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VERTICAL PRODUCT DIFFERENTIATION AND THE IMPORT DEMAND FUNCTION: THEORY AND EVIDENCE

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Abstract

In this paper we use a model of vertical product differentiation to cast doubt on the general validity of the import demand function as specified in macroeconomic models. The empirical importance of our theoretical concerns is then examined with the aid of two hypotheses. According to the first hypothesis, an increase in domestic wages is expected to reduce the share in total imports for goods in which the domestic comparative advantage is in high quality varieties of these goods. The second hypothesis states that an increase in non-wage income will increase the share of a good's imports if the country has comparative advantage in high quality varieties of this good. We find considerable empirical support for both hypotheses in the data for Germany, Japan and the United States.

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1. Introduction

If the question "what will be the effect of a *manna-from-heaven* increase in national income on the volume of a small country's imports was posed, economists schooled in the Mundell-Fleming (M-F) tradition (see Mundell (1963) and Fleming (1962)) would not hesitate before answering that the volume of imports would be expected to increase[1]. It is the purpose of this paper first to argue that the answer to the above question is not generally valid and second, to present some evidence in this regard[2]. This is an important endeavour as the "imperfect substitutes" model remains the chief work-horse of applied trade balance analysis (see Hooper and Marquez (1995) and Krugman (1995)).

Our argument is based on the idea that (household) income determines the quality of goods demanded. Linder (1961) was the first to draw a sharp distinction between trade in primary goods and trade in manufacturing products. For the latter he argued that the principal determinant of the distribution of demand between high and low quality varieties would be the level of *per capita* income. Households with high incomes would not only consume more cars, for example, but also higher quality cars. With these in mind consider now a country trading in a single vertically (according to quality) differentiated product with the rest of the world (ROW)[3].

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[1] In contrast, proponents of the intertemporal approach to the current account (see, Obstfeld and Rogoff (1996) for an extensive coverage of this approach), would predict an improvement in the current account (at least if the increase in income was temporary).

[2] Benavie (1973) has also raised a concern regarding the specification of the income argument in the import demand function. Within the framework of a Keynesian 45-degree model he argued that final sales instead of GNP should be the "income" argument in the import demand function. An earlier concern regarding the relationship between the terms of trade and the current account relates to the Laursen-Metzler-Harberger (L-M-H) effect (see, Laursen and Metzler (1950) and Harberger (1950)) according to which a decrease in the terms of trade will decrease the amount saved out of a given domestic income and therefore reduce the external surplus. However, modern analysis of the L-M-H effect (see, Obstfeld (1982) and Svensson and Razin (1983)) has weakened its generality.

[3] Falvey (1981) was the first to construct an explicit model of trade in vertically differentiated products. Another notable contribution is Flam and Helpman (1987). In the meantime, a considerable body of evidence has accumulated which testifies to the importance of vertical intra-industry trade (see, for example, Greenaway Hine and Milner (1995) and Greenaway and Trostensson (1998)). They conclude for that the U.K. and Sweden vertical intra-industry trade is quantitatively more important than horizontal intra-industry trade.

Assume also that this country (the domestic one) has an absolute advantage *vis-a-vis* the ROW in the production of all quality levels (varieties) and comparative advantage (*CA*) in high quality varieties of the differentiated product. In other words, we assume that the country is technologically advanced. This implies that the domestic country will be producing and exporting high quality varieties of the differentiated product, and it will be importing low quality varieties from the ROW. A *manna-from-heaven* increase in the incomes of domestic households will induce them to demand higher quality varieties. The resulting switch in demand towards varieties in which the domestic country has *CA* may well result in a reduction in the volume of imports.

It is clear that to be able to test the implications of our theoretical framework we must find an empirical analogue to the *manna-from-heaven* increase in household income assumed earlier. We now explain why wage changes can play this role. In our basic model (presented in section 2.1) the domestic country is assumed to trade with the ROW in a single vertically differentiated product and to have absolute advantage at all quality levels and *CA* at high quality varieties[4,5]. In this setting, the ratio of domestic to foreign wages determines the "dividing" quality level; all varieties with quality up to the "dividing" quality level will be produced at lower

[4] Our model draws on Flam and Helpman's (1987) application of vertical product differentiation to North-South trade. There is, however, one difference (amongst others) between their model and ours which we wish to highlight. They assume that production of the differentiated product requires only the use of labour; we assume that in addition to labour, production of the differentiated good requires the use of an imported intermediate input. This assumption allows us to translate nominal wage changes in the domestic country to real wage changes.

[5] An important characteristic of the model in this paper is that although it addresses a macroeconomic issue, the concept of *CA* is explicitly taken into account. We must, nevertheless, state at this point that we do not aim for a general equilibrium integration of open economy macroeconomics with the pure theory of international trade as suggested by Krugman (1995). Dornbusch, Fischer and Samuelson (1977) have expertly accomplished this in their integration of a Ricardian trade model with a macroeconomic model. The work of Dixon (1994, especially section 7) is also another rare general equilibrium attempt at integrating the imperfect competition strand of modern macroeconomics (see, Dixon and Rankin (1994) for a survey) with the partial equilibrium version of the "new trade theory" (see, Brander (1995) for a survey of this work). However, Dixon's approach remains rooted in the tradition of open economy macroeconomics in that the concept of CA is not explicitly taken into account in his models.

cost by ROW firms, and the remaining varieties will be produced at lower cost by domestic firms[6]. An increase in domestic wages reduces the range of varieties, which the domestic country can offer at lower cost than the ROW. This is expected - *ceteris paribus* - to increase imports of the domestic country. We term this effect the *cost* effect. But the increase in domestic wages (and hence - as explained later in Section 2.1 - household incomes), also induces domestic households to demand higher quality varieties than before, i.e. there is a shift in demand towards varieties in which the domestic country has *CA*. This second effect has hitherto been ignored. We term this, the *income* effect and we use it as the empirical analogue of a *manna-from-heaven* increase in household incomes.

What the previous paragraph makes clear is that the *income* effect can be either positive or negative. If the domestic country has *CA* in high quality varieties, the *income* effect is negative (i.e., an increase in wages results in a reduction in the volume of imports), whereas it is positive if the domestic country has *CA* in low quality varieties. This should be contrasted with the "income" effect in the Mundell-Fleming model in which an increase in national income is always expected to result in a higher volume of imports (i.e. the "income" effect is positive)[7]. In any case, even in our very simplified case of trade in a simple differentiated product, whether the volume of imports is positively or negatively affected by wage changes depends not only on the sign of the *income* effect but also on its strength relative to the *cost* effect. It is therefore clear that we must introduce more structure (realism) into the model to derive testable hypotheses regarding the presence of *income* effects.

[6] There is a close correspondence between the "dividing" quality level in our paper and the "dividing" good in Dornbusch, Fischer and Samuelson's (1977) presentation of the Ricardian model with a continuum of goods.

[7] In the Mundell-Fleming model the "income" effect is positive independently of whether an increase in national income comes about through an increase in the number of households (with household income being constant) or through an increase in household incomes (with the number of households being

This is accomplished in Section 2.2 in which the domestic country is assumed to produce and trade with the ROW a large number of vertically differentiated products. For a subset of these products the domestic country is assumed to have *CA* in high quality varieties, whereas for the rest of the products the *CA* lies in low quality varieties. An increase in domestic wages (and hence household incomes) will reduce the range of varieties that the domestic country can offer at lower cost than the ROW for all products, (i.e. the *cost effect* will be working in the same direction for all products). However, the *income* effect will not work in the same direction for all products. For the subset of products in which the domestic *CA* lies in high quality goods, the *income* effect will be working in opposite direction to the standard import expansion effect due to higher wages (i.e. due to the *cost* effect). For the rest of the products, the *income* effect will be reinforcing the standard import expansion effect, since higher wages (incomes) shift demand towards varieties in which the domestic country has a comparative disadvantage. An increase in domestic wages is thus expected to decrease (increase) the share of a good's imports in total imports if the country has a *CA* in high (low) quality varieties of this good (*hypothesis I*). This hypothesis is based on the differential impact of the *income* effect, depending on whether the country has *CA* in low quality or high quality varieties.

In Section 2.3 we develop a second hypothesis regarding the effects of non-wage income on commodity import shares. According to this hypothesis, a rise in non-wage income is expected to increase (decrease) the share (in total imports) of those goods imports in which the country has a *CA* in high (low) quality varieties of these goods (*hypothesis II*). Again, the

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constant). In our framework, only in the first case we would definitely expect an increase in the volume of imports.

differential impact of the *income* effect (and assumptions about how the non-wage income is distributed across households) is instrumental for generating *hypothesis II.*

In Section 3 we test the above hypotheses for Germany, Japan and the United States using detailed trade (i.e. for 69 goods) data. Our strategy relies on estimating how changes in real wage rates and non-wage income, separately affect commodity import shares. We then relate the estimated real wage and non-wage coefficients to measures of revealed CA. Given that the bulk of demand by households in the G-3 will be on high quality products, measures of revealed CA will (in most cases) be closely associated with CA in high quality varieties. Based on the strong empirical support that we find for our hypotheses, we conclude in the final section of the paper with some implications regarding the specification of the "income" and the "real exchange rate" arguments in standard-aggregate import demand equations.

2. The Model and its Implications

2.1 The Basic Model

We start this section by first presenting a basic model in which the domestic country trades with the rest of world (ROW) in a single vertically differentiated product. 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 composition of imports, we treat domestic (and ROW) wages as exogenous.

2.1.1 Technology

We begin by assuming that there are two goods produced in the domestic country: a homogeneous non-traded good and a quality-differentiated product, which 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). For simplicity, and without any loss of generality, we assume that the homogeneous good is produced with Leontief technology[8]:

$$H = \min\{bL, bS\}. \tag{1}$$

Perfect competition ensures that

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

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 b is a positive parameter.

The quality-differentiated good is also produced under perfectly competitive conditions[9]. 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

$$Y_Q = \min\left\{\frac{L}{gQ^e}, \frac{S}{gQ^e}\right\}, \ e \geq 1, \ g > 0 \tag{3}$$

where Y_Q denotes the number of units of quality Q produced in the domestic country and e and g 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

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

[9] Greenaway, Hine and Milner (1995) present evidence which suggests that models with a large numbers of firms explain better the presence of vertical intra-industry trade.

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

$$P(Q) = gQ^{e}(W + P_{S}) . \tag{4}$$

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),

$$Y_{Q}^{*} = \min\left\{\frac{L^{*}}{dQ^{m}}, \frac{S}{dQ^{m}}\right\}, \;\; d > 0,\; m > 1,\; m > e,\; d > g \;. \tag{5}$$

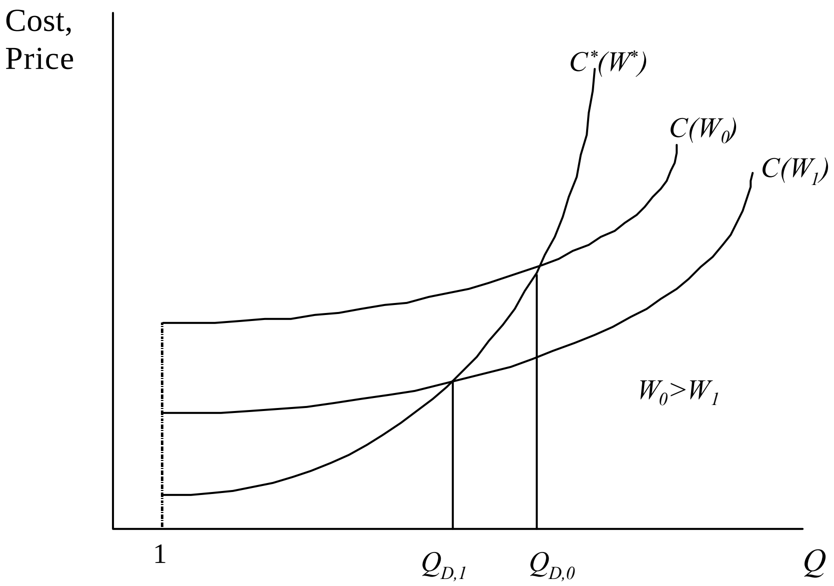
According to equation (5), the price at which each unit of quality Q, will be offered by ROW producers is equal to

$$P^{*}(Q) = dQ^{m}(W^{*} + P_{S}) . \tag{6}$$

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.

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.

Figure 1: The relationship between quality and cost



2.1.2 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 equiproportional changes in household income and total compensation per employee. There are however, differences in skill between households (both within and across regions) which are reflected in differences in the endowment of effective labour supply. This is in turn reflected in differences in income across households. 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 in then defined as $E_l = K_l W; E_m = K_m W; E_h = K_h W$ 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 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 (the subscripts denoting income classes have been dropped for convenience). 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.

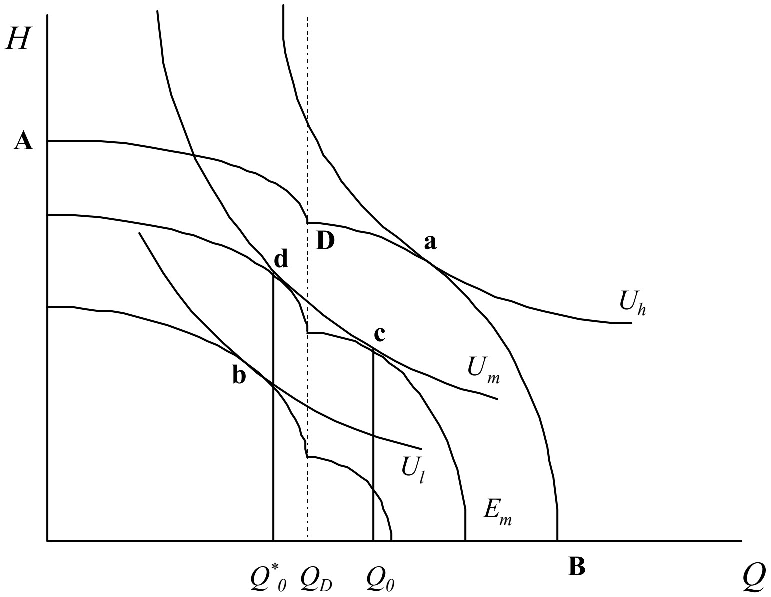
The free-trade price of each quality (variety) of the differentiated product will be equal to the lower cost of producing in the two regions:

$$P(Q) = \min\{gQ^e(W + P_S), dQ^m(W^* + P_S)\} .$$

(8)

Equation (8) implies that the budget constraint is non-differentiable 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[10]. The budget constraint is non-differentiable 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 maximise its utility by consuming an imported

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

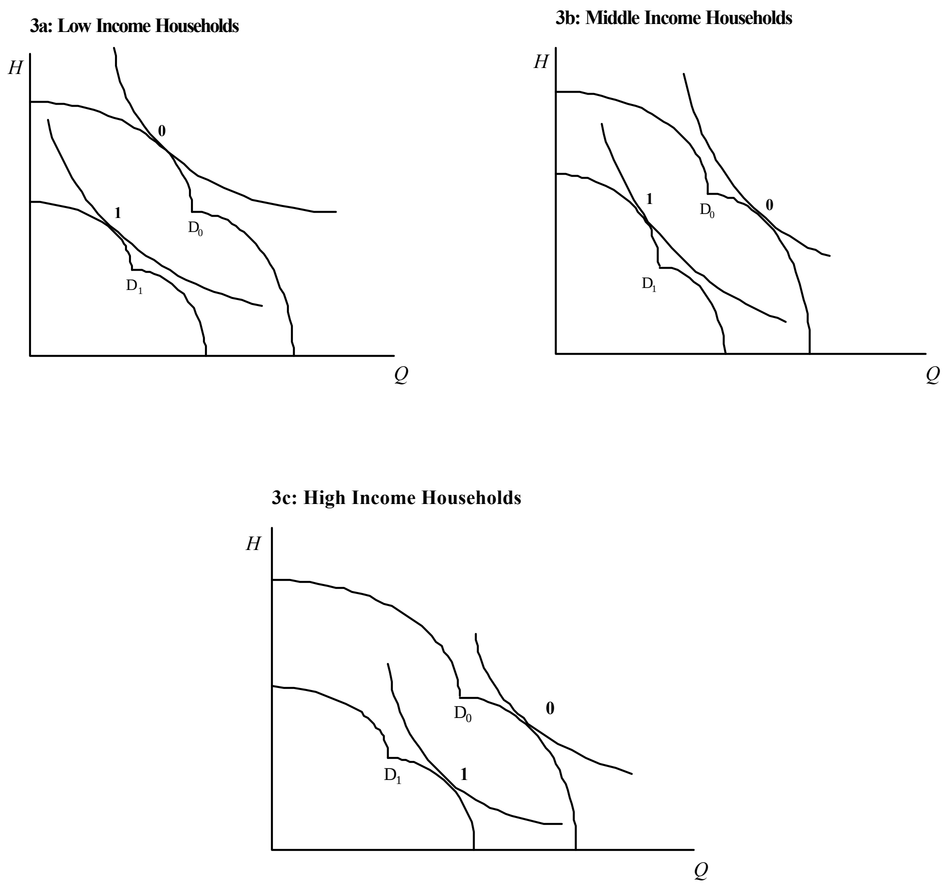
variety (point **b**), whereas the high-income household achieves it highest utility level by consuming a domestically produced variety (point **a**).

2.1.3 Real Wages and Imports

Before proceeding to the subsection deriving our main testable propositions, we examine how the presence of the *income* effect and of different income groups makes the effects of wage changes on the total volume of imports ambiguous. The effects of a reduction in the real wage rate on the (volume of) imports depend heavily on the specification of the initial equilibrium. We start by considering the case in which the domestically produced variety is consumed initially only by the high and the middle-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 a decrease in domestic wages. Given perfect competition, all income accruing to domestic households consists of wages. This implies that the budget constraint moves inwards for all three-income groups. This happens because the prices of both the homogeneous good and the quality differentiated good fall 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 decreases to a decline in real income. Along with the decline in domestic real income there is an increase in the range of qualities (varieties) of the differentiated good, which the domestic country can offer at a lower cost than the ROW. In Figure 3a, the decline in domestic wages is associated with a shift of consumption for the low-income domestic households from higher to lower quality ROW produced goods. In Figure 3c, as in Figure 3a, the decrease in domestic wages does not switch demand from goods (varieties) produced in one region to another. It only leads domestic consumers to demand lower quality (domestically produced) varieties than before.

Figure 3: Real Wage Changes and Imports



In Figure 3b, the reduction in domestic wages is associated with a switch in the consumption pattern of the middle-income domestic consumers. The decline in their real income forces them to substitute lower quality ROW produced goods for the higher quality domestically produced goods they were demanding before. This switch will <u>increase</u> the volume of domestic imports. The reduction in domestic wages could obviously lead to a shift from higher to lower quality domestically produced goods, without a corresponding increase in imports. But in any case, the traditional expected decrease in the volume of imports would not be observed.

What Figures 3a-3c make clear is that, the volume of domestic imports may well increase following a decrease in domestic wages (i.e. household 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 increase in domestic imports since this is the group for which the decrease in real income may result in a switch from varieties produced in the domestic country to varieties produced in the ROW.

The reasons for this unexpected result 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. A decrease in domestic wages makes the home country even more competitive in the qualities (varieties) in which it already was more competitive than the ROW and it expands the range of qualities which the domestic country produces at a lower cost. We term this the *cost* effect. The second effect arises from the influence that wages have on household income and hence spending patterns. A decrease in the wage rate results in lower household income, and a switch of demand to lower quality varieties. But, these are precisely the varieties in which the domestic country has comparative disadvantage. 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 to toward varieties in which the domestic country has comparative disadvantage (the *income* effect)[11].

It must, however, be noted that the effects on the "total volume" of imports of differentiated goods resulting from a reduction 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 reduction in domestic wages. But these imports are now of a lower quality than

[11] 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.

before. In this sense, the "total volume" of imports by this group decreases[12]. 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 decrease in domestic wages.

2.2 Real Wages and Commodity Import Shares

Consider now a more realistic case in which the domestic country produces (in addition to the homogenous non-traded good) and trades with the ROW a number of vertically differentiated goods which we denote by Y_i, i=1,...,n. For ease of diagrammatic exposition we assume that for all n goods there is a common production function in the domestic country which is described by equation (3) in section 2.1. For the ROW, it is now (more realistic) to assume that it has a absolute (technological) disadvantage in producing <u>some</u> of these goods (i.e., those Y_i for i=1,...,k; $k<n$) and absolute advantage in producing the rest of the goods (i.e., those Y_i with $i=k+1$, ...,n). We also assume that for the first set of goods (i=1,...,k) the domestic country has CA in high quality varieties, whereas for the second set of goods ($i=k+1$,...,n) the domestic country has CA in low quality varieties. These assumptions are reflected in the following production function

$$\begin{aligned} &Y^*_{Q,i} = \min\left\{\frac{L^*}{d_i Q_i^{m_i}}, \frac{S}{d_i Q_i^{m_i}}\right\}, \quad i=1,\ldots k,\cdots n; \\ &d_1 > d_2 > \cdots d_k > g > d_{k+1} > d_{k+2} > \cdots d_n; \\ &m_1 > m_2 > \cdots m_k > e > m_{k+1} > m_{k+2} > \cdots m_n; \end{aligned} \tag{9}$$

[12] Even though we will repeatedly use the term "total volume" of imports we do not include imported intermediate inputs in this measure. Given our assumptions, the volume of these intermediate inputs is directly related to both the "volume" and "quality" of domestically produced products. Any conclusions we derive pertain thus to final goods imports alone.

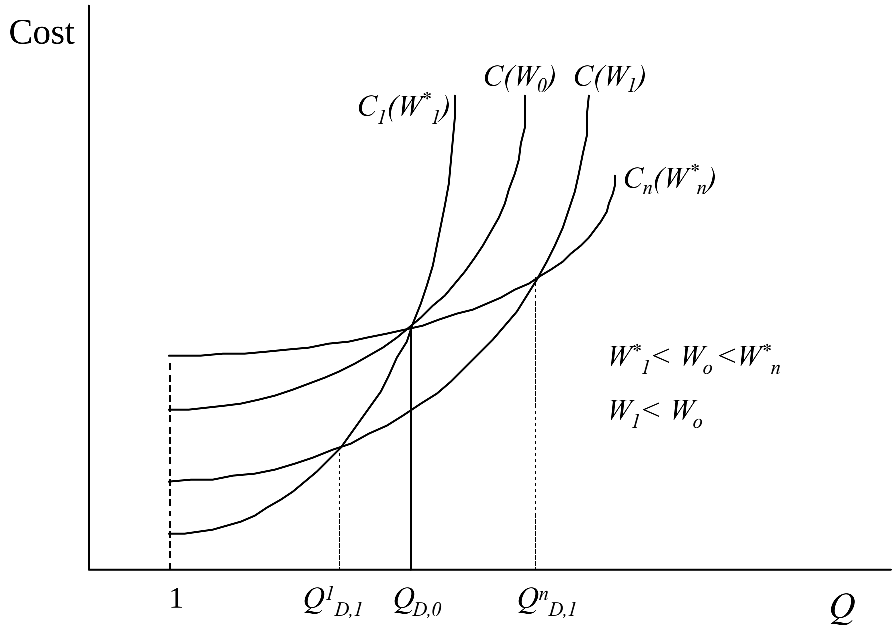
where $Y^*_{Q,i}$ denotes the number of units of quality Q of product i. The implication of this is that the domestic country has its highest comparative (technological) advantage in good 1 and its highest comparative (technological) disadvantage in good n.

At this point it is obvious that we can not maintain the assumption of wages being higher in the domestic country than in the ROW. For, in this case, under free trade there would be no domestic production of the goods in which the domestic country has absolute (technological) disadvantage. For this reason we can think of the ROW as consisting of many regions with each region producing only a small set of goods. Wages in each region *vis-a-vis* the domestic country will then depend on whether a region produces the first (i=1,...,k) or the second (i=k+1,...,n) set of goods[13]. We therefore assume that $W^*_i<W$ for i=1,...,k and $W^*_i>W$ for i=k+1,...,n.

In Figure 4, we show the cost-quality schedules only for goods i=1 and i=n in the domestic country and in the ROW. For ease of exposition we have drawn them in such a way that (at the initial domestic wage rate, W_0) the "dividing" quality level $Q_{D,0}$ is the same for goods 1 and n. Varieties with quality up to $Q_{D,0}$ will be produced at a lower cost in the domestic country for good n, whereas varieties of good 1 with quality up to $Q_{D,0}$ will be cheaper to produce in the ROW. Consider now a decrease of domestic wages to W_1. The "dividing" quality level for good 1 is now $Q^1_{D,1}$, whereas for good n it is $Q^1_{D,n}$. Despite the movement of the "dividing" quality level for the two goods in opposite directions, for both goods there is an increase in the range of goods which the domestic country can offer at a lower cost. For good 1, it can now offer all varieties with quality larger than $Q^1_{D,1}$ (rather that $Q_{D,0}$) at a lower cost. For good n, it can now offer at a lower cost all varieties with quality up to $Q^n_{D,1}$ (rather that up to $Q_{D,0}$). The increase in the range of varieties, which the domestic country can offer at a lower cost, is expected to decrease the imports of both goods. However, the decline in the wages (incomes) of the domestic households will induce them to demand lower quality varieties than before. For good *n*, this will reinforce the decrease in imports of this good. Households who were consuming varieties with quality larger than $Q^n_{D,1}$ before the decrease in wages, may now demand qualities smaller than $Q^n_{D,1}$. The decline in household income in this case shifts demand to varieties in which the country has *CA*, and it thus contributes to a larger decrease in imports. By the same token, the decline in wages shifts demands away from varieties in which the country has *CA* in the case of good 1. This effect, as we have shown in Figure 3, may even overturn the expected decrease in imports. In any case it dampens the decline in imports of good 1. We therefore expect that imports of good *n* will adjust by more than imports of good 1. We thus state our *hypothesis I* as follows: *an increase in domestic wages will reduce (increase) the share of a good's imports in total imports if the country has CA in high (low) quality varieties of this good.*

[13] Alternatively, we may consider that the ROW is a single political entity, but that wages differ between sectors.

Figure 4: Cost & Quality for Domestic Country & ROW



2.3 Non-Wage Income and Commodity Import Shares

In this Section we develop our second testable hypothesis[14]. To draw-out the implications of changes in non-wage income as clearly as possible we maintain all the assumptions of Section 2.1 regarding the production of vertically differentiated goods. The only change we introduce concerns the production function of the homogeneous non-traded good. We now assume that in addition to labour and imported intermediate inputs, the production of the homogeneous good requires the use of one unit of a specific factor (e.g. land). The price of the homogeneous good now becomes

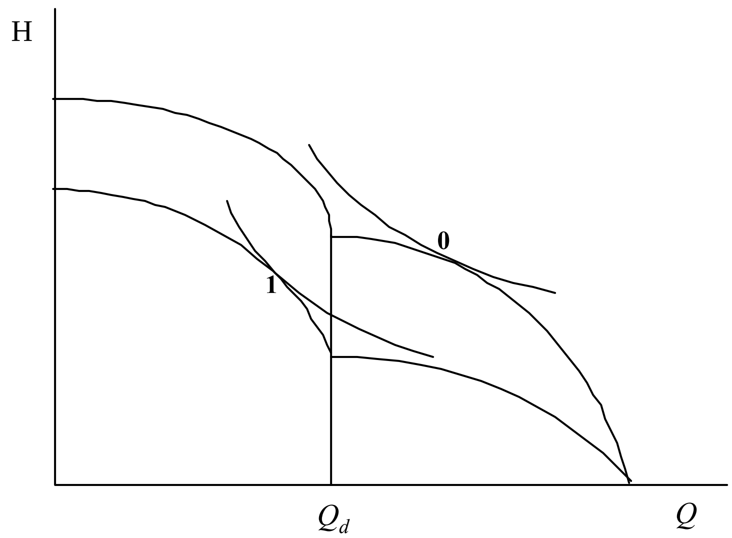
$$P_H = (W + P_S + P_I) / \boldsymbol{b} \qquad (10)$$

[14] We wish to thank an anonymous referee for suggesting the development of this hypothesis.

where P_I is the price of the specific factor. We assume that only high-income households are owners of the specific factor. This assumption is made to capture, in a sharp way, the fact that non-wage income is a significant part of household income only for high-income households.

In Figure 5, we depict the consequences for the volume of imports of a rise in P_I, for a middle-income household, which initially maximises its utility by choosing point **0** on its budget constraint. Assuming that the country has *CA* in high quality varieties of the differentiated good, at point **0** the middle-income household consumes a domestically produced variety. Since middle-income households do not receive any non-wage income, but they have to pay a higher price for the homogeneous good when P_I increases, the budget constraint for the middle-income households moves inwards as depicted in Figure 5. Notice that the dividing quality level does not change since the specific factor is not used in the production of the differentiated good. The new point of maximum utility is obtained at point **1**; the middle-income household has switched its demand from domestically produced to ROW–produced varieties of the differentiated good.

Figure 5: *CA* in High Quality Varieties



It is obvious that the above-described switch in demand for a middle-income household will not be observed in the case of low-income and high-income households. In the case of low-income households, the inward move of their budget constraint will also lead them to demand lower quality varieties. But since, by assumption, they were already consuming imported (low-quality) varieties no switch to imported varieties will be observed. In the case of high-income households, the budget-constraint will move outwards since the proportional increase in the price of the homogeneous good will be smaller than the increase in the price (and income of the owners) of the specific factor. As a result, high-income households will consume even higher quality varieties of the domestically produced good and so there will be no switch to imported varieties.

Figure 5 can also be used to gauge the effects of an increase in non-wage income (of high-income households), when the country has *CA* in low quality varieties of the differentiated product. Again, starting from point **0**, and following an increase in P_I, the middle-income household will switch to point **1**. But now, since the switch in demand for the middle-income household is from a ROW produced variety to a domestically produced one, the volume of imports will decrease. For the low-income and high-income households the observations of the previous paragraph apply here as well; there will be no switch in demand from domestically produced to ROW-produced varieties (or *vice-versa*).

The above findings imply that there is complete contrast between wage and non-wage income changes on the volume of imports. Following the arguments of the previous Section, we can now state *hypothesis II* as follows. *An increase in non-wage income is expected to increase (decrease) the share of those commodities' imports for which the country has CA in high (low) quality varieties of these products.*

3. Econometric Evidence

In this section we test the two propositions developed in Sections 2.2 and 2.3. To this end we employ annual data from 1967-95 for the G-3 (i.e. Germany, Japan and the U.S.) using the CHELEM (Harmonized Data for International Trade and the World Economy) and the OECD (National Accounts and Economic Outlook) databases[15].

3.1 Specification and Methodology

The theoretical hypotheses developed in the previous section made extensive use of a number of assumptions, which are obviously at variance with the complex world. The first assumption was that the number of households is fixed. However, an increase in the number of households (for example due to immigration) will result in a higher volume of imports - even if the real wage remains constant. Since the spending pattern of immigrants may differ from the rest of the population, such changes in national income can alter the composition of imports. In addition, changes in government spending (which are usually strongly correlated with aggregate income) may introduce variations in the composition of imports (i.e. more guns than butter) for reasons unrelated to real wage changes. Moreover, increases in aggregate income have been observed with barely changing real wage rates (e.g. the case of the U.S.). The resulting changes in income distribution can again influence the structure of imports if, for example, preferences are non-homothetic. Another important reason for including an aggregate activity variable is to account for differences in the degree in which imported intermediate inputs are used in production of both homogeneous and differentiated goods. An expansion of economic activity can therefore influence the share of each commodity's imports since the import data we use

[15] See the Data Appendix for further details on variable definitions, sources and methods.

include not only final goods but intermediate inputs as well. Aggregate income is thus included in our econometric estimation to control for all of these additional effects.

Movements in the nominal exchange rate and/or in the foreign currency prices of imported goods (both final and intermediate) are another "nuisance" of the real world that - in addition to (real) wage changes - can also affect competitiveness and the "dividing" quality level. What is more important in our context is the probable presence of differences in the degree to which intermediate inputs are used in the production of each differentiated commodity. For in this case an increase, for example, in the domestic currency price of imported intermediate goods will affect to a different extent the "dividing" quality level of each commodity; i.e. the import shares of commodities which make more intensive use of imported intermediates will rise. To control for such effects we include a measure of competitiveness in our econometic estimation.

Given the above arguments, as a first step in our empirical examination of *hypothesis I* (i.e. *an increase in domestic wages will reduce the share of a good's imports in total imports if the country has CA in high quality varieties of this good*) we employ the following constant elasticity import share specification for each G-3 country:

$$\frac{M_{i,t}}{M_t} = e^{\tilde{a}_1} Y_t^{\tilde{b}_1} C_t^{\tilde{g}_1} \left(\frac{W_t}{P_t} \right)^{\tilde{d}_1} e^{\tilde{e}_1 T_t} e^{m_{1i,t}} \tag{11}$$

where M_{it} $(i=1, \ldots, 69)$ refers to a country's imports of the i[th] product from the rest of the world[16] in time t; M_t is total imports of all 69 commodities from the rest of the world; Y_t is real GDP; C_t is a measure overall competitiveness (i.e. relative unit labour costs); W_t is the nominal

[16] Note that in Japan product #57 (i.e. electricity) had to be excluded due to insufficient observations. See the Data Appendix for a full list of all 69-product codes.

hourly manufacturing wage; P_t is the aggregate consumption deflator, T_t is a linear deterministic time trend and $m_{1i,t}$ is a stochastic error term.

To aid in the testing of *hypothesis II* (i.e. *an increase in non-wage income is expected to increase the share of those commodities' imports for which the country has CA in high quality varieties of these products*), our first step is to again estimate import shares for all commodities for each G-3 country. However we will now substitute a measure of non-wage income for the wage rate in (11), e.g.

$$\frac{M_{i,t}}{M_t} = e^{\tilde{a}_2} Y_t^{\tilde{b}_2} C_t^{\tilde{g}_2} \left(\frac{NW_t}{P_t} \right)^{\tilde{d}_2} e^{\tilde{e}_2 T_t} e^{m_{i2,t}} \qquad (12)$$

where all variables are defined as in (11) and NW_t is nominal per capita property and entrepreneurial income. To determine to what extent our two hypotheses find support in the data for the G-3[17], we next relate the estimated coefficients (of both the real wage rate (i.e. $\hat{d}_{1i}$) and non-wage income (i.e. $\hat{d}_{2i}$) for the 69 commodities) to a measure of revealed CA[18] for each commodity[19]. Based on the arguments set out in Section 2, we expect the estimated wage

[17] Note that in (11) and (12) we also include a linear deterministic time trend. This is motivated by the weight of univariate evidence suggesting that although our data appear to be I(1), many variables, including the shares, also contain either positive or negative linear trends. Given the sheer volume of this evidence (i.e. 210 variables i.e. ((69x3) -1) for the shares plus 4 conditioning variables) we do not report these results here but will make them available on request.

[18] Revealed CA is calculated in CHELEM as follows: $f_{ik}=y_{ik}-g_{ik}*y_i$, where, $y_{ik}=(X_{ik}-M_{ik})/Y_i$; $g_{ik}=(X_{ik}+M_{ik})/(X_i+M_i)$; $y_i=(X_i-M_i)/Y_i$; f_{ik} is the contribution of product k to the trade balance in country i relative to GDP; X_{ik} and M_{ik} are product k exports and imports of country i; Y_i is GDP in country i; and X_i and M_i are aggregate exports and imports of country i. To eliminate the influence of changes which are not country specific but due to the importance of product k in world trade; the flows of X and M are adjusted by multiplying them by $e^k_n=(W^k_r/W^r)*(W_n*W^k_n)$, where W^r_k and W^r are world trade in commodity k and world trade in all commodities in base year r (=1990) respectively; and W^n_k and W^n are world trade in commodity k and world trade in all products respectively in years n (=1967 to 1995). In the base year, the indicator of CA, f^*, is equal to f but for other years the difference is greater, the more world trade in product k diverges from the average for all k. For further details see (see G. Lafay, 1988).

[19] For example, illustrating with the coefficients from (11), we first examine the degree of linear association via the correlation coefficient, i.e. $\hat{r}_1 = s^2\left(\hat{d}_{1i}, CA_i\right)\left[s_{\hat{d}_{1i}} s_{CA_i}\right]^{-1}$, where s is the sample standard deviation. Second we report the extent of the quantitative link, via the estimated slope parameter, obtained from a linear regression of the vector of real wage coefficients on the measure of CA, i.e. $\hat{b}_1 = \hat{r}_1\left[s_{\hat{d}_{1i}} s^{-1}_{CA_i}\right]$.

coefficients to be negatively related to the *CA* index, whereas the non-wage (income) coefficients to be positively related.

Given that our main focus is to separately determine the effects of the real wage rate and non-wage income on the product import shares once we have conditioned for aggregate income and competitiveness, we treat the above specifications symmetrically and directly estimate the static representations using ordinary least squares (*OLS*)[20]. In other words, irrespective of statistical significance, the same set of conditioning variables as specified in (11) and (12) is maintained. Given that we estimate 412 models (i.e. 69 shares for Germany and the US and 68 shares for Japan) for (11) and the same for (12), 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 we are estimating shares, which are bounded in the [0,1] interval, we refrain from applying a long-run co-integrating, co-trending interpretation if the estimated models prove to be non-spurious.[21] 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 not conduct extensive specification and misspecification testing. However, given our concentration on hypothesis testing, we calculate heteroscedastic consistent standard errors and report information pertaining to both the stationary[22] of the errors and the exogeneity[23] of the contemporaneous regressors. While, in

[20] 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.

[21] This is because, if the sample period incorporated information pertaining to the long-run, the shares would be *I(0)* by construction.

[22] To address this issue former we apply a modified von Neumann type ratio (see Bhargava (1986)) to the errors in specifications (11) and (12). Note that the DW statistic from the commodity share equations is

general, we will not employ the standard alternative estimators in an attempt to obtain stationary errors and unbiased coefficients in the equations which are not performing satisfactorily we will selectively re-estimate as required to augment a more detailed analysis of the relevant results (see Table 3 below).

3.2 Results

We now turn to the economic implications of our estimating the import share equations incorporating separately the wage rate and non-wage income. Table 1 reports the proportions of significant coefficients for (11) and (12) respectively. We also summarise in the notes to this Table the results of the stationarity and endogeneity tests, discussed in footnotes 19 and 20 as well as descriptive information pertaining to the equation fit (i.e. adjusted R^2).

Table 1 - % Significant Coefficients: Specifications (11) and (12)

	Germany					
	Specification (11)			*Specification (12)*		
	Total	*Positive*	*Negative*	*Total*	*Positive*	*Negative*
Y	0.51	0.25	0.26	0.55	0.23	0.32
C	0.55	0.46	0.09	0.44	0.41	0.03
W/P; NW/P	0.60	0.17	0.43	0.74	0.58	0.16
T	0.56	0.28	0.28	0.46	0.23	0.23
	Japan					
	Specification (11)			*Specification (12)*		
	Total	*Positive*	*Negative*	*Total*	*Positive*	*Negative*

equivalent to the Bhargava (1986) R_1 [$= \sum_{t=2}^{T}(y_t - y_{t-1})^2 / \sum_{t=1}^{T}(y_t - \bar{y})^2$] test statistic, where y is defined as the equation residual. R_1 is used to test the null of a simple random walk, (i.e. $\Delta y_t = e_t$, where $y_1 = m + e_1$, t=2,…,T) against the stationary alternative (i.e. $(y_t - m) = (y_{t-1} - m) + e_t$, where $y_1 = m + [e_1 / (1 - r^2)^{1/2}]$, t=2,…,T, $0 \leq r < 1$). The exact limit at 5% for R_1, for our sample period, N=29 is 0.814 and is found by interpolation using Table 1 in Bhargava (*op cit*.).

[23] With respect to the issue of simultaneity or joint endogeneity of the variables, we test the effect on the *OLS* parameter estimates of any endogeneity that may be present. Using the Durbin-Wu-Hausman (DWU) test (see Hausman (1978)) we compare *OLS*, which is efficient (or more efficient) under the null but inconsistent under the alternative, with the Instrumental variable (*IV*) estimator which is consistent (and less efficient) under both hypotheses. We calculate DWH as follows, $DWH = (b_{OLS} - b_{IV})'(\Sigma_{OLS} - \Sigma_{IV})^{-1}(b_{OLS} - b_{IV}) \sim c^2(k)$ where $\mathbf{b}_{OLS}$ $\mathbf{b}_{IV}$ are the vectors of estimated parameters of *OLS* and *IV* respectively, Σ_{OLS}, Σ_{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 $(\Sigma_{OLS} - \Sigma_{IV})$. The instruments we employ include a one-year lag of each conditioning variables in (11) and (12) plus a constant and a time trend. Accordingly, at the 5% level of significance the critical value of $\chi^2(5)$=11.07.

Y	0.70	0.67	0.03	0.71	0.14	0.57
C	0.70	0.61	0.09	0.54	0.42	0.12
W/P; NW/P	0.84	0.06	0.78	0.84	0.78	0.06
T	0.46	0.04	0.42	0.68	0.54	0.14
			U.S.			
	Specification (11)			*Specification (12)*		
	Total	*Positive*	*Negative*	*Total*	*Positive*	*Negative*
Y	0.54	0.41	0.13	0.22	0.09	0.13
C	0.58	0.45	0.13	0.35	0.23	0.12
W/P; NW/P	0.77	0.23	0.54	0.41	0.29	0.12
T	0.53	0.17	0.36	0.25	0.16	0.09

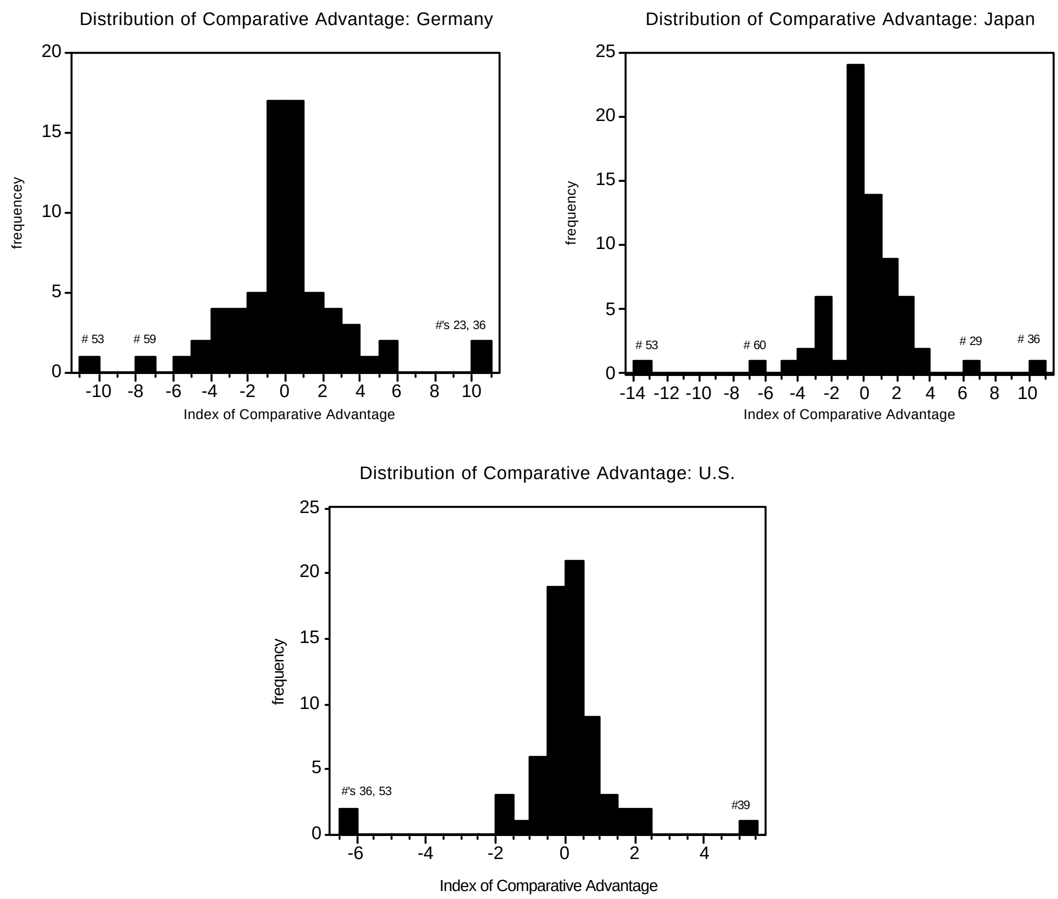
Note: (i) the *t-ratios* used to determine significance are based on *heteroscedastic-consistent* standard errors; (ii) for specification (11): (a) the proportion of equations with stationary errors are 0.91, 0.88 and 0.90 for Germany, Japan and the U.S. respectively; (b) the proportion of equations in which the *OLS* estimates do not differ significantly from the *IV* estimates are 0.96, 1.00, and 0.93 for Germany, Japan and the U.S. respectively; (c) adjusted R^2 is greater that 0.5 for 0.83, 0.93, and 0.84 for Germany Japan and the U.S. respectively; (iii) for specification (12): (a) the proportion of equations with stationary errors are 0.90, 0.88 and 0.94 for Germany, Japan and the U.S. respectively; (b) the proportion of equations in which the *OLS* estimates do not differ significantly from the *IV* estimates are 0.90, 0.97, and 0.58 for Germany, Japan and the U.S. respectively; and (c) adjusted R^2 is greater that 0.5 for 0.81, 0.88, and 0.58 for Germany Japan and the U.S. respectively.

From the notes in Table 1, we can see that for specifications (11) and (12) (i) the vast majority of commodities for each country or 90% across the G-3 contain stationary errors; (ii) the extent of bias in our parameter estimates due to potential simultaneity for each country (except the U.S. for specification (12)) is limited (i.e. only 11% across the G-3). Finally most equations for each country appear to fit reasonably well (i.e. 80% across the G-3 record a value of adjusted R^2 greater than 0.5). From Table 1 we also observe that the real wage rate and non-wage income are significant at a higher frequency (at the 5% level) than any of the other conditioning variables for all countries. This certainly matches well with our discussion in Sections 2.2 and 2.3 regarding the differential impact of wage and non-wage income on commodity import shares.

We now proceed to relate the estimated coefficients to revealed CA (RCA). In Figure 6, we present for the G-3 the distribution of the *RCA* for the 69 commodities. Note that commodity number 53 is crude oil. The G-3 have their largest revealed comparative disadvantage in this commodity and the estimated real wage elasticity is positive and large for this commodity, as we would expect from our theoretical analysis. Nevertheless, we do not think that this observation accords well with our theoretical framework, since crude oil hardly matches with our perception of a quality-differentiated product. In general, there is a shortcoming of trying to use the revealed *CA* index as a proxy that matches perfectly with our theoretical concept of *CA* developed in Section 2[24]. The *RCA* measure may just reflect natural resource supplies and not technological capabilities (e.g. crude oil, natural gas). Nevertheless, for the G-3 (and especially for Germany and Japan) natural resource supplies are not a significant determinant of *CA* for the vast majority of the product groups in our sample. Moreover, the fact that *per capita* income is high in these countries implies that domestic demand is in each country concentrated on high quality goods. Consequently, a trade surplus for any particular commodity (which is essential for a positive measure of *RCA*) implies that the country is relatively good at producing high quality varieties of this commodity. This certainly reduces the problem caused by the lack of data on the quality of products.

Figure 6 - Revealed Comparative Advantage Histograms

[24] Another measure that could act as a proxy for *CA* in either high or low quality varieties is the ratio of import to export prices. Unfortunately there are no such data available (which could match with the product groupings in the CHELEM database). Moreover, such ratios would also not be devoid of problems due to aggregation. Consider, for example, the product category "clothing". A country may export (mainly) high quality varieties of shirts and import (mainly) low quality varieties of coats. Given that the price of a low quality coat is (on average) higher than the price of a high quality shirt, one may wrongly surmise that the country has CA in low quality varieties of "clothing".



In Table 2 we present two sets of correlation and slope coefficients for the three countries. First between the real wage elasticity and the index of *RCA* and second between the non-wage income elasticity and the index of *RCA*. The existence of significant negative correlations in the first case, for the three countries, provides strong evidence in support of *hypothesis I.* The existence of significant positive correlation in the second case for all countries provides also strong evidence in support of *hypothesis II.*

Table 2 – Relationship between Wage Elasticities, d_{1i} and Non-Wage Elasticities, d_{2i} with Revealed Comparative Advantage, RCA_i, $(i=1 \ldots n)$

	Germany, *n=69*	Japan, *n=68*	U.S., *n=69*
[illegible]	-0.306 (0.011)	-0.528 (0.000)	-0.377 (0.001)
[illegible]	-0.296 (0.014)	-0.527 (0.000)	-0.383 (0.001)

$\hat{b}_1 = \hat{r}_1(s_{\hat{d}_{1i}} s^{-1}_{RCA_{1i}})$	-0.197 (0.011)	-0.650 (0.000)	-1.253 (0.001)
$\hat{b}^*_1 = \hat{r}^*_1(s_{\hat{d}_{1i}} s^{-1}_{RCA_{2i}})$	-0.194 (0.014)	-0.668 (0.000)	-1.210 (0.001)
$\hat{r}_2(\hat{d}_{2i}, RCA_{1i})$	0.436 (0.000)	0.546 (0.000)	0.305 (0.011)
$\hat{r}^*_2(\hat{d}_{2i}, CA_{2i})$	0.422 (0.000)	0.545 (0.000)	0.308 (0.010)
$\hat{b}_2 = \hat{r}_2(s_{\hat{d}_{1i}} s^{-1}_{RCA_{1i}})$	0.159 (0.000)	0.323 (0.000)	0.717 (0.011)
$\hat{b}^*_2 = \hat{r}^*_2(s_{\hat{d}_{1i}} s^{-1}_{RCA_{2i}})$	0.157 (0.000)	0.331 (0.000)	0.689 (0.010)

Notes: (i) two sets of results for estimated r are reported since two different measures of comparative advantage are employed (i.e. RCA_1 and RCA_2) - these measures are based on the mean and median of the Chelem measure of *RCA* from 1967-1995 respectively; (ii) the numbers in parentheses are *p-values*.

In Table 3 we present more detailed evidence in support of our hypotheses. The top-5 commodities in terms of the *RCA* index for the G-3 are presented along with the import share real wage elasticities. With the exception of the iron and steel making product category, none of these commodities can be thought of as providing *CA* because of abundant nature resource supplies. For 12 out of the 15 product groups presented, the real wage elasticity is negative (and significant), whereas for the remaining three (vehicle components, miscellaneous hardware and engines, turbines and pumps) the elasticity is not (statistically) different from zero. It is also worth noting that three of the four products (i.e. vehicle components, miscellaneous hardware and engines, turbines and pumps) whose elasticity is not (statistically) different from zero are mainly used as intermediate goods rather than final consumer goods. The non-wage income elasticities are positive (and significant) also for twelve product groups, whereas for the remaining three (miscellaneous hardware, aeronautics and engines, turbines and pumps) the elasticity is not (significantly) different from zero. Both of our hypotheses are, thus, supported by these findings.

Table 3 - Ranking of Top-5 Commodities by Degree of Revealed Comparative Advantage and Corresponding Elasticities from (11) and (12)

Germany

Product	*RCA*	*Wage Elasticity*	*Non-Wage Elasticity*
Specialised machines	10.10	-1.60 (0.000)[25]	1.41 (0.000)
Cars (including motorcycles)	10.09	-1.18 (0.001)	1.30 (0.000)
Engines, turbines & pumps	5.66	-0.67 (0.010)	0.34 (0.014)
Vehicle components	5.60	-0.07 (0.746)	0.57 (0.001)
Miscellaneous hardware	4.35	-0.14 (0.662)	0.19 (0.110)

Japan

Product	*RCA*	*Wage Elasticity*	*Non-Wage Elasticity*
Cars (including motorcycles)	10.29	-7.57 (0.000)	3.93 (0.000)
Consumer electronics	6.53	-5.84 (0.000)	2.78 (0.000)
Iron & steel making	3.86	-7.47 (0.000)	3.69 (0.000)
Telecommunications equip.	3.20	-5.06 (0.000)	2.48 (0.000)
Engines, turbines & pumps	2.92	-0.06 (0.965)	0.68 (0.266)

U.S.

Product	*RCA*	*Wage Elasticity*	*Non-Wage Elasticity*
Aeronautics	5.17	-4.72 (0.000)	2.00 (0.360)
Computer equip.	2.33	-4.95 (0.000)	3.24 (0.010)[26]
Cereals	2.30	-11.38 (0.000)[27]	8.06 (0.006)
Engines, turbines & pumps	1.68	-5.00 (0.000)	2.86 (0.037)
Precision instruments	1.58	-2.37 (0.000)	2.07 (0.003)

Notes: (i) the index of revealed *CA* is the median value between 1967-95; (ii) the numbers in parentheses are the *p-values* for the heteroscedastic-consistent *t-ratios*; (iii) none of *OLS* estimates for the commodities reported in this table significantly differ from their corresponding *IV* estimates.

[25] Note that the stationarity tests summarised in the notes to Table 1 indicate that this import share equation has serially correlated errors. Standard single-equation solutions to this problem include re-estimating in differences, applying a first-order serial correlation correction and re-estimating an ARDL model. Here, we opt for the ARDL solution since (i) we lose the constant elasticity interpretation with first differences and (ii) the serial correlation correction is a restricted form of the ARDL, which requires that the lag polynomials have the same factor in common. The result of estimating and ARDL (1,1) model and then dropping insignificant regressors to conserve *df*, leads to a long-run value real wage elasticity of $\bar{\hat{d}}_{1,23} = -1.37$. The value of the Wald test $\chi^2(1)$ is 11.24, which constitutes a rejection of the null that $\bar{\hat{d}}_{1,23} = 0$ at the 0.001 level.

[26] Evidence from the stationarity tests suggests that all commodities (when conditioning on non-wage income) expect Aeronautics contain serial correlation. Re-estimating as in footnote 24 leads to poorly determined parameter estimate for $\bar{\hat{d}}_{2,31}$ and $\bar{\hat{d}}_{2,58}$ whereas the new estimates for $\bar{\hat{d}}_{2,19}$ and $\bar{\hat{d}}_{2,25}$ are 2.19 and 2.86 respectively. The Wald tests respectively are 9.22 and 6.92 and are both significant at the 0.002 level.

[27] The errors in the Cereal commodity share equation are also serially correlated. Re-estimating as in footnote 24 leads to $\bar{\hat{d}}_{1,58} = -14.74$. The Wald test $\chi^2(1)$ is 9.31 and is significant at the 0.002 level.

Table 4 – Wage & Non-Wage Elasticities Using Aggregated Import Shares

	Germany		Japan		USA	
	(-) RCA	(+) RCA	(-) RCA	(+) RCA	(-) RCA	(+) RCA
W/P	0.75	-0.47	0.99	-5.42	1.70	-3.30
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
NW/P	-0.25	0.39	-0.50	2.61	-1.26	2.43
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)

Note: the numbers in parentheses are the *p-values* for the heteroscedastic-consistent *t-ratios*.

As a final test of both hypotheses, we split total imports into two groups. The first group contains all those commodities with a negative *RCA* and the second contains all the commodities with a positive *RCA*. According to *hypothesis I*, the share of the first group's (negative *RCA*) imports will increase when the real wage increases (obviously the opposite holds for the second group). According to *hypothesis II*, the share of the first group's (negative RCA) imports will decrease when non-wage income increases (again the opposite holds for the second group). The results reported in Table 4 for these two groups, using specifications (11) and (12), show that both hypotheses are indeed verified for our three countries.

4. Conclusions

In their survey of income and price effects in international trade, Goldstein and Khan (1985) conclude by stating that a "…priority area for future research is in the area of inter-country differences in price and income elasticities…". Our analysis has implications about the possible sources of the differences in these elasticities. Consider first the income argument. Let there be a *manna-from-heaven* increase in national income. We already know the answer as to the effect on the volume of imports predicted by standard import demand functions. However, even a qualitative answer is impossible in our framework. As we have seen, the answer depends on whether the country has *CA* in high quality varieties. But it also depends on whether the increase in national income is for example, a result of an increase in *per capita* income with a constant population, or whether it is a result of an increase in population with a constant *per capita* income. In the former case the volume of imports may decrease, whereas in the latter case imports will increase if even a small number of the "new" households register a demand for imported (low quality) varieties. Detailed econometric work, which takes into account this issue of the "composition" of changes in national income, may prove fruitful.

Exchange rate changes may also have different effects depending on whether the country has *CA* in high quality varieties. With a fixed foreign currency price of imported intermediate inputs, a depreciation of the domestic currency implies a reduction in real wages (incomes). If the country has *CA* in high quality varieties, then the volume of imports of the differentiated product will increase if the *income* effect proves stronger than the *cost* effect. This may be an explanation for the challenge to prevailing view posed by the work of Rose and Yellen (1989) and Rose (1991). Their estimation of a non-structural trade balance equation for five major OECD countries lead them to conclude that the (real) exchange rate is not a significant determinant of the trade balance. We hope that our findings based on a less aggregate approach encourage researchers to pursue these issues at a more aggregate level.

5. References

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6. Appendix

In this Appendix we give an example of how a reduction in wages can switch demand from domestically-produced varieties to varieties imported from the ROW.

We assume that preferences are described by a Stone-Geary utility function, i.e.

(A1) $$U = (H - V)^{a}\, Q^{1-a}$$

where H is the volume of consumption of the homogeneous non-traded good, Q is the quality of the vertically-differentiated good and V is the minimum necessary consumption of the H good. The household is assumed to maximise (A1) subject to the budget constraint $P_H H + P(Q) = E$ where $P_H = b^{-1}(W + P_S)$ and $P(Q) = \min\left[g Q^{e}(W + P_S),\ d Q^{m}(W^{*} + P_S)\right]$ with E being household income.

For the particular example we present, we will assume that the household is endowed with less than 1 unit of <u>effective</u> labour supply (W>E). 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 maximised 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 $g Q^{e}(W + P_S)$ or to $d Q^{m}(W^{*} + P_S)$).

The demand functions resulting from the above optimisation problem are

(A2) $$Q_D = \left[\frac{(1-a)(E - b^{-1}(W + P_S)V)}{g(1 + a(e-1))(W + P_S)}\right]^{1/e}$$

(A3) $$H_D = \frac{aeE + (1-a)b^{-1}(W + P_S)V}{b^{-1}(W + P_S)(1 + a(e-1))}$$

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

(A4) $$Q_R = \left[\frac{(1-a)(E - b^{-1}(W + P_S)V)}{d(1 + a(m-1))(W^{*} + P_S)}\right]^{1/m}$$

(A5) $$H_R = \frac{amE + (1-a)b^{-1}(W + P_S)V}{b^{-1}(W + P_S)(1 + a(m-1))}.$$

We next assume the following parameter values: $W = 4.4,\ E = 2.75,\ W^{*} = 1.5,$ $P_S = 2,\ e = 1,\ m = 2,\ a = 0.5,\ V = 0.15\ g = 0.04$ and $d = 0.06$. If the household is allowed to purchase only domestically-produced varieties of the differentiated good, we find from (A2) and (A3) that Q_D=1.621 and H_D=0.1824. The utility index associated with these consumption levels is found from (A1) to be U_D=0.2291. In a similar way we can calculate (from (A4), (A5) and (A1)), the utility index resulting from constraining the household to consume only ROW-produced varieties. We find that Q_R=1.2067 and H_R=0.1932 and U_R=0.223. Since $U_D > U_R$, the household achieves maximum utility by purchasing a domestically-produced variety of the differentiated good.

We consider now a drop in domestic wages by about 10% to W=4. The income of the household drops by the same proportion to E=2.5. We now calculate that Q_D=1.458, H_D=0.1791 and U_D=0.2062 if the household buys only domestically-produced varieties. If the household is allowed to buy only ROW-produced varieties, the relevant numbers are Q_R=1.108 and H_R=0.1888 and U_R=0.2075. Since now $U_R > U_D$, the household achieves maximum utility by purchasing a ROW-produced variety; the reduction in domestic wages has resulted in a switch from consuming domestically-produced varieties to imported ones.

In a similar way one can determine whether domestically-produced or ROW-produced varieties will be purchased if there are many vertically-differentiated products. However, it becomes very cumbersome to do so as the number of differentiated products increases. For example, when there are three products, one must compare the utility levels resulting from nine different combinations of domestically-produced and ROW-produced purchases.

7. Data Appendix

The trade data that we employ in this study is from the CHELEM database. The forty-five countries and sixty nine[28] commodities reported in CHELEM account for over 90% of world trade and output. This data has been collected from various international sources and has been harmonised by the CEPII (*Centre D¢Études Prospectives Et D¢Informations Internationales*, Paris)[29].

Variable	Definition	Source
C	Relative unit labour costs, manufacturing	OECD Economic Outlook
CA_i	Comparative advantage indices 1990=100	CHELEM
MN_i	Nominal product imports	CHELEM
M	Sum of nominal product imports	CHELEM
P_m	Import price deflator, 1990=100	OECD National Accounts
P	Consumption price deflator, 1990=100	OECD National Accounts
POP	Population	OCED Economics Outlook
W	Nominal hourly earnings, manufacturing	OECD Economic Outlook
NW	Nominal property & entrepreneurial income	OECD National Accounts
Y	Real GDP, 1990=100	CHELEM

Table A1 – Products Reported 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
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		

[28] Note that several more commodities are available in CHELEM, e.g. (i) precious stones, jewellery & works of art (ii) non-monetary gold and (iii) commodities not elsewhere specified. However, we do not make use of them since the corresponding revealed *CA* indices are not available.
[29] See the CEPII Database on CD-ROM, CHELEM (Harmonised Data for International Trade and the World Economy): Detailed Nomenclatures and Indicator, July 1997.