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Global Production Sharing and the Measurement of Price Elasticities in International Trade

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Abstract

Global production sharing—the breakup of the production process into geographically separated stages— has been an increasingly important facet of economic globalisation over the past few decades. As the scale of activities in a vertically integrated production process expands, opportunities are created for locating parts of the production process based on their relative cost of production. This has resulted in a steady rise in trade in parts and components and assembled final products across national borders. This paper probes the implication of the dichotomy between trade in parts and components and final goods for the measurement of price elasticities in international trade using a unique disaggregate dataset relating to US manufacturing imports. It is found that parts and components are remarkably less sensitive to changes in relative prices and, consequently, the sensitivity of aggregate trade flows to relative prices tends to diminish as trade cuts ever more rapidly into the production process. This finding casts doubt on the reliability the conventional approach to trade flow modeling which treat parts and components and finals goods as a unified, homogeneous product.

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Global Production Sharing and the Measurement of Price Elasticities in International Trade[1]

1. INTRODUCTION

Global production sharing—the breakup of a production process into vertically separated stages carried out in two or more countries—has become one of the defining characteristics of the nature of world trade over the past few decades.[2] As the scale of activities in a vertically integrated production process expands, so do the opportunities for reducing costs by locating parts of the production process in different countries. This has resulted in a steady rise in the trade in parts and components and assembled goods across national borders as a global phenomenon involving countries at varying stages of development.

There are many theoretical studies examining the causes and modalities of global production sharing, and implications of the growing dichotomy between parts and components and final products for trade flow analysis and trade policy.[3] The idea that trade in parts and components and assembled goods within global production networks can have an effect on production, prices and trade flows that is different from trade in goods produced in a single country is gaining widespread acceptance. However, applied trade economists have been rather slow to incorporate this new form of international specialization into trade flow analysis, which continues to rely upon the traditional notion that countries trade goods that are produced from start to finish in a single country (products that are "made" in a given country). Trade flow analysis is still carried out using trade elasticities estimated at highly aggregated levels, grouping parts and components and final goods together.

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[2] This phenomenon has also been described as international production fragmentation, vertical specialization, intra-product specialization, slicing the value chain, and outsourcing.

[3] For comprehensive surveys of this literature see Feenstra (2010), Grossman and Rossi-Hansberg, (2008) and Helpman (2006).

The purpose of this paper is to probe the implications of the growing dichotomy between trade in parts and components and final goods for the measurement of price elasticities in world manufacturing trade. The methodology involves comparing the results when the standard import equation is estimated separately for *total* imports, parts and components and final goods using manufacturing import data of the USA. The USA is chosen for the study based on data availability and the role of USA as the single most important player in world trade. Relating to data availability, our foremost consideration here is the availability of genuine trade price indices (rather than unit value series) at a sufficiently disaggregated level, covering a reasonable period of time. Unit value indices have well-known limitations as price proxies, particularly for manufactured goods.[4] It is important to emphasize at the outset that the purpose of here is to examine the implications of global production sharing for price elasticities of trade estimated using the standard import-demand model, rather than to estimate the best-fit model for explaining trade flows in the presence of global production sharing. Our results provide strong support for the hypothesis that trade taking place writhing global production networks tends to weaken the explanatory power of the standard import demand function.

The paper is structured as follows. Section 2 provides an overview of the process of global production sharing, the resultant dichotomy between trade in parts and components and final (assembled) goods, the likely implications for the responsiveness of trade flows to changes in relative prices. Section 3 describes the model, data and the estimation method. Section 4 presents the results of a trade flow modeling exercise. The final section summarizes key findings and considers policy implications.

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[4] For details on the US foreign trade database with an interesting comparison of export price indices and unit value indices see Lipsey et al (1991).

2. ANALYTICAL CONTEXT

The Process

International production sharing is not entirely a new phenomenon. Pollard (1981) tells a fascinating story about how British textile and clothing manufactures at the height of the industrial revolution began to shift labour intensive segments of the production process to countries in the European mainland in face of domestic labour shortages and mounting wage pressure. In a study of merging patterns of industrial production in the USA in the first two decades of the 20th century, Young (1928:527) observes that 'over a large part of the field of industry, an increasingly intricate nexus of specialized undertakings has inserted itself between the production of raw materials and the consumer of the final product'. Kindleberger (1967) writes on the role of Belgium in the 1960s as a low-cost base for parts and components assembly for automobile producers located in Germany. as By the late 1950s, when national statistical agencies began reporting data disaggregated enough to allow for tentative estimations, machinery components accounted for nearly 15% of the manufacturing exports of mature industrial countries.[5]

What is new about the contemporary process of global production sharing is its wider and ever increasing product coverage, and its rapid global spread from mature industrial countries to developing countries (from the developed North to the developing South). With a modest start in electronics and clothing industries in the late 1960s, North-South exchange within international production networks encompassing developed and developing countries has gradually evolved and spread to many industries such as sport footwear, automobile, televisions and radio receivers, sewing machines, office equipment, electrical machinery, power and machine tools, cameras, and watches. Cost competitiveness and scale economies achieved through global production sharing has

[5] Calculation based on the data appendix of Maizels (1963).

provided the setting for the emergence of many new products leading to growth in world trade at a much faster rate than world production.[6]

In its infancy, global production sharing was predominantly a two-way exchange between the home and host countries; parts and components were exported to the low-cost, host country for assembly, and the assembled components were re-imported to the home country to be incorporated in final products. Over the years, production networks have evolved to encompass multiple countries involved in different stages of the assembly process. As international supply networks of parts and components have become firmly established, producers in advanced countries have begun to move the final assembly of an increasing range of consumer durables (for example, computers, cameras, TV sets and motor cars) to overseas locations, in order to be physically closer to their final users and/or to take advantage of cheap labour (Jones 2000, Brown et al. 2004).

In the case of standard consumer goods such as garments and footwear, global production sharing normally take place through arm's length relationships, with international buyers playing a key role in linking the producers and the sellers in developed countries.[7] Global production sharing in electronics and other high-tech industries, on the other hand, has evolved in a different manner. In the beginning, the process essentially involved a multinational enterprise (MNE) building an overseas subsidiary to perform some of the functions that it once did at home (Helleiner 1973, Sturgeon 2003). As production operations in the host countries became firmly established, production fragmentation in these industries eventually began to spread beyond the MNEs. MNE subsidiaries began to subcontract some activities to local (host-country) firms, providing the latter with detailed specifications and even fragments of their own technology. At the same time, many firms which were not part of MNE networks began to procure components globally through arm's-length trade. However,

[6] Many products such as small lap-top computers, hand phones, and various entertainment devices (such as iPod) could not have been produced at prices that assure commercial viability if it were not for the cost reduction achieved through th global spread of various slices of the production process.
[7] For instance the Swedish furniture firm Ikea has for years outsourced the actual manufacture of items to subcontracting-firms in countries like Poland and Vietnam, retaining the design tasks in Sweden. The US based sportswear producer Nike undertakes its design work and advertising at home carries out most of its actual production in a number of Asian countries through arm's length relations.

the bulk of global production sharing within global high-tech industries still takes place under the aegis of MNEs. This is because the production of final goods require highly customized and specialized parts and components whose quality cannot be verified or assured by a third party (and it is not possible to write a contract between the final producer and input supplier which would fully specify product quality).

There is evidence that trade based on global production sharing ('network trade') has grown at a much faster rate than total world manufacturing trade over the past four decades. In a pioneering attempt to quantify global production sharing using trade data for the OECD countries, Yeats (2001) found that parts and components accounted for 30% of total trade in machinery and transport equipment[8] of these countries in 1996, compared to around 15% in the mid-1980s. Following Yeast's approach, but with broader commodity coverage, Athukorala (2010) estimated the share of parts and components in total world manufacturing trade in 2007 at 32.1%, up from 23.6% in 1992. According to his estimates total network trade (parts and components and final assembly) accounted for a half of total manufacturing trade in 2007. A number of studies have used the input-output technique to measure the degree of dependence of manufacturing production and trade of selected countries on global production sharing (Hummels et al. 20001, Chen *et al* 2005, Johnson and Noguera 2012, Dean *et al* 2010, Koopman *et al.* 2010). Hansen *et al*. (2005) and Burstein *et al* (2008) measure the extent of production sharing using trade flows between US multinational enterprises and their foreign affiliates. All these studies, regardless of the yardstick used, point to the growing importance of production sharing in world trade and increasing cross-border interdependencies in the world economy.[9]

[8] These are the products belonging to Section 7 of the Standard International Trade Classification (SITC 7). They roughly account for more than one-half of all trade in manufactures.

[9] In addition to these direct quantifications, there is a large number of case studies of the nature and growing importance of production sharing in industries such as electronics and electrical goods, apparel, and motor vehicle. The popular press is also replete with relevant stories. Krugman (2008) and Burstein provides useful summaries.

Implications for trade flow modeling

What are the implications of the on-going process of global production sharing for the degree of sensitivity of trade flows to change in international prices relative to domestic prices? In the recent literature, two competing view have emerged on this issue.

One view holds that global production sharing would have increased the sensitivity of trade flows to relative price changes, enhancing the efficacy of exchange rate policy (Obstfeld 2002 and 2001). The global spread of production processes, so the argument goes, would induce firms to respond swiftly to changes in relative prices (brought about by changes in exchange rates and tariffs) by switching between domestic and imported inputs, shifting tasks across borders, or changing procurement sources of final (assembled) products. Production networks not only open up greater opportunities for shifting production/procumbent sources in line with such price changes but also act as swift and efficient purveyors of market information among the participants.

The alternative view, which takes a broader perspective of the nature and modalities of global production-sharing based international exchange, holds that global production sharing could in fact weaken the link between international price changes and trade flows, for a number of reasons (Burstein et al. 2008; Arndt 2008; Jones and Kierzkowski 2001; Jones 2000, Chapter 7). First, within global production networks, production units located in different countries normally specialize in specific tasks which are not directly substitutable for tasks undertaken elsewhere. In other words, different segments of the production process (including final assembly) are differentiated by country of origin. Therefore, the substitutability of parts and components obtained from various sources is rather limited.

Second, in the process of global production sharing, international prices/cost differentials are only one consideration in production location/procurement decisions of firms. Setting up of overseas production bases and establishing the services links entail high fixed costs. Once such fixed costs are incurred, relative price/cost changes become less important in business decision making. This may be particularly so when it comes to business dealings with production bases located in developing countries because the wage gap between these countries and home countries are so vast that even a large change wage is unlikely to have a significant impact on profit margins.[10]

Third, global production sharing could weaken the link between the domestic cost of production and export competitiveness. When a firm in a given country is engaged in a particular segment (slice) of a vertically integrated production process, its export profitability depends not only on external demand and the domestic cost of production, but also on supply conditions in other countries supplying parts and components and the bilateral exchange rates with them. Consequently, the change in the price of imported parts and components becomes an important determinant of export profitability, depending on the magnitude of the share of domestic content (value added + domestically produced inputs) in exported goods.

Fourth and related to the first point, changes in exchange rates affect component imports and end-product exports differently. If exports are made with imported components, then exchange rate depreciation (appreciation) of a given country increases (reduces) the domestic currency price of its exports but it also reduces (increases) the home-currency prices of its component imports, reducing (increasing) the overall profitability of exporting compared a situation where the production is entirely based on locally-procured inputs. This relationship becomes more complicated when (i) parts and components are procured from countries other than the countries for which the end products are destined; and (ii) the number of countries involved in the production chain increases (Riedel 1982, Arndt 2008). In sum, changes in exchange rates have offsetting effects on imports and exports and thus the net effect of exchange rate changes on exports will consequently tend to be weaker than in the standard case of producing the entire product in the given country.

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[10] This point is relevant only to vertical specialisation within multinational enterprises, not to arms-length value chain slicing. However, as noted earlier, the former is by far the dominant force in global production sharing. See also Chen et al. (2005).

The above consideration suggests that the implication of global production sharing for estimating price elasticity of world trade is very much an empirical issue. However, the issue has not yet been subjected to sufficient empirical scrutiny, in spite of its immense relevance for trade policy and open-economy macroeconomic policy. To our knowledge, so far the only attempt to examine this issue has been the study by Arndt and Huemer (2007). This study examines whether goods flowing within production networks alter the sensitivity of manufacturing trade between US-Mexico bilateral manufacturing trade to changes in the real exchange rate, and home (US) and Mexican GDP. The findings reveal that exports of automotive parts and components do not respond to the real exchange rate and are solely determined by income levels in the two countries. Escaith et al. (2010) presents estimates of income elasticity of demand for trade within global value chains for 30 major trading nation through a bivariate model linking imports to income (GDP). Their income elasticity estimates are presumably biased because of the failure to allow for the relative price effect.

3. THE MOMEL, DATA AND ECONOMETRICS

The standard import demand equation in a panel data setting takes the form:

$$M_{it} = \alpha + \beta_1 Y_t + \beta_2 RPM_{it} + \delta_i + \gamma_t + \epsilon_{it}$$

where i=1,2,...,N is the product category, t=1,2,...,T is the time unit in quarters and, M is real imports, Y is domestic income (real GNP), RPM = PM/PD is relative import price (import price/domestic producer price), α_i is product specific effects, γ_t is time-specific fixed effects and ε_{it} is the disturbance term. The three key variables, *M*, *Y*, and *RPM* are measured in natural logarithms so that the coefficients of the latter two variables can be interpreted as income elasticity and price elasticity of import demand.

The model is estimated using a quarterly panel data set put together from electronic databases of the US Trade Commission (data on imports and import prices) and the US Bureau of Labor Statistics (data on domestic producer price indices and

GNP). The original data on manufacturing imports available at the five digit level of the Standard International Trade Classification (SITC) were separated into parts and components and final goods[11], and aggregated at the 3-digit level for the purpose of the analysis. Domestic price series (available at the 4-digit US Industrial Classification (USSIC) were matched with the SITC 3-digit import price series using the standard SITC-SIC concordance obtained from the website of the UN Statistical Office. Details on the commodity and time coverage of the data set, together with parts and components shares in each commodity, are given in Appendix Table A-1.

The dataset cover 43 SITC3-digit products which accounted for nearly 62.5% of total US manufacturing export during 1990-2007. The data panel is unbalanced: the time coverage of data for individual products varies from 1992Q4 – 2007Q4 to 2003Q$ - 2007Q4. Import demand functions are estimated using data for all 43 products and machinery and transport equipment two sub-categories (machinery and transport equipment, information and communication technology products, and miscellaneous manufacturing), distinguishing between parts and components and final imports.

Estimation of the static model specified in equation (1) using the standard OLS, random-effects (*RE*) or fixed-effects (*FE*) estimators could yields spurious results if the variables *M*, *Y* and *RPM* are non-stationary. Non-stationarity is likely to be the case when dealing with macroeconomic data of this sort. If the variables are co-integrated (that is, the variables share a common stochastic trend), estimation of the static model gives super-consistent results characterized by extremely high *t*-ratios. Even though the coefficients then represent a consistently estimated long-run relationship, inference about their statistical significance is misleading as the estimator is not normally distributed. The issue can be addressed by estimating an ARDL formulation of the model. In addition to providing valid inference about the statistical significance of the variables, this also allows estimating both the short run and the long run relationships by reparameterizing the ARDL model into an error-correction representation.

[11] The list of parts and components used for this purpose is based on UN Broad Economic Classification (BEC) Registry (available at http:/www. unstats.un.org/unsd/cr/registry). Following Yeast (2000), we separated parts and components (middle products) from the standard intermediate goods based on the detailed commodity nomenclatures given in the BEC directory supplemented with product covered under the WTO Information Technology Agreement. The list available from the authors on request..

We therefore started estimation by conducting a test for the presence of unit root in the three variables. The Fisher combination test developed by Maddala and Wu (1999) is used for this purpose as it can be employed on an unbalanced panel data-set such as ours. Under the null hypothesis, all panels contain a unit root. The results are reported in Table 1. While the null cannot be rejected for the level of any variable, it can be rejected emphatically for the first difference. These test results make a convening case for using the ARDL (1,1,1) panel specification of equation (l):

$$M_{it} = \alpha_1 Y_t + \alpha_2 RPM_{it} + \alpha_3 M_{it-1} + \alpha_4 Y_{it-1} + \alpha_5 RPM_{it-1} + \delta_i + \gamma_t + \varepsilon_{it} \quad (2)$$

Simple algebraic manipulation converts the ARDL(1,1,1) specification into the following panel error-correction formulation:

$$\Delta M_{it} = \lambda_1 \Delta Yit + \lambda_2 \Delta RPM_{it} + \mu_i \left(M_{it-1} - \beta_{0i} - \beta_1 Y_{it} - \beta_2 RPM_{it} + \tau_t \right) + \varepsilon_{it} \quad (3)$$

where $\mu_i = -(1-\alpha_3)$; $\beta_{0i} = \delta_i / (1-\alpha_3)$; $\beta_1 = (\alpha_1 + \alpha_4)/(1-\alpha_3)$; $\beta_2 = (\alpha_2 + \alpha_5)/(1-\alpha_3)$; $\tau_t = \gamma_t /(1-\alpha_3)$

In Equation 3, the βs are the long run coefficients and μ is the parameter of adjustment towards the long run equilibrium as a result of deviations away from it. Evidence for the presence of a long run co-integrating relationship amongst the variables exists if the estimated adjustment parameter is negative and statistically significant.

It estimating Equation 3, it is important to use an estimation method, which addresses potential parameter heterogeneity across different products covered in our data sect. In experimental runs, we use three estimation methods: the dynamic fixed effects estimator (DFEE), the Mean Group estimator (MGE), and the Pooled Mean Group (PMG) estimator (PMGE). FDEE imposes the highly restrictive constraint that all parameters except those relating to the product specific effects/intercepts are homogenous. MGE assumes complete heterogeneity, that is, it imposes no constraints on any of the parameters (Pesaran, Shin and Smith 1997). This in effect would mean estimating a separate equation for each product group and then simply averaging the regression coefficients. Thus MG is consistent but less efficient. PMGE allows the short run coefficients to differ but constrains the long run coefficients to be the same for all product groups (Pesaran, Shin and Smith (1999).

4. RESULTS

Of the three estimation methods used for estimating the dynamic model (Equatrion3), DFEE turned out to be our preferred estimator. In terms of the standard Durbin-Wu-Hausman test there is no evidence that the estimates from DFEE systematically differ from the less restrictive PMGE and MGE. Therefore DFEE is preferred on efficiency grounds. Most of the empirical literature that estimates error correction representations similar to equation (3) rejects the null that DFE is consistent (Foreman 2000, Broeck and Slok 2001, Bassanini and Scarpetta 2002, Martinez-Zarsozo and Bengochea-Morancho 2004, Goswami and Junayed 2006, Frank 2009 etc). However our investigation differs from previous applications of this methodology in that the cross-section here consists of product types within a given country rather than countries or states. A comparison using the Hausman test also leads to the selection of DFEE on efficiency grounds. The results based on DFEE are reported in Table 2. Alternative PMGE and MGE results are reported in Appendix tables A-2 and A-3 for comparison. Overall, the results based on the three dynamic estimators are remarkably similar.

The adjustment coefficient is statistically significant at the one-percent level or better with the negative sign in all equations reported in Table 2, clearly indicating the presence of a long run co-integrating relationship amongst the variables. The magnitude of the estimated long-run (steady state) price elasticity of parts and components is all equation. By contrast, it is statically significant at the one-percent level in all three equations for final goods. Interestingly, the magnitude of the estimated price elasticity (around 2.3) is strikingly similar among the three equations. Thus the hypothesis that global production sharing tends to increase price elasticity of trade flows by opening up greater opportunities for traders to shift production/procumbent sources in line with price changes seem to hold only for assembled final goods.

Finally, the coefficient of domestic income variable (income elasticity of import demand) is close to 4 and is highly significant in all cases. There is no statistically significant difference among the estimated coefficients for parts and components and final goods. All in all, global production sharing seems to have direct implications only for the estimation of price elasticities in world trade.

(This section is to be expanded)

4. CONCLUDING REMARKS

Global production sharing has become a defining characteristic of economic globalization over the past three decades. Consequently, trade in parts and componentshas been expanding more rapidly than that of conventional final-goods trade. At the same time, geographical patterns of final good trade has been undergoing a dramatic transformation as final assembly stages of the production processes of vertically integrated global industries are increasingly shifted to low-cost countries.

The rapid expansion of global production sharing poses a challenge for the standard approach to trade flow modeling which treat parts and components and finals goods as a unified, homogeneous product. The findings of our preliminary econometric analysis suggest that parts and components are relatively less sensitive to changes in relative prices and consequently the sensitivity of aggregate trade flows to relative prices tends to diminish as trade cuts ever more rapidly into the production process.

As regards the role of exchange rate in balance of payment adjustment, our finding has direct implications for the current policy concern about the role of China's exchange rate policy (which allegedly keeps Yuan undervalued) in widening Chinese trade surplus. Given China's pivotal role as the premier final assembly center within global production networks, the potency of exchange rate adjustment in determining the current account surplus could well be much more than what is suggested by the available aggregate price elasticity estimates suggest.

Appendix Table A-1

Products Covered in the Estimates of US Import Demand Functions

SITC No.	Commodity	Time-coverage	Composition of total imports[1] (%)	Parts and components[1]	
				Composition (%)	Share in total imports
514	Nitrogen compounds	2001Q407Q4	0.3	0.0	0.0
515	Organic/inorganic compounds	1992Q4-07Q4	1.5	0.0	0.0
541	Medicinal and pharmaceutical products	1992Q4-07Q4	0.6	0.0	0.0
542	Medicaments	1992Q4-07Q4	1.6	0.0	0.0
553	Perfumery, cosmetic/toilet preparations	2003Q4-07Q4	0.3	0.0	0.0
582	Plates, sheets, films etc. of plastics	1992Q4-07Q4	0.4	0.1	9.4
598	Miscellaneous chemical products	1996Q4-07Q4	0.4	0.4	24.6
641	paper and paper boards	1996Q4-07Q4	1.3	0.0	0.0
642	Articles of paper or paperboards	2001Q4-07Q4	0.4	0.0	0.0
695	Machine or hand tools	1990-07Q4	0.4	0.9	59.6
699	Manufactures of base metals	1990-07Q4	1.0	0.7	18.1
713	Internal combustion piston engines	2004Q4-07Q4	1.6	5.7	89.9
714	Engines and motors, non-electric	1997Q4-07Q4	1.1	4.1	100.0
716	Rotating electric plants and parts	1990-07Q4	0.6	2.1	84.0
723	Civil engineering plants and equipment and parts	1990-07Q4	0.6	0.9	38.5
728	other specialised machinery and equipment and parts	1990-07Q4	0.9	1.0	29.1
741	Heating and cooling equipment and parts	1996Q4-07Q4	0.5	1.0	47.4
742	pumps for liquid, liquid elevators and parts	1990-07Q4	0.3	0.8	59.1
743	pumps and compressors and parts	1990-07Q4	0.8	0.9	27.9
744	Mechanical handling equipment and parts	1996Q4-07Q4	0.6	0.7	32.7
745	Non-electrical machinery and parts	1990-07Q4	0.4	0.5	28.1
747	taps, cocks, valves etc. for pipes, boiler cells etc.	1990-07Q4	0.6	2.2	100.0
752	Automatic data processing machines and units thereof	1990-07Q4	5.3	16.4	80.3
759	Parts and accessories of communication equipment	1990-07Q4	2.8	10.9	99.5
764	Telecom. Equipment n.e.s. and parts	1990-07Q4	4.0	7.9	51.2

771	Electrical power machinery and parts	1990-07Q4	0.7	0.9	33.3
772	Electrical apparatuses for switching/protecting electrical circuits	1990-07Q4	1.4	5.5	98.2
773	Equipment for distributing electricity	1999Q4-07Q4	0.9	3.5	100.0
774	Electro diagnostic apparatus	1996Q4-07Q4	0.4	0.3	18.2
775	Household electrical and non-electrical equipment	1990-07Q4	0.8	0.2	6.2
776	Thermionic, cold cathode or photo-cathode values and tubes	1990-07Q4	3.5	13.6	100.0
778	Electrical machinery and apparatus n.e.s	1990-07Q4	1.6	3.9	61.8
781	Passenger motor cars and other motor vehicles	1990-07Q4	10.8	0.0	0.0
782	Motor vehicles for transport	1993Q4-07Q4	1.6	0.0	0.0
784	Parts & accessories of motor vehicles	1989Q1-07Q4	3.3	12.9	100.0
845	Arties of apparels, of textile fabrics	1992Q4-07Q4	2.1	0.1	0.7
872	Medical/surgical instruments and apparatus	1993Q4-07Q4	0.6	0.0	0.0
874	Measuring,/checking equipments and apparatus n.e.s.	1990-07Q4	1.3	1.0	19.7
884	Optical goods, n.e.s.	1990-07Q4	0.3	0.3	22.4
892	Printed matter	1993Q1-07Q4	0.4	0.1	5.1
893	Articles of plastic n.e.s.	1990-07Q4	1.0	0.0	0.9
894	Bay carriages, toys, games and sporting goods	1990-07Q4	2.3	0.0	0.6
898	Miscellaneous instruments and parts	1990-07Q4	0.6	0.5	23.6
899	Miscellaneous manufactured articles n.e.s	1990Q2-07Q4	0.6	0.1	3.8
			62.5		41.4
	other		37.5		
	Total		100	100	25.9

Note: Date for the period 1990Q1-2007Q4

Table A-2 Import Dead: Pooled Mean Group Estimation Results[1]

	Total	Parts	Final
(1)Total manufactured imports (SITC 5 to 8)			
Adjustment Coefficient	-0.31*** (-6.83)	-0.21*** (-7.46)	-0.35*** (-6.62)
Relative Price Short Run	0.04 (0.18)	0.14 (0.58)	0.00 (0.01)
Long Run	-0.47*** (-6.12)	0.13 (0.83)	-0.43*** (-4.51)
Income Short Run	1.73*** (4.64)	2.86*** (5.69)	1.76*** (2.87)
Long Run	2.13*** (6.73)	1.86*** (5.13)	1.65*** (5.55)
Constant Term	-0.94*** (-6.09)	-1.16*** (-5.93)	0.20** (2.20)
Number of Observations	2602	2127	2222
Number of Groups	44	34	38
Hausman test p-value (MG versus PMG)	0.30	0.81	0.12
(2) Machinery and Transport Equipment (SITC 7)			
Adjustment Coefficient	-0.23*** (-5.46)	-0.17*** (-5.42)	-0.31*** (-4.61)
Relative Price Short Run	-0.12 (-0.07)	-0.10 (-0.56)	-0.02 (-0.04)
Long Run	-0.42** (-2.13)	0.11 (0.47)	-0.47*** (-2.94)
Income Short Run	2.26*** (4.20)	2.61*** (4.92)	2.51** (2.15)
Long Run	1.32*** (3.01)	2.12*** (4.73)	0.88** (2.48)
Constant Term	0.73*** (4.97)	-1.21*** (-5.02)	1.89*** (4.43)
Number of Observations	1471	1344	1091
Number of Groups	24	22	18
Hausman test p-value (MG versus PMG)	0.32	0.70	0.19
(3) ICT Products (SITC 752 - 778)			
Adjustment Coefficient	-0.20** (-2.55)	-0.11*** (-4.00)	-0.30*** (-2.88)
Relative Price Short Run	0.42 (0.97)	0.02 (0.07)	0.67 (1.11)
Long Run	-3.24*** (-9.41)	0.53 (1.32)	-2.87*** (-7.60)

Income Short Run	2.96*** (4.85)	3.86*** (4.72)	3.20*** (2.96)
Long Run	2.21** (2.45)	4.39*** (4.32)	0.51 (0.48)
Constant Term	-1.88*** (2.58)	-2.92*** (-3.96)	5.93*** (2.79)
Number of Observations	644	644	446
Number of Groups	10	10	7
Hausman test p-value (MG versus PMG)[2]		0.38	0.79

Note:

1. t-ratios computed using heteroscadasticity-robust standard errors are reported in rackets, with the statistical significance denotes as *** 1% , ** 5% and * 10% .
2. Hausman test conducted using the variance-covariance matrix from the efficient model to calculate the statistic. Under the null, PMG is consistent and efficient.

Table A-3: Import Demand: Mean Group Estimation Results

	Total	Parts	Final
(1)Total manufactured imports (SITC 5 to 8)			
Adjustment Coefficient	-0.58*** (-11.94)	-0.41*** (-9.67)	-0.64*** (-12.87)
Relative Price Short Run	0.16 (0.61)	0.29 (0.84)	-0.04 (-0.14)
Long Run	-0.19 (-0.60)	0.31 (0.63)	-0.59 (-0.96)
Income Short Run	0.66 (1.16)	2.28*** (4.73)	0.62 (0.82)
Long Run	4.04*** (4.59)	16.29 (1.32)	3.29*** (4.06)
Constant Term	-7.77 (-1.53)	-5.41 (-1.10)	-10.30* (-1.84)
Number of Observations	2602	2127	2222
Number of Groups	44	34	38
(2) Machinery and Transport Equipment (SITC 7)			
Adjustment Coefficient	-0.50*** (-7.21)	-0.37*** (-6.38)	-0.58*** (-7.35)
Relative Price Short Run	0.13 (0.35)	0.29 (0.84)	-0.34 (-0.70)
Long Run	-0.08 (-0.15)	0.17 (0.27)	-0.74 (-0.59)
Income Short Run	1.31** (1.99)	2.34*** (3.68)	1.58 (1.37)
Long Run	4.17*** (3.12)	23.24 (1.22)	2.65** (2.31)
Constant Term	-1.32 (-0.29)	-1.23 (-0.21)	-4.90 (-1.03)
Number of Observations	1471	1344	1091
Number of Groups	24	22	18
(3) ICT Products (SITC 752 - 778)			
Adjustment Coefficient	-0.40*** (-4.44)	-0.27*** (-4.00)	-0.46*** (-4.27)
Relative Price Short Run	0.33 (0.70)	0.22 (0.70)	0.55 (0.77)
Long Run	-0.14 (-0.15)	0.71 (0.65)	-1.52 (-1.13)
Income Short Run	2.47*** (3.10)	3.34*** (3.32)	4.10*** (3.81)
Long	7.07***	49.63	0.36

Run	(2.71)	(1.20)	(0.35)
Constant Term	-5.73 (-1.35)	-10.12*** (-2.58)	5.59 (1.20)
Number of Observations	644	644	446
Number of Groups	10	10	7

Note:
1.t-ratios computed using heteroscadasticity-robust standard errors are reported in rackets, with the statistical significance denotes as *** 1% , ** 5% and * 10% .

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Table 1 Maddala-Wu Fisher Tests for Unit Root[1]

	Level	First Difference
Real Imports (Total)	71.98 (0.90)	2684.95* (0.00)
Real Imports (Final)	61.18 (0.90)	2249.38* (0.00)
Real Imports (Parts &Comp)	72.59 (0.33)	2052.90* (0.00)
Income	2.81 (1.00)	1607.41* (0.00)
Relative Price	60.82 (0.99)	2275.58* (0.00)

Note:

1. H_0: All panels contain a Unit Root.
   Chi_sq statistic reported along with p-value in parenthesis.
   *Significant at 1% level

Table 2: Import Demand: Dynamic Fixed Effects Estimation Results

		Total	Parts	Final
(1)Total manufactured imports (SITC 5 to 8)				
Adjustment Coefficient		-0.18*** (-3.12)	-0.16*** (-2.76)	-0.17*** (-4.62)
Relative Price	Short Run	-0.04 (0.35)	-0.04 (-0.36)	0.06 (0.30)
	Long Run	-1.10*** (-4.77)	-0.15 (-0.23)	-2.29*** (-3.66)
Income	Short Run	2.56*** (6.90)	3.32*** (7.19)	2.97*** (5.04)
	Long Run	3.56*** (5.28)	4.06*** (2.83)	3.54*** (2.52)
Constant Term		-2.22** (-2.09)	-3.63* (-1.79)	-1.26 (-0.60)
Number of Observations		2602	2127	2222
Number of Groups		44	34	38
Hausman test p-value (PMG versus DFE)		0.95	0.98	0.25
Hausman test p-value (MG versus DFE)		1.00	1.00	1.00
(2) Machinery&Transport Equipment (SITC 7)				
Adjustment Coefficient		-0.14*** (-3.42)	-0.08*** (-6.27)	-0.17*** (-5.53)
Relative Price	Short Run	-0.07 (-0.69)	-0.12* (-1.72)	0.07 (0.75)
	Long Run	-1.09*** (-3.08)	-0.24 (-0.47)	-2.96*** (-10.14)
Income	Short Run	2.92*** (6.29)	3.01*** (7.24)	3.58*** (4.43)
	Long Run	3.76*** (4.07)	4.78* (1.76)	3.82** (2.30)
Constant Term		-2.02* (-1.87)	-2.26 (-1.23)	-1.22 (-0.32)
Number of Observations		1471	1344	1091
Number of Groups		24	22	18
Hausman test p-value (PMG versus DFE)		0.99	0.97	0.27
Hausman test p-value (MG versus DFE)		1.00	1.00	1.00
(3) ICT Products (SITC 752 - 778)				
Adjustment Coefficient		-0.18*** (-3.12)	-0.16*** (-2.76)	-0.17*** (-4.62)
Relative Price	Short Run	-0.04 (-0.35)	-0.04 (-0.36)	0.06 (0.30)
	Long Run	-1.10*** (-4.77)	-0.14 (-0.23)	-2.29*** (-3.66)

Income	Short Run	2.56*** (6.90)	3.32*** (7.19)	2.97*** (5.04)
	Long Run	3.56*** (5.28)	4.06*** (2.83)	3.54*** (2.55)
Constant Term		-2.22** (-2.09)	-3.63* (-1.79)	-1.26 (-0.60)
Number of Observations		644	644	446
Number of Groups		10	10	7
Hausman test p-value (PMG versus DFE)[2]		0.99	0.97	0.27
Hausman test p-value (MG versus DFE)[2]		1.00	1.00	1.00

Note:

1. The results for time dummies are not reported.
   t-ratios computed using heteroscadasticity-robust standard errors are reported in rackets, with the statistical significance denotes as *** 1% , ** 5% and * 10% .
2. Hausman test conducted using the variance-covariance matrix from the efficient model to calculate the statistic. Under the null, DFE is consistent and efficient