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by

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Abstract

Krugman (1989) argued that differences across countries in estimated income elasticities of import demand are due to omission of an exporter supply effect. He showed that such an effect can be derived in a theoretical model with economies of scale in production and a taste for variety in consumption. In his model, countries grow by producing new varieties of goods, and they are able to export these goods without suffering any deterioration in their terms of trade. This paper analyzes U.S. import demand from different source countries and finds strong evidence of a supply effect of roughly half the magnitude (0.75) of the income elasticity (1.5). Price elasticities for the most part are estimated close to -1, which is typical for the literature. Exclusion of the supply effect leads to overestimation of the income elasticity. Results based on U.S. exports to different destinations are less robust, but largely corroborate these findings.

Keywords: import demand, income elasticity, international trade, product differentiation

JEL Classification: F1, F4

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Introduction

The elasticities approach to trade is one of the most successful areas of empirical economics. Equations relating trade flows to relative prices and importer income have been derived and estimated since the 1950s, with generally good statistical fit and sensible economic interpretation. The basic structure and theoretical motivation of import demand equations are covered in Leamer and Stern (1970); Goldstein and Khan (1985) provide a thorough review of published empirical findings; and Hooper, Johnson, and Marquez (2000) and Marquez (2002) present updated estimates and discuss recent methodological advances. Such equations are the workhorses of multi-country macroeconomic models used by policymakers and others to analyze economic developments that have important spillovers across countries through trade.

One empirical property of traditional import demand equations that has been noted since at least Houthakker and Magee (1969) is that income elasticities differ substantially across countries. In particular, U.S. imports are generally characterized by a higher income elasticity than imports in other countries. One implication of this asymmetry is that at constant relative prices and equal growth rates of income across countries, the United States would be expected to have an ever-growing trade deficit. Alternatively, to keep trade in balance requires that the United States grow more slowly than most other countries or that it experience a continuous depreciation of its real exchange rate.

Krugman (1989) questioned this interpretation of the typical elasticity estimates. He noted that there is a negative cross-country correlation between countries' estimated income elasticities of imports and their average income growth rates. In other words, slow-growing countries tend to have higher income elasticities of imports than fast-growing countries. This property has allowed countries to grow at different rates over long periods of time with relatively

modest trends in relative prices and small trade imbalances for the most part. Krugman thought this outcome was too fortuitous to be a coincidence. Instead, he argued that product differentiation and scale economies imply that countries grow by producing new goods that can be exported without an adverse effect on the terms of trade. His theory implies that standard trade equations are mis-specified – they omit a supply term in import demand.[2]

Krugman's simple model channels all economic growth into product proliferation, so that real output is directly proportional to the number of goods produced. In the empirical work of this paper, we follow the Krugman model and use potential output growth in the exporting country as the supply term in import demand. However, to the extent that growth also is associated with more production of existing goods, potential output growth may overstate the supply effect in import demand. For this reason, we estimate an unrestricted version of the Krugman model that freely estimates the elasticity of imports with respect to foreign potential output.[3]

Unbeknownst to Krugman when he published his paper, other studies had already found evidence of a supply effect in import demand.[4] Sato (1977) and Helkie and Hooper (1988)

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[2]Riedel and Athukorala (1995) propose an alternative explanation based on the assumption that traded goods are perfect substitutes. However, the overwhelming consensus in the literature (see Goldstein and Khan (1985)) is that manufactures produced in different countries are not close to being perfect substitutes.

[3]Note that incomplete quality adjustment in import prices may provide an alternative role for exporter potential output to the extent that growth in output is associated with production of higher quality goods. In such a case, incorporating exporter potential output in the import demand equation can help to correct the bias introduced by mis-measured import prices.

[4]The gravity approach to bilateral trade has long recognized a role for both importer and exporter income. However, this approach has been used almost exclusively to explain the cross-country pattern of trade at a point in time and not the variation of trade over time. See, for example, Bergstrand (1989). Two exceptions are Baier and Bergstrand (2001) and Glick and

estimated import demand equations that augmented the usual relative price and importer income terms with an exporter supply term. Sato's supply term was based on manufacturing capacity in the exporting countries. Helkie and Hooper used relative capital stocks between the exporting and importing countries. In both studies, the addition of a supply term eliminated the asymmetry of income elasticities in import demand equations between fast-growing and slow-growing countries.[5]

One weakness of the Sato and Helkie-Hooper approaches is that capacity and capital stocks are both very smooth time series, and in most countries capacity and the capital stock must be estimated statistically rather than observed directly. These properties make it difficult to get precise and significant estimates of the supply effect in pure time-series data. The approach adopted here is to disaggregate imports by up to 74 source countries to see if different long-run capacity trends across exporters are important in explaining differences in the growth of their exports to the same importing country. Bayoumi (1999) takes a related approach using pooled bilateral time-series regressions on 21 industrial countries and he finds a significant role for a supply effect in the long run (among other conclusions). This paper extends Bayoumi's results by focusing on the long-run supply effect and demonstrating the robustness of this effect to

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Rose (2002), but in these studies exporter and importer income are constrained to have equal effects on trade.

[5]An alternative to introducing a supply term in import demand is to correct the bias in import prices that arises from ignoring brand proliferation and not fully capturing quality improvement. In principle, the introduction of a new brand could be viewed as a decline in the price of the brand from a value that exceeds the reservation price of demand. Feenstra (1994) makes partial progress toward explaining the elasticity asymmetry by adjusting aggregate import prices downward with the entrance of new source countries in specific categories of U.S. imports. However, the Feenstra approach does not take into account new brands within import categories, nor does it address the issue of quality improvement.

different sample periods, data definitions, and a much broader range of countries.

Data and Specification

The dependent variables in the regressions of this paper are long-term average growth rates of U.S. bilateral non-oil import values (deflated by the U.S. producer price index) for various source countries.[6] In any given regression we include only one growth rate per source country, so that the statistical analysis is cross-sectional. We restrict our analysis to long-term changes in the data for two reasons: 1) the focus of the paper is on long-run demand and supply elasticities and we do not wish to specify and estimate adjustment dynamics; and 2) we do not observe exporter productive capacity and we want to proceed on the assumption that actual and potential output grow at the same rate in the long run.

Non-oil imports were obtained from the Bureau of the Census website for recent years and from hard copies of Census publication FT-990 for earlier years. All other variables were taken from the IMF's International Financial Statistics (IFS) database, including the consumer price indexes (CPIs), producer (or wholesale) price indexes (PPIs), export prices, GDP volumes, and exchange rates. The growth rates are calculated as averages over two periods: 1978-2001 and 1989-98. The longer period has the advantage of smoothing over transitory shocks. The shorter period has the advantage of greater availability of data from source countries at the cost of including lower quality (noisier) data for some countries. Sample countries were chosen based on data availability except that OPEC members and other countries in which oil exports

[6]We excluded oil imports because oil does not fit into the differentiated products framework we wish to test.

are a substantial share of GDP have been excluded.[7]

The simple model presented in Krugman (1989) shows how the presence of economies of scale and a taste for variety in the consumption of differentiated products leads to a role for exporter production capacity in determining import demand. To test for the importance of this effect, we augment a standard import demand equation with a term for the production capacity of the exporting country.

$$(1) \qquad M = \alpha Y^{\beta} \left(\frac{PM}{P} \right)^{\gamma} QP^{\lambda} U$$

In this equation, *M* denotes real imports, *PM* denotes the price of imports, *Y* denotes importer real income, *P* denotes the price level of competing goods in the importing country, *QP* denotes exporter production capacity, *U* is a stochastic shock, and parameters are denoted by Greek letters. In the standard model there is no role for exporter capacity ($\lambda=0$) whereas in the Krugman model imports respond equally to both exporter capacity and importer income ($\lambda=\beta$). Here we allow both terms to be estimated freely. To the extent that growing capacity increases the output of existing products rather than new brands and types of products, we would expect the supply effect (λ) to be less than 1. However, if economic growth enhances the ability of poor

[7]The full sample of 74 countries includes Argentina, Australia, Austria, Bangladesh, Belgium-Luxembourg, Bolivia, Botswana, Brazil, Burundi, Canada, Chile, China, Colombia, Costa Rica, Cyprus, Denmark, Dominican Republic, Ethiopia, Finland, France, Germany, Greece, Guatemala, Haiti, Honduras, Hong Kong, Hungary, Iceland, India, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Korea, Madagascar, Malawi, Malaysia, Malta, Mauritius, Mexico, Morocco, Mozambique, Namibia, Nepal, Netherlands, New Zealand, Niger, Pakistan, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Rwanda, Senegal, Seychelles, Sierra Leone, Singapore, South Africa, Spain, Sri Lanka, Swaziland, Sweden, Switzerland, Thailand, Togo, Tunisia, Turkey, United Kingdom, and Uruguay.

countries to produce the types of goods demanded by rich countries, the supply effect may be greater than 1. The income effect (β) will be greater or less than 1 to the extent that imports are luxuries or necessities.

Nominal U.S. imports in dollars are equivalent to $PM \cdot M$. It is convenient to deflate the import data by the competing U.S. price level (P), which we take to be the producer price index. Collecting terms leads to equation (2).

$$(2) \qquad \left(\frac{PM \cdot M}{P}\right) = \alpha Y^{\beta} QP^{\lambda} \left(\frac{PM}{P}\right)^{1+\gamma} U$$

Taking logarithms and focusing on the changes in variables eliminates the parameter α and yields equation (3) where lower-case letters denote log variables and we have made the assumption that long-term changes in potential output (QP) are equal to long-term changes in actual output (Q). The subscripts i denote individual exporting countries. U.S. real income (Y) is the same for all source countries, so the import demand elasticity, β, is estimated through the constant term in the regression (which is set equal to U.S. income growth).

$$(3) \qquad \Delta\left(pm_i + m_i - p\right) = \beta \Delta y + \lambda \Delta q_i + \left(1 + \gamma\right) \Delta \left(pm_i - p\right) + \Delta u_i$$

Consistent estimation of equation (3) requires that shocks to M not be correlated with the right-hand-side variables. (Note that shocks to PM and P are controlled by the addition of 1 to the coefficient γ on the right.) We dismiss out of hand the possibility that shocks to U.S. demand for imports (M) from these countries can have a significant effect on the long-term growth rates of U.S. income (Y) or the U.S. price level (P). However, we note that since U.S.

income growth is constant across source countries, the estimated income elasticity will be biased if some omitted factor influences U.S. imports from all sources in the same way. One candidate for such a factor is multilateral reductions in trade barriers; but for U. S. imports, tariff reductions have been small since 1978, and changes in non-tariff barriers have been focused mainly on specific source countries in a limited range of product categories.[8] Another common factor is declining transportation costs, but transportation costs were already a very small share of trade in 1978, so that further declines would not be expected to have large effects.[9]

It is possible that shocks to U.S. demand for imports from specific countries could have a long-term effect on output growth (Q) in those countries. We would expect such a correlation to be greatest for countries whose exports to the United States comprise a significant share of total output. In 1998, exports to the United States accounted for an (unweighted) average of 5 percent of GDP among the 74 countries in our sample; in 7 countries, exports to the United States exceeded 20 percent of GDP. Exclusion of these 7 countries had no economically or statistically significant effect on our results, leading us to the conclusion that correlation of exporter output with U.S. import demand is not a significant source of bias. Finally, shocks to U.S. import demand from specific countries may be correlated with the price charged for the imports (PM),

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[8]Baier and Bergstrand (2001) estimate that average tariff reductions of 8½ percentage points between 1959 and 1987 account for 35 percentage points of cumulative trade growth of 148 percentage points among industrial countries. Over the longest sample period used here (1978-2001) the average tariff on U.S. merchandise imports fell by only 2½ percentage points, whereas U.S. non-oil imports (deflated by the GDP deflator as in Baier and Bergstrand) grew 244 percentage points, implying a relatively small upward bias in our estimated income elasticity.

[9]Baier and Bergstrand (2001) find that declines in transportation costs explain only 8 percent of the growth of trade between 1959 and 1987.

which may bias the estimate of γ, but should not affect the estimates of the main parameters of interest, λ and β.[10]

A difficulty in estimating equation (3) is that the price of bilateral non-oil imports to the United States is available (from the Bureau of Labor Statistics) for only Canada and Japan. One way around this difficulty is to use the price index of total multilateral exports from each source country converted into U.S. currency: these results are presented in Table 1 below. However, this proxy variable for the bilateral import price also suffers from somewhat limited availability, and using it introduces measurement error into the relative price regressor.

In order to expand our sample to include more foreign source countries, we seek an estimation framework that does not require observations on the bilateral import price. Equation (4) presents a model of import supply that can be substituted into the import demand equation to obtain a reduced form. This model incorporates the concept of pricing to market, so that import prices are a weighted average of costs in the exporting country (PF/E) and competitors' prices in the importing country (P).[11] Here PF is an index of prices in the exporting country and E is the exchange rate expressed as the amount of exporter currency per unit of importer currency. The parameter ϕ captures the extent of pass-through of exporter costs, where $\phi=1$ implies full pass-through (no pricing to market) and $\phi=0$ implies no pass-through (complete pricing to market). This equation implies no effect of demand in the importing country on the import price except indirectly through competitors' prices. Such a framework is consistent with monopolistic

[10]The results below also consider the use of instrumental variables to address this potential simultaneity bias.

[11]Goldberg and Knetter (1997) provide a survey of the pass-through and pricing to market literature.

competition in differentiated products under the assumption that marginal cost is well-captured by overall prices in the exporting country (*PF/E*).[12] Given our focus on long-run changes we believe it is reasonable to assume that marginal costs move in proportion to overall prices in the exporting country and that they are constant with respect to the volume of imports.

$$PM = \delta \left(\frac{PF}{E} \right)^{\phi} P^{1-\phi} \tag{4}$$

Substituting equation (4) into equation (2) and converting to log differences yields the reduced form equation (5), where *r* denotes the (log) real exchange rate (*pf-e-p*). As with *P*, it is most appropriate to define *PF* as a price index of tradable goods, such as the producer (or wholesale) price index. However, consumer prices are available for a wider selection of countries and some of the work that follows employs a real exchange rate defined in terms of consumer prices.[13]

$$\Delta \left(pm_i + m_i - p \right) = \beta \Delta y + \lambda \Delta q_i + \phi \left(1 + \gamma \right) \Delta r_i + \Delta u_i \tag{5}$$

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[12]See Knetter (1989) for a derivation.

[13]Consumer prices tend to increase faster than wholesale prices, reflecting declining costs due to rapid technological progress in goods production relative to services output. If the gap between CPI and WPI inflation rates is similar across countries, use of a CPI-based real exchange rate will not bias the estimates as long as the WPI is used to deflate nominal imports (as is the case in Table 2 below). Balassa (1964) and Samuelson (1964) argue that the gap between CPI and WPI inflation is larger in faster-growing countries, thereby tending to bias down our estimates of the supply effect, λ, when we use the CPI-based real exchange rate.

Empirical Results

Table 1 presents OLS estimates of structural export demand (equation (3)) using the two different sets of growth rates. Complete data are available for only 13 countries over the 1978-2001 period, so it is not surprising that the coefficient estimates are not statistically significant. However, they have plausible values with an income elasticity of 1.26, a supply elasticity of 1.10, and a price elasticity of -0.76. Dropping exporter supply from the regression (the second column) leads to a much worse fit, with a small effect on the price elasticity and a large effect on the income elasticity.[14]

Data are available for 37 countries over the 1989-98 period. In this case the estimates are highly significant and still plausible. Once again, dropping the supply effects leads to a significantly worse fit, little change in the price elasticity and a large increase in the income elasticity. These data thus confirm the view that estimated income elasticities of demand for U.S. imports may be biased upwards in regressions that omit supply effects, providing a potential explanation for the Houthakker-Magee asymmetry of income elasticities across countries.

In order to test for the potential significance of simultaneity bias from import volumes to import prices, we also estimated equation (3) using two-stage least squares with either (or both) the CPI or the PPI real exchange rate as an instrument for the relative price of imports.[15] In most

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[14]Dropping the supply term leads to an R^2 of essentially zero because the income term is a constant and the overall effect of relative prices on the regressand is $1+\gamma$, which is close to zero.

[15]This choice of instruments reflects the plausible assumption that broad price indexes are much less affected by import demand than the import price. However, both the relative import price and the real exchange rate are correlated with the nominal exchange rate, which could in principle respond to changes in import demand. Gagnon (1996) and Cheung, Chinn, and Pascual (2002) find some evidence that trade flows can affect exchange rates through the associated buildup of net foreign assets, but this effect at best accounts for only a small fraction of exchange

cases all the coefficients were very close to those presented in Table 1, and in no case were the differences significant at any level.

Table 2 presents OLS estimates of the reduced form combining import supply and demand (equation (5)). These regressions benefit from larger samples, particularly for the CPI-based regression using 1989-98 growth rates, where the full sample of 74 countries was available. Regardless of the time period or definition of the real exchange rate, the supply effect (λ) is always statistically significant with a plausible magnitude. The estimated income elasticities (β) vary somewhat more across specifications, but generally lie within a plausible region. It is more difficult to interpret the coefficient on the real exchange rate, which combines pass-through (ϕ) and the price elasticity of demand (γ). With reasonable values of ϕ bounded between 0 and 1, and typical estimates of γ around -1 (from Table 1 and from other studies), one would expect to find estimated coefficients near zero, as is the case for three of the four regressions. However, for the PPI real exchange rate over 1978-2001 (the first column) the coefficient estimate is far from zero and the R^2 is suspiciously large, suggesting a spurious result. As was the case in Table 1, dropping the supply effects in Table 2 (not shown) leads to higher estimated income elasticities in every case, with estimates around 2 to 2.5.

To summarize the results of Tables 1 and 2, the estimates of the supply effect are clustered around 0.7 to 0.8 and are never significantly different from either 0.7 or 0.8. As discussed earlier, to the extent that the simple Krugman model overstates the role of new brands and products in long-run growth, we would expect the supply effect to be less than 1. The

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rate movements, even in the long run. The dominance of macro and financial-market influences on exchange rates implies that it is not a bad approximation to assume that exchange rates are exogenous for import demand.

estimated income elasticities have a central tendency of around 1.5 and only two estimates are (marginally) significantly different from this central value. An income elasticity estimate greater than 1 implies either that preferences are not homothetic (and traded goods are luxuries) or that some omitted common factor is contributing to trade growth. With one exception, the coefficients on the real exchange rates are consistent with price elasticities of around -1. Finally, dropping the supply effects tends to bias the income elasticities upward with little effect on the price elasticities.

In order to check on the robustness of the above results, we utilized this framework to examine trade flows in the opposite direction. Table 3 presents estimates of equation (3) adapted to U.S. bilateral exports. As in Table 1, we use the aggregate export price as a proxy for the bilateral export prices. In contrast to Table 1, the income elasticity is estimated as the coefficient on the foreign GDP growth rates and the supply effect is estimated via the (constant) U.S. GDP growth rate. The supply effect is thus the common component in U.S. exports across countries that is not explained by the importer income and relative price terms. To the extent that foreign trade barriers have fallen by more than U.S. trade barriers in recent years, the supply effect in the export regressions may be biased upward by more than the income elasticity is biased in the import regressions. Another source of bias in this regression is the fact that in some countries, unlike in the United States, output and income can diverge significantly due to transfers from foreigners and earnings on labor and capital employed abroad. By using GDP as a proxy for income in foreign countries we introduce measurement error that will tend to bias down our estimates of the income elasticity and may also distort our estimated supply and price effects. (This bias is less important in the preceding analysis of U.S. imports because foreign GDP is a

better measure of foreign output than of foreign income.)

The first column of Table 3 displays coefficient estimates over the 1978-2001 sample. The income elasticity is rather low, possibly due to the measurement error described above. The supply effect is comparable to those estimated in Tables 1 and 2. The price elasticity has the wrong sign, but is not significantly different from zero. As in Table 1, dropping the supply effect (column two) reduces the equation fit, greatly increasing the estimated income elasticity and having little effect on the price elasticity. In the 1989-98 sample, the price elasticity is close to its expected value of -1, but the income elasticity has dropped to zero. This may again reflect the bias from mis-measurement of income, and it is associated with an implausibly large estimate of the supply effect. Dropping the supply term induces essentially the same effects as in the other sample.[16] Regressions of equation (5) with U.S. export data (not shown) led to very similar outcomes. Overall, the export-based regressions support the role of a supply effect in import demand and the finding that income elasticities are biased upward when supply terms are not included. The export equations, however, exhibit less stability across samples than the import equations, and are subject to greater potential biases due to measurement error and omitted variables.

As a further check on the robustness of these findings, the regressions of Tables 1, 2, and 3 were implemented using alternative measures of real GDP growth from the Penn World Table dataset. The results are presented in the Appendix. They are very similar to the results shown above.

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[16]Note that the R^2 can be negative because there is no constant term.

Conclusion

In an analysis of U.S. import demand from different source countries, there is strong evidence of a supply effect of roughly half the magnitude (0.75) of the income elasticity (1.5). Price elasticities for the most part are estimated close to -1, which is typical for the literature. Exclusion of the supply effect leads to overestimation of the income elasticity. Results based on U.S. exports to different destinations are less robust but largely corroborate these findings.

These results support the view that the standard model of trade elasticities is mis-specified by the exclusion of a supply effect. Moreover, this mis-specification may explain why previous studies of import demand have found substantial differences in estimated income elasticities across countries.

The presence of a supply effect has profound implications for the evolution of a country's exchange rate and external balances in the face of a shock to potential output. In the standard model, an increase in a country's growth rate leads either to a decrease in its trade balance or a depreciation in its real exchange rate. With a supply effect, a country that begins to grow faster will also experience an increase in demand for its exports that can partially or fully offset the increased demand for imports at a given real exchange rate.

Table 1
U.S. Import Demand, Structural (Eq. 3)

	1978-2001		1989-1998	
β (income)	1.26	2.47**	1.81***	2.52***
	(1.48)	(.96)	(.45)	(.35)
λ (supply)	1.10		0.55**	
	(1.03)		(.24)	
γ (price)	-0.76	-0.86	-1.02***	-1.01***
	(1.37)	(1.38)	(.13)	(.14)
R^2	0.10	0.00	0.13	0.00
No. Obs.	13	13	37	37

*, **, and *** denote significance at the 10, 5, and 1 percent levels, respectively.

Table 2
U.S. Import Demand, Reduced Form (Eq. 5)

	1978-2001		1989-1998	
	PPI	CPI	PPI	CPI
β (income)	0.44	1.29**	2.14***	1.37***
	(.48)	(.60)	(.37)	(.39)
λ (supply)	0.85**	0.96**	0.44**	0.69***
	(.34)	(.44)	(.20)	(.21)
ϕ(1+γ) (price)	-1.66***	0.21	-0.01	0.08
	(.42)	(.63)	(.37)	(.27)
R^2	.58	.17	.11	.13
No. Obs.	19	27	42	74

*, **, and *** denote significance at the 10, 5, and 1 percent levels, respectively.

Table 3
U.S. Export Demand, Structural (Eq. 3)

	1978-2001		1989-1998	
β (income)	0.56*	1.02***	-0.10	0.95***
	(.32)	(.18)	(.20)	(.20)
λ (supply)	0.68		2.49***	
	(.40)		(.36)	
γ (price)	0.14	0.28	-0.87***	-1.13**
	(.40)	(.41)	(.31)	(.44)
R^2	0.38	0.30	0.01	-1.07
No. Obs.	23	23	48	48

*, **, and *** denote significance at the 10, 5, and 1 percent levels, respectively.

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Appendix: Results Using Data from the Penn World Table

The regressions reported in the body of the paper rely on national estimates of real GDP growth rates as reported to the IMF. Alternative estimates of real GDP on a chain-weighted purchasing power parity basis are available in the Penn World Table (PWT) dataset.[17] Tables A1, A2, and A3 present regression results analogous to Tables 1, 2, and 3 using these data. The PWT dataset does not include prices of traded goods, so the export prices and PPIs are the same as in the main results above. The PWT dataset does include GDP prices relative to the United States, and these relative prices are used in place of the CPI relative prices that are used above. The country coverage is similar to that in the main results, with differences primarily occurring in the regression using GDP prices over 1989-98, where 80 countries are included, compared with 74 countries in the main results using CPIs.[18]

Tables A1 through A3 confirm the findings of the paper.[19] The supply effect is usually significant and always in a plausible range. Dropping the supply effect biases the estimated income elasticity upwards.

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[17]Alan Heston, Robert Summers, and Bettina Aten, Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania, October 2002, http://pwt.upenn.edu/.

[18]Benin, Cameroon, Central African Republic, Gambia, Ghana, Guyana, Lesotho, Mali, Romania, Zambia, and Zimbabwe were added. Cyprus, Malta, Sierra Leone, Singapore, and Swaziland were dropped. Chad and Haiti were not added due to apparent errors in the data.

[19]We tested for a differential effect between per capita GDP and population. When entered separately in the regressions, per capita GDP growth always had a higher estimated effect on trade growth than population growth. This result is true both for U.S. imports (the supply effect) and for U.S. exports (the income effect). However, in no case could one reject the restriction at the 5 percent level (and only once at the 10 percent level) that both population growth and per capita income growth have the same effect on trade.

Table A1
U.S. Import Demand, Structural (Eq. 3)

	1978-2001[1]		1989-1998	
β (income)	1.27	2.50**	1.40**	2.54***
	(1.27)	(.83)	(.55)	(.35)
λ (supply)	1.09		1.13**	
	(.87)		(.44)	
γ (price)	-0.71	-0.81	-0.96***	-1.01***
	(1.24)	(1.26)	(.13)	(.14)
R^2	0.12	0.00	0.16	0.00
No. Obs.	15	15	37	37

[1]Foreign GDP (supply) growth rates are 1978-2000.
*, **, and *** denote significance at the 10, 5, and 1 percent levels, respectively.

Table A2
U.S. Import Demand, Reduced Form (Eq. 5)

	1978-2001[1]		1989-1998	
	PPI	PGDP	PPI	PGDP
β (income)	0.64	0.27	1.79***	1.44***
	(.53)	(.58)	(.49)	(.50)
λ (supply)	0.87**	1.70***	0.78**	0.70*
	(.40)	(.44)	(.38)	(.37)
ϕ(1+γ) (price)	-1.26***	0.33	0.15	0.78**
	(.42)	(.65)	(.37)	(.30)
R^2	0.44	0.36	0.11	0.12
No. Obs.	21	33	42	80

[1]Foreign GDP (supply) and PGDP (price) growth rates are 1978-2000.
*, **, and *** denote significance at the 10, 5, and 1 percent levels, respectively.

Table A3
U.S. Export Demand, Structural (Eq. 3)

	1978-2001[1]		1989-1998	
β (income)	0.20	0.94***	0.64*	1.67***
	(.31)	(.17)	(.35)	(.21)
λ (supply)	1.03**		1.57***	
	(.37)		(.45)	
γ (price)	0.14	0.23	-0.96***	-1.03**
	(.33)	(.37)	(.31)	(.34)
R^2	0.38	0.16	0.07	-0.19
No. Obs.	25	25	46	46

[1]Foreign GDP (income) growth rates are 1978-2000.
*, **, and *** denote significance at the 10, 5, and 1 percent levels, respectively.