Do Excessive Wage Increases Raise Imports? Theory and Evidence

Jim Malley
Thomas Moutos

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Abstract:

This paper uses a model of trade in vertically differentiated products to examine the effects of "excessive wage" increases (i.e. above productivity) on the volume of commodity imports. The model predicts that if the domestic country has comparative advantage in producing high quality varieties of some products, then "excessive wage" increases may result in a decrease in the volume of imports for these products. The empirical validity of the model's predictions is demonstrated with the use of disaggregated Japanese import data for the period 1967-95. We also find that the aggregate volume of Japanese imports is not responsive to "excessive wage" changes.

JEL Classification: E1, F41

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Jim Malley, Department of Economics, University of Glasgow, Glasgow G12 8RT, UK, email: j.malley@socsci.gla.ac.uk (corresponding author).

Thomas Moutos, DIEES, Athens University of Economics & Business, Patission 76, Athens 10434, Greece, email: tmoutos@aueb.gr.

1. Introduction

According to the received wisdom in open-economy macroeconomics, the effects of an increase in a country's real wage - *ceteris paribus* – on the volume of its imports are unambiguous. Since wage costs are part of total production costs, the price of domestically produced goods will increase relative to the price of imported goods, thereby increasing domestic demand for foreign produced goods and the volume of imports. This prediction of open economy macroeconomic models is the cornerstone of almost all applied trade balance analysis (see, for example, Hooper and Marquez (1995) and Krugman (1995)). In the present paper we argue that this prediction is not generally valid. To this effect we construct a model in which the volume of imports may not change (or even decline) in response to a rise in the real wage. The empirical validity of our theoretical arguments is then demonstrated with the use of disaggregated Japanese import data for the period 1967-95.

The standard specification of the import demand equation in macroeconomic models states that the (aggregate) volume of imports is positively related to aggregate income and positively related to the ratio of domestic to foreign prices (see, for example, Goldstein and Khan (1985)). In accordance with the representative agent model, the standard specification can be thought of as arising as a result of a household's maximization of utility (which depends on the consumption of a "domestic" and an "imported" good) subject to a budget constraint. Implicitly, the predictions of the standard import demand equation are based on the assumption that the effects of changes in wages (and thus, prices) on the volume of imports arise for a **given** level of income. In this paper we argue that once we abandon the assumption of a representative agent, and treat the "domestic" and "imported" goods as different varieties of a vertically differentiated product, then increases in domestic wages -

even though they may result in increases in the (relative) price of domestic products **and** household incomes - may still cause a decline in the volume of imports.

The present paper follows Linder (1961) and assumes that household income determines the quality of goods demanded. In addition we assume that the goods, which the domestic country trades with the rest of the world (ROW), are vertically differentiated according to quality and that the domestic country has absolute advantage at all quality levels and comparative advantage (*CA*) at high quality varieties[1]. In other words, we assume that the domestic country is technologically advanced. An increase – *ceteris paribus* - in domestic wages will obviously reduce the range of qualities (varieties), which can be produced at lower cost by domestic producers. This, of course, implies the orthodox conclusion that – *ceteris paribus* – the volume of domestic imports will increase. But this is only half of the story because the increase in domestic wages (and hence – as explained later - household incomes) induces domestic consumers to switch their demand to higher quality varieties; i.e. to varieties in which the domestic country has a *CA*. It is thus possible that the latter effect largely offsets (or even overcomes) the traditionally expected one, so that the switch in demand to higher quality varieties results in no noticeable effect (or even a decline) in the volume of imports.

The theoretical possibility that increases in real wages may not lead to an increase in the volume of imports necessitates an empirical examination of the issue. Nevertheless, it is obvious that the *ceteris paribus* proviso on which the theoretical

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[1] There is a considerable body of evidence, which testifies to the importance of vertical intra-industry trade (see, for example, Schott (2001)). The evidence also suggests that vertical intra-industry trade is quantitatively more important than horizontal intra-industry trade. In addition, some studies (e.g. Grossman (1982), Muscatelli, Stevenson and Montagna (1995)) have attributed a significant role to vertical product differentiation regarding the size and interpretation of estimated price and income elasticities in international trade.

analysis is based should not be ignored. If, for example, real wage increases did not keep pace with productivity increases, then nobody would be surprised to find a negative relationship between real wages and the volume of imports. On the other hand, if real wages increased at a faster rate than productivity (i.e. real wage increases were "excessive"), standard theory would predict a positive association between real wages and the volume of imports. For this reason, in our empirical analysis, we enquire into the relationship between the volume of imports and (real) wages changes not accounted for by (or falling short of) productivity changes. Our econometric findings based on annual data for Japanese imports of 68 commodity groups provide considerable support for our theoretical framework of a technologically advanced country. We find that real wage changes not accounted for by productivity changes exert a (statistically) significant and positive influence on the volume of imports for only 28 of the commodity groups, whereas they exert a significantly negative influence for 10 of them, with the influence on the remaining 30 commodities being insignificant. Having established the empirical relevance of our theoretical framework at a disaggregated level we proceed to enquire about its macroeconomic importance. To this effect, we simulate for each commodity group the effects of a one-percentage-point increase in "excessive wages" on the volume of imports and then aggregate the responses. We find that the aggregate volume of imports does not respond to changes in "excessive wages".

The outline for the remainder of the paper is as follows. In Section 2 we set up our model of trade in vertically differentiated products and demonstrate how it is possible for a – *ceteris paribus* – increase in wages to results in a reduction in the volume of imports. In Section 3 we use Japanese data to enquire into the empirical importance of our theoretical priors. Our conclusions are then presented in Section 4.

2. The Model and its Implications

We construct the simplest possible model capable of illustrating the main idea of the paper. Given that our objective is the study of the *partial* equilibrium effects of wage rate changes on the volume of imports (something akin to the import demand equation in macroeconomic models), we treat domestic (and ROW) nominal wages as exogenous. The model follows closely Malley and Moutos (2002) which has in turn borrowed from Rosen (1974) and Flam and Helpman (1987).

2.1 Technology

We start by assuming that there are two goods produced in the domestic country: a homogeneous non-traded good and a quality-differentiated product that is traded with the ROW. The ROW is also assumed to produce the differentiated product, albeit with a different technology. The homogeneous good H is produced under perfectly competitive conditions in the domestic country, with the use of labour L, and imported intermediate inputs S (e.g. oil), which are produced in the ROW. For the purpose of simplicity, we assume that the homogeneous good is produced with Leontief technology[2]:

$$H = \min\{\beta L, \beta S\}. \tag{1}$$

Perfect competition ensures that

$$P_H = (W + P_S) / \beta \tag{2}$$

where P_H is the price of the homogeneous good, W is the (domestic) wage rate, P_S is the domestic price of the imported intermediate input and β is a positive parameter. We assume that all prices in the domestic economy and in the ROW are expressed in a common currency (the exchange rate is assumed fixed at unity).

[2] Schmid (1976) and Findlay and Rodriquez (1977) were the first to employ this assumption in open-economy macroeconomics.

The quality-differentiated good is also produced under perfectly competitive conditions. We assume that quality is measured by an index Q in the range [1, ∞], and that there is complete information regarding the quality index. We further assume that in both the domestic country and the ROW costs depend on quality, and that each unit of a given quality is produced at constant cost. That is, the production function for the quality-differentiated good in the domestic country is

$$Y_Q = \min\left\{\frac{L}{\gamma Q^{\varepsilon}}, \frac{S}{\gamma Q^{\varepsilon}}\right\}, \ \ \varepsilon \geq 1, \ \gamma > 0 \tag{3}$$

where Y_Q denotes the number of units of quality Q produced in the domestic country and ε and γ are constant parameters. The above equation implies that although costs per unit in terms of quantity are constant, costs may be increasing per unit of the quality index. The latter assumption is motivated by the fact that increases in quality - for a given state of technological capability - involve the "sacrifice" of an increasing number of personnel. These workers must be allocated not only to the production of a higher number of features attached to each good (e.g. electric windows, air bags, ABS etc. in the case of automobiles) that directly absorb labour and intermediate inputs, but also to the development and refinement of these features. According to equation (3), the price at which each unit of quality Q will be offered is equal to

$$P(Q) = \gamma Q^{\varepsilon}(W + P_S). \tag{4}$$

The domestic country is assumed to have absolute advantage in the production of the quality-differentiated good, and this advantage becomes larger as the quality index increases. This assumption can be captured by writing the production function for the ROW (we denote variables pertaining to the ROW by an asterisk),

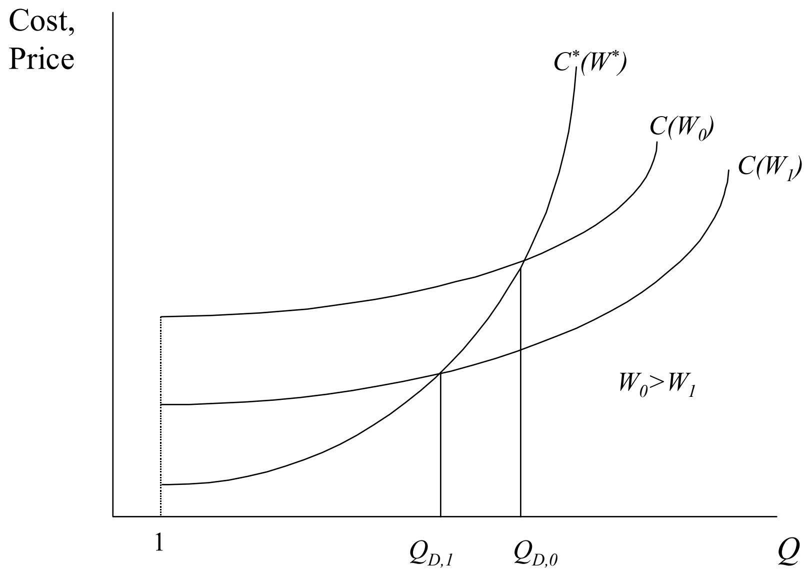
$$Y_Q^* = \min\left\{\frac{L^*}{\delta Q^{\mu}}, \frac{S}{\delta Q^{\mu}}\right\}, \ \ \delta > 0, \ \mu > 1, \ \mu > \varepsilon, \ \delta > \gamma. \tag{5}$$

According to equation (5), the price at which each unit of quality Q, will be offered by ROW producers is equal to

$$P^*(Q) = \delta Q^{\mu}(W^* + P_S) \qquad (6)$$

Under these circumstances it is obvious that only if domestic wages are higher than ROW wages, will the ROW be able to produce some varieties (qualities) at a lower cost than the domestic country. Figure 1 illustrates such a case.

Figure 1: The relationship between quality and cost



The schedule $C(W_0)$ represents the cost of producing different qualities of the differentiated good in the domestic country. The position of the schedule obviously depends on domestic wages, which are initially assumed to be W_0. For the ROW, the corresponding schedule is $C^*(W^*)$ with $W^* < W_0$. Under this particular structure of wages, the ROW will be offering all qualities up to $Q_{D,0}$ at a lower cost than the domestic country. We term $Q_{D,0}$ the "dividing" level of quality. All varieties with quality larger than $Q_{D,0}$ will be offered by domestic producers. From Figure 1 it is obvious that the domestic country can increase the range of varieties which it can produce at lower cost than the ROW, if the wage rate is reduced to W_1. The new dividing level of quality is now $Q_{D,1}$. This reduction in the range of varieties, which the ROW can provide at lower cost, is traditionally always expected to result in a reduction of domestic imports.

2.2 Preferences

Households in both the domestic country and the ROW are assumed to have identical preferences, and to be endowed with one unit of labour, which they offer inelastically. In this sense, changes in the real wage rate produce equi-proportional changes in household income and total compensation per employee. There are, however, differences between households (both within and across regions) in the endowment of effective labour supply. We assume that firms pay the same wage rate to all workers per effective unit of labour (thus costs are independent of the distribution of talent across firms). This implies that there will be differences in income across households, with households owning more effective units of labour earning more income than those with fewer units. We assume that there are only three income classes: the low income, the middle income and the high-income class. Let K_l, K_m, K_h signify the effective labour endowments of members in the low, middle and high-income class respectively. Income of the three classes is then defined as $E_l = K_lW$; $E_m = K_mW$; $E_h = K_hW$ with $K_l < K_m < K_h$.

Following Flam and Helpman (1987) we assume that the homogeneous good can be consumed in every desirable quantity, whereas the quality-differentiated product is indivisible and consumers can consume only one unit of it. Households with income E (the subscripts have been dropped for convenience) choose the consumption level of the homogeneous product and the quality level (variety) of the differentiated product to

$$\max \ u(H,Q) \ \ s.t. \ \ P_H H + P(Q) = E \tag{7}$$

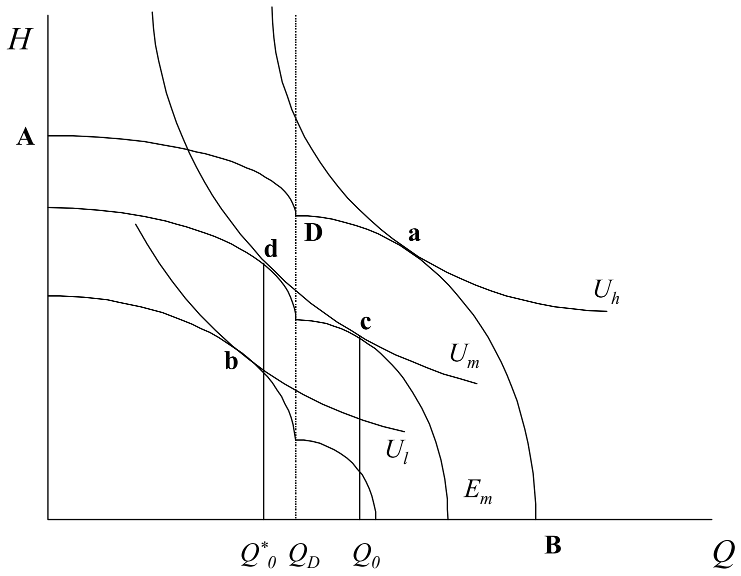
where H stands for the consumption of the homogeneous good, Q is the quality index of the differentiated good and $P(Q)$ is the price at which quality Q can be bought under free trade. We assume that for all households the solution to the above problem is such that the utility level that obtains from consuming both goods is higher than the utility that obtains from consuming only the homogeneous good.

The free-trade price of each quality (variety) of the differentiated product will be equal to the lower cost of producing in the two regions:

$$P(Q) = \min\{\gamma Q^{\varepsilon}(W + P_S), \delta Q^{\mu}(W^* + P_S)\}\,. \tag{8}$$

Note that although the price of the homogeneous good remains constant no matter how much the household consumes of this good, the price 'per unit of the quality index" $(P(Q)/Q)$ which the consumer pays for the differentiated good is not constant. As can be seen from equation (8) (see also Figure 1), $P(Q)/Q$ increases initially – until it reaches the "dividing" quality level, then it drops as the cost of producing higher quality varieties is lower in the domestic country than in the ROW, and rises again as even higher quality varieties demand more than proportional increases in the use of labour and intermediate inputs. Nevertheless, the household knows the exact correspondence between quality and price, as both the domestic and the ROW firms are assumed to announce to households a price list linking quality to price according to equations (4) and (6). Equation (8) implies that the budget constraint has a kink at the "dividing" level of quality Q_D (see Figure 1), i.e. the quality level at which the cost of production is the same in the domestic country and the ROW.

Figure 2: Incomes and Choice of Consumption



In Figure 2, the budget constraint for a high-income household is shown as the curve **ADB.** Points **A** and **B** denote the maximum quantity and quality of the homogenous and the differentiated good, respectively, that a high-income household can buy[3]. The budget constraint has also a kink at point **D** (which corresponds to the "dividing" level of quality Q_D). It is then possible that there may be an income (say E_m) such that the household is indifferent between buying the ROW produced quality Q_0^* and the domestically produced quality Q_0. It is also clear that in this case that there will be no demand for qualities in the range (Q_0^*, Q_0). Further consideration of such a situation presents no new insights for the analysis that follows. It is for this reason that we assume incomes of all classes to be such that consumers have a clear preference for either domestic or ROW varieties. This is also demonstrated in Figure 2, in which the low income household is shown to maximize its utility by consuming

[3] The horizontal axis has been properly re-labeled to reflect the assumption that the differentiated good is not offered at qualities Q<1.

an imported variety (point **b**), whereas the high income household achieves it highest utility level by consuming a domestic produced variety (point **a**).

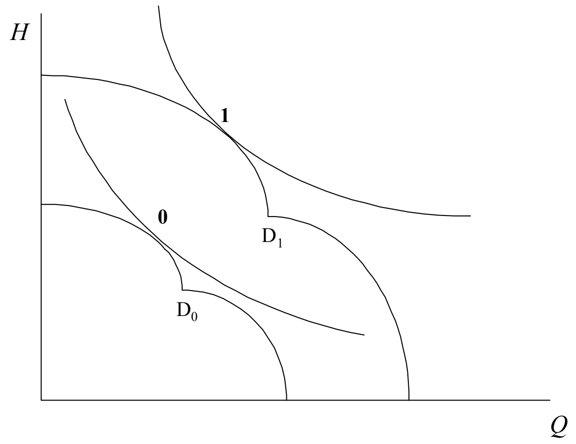
2.3 Real Wages and Imports

Given our interest in showing that wage increases may result in a reduction in the volume of imports, we concentrate on an initial equilibrium for which this is possible. It goes without saying that other specifications of the initial equilibrium can produce the standard result that wage increases result in an increase in the volume of imports. Nevertheless since our objective in this section is to establish the theoretical possibility that the standard result may not obtain, we start by considering the case in which the domestically produced variety is consumed initially only by the high - income households in the domestic country. In Figures 3a-3c the initial equilibrium is displayed by the tangency of the budget constraints and the indifference curves at point **0**.

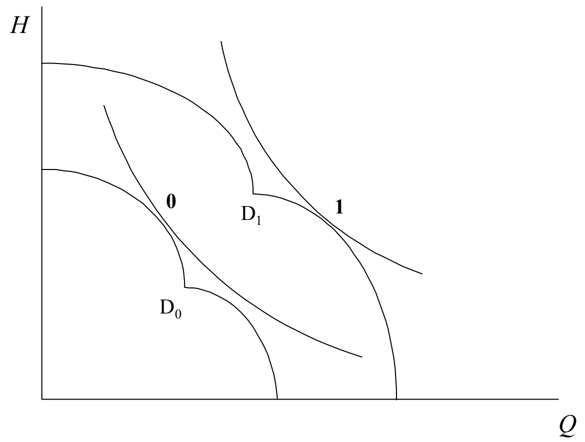
Consider now an increase in domestic wages. Given perfect competition, all income accruing to domestic households consists of wages. This implies that the budget constraint moves outwards for all three-income groups. This happens because the prices of both the homogeneous good and the quality differentiated good rise less than proportionately to the wage rate. The assumption of an exogenous price for the imported intermediate input is thus crucial for connecting nominal wage increases to a rise in real income. Along with the rise in domestic real income there is a decrease in

Figure 3: Real Wage Changes and Imports

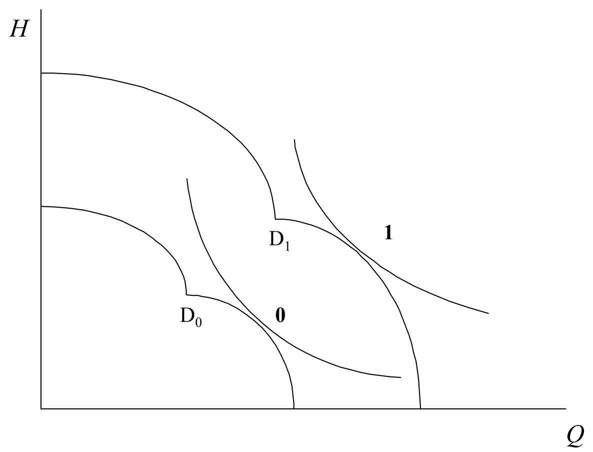
3a: Low Income Households



3b: Middle Income Households



3c: High Income Households



the range of qualities (varieties) of the differentiated good that the domestic country can offer at a lower cost than the ROW. In Figure 3a, the rise in domestic wages is associated with a shift of consumption for the low-income domestic households from lower to higher quality ROW produced goods. In Figure 3c, as in Figure 3a, the increase in domestic wages does not switch demand from goods (varieties) produced in one region to another. It only leads domestic consumers to demand higher quality (domestically produced) varieties than before.

In Figure 3b, the increase in domestic wages is associated with a switch in the consumption pattern of the middle-income domestic consumers. The increase in their real income induces them to substitute higher quality domestically produced goods for the lower-quality ROW produced goods they were demanding before. This switch will <u>decrease</u> the volume of domestic imports.

We now use a particular functional form for the utility function in order to determine under what conditions middle-income households would achieve higher utility by switching from consuming ROW produced varieties to domestically produced varieties when domestic wages increase. For simplicity, we assume that individuals have Cobb-Doublas preferences (i.e. $U = H^{\alpha}Q^{1-\alpha}, \alpha < 1$). Given the non-differentiability of the budget constraint when free trade is allowed, the household finds the combination of *H* and *Q* for which utility is maximized by comparing the utility levels it could achieve if it was forced to buy either only domestically produced or only ROW-produced varieties of the differentiated good (i.e. if *P(Q)* is equal to either $\gamma Q^{\varepsilon}(W + P_S)$ or to $\delta Q^{\mu}(W^* + P_S)$).

The demand functions resulting from the above optimization problems are

$$Q_D = \left((1-\alpha)kW / \gamma(1+\alpha(\varepsilon-1))(W+P_S)\right)^{1/\varepsilon} \tag{9}$$

$$H_D = \alpha\varepsilon kW / \beta^{-1}(W+P_S)(1+\alpha(\varepsilon-1)) \tag{10}$$

if the household is allowed to buy only domestically produced varieties. On the other hand, if the household is allowed to buy only ROW-produced varieties, the demand functions are

$$Q_R = \left((1-\alpha)kW / \delta(1+\alpha(\mu-1))(W^*+P_S)\right)^{1/\mu} \tag{11}$$

$$H_R = \alpha\mu kW / \beta^{-1}(W+P_S)(1+\alpha(\mu-1)). \tag{12}$$

As defined in Section 2.1.2, we assume that the household's income is proportional to wages, *E=kW*, *k>0*. Note that in both cases the Engel curve is positively sloped everywhere, but despite the homotheticity of the utility function it is not a straight line. As incomes increase (i.e. a higher *k*) the Engel curve bends towards the vertical (H) axis. Nevertheless, expenditure shares remain independent of income. The indirect utility functions associated with the above demand functions are

$$\begin{aligned} U_D = &\left[(1-\alpha)kW / \gamma(1+\alpha(\varepsilon-1))(W+P_S)\right]^{(1-\alpha)/\varepsilon} \\ &\times\left[\alpha\varepsilon kW / \beta^{-1}(W+P_S)(1+\alpha(\varepsilon-1))\right]^{\alpha} \end{aligned} \tag{13}$$

$$\begin{aligned} U_R = &\left[(1-\alpha)kW / \delta(1+\alpha(\mu-1))(W^*+P_S)\right]^{(1-\alpha)/\mu} \\ &\times\left[\alpha\mu kW / \beta^{-1}(W+P_S)(1+\alpha(\mu-1))\right]^{\alpha} \end{aligned} \tag{14}$$

If U_D-$U_R>0$, then the household achieves maximum utility by purchasing a domestically produced variety of the differentiated good. Consider now the effect on U_D-U_R of changes in domestic wages, under the restriction that initially $U_D=U_R$. We find that

$$\frac{d(U_D-U_R)}{dW} = J\left(\frac{\mu-\varepsilon}{\varepsilon} - \frac{W}{P_S}\right)\boxed{\begin{matrix}>\\<\end{matrix}}0 \tag{15}$$

where $J = \frac{(1-\alpha)U_D}{\mu W P_S (W + P_S)}$. What equation (15) implies is that for a household whose initial income level (=kW) is such that U_D is equal to U_R, an increase in wages will make $U_D > U_R$ only if $(\mu - \varepsilon)/\varepsilon > W/P_S$. Equation (15) also implies that $J\left(\frac{\mu - \varepsilon}{\varepsilon} - \frac{W}{P_S}\right)$ is a measure (around the initial dividing quality level) of the number of households (among those which had initially U_D slightly smaller than U_R) which will switch from ROW to domestically produced varieties (or vice versa). In this sense it makes clear that (marginal) changes in wage rates will not result in a switch in demand for households whose initial income level is such that the difference between U_D and U_R is large. A final implication of (15) is that if the domestic country has *CA* in low-quality varieties of the differentiated product $(\varepsilon > \mu)$, then an increase in domestic wages will definitely result in a rise in imports.

The intuition behind this condition can be better appreciated if we conceptually divide the shift from point **0** to point **1** in Figure 3b into two separate effects. The first effect relates to the traditional influence of wages on costs. An increase in domestic wages makes the home country less competitive in the qualities (varieties) in which it were more competitive than the ROW and it contracts the range of qualities which the domestic country produces at a lower cost. A measure that captures the amount by which the range of qualities contracts is $(\mu - \varepsilon)/\varepsilon$, i.e. the proportional difference in the slopes of the average cost curves in the domestic country and in the ROW. We term this the *cost* effect. The second effect arises from the influence that wages have on household income and hence spending patterns. An increase in the wage rate results in higher household income, and a switch of demand to higher quality varieties. But, these are precisely the varieties in which the domestic country has comparative advantage. A measure that captures the influence of this effect is the ratio W/P_S. The smaller is W/P_S, the larger is the increase in (real) household income resulting from a rise in wages since in this case non-wage costs are a smaller proportion of total costs. This second effect has hitherto been ignored. We term this the *income* effect. The typical analysis of the effects of wage changes concentrates only on competitiveness (the *cost* effect), and it ignores the resulting switch in demand toward varieties in which the domestic country has comparative advantage (the *income* effect)[4].

What Figures 3a-3c make clear is that, the volume of domestic imports may well decrease following an increase in domestic wages (incomes). The precise effect will obviously depend on the size of the three income groups. The larger the middle-income group, the larger will be the expected decrease in domestic imports since this is the group for which the increase in real income may result in a switch from varieties produced in the ROW to domestically produced varieties[5]. The reason behind this unexpected result is that an increase in domestic wages even though it makes the home country less competitive, it induces domestic consumers to switch their demand to higher quality goods. But these are precisely the goods in which the domestic country has a *CA*. This latter effect has hitherto been ignored. The typical analysis of the effects of wage changes concentrates only on cost competitiveness, and it ignores the resulting switch in demand to varieties in which the domestic country has a *CA*.

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[4] The *income* effect identified in this paper must be distinguished from the traditional inclusion of an aggregate activity variable (GDP, for example) in import demand equations. We discuss this issue further in Section 3.

[5] This, in effect, implies that income distribution is an important determinant of trade flows (see, for example, Gould (1994) and Marquez (2000)). It also implies that as long as the distribution of income is not bimodal with little mass in the middle, the empirical importance of our mechanism will not necessarily be trivial. In any case, the distribution of income in Japan (and almost all OECD countries) is not bimodal.

It must, however, be noted that the effects on the "total volume" of imports of differentiated goods resulting from an increase in domestic wages is more complicated. Notice (as shown in Figure 3a), that the low-income group still consumes varieties produced in the ROW after the increase in domestic wages. But these imports are now of a higher quality than before. In some sense, the "total volume" of imports by this group increases. It is thus possible (even for the special case presented in Figure 3) that, despite the switch depicted in Figure 3b, the aggregate "volume" of imports responds in the traditional manner following a increase in domestic wages.

It should be noted that, of course, there is no country in the world, which has *CA* in high quality varieties for all the commodities that it trades with the ROW. In the case of commodities for which the domestic country's *CA* is in low quality varieties, our analysis predicts – in common with standard theory – that a – *ceteris paribus* – increase in domestic wages will result in an increase in the volume of imports. Moreover countries trade not only in differentiated products, but in homogeneous goods as well. For this reason we have chosen Japan as the country on which to conduct our empirical analysis, since Japan's international trade is probably the most technology (rather than natural resources) driven than any country in the world. In this respect it is also worth noting that Grossman (1982) has found that for many product categories the US produces varieties, which cover the whole quality spectrum, and as such US producers of a given product compete with imports originating from both developed and less-developed countries. Thus, the US – although it is probably equally or more technologically sophisticated than Japan – does not appear to specialize in the production of high-quality varieties.

3. Empirical Implications and Evidence

In this section we develop and test the main empirical implication of the theory developed in Section 2. As explained, our model predicts that real wage changes have an ambiguous effect on the volume of imports. Nevertheless, the – *ceteris paribus* – wage change assumed in our theoretical analysis surely finds no match in the data of any real economy. The actual real wage data certainly reflect labour productivity changes, in which case costs may not rise is response to real wage increases. For this reason we construct a variable that measures the amount by which real wage changes deviate from productivity changes. We term this variable "excess wages" (w^e), and we obtain it from the residuals of a regression of the natural logarithm of real compensation per employee (w) on the natural logarithm of an index of productivity (p), i.e.

$$w^e = w - w^* = w - \delta - \phi p \tag{16}$$

where w^* is the part of w directly attributable to productivity. According to received wisdom, an increase in w^e is expected to increase the volume of imports.

In addition to the "excess wage" variable, we include two other "traditional" explanatory variables for the volume of imports in our econometric investigation: an aggregate activity variable and competitiveness[6]. The inclusion of an aggregate activity variable in our framework is essential for two reasons. First, note that in our theoretical analysis labour is assumed to be the only domestically owned factor of production. Nevertheless, since household consumption choices are made on the basis of total household income, rather than income derived from the sale of the household's labour services alone, care must be taken to control for the other sources

[6] These two variables are standard ones used in the empirical literature on import demand. See Goldstein and Khan (1985) for a thorough discussion of specification issues.

of income. Second, the presence of not only final consumption goods but of intermediate inputs as well in the actual import data necessitates the inclusion of a variable measuring aggregate domestic activity. We use domestic GDP to control for the influence of the above concerns. Changes in the prices of imported goods (resulting from changes in exchange rates, foreign wages, foreign productivity, etc.) can also affect the "dividing" quality level and the volume of imports. We control for these (independent of the behavior of domestic wages) changes in competitiveness by including the price of imported goods (expressed in domestic currency (i.e. yen)) in the econometric estimation. Note that had we included the ratio of domestically produced to imported goods prices (i.e. the terms of trade) as an independent variable instead of just the prices of imported goods, the estimated coefficient of the "excessive wages" variable would measure only (what we termed in the previous Section) the "income effect". Since we want to investigate whether the "income" or the "cost" effects of "excessive wages" changes predominate, we control for only those changes in competitiveness, which are independent of the behavior of domestic wages. Nevertheless, in order to provide an extra test of our theoretical priors we also report results based on a separate regression in which the "terms of trade" are included instead. This issue is discussed further in the following pages.

Our regression analysis is conducted with Japanese annual data from the period 1967-95 for sixty-eight commodity groups[7]. These data are obtained from the CHELEM (Harmonized Data for International Trade and the World Economy) and

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[7] A number of alternative univariate unit root tests are reported in Appendix Tables 1 and 2 for all 68 commodities as well as for all the conditioning variables (and when relevant their constituent parts). The preponderance of evidence resoundingly suggests that none of the logged levels data are distributed I(0). While this finding might not accord with theoretical priors regarding the excess wage variable (as defined above) and competitiveness (i.e. the terms of trade), it is nonetheless a clear sample property of our data. The implications of these findings will be discussed further below.

the OECD (Annual National Accounts and Economic Outlook) databases[8]. We begin by estimating the relationship between real commodity imports and the real "excess wage" per employee, controlling for aggregate income, import prices and deterministic trends, e.g.

$$m_i = w^e\alpha + \mathbf{X}\beta + \mathbf{D}\gamma + \varepsilon; \quad \varepsilon \sim iid(0, \sigma^2\mathbf{I}); \quad \text{cov}(z, \varepsilon) = 0 = \text{cov}(\mathbf{X}, \varepsilon), \quad (17)$$

where m_i is the vector of real imports for the i^{th} commodity ($i=1,\ldots,68$); w^e is the excess wage vector[9], $\mathbf{X}$ is a matrix of stochastic control variables [y, m_p]; y is real GDP and m_p is the yen price of imports; and $\mathbf{D}$ is a matrix of deterministic components containing a constant term and linear and quadratic trends. Lower case letters for the variables denote natural logarithms.

Since our main focus is to separately determine the effects of excess wages on the volume of imports once we have conditioned for aggregate income and import prices (and later competitiveness), we treat the above specification symmetrically and directly estimate the static representations using ordinary least squares (*OLS)*[10]. In other words, irrespective of statistical significance, the *same* set of conditioning variables as specified in (17) is maintained. Given that we estimate 68x2 equations, this approach has the practical advantage of facilitating comparability across models and, as such, primarily constitutes an exercise in hypotheses testing. This is in contrast to a specification strategy led by the desire to estimate the best fitting parsimonious model. Furthermore, since our time-period is restricted to 1967-1995

[8] Note that commodity #57 (electricity) reported in the Data Appendix is excluded from the analysis since it is not reported in CHELEM for Japan (see the Data Appendix for further details on variable definitions, sources and methods).

[9] Both Pudney (1982) and Pagan (1984) have shown that the two-step estimator of (17) is consistent as long as $\text{cov}(\mathbf{X}, \varepsilon) = \text{cov}(z, \varepsilon) = 0$. We will examine the validity of this assumption using the Durbin-Wu-Hausman test below.

[10] It is not possible to apply seemingly unrelated regression (*SUR*) here since the number of equations exceeds the number of observations. However, even in the absence of this restriction, *SUR* would still be equivalent to *OLS* since we employ the same set of regressors in each equation.

and consistent with the univariate evidence reported above, we refrain from applying a long-run co-integrating, co-trending interpretation if the estimated models prove to be non-spurious. We instead view any observed stationarity in the errors as simply reflecting the medium-term properties of the data over our available estimation period.

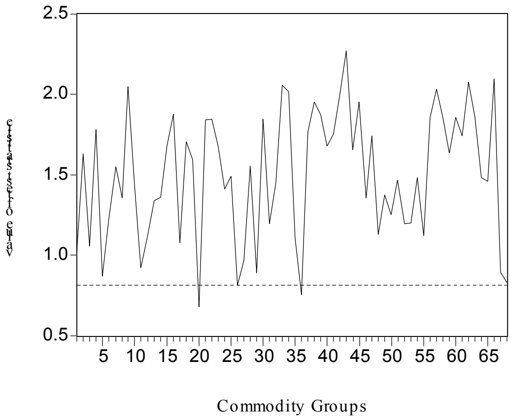
Given the above arguments we will obviously not conduct extensive specification and misspecification testing. Nonetheless, given our concentration on hypothesis testing, we would like to at least ensure that (17) is not spurious and further that our stochastic conditioning variables, i.e. the generated regressor, w^e, and the control variables y and m_p, (and later competitiveness, c) are not correlated with the errors. To address the former we apply a modified von Neumann type ratio test to the errors in specification (17). For example, we test for stationarity of the errors using the Bhargava (1986) statistic, e.g.

$$R_1 = \sum_{t=2}^{T} (\hat{\varepsilon}_t - \hat{\varepsilon}_{t-1})^2 / \sum_{t=1}^{T} (\hat{\varepsilon}_t - \bar{\hat{\varepsilon}})^2 \qquad (18)$$

where $\hat{\varepsilon}$ is the equation residual. The statistic R_1 is used to test the null of a simple random walk, (i.e. $\Delta\hat{\varepsilon}_t = e_t$, where, $\hat{\varepsilon}_1 = \mu + e_1$, $t=2,...T$) against the stationary alternative $(\hat{\varepsilon}_t - \mu) = (\hat{\varepsilon}_{t-1} - \mu) + e_t$, where $\hat{\varepsilon}_1 = \mu + [e_1/(1-\rho^2)^{1/2}]$, t=2,…,T, $0 \leq \rho < 1$). Applying this test we find that the errors in virtually all commodity equations are stationary. The exceptions include industries 20 and 36, i.e. watch & clock-making and vehicle components respectively. These results are summarized in Figure 4, where the vertical axis represents the value of the R_1 test statistic and the horizontal the sixty-eight commodity groups. Finally, the horizontal line in Figure 4 is the exact limit at 5% for R_1, N=29 (i.e. 0.814)[11].

[11] This value is found by interpolation using Table 1 in Bhargava (*op cit*).

Figure 4 – Stationarity Test for all Import Equations



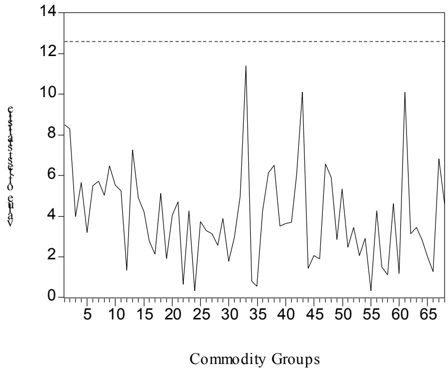
With respect to the issue of potential correlation between the conditioning variables and the errors we compare *OLS*, which is efficient (or more efficient) under the null but inconsistent under the alternative, with the *IV* estimator, which is consistent (and less efficient) under both hypotheses. For example, the Durbin-Wu-Hausman (DWH) test (see Hausman (1978)) is calculated as follows:

$$DWH = (b_{OLS} - b_{IV})'(\mathbf{S}_{OLS} - \mathbf{S}_{IV})^{-1}(b_{OLS} - b_{IV}) \sim \chi^2(k), \qquad (19)$$

where b_{OLS}, b_{IV} are the vectors of estimated parameters of *OLS* and *IV* respectively, $\mathbf{S}_{OLS}$, $\mathbf{S}_{IV}$ are the estimated variance covariance matrices of *OLS* and *IV* respectively and k refers to the degrees of freedom which are equal to the rank of $(\mathbf{S}_{OLS} - \mathbf{S}_{IV})$[12]. Applying this test we find that in none of the 68 cases, do the *OLS* estimates significantly differ from the *IV* estimates. These results are summarized in Figure 5, where the vertical axis represents the value of the DWH test statistic and the horizontal the sixty-eight commodity groups. Finally, the horizontal line in Figure 5 is the critical value of the χ^2 distribution at k=6 (i.e. 12.59).

[12] Note that the parameter vector b includes $\hat{\alpha}$ and the $\hat{\beta}$ and $\hat{\gamma}$ vectors. Also note, in addition to all the deterministic components in (17), that the instrument set includes a one-year lag of each conditioning variable.

Figure 5 – DWH Test for all Import Equations



Next we report a summary of the *OLS* parameter estimates of (17) in both Figure 6 and Table 1[13]. Figure 6 contains a frequency distribution for α and for each element of the parameter vector β (except for commodity groups 20,36 – for which the errors were non-stationary) and 57 (for which no data are available). As can be seen from Table 1, for the majority of commodity groups the estimates of the GDP coefficient and the import prices coefficient are consistent with standard theoretical priors. In the case of GDP, for about seventy percent of the commodity groups (47 out of 66) the coefficient is positive, whereas for the rest of the commodity groups the coefficient is (statistically) not different from zero. In the case of import prices, for about sixty-two percent of the commodity groups (41 out of 66) the coefficient is negative, whereas there are 3 commodity groups for which the coefficient is positive. In contrast, for the majority of commodity groups (38 out of 66), the volume of imports is not positively affected by "excessive wages" (w^e). The results in Appendix Table 3 show that for 10 groups the estimated value of α_i is negative (and statistically significant) and for 28 groups it is positive (and statistically significant).

[13] Note that the full set of results is reported in the Results Appendix , Table 3.

Figure 6 – Distributions for OLS Parameter Estimates

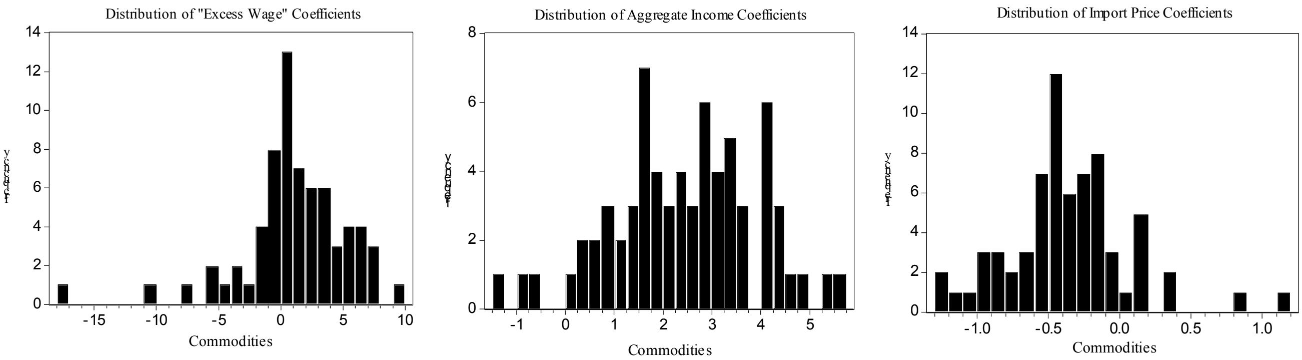


Table 1: Summary Statistics for the Distributions of *OLS* Parameter Estimates

$\partial m_i / \partial w^e = \hat{\alpha}_i$		$\partial m_i / \partial y = \hat{\beta}_{1i}$		$\partial m_i / \partial m_p = \hat{\beta}_{2i}$	
Mean	1.053	Mean	2.465	Mean	-0.341
Median	0.872	Median	2.516	Median	-0.368
Std. Dev.	4.261	Std. Dev.	1.476	Std. Dev.	0.416
# significantly (+)	28	# significantly (+)	47	# significantly (+)	3
% significantly (+)	0.424	% significantly (+)	0.712	% significantly (+)	0.045
# significantly (-)	10	# significantly (-)	0	# significantly (-)	41
% significantly (-)	0.152	% significantly (-)	0.000	% significantly (-)	0.621

According to our theoretical framework, a positive $\hat{\alpha}_i$ implies that the "cost" effect dominates the "income" effect of "excessive wages". This will obviously be the case for homogenous products or for goods in which Japan's *CA* is in low quality varieties. On the other hand, a negative $\hat{\alpha}_i$ implies that the "income" effect dominates the "cost" effect, whereas for the remaining commodities the two effects appear to mostly cancel each other out.

As a further test of our theoretical framework, in Figure 7 and Tables 3 and Appendix Table 4 we show the results of allowing "excessive wages" to affect the volume of imports only through the "income" effect. For this reason, we re- estimate the import volume equations for the 66 commodity groups[14]. In the new equations we

[14] Applying the DWH revealed that in none of the 68 cases, do the *OLS* estimates significantly differ from the *IV* estimates. Moreover applying the stationarity tests to the residuals reveals that none of the 68 cases are spurious.

use the relative price of imported to domestic goods (i.e. competitiveness) to restrict w^e to affect the volume of imports only through the "income" effect. We note through comparison of Tables 1 and 3 that the number of commodity groups with a negative $\hat{\alpha}_i$ has increased to 15 (from 10), whereas the number of commodity groups with a positive $\hat{\alpha}_i$ has decreased to 18 (from 28). These changes are in agreement with our theoretical priors. We expect that when only the "income" effect is allowed to operate the number of commodity groups with a positive $\hat{\alpha}_i$ should decrease. Indeed, our estimation reveals that the set of commodity groups with a positive $\hat{\alpha}_i$ shrinks when only the "income" effect is operating, and – more importantly – it includes only these commodity groups for which $\hat{\alpha}_i$ is positive when both ("income" and "cost") effects are allowed to influence the volume of imports. In the same vein, we expect that when only the "income" effect is allowed to operate, the number of commodity groups with a negative $\hat{\alpha}_i$ will increase. Comparison of Appendix Tables 3 and 4 reveals this to be the case as well. Thus, we can have some confidence that our econometric specification captures the intended interactions.

Figure 7 – Distributions for OLS Parameter Estimates

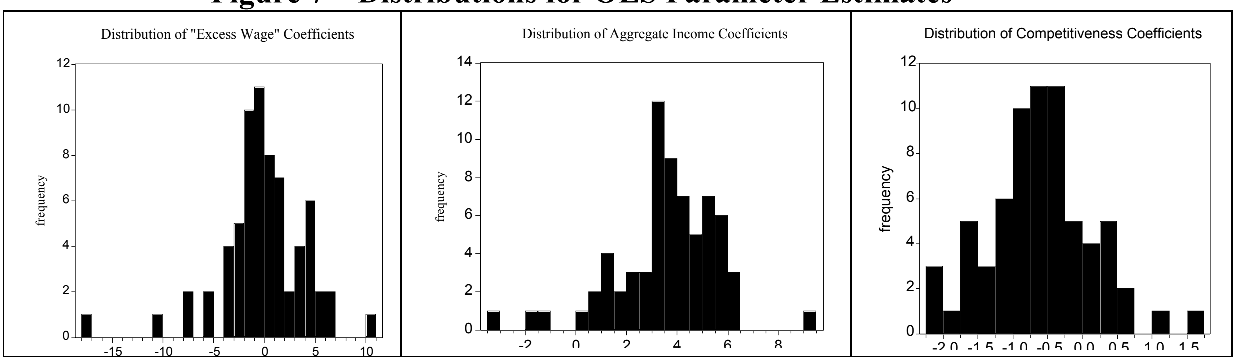


Table 3: Summary Statistics for the Distributions of *OLS* Parameter Estimates

$\partial m_i / \partial w^e = \hat{\alpha}_i$		$\partial m_i / \partial y = \hat{\beta}_{1i}$		$\partial m_i / \partial c = \hat{\beta}_{2i}$	
Mean	0.104	Mean	4.310	Mean	-0.464
Median	-0.294	Median	4.573	Median	-0.433
Std. Dev.	3.78	Std. Dev.	2.759	Std. Dev.	0.586
# significantly (+)	18	# significantly (+)	58	# significantly (+)	2
% significantly (+)	0.265	% significantly (+)	0.853	% significantly (+)	0.029
# significantly (-)	15	# significantly (-)	2	# significantly (-)	39
% significantly (-)	0.221	% significantly (-)	0.029	% significantly (-)	0.574

Given the existence of large differences in the response of the volume of imports to "excessive wages" across the different commodity groups, a natural question to ask is what is the net effect at the aggregate level? To answer this question we use the estimated equations for each commodity group to predict the effects of a one percentage-point increase in w^e on the volume of imports. We then sum over the predicted change in the volume of imports for each commodity group. For example, we find that in response to a one percentage-point increase in w^e, the aggregate volume of imports is expected to increase by about one-hundredth of one percentage point. Additionally, this very small net response of the aggregate volume of imports is found to be not (statistically) different from zero. The aggregate effects thus provide some support for our theoretical framework.

4. Conclusions

In this paper we presented a model of trade in vertically differentiated products. An important result emanating from the structure of this model is that a – *ceteris paribus* – increase in the wage rate of a technologically advanced country may not lead to an increase in the volume of its imports. This prediction was supported by our analysis of Japanese imports of 66 commodity groups. We found that not only there exist some commodities, for which the volume of imports is negatively associated with domestic wages, but that the volume of aggregate imports does not respond to an increase in domestic wages.

Our findings also provide an explanation for the presumed difference in the income elasticity of imports between Japan and the US, first identified by Houthakker and Magee (1969). They found that the US income elasticity of imports exceeded one whereas the Japanese elasticity was smaller than one. If, as argued in section 2.3, Japan is more specialized than the US in the production of high quality varieties, then a – *ceteris paribus* – increase in *per-capita* and aggregate income is expected to result in a higher increase in imports for Japan than the US. Our framework also implies that for technologically advanced countries, an increase in aggregate income, which is associated with an increase in population, and constant *per-capita* incomes will have a larger effect on aggregate imports than one with constant population and higher *per-capita* incomes. This explanation must be considered as complementary to the one advanced by Marquez (2000) who argued that the relaxation of the representative agent assumption (an assumption which is rather untenable for the US given its large influx of immigrants) is part of the solution of the puzzle of the greater than unity income elasticity of US imports.

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6. Data Appendix

The trade data that we employ in this study is from the CHELEM (Harmonized Data for International Trade and the World Economy): Detailed Nomenclatures and Indicators database, July 1997. This data has been collected from various international sources and has been harmonized by the CEPII (Centre D′Études Prospectives Et D′Informations Internationales, Paris). The remaining data is from the OECD Statistical Compendium 1998(2).

Variable	Definition	Source
C	Competitiveness, 1991=100	OECD Economic Outlook
E	Nominal bilateral exchange rate with the dollar Yen/$	CHELEM
M_i	Real imports, $M_i = (MN_i \cdot E) / M_P$	transformation
MN_i	Nominal imports by commodity, $	CHELEM
M_P	Import price deflator, 1990=100	OECD Economic Outlook
P	Index of Productivity, 1991=100	OECD Economic Outlook
W	Real total compensation per employee, 1991=100	OECD Economic Outlook
Y	Real GDP, 1990 prices	OECD National Accounts

List of Goods in CHELEM

1	Cement & derived products	36	Cars (inc. motorcycles)
2	Ceramics (inc. manuf. Mineral articles)	37	Commercial vehicles & transport equip.
3	Glass (flatware & hollow-ware)	38	Ships (inc. oil rigs)
4	Iron & steel (inc. pig iron & sheet steel)	39	Aeronautics
5	Tubes & first stage processing products	40	Basic inorganic chemicals
6	Non-ferrous metals	41	Fertilisers
7	Yarns & fabrics	42	Basic organic chemicals
8	Clothing (with fabrics as the main input)	43	Paints, colourings & inter. Chem. Products
9	Knitwear (made directly from yarns)	44	Toilet products, soaps & perfumes
10	Carpets & textile furnishings	45	Pharmaceuticals
11	Leather furskins & footwear	46	Plastics, fibers & synthetic resins
12	Articles in wood	47	Plastic articles
13	Furniture (made of wood or other materials)	48	Rubber articles (inc. tyres)
14	Paper & pulp	49	Iron ores & scrap
15	Printing & publications	50	Non-ferrous ores & scrap
16	Toys, sports equip. & misc. manuf. Articles	51	Unprocessed minerals
17	Large metallic structures	52	Coal (inc. lignite & other prim. energy)
18	Miscellaneous hardware	53	Crude oil
19	Engines, turbines & pumps	54	Natural gas (inc. all petroleum gases)
20	Agricultural equipment	55	Coke
21	Machine tools	56	Refined petroleum products
22	Construction & public works equipment	57	Electricity [not reported for Japan]
23	Specialised machines	58	Cereals
24	Arms & weaponry	59	Other edible agricultural products
25	Precision instruments	60	Non-edible agricultural products
26	Watch & clockmaking	61	Cereal products
27	Optics & photo- & cinema-graphic equip.	62	Fats (of vegetable or animal origin)
28	Electronic components	63	Meat and fish
29	Consumer electronics	64	Preserved meat & fish products
30	Telecommunications equipment	65	Preserved fruit & vegetable products
31	Computer equip. (inc. office equip.)	66	Sugar products (inc. chocolate)
32	Domestic electrical appliances	67	Animal products
33	Heavy electrical equip.	68	Beverages
34	Electrical apparatus (inc. passive devices)	69	Manufactured tobaccos
35	Vehicle components		

7. Results Appendix

Table 1: Univariate Unit Root Tests I

		P-Values					
	Dependent Varibles				*Dependent Variables*		
	WS	**DF**	**PP**		**WS**	**DF**	**PP**
m1	0.99	0.62	0.84	*m40*	1.00	0.63	0.83
m2	1.00	0.96	0.94	*m41*	0.99	0.87	0.83
m3	1.00	0.98	0.92	*m42*	1.00	0.94	0.96
m4	0.89	0.94	0.89	*m43*	0.96	0.83	0.85
m5	0.99	0.94	0.94	*m44*	0.99	0.97	0.89
m6	0.82	0.83	0.51	*m45*	1.00	0.94	0.86
m7	0.97	0.22	0.44	*m46*	0.84	0.90	0.87
m8	1.00	0.82	0.86	*m47*	1.00	0.84	0.87
m9	1.00	0.77	0.86	*m48*	1.00	0.61	0.84
m10	1.00	0.86	0.87	*m49*	0.74	0.82	0.82
m11	1.00	0.73	0.88	*m50*	0.07	0.20	0.13
m12	0.71	0.72	0.73	*m51*	0.57	0.40	0.33
m13	1.00	0.52	0.84	*m52*	0.98	**0.00**	0.20
m14	0.99	0.90	0.84	*m53*	0.86	0.07	0.45
m15	0.98	0.98	0.85	*m54*	0.98	**0.02**	0.74
m16	0.99	0.94	0.89	*m55*	0.36	0.57	0.30
m17	0.99	0.94	0.95	*m56*	0.97	0.15	0.34
m18	1.00	0.98	0.94	*m58*	0.34	0.51	0.24
m19	1.00	0.99	0.99	*m59*	0.80	0.10	0.30
m20	0.19	0.45	0.39	*m60*	0.10	0.25	0.11
m21	0.34	0.59	0.43	*m61*	0.99	0.14	0.39
m22	0.98	0.80	0.44	*m62*	0.76	0.83	0.57
m23	0.93	0.82	0.68	*m63*	1.00	0.66	0.80
m24	0.90	0.73	0.56	*m64*	1.00	0.64	0.81
m25	1.00	0.98	0.95	*m65*	1.00	0.93	0.86
m26	0.99	0.98	0.94	*m66*	0.51	0.72	0.73
m27	1.00	0.98	0.88	*m67*	0.99	0.96	0.68
m28	1.00	0.99	0.96	*m68*	1.00	0.57	0.81
m29	1.00	0.99	1.00	*m69*	0.97	0.96	0.97
m30	1.00	0.99	1.00				
					Conditioning Variables		
m31	1.00	1.00	1.00				
m32	1.00	0.92	0.92	w	1.00	0.18	0.61
m33	1.00	0.99	0.99	p	1.00	0.24	0.74
m34	1.00	0.99	0.97	w^e	0.22	0.23	0.54
m35	0.99	0.99	0.98	y	1.00	0.44	0.80
m36	0.99	0.96	0.96	m_p	0.75	0.35	0.54
m37	0.97	0.84	0.86	c	0.33	0.59	0.37
m38	0.09	**0.00**	**0.05**				
m39	0.86	0.61	0.42				

Notes: (i) **WS**, **DF** and **PP** stand for the Weighted Symmetric τ, Dickey-Fuller and Phillips-Perron tests respectively; (ii) the above results include a *constant* term; (iii) a maximum of two augmenting lags was employed to represent the **AR** process generating the individual time-series; (iv) the **AIC** information criterion was used to choose the optimal lag length; (v) **bold** highlighting indicates significance at the 5% level of less (i.e. reject Ho: of a unit root).

Table 2: Univariate Unit Root Tests II

		P-Values					
	Dependent Varibles				*Dependent Variables*		
	WS	**DF**	**PP**		**WS**	**DF**	**PP**
m1	0.37	0.24	0.51	*m40*	0.57	0.87	0.35
m2	0.74	0.82	0.77	*m41*	0.53	0.71	0.61
m3	0.68	0.71	0.62	*m42*	0.19	0.60	0.17
m4	0.96	0.35	0.59	*m43*	0.68	0.81	0.80
m5	0.47	0.47	0.71	*m44*	0.18	0.37	0.25
m6	0.49	0.51	0.40	*m45*	0.50	0.49	0.55
m7	0.29	0.15	0.37	*m46*	0.72	0.30	0.68
m8	0.70	0.65	0.64	*m47*	0.11	0.29	0.22
m9	0.58	0.47	0.59	*m48*	0.42	0.16	0.43
m10	0.53	0.67	0.55	*m49*	0.19	0.01	0.36
m11	0.47	0.32	0.53	*m50*	0.38	0.42	0.41
m12	0.72	0.85	0.91	*m51*	0.47	0.57	0.64
m13	0.83	0.15	0.64	*m52*	0.91	**0.00**	0.59
m14	**0.04**	0.15	0.21	*m53*	0.94	0.41	0.92
m15	0.88	0.93	0.86	*m54*	0.99	0.85	0.99
m16	0.62	0.68	0.76	*m55*	0.76	0.79	0.69
m17	0.67	0.78	0.67	*m56*	0.95	0.96	0.45
m18	0.78	0.85	0.82	*m58*	0.68	0.13	0.43
m19	0.93	0.96	0.97	*m59*	0.21	0.07	0.42
m20	0.50	0.67	0.74	*m60*	0.45	0.58	0.40
m21	0.65	0.72	0.81	*m61*	0.79	0.06	0.59
m22	0.56	0.74	0.35	*m62*	0.84	0.93	0.67
m23	0.54	0.70	0.78	*m63*	0.29	0.17	0.33
m24	0.47	0.66	0.42	*m64*	0.47	0.20	0.42
m25	0.73	0.70	0.73	*m65*	0.49	0.45	0.33
m26	0.82	0.86	0.88	*m66*	0.80	0.46	0.63
m27	0.95	0.91	0.69	*m67*	0.83	0.95	0.53
m28	0.88	0.97	0.74	*m68*	0.76	0.17	0.65
m29	0.88	0.89	0.96	*m69*	0.90	0.69	0.89
m30	0.97	0.97	0.99				
					Conditioning Variables		
m31	0.99	0.99	1.00				
m32	0.84	0.70	0.85	w	1.00	0.06	0.85
m33	0.85	0.98	0.81	p	1.00	0.31	0.70
m34	0.83	0.96	0.83	w^e	0.71	0.14	0.90
m35	0.92	0.81	0.91	y	1.00	0.39	0.59
m36	0.81	0.82	0.82	m_p	0.92	0.93	0.96
m37	0.20	0.36	0.38	c	**0.02**	0.09	0.25
m38	0.17	0.08	0.17				
m39	0.22	0.41	0.38				

Notes: (i) **WS**, **DF** and **PP** stand for the Weighted Symmetric τ, Dickey-Fuller and Phillips-Perron tests respectively; (ii) the above results include a *constant* and *time-trend* terms; (iii) a maximum of two augmenting lags was employed to represent the **AR** process generating the individual time-series; (iv) the **AIC** information criterion was used to choose the optimal lag length; (v) **bold** highlighting indicates significance at the 5% level of less (i.e. reject Ho: of a unit root).

Table 3: Detailed results for equation (17)

Good	Average M_i/M	$\hat{\alpha}_i$	T-stat. $\hat{\alpha}_i$	$\hat{\beta}_{1i}$	T-stat. $\hat{\beta}_{1i}$	$\hat{\beta}_{2i}$	T-stat. $\hat{\beta}_{2i}$	Durbin Watson Test	$\overline{R}^2$
1	0.002	1.38	1.04	2.13	1.37	-1.23	-5.81	1.02	0.97
2	0.001	1.23	1.54	3.53	6.07	-0.37	-4.51	1.63	0.98
3	0.002	-1.55	-1.79	2.06	3.57	-0.42	-2.92	1.06	0.97
4	0.012	-10.01	-5.15	0.88	0.63	0.13	0.45	1.78	0.87
5	0.001	0.68	0.41	1.43	1.25	-0.62	-1.91	0.87	0.91
6	0.037	-3.14	-2.82	3.00	2.88	-0.12	-0.58	1.23	0.73
7	0.013	2.80	3.15	2.32	2.09	-0.82	-5.86	1.55	0.88
8	0.011	7.12	5.40	4.03	4.56	-0.49	-2.45	1.35	0.97
9	0.010	5.56	5.36	2.44	2.93	-1.03	-5.87	2.05	0.98
10	0.003	6.20	4.85	1.72	1.61	-0.78	-4.16	1.45	0.94
11	0.011	3.68	4.31	1.81	1.98	-0.65	-4.21	0.92	0.98
12	0.006	9.61	3.91	5.37	3.12	-1.18	-2.50	1.11	0.82
13	0.003	6.47	7.08	3.07	3.19	-0.58	-3.73	1.34	0.99
14	0.012	0.05	0.03	1.06	1.59	-0.23	-1.20	1.36	0.86
15	0.002	-0.10	-0.12	3.18	4.47	-0.36	-2.60	1.68	0.90
16	0.015	0.65	1.33	3.09	6.30	-0.78	-6.58	1.88	0.98
17	0.001	4.41	2.41	4.01	2.46	-0.12	-0.34	1.08	0.93
18	0.009	0.21	0.38	3.05	9.75	-0.26	-3.47	1.71	0.98
19	0.009	0.44	1.04	2.73	8.10	-0.17	-1.94	1.60	0.97
20	0.001	3.02	2.66	2.65	2.29	-0.86	-3.04	0.68	0.67
21	0.005	-7.16	-4.88	5.75	6.20	-0.01	-0.03	1.84	0.81
22	0.002	0.60	0.58	4.68	6.20	0.37	2.17	1.85	0.78
23	0.011	-1.53	-1.97	4.34	9.48	-0.48	-4.65	1.67	0.94
24	0.001	-17.64	-2.92	-0.89	-0.18	0.32	0.26	1.41	0.77
25	0.011	-0.60	-1.45	1.73	5.60	-0.45	-7.70	1.49	0.99
26	0.003	2.28	2.83	3.37	5.23	-0.54	-3.33	0.81	0.96
27	0.003	4.64	6.55	3.51	7.51	-0.28	-2.34	0.97	0.98
28	0.010	1.92	1.76	4.17	4.92	-0.22	-1.87	1.55	0.98
29	0.003	5.83	4.69	0.40	0.39	-0.94	-3.35	0.89	0.95
30	0.006	2.47	4.04	1.52	2.88	-0.58	-7.24	1.85	0.99
31	0.017	0.13	0.14	3.44	5.83	-0.43	-3.50	1.20	0.97
32	0.002	7.31	9.16	4.10	5.94	-0.70	-5.23	1.45	0.98
33	0.003	1.76	2.09	3.70	4.00	-0.03	-0.35	2.06	0.98
34	0.009	0.04	0.05	3.36	5.24	-0.22	-2.40	2.02	0.98
35	0.002	-0.50	-0.63	1.49	1.71	-0.56	-3.23	1.11	0.97
36	0.011	3.86	2.55	1.56	1.06	-1.30	-4.52	0.76	0.95
37	0.001	-4.59	-2.79	4.01	3.34	-0.45	-2.25	1.77	0.93
38	0.002	-2.65	-1.05	2.57	1.15	-0.12	-0.22	1.95	0.30
39	0.016	-5.09	-2.75	4.20	3.71	-0.32	-1.26	1.87	0.80
40	0.009	-3.01	-4.25	0.81	1.25	-0.23	-1.77	1.68	0.96
41	0.003	-0.57	-0.96	0.72	2.35	-0.30	-3.35	1.75	0.90
42	0.017	-1.18	-1.20	0.13	0.25	-0.30	-2.47	2.00	0.96
43	0.005	0.75	1.03	3.35	6.06	-0.57	-6.82	2.27	0.96
44	0.007	-1.74	-2.09	1.86	3.38	0.18	0.92	1.65	0.86
45	0.011	0.04	0.11	1.91	5.30	-0.49	-6.89	1.96	0.99
46	0.001	-5.25	-3.91	-1.25	-1.78	-0.45	-2.43	1.36	0.88

Table 3: continued

Good	Average M_i/M	$\hat{\alpha}_i$	T-stat. $\hat{\alpha}_i$	$\hat{\beta}_{1i}$	T-stat. $\hat{\beta}_{1i}$	$\hat{\beta}_{2i}$	T-stat. $\hat{\beta}_{2i}$	Durbin Watson Test	$\overline{R}^2$
47	0.007	-0.12	-0.09	1.70	2.31	-0.46	-3.55	1.74	0.95
48	0.002	1.47	1.18	1.92	2.54	-0.49	-2.84	1.13	0.97
49	0.035	0.18	0.35	2.92	6.21	0.01	0.13	1.37	0.91
50	0.034	0.14	0.15	4.28	6.09	-0.04	-0.25	1.25	0.56
51	0.010	-0.21	-0.38	2.95	7.69	-0.17	-1.80	1.47	0.81
52	0.036	3.35	4.31	2.83	3.69	0.11	0.81	1.20	0.85
53	0.205	6.58	9.72	2.46	4.65	1.16	7.61	1.20	0.96
54	0.036	1.75	2.48	-0.67	-1.03	0.84	5.11	1.48	0.99
55	0.000	3.75	0.86	2.80	0.81	-0.14	-0.18	1.12	0.44
56	0.042	-0.76	-0.60	1.35	1.53	0.18	0.98	1.86	0.76
58	0.036	3.59	5.32	1.69	3.02	0.17	1.39	2.03	0.69
59	0.040	2.61	5.14	0.49	1.27	-0.51	-6.89	1.85	0.88
60	0.097	1.37	1.70	2.08	3.25	-0.50	-3.49	1.63	0.63
61	0.002	6.10	10.17	4.48	9.08	-0.35	-3.57	1.86	0.96
62	0.005	4.18	4.89	1.59	1.70	-0.17	-1.11	1.74	0.76
63	0.048	2.95	3.87	0.79	1.22	-0.89	-9.12	2.08	0.98
64	0.006	5.01	6.35	0.57	0.94	-0.93	-7.92	1.86	0.97
65	0.006	2.45	3.90	1.18	3.24	-0.56	-6.16	1.48	0.99
66	0.011	7.17	5.27	3.34	3.60	-0.11	-0.48	1.46	0.86
67	0.006	0.99	0.77	2.78	4.16	-0.48	-2.75	2.10	0.86
68	0.004	5.30	5.10	4.99	4.56	-0.34	-1.83	0.89	0.97
69	0.002	-0.24	-0.13	2.26	1.38	-0.94	-2.92	0.83	0.96

Notes: Heteroscedastic consistent standard errors are used to calculate the t-statistics.

Table 4: Detailed results for equation (17) using competitiveness instead of import prices

Good	Average M_i/M	$\hat{\alpha}_i$	T-stat. $\hat{\alpha}_i$	$\hat{\beta}_{1i}$	T-stat. $\hat{\beta}_{1i}$	$\hat{\beta}_{2i}$	T-stat. $\hat{\beta}_{2i}$	Durbin Watson Test	$\overline{R}^2$
1	0.002	-3.10	-2.23	8.96	7.01	-1.75	-5.63	1.91	0.97
2	0.001	0.00	0.00	5.47	11.52	-0.46	-3.95	1.76	0.98
3	0.002	-3.04	-3.72	4.35	8.22	-0.57	-2.95	1.25	0.97
4	0.012	-10.39	-4.81	1.04	0.69	-0.29	-0.93	1.84	0.87
5	0.001	-1.54	-0.77	4.83	2.97	-0.86	-2.00	1.08	0.91
6	0.037	-4.05	-2.94	4.17	4.87	-0.43	-1.82	1.39	0.75
7	0.013	-0.23	-0.27	6.93	5.90	-1.19	-5.03	1.96	0.90
8	0.011	4.49	3.39	7.63	7.54	-1.17	-5.34	2.08	0.98
9	0.010	2.16	1.83	7.80	10.38	-1.26	-5.05	2.21	0.98
10	0.003	2.82	2.26	6.61	6.89	-1.41	-6.36	2.36	0.96
11	0.011	1.00	1.34	5.75	8.26	-1.10	-6.51	1.74	0.99
12	0.006	5.52	2.38	11.70	11.16	-1.56	-3.24	1.11	0.83
13	0.003	4.09	4.63	6.56	7.29	-0.97	-4.40	1.97	0.99
14	0.012	-1.12	-0.73	2.69	4.41	-0.51	-2.55	1.54	0.87
15	0.002	-1.17	-1.88	4.94	6.77	-0.38	-1.51	1.71	0.89
16	0.015	-1.12	-1.39	6.29	6.91	-0.51	-2.37	1.58	0.96
17	0.001	3.86	2.22	4.79	2.86	-0.24	-0.56	1.12	0.93
18	0.009	-0.59	-1.02	4.35	13.43	-0.29	-3.06	1.82	0.98
19	0.009	0.07	0.18	3.41	8.67	-0.10	-0.90	1.63	0.97
20	0.001	-0.03	-0.03	7.33	4.83	-1.17	-3.23	1.15	0.68
21	0.005	-7.29	-4.45	5.90	6.25	-0.07	-0.34	1.84	0.81
22	0.002	1.93	2.07	2.64	3.41	0.52	2.26	1.96	0.79
23	0.011	-2.92	-3.83	6.63	16.02	-0.49	-3.92	1.49	0.93
24	0.001	-15.50	-2.78	-3.67	-1.38	1.00	0.81	1.43	0.78
25	0.011	-1.70	-2.80	3.68	11.46	-0.34	-2.63	1.36	0.98
26	0.003	0.46	0.64	6.22	8.35	-0.68	-2.94	1.16	0.96
27	0.003	3.96	5.12	4.71	12.62	-0.21	-1.78	0.95	0.98
28	0.010	1.81	1.61	4.68	6.26	0.07	0.37	1.49	0.98
29	0.003	2.53	1.72	5.49	3.78	-1.27	-3.06	1.37	0.95
30	0.006	0.67	1.14	4.42	6.62	-0.65	-4.42	1.45	0.99
31	0.017	-0.69	-0.69	5.06	9.86	-0.19	-0.97	0.88	0.97
32	0.002	5.32	5.34	7.41	10.41	-0.69	-2.90	1.28	0.98
33	0.003	1.80	2.06	3.72	4.60	0.04	0.18	2.05	0.98
34	0.009	-0.36	-0.44	4.16	9.32	-0.09	-0.61	1.74	0.98
35	0.002	-1.59	-2.10	3.61	3.37	-0.27	-1.02	1.07	0.97
36	0.011	-0.66	-0.50	8.55	6.28	-1.74	-4.93	1.33	0.95
37	0.001	-5.97	-3.85	6.24	5.81	-0.50	-1.77	1.82	0.93
38	0.002	-2.61	-1.06	2.74	1.19	0.10	0.14	1.98	0.30
39	0.016	-5.21	-2.67	4.88	3.47	0.13	0.40	1.84	0.79
40	0.009	-3.47	-4.60	1.70	1.64	-0.12	-0.60	1.56	0.96
41	0.003	-1.35	-2.04	2.07	5.69	-0.25	-2.11	1.66	0.88
42	0.017	-2.28	-2.18	1.81	4.00	-0.43	-3.15	2.05	0.96
43	0.005	-0.93	-1.17	6.11	12.10	-0.59	-3.44	1.88	0.94
44	0.007	-1.35	-1.49	1.14	1.35	0.11	0.44	1.59	0.86
45	0.011	-1.09	-1.94	3.95	9.61	-0.34	-2.33	1.37	0.97
46	0.001	-6.82	-4.84	1.18	2.30	-0.61	-3.00	1.35	0.88

Table 4: continued

Good	**Average M_i/M**	$\hat{\alpha}_i$	**T-stat.** $\hat{\alpha}_i$	$\hat{\beta}_{1i}$	**T-stat.** $\hat{\beta}_{1i}$	$\hat{\beta}_{2i}$	**T-stat.** $\hat{\beta}_{2i}$	**Durbin Watson Test**	$\bar{R}^2$
47	0.007	-1.99	-1.46	4.46	5.51	-0.76	-4.45	1.97	0.96
48	0.002	-0.78	-0.70	5.13	7.48	-0.96	-5.99	1.76	0.98
49	0.035	0.73	1.94	2.32	7.78	0.30	2.37	1.59	0.93
50	0.034	-0.47	-0.41	5.00	7.39	-0.31	-1.59	1.40	0.59
51	0.010	-0.62	-1.10	3.67	7.02	-0.13	-1.05	1.34	0.80
52	0.036	4.21	6.55	1.74	2.74	0.41	2.55	1.45	0.87
53	0.205	9.72	8.81	-2.86	-6.41	1.05	3.57	1.26	0.91
54	0.036	4.10	5.21	-4.60	-9.22	0.80	3.43	1.58	0.99
55	0.000	3.10	0.62	3.73	0.87	-0.28	-0.28	1.13	0.44
56	0.042	-0.51	-0.37	0.77	0.91	0.03	0.15	1.94	0.75
58	0.036	3.83	5.11	1.15	1.81	0.03	0.19	1.99	0.67
59	0.040	1.32	2.03	2.73	7.67	-0.40	-3.66	1.13	0.79
60	0.097	-0.52	-0.55	4.92	10.99	-0.75	-5.78	1.95	0.69
61	0.002	5.02	10.14	6.22	10.94	-0.39	-2.50	1.87	0.96
62	0.005	3.21	3.09	2.90	3.74	-0.43	-2.25	2.06	0.79
63	0.048	0.37	0.33	5.03	8.87	-0.90	-4.77	2.29	0.97
64	0.006	1.81	1.86	5.55	11.91	-1.22	-9.35	1.92	0.98
65	0.006	0.90	1.20	3.77	9.28	-0.52	-3.03	1.55	0.98
66	0.011	6.48	4.48	4.26	3.22	-0.32	-1.07	1.55	0.86
67	0.006	-0.79	-0.57	5.49	7.14	-0.70	-4.04	2.07	0.87
68	0.004	3.44	4.11	7.53	9.40	-0.84	-5.17	1.46	0.98
69	0.002	-3.24	-1.58	7.05	4.71	-1.10	-2.63	1.30	0.96

Notes: Heteroscedastic consistent standard errors are used to calculate the t-statistics.