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Import Elasticities Revisited

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Abstract

Should the long run income elasticity of aggregate import demand be equal to one, as implied by the neoclassical demand theory? Why are many empirical estimates of income elasticities not equal to one, and why are some of them very high? The author addresses these and some other related questions by revisiting the relevant theories and empirical modeling frameworks.

Key words: Trade elasticities, trade models

JEL classification code: F10, C32

Introduction

Since the end of the 1980s, there has been an acceleration in the growth of international trade, as indicated by the ratio of the growth rate of world trade volume to the growth rate of world output (real world gross product). This ratio has risen from an average of 2 in the 1980s to an average of 2.9 for the 1990s so far.

While this ratio is a good indicator for measuring the degree of openness of the world economy, it may have created some confusion about the economic relationship between international trade and income. Sometimes, this ratio has been mistaken as the income elasticity of international trade. Although the formula for calculating this ratio looks similar to that of income elasticity of trade, their economic meanings are totally different. The former ratio indicates the relative growth between international trade and income (without any implication of causality), but the income elasticity of trade measures the impact of a change in income on international trade (with everything else remaining the same).

Trade elasticities are crucial for both economic forecasting and international economic policy analysis. In many international economic policy debates, a core issue behind different opinions, political factors aside, is the different beliefs in the value of trade elasticities. For example, the extent of the welfare effects of trade liberalization and the impacts of exchange rate changes on trade volume, on trade prices and on the external balance (exchange-rate pass-through) all depend on the estimates of trade elasticities.

There have been many empirical studies of trade elasticities, and few of them, especially those based on econometric modeling techniques (but not simple regressions of trade growth against GDP growth, as reported in some empirical studies of trade elasticities across countries) would make the kind of mistakes mentioned above. However, there are still some unsolved interesting problems in this area. For example, most reported estimates of income elasticity of aggregate imports are greater than one and therefore seemingly inconsistent with the economic theory behind the modeling framework used in these empirical studies.

A systematic study of international trade should include the behavior of import demand, the behavior of exports and the behavior of prices, but we concentrate only on the issues of import demand in this paper.

In section 2 of the paper, we will give a brief theoretical background, by reviewing three major schools of modern international trade theory. In section 3, we will compare two trade modeling frameworks which are widely used in most empirical studies of trade elasticities, including the debates and the latest developments. In section 4, we will compare the import demand functions and the implied elasticities across some country models in the LINK modeling system. In the last section, we conclude with some remarks.

Income and price elasticities in trade theory

There are three major frameworks in the modern theory of international trade, namely, the theory of comparative advantage, the Keynesian trade multiplier, and the so called new trade theory (or, the imperfect competition theory of trade). The roles of income and prices in the determination of trade are explained differently in these theoretical frameworks.

In the neoclassic trade theory of comparative advantage, as characterized by the Heckscher-Ohlin framework extended from the classic Ricardian theory, the focus is on how international trade, its volume and direction, is affected by changes in relative prices, which in turn are explained by the differences in factor endowments between countries. The effects of changes in income on trade is not the concern—the level of employment is assumed to be fixed and output is assumed to be always on a given production frontier.

By applying the general equilibrium framework to the global economy, the analytical form of the neoclassical import demand function is defined as

follows (see W. Ethier(1983), A. Dixit and V. Norman (1980)):

$$M(P) = D(P, E(P,u)) - S(P) \qquad (1)$$

where M is the real demand for imports, P is the relative price of imports, D is the total demand for importable goods, derived from the optimal consumer assumption, E is expenditure at the given relative price P and the given utility level u, S is the domestic supply of importables. Expenditure is equal to income, i.e. E(P,u)=y(P).

The elasticity form of (2.1) is as follows:

$$\frac{P}{M}\cdot\frac{dM}{dP} = \frac{P}{M}\cdot\frac{\partial D}{\partial P} - \frac{P}{M}\cdot\frac{PdS}{MdP} - P.\frac{\partial D}{\partial E} \qquad (2)$$

or

$$e = c - s - m \qquad (3)$$

where e is the price elasticity of import demand, c is the demand substitution elasticity, s is the supply substitution elasticity and m is the marginal propensity to import. By the same token, one can also define the import price elasticity of the foreign country as e^* . The summation of the absolute value of both e and e^* plays an important role in international trade policy analyses. For example, $| e | + | e^* | > 1$, the Marshall-Lerner condition, defines a condition for the stability of international trade equilibrium.

While the neoclassic import demand function is based on the assumed neoclassic microeconomic consumer behavior and general equilibrium theory, the Keynesian import demand function is based on macroeconomic multiplier analysis. In the Keynesian framework, as distinguished from the neoclassical comparative advantage analysis, relative prices are assumed rigid and employment is variable. Further, international capital movements are not assumed away and they will passively adjust as required by the trade balance. So, in this framework, the focus is on the relationship between income and import demand at the aggregate level (and in the short term). The relationship can be defined by a few ratios, such as the average propensity to import, the marginal propensity to import and the income elasticity of imports.

The new trade theory, or the imperfect competition theory of trade, the latest school in trade theory, focuses on intra-industry trade, which is not explained well by the theory of comparative advantage. The new trade theory explains the effects of economies of scale, product differentiation and monopolistic competition on international trade. The analytical framework of this theory depends on specific assumptions about the market structure that give rise to increasing returns. Details can be found in A. Dixit and V. Norman (1980), W. Ethier (1979), E. Helpman (1981), G. Grossman (1992) and P. Krugman (1987).

Three approaches are usually used to define an imperfectly competitive market in studying its effects on international trade. The first is the Marshallian approach, in which constant returns are assumed at the level of individual firm, but increasing returns, external to the firm, are assumed at the level of the industry. The second is the Chamberlinian approach, in which it is assumed that an industry consists of many monopolistic firms and new firms are able to enter to differentiate their products from existing firms so that any monopoly profit at the level of industry can be eliminated. The last is the Cournot approach, in which an industry is assumed to consist of only a few imperfectly competitive firms and each will take each others' outputs as given. With any one of these three market structures, an opening of international trade will lead to larger market size, decreasing costs and, thus, more output and trade.

In the literature of the imperfect competition theory of trade, one usually assumes an economy containing both a sector of constant returns and a sector of increasing returns. Then, comparative advantage and imperfect competition can be integrated to explain both inter- and intra-industry trade, with the difference in factor endowments and the increasing returns as the driving forces respectively. One distinguishing feature, however, is that the existence of increasing returns usually implies multiple equilibria, and the pattern of trade in goods is not as precisely defined as in a pure comparative advantage framework.

The framework of the imperfect competition theory of trade seems to have given a new linkage between trade and income: if part of international trade

is driven by the scale of output and if the income variable is used as a proxy for scale, then the role of income in determining imports will go beyond that as defined both in the neoclassic and in the Keynesian import demand functions, where income plays only the role of purchasing power.

We would like to make two remarks on pure trade theory as briefly reviewed above. First, international trade is a natural extension of domestic trade and import demand is just part of general demand. The economic motivations behind the trade between two domestic locations (or two groups, or even two individuals), say, New Jersey and New York, would be the same as those behind the trade between two locations in different countries, say Shanghai and New York. Trade, no matter where it happens, is just the means to pursue higher economic efficiency from a deepening division of labor. While the market is the institutional framework to conduct the trade, technological innovation is the material condition to make the deepening division of labor possible. In this sense, we do not need any international economic theory, other than a general economic theory, to explain the justification and the determinants of international trade. What explains general domestic trade will explain international trade. International trade theory should reverse its current procedure of analysis: rather than analyze an economy from autarky to free trade, it should start from an ideal world of free trade to a world with restricted trade. In other words, we need international economic theory only to explain why, in an economic sense, international trade is NOT as developed as domestic trade, and we need an economic theory to explain the economic function of international borders.

Secondly, import demand in a market economy can be fully modeled by two determinants: income and relative prices. The other factors can all be subsumed within these two factors, at least theoretically. For example, the factors behind relative prices include: relative endowments of resources and productive factors, taste, market structure, scale, exchange rates, trade barriers etc. The impacts of changes in these factors on import demand will take place through a change in relative prices.

Empirical framework of trade elasticities

Most empirical studies of international trade fall into one of two basic frameworks: the “imperfect substitutes” model and the gravity model. While the former is most relevant to our discussion, the latter is also of interest.

The imperfect substitutes framework

Recent surveys of research in this area include Goldstein and Khan(1985), Knetter (1992), Marquez (1993), and Hooper and Marquez (1995). As pointed by Hooper and Marquez (1995), much of the work in this area since Goldstein and Khan (1985) has focused on the relation between exchange rates and trade prices, i.e. exchange rate pass-through, rather than price and income elasticities themselves. Most empirical studies have taken the “imperfect substitute” framework for granted.

In summarizing the empirical studies of price and income effects in foreign trade, Goldstein and Khan (1985) presented two trade models: the imperfect substitutes model and the perfect substitutes model. While the latter is mainly for the trade of homogeneous commodities, such as those included in SITC groups 0 to 4, the former is the one mostly used in studying imports of manufactured goods and aggregate imports.

The key assumption of the imperfect substitutes model is that imports and exports are not perfect substitutes for domestic goods. The basic model contains eight equations for the quantities and prices of trade between a country and the rest of world. Among them, the import demand function is defined as:

$$M_i = f(Y_i, PM_i, P_i) \qquad (4)$$

where M_i is the real import demand of country I, Y_i is the nominal income, PM_i , is the import price index in local currency, and P_i is the price index for domestically

produced goods.

Under the assumption of homogeneity, (4) is usually expressed as :

$$M_i = f(y_i, PM_i / P_i) \qquad (5)$$

where y_i is real income.

Function (5) is the framework most commonly used in empirical studies of import behavior. There are several issues in applying it to actual data for estimating empirical import demand equations. The following are the main issues and some recent developments in this area.

Dynamic specification

In empirical studies, equation (5) is almost always estimated in log linear form. Taking into account the costs of adjustment, delivery lags, etc., a lag structure is always specified and estimated. The traditional approach to handling the lag structure usually imposes a polynomial (Almon) lag distribution, or a geometric lag distribution.

However, as pointed out recently by some economists, the ad hoc approach to specifying and estimating the dynamic structure seems to be inconsistent with the optimality assumption implied by the new classical demand theory behind the import demand function. This is a common issue in the dynamic specification of all kinds of models[1] .

To specify a more consistent, at least theoretically, dynamic structure of the import demand function, some authors have incorporated the permanent income consumption theory in specifying import demand. For example, R. Amano and T. Wirjanto (1996) specified a framework that assumed that consumers would make their decision on consumption and asset holdings for each period by solving the following dynamic programming model:

$$E[\sum_{t=0}^{\infty} \beta^t U(C_t, M_t)]$$

subject to

$$A_t = (1+R_t)A_{t-1} + Y_1 - P^H{}_t C_t - P^F{}_t M_t \qquad (6)$$

where E is the expectation operator, $ is a discount factor, U (C_t , M_t) is the utility function of real consumption of domestically produced goods (C) and real consumption of imported goods (M), A_t is real financial assets at the end of period t, R_t is the real interest rate on assets , Y_t is real non-property income in period t, P^H is the price of domestic goods, and P^F is the price of imported goods.

By assuming certain conditions for the existence of a solution of the dynamic programming problem, the time path of consumption of both domestic and imported goods will be defined by a set of Euler equations. With a specific form of the utility function, and with the introduction of a stationary stochastic process of random shocks to preferences, Amano and Wirjanto applied this framework to United States domestic and imported consumption of non-durable goods. They also made a comparison between estimates from the GMM (generalized method of moments) approach and estimates from the cointegration approach. Their study suggested that intertemporal substitution of imports in this framework was important: this had not been taken into account in the conventional import models.

Meanwhile, R. Clarida (1996) has used almost the same framework to study United States demand for imported consumer durables. In his theoretical specification, price elasticity of import demand is not constant but converges to -1 as the share of total spending on imports rises, and income elasticity is also not constant but declines over time as the share of spending on imports rises. Nevertheless, his empirical estimates of the long-run price and income elasticities are in the range of those reported by previous authors, as surveyed in Goldstein and Kahn (1985), who have estimated the conventional import demand equations.

Cointegration and Error Correction Model

Since the 1990s, cointegration and error correction modeling techniques have been used more and more in estimating the price and income elasticities of imports. However, as some recent studies

1 A detailed discussion of this issue in the literature of investment functions was reported in Hong and Pauly (1996).

have reported, the estimated elasticities from cointegration and error correction modeling are not much different from those estimated by the conventional methods. For example, Clarida (1991) found that the cointegrating relation among imports, income, and relative prices for the United States would yield income and price elasticities that were very similar to those found by Helkie and Hooper(1988) and Cline (1989), who did not use cointegration analysis.

In a more recent study, Carone (1996) reported his new estimates of the aggregate demand for both total and non-oil merchandise imports of the United States obtained by using cointegration techniques and error correction modeling. His estimates of a relatively high income elasticity and a relatively low price elasticity for the United States imports, as he reported, were basically in the range of those previously reported by many other studies using "conventional" econometrics. The only difference was that the estimated income and price elasticities of his error correction models did not show significant changes over time, while some other previous studies with "conventional" econometric techniques had reported contrary results.

Why are the income elasticities not equal to one?

One observation from many empirical studies of import behavior, such as those surveyed by Goldstein and Khan(1985), Hooper and Marquez (1995), and many others, is that there exists a wide range of estimated income and price elasticities, both across countries and across different studies for the same country. For example, the estimated income elasticities of imports for the United States among the empirical studies surveyed by Goldstein and Khan (1985) ranged from 0.76 to 4.

According to neoclassical demand theory, which is the theory behind the imperfect substitutes import demand function as defined by equation (5), the marginal income propensity to consume a particular commodity could be any value, depending on whether the commodity is a normal, an inferior, or a luxury good. But when aggregate imports are considered, it is reasonable to assume that on average they are normal goods. So the marginal income propensity to import , i.e. m as defined in (3), should be between zero and one. Assuming that the average income propensity to import in period t is M_t / Y_t and that there is an increase in income, ΔY_{t+1}, if nothing else changes (no relative price changes, etc.), there is no reason to assume that the proportion of the additional demand for imports, ΔM_{t+1} induced by the additional income would be different from the prevailing average proportion of total imports in total income. In other words, the marginal income propensity to import would be equal to the current average income propensity to import, namely, $\Delta M_{t+1} / \Delta Y_{t+1} = M_t / Y_t$. Therefore, by definition, it implies that the income elasticity of imports is equal to one (income elasticity = $(\Delta M_{t+1} / \Delta Y_{t+1}) / (M_t / Y_t) = 1$). Over time, when everything else is also changing (most of these changes will be eventually reflected in changes in relative prices), there will be additional changes in import demand , meaning that the average income propensity to import, defined as the ratio of the total import to income, will change over time and so will the marginal propensity. But as long as the marginal income propensity to import is always equal to the prevailing average propensity (and, as argued above, there is no reason to assume they are not equal), the income elasticity will always be equal to one over time.

If so, why are most reported estimates of income elasticities not equal to one and, in particular, why are most estimates significantly greater than one?

A conventional argument is that continuously added new capacities in exporting countries, i.e. some new goods which are not included in the import price index in importing countries, will lead to an underestimation of price effects and thus an overestimation of income effects. In other words, because the existing import price index cannot fully reflect the changes in the prices of importable goods, part of the change in import demand, which should be explained by changes in prices, has been attributed to changes in income.

Another argument is that the unit income elasticity implied by the neoclassic demand theory only applies to final goods, but it may not apply to aggregate imports which include raw materials and intermediate

goods. In effect, what makes the income elasticity equal to one is the budget constraint in the neoclassic demand theory: the sum of all spending on foreign produced goods and domestically produced goods should be equal to income. However, in modeling aggregate imports, this constraint does not hold, because aggregate imports are measured in terms of gross value of all goods from abroad, including final goods and intermediate goods; but income (or GDP) is measured in terms of value added, so that the estimated income elasticity would not be equal to one. Therefore, an alternative is to use gross output, or GDP plus exports, as the activity variable to explain import demand. In this case, there will be two kinds of import demand: one for final goods based on the neoclassic demand theory, and another for raw material and intermediate goods based on the neoclassic production theory (that is, facing given prices, firms would maximize their profit by choosing optimal inputs, which, as a result, will be a function of output and relative prices), with gross output, rather than income (value added), as an explanatory variable.

However, we may argue that, as long as the production technology has constant returns, and as long as the ratio of value added to gross output is a constant, the use of gross output, instead of income, in the aggregate import demand function should still yield an income (or activity) elasticity of one.

Finally, a more theoretically interesting argument to support larger-than-one income elasticity of imports may be derived from a combination of the neoclassical framework and the new trade theory. Assume that we could divide total imports into two parts, inter-industry goods and intra-industry goods so that they can be modeled separately— the neoclassical import demand model for inter-industry imports and an increasing returns model for intra-industry imports. In the model of increasing returns, income will be used as a proxy for economic scale. The income elasticity in the first model will be equal to one, while the income elasticity in the second model will be greater than one. In practice, when the ad hoc import demand function is estimated, the estimated income elasticity is a result of the overlapping effects of the two roles of income played on inter- and intra-industry imports. The larger the proportion of intra-industry goods in imports, the greater the income elasticity would be. This argument should be tested against cross-country data: it implies that industrial countries should have relatively higher income elasticities than developing countries.

Nevertheless, we have a few caveats to this argument. First, in the pure neoclassical framework, the theory implies unit income elasticity but, when increasing returns are allowed, there is no theoretical value for the elasticity. Secondly, although imperfectly competitive market structures can exist in reality, monopoly profits should not last too long and should not be too much higher than the average profit, and so the income elasticity based on this factor should not be much greater than one.

Gravity model of trade

While the imperfect substitutes framework discussed above focuses on the determinants of aggregate international trade with emphasis on structural parameters and their economic policy implications, the gravity modeling framework focuses on the determinants of bilateral trade flows, with an emphasis on location factors and their geo-political and geo-economic policy implications.

Developed in the 1960s by Tinbergen (1962) and Pöyhönen(1963), the gravity model of bilateral trade has recently re-emerged in the debate on multilateralism and regionalism. For example, Frankel et al (1994) used this model to demonstrate that a preferential trade arrangement among the countries of the Asian Pacific Economic Cooperation (APEC) was naturally consistent with the “law of gravity ” (in an economic sense, as implied by the gravity model of trade).

The Newtonian Law of Universal Gravitation, in the mechanics of a single particle, states that there is a force of attraction between any two masses, m_1 and m_2 , which is directly proportional to the product of the masses and inversely proportional to the square of their distance apart:

$$F = \gamma m_1 m_2 r_{12}^{-2} \qquad (7)$$

When the two kinds of mass are assumed to be the same, (has the constant value of 6.66×10^{-8} .

The gravity model of international trade, by the same token, states that trade between any two

countries is proportional to their economic sizes, i.e. GDPs, and inversely proportional to the distance between them. A typical form of the model is as follows:

$$T_{ij} = kY_i^{\alpha}Y_j^{\beta}D_{ij}^{-\epsilon} \qquad (8)$$

where k is a constant.

Strictly speaking, equation (8) is not in the same functional form as (7). In effect, it is even more "universal" than (7): (7) is a special case of (8) when "=$=1 and ,=2.

It has been a fashion for some economists to borrow concepts and models from physics, probably because of the rigorous mathematical beauty of the latter. For example, Brownian motions are probably more talked in finance today than in physics. However, we should keep in mind that the objectives of these two sciences are different, and a successful model in one science does not necessarily imply its success in the other.

There have been many debates on bilateral trade issues, such as the bilateral trade imbalances between United States and Japan, between United States and China, etc. However, most bilateral trade issues are more of political interest than economic interest. A country 's total trade with the rest of the world, or its overall external balance, is more important than its bilateral trade in terms of economic analysis. What are the implications of the gravity model for a country's total trade, and for trade elasticities ?

By assuming an ideal world in which "=$=1 and ,=0, Krugman (1995) obtained two equations from (8) as the follows, one for a country's total trade and another for the total trade of the world.

$$T_i / Y_i = k(1 - s_i) \qquad (9)$$

where T_i is country i's total trade (exports plus imports), Y_i is its GDP and s_i is its share in gross world product;

$$T_w / Y_w = k(1 - \sum s_i^{\,2}) \qquad (10)$$

where subscript w refers to the world total.

Krugman claimed that, as indicated by (9), an individual country's ratio of trade to GDP would be larger, the smaller its share of world income; and that, as indicated by (10), the overall share of trade in the world would be larger, the more equal in size its national economies. He believed that these two conclusions were consistent with the facts, and that the gravity model provided a good explanation why the rise in the ratio of trade to GDP had been more dramatic for the United States than for other industrial countries in the last two decades or so: it was because the share of United States GDP in the gross product of market economies had been declining from 31 per cent to 25 per cent in the same period.

However, we have reservations regarding these observations. First of all, this explanation for the United States seems entirely contradictory to the observed trend in some Asian countries, such as the NIEs, China etc., in which their ratios of trade to GDP have been increasing along with their increasing shares of GDP in gross world product.

Secondly, in deriving (9) and (10) from the gravity model (8), [2] Krugman seems to have omitted the term Y_w on the right-hand side of both equations. The correct form of these equations should be as follows.

$$T_i / Y_i = kY_w(1 - s_i) \qquad (11)$$

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2 By assuming "=$=1 and ,=0, (8) will become:

$T_{ij} = kY_iY_j$

Then the country I's total trade will be equal to the sum of T_{ij} over j ($j \neq i$), as follows:

$$Ti = \sum_{j \neq i} T_{ij} = \sum kY_iY_j = kY_i \sum Y_j = kY_i(Y_w - Y_i) = kY_iY_w(1 - s_i)$$

where $s_i = Y_i / Y_w$

so $T_i / Y_i = kY_w(1 - s_i)$

By the same token,

$$T_w = \sum_I T_i = \sum kY_iY_w(1 - s_i) = kY_w \sum Y_i(1 - s_i) = kY_wY_w(1 - \sum s_i^{\,2})$$

so $T_w / Y_w = kY_w(1 - \sum s_i^{\,2})$

$$T_w / Y_w = kY_w(1 - \sum s_i^2) \qquad (12)$$

With these two equations, his claim would not have been so straightforward. As indicated by (11), a country's share of trade in GDP[3] not only depends on its relative size in the world economy, but also on the absolute size of the world economy. Likewise (12) indicates that the overall share of trade in world economy will not only depend on the variance of the size across all countries, but also on the absolute size of the world economy.

Moreover, (12) also implies that $T_w = kY_w^2(1- G s_i^2)$, implying the income elasticity of trade for the world as a whole is equal to two. No economic theory could support this magic number.

There have been debates on the theoretical foundations of the gravity model of trade and its practical value in explaining actual trade patterns. Deardorff (1995) showed that a simple gravity model could be derived from standard trade theories, such as the Heckscher-Ohlin framework. But his study focuses on two special cases: frictionless trade, in which there is an absence of all impediments to trade in homogeneous products, consumers are indifferent among trading partners, and there is complete specialization. He also concluded that the use a gravity model of trade to test any of the trade theories is suspect because the gravity model characterizes many models.

Polak (1996), on the other hand, has directly criticized the validity of the gravity model in the study of APEC by Frankel *et al* (1994). He re-examined the gravity model against some actual data and concluded that the model lacked the theoretical foundation for the conclusions made by Frankel *et al*.

In the gravity model, the use of income variables can be justified by any trade theories, as we reviewed in section 2 (but not necessarily in the functional form of the gravity model). It is the specification of distance as an explanatory variable that is controversial. Geographic distance is correlated with some trade barriers, such as transportation costs and cultural differences, and that is probably why the estimated coefficient of the distance variable could be statistically significant, as reported in some studies. However, geographic distance may not be correlated with many other trade barriers. Furthermore, geographic distances between different countries are not homogenous, even in terms of transportation cost— trade between countries separated by mountains will not be the same as trade between countries separated by the same the same distance of ocean, or land. There is also a practical difficulty: one has to define the "centers" of countries before the distances among countries can be determined.

The gravity model may at most be used as a tool for normative studies to set a benchmark for what the ideal international trade flows among different geographic areas ought to be if there were no trade frictions. In this case, there should be strict constraints that " = $ =1 and , =2, leaving just one universal parameter, namely k, to be estimated against actual data for trade among locations within one country (say United States) (since domestic trade is close to an ideal frictionless state). It is not a proper model for positive studies to investigate why, in the real world, international trade flows should be as they are—any attempt to add dummy variables, allowing different parameters across countries or modifying the concept of geographic distance, would damage the beauty of simplicity in the original Newtonian physics.

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3 It is better to call it the ratio of trade to GDP, because, as mentioned above, GDP is measured in value added and trade is measured in gross value, and what in GDP identity is not the total trade but the net export, i.e., export minus import.

Import elasticities in the link models

The LINK modeling system, which is jointly run by the United Nations, the University of Toronto and the University of Pennsylvania, consists of 80 country and regional models linked through bilateral trade flows and other international economic variables. International trade and prices are simultaneously determined in the LINK system, together with the domestic economic activities in each country model.

Table 1 summarizes the long term activity (income, expenditure, total consumption spending and any other activity variables) elasticities and price elasticities of imports from selected country models in the LINK system. We focus on imports of manufactural goods. In the LINK trade linkage, the imports of every country have been reorganized into four standard SITC groups. But within a country model, imports can be defined as capital goods, consumption goods, or in other classifications, depending on national model builders. The table lists the elasticities in their original equations.

Among the models listed here, the error correction modeling framework is used in specifying the import demand functions in the United Kingdom and Chile models and the conventional framework is used in the other models.

We may tentatively make two observations from table 1. First, income elasticities of import demand across different country models, especially for consumer goods, do not diverge by a large amount and most of them are greater than one by a fraction. Secondly, price elasticities, on the other hand, vary more widely across countries.

Table 4.1: Long-term activity and price elasticity of imports

Country	Activity elasticity	Price elasticity	Notes
United States	0.98	-1.05	Consumer goods
Japan	1.35	-0.52	SITC 5+6+8+9
Finland	$I_1 = 1.56$ $I_2 = 0.99$	$P_1 = -0.46$ $P_2 = -0.6$	1 - Consumer goods 2 - Investment goods
Chile	$I_1 = 1.15$ $I_2 = 1.1$ $I_3 = 1$	$P_1 = -0.15$ $P_2 = -0.48$ $P_3 = 0$	1 - Consumer goods 2 - Intermediate goods 3 - Investment goods
China	1.2	-0.6	SITC 5-9
South Africa	1.06	-0.8	SITC 5-9
United Kingdom	1.0	-0.6	Final manufactural

Summary remarks

We can now summarize the discussion above in a few points.

Trade elasticities should be estimated in a fully specified modeling framework, with economic theories as guidance, rather than be mistakenly approximated by ratios of observed relative growth rates.

While neoclassical economic theory implies that the long run income elasticity should be equal to one, a slightly-greater-than-unity income elasticity can be supported by the new trade theory. The higher the share of intra-industry trade, the higher (relatively) the income elasticity could be, meaning that income elasticity in developed economies, on average, could be higher than that in developing economies. However, the income elasticities of imports across countries should not be too different. Ideally, international trade should be modeled by separating inter- and intra-industry goods.

The estimates of trade elasticities from the conventional modeling techniques may not be significantly different from the estimates by some new modeling techniques, such as the intertemporal specification, the cointegration and the error correction modeling techniques. However, the new approaches are superior to the conventional ones in a number of ways, including their improved theoretical consistency.

The gravity model of trade, which may have some value in analyzing the geopolitical factors behind bilateral trade flows, does not seem to be useful in analyzing the economic factors behind aggregate trade.

The estimation of price elasticities is more important and more difficult than that of income elasticities, which, by a conservative rule, may be imposed as unity. Many factors affect import demand through their impacts on relative prices. But the statistical relative price index may not fully reflect the actual changes in relative prices.

As mentioned at the beginning of this paper, the ratio of the growth rate of world trade to the growth rate of world gross product has risen from an average of 2 in the 1980s to 2.9 in the late 1990s. This implies, if we take the conservative estimate of an unit income elasticity, that there must have been a worldwide continuing decline in the relative prices of foreign goods with respect to domestic goods. In other words, on average, more than half of the increase in world trade each year has been caused by price related factors, such as the reduction in tariff and non-tariff barriers as a result of trade liberalization, the reduction in the cost of long-distance transportation and telecommunications as a result of changes in technology (but changes in technology could change both domestic and international prices such that the relative prices would remain the same, unless the changes in technology were asymmetric across countries), pricing strategies at firm levels, etc.

Moreover, since the income elasticity of trade should be stable and close to one, most year to year fluctuations in the growth rates of international trade should then be attributed to changes in relative prices.

In forecasting world trade and world output, we have to keep in mind that one percent of growth of world GDP can only bring about one per cent growth of the international trade. Consequently, any optimistic forecast of world trade growth, in terms of a high ratio of trade growth relative to output growth, should have as a foundation the expectation that there will be a continuous decline in the relative prices of international tradable goods, either implied by policy assumptions of worldwide trade liberalization, or by any other foreseen factors which will lead to a continuous decease relative prices.

Every country's income elasticity should not be too different, so the commonly accepted hypothesis that United States has a high income elasticity of imports and is acting as an engine of world trade is not true. The United States economy may have a large impact on world trade because of its relative size, but not because it has a high income elasticity of imports.

Relative prices matter more than income in determining the growth of trade, so a sustainable high growth of world trade in the future will mainly depend on policies which will effectively reduce the relative prices of tradables, such as reduction in different kinds of trade barriers.

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