on the relationship of consumption prices to output prices. But we introduce some other controls in our tests with results that, in turn, strongly reinforce our interpretation of our measure as reflecting the influence of trade costs.

The outline of the remainder of the paper is as follows. In the next section we provide a general overview of some closely related work in order to motivate our research. Section 3 develops our theory and test specification. There we explain both our general version of the gravity model and the particular features of our model that permit us to reason about national trade balances despite our reliance on bilateral trade data. Our data set is discussed in Section 4. Section 5 contains our empirical results of the tests of the gravity equation. In this section, we demonstrate that large movements in the trade balance require large changes in the prices of imports relative to home goods. According to our estimate, a one percentage-point movement in the trade balance would require a one and two-thirds percentage-point movement in consumer prices relative to domestic-output prices. Section 6 develops the reasoning underlying our view that this relative price influence can be properly seen as reflecting essentially trade costs. Next, section 7 reconciles our results with OR's analysis of the home bias puzzle, which emerges as an important issue, as we shall see. Section 8 concludes.

2. Motivation and Related Literature

In this section we consider the basic story OR use to explain the FH puzzle in terms of trade costs, entertain an alternative explanation offered by Kraay and Ventura (2000, 2002)

and show how our own methods can be used to explain the FH puzzle.

As we have seen, the OR explanation for the FH puzzle relies on exploiting the intertemporal budget constraint. In the current period, a country with a large negative trade balance will face higher CIF prices relative to FOB prices, and the resulting need to pay the added obligations on foreign debt in the next period will imply an opposite movement in the terms of trade at that time. Thus, because of trade costs alone, negative trade balances today mean lower expected future consumer prices relative to present consumer prices now and therefore imply higher expected real interest rates. However, and crucially, the associated swings in desired trade balances, in turn, should lead to corresponding capital flows. The reality, as Feldstein and Horioka and many others have observed, is quite different. Instead, there is a close link between national savings and national investment suggesting that international capital movements provide for only limited intertemporal substitution. The reason, in OR's view, is that agents recognize that, because of trade costs, swings in trade balances will imply dramatic movements in real interest rates that, in turn, are socially costly. The existence of trade costs therefore places limits on intertemporal substitution and the smoothing of consumption through trade. As a result, we observe rather sluggish current account behavior. OR and in their wake, Bergin and Glick (2003), support this hypothesis with evidence of a strong negative correlation between average real interest rates and current account surpluses.

Interestingly, Kraay and Ventura (2000, 2002) and Ventura (2002) propose a completely different explanation of the FH puzzle to Obstfeld and Rogoff's that, nonetheless, also focuses on the current account. Instead of trade in goods markets, Kraay and Ventura (KV) stress financial behavior and, in particular, desired portfolio diversification, as the key to understanding the FH puzzle. They assume that wealth consists of capital and foreign assets (net foreign assets), while, in investing in capital, investors are concerned not only with the expected return of their investment, but also the riskiness of their investment. In addition, they also assume that the rates of return on capital in productive activity – both domestic and foreign – are approximately constant (i.e. the marginal product of capital is constant) rather than declining over time. Therefore, as wealth changes over time, agents try to maintain the same portfolio balance between capital and foreign debt: the desired mix of capital to wealth stays

the same. Consequently, savings over time lead to progressive rises in the size of country portfolios, but not their composition. With growth, deficit countries will borrow more while surplus countries will lend more. FH's essential result follows: since wealth to output ratios stay the same, ratios of the current account balances to output tend to stay the same over time and savings and investment are closely correlated.

However, the essential facts of current account behavior suggest that focusing directly on the current account in order to make sense of the FH puzzle, as both OR and KV do, is likely to be misguided. Contrary to OR, current borrowers cannot expect to be future lenders within the foreseeable future. Instead, the evidence would support the view that many deficit countries can run deficits almost indefinitely because of previously accumulated net foreign assets, and conversely. Both Kraay, Loayza, Servén and Ventura (2000) (based on a study of 68 countries) and Lane and Milesi-Ferretti (2002a) (based on a study of 20 OECD countries) demonstrate this very point. In another study covering the same 68 countries as Kraay et al. do over the period 1970-1998, Lane and Milesi-Ferretti (2002b) point out that a (small) majority of countries did not switch at any time between the state of net lender or net borrower. Moreover, when they used an error-correction representation of the data to estimate the speed of adjustment towards a trend value of the ratio of net borrowing to GDP, they found that the movement has a half-life of 5-6 years.[1] All of this supports KV's departure from OR and their preference for the assumption that countries are essentially close to a desired mix of debt in international wealth and try to maintain that mix.

However, contrary to KV's position, in practice, current account balances are no more sluggish than trade balances. If countries really tried to restore a certain desired portfolio mix in the long run, as KV posit, then whatever might happen in the short run (partly as a result of changes in asset prices and yields), changes in trade balances would lead to offsetting movements in trade balances and net interest payments on net foreign assets in the long run. Thus, the trade balance would be less sluggish than the current account. More generally still, KV's view would imply a tendency for the current account balance to be stationary in the long run

[1] In a study that focuses precisely on current account reversals (understood as sharp changes in a short period of time) in all countries of the world for which data are available, 157 of them, over 1970-2001, Edwards (2004) reports reversals constituting only 12 percent of the national observations.

without bearing any similar implication about the trade balance. In this paper, we demonstrate that the current account is no more persistent or sluggish than the trade balance. Thus, in our view, the key to understanding the FH puzzle lies in the sluggish nature of trade balances.

These considerations suggest a basic modification of OR's explanation of the FH puzzle. Evidently, any country wishing to alter its current account position must alter its trade balance and therefore must move some of its prices from prices FOB to prices CIF or the other way. What our previous discussion suggests then is that if the shift in relative prices needed to obtain a modest change in the current account is large, the resulting shift in prices will act as a deterrent. Sluggishness of trade balances will ensue and this will render current account balances sluggish too. On this view, trade costs then underlie the FH puzzle, just as OR say, but on more direct grounds than theirs. We shall proceed on this logic, which we view as containing the crux of OR's argument.

Our test procedure will also deviate from previous methods of dealing with trade balances, current accounts and the FH puzzle. Since trade costs are the key issue, we shall use the principal tool in trade to deal with trade frictions, namely, the gravity model. We believe this has a number of advantages. First, it relates our results to a large body of earlier empirical work on trade flows. Second, by centering attention on bilateral trade rather than aggregate trade or the current account, our choice of procedure greatly widens the range of relevant observations available for testing. Third, by focusing on bilateral trade, the choice also enables us to treat the prices of imports relative to home goods as an exogenous variable. Evidently, the influence of a country's imports from any specific trade partner on its relative prices at home can be supposed small. Thus, single-equation estimation is reasonable.

Yet, since the gravity model focuses on bilateral trade, a difficult challenge arises in the effort to draw implications about aggregate trade balances from the model. This is a challenge we try to meet by conditioning our estimates of the influence of relative prices on bilateral trade on countries' desired aggregate trade balances (which, in turn, depend on their desired intertemporal substitution). Crucially, we find that relative prices only emerge clearly as an influence in the econometric results once we constrain countries to have an intertemporal objective throughout the estimation period. Thus, not only are our macroeconomic concerns

reflected in our methodology, but they play a vital role in our estimates.

There is also the fundamental issue of the appropriate measure of relative prices to use in a gravity framework. What we need is some index of prices of imported goods relative to prices of domestically produced ones. To this end, we employ the ratio of CPI prices relative to GDP prices. Better alternatives may exist, some of which relate more closely to trade costs, but their use would gravely limit the number of observations in our study. This consideration led us to stick to the CPI/GDP measure in this exploration of the topic, which is our first. But we shall control for other factors besides trade costs that may affect the results. In particular, the foreign exchange rate will enter. OR ignore this factor in developing their general argument. They do so for good reason, since even under a single world money, countries cannot import more and export less without an increase in their prices CIF relative to prices FOB. Trade costs inexorably come in even under a common currency. Notwithstanding this consideration, in the data itself the prices CPI relative to prices GDP could evidently reflect the influence of the nominal exchange rate to some extent, and if they did so, the required price adjustment in order to move the trade balance would partly reflect a nominal change. In this case, the price adjustment might be less socially costly. Furthermore, the coefficient of our relative price variable would then reflect something other than trade costs. However, when added as a conditioning variable (with appropriate weights), the nominal exchange rate does not alter the level or the significance of our estimate of the ratio of prices CPI relative to prices GDP. Consequently, we interpret the impact of this price ratio as truly independent of any nominal influence.

3. Theory and test specification

a. *Theory*

We propose deviating from the simple form of the gravity model on a single point in order to apply this model to the impact of trade costs on trade balances: we shall assume that households in different countries differ in their tastes for intertemporal substitution. In all other respects, we shall follow the typical treatment where all preferences for goods in the world are identical, output is exogenous and exports are demand-determined. On these as-

sumptions, there is generally no reason for systematic deviations from bilateral trade balance.[2] Accordingly, researchers who rely on these assumptions usually take the dependent variable as total bilateral trade, measured as the sum, or the average, of bilateral imports both ways. Subsequently, they ignore any influence of relative price, as they must, since the opposite influence of this variable on trade partners (in the case of an elasticity of substitution different from one) becomes impossible to study. However, once we allow for differences in intertemporal preferences, each country may aim for a different trade balance. Consequently, it makes sense to distinguish the desired imports of country A from country B and the desired imports of country B from country A. In this context, it is possible to study the influence of relative price on imports as distinct from exports in the framework of the simple gravity model.[3]

Suppose then that households in each country decide on their aggregate current consumption by maximizing an intertemporal utility function, subject to an intertemporal budget constraint. A certain desired level of current spending follows in each country depending on exogenous endowments, production functions and (assuming small countries) exogenous prices. Let us label this desired current spending, or absorption, by a particular country, i, as A_i. Having allowed for divergences in desired intertemporal substitution between nationals of different countries, varying desired trade gaps between A_i and output Y_i can also appear. Whatever the resulting desired borrowing or lending, all households decide the composition of their consumption spending by maximizing an identical CES utility function (more precisely, an identical intratemporal sub-element of their intertemporal utility function) of the following form:

$$U_i = \sum_{j=1}^{K} \beta_j^{\frac{1}{\theta}} c_{ij}^{\frac{\theta-1}{\theta}}, \qquad (1)$$

where c_{ij} is country i's consumption (in physical units) of the goods (varieties) produced by country j, β_j is a distribution parameter, reflecting Y_j/Y_w, the output of country j relative to world output, and K is the number of countries in the world. Country i maximizes this func-

[2] Helpman, Melitz and Rubinstein (2004) make the same point and then proceed to distinguish between bilateral imports and exports differently than we do: by allowing for heterogeneities between firms. But there is plainly no conceptual conflict between their manner of proceeding and ours.

[3] See Helpman (1987), McCallum (1995) and Anderson and van Wincoop (2003). For a notable example of a version of the gravity model distinguishing between import and export behavior from the start and where relative prices thus prominently enter, see Bergstrand (1985, 1989).

tion subject to the condition:

$$A_i = \sum_{j=1}^{K} p_{ij} c_{ij}, \tag{2}$$

where p_{ij} is the (common) price of goods (varieties) produced by country j and facing country i. The solution to the maximization problem yields:

$$c_{ij} = \beta_j \left(\frac{p_{ij}}{P_i} \right)^{-\theta} \frac{A_i}{P_i}, \tag{3}$$

where

$$P_i = \left(\sum_{j=1}^{K} \left(\beta_j p_{ij}^{1-\theta} \right) \right)^{\frac{1}{1-\theta}}, \tag{4}$$

Imports of country i from country j, m_{ij}, equal $p_{ij}c_{ij}$ and therefore:

$$m_{ij} = \left(\frac{p_{ij}}{P_i} \right)^{1-\theta} \frac{A_i Y_j}{Y_W}. \tag{5}$$

A similar relationship holds for bilateral imports of country j from i:

$$m_{ji} = \left(\frac{p_{ji}}{P_j} \right)^{1-\theta} \frac{A_j Y_i}{Y_W}. \tag{6}$$

However, since $A_i Y_j$ need not equal $A_j Y_i$, m_{ij} need not equal m_{ji}

Suppose, next, that trading costs drive a wedge between home and foreign prices:

$$p_{ij} = (1 + t_{ij})\, p_j \text{ and } p_{ji} = (1 + t_{ji})\, p_i, \quad t_{ij} > 0 \text{ for } i \neq j \text{ and } t_{ii} = 0 \tag{7}$$

where t_{ij} reflects all border costs faced by country i in its trade with country j as a percentage of P_j, both monetary and non-monetary. p_{ij} will now differ considerably between countries even though p_j is everywhere the same, and partly so for non-monetary reasons. In the light of the trade costs, equation (6) can be written as:

$$m_{ij} = \left(\frac{(1 + t_{ij})\, p_j}{P_i} \right)^{1-\theta} \frac{A_i Y_j}{Y_W}. \tag{8}$$

In this paper, we shall estimate a version of equation (8).

b. *Test specification*

In order to estimate equation (8), we need a measure of the term $(1+t_{ij})p_j/P_i$, which is often referred to as bilateral trade resistance relative to multilateral trade resistance, where the t_{ij} term captures bilateral resistance and the P_i one (itself a weighted-average) reflects multilateral resistance. As is common in the gravity approach, we treat bilateral trade resistance and multilateral trade resistance separately. In the case of bilateral trade resistance, we introduce the usual gravity variables concerning impediments or aids to bilateral trade, such as distance, language and political associations.

Multilateral trade resistance requires special discussion. Assume that the price of GDP, P^i_{GDP}, is a reflection of p_i, the price of the home good(s). Suppose, in addition, that we can interpret the consumer price index, P^i_{CPI}, as a weighted average of prices of home goods and import prices. If P^i_{CPI} / P^i_{GDP} rises, there is then a rise in foreign relative to home prices and a negative price influence on country i's demand for foreign goods in general relative to home goods. This is clear in the case of final goods, to which we limit the theoretical discussion (like OR and most of the literature on the gravity model). Imports of intermediary goods may raise a complication, since they also affect P^i_{GDP}. However, they influence P^i_{CPI} as well. Thus, in their presence, if only the mix of final and intermediate goods in trade stays constant, a rise in imports will still increase P^i_{CPI} relative to P^i_{GDP}. Regardless, therefore, P^i_{CPI} / P^i_{GDP} is a basic reflection of multilateral trade resistance.

In a multiple currency world, another such reflection will be a weighted average of the exchange rate of the currency of country i with the other world currencies. This next variable may be partly registered in P^i_{CPI} / P^i_{GDP} but will not necessarily be fully so. Besides, as already indicated, it is important to separate the potential influence of the nominal exchange rate from the relative price term. Therefore, we will consider the weighted-average nominal exchange rate of country i, E_i, as a separate influence in the analysis. In addition, even upon a cursory examination of equation (4), we see that P^i_{CPI} / P^i_{GDP} and E_i only cover two of many sources of multilateral trade resistance affecting trade between countries i and j (since all bilateral trade frictions connected to third countries enter into the expression). In order to reflect these other influences, country fixed effects for countries i and j may serve in the typical way. The

dummy for country i will then reflect all the missing effects on country i's desired imports from everyone, while that for country j will reflect all the missing effects on its exports to everyone. Since both P^i_{CPI} / P^i_{GDP} and E_i are country-specific variables, once the country dummies are added, the estimates of the influences of the two evidently will only relate to the time dimension or their movement over time.

In light of these considerations, we may write equation (8) in the following form:

$$\ln (m_{ij}) = a_1 + a_2 \ln (A_i Y_j) + a_3 \ln (P^i_{CPI} / P^i_{GDP}) + a_4 \ln E_i + a_5 Z^M_i + a_6 Z^X_j + \mathbf{A_7 G_{ij}} + \varepsilon_{ij}, \quad (9)$$

where Z^M_i is a dummy for the importing country, Z^X_j is a dummy for the exporting country, $\mathbf{G_{ij}}$ is a matrix of bilateral gravity variables pertaining to bilateral trade resistance (relating specifically to trade of country i with the particular partner j), and ε_{ij} is a disturbance term with the usual properties. On the basis of equation (8), it follows that: $a_1 = -\ln Y_W$ and $a_2 = 1$.

A corresponding equation to (11) exists for the imports of country j from country i:

$$\ln (m_{ji}) = a_1 + a_2 \ln (A_j Y_i) + a_3 \ln (P^j_{CPI} / P^j_{GDP}) + a_4 \ln E_i + a_5 Z^M_j + a_6 Z^X_i + \mathbf{A_7 G_{ji}} + \varepsilon_{ij}, \quad (10)$$

where Z^M_j and Z^X_i are, respectively, dummies for countries j and i as importer and exporter. Consequently, a more general statement of the estimating equation is:

$$\ln (m_{ij})_t = a_1 + a_2 \ln (A_i Y_j)_t + a_3 \ln (P^i_{CPI} / P^i_{GDP})_t + a_4 \ln E_{it} + a_5 Z^M_i +$$

$$a_6 Z^X_i + a_7 Z^M_j + a_8 Z^X_j + \mathbf{A_9 G_{ijt}} + \mathbf{A_{10} D_t} + \varepsilon_{ijt}. \quad (11)$$

where we have also added a matrix of time dummies $\mathbf{D_t}$. There are effectively 2N different country dummies of the sort displayed in equation (11), two per country. In the case of any particular observation, m_{ij}, all of these dummies are zero except two, Z^M_i and Z^X_j. We thus propose estimating equation (8) in the form of equation (11).

However, equation (11) only reflects the intertemporal concern of countries in the derivation in a vague way. The most direct reflection of this concern is the substitution of domestic absorption for domestic income in the aggregate for current spending by the importer. The only other reflection is our distinction between bilateral imports and exports and our associated introduction of the price variables, (P^i_{CPI} / P^i_{GDP}) and E_i. But these features do little to insure that the desired trade balance has a basic role in the estimates. In sum, equation

(11) offers inadequate reflection of the emphasis on desired intertemporal substitution in the theoretical derivation. In order to sharpen the role of the intertemporal aspect, we propose estimating equation (11) under the theoretical constraint that each country continually tries to achieve a desired balance between imports and exports during the study period.

Specifically, we shall introduce the following restriction on the coefficient of the fixed effect for the importing country, a_5:

$$a_5 N_i^M - a_6 N_i^X = \sum_{t=1}^{t=T} \left(M_i - M_{ji} \right)_t . \qquad (12)$$

where N_i^M is the number of in-sample observations of imports by country i, N_i^X is the number of in-sample observations of exports by country i, M_i are the imports of country i from its K–1 trade partners,

$$M_i = \sum_{j=1}^{K-1} m_{ij} , \qquad j \neq i \qquad (13)$$

and M_{ji} are the imports from country i by its K–1 trade partners,

$$M_{ji} = \sum_{j=1}^{K-1} m_{ji} \qquad j \neq i \qquad (14)$$

The coefficient a_5 evidently is a factor in each period. According to equation (12), each country adjusts its imports continually so as to attain the observed aggregate of imports minus exports over the observation period as a whole (T individual periods).[4] Therefore, the equation gives teeth to the idea that countries pursue a trade balance objective. Note that imposing the constraint strictly on the fixed effects for the importing country is precisely correct since exports are demand-determined according to the model.

Ideally, the constraint should refer to the difference between the imports and the exports of countries, X_i, rather than the difference between their imports and the imports of the rest from them M_{ji}. X_i is always lower than M_{ji} because of trade costs. Specifically,

$$X_i = \sum_{j=1}^{K-1} \left(m_{ji} - \tau_{ji} p_i c_{ji} \right), \qquad j \neq i \qquad 0 < \tau_{ij} < t_{ij}, \qquad (15)$$

[4] A preferable form of the restriction might be

$$\exp(a_5 N_i^M) - \exp(a_6 N_i^X) = \sum_{t=1}^{t=T} (M_i - M_{ji})_t \qquad i \neq j$$

But this form is not feasible.

where τ_{ji} is the *money* difference between the price to the importer and the price to the exporter as a percentage of the export price p_i. τ_{ji} must be less than t_{ji} because, as mentioned earlier, at least on a cross-sectional basis, the demand for imports also depends on various non-monetary trade costs (related to language, cultural affinities and political ties, etc.) which do not affect the difference between the value of shipments from i and foreign purchases from i. But as we do not model the differences $X_i - M_{ji}$, or the K–1 monetary differences between prices FOB and prices CIF, $\tau_{ji}p_i$, in equation (15) (any more than we model other aspects of trade resistance), these differences must be seen as exogenous. Thus, imposing the restriction on $M_i - X_i$ or on $M_i - M_{ji}$ amounts to the same thing.

Equation (12) imposes K^M different restrictions in the estimates of equation (11), where K^M is the number of importing countries in our sample. In the absence of these restrictions, the correlation between $(M_i–M_{ji})_t$ and the estimated values $(\hat{M}_i - \hat{M}_{ji})_t$ in equation (11) is only 36%. Hence, the estimate of (11) reflects the trade balance behavior of the countries only in a vague way, as we suspected it would. However, once these restrictions are imposed, the correlation between $(M_i–M_{ji})_t$ and $(\hat{M}_i - \hat{M}_{ji})_t$ rises to over 80%. There is therefore little doubt that the restrictions serve their assigned role of reflecting the individual countries' aggregate net imports (which we identify with their desired net imports) over the observation period. Moreover, it turns out that the impact of P^i_{CPI} / P^i_{GDP} on trade only emerges significantly in our work following the introduction of these restrictions. This is very reassuring since, as we mentioned before, the role of P^i_{CPI} / P^i_{GDP} in our specification rests essentially on desired intertemporal substitution. It is thus entirely consistent with our analysis that P^i_{CPI} / P^i_{GDP} would emerge as significant when desired intertemporal substitution plays a major role in the estimate, but not otherwise.[5]

The main focus of our empirical work will be on the coefficient of the relative price term, P^i_{CPI} / P^i_{GDP}. This coefficient is our basis for inferring how large a movement in the price of imports relative to home goods a country must entertain if it wishes to change its trade bal-

[5] Note, in this connection, that the trade balance constraint in our work operates completely differently in the observations for US imports from Japan than in the observations for Japanese imports from the US, for example. Note also, once again, that our treatment of P^i_{CPI} / P^i_{GDP} as an exogenous variable poses little problem since we estimate bilateral imports rather than aggregate imports or the trade balance.

ance. In other words, we base our conclusions entirely on the results following the restrictions in equation (12).

4. Data

Our data set consists of annual observations over 1980-2000 inclusively covering imports of 134 countries from 154 countries (see the data appendix for a full listing). The data on CIF bilateral imports, M_{ij}, come from the IMF Direction of Trade Statistics (DTS, 2002). They are expressed in US dollars and converted into constant dollars using the US Consumer Price Index. The IMF database accounts for 99% of world trade in merchandise, but the percentage of trade in merchandise by the 134 importing countries in our regressions is somewhat lower because of missing data for some of the relevant macroeconomic variables aside from trade. The absorption of country i, A_i, is obtained by subtracting the trade balance from GDP_i, where both series come from the World Bank, *World Development Indicators* (WDI (2003)), are expressed in US dollars and divided by the US consumer price index. The ratio of consumer price indices, $P_{CPI,}$ to GDP deflator indices, P_{GDP}, is taken from the World Bank CD-Rom (WDI, 2003). The nominal effective exchange rate is computed for each importing country i based on the nominal exchange rates found in the WDI (2003) and a matrix of imports weights for all the trading partners in the sample with a weight greater than one per cent.[6] The other variables are quite standard in the literature on the gravity model of trade. The computation of distance relies on the arc-geometry formula between the two most populous cities. Population is drawn from the WDI (2003). A set of dummies serve to identify whether two trading partners are in a free trade area, whether they share a border, whether they use the same currency, whether one of the two is a protectorate or an overseas territory (e.g. France and French Guyana), whether they have been in a colonial relationship post-1945, or they have had the same colonizer. The data appendix contains a full account of these dummies. The common language variable is from Melitz (2005), who calculates a continuous

[6] We experimented with different alternative specifications of the nominal effective exchange rate. Since these different measures did not materially affect any of our results, they are not reported in the paper, but are available on request from the authors.

indicator with values going from 0 to 1 rather than a 0-1 dummy. A summary of the statistics and the correlation matrix are in the appendix.

5. Econometric Results

a. *The time series behavior of trade balances and current accounts*

As discussed in section 2, Kraay and Ventura's argument says that the ratio of the current account balance to output is stationary whereas the ratio of the trade balance to output is less so, if at all. In general, following KV, we would expect the persistence properties of the two series to be quite different.

We shall base our inferences about the persistence of the two series on variance ratio statistics for different annual lags up to 8 (in a time series of 21 years for most countries). This statistic (see Cochrane (1988)) rests on the null hypothesis of a random walk against the alternative of mean-reversion. The statistic is:

$$V_k = (1/k)\,[(\mathrm{Var}(q_t - q_{t-k}))\,(\mathrm{Var}(q_t - q_{t-1}))^{-1}],$$

where k denotes the lag length, and Var is the variance of the series q, i.e. the ratio of either the trade balance or the current account to output. Under the null of a random walk V_k should equal unity, while if a series is stationary V_k will be significantly less than unity.

The most telling feature of the results is that a very similar pattern of persistence appears for the current account and the trade balance. For the majority of countries, both series are stationary. But especially when this is so, there is little to distinguish the behavior of one time series from the other. Figure 1 displays this point for a sample of 16 countries, chosen to reveal the general picture. The sample consists of Austria, Belgium, Denmark, France, Finland, Germany, Italy, Mexico, Netherlands, Norway, Singapore, South Korea, Switzerland, Thailand, US, and the United Kingdom. In 12 of the cases, both ratios to output are stationary (the ratio of net income on foreign assets to output is included in the figure as supplementary information). For these cases, the persistence of the two series is much alike. In three of the other four cases – Finland, Germany and the United Kingdom (the US is the fourth) – the current account is more non-stationary than the trade balance.

This evidence is difficult to reconcile with KV's explanation of current account behav-

ior based on desired international portfolios. Countries can only maintain a stable current account as a percentage of output by adapting their trade balance to that end. Thus, the evidence that ratios of trade balances to output are as persistent as current account ratios does not fit with their view. On the other hand, this behavior is consistent with our position that the sluggishness of trade balances underlies the sluggishness of current accounts.

b. *The gravity model results*

We turn next to the evidence regarding our basic equation (11). All of our tests are maximum likelihood. Table 1 presents the estimates of this equation in the absence of any constraints for the full sample period and for two sub-samples, 1980-1989 and 1990-2000. In these estimates, therefore, differences in desired trade balances between countries play only a vague role, as explained previously. The nominal exchange rate is also not included in the equations reported in Table 1. According to the full sample results, the coefficient on the relative price term P_{CPI}/P_{GDP} has the correct sign but is very small and indeed statistically indistinguishable from zero. In addition, all of the coefficients pertaining to distance and absorption, two essential gravity terms, bear the correct signs, are significant and have plausible coefficient values. The remaining gravity terms, except for the Common Country and Free Trade Area dummies, are also statistically significant and have plausible magnitudes. One interesting result is that the common language dummy has a larger impact on trade than the currency union dummy, whose influence is notably lower in magnitude than the figure initially proposed by Rose (2000) in his provocative study. In general, the results for the two sub-samples resemble those for the full sample, though the coefficient on the relative price term is barely statistically significant at the 10% confidence level in the sub-sample of 1980 to 1989.

The previous results do not impose intertemporal preferences in equation (11) precisely. However, the set of results contained in Table 2 follow once such preferences have been imposed. Once again, we offer these results separately for the full sample period and for the two sub-samples of 1980-1989 and 1990-2000. Crucially, the coefficient on the P_{CPI}/P_{GDP} term is now highly statistically significant in the entire period as well as in both sub-periods.

In all three cases, it has a value of approximately 0.3. In addition, the sign, magnitude and significance of the usual gravity variables are broadly similar to those reported in Table 1 where the trade constraint was not imposed. Once again, the coefficients on the gravity terms are broadly similar across the two sub-samples (although, in this case, there are some differences).[7]

We believe that these results strongly support the theory. In principle, the relative price term affects imports relative to exports rather than total trade in the model. Thus, it makes sense that its impact would only show up clearly once desired intertemporal trade came explicitly into play. On the other hand, the other influences (apart from the nominal exchange rate) affect total trade, rather than the trade balance. Therefore, they should all be essentially independent of intertemporal considerations and that is in fact exactly what we find.

Quite significantly too, these results incorporate the impact of all relative price movements at the world level. Such movements are perfectly correlated with the time dummies. Thus, the estimates allow for the three oil shocks (1974, Iranian revolution, Gulf War) as well as all other changes in relative prices during the period. This will be important below in our interpretation of the impact of P_{CPI}/P_{GDP} as relating to trade costs.

In Table 3 we present the regressions with the nominal exchange rate as a separate conditioning variable. As we noted earlier, this serves the essential role of clarifying whether the coefficient on our relative price term partly reflects the influence of the nominal exchange rate on trade as well as trade costs. In accordance with the theoretical analysis, the nominal exchange rate we use is the effective rate, constructed on the basis of the import trade weights. The results are interesting: the coefficient on the nominal exchange rate is statistically significant in the constrained regression at the 10 percent confidence level. But its magnitude is numerically very close to zero, and its presence does not affect the magnitude or the significance of the coefficient on the relative price term.[8] Of some interest too, the variable is

[7] For example, the population term shows up with the wrong sign in the first sub-sample and the coefficient on the FTA term becomes significant at the 10% level in this sub-sample. For a clear statement of the reason to expect a negative sign of the population term in the gravity model, see Frankel and Romer (1999).

[8] This need not be surprising since our estimates pertain to long run adjustments in trade balances. Nominal exchange rate movements promote real exchange rate changes in the short run. But their contribution to long run movements in the real exchange rate is not nearly as plain.

completely insignificant in the unconstrained regression. This reinforces our view that the constraint is important in bringing to light the effects of price variables that influence the desired trade balance or imports relative to exports.

Our 'headline' figure for the elasticity of the influence of P^i_{CPI}/P^i_{GDP} on m_{ij} is 0.3. By implication, this 0.3 estimate also applies (with the opposite sign) to the impact of P^i_{CPI}/P^i_{GDP} on country i's exports to its trading partners. If we start from balanced trade, it follows that the elasticity of influence of our relative price term on the aggregate balance of trade is 0.6, where this figure refers to the change in exports minus imports as a percentage of trade (exports plus imports divided by two). Consequently, the required percentage change in this relative price term in order to obtain a one percent movement in the trade balance is 1.67 percent.

Two fundamental issues remain for discussion. One is why we can reasonably conclude that trade costs are the essential factor underlying our estimates of the impact of P^i_{CPI}/P^i_{GDP}. The other is the reconciliation of our proposed solution to the FH puzzle with OR's explanation of the "home bias" puzzle.

6. Trade Costs and the Influence of Consumer Prices Relative to Producer Prices

The consumer price index is made up of prices of imports and home-produced goods. Purely as an expository device, suppose we equate all producer prices and consumer prices on home-produced goods. This agrees with our theoretical discussion, where we suppose zero trade costs at home, although, as we shall see shortly, this assumption is inessential. Then if we let p_i be the index of the production price of the home good, p_j be the index of the production price of the good of country j and K be the number of countries, we may write P^i_{CPI}/P^i_{GDP} as:

$$\frac{P^i_{CPI}}{P^i_{GDP}} = \frac{\alpha_i p_i + (1-\alpha_i)\bar{p}_j(1+\bar{\tau}_i)}{p_i} = \alpha_i + (1-\alpha_i)\frac{\bar{p}_j(1+\bar{\tau}_i)}{p_i} \tag{16}$$

$$\text{where } \bar{p}_j = \frac{1}{1-\beta_i}\sum_{j=1}^{K-1}\beta_j p_j \quad \text{and} \quad \bar{\tau}_i = \frac{1}{1-\beta_i}\sum_{j=1}^{K-1}\beta_j \tau_{ij} \qquad i \neq j$$

τ_{ij} in equation (16), we may recall, is the fraction of t_{ij} consisting exclusively of money trade

costs or differences between prices CIF and FOB.

P^i_{CPI}/P^i_{GDP} thus depends on $\overline{p}_j/p_i$ and $\overline{\tau}_i$. Quite importantly, values of $\overline{p}_j/p_i$ are negatively related across countries and average around one. If production costs and mark-ups are low (below one) in some countries relative to others, they must be high (above one) elsewhere, at least on average. Therefore, if we suppose symmetry of positive and negative effects, the costs and mark-ups have no significant impact on the coefficient of P^i_{CPI}/P^i_{GDP} on the whole. In fact, this reasoning applies to domestic trade costs too, so that our earlier assumption of no domestic trade costs is unnecessary, as stated above (but it aids the exposition). On the other hand, foreign trade costs necessarily raise consumer prices relative to production prices everywhere. Indeed, we believe this factor to be implicit in OR's emphasis on trade costs as the key to the six major puzzles in international macroeconomics.

However, we make allowance for some major deviations from this general reasoning in our empirical tests. Quite specifically, we admit asymmetric effects of changes in $\overline{p}_j/p_i$ on importing and exporting countries by controlling for the net impact of all *movements* in production costs, mark-ups and domestic trade costs (including taxes) at the world level on desired imports through the use of time dummies. Thus, as explained before, the net difference between the impact of the oil shocks on the demand for imports of oil importers and oil exporters enters fully in our results. In addition, we control for movements in the nominal effective exchange rate. By construction, this price must work in the same direction for all countries on the demand for imports (that is, in the case of pass-through). Given that we control for all changes at the world level over time and the nominal effective exchange rate, we conclude that the coefficient of P^i_{CPI}/P^i_{GDP} in our work truly reflects the impact of $\overline{\tau}_i$ or trade costs and little else.[9]

[9] In the case of the price of oil, we experimented with the separate effects on demand for imports of oil importers and exporters (using as our measure of the oil price the average 3-month spot price of crude in US dollars, as recorded in the IMF *International Financial Statistics* CD-Rom (IFS, 2002), divided by the US consumer price index.) The results confirm the usual impression that the adverse impact of the oil shocks on the imports of the oil-importing nations exceeded the impact on the oil-exporting ones. Since some collinearity arises between the relative oil price for importers and P^i_{CPI}/P^i_{GDP}, and since we wish to isolate the impact of P^i_{CPI}/P^i_{GDP}, it seems right to focus on the results in the absence of any disaggregation of the price of oil.

7. Trade Costs and the Home Bias Puzzle

A higher coefficient of P^i_{CPI}/P^i_{GDP} than .3 would have meant the need for a lower change in P^i_{CPI}/P^i_{GDP} in order to obtain a one percent change in the trade balance. Evidently, therefore, our explanation of the FH puzzle depends on a low, yet significant, impact of trade costs on imports. On the contrary, OR require a large impact of trade costs on imports to explain the "home bias" puzzle in their way. There is therefore a basic tension between our proposed solution to the FH puzzle and OR's explanation of the "home bias" puzzle.[10] In dealing with this issue, we shall proceed in two steps. First, we will explain why our estimate for the impact of P^i_{CPI}/P^i_{GDP} on the trade balance of 0.3 is really too low to explain the "home bias" puzzle based on trade costs alone, along the lines of OR. Second, we shall go on to suggest a solution and also try to justify it. As we shall see, our solution relies on a basic distinction between trade costs relating to the trade balance and trade costs arising due to increasing levels of openness. The Feldstein-Horioka puzzle evidently relates to intertemporal substitution and therefore the trade balance, while the home bias puzzle relates to openness or the ratio of total trade to output.

OR's results can be shown to follow exactly in our set up under their assumptions. Consider two nations of equal size, and therefore $Y_i = Y_j$, and assume balanced trade, or $Y_i = A_i$. Additionally, assume endowment economies with all relative prices the same and equal to one. Under these assumptions, (since $t_{ii} = 0$) our equation (8) says that the ratio of home trade to foreign trade of either country with the other, m_{ii}/m_{ij}, is:

$$(1 + t_{ij})^{\theta-1}.$$

According to OR's suggested baseline figures, θ equals 6 and the export price is 25% below the import price. Given their further assumption that all trade costs are money costs, or $t_{ij} = \tau_{ij}$, this implies a value of $1+t_{ij}$ of 1/0.75, or 1.33. Consequently, m_{ii}/m_{ij} is about 4.2, which implies a degree of openness of 0.19 (a ratio of 81/19 of home to foreign goods). These are

[10] OR effectively sidestep this difficulty by switching to an analysis of the impact of the real interest rate on the current account when they turn from the "home bias" to the FH puzzle. Even a moderate percentage change in relative prices may imply a large percentage movement in present relative to future real interest rates. Therefore, the same moderate change in relative price that they think would suffice to explain home bias would contribute heavily, in their reasoning, to the FH puzzle as well.

precisely the numbers that OR propose as reasonable for the world as a whole. In this schema, if t_{ij} were zero, m_{ii}/m_{ij} would be one. Thus, all of "home bias" stems from trade costs.

However, the value of t_{ij} that we recover from our regressions using OR's assumptions is considerably below the one they suggest. To see this, note to begin with that P^i_{CPI}/P^i_{GDP} in our work does not correspond exactly to the import price relative to the export price in OR's example. Instead, it refers to $\alpha_i + (1-\alpha_i)(1 + t_{ij})$, as seen from equation (19) (after equating τ_{ij} and t_{ij} and setting $\bar{p}_j$ and p_i equal to one). Thus, in terms of OR's schematic example, our estimate relates to the value of $(1-\alpha_i)(1+t_{ij})^{1-\theta}$. For m_{ii}, $(1+t_{ij})^{1-\theta}$ reduces to 1, and therefore our estimate of the impact of P^i_{CPI}/P^i_{GDP} on m_{ii}/m_{ij} corresponds to $(1-\alpha_i)(1+t_{ij})^{\theta-1}$ rather than $(1+t_{ij})^{\theta-1}$. We estimate this value as .3. Therefore, if we assign a value of .81 to α_i, we have an estimate of $(1+t_{ij})^{\theta-1}$ of around 1.58. This implies a value of t_{ij} of around .1 – far below the .33 value that OR regard as reasonable (given their treatment of $1+ t_{ij} = 1/.75$ as a baseline).[11]

In fact, the problem is more complicated for two reasons. OR's ratio of 4.2 for m_{ii}/m_{ij} only looks reasonable because of their two-country example. In a multi-country framework this ratio would change dramatically. For example, assume the same parameter values as theirs but 100 identical countries so that country i imports from 99 others. In that case, the baseline situation without trade costs is one of .99 openness. Trade costs raising the ratio m_{ii}/m_{ij} by a factor of 4.2 in relation to each of the 99 foreign countries would then yield a rise in the percentage of home consumption from .01 to approximately .041.[12] In order to reduce the value of openness to a level as low as .19, OR require a value of m_{ii}/m_{ij} of approximately 422 or about 100 times 4.2.[13] In that case, $1 + t_{ij}$ becomes around 3.35. This then widens the gap between our estimate of t_{ij} of only .1 and the value necessary for the benchmark of .19

[11] In light of our estimate of the influence of $(1-\alpha_i)(1 + t_{ij})$ on m_{ij}, one could argue that the corresponding impact on m_{ii} is $\alpha_i (1 + t_{ij})$. In this case, our estimate of .3 would correspond to a value of $[(1-\alpha_i)/\alpha_i](1 + t_{ij})^{\theta-1}$ for the impact on m_{ii}/m_{ij}. This would heighten the problem. In that case, we would have an implicit value of t_{ij} of only around .05 in case $\alpha_i = .81$.

[12] The ratio of home consumption will be 4.2X where 99X + 4.2X = 1.

[13] Let spending on the 99 foreign goods make up altogether .19 of the total consumer basket. Then the spending on the home good in relation to the individual foreign one is .81 divided by .19/99.

openness (the needed t_{ij} becomes 235%).[14] It also raises doubts about OR's claim that moderate trade costs suffice to generate the observed degree of home bias in the world under their assumptions.

The second problem relates to the identification of t_{ij} and τ_{ij}. So far as t_{ij} exceeds τ_{ij}, our implicit figure for money trade costs will be even lower than .1. But we regard this next problem as minor relative to the distortion introduced by limiting the analysis to a two-country framework. As indicated before, non-money trade costs matter mostly on a cross-sectional basis, or in choosing to trade between alternative foreign partners. In the strict temporal dimension, money costs probably dominate trade costs. Our estimate of the impact of P^i_{CPI}/P^i_{GDP} relates strictly to the temporal dimension. Thus, we do not believe that equating t_{ij} and τ_{ij} is a big problem in our present context or OR's. This same line of reasoning probably underlies OR's willingness to identify trade costs with the monetary costs.

As a preliminary remark, note that our estimate of τ_{ij} of .1 is highly sensitive to the coefficient of .3. Even if we stick with all of OR's assumptions, $\alpha_i = .81$ and $\theta=6$, a doubling of the estimate of the impact of P^i_{CPI}/P^i_{GDP} or a rise to .6 leads to a rise of τ_{ij} from around .1 to .26 ($x \cong 1.26$ for $x^5 = .6 \div .19$), which is clearly much closer to OR's ballpark figure of 0.33. (Lower values of $1-\alpha_i$ and θ further reduce the problem of raising τ_{ij}.) How might this higher figure obtain?

In answer, the assumption of flat values of τ_{ij} is dubious, as OR recognize themselves. As ratios of trade to output rise, trade in highly heterogeneous goods and in heavy, difficult-to-transport goods, must increase. Consequently, even if values of τ_{ij} of around .33 exist in trade, the values of τ_{ij} relating to many goods that are not traded may well be over 100 percent.[15] (Betts and Kehoe (2001) and Bergen and Glick (2004) recently reason on this basis.) As a result, there are really two separate values of trade costs that enter in case of movements

[14] Anderson and van Wincoop (2004) recently estimate t_{ij} as 170%. This might suggest that 235% is not as outlandish as it may seem at first blush. But the impression is probably misleading, since their figure covers far more than ours: it includes the tax equivalent of all non-money impediments to foreign trade and all of the home impediments to domestic trade as well.

[15] In addition, elasticities of substitution may vary between goods, going from extremely high figures for home goods with very close substitutes abroad to very low figures. Consequently, as long as t_{ij} is non-trivially greater than zero, θ alone may account for a significant rise of α above .01 in our example with 100 countries (because of the low values of θ). This further reduces the difficulty of obtaining high values of α in equation (16).

of bilateral trade. One of them is relevant when the movements concern mere redistributions of output between existing firms or the churning of firms and varieties without any change in aggregate trade at a given level of output. The other is relevant when the ratio of trade to output changes. The first level, occurring when the trade ratio or degree of openness stays the same, is lower than the second, occurring when the trade ratio moves. The first is also the relevant one in the case of the FH puzzle, while the second is the relevant one in the case of the "home bias" puzzle. Our estimates relate to the first. OR clearly have in mind the second.

There are several reasons why the two values of trade costs may be expected to differ even at the margin. If additional trade means that new goods (not simply new varieties) enter into foreign trade, the rise in trade costs at the margin may jump up rather than go up continuously. In addition, the trade costs may be higher at first than they will become later, after the initial information and distribution problems of launching the new products abroad settle down. In this connection, a lot of recent empirical work notably shows that entry of individual firms into export activity always entails major once-and-for-all costs of production and distribution. (See Roberts and Tybout (1997), Bernard and Jensen (2001) and Bernard and Wagner (2001).) Those fixed costs may well be more severe if entry means introducing new products abroad (rather than previously exported ones or newly exported ones that are merely differentiated, as is more likely when the adjustments concern the trade balance at a set level of national trade).

Our analysis focuses on the trade balance, and therefore our estimate of trade costs relates to the lower margin. The higher margin relates to openness and therefore to the ratio of total trade to output, which we do not analyze. This is not necessarily conclusive, however, since movements in the ratios of trade balances to output in our sample period could be positively correlated with movements in the ratios of trade to output. Thus, we calculated the correlation between the two ratios in our panel. The result is as follows:

$$\mathrm{Corr}\left(\frac{M_i + M_{ji}}{2Y_i}, \frac{|M_{ji} - M_i| + |M_i - M_{ji}|}{2Y_i}\right) = -0.0168 \ \ (0.405)$$

(where the number in parentheses is the p value). The correlation is negligible, negative and statistically insignificant. We therefore conclude that our estimate relates to the lower margin

for trade costs.

Ruhl (2003) makes a similar point in a closely related context. He seeks to reconcile the low estimates of the elasticity of substitution between home and foreign goods in the business cycle literature with the much higher estimates of this same elasticity in the literature on the growth of trade, where the concern is with the impact of trade liberalization, free trade agreements and the like. In the former literature, the elasticities regard responses to transitory shocks whereas in the latter, they relate to responses to permanent shocks. He considers the former adjustments as ones on the "intensive margin" and the latter as ones on the "extensive margin". Our context differs because the adjustments in trade balance that we are interested in may well be persistent. However, the similarity remains so far as those adjustments do not necessarily require any change in the size of the traded goods sector relative to the economy as a whole, and therefore in the total range of goods entering into trade (ordered by trade costs). Thus, his distinction between adjustments at the intensive margin (same range of goods) and the extensive margin (wider range of goods) is apt.

8. Concluding discussion

In this paper, we have provided empirical support for OR's hypothesis that trade costs contribute to resolving the FH puzzle. According to our estimates, countries require a 1.67 percent adjustment in the price of the goods they consume relative to the price of the goods they produce for every percentage movement in their trade balance. Based on our interpretation of the relative price term, trade costs are the essential factor in the explanation. In support of this view, we have admitted time fixed effects and the nominal effective exchange rate as separate conditioning variables. Therefore, we can exclude relative price movements at the world level and the effective exchange rate as influences in our estimates.

Two points deserve renewed emphasis at the end. First, our effort to resolve the FH puzzle in terms of trade costs deviates from OR in one crucial respect: we do not rely on expected future reversals in trade balance positions for our solution. Rather, in our view, the argument for their position can be made without going beyond the implications of their stand

relating to trade balances. The reason for this deviation from them seems to us strong: countries with trade balance deficits tend to be net creditors, while those with trade surpluses tend to be net debtors. Studies of the FH puzzle cover wide samples of countries. Therefore, in dealing with the puzzle, it seems precarious to us to treat trade imbalances as unsustainable. There is little reason for markets systematically to expect trade balances to reverse and to embed such reversals in their real interest rate expectations (all the less so since the countries with trade deficits may have adequate future income prospects). This deviation from OR brings us close to Lane and Milesi Ferretti (2002a) and their emphasis on the stability of trade balance positions, but takes us away from the position of KV, who attempt to explain the FH puzzle on the basis of desired asset portfolio behavior in the long run. Contrary to KV's position, the time series evidence shows trade balances to be just as sluggish as current accounts. If KV were correct, and markets deliberately adapted their trade balances to achieve desired portfolio balances, we would expect trade balances to be less sluggish than current account balances. The time series evidence, though, is consistent with our view that the sluggishness of trade balances is the key to the sluggishness of current accounts.

The second point requiring emphasis in closing regards certain econometric features of our work. We have used a gravity framework and data on bilateral trade to draw out implications about the impact of relative prices on national trade balances. Previous researchers have also introduced relative prices into the gravity framework, but their emphasis was on separate import and export responses to such prices (see, for example, Bergstrand (1989) and Bayoumi (1998)). As far as we are aware, ours is the first attempt to use the gravity model to address the relationship between relative prices and national trade balances. In order to do so, despite the essential bilateral trade orientation of the model, we adopted a simple yet popular version of the gravity approach with passive export behavior, in which we incorporated desired intertemporal substitution at the national level. The relevant macroeconomic concern with the future has a profound role on our estimates. When we do not incorporate this effect, the relative price variable has no influence on bilateral trade, but when we do incorporate it the influence of this variable emerges clearly.

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Table 1 – Unconstrained Estimates

	1980–2000	1980-1989	1990-2000
Log(A_i*Y_j)	**.670** **(.020)**	**.466** **(.028)**	**.546** **(.026)**
Log(P_{CPI} / P_{GDP})	-.056 (.062)	-.154* (.093)	.139 (.091)
Log(Distance)	**-1.345** **(.030)**	**-1.250** **(.036)**	**-1.390** **(.030)**
Common Border (0,1)	**.418** **(.130)**	.266* (.145)	**.546** **(.135)**
Common Country (0,1)	.255 (.407)	-.049 (.705)	.196 (.532)
Ex-Common Colonizer (0,1)	**.572** **(.070)**	**.531** **(.084)**	**.589** **(.074)**
Ex-Colonial Relationship (0,1)	**1.525** **(.140)**	**1.471** **(.142)**	**1.541** **(.145)**
Log($Population_i$*$Population_j$)	**-.023** **(.008)**	-.016 (.022)	**-.020** **(.006)**
Free Trade Area (0,1)	.176 (.110)	.272** (.125)	.119 (.110)
Currency Union (0,1)	**.776** **(.165)**	**.920** **(.192)**	**.656** **(.171)**
Common Language	**.894** **(.067)**	**.803** **(.076)**	.945 (.071)
Number of Observations	186362	70682	115680
Wald-χ^2 Test	5741.59 p=[.000]	35327.02 p=[.000]	58058.14 p=[.000]
Rho	.364	-	-

NOTES: Regressions include time fixed effects and separate countries fixed effects for countries as importers and as exporters (see equation (11) in the text). The coefficients of these dummies are not reported; robust standard errors in parentheses; correction for clustering of country pairs; characters in bold indicate coefficients significant at the 1% level; ** and * denote significance at the 5% and at the 10% level, respectively. *Rho* denotes the correlation between observed net imports and predicted net imports: Corr($\Sigma_t(M_i-M_{ji})_t$, $\Sigma_t(\hat{M}_i - \hat{M}_{ji})_t$)

Table 2 – Constrained Estimates

	1980–2000	1980-1989	1990-2000
Log(A_i*Y_j)	**.508** **(.033)**	**.402** **(.044)**	**.412** **(.048)**
Log(P_{CPI} / P_{GDP})	**-.306** **(.102)**	-.285** (.127)	-.291* (.160)
Log(Distance)	**-1.339** **(.030)**	**-1.271** **(.037)**	**-1.393** **(.030)**
Common Border (0,1)	**.447** **(.132)**	.309** (.146)	**.573** **(.140)**
Common Country (0,1)	.698 (.492)	.366 (.561)	.630 (.772)
Ex-Common Colonizer (0,1)	**.683** **(.072)**	**.563** **(.086)**	**.605** **(.076)**
Ex-Colonial Relationship (0,1)	**1.429** **(.145)**	**1.338** **(.149)**	**1.434** **(.156)**
Log($Population_i$*$Population_j$)	**-.175** **(.019)**	.062* (.034)	.020 (.014)
Free Trade Area (0,1)	.152 (.110)	.216* (.127)	.097 (.111)
Currency Union (0,1)	**.602** **(.183)**	**.710** **(.221)**	**.577** **(.184)**
Common Language	**.893** **(.070)**	**.775** **(.081)**	**.920** **(.074)**
Number of Observations	186362	70682	115680
Wald-χ^2 Test	49317.01 p=[.000]	26898.35 p=[.000]	56381.22 p=[.000]
Rho	.813	-	-

NOTES: Regressions include time fixed effects and separate countries fixed effects for countries as importers and as exporters (see equation (11) in the text). The coefficients of these dummies are not reported; robust standard errors in parentheses; correction for clustering of country pairs; characters in bold indicate coefficients significant at the 1% level; ** and * denote significance at the 5% and at the 10% level, respectively. *Rho* denotes the correlation between observed net imports and predicted net imports: Corr($\Sigma_t(M_i\text{-}M_{ji})_t$, $\Sigma_t(\hat{M}_i - \hat{M}_{ji})_t$)

Table 3 – Regressions with the Nominal Effective Exchange Rate (1980-2000)

	Unconstrained	Constrained
Log(A_i*Y_j)	**.674** **(.020)**	**.544** **(.037)**
log(P_{CPI} /P_{GDP})	-.062 (.062)	**-.322** **(.103)**
Log of Nominal Effective Exchange Rate	.000 (.001)	.005* (.003)
Log(Distance)	**-1.346** **(.030)**	**-1.34** **(.030)**
Common Border (0,1)	**.419** **(.130)**	**0.446** **(.133)**
Common Country (0,1)	.252 (.412)	0.653 (.504)
Ex-Common Colonizer (0,1)	**.568** **(.070)**	**0.673** **(.072)**
Ex-Colonial Relationship (0,1)	**1.517** **(.141)**	**1.425** **(.146)**
Log($Population_i$*$Population_j$)	**-.023** **(.008)**	**-.177** **(.020)**
Free Trade Area (0,1)	.187* (.110)	.168 (.111)
Currency Union (0,1)	**.793** **(.166)**	**.618** **(.184)**
Common Language	**.894** **(.068)**	**.898** **(.070)**
Number of Observations	184806	184806
Wald-χ^2 Test	56475.82 p=[.000]	48556.18 p=[.000]
Log-Likelihood	-377463	-415926

NOTES: Regressions include time fixed effects and separate countries fixed effects for countries as importers and as exporters (see equation (11) in the text). The coefficients of these dummies are not reported; robust standard errors in parentheses; correction for clustering of country pairs; characters in bold indicate coefficients significant at the 1% level; ** and * denote significance at the 5% and at the 10% level, respectively.

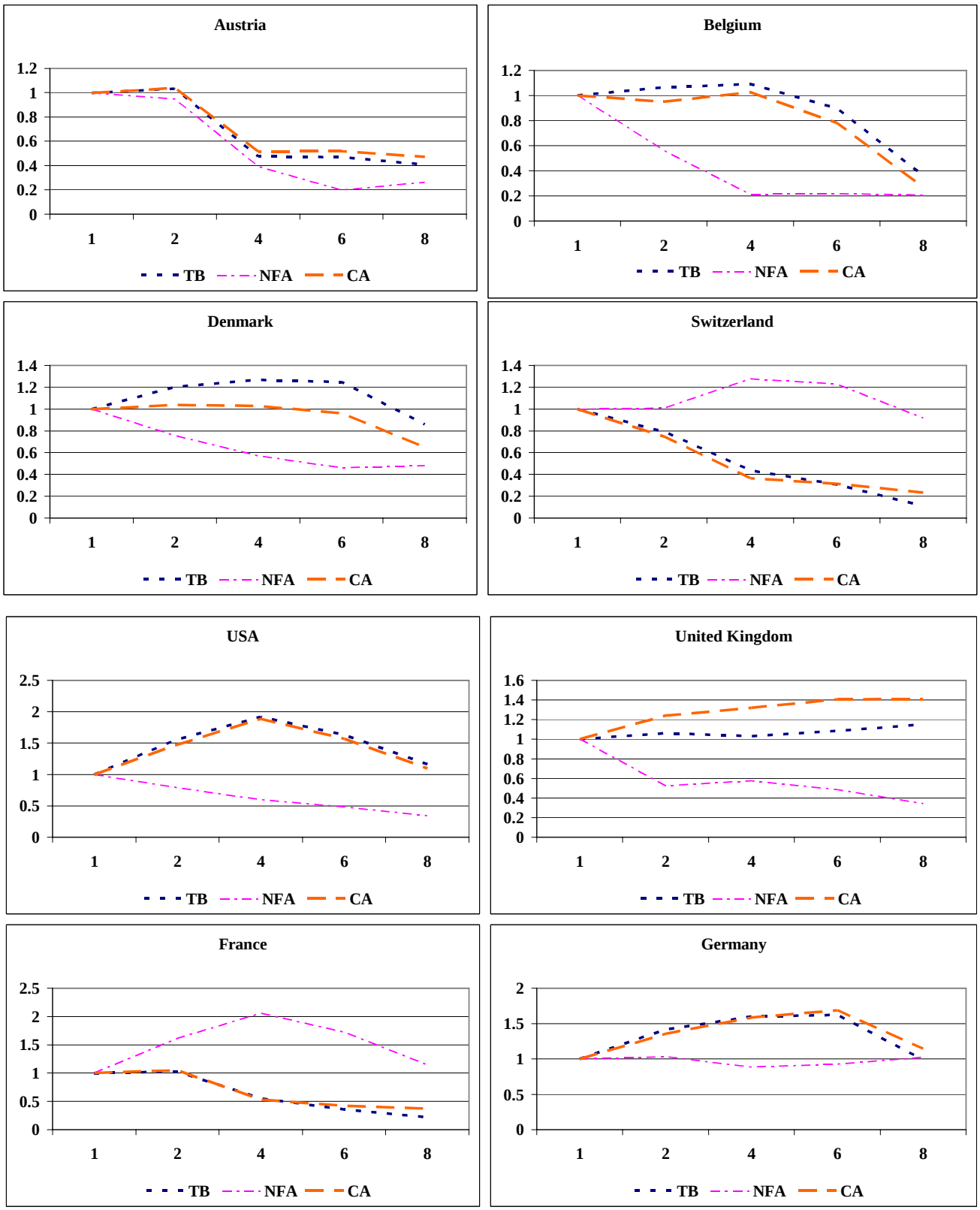
Table 4 – Summary Statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
Log of M_{ij}	-3.1895	3.6301	-18.5097	7.6148
Log of A_i*Y_j	39.1436	2.8909	26.9055	49.7239
Log of P_{CPI}/P_{GDP}	-.02056	.1328	-.5782	1.3721
Log of Real Oil Price	.3070	.4297	-.3419	1.3717
Log of Distance	8.6360	.8459	1.3871	9.8934
Log Product of Population	32.2735	2.5630	21.5657	41.6974
Common Border	.0292	.1686	0	1
Common Country	.0001	.0113	0	1
Ex-Common Colonizer	.0919	.2889	0	1
Ex-Colonial Relationship	.01505	.1217	0	1
Free Trade Area	.0398	.1956	0	1
Currency Union	.0127	.1121	0	1
Common Language	.1420	.2933	0	1

Table 5 – Correlation Matrix

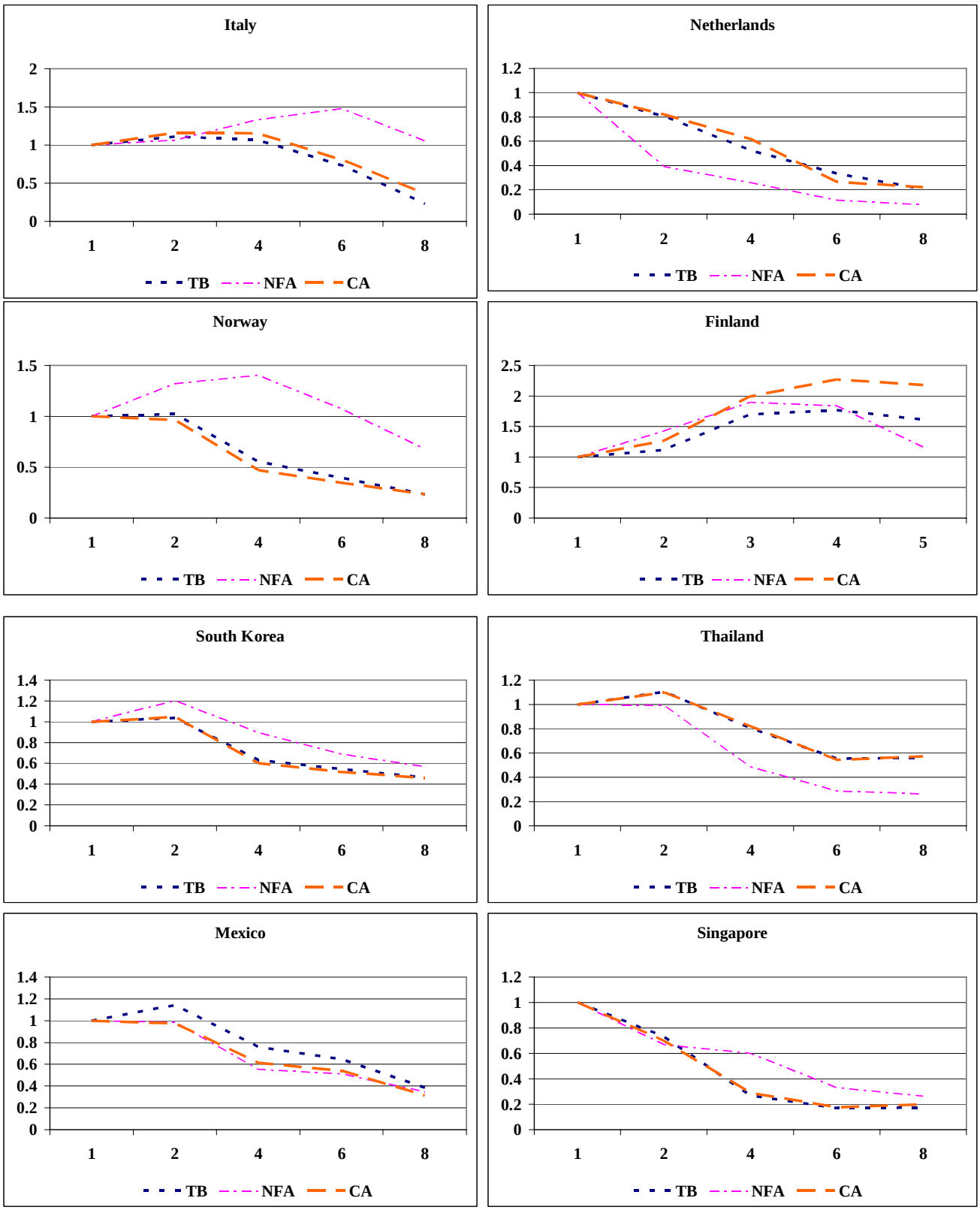
	A_i*Y_j	P	PO	D	Border	ComCty	ComCol	ColRel	P_i*P_j	FTA	CU	CL
A_i*Y_j - Log of (Absorption$_i$*GDP$_j$)	1											
P - Log of (P_{CPI}/P_{GDP})	-.013	1										
PO - Log of Real Oil Price	.032	-.158	1									
D - Log of Distance	.156	.013	-.005	1								
Border	-.030	-.024	.004	-.397	1							
ComCty – Common Country	.004	.001	.001	-.003	.020	1						
ComCol – Ex-Common Colonizer	-.343	-.006	-.014	-.142	.065	-.003	1					
ColRel –Ex-Colonial Relationship	.054	.006	.012	.001	-.021	-.001	-.039	1				
P_i*P_j - Log Product of Population	.705	-.011	-.036	.126	.052	-.005	-.211	.017	1			
FTA – Free Trade Area	.010	.019	-.000	-.341	.095	.031	.041	.003	-.163	1		
CU - Currency Union	-.153	.005	.000	-.205	.145	.007	.218	-.014	-.073	.060	1	
CL – Common Language	-.234	-.007	.020	-.187	.121	.019	.275	.190	-.211	.111	.161	1.
Nominal Effective Exchange Rate	.049	-.073	.385	-.012	.003	.005	-.048	-.025	.036	-.015	.010	.037

Figure 1 - Variance Ratios for Trade Balance (TB), Current Accounts (CA), and Net Foreign Assets (NFA) as a Percentage of Output



NOTES: Variance Ratios are: $V_k=(1/k)\cdot[(Var(q_t-q_{t-k}))\cdot(Var(q_t-q_{t-1}))^{-1}]$, k=1, 2, 4, 6, 8. Trade Balances, Current Accounts, and Net Foreign Assets are scaled by Gross Domestic Product.

Figure 1 (continued)



NOTES: Variance Ratios are: $V_k=(1/k)\cdot[(Var(q_t-q_{t-k}))\cdot(Var(q_t-q_{t-1}))^{-1}]$, k=1, 2, 4, 6, 8. Trade Balances, Current Accounts, and Net Foreign Assets are scaled by Gross Domestic Product.

DATA APPENDIX

M_{ij}: Bilateral Imports CIF of i from j (Source: IMF Directions of Trade Statistics, DOTS 2002), expressed in US$ and transformed in constant dollars by dividing by the US CPI

$Distance_{ij}$: Great circle distances are calculated using the arc-geometry formula on the latitude and longitude coordinates of the most populous city.

A_i: Absorption of country i. The figure is obtained by subtracting the trade balance (in US$, divided by the US CPI) from the GDP (in US$ divided by the US CPI). Both series are taken from the World Bank World Development Indicators (hereafter WDI (2003))

Y_j: Gross Domestic Product of country j in current US$ divided by the US CPI series. Both series are taken from the WDI (2003)

P_{CPI}: Consumer Price Index (1995=100) taken from the WDI (2003)

P_{GDP}: GDP Deflator (1995=100) taken from the WDI (2003)

Real Price of Oil: Average crude oil price 3-months Spot Price Index from the IMF-IFS CD-Rom (2002), line 00176AADZF). The series is in US$ and has been divided by the US CPI.

Population: Population taken from the WDI (2002)

Common Language: See Melitz (2004)

List of Countries

I.S. Of Afghanistan*, Albania, Algeria, Angola, Antigua And Barbuda*, Argentina, Aruba*, Australia, Austria, The Bahamas, Bahrain, Bangladesh, Barbados, Belgium, Belize, Benin, Bhutan*, Bolivia, Brazil, Brunei Darussalam*, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Central African Rep., Chad, Chile, People's Rep Of China, Colombia, Comoros*, Dem. Rep. Of Congo, Republic Of Congo, Costa Rica, Cote D'Ivoire, Cyprus, Czech Republic, Denmark, Djibouti*, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Fiji, Finland, France, Gabon, The Gambia, Germany, Ghana, Greece, Grenada, Guatemala, Guinea*, Guinea-Bissau, Guyana, Haiti, Honduras, Hong Kong, Hungary, Iceland, India, Indonesia, I.R. Of Iran, Iraq*, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Kiribati*, Kuwait, People's Dem. Rep. Of Lao, Lebanon*, Liberia*, Libya*, Macedonia, Republic Of, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Mauritania, Mauritius, Mexico, Mongolia, Morocco, Mozambique, Nepal, Netherlands, Netherlands Antilles*, New Caledonia*, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar*, Romania, Russian Federation, Rwanda, Samoa, Sao Tome & Principe*, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Solomon Islands, Somalia*, South Africa, South Korea, Spain, Sri Lanka, St. Kitts And Nevis, St. Lucia, St. Vincent & Grens., Sudan, Suriname, Sweden, Switzerland, Syrian Arab Republic, Tanzania, Thailand, Togo, Tonga, Trinidad And Tobago, Tunisia, Turkey, Uganda, United Arab Emirates*, United Kingdom, United States, Uruguay, Venezuela, Vietnam, West Bank*, Zambia, Zimbabwe.

*the country is only an exporter in the dataset

Free Trade Areas
Regional Trade Agreements notified to the GATT/WTO and in force.
(Source: http://www.wto.org as of 30th of June 2002)

1) ***EC/EEA/EFTA/EU***
Belgium, Bel-Lux, Denmark, France, Germany, Ireland, Italy, Luxembourg, Netherlands, UK, Norway, Switzerland, Malta, OCTs (Greenland, New Caledonia, French Polynesia, St. Pierre and Miquelon, Aruba, New Antilles, Falklands, St. Helena);
Austria (since 1995), Finland (since 1995), Sweden (since 1995), Greece (since 1981), Portugal (since 1986), Spain (since 1986).
2) ***NAFTA*** Free Trade Agreement, since 1994
Canada, Mexico, USA
3) ***CARICOM*** Customs Union, since 1973
Antigua and Barbuda, The Bahamas, Barbados, Belize, Dominica, Grenada, Haiti, Jamaica, Trinidad and Tobago, St. Vincent and Grenadines, St. Kitts and Nevis, Suriname
4) ***SPARTECA*** Free Trade Agreement, since 1977
Australia, New Zealand, Fiji, Kiribati, Nauru, Papua New Guinea, Solomon Islands, Tonga, Tuvalu, Vanuatu.
5) ***MERCOSUR*** Customs Union, since 1991
Argentina, Brazil, Paraguay, Uruguay
6) ***BAFTA*** Free Trade Agreement, since 1994
Estonia, Latvia, Lithuania
7) ***CACM*** Customs Union, since 1961
Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua.
8) ***US-ISRAEL*** Free Trade Agreement, since 1985
United States, Israel
9) ***CER*** Free Trade Agreement, since 1983
Australia and New Zealand

Common Countries
(Source: CIA World Factbook 2002)

China, Hong Kong (since 1997) and Macao; *Denmark,* Faeroe Islands and Greenland; *France,* French Polynesia, Guadeloupe, French Guiana, Martinique, New Caledonia, Reunion, and St. Pierre & Miquelon; *The Netherlands,* —Aruba and Netherlands Antilles; *United Kingdom,* Bermuda, Falkland Islands, Gibraltar, and St. Helena; *United States,* American Samoa and Guam.

Ex-Colonial Relationship and Ex-Common Colonizer
(Source: CIA World Factbook 2002)

Australia and Papua New Guinea; **Belgium** and Burundi, Dem. Rep. Of Congo; **France** and Algeria, Benin, Burkina Faso, Cambodia, Cameroon, Central African Rep., Chad, Congo Rep. Of, Djibouti, Gabon, Guinea, Lao People's Rep, Madagascar, Mali, Mauritania, Morocco, Niger, Senegal, Syrian Arab Rep., Togo, Tunisia, Vietnam; **Italy** and Libya; **New Zealand** and Samoa; **Portugal** and Angola, Cape Verde, Guinea-Bissau, Mozambique, Sao Tome & Principe, Timor; Spain and Equatorial Guinea; **South Africa** and Namibia; **The Netherlands** and Indonesia, Suriname; **Japan** and North Korea, South Korea; *USA* and Palau, Philippines; **United Kingdom** and The Bahamas, Bahrain, Bangladesh, Barbados, Belize, Bhutan, Bot-

swana, Brunei Darussalam, Cyprus, Dominica, Fiji, The Gambia, Ghana, Grenada, Guyana, Hong Kong, India, Jamaica, Jordan, Kenya, Kiribati, Kuwait, Lesotho, Malawi, Malaysia, Maldives, Malta, Mauritius, Myanmar, Nauru, Nigeria, Pakistan, Qatar, Seychelles, Sierra Leone, Singapore, Solomon Islands, Somalia, Sri Lanka, St. Kitts & Nevis, St. Lucia, St. Vincent & Grenadines, Sudan, Swaziland, Tanzania, Tonga, Trinidad and Tobago, Tuvalu, Uganda, United Arab Emirates, Vanuatu, Zambia, Zimbabwe. (Countries in bold characters are the ex-colonizers).

Currency Unions
(Source: Glick and Rose (2002), updated with information from the IMF International Financial Statistics Book (2002))

1) Antigua and Barbuda, Dominica, Grenada, Montserrat, St. Kitts & Nevis, St. Lucia, St. Vincent & Grenadines;
2) Aruba, Netherlands Antilles, Suriname (until 1994); Australia, Kiribati, Nauru, Tonga (until 1991), Tuvalu;
3) Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, The Netherlands, Portugal and Spain (Since 1999);
4) Cameroon, Togo;
5) Central African Rep., Benin, Burkina Faso, Chad, Comoros (until 1994), Rep. of Congo, Ivory Coast, Equatorial Guinea, Gabon, Guinea-Bissau, Madagascar (until 1982), Mali, Niger, Senegal, Togo;
6) Denmark, Faeroe Islands, Greenland;
7) France, French Guiana, Guadeloupe, Martinique, Reunion, St. Pierre & Miquelon;
8) Lesotho, South Africa, Swaziland;
9) New Caledonia, French Polynesia, Wallis & Futuna;
10) Qatar, United Arab Emirates;
11) United Kingdom, Falkland Islands, Gibraltar, St. Helena;
12) United States, American Samoa, Bahamas, Bermuda, Dominican Rep. (until 1985), Guam, Guatemala (until 1986), Liberia, Panama.