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Is the "Houthakker-Magee" Finding Durable? Evidence from Disaggregated Trade Flows between China and Korea

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Using income growth to explain trade flows has a long history in international trade. This paper examines the income elasticities for the categories of goods to be consistent with the theoretical implications, using the trade flows between China and Korea over the sample period of 1991-2008. The new trade theory implies that the inclusion of new variety terms reduces the magnitude of income elasticities, disaggregation of trade flows yields different magnitudes of income elasticity, and income elasticity of differentiated goods is higher than that of homogeneous goods. The empirical findings are consistent with the implication from the new trade theory. However, the asymmetry in income elasticity (Houthakker-Magee finding) is quite durable. This paper enhances the consistency between the theories and evidence.

Key Words: Income elasticity; Dis-aggregate trade; China; Korea.
JEL Classification Numbers: F10, F14.

1. INTRODUCTION

Since the beginning of 2000, there has been acceleration in trade between China and the rest of the world. China's penetration of the world market has been accelerating over the last few decades, and its penetration of the Korean market in terms of trade volume has also been very impressive. As shown in Table 1, the volume of Korean imports from China grew from $ 3.4 billion in 1991 to $ 76.9 billion in 2008. In fact, China has been Korea's largest import partner since 2004. In Korea, the Chinese market share rapidly increased from 4% in 1991 to 18% in 2008. Korea's

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penetration of the Chinese markets has been even more remarkable. The volume of Chinese imports from Korea grew from $ 1.0 billion in 1991 to $ 91.3 billion in 2008. China has been Korea's largest export partner since 2004. After the official trade between the two countries began in 1991, the Korean trade surplus has been expanding chronically (See Figure 1).

TABLE 1.

Description of Aggregate Trade Flows between China and Korea

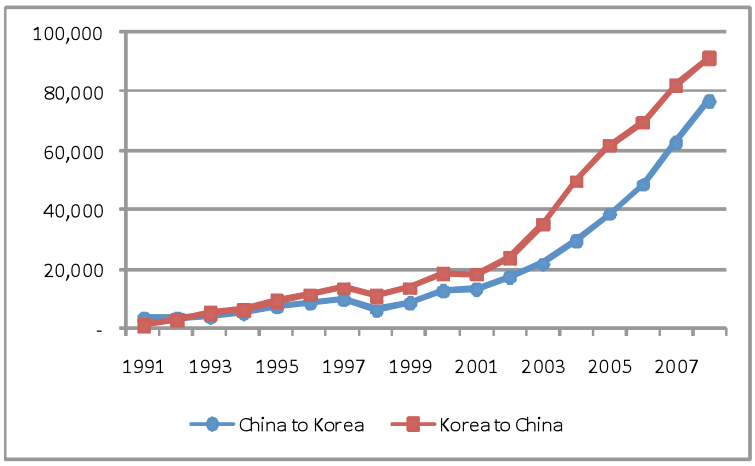
Year	China to Korea			Korea to China		
	Value	Annual Growth	Share (World to Korea)	Value	Annual Growth	Share (World to China)
1991	3,440		4%	1,002		2%
1992	3,725	8%	5%	2,654	165%	3%
1993	3,929	5%	5%	5,151	94%	5%
1994	5,463	39%	5%	6,203	20%	5%
1995	7,401	35%	5%	9,144	47%	7%
1996	8,538	15%	6%	11,377	24%	8%
1997	10,117	18%	7%	13,572	19%	10%
1998	6,227	−38%	7%	10,967	−19%	8%
1999	8,867	42%	7%	13,685	25%	8%
2000	12,799	44%	8%	18,455	35%	8%
2001	13,303	4%	9%	18,190	−1%	7%
2002	17,400	31%	11%	23,753	31%	8%
2003	21,909	26%	12%	35,110	48%	9%
2004	29,585	35%	13%	49,763	42%	9%
2005	38,648	31%	15%	61,915	24%	9%
2006	48,557	26%	16%	69,459	12%	9%
2007	63,025	30%	18%	81,985	18%	9%
2008	76,927	22%	18%	91,389	11%	8%

Note: Value-million dollars

As shown in Figure 2, the growth of trade appears to be highly related to the growth of GDP. Explaining trade flows and trade balance by using income growth has a long history in international trade. Johnson (1958) pointed out that the trade balance over time depends on each country's income elasticity of demand for imports and on the rest of the world's income elasticity of demand for each country's exports. Houthakker and Magee (1969) first estimated demand elasticities for both imports and exports with respect to income and price for a number of countries. However,

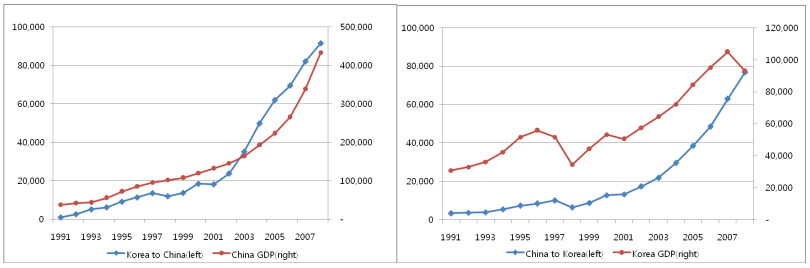
the income elasticity of U.S. imports exceeds that of exports.[1] This asymmetry in the income elasticity is called the "Houthakker-Magee" finding.

FIG. 1. Aggregate Bilateral Trade Flows between China and Korea



Note: trade flows - thousand dollars

FIG. 2. Trade Flows and GDP



Note: trade flows — thousand dollars, China's GDP — million dollars, Korea's GDP — thousand dollars

However, these empirical investigations are not consistent with the theoretical implications from the neoclassical theory, which states that the income elasticity implied by the neoclassical demand theory is equal to one.[2] There are several reasons why the income elasticities would be greater than

[1] Houthakke and Magee (1969) found that the U.S. income elasticity for imports is 1.7 and the foreign income elasticity for US exports is about 1. Hooper *et al.* (2000) found that the long run income elasticities for U.S. exports and import are 0.8 and 1.8.

[2] Hong (1999) provided the reasons why most estimates are significantly greater than one in detail. In the microeconomic theory, the marginal income propensity to consume

one. The first reason why the income elasticities are so large is due to the omission of new goods in the price index. This argument is based on the new trade theory. Helpman and Krugman (1985), and Krugman (1989) argued that product differentiation and scale economies imply that countries grow by producing new goods. However, the new products are not included in the price index. Thus, the increase in import (export) to be explained by the price is attributed to changes in income. This apparently overstates the income elasticity of foreign demand for their exports. The subsequent research has showed that import demand equations have been mis-specified due to the omission of product variety, and that the price indexes and income elasticities have been biased. Feenstra and Shiells (1997) found that the income elasticity for U.S. imports is reduced from 2.5 to 2.2, and that the aggregate import price index is upwardly biased by 1% to 2% annually. Gagnon (2003) analyzed U.S. import demand from different source countries and found strong evidence of a supply effect of roughly half the magnitude (0.75) of the income elasticity (1.5).[3] There is a second reason why the income elasticity implied by the neoclassical demand theory is equal to one. This reason is because the theory considers only final goods, but the aggregate import (export) includes intermediate goods.[4] Recently, some researcher has provided evidence that income elasticities are reduced by the inclusion of the supply effect, and differ by the commodity categories. Mann and Pluck (2007) showed that income elasticities differ between development groups and across product categories. The disaggregation in the end-use classification system (e.g., autos, industrial supplies and materials, consumer goods, and capital goods) yields more plausible estimates of income elasticities. They also found that product variety is an important variable in the behavior of capital goods trade. Chinn (2010) suggested that accounting for the inclusion of the supply side factor and vertical specialization (i.e., intermediate goods trade used to

a particular commodity could be any value, depending on whether the commodity is a normal good, an inferior good, or a luxury good. But when aggregate imports are considered, it is reasonable to assume that, on average, they are normal goods. Thus, the income elasticity should be between zero and one. Furthermore, as long as the marginal propensity to income is equal to the average propensity, the income elasticity will always be equal to one over time.

[3]Sato (1977), and Helkie and Hooper (1988) used import demand equations that augmented price and income terms with a measure of exporter potential output, such as manufacturing capacity and capital stock, to reflect the effect of product variation. Feenstra (1994) suggested how to incorporate new varieties into a constant elasticity of substitution aggregate of import prices and shows that the corrected index is able to account for part of the high estimated U.S. income elasticity.

[4]Aggregate imports are measured in terms of gross value of all goods including final goods and intermediate goods, but income (GDP) is measured in terms of value added. That is another reason that the income elasticity is not one. Hong (1999) suggested the two import demand equations: one for final goods with income, and another for intermediate goods with gross output, rather than income (value added).

produce other trade goods)[5] yields more plausible estimates of income elasticities. The third reason is that the neoclassical import demand theory considers only inter-industry trade, but the new trade theory with increasing returns and product differentiation includes intra-industry trade. Thus, the income elasticity in the inter-industry is equal to one, but the income elasticity in the intra-industry is greater than one. Thus, as the proportion of intra-industry goods in trade increases, the income elasticity may increase as well. However, there is no empirical evidence for this third reason. This paper goes beyond previous studies by providing evidence that the income elasticity in intra-industry goods is greater than that in inter-industry goods. In this paper, we examine that with the variety effect, the disaggregation of trade data yields more plausible estimates of income elasticities in the trade flows between China and Korea over the sample period of 1991-2008. The import demand equation should be just modeled by separating the goods into the categories by the end-use classification system, or intra-industry versus inter-industry classification. To this end, we classify trade goods by the Bureau of Economic Analysis (BEA)'s end-use and Rauch (1999)'s classification. Mann and Pluck (2007) estimated the income elasticities by using the country panel data in each category aggregated, and Chinn (2010) estimated the income elasticities by using the time-series data in each category aggregated. However, this paper estimates the income elasticities by using product panel data in each category. In an end-use classification system, a good is classified as a capital good, a consumer good, a food and beverage, or industrial supplies and materials. In the Rauch (1999) classification, a good is classified as a homogeneous, differentiated, or referenced-priced good. The intra-industry of trade is mainly generated from differentiated goods. The larger the proportion of intra-industry goods in trade, the greater the income elasticity might be. As long as we estimate the income elasticities for the categories of goods with the inclusion of export supply capacity terms, particularly new variety terms, there is no reason that the income elasticities of imports across countries are not too different. In other words, the "Houthakker- Magee" finding should not be detected. This paper presents several empirical findings from the bilateral trade flows between China and Korea over the period of 1991-2008. First, with new trade variety terms, income elasticity is reduced. Second, with the disaggregation of trade data, income elasticity is significantly different. Third, as the proportion of intra-industry goods in trade increases, the income elasticity becomes greater. Fourth, even with new trade variety terms and a disaggregation of trade data, the asymmetry in income elasticity would not disappear. The "Houthakker-

[5]To take into account the effect of intermediate goods, Barrell and Dees (2005), and Camerero and Tamarit (2003) incorporated FDI into the specification of the import demand equation.

Magee" finding holds for the trade flows between China and Korea. This paper is organized in the following manner. Section 2 provides an overview of the dis-aggregated trade flows between China and Korea. In Section 3, this paper presents an import demand equation with variety terms effect, the estimation method, and data construction. Section 4 reports the estimates of the income elasticity. In Section 5, the paper is concluded with a summary.

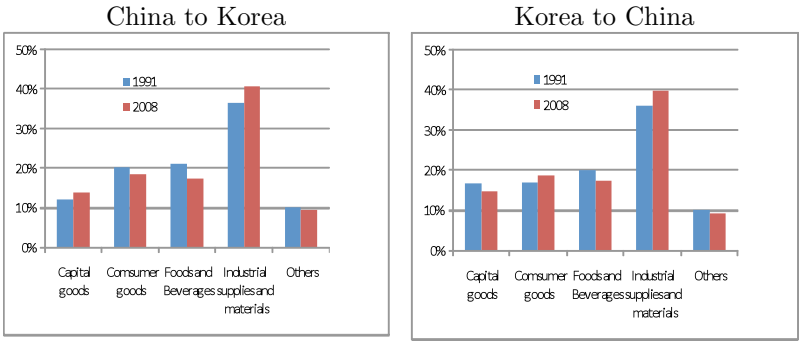
2. DISAGGREGATED TRADE FLOWS BETWEEN CHINA AND KOREA

This section shows the trade flows between China and Korea. It is disaggregated into both the end-use and Rauch (1999) classifications. We use the disaggregated trade data classified by the four-digit SITC level from the UN Comtrade database. The Bureau of Economic Analysis (BEA) has classified and updated the commodities by their end-use characteristics: (1) foods, feeds, and beverages, (2) industrial supplies and materials, (3) capital goods except automotive, (4) automotive vehicles, parts, and engines, 5) consumer goods, (6) other goods. However, this paper will only consider foods, feeds, and beverages, industrial supplies and materials, capital goods except automotive, consumer goods. Because the trade flows in the other categories are extremely small, we will exclude the following two categories: automotive vehicles, parts, and engines, and other goods. Figure 3 displays the share of disaggregated trade flows between two countries along the end-use classification system: capital goods, consumer goods, foods and beverages, and industrial supplies and materials. The composition of trade flows between the two countries is very similar. The largest category of the bilateral trade flows is the category of industrial supplies and materials in both 1991 and 2008. The share of industrial supplies and materials is about 40%. The share of each category is unchanged from 1991 to 2008.

As mentioned previously, the larger the proportion of intra-industry goods in trade, the greater the income elasticity might be. A high degree of intra-industry trade is obtained for the trade of highly differentiated products. Rauch (1999)'s scheme is commonly employed in international trade literature because it provides a tractable way to handle product differentiation. He separates trade products into three categories at the three- and four-digit SITC level: those traded on organized exchanges ("organized exchange" or "homogeneous"), those not traded on organized exchanges but whose prices can be found in catalogs ("referenced-priced"), and all other products ("differentiated").[6] This paper classifies the products into ho-

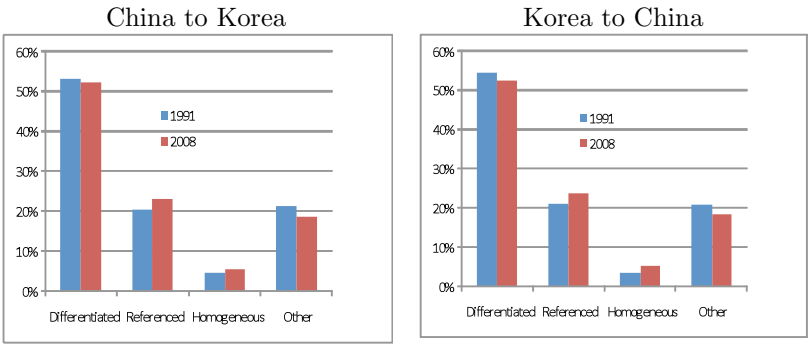
[6]The Standard International Trade Classification (SITC), Revision 2 has 1189 subgroups in 4-digit level. The conservative Rauch classification consists of 146 homoge-

FIG. 3. Share of Trade Flows by End-use Categories



mogenous, differentiated, referenced, and other products. Figure 4 shows the share of disaggregated trade flows along the Rauch classification. The share of the disaggregated trade flows has not significantly changed over time, and the shares across two countries are almost identical. The largest category is the category of differentiated goods. Its share is over 50%.

FIG. 4. Share of Trade Flows by Rauch Classification



neous, 349 reference priced, and 694 differentiated product groups, and the liberal Rauch Classification consists of 212 homogeneous, 321 reference priced, and 656 differentiated product groups.

3. EMPIRICAL ANALYSIS STRATEGY

3.1. Model Specification

The empirical specification is motivated by the traditional partial equilibrium view of the "imperfect substitutes" model, which suggests that the demand for traded goods arise because not all the demand for goods can be substituted by domestic production.[7] The demand for goods imported from country j in country i depends on importing country i's income and the relative price index of import goods to competing goods in the import country i. Correspondingly, the demand for export goods of country i in importing country j depends on importing country j's income and the relative price index of export goods to competing goods in the import country j. To test for the importance of the new products, many studies augment the standard import demand equation with the variety term of exporting country.

$$X^{ij} = \alpha(Y^j)^{\beta}(RP^{ij})^{\phi}(PV^{ij})^{\gamma} \tag{1}$$

where X^{ij} represents the trade flow from country i to j, RP^{ij} represents the relative overall price of goods from country i to j, and PV^{ij} is the measure of product variety. We will empirically examine the above relationship by using the following dynamic panel specification. Since we estimate the income elasticity for the categories of goods with the inclusion of variety terms, the estimation equation is as follows:

$$\ln X^{ij}_{g,t} = \beta_0 + \beta_1 \Delta \ln Y^j_t + \beta_2 \ln RP^{ij}_{g,t} + \beta_3 \Delta PV^{ij}_{g,t} + \beta_4 \ln X^{ij}_{g,t-1} + \mu_g + \eta_t + \nu_{g,t} \tag{2}$$

where g refers to the product, and $t = 1, \ldots, 16$ (1991-2008) refers to the time period. μ_g is the commodity specific fixed effect, η_t is the time-specific effect, and $\nu_{g,t}$ is the error term (IID). $X^{ij}_{g,t}$ denotes the trade flows of good g from country i to j in period t, $\Delta \ln Y^j_t$ is the first-differenced GDP of country j, $RP^{ij}_{g,t}$ is the relative price of good g from country i to country j in period t, and $\Delta PV^{ij}_{g,t}$ is the change in the trade variety of product g in period t.

The relative price of good g from country i to country $j(RP^{ij}_{g,t})$ is defined as the price of good g from country i to country $j(P^{ij}_{g,t})$ relative to the price of good g from the world w to country $j(P^{wj}g,t)$. The relative price in our import demand equation is the price relative to the import competing substitute. To calculate the relative price, we use the data classified at four-digit SITC (Standard International Trade by Commodities) Revision

[7] Goldstein and Khan (1985) provided a clear explanation of the "imperfect substitution" model and "perfect substitution" model. The "imperfect substitution" model should be used for the imports of manufactured goods and aggregate goods, whereas the "perfect substitution" model should be used for the trade of homogeneous goods.

2, obtained from UN Comtrade.

$$RP_{g,t}^{ij} = \frac{P_{g,t}^{ij}}{P_{g,t}^{wj}} \tag{3}$$

To construct the change in the trade variety of product g in period t, we adapt the Feenstra index[8]. The change in the trade variety of two years (t and $t-1$) is a function of the value of total trade and the value of trade on new varieties of the two periods. For the variety for each SITC 4-digit category (g), we use the HS 10-digit category ($\tilde{g}$).[9]

$$\Delta PV_{g,t/t-1}^{ij} = \frac{\sum_{\tilde{g}\in I_t^{ij}} p_{\tilde{g},t}^{ij} q_{\tilde{g},t}^{ij} / \sum_{\tilde{g}\in I^{ij}} p_{\tilde{g},t}^{ij} q_{\tilde{g},t}^{ij}}{\sum_{\tilde{g}\in I_{t-1}^{ij}} p_{\tilde{g},t-1}^{ij} q_{\tilde{g},t-1}^{ij} / \sum_{\tilde{g}\in I^{ij}} p_{\tilde{g},t-1}^{ij} q_{\tilde{g},t-1}^{ij}} \tag{4}$$

where g denotes the good in the SITC 4-digit level, and $\tilde{g}$ denotes the good in the HS 10-digit level category. We have two sets of $I_{t-1}^{ij} = \{1, \ldots, N_{t-1}^{ij}\}$ and $I_t^{ij} = \{1, \ldots, N_t^{ij}\}$. I^{ij} is the common set of the products. If the number of product variety has increased, namely, $N_t^{ij} > N_{t-1}^{ij}$, the common set is $I^{ij} = I_{t-1}^{ij}$. Hence, the denominator is 1 and the numerator exceeds unity, and vice-versa.

3.2. Estimation Method

Because of the lagged dependent variable in the augmented import demand equation, the OLS estimation is biased and inconsistent. Instrumental variable estimation has been suggested to obtain consistent estimates in the dynamic panel. Arellano and Bond (1991) have developed a first-difference GMM estimator. Thereby, the destination specific fixed effect μ_g is eliminated by using the first difference. This generates a correlation between the differenced error terms and the lagged difference of the dependent variables. The difference introduces a moving-average with unit root in the disturbance $\Delta\nu_{g,t}$ However, lagged values or lagged difference can be used as instruments, namely instrumental variable estimation should be used.

Another reason to use instrumental variables is the problem of endogenous (pre-determined) independent variables. Because causality may run from exports to relative price and the variety terms, the relative price and variety terms might be endogenous. Since the relative price and variety

[8]To measure product variety, Feenstra (1994) proposed a method in which new varieties enter a constant elasticity of substitution (CES) aggregator function. This method has been widely used in many empirical studies.

[9]To calculate the product variety of each SITC 4-digit level category, we use the HS 10-digit code. We follow the correspondence between HS 2002 and SITC Rev. 2.

terms are considered endogenous, the lagged values of the variables are used as instruments.

Arellano and Bond (1991) showed that the use of all available instruments (lags of $t-2$ or earlier) yields a more efficient estimator. The consistency depends on the absence of second-order serial correlation. When the restriction, $E\lfloor \Delta\nu_{g,t}\Delta\nu_{g,t-2}\rfloor = 0$, holds, there is no second-order serial correlation in the residuals of the first-differenced equation. We will report the test of first-order and second-order serial correlations. Another problem is the validity of the set of instruments. The overall validity of the instrument is tested using a Sargan test of over-identifying restrictions.

4. ESTIMATION RESULTS AND CONSISTENCY WITH THEORY

4.1. Variety Terms and End-use Classification

In this section, we are going to see whether the inclusion of product variety terms and the disaggregation of trade data yield more plausible estimates of income elasticity or not. First, we examine the argument that the income elasticity is equal to one because the neo-classical theory considers only final goods. Thus, we must estimate the import demand equation by using disaggregated trade data based on the end-use classification system. In this paper, we begin by estimating the equation excluding the new variety variable to check how the estimated results are affected by the inclusion of the variable. We can predict that the income elasticity of consumer goods, which may be classified into final goods, is close to one. This is consistent with the neo-classical theory. Table 2 presents the estimated results for the trade flows from China to Korea by the end-use categories. We can confirm several important results. With the variety terms, the income elasticities for total goods, capital goods, food and beverages, and industrial supplies and materials are reduced. The income elasticity of total goods falls from 2.16 to 2.12. The income elasticity of capital goods falls from 2.89 to 2.71. However, the income elasticity of consumer goods rises from 2.36 to 2.43. The income elasticities significantly differ across product groups, but income elasticity of consumer goods which may be classified into final goods, is not close to one.

Table 3 presents the estimated results for the trade flows from Korea to China by the end-use categories. With the variety terms, the income elasticities for total goods, capital goods, and food and beverages are reduced. However, the income elasticity of industrial supplies and materials rises. Inconsistent with the prediction from the neo-classical theory, the income elasticity of consumer goods, which may be classified into final goods, is not close to one.

TABLE 2.

Estimation Results by End-use Categories: China to Korea

	Independent Variable	total goods	capital goods	consumer goods	foods and beverages	industrial supplies and materials
Without variety terms	GDP	2.16^{***}	2.89^{***}	2.36^{***}	2.27^{***}	2.15^{***}
		(0.05)	(0.01)	(0.00)	(0.08)	(0.03)
	RP	-0.67^{***}	-0.08^{***}	-0.25^{***}	-0.41^{***}	-0.65^{***}
		(0.11)	(0.00)	(0.00)	(0.08)	(0.04)
	V					
	$X(t-1)$	0.95^{***}	0.98^{***}	0.93^{***}	0.95^{***}	0.97^{***}
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	AC1	-4.21	-4.53	-4.73	-4.51	-4.52
	AC2	1.08	1.28	0.93	1.34	1.02
	Sargan	$\chi(187)$	$\chi(85)$	$\chi(85)$	$\chi(35)$	$\chi(117)$
		$= 431$	$= 88$	$= 87$	$= 38$	$= 205$
	N. Ob.	6,784	984	1,123	508	2,888
With variety terms	GDP	2.12^{***}	2.71^{***}	2.43^{***}	1.64^{***}	1.96^{***}
		(0.09)	(0.01)	(0.02)	(0.00)	(0.11)
	RP	-0.10	0.27^{***}	-0.17^{***}	-1.36^{***}	0.80^{***}
		(0.12)	(0.01)	(0.00)	(0.00)	(0.07)
	V	0.46^{***}	0.04^{***}	0.27^{***}	-0.00^{***}	0.53^{***}
		(0.10)	(0.00)	(0.00)	(0.00)	(0.05)
	$X(t-1)$	0.93^{***}	0.92^{***}	0.95^{***}	0.88^{***}	0.89^{***}
		(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
	AC1	-4.45	-3.82	-4.83	-4.05	-4.04
	AC2	0.98	1.04	1.68	1.53	1.09
	Sargan	$\chi(101)$	$\chi(86)$	$\chi(82)$	$\chi(22)$	$\chi(102)$
		$= 318$	$= 85$	$= 87$	$= 23$	$= 158$
	N. Ob.	4,260	889	955	178	1,561

Note: The table presents the Arellano and Bond (1991) GMM estimates. AC1 (AC2) is the test of first-order (second-order) serial correlation. The sample period is 1991 to 2008. Sargan is the test of over-identifying restrictions under the null of valid instruments. *** Significant at 1 percent, ** Significant at 5 percent, * Significant at 10 percent.

From the theoretical implications from the neo-classical theory, the income elasticity of consumer goods should be close to one. From Tables 2 and 3, however, we provide evidence that the empirical results are not consistent with the prediction. We notice that the income elasticities significantly differ across product groups, as well as the persistence of the "Houthakker-Magee" findings. The income elasticity of the Chinese imports from Korea exceeds that of the Korean imports from China. Even with the inclusion of new product terms and the disaggregation of trade

TABLE 3.

Estimation Results by End-use Categories: Korea to China

	Independent Variable	total goods	capital goods	consumer goods	foods and beverages	industrial supplies and materials
Without variety terms	GDP	4.17^{***}	2.66^{***}	4.45^{***}	15.5^{***}	4.72^{***}
		(0.32)	(0.02)	(0.16)	(0.19)	(0.27)
	RP	-0.14^{***}	-0.01^{***}	-0.12^{***}	0.18^{***}	0.33^{***}
		(0.02)	(0.00)	(0.00)	(0.00)	(0.02)
	V					
	$X(t-1)$	0.79^{***}	0.76^{***}	0.71^{***}	0.67^{***}	0.79^{***}
		(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
	AC1	-6.44	-6.52	-6.75	-6.51	-6.68
	AC2	1.08	1.18	1.24	1.10	1.26
	Sargan	$\chi(116)$	$\chi(82)$	$\chi(86)$	$\chi(35)$	$\chi(116)$
		$= 326$	$= 86$	$= 89$	$= 39$	$= 183$
	N. Ob.	5,003	753	805	355	2,381
With variety terms	GDP	3.86^{***}	2.34^{***}	3.86^{***}	13.5^{***}	5.66^{***}
		(0.35)	(0.03)	(0.12)	(0.21)	(0.40)
	RP	-0.24^{***}	-0.02^{***}	-0.13^{***}	-0.11^{***}	0.51^{***}
		(0.03)	(0.00)	(0.00)	(0.00)	(0.04)
	V	0.93^{***}	-1.56^{***}	-0.58^{***}	-0.11^{***}	-1.79^{***}
		(0.26)	(0.00)	(0.00)	(0.02)	(0.04)
	$X(t-1)$	0.80^{***}	0.75^{***}	0.76^{***}	0.76^{***}	0.84^{***}
		(0.01)	(0.00)	(0.00)	(0.00)	(0.01)
	AC1	-6.64	-6.73	-6.27	-6.65	-6.41
	AC2	1.71	1.76	1.27	1.07	1.32
	Sargan	$\chi(100)$	$\chi(79)$	$\chi(85)$	$\chi(32)$	$\chi(101)$
		$= 285$	$= 86$	$= 84$	$= 34$	$= 167$
	N. Ob.	4,453	707	728	290	2,124

Note: The table presents the Arellano and Bond (1991) GMM estimates. AC1 (AC2) is the test of first-order (second-order) serial correlation. The sample period is 1991 to 2008. Sargan is the test of over-identifying restrictions under the null of valid instruments. *** Significant at 1 percent, ** Significant at 5 percent, * Significant at 10 percent.

data, the income asymmetry between the China and Korea trade flows is quite durable.

The plausibility of the estimates in this paper is provided by recent related literature. Mann and Pluck (2007) found that the income elasticity is reduced with product variety, and differs significantly across product groups. Their findings used the bilateral trade flows between the U.S. and 31 countries in four categories of goods. The estimating results by Mann and Pluck (2007) are quite similar to the results in this paper. The

TABLE 4.

Estimation Results by Homogeneous and Differentiated Goods: China to Korea

Independent Variable	Without variety terms			With variety terms		
	homo. goods	diff. goods	re. goods	homo. goods	diff. goods	re. goods
GDP	1.92^{***}	2.34^{***}	2.03^{***}	1.69^{***}	2.22^{***}	1.66^{***}
	(0.03)	(0.04)	(0.00)	(0.54)	(0.08)	(0.02)
RP	-0.05	-0.26^{***}	-0.86^{***}	-0.26^{**}	-0.24^{**}	-0.25^{***}
	(0.04)	(0.05)	(0.00)	(0.11)	(0.11)	(0.01)
V				0.32^{*}	0.60^{***}	0.21^{***}
				(0.16)	(0.09)	(0.00)
$X(t-1)$	0.88^{***}	0.95^{***}	0.98^{***}	0.93^{***}	0.94^{***}	0.88^{***}
	(0.00)	(0.00)	(0.00)	(0.13)	(0.01)	(0.00)
AC1	-4.73	-4.32	-4.72	-4.02	-4.81	-4.20
AC2	1.30	1.47	1.61	1.39	1.45	1.43
Sargan	$\chi(27)$	$\chi(117)$	$\chi(117)$	$\chi(17)$	$\chi(102)$	$\chi(90)$
	$= 30$	$= 244$	$= 120$	$= 10$	$= 197$	$= 94$
N.Ob	367	3,612	1,664	173	2,694	737

Note: The table presents the Arellano and Bond (1991) GMM estimates. AC1 (AC2) is the test of first-order (second-order) serial correlation. The sample period is 1991 to 2008. Sargan is the test of over-identifying restrictions under the null of valid instruments. *** Significant at 1 percent, ** Significant at 5 percent, * Significant at 10 percent.

income elasticities of U.S. imports exceed those of U.S. exports in almost all categories. The asymmetry is still durable. A similar finding is obtained in China (2010). The income elasticities are too high to be warranted by standard theories and remain high even when it is assumed that the supply factors are important. The disaggregation (capital goods and non-capital goods, durables and non-durables) yields more plausible estimates.

4.2. Variety terms and Intra-Industry

To examine whether the income elasticity in inter-industry is equal to one, but the income elasticity in intra-industry is greater than one, we regress the import demand equation by using disaggregated trade data based on Rauch (1999)'s classification system. We can predict that the income elasticity of differentiated goods, which may be classified into intra-industry goods, is larger than that of the rest of goods.

Table 4 shows the estimated results for the trade flows from China to Korea by Rauch (1999) classification. With the variety terms, the income elasticities of homogeneous, differentiated, and reference-priced goods are reduced. The noticeable finding is that the income elasticity of differentiated goods (2.22) is higher than that of homogeneous goods (1.69). Con-

sistent with the prediction, the income elasticity of differentiated goods is larger than that of homogeneous goods and referenced-price goods. The inclusion of new product terms and the disaggregation of trade data by Rauch (1999) yield more plausible estimates of income elasticities. Table 5 presents the coefficients of the trade flows from Korea to China. The income elasticity of differentiated goods is also higher than that of homogeneous goods. But the inclusion of variety terms is slightly less successful.

TABLE 5.

Estimation Results by Homogeneous and Differentiated Goods: Korea to China

Independent Variable	Without variety terms			With variety terms		
	homo. goods	diff. goods	re. goods	homo. goods	diff. goods	re. goods
GDP	2.61^{**}	2.99^{***}	5.61^{***}	2.25^{***}	2.89^{***}	6.25^{***}
		(0.24)	(0.04)		(0.36)	(0.13)
RP	0.06^{***}	-0.18^{***}	0.06^{***}	0.02^{***}	-0.05^{***}	0.02^{***}
	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
V				1.87^{***}	3.86^{***}	1.87^{***}
				(0.04)	(0.41)	(0.04)
$X(t-1)$	0.75^{***}	0.81^{***}	0.75^{***}	0.79^{***}	0.82^{***}	0.79^{***}
	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
AC1	-4.21	-4.00	-4.23	-4.56	-4.80	-4.09
AC2	1.39	1.48	1.44	1.21	1.32	1.53
Sargan	$\chi(116)$	$\chi(116)$	$\chi(116)$	$\chi(101)$	$\chi(101)$	$\chi(101)$
	$= 121$	$= 202$	$= 121$	$= 114$	$= 172$	$= 114$
N.Ob.	1,394	2,776	1,394	1,235	2,531	1,124

Note: The table presents the Arellano and Bond (1991) GMM estimates. AC1 (AC2) is the test of first-order (second-order) serial correlation. The sample period is 1991 to 2008. Sargan is the test of over-identifying restrictions under the null of valid instruments. *** Significant at 1 percent, ** Significant at 5 percent, * Significant at 10 percent.

From Tables 4 and 5, we can also confirm the persistence of the "Houthakker-Magee" findings. The income asymmetry between the China and Korea trade flows is still durable. Additionally, we notice that, with the inclusion of new product terms and the disaggregation of trade data by Rauch (1999), the income elasticity for the trade flow from China to Korea is more consistent with the new trade theory than that from Korea to China. These results have been confirmed by the following robustness check. This paper classifies trade goods by using the formula for the index of intra-industry trade (IIT)[10]: high IIT goods versus low IIT goods. The highest index

[10]Index of intra-industry trade = (Minimum of imports and exports)/ 1/2*(imports + exports)

(1) means that an equal amount of goods is imported and exported. This paper classifies trade goods by using the index. The goods with the higher index than the average index (0.73) is classified as having a high level of IIT goods, whereas the goods with the lower index than the average index is classified as having a low level of low IIT goods.

TABLE 6.

Estimation Results by Inter- and Intra- industry Goods: China to Korea

Independent Variable	Without variety terms		With variety terms	
	Inter-Industry goods	Intra-Industry goods	Inter-Industry goods	Intra-Industry goods
GDP	2.15^{***}	2.23^{***}	1.92^{***}	2.17^{***}
	(0.04)	(0.03)	(0.12)	(0.05)
RP	-0.46^{***}	-0.27^{***}	-0.06	-0.25^{***}
	(0.05)	(0.03)	(0.11)	(0.07)
V			0.74^{***}	0.09^{**}
			(0.11)	(0.04)
$X(t-1)$	0.94^{***}	0.96^{***}	0.88^{***}	0.95^{***}
	(0.00)	(0.00)	(0.01)	(0.00)
AC1	-5.54	-5.35	-5.34	-5.10
AC2	1.62	1.85	1.92	1.94
Sargan	$\chi(117)$	$\chi(117)$	$\chi(102)$	$\chi(104)$
	$= 121$	$= 215$	$= 156$	$= 146$
N. ob	2,921	3,236	1,691	2,312

Note: The table presents the Arellano and Bond (1991) GMM estimates. AC1 (AC2) is the test of first-order (second-order) serial correlation. The sample period is 1991 to 2008. Sargan is the test of over-identifying restrictions under the null of valid instruments. *** Significant at 1 percent, ** Significant at 5 percent, * Significant at 10 percent.

Table 6 presents income elasticities for both the inter-industry and intra-industry in the trade flow from China to Korea. Incorporating variety terms reduces the estimated income elasticities. The income elasticity for intra-industry goods (1.92) is larger than that for inter- industry goods (2.17). The income elasticities are consistent with the implication from the new trade theory. On the side of the trade flow from Korea to China (Table 7), however, the inclusion of the variety terms does not reduce the estimated income elasticities. Furthermore, the income elasticity for intra-industry goods is smaller than that for inter-industry goods. The income elasticity for trade flow from Korea to China is less consistent with the new trade theory than that from Korea to China.

TABLE 7.

Estimation Results by Inter- and Intra- Industry Goods: Korea to China

Independent Variable	Without variety terms		With variety terms	
	Inter-Industry goods	Intra-Industry goods	Inter-Industry goods	Intra-Industry goods
GDP	4.53^{***}	3.24^{***}	4.73^{***}	4.53^{***}
	(0.26)	(0.20)	(0.37)	(0.40)
RP	-0.05^{***}	-0.15^{***}	-0.06^{*}	-0.14^{***}
	(0.01)	(0.01)	(0.03)	(0.01)
V			2.38^{***}	4.14^{***}
			(0.25)	(0.35)
$X(t-1)$	0.76^{***}	0.79^{***}	0.78^{***}	0.81^{***}
	(0.01)	(0.01)	(0.01)	(0.01)
AC1	-4.45	-4.61	-4.04	-4.60
AC2	1.43	1.02	1.30	1.10
Sargan	$\chi(116)$	$\chi(116)$	$\chi(116)$	$\chi(116)$
	$= 186$	$= 188$	$= 152$	$= 176$
N. ob	2,302	2,548	2,015	2,344

Note: The table presents the Arellano and Bond (1991) GMM estimates. AC1 (AC2) is the test of first-order (second-order) serial correlation. The sample period is 1991 to 2008. Sargan is the test of over-identifying restrictions under the null of valid instruments. *** Significant at 1 percent, ** Significant at 5 percent, * Significant at 10 percent.

5. CONCLUSIONS

Studies for estimating income elasticities have argued that there is asymmetry in income elasticity between countries. Even in classical microeconomics, the income elasticity would be one. The new trade theory suggests that income elasticities differ across product categories. This paper examines the income elasticities for the categories of goods to be consistent with the theoretical implications, specifically, we use the trade flows between China and Korea.

In this paper, we examine the empirical findings to see if they are consistent with the theoretical implications. First, we can predict that each country's income elasticity should not be too different with variety terms and disaggregation of trade data. However, the asymmetry is not disappearing. The "Houthakker-Magee" finding persists into the trade flows between China and Korea. Second, the inclusion of new variety terms evidently reduces the magnitude of income elasticities for the goods in most of categories, which is consistent with the implication from the new trade theory. Third, the disaggregation of trade flows yields different magnitudes of income elasticity. The neoclassical demand theory is limited when we deal with income elasticity because the theory only considers final goods.

Fourth, the income elasticity of differentiated goods is higher than that of homogeneous goods. This statement is consistent with the implication from the new trade theory with intra-industry, which states that the income elasticity would be higher than one. Fifth, the trade flow from China to Korea is more consistent with the theoretical implications than that from Korea to China. The evidence suggests that the inclusion of variety terms and the disaggregation by product categories allow us to obtain more plausible values. However, some income elasticities are still inconsistent with the implications from the theories. In particular, the asymmetry in income elasticity would not disappear. Many researchers are trying to improve the consistency by resorting to several methods such as the inclusion of another variable, the estimation methodology, and the disaggregation of trade data. However, the asymmetry is still durable. This is the reason why their finding is called the "Houthakker-Magee" puzzle.

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