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Time Series Analysis of Export Demand Equations: A Cross-Country Analysis

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The paper estimates export demand elasticities for a large number of developing and industrial countries, using time-series techniques that account for the nonstationarity in the data. The average long-run price and income elasticities are found to be approximately –1 and 1.5, respectively. Thus, exports do react to both the trade partners' income and to relative prices. Africa faces the lowest income elasticities for its exports, while Asia has both the highest income and price elasticities. The price and income elasticity estimates have good statistical properties. [JEL: C22, E21, F14, F41]

In many developing countries that have relatively limited access to international financial markets, exports play an important role in the growth process by generating the scarce foreign exchange necessary to finance imports of energy and investment goods, both of which are crucial to capital formation. In his Nobel prize lecture, Lewis (1980) pointed out that the secular slowdown in industrial countries will inevitably reduce the speed of development in developing countries unless an alternative engine of growth is found. That engine, he believed, was trade among developing countries. Riedel (1984) challenges Lewis's conclusions by arguing that most developing countries face a downward export demand function and therefore could expand their exports, despite the slowdown in industrial countries, by engaging in price competition. However, Faini, Clavijo, and Senhadji (1992) empirically show that Riedel's reasoning suffers from the fallacy of composition

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argument in that a country alone can increase its market share through a real devaluation but all countries cannot. A central element in this controversy is the size of the price and income elasticities of developing countries' export demand. Similarly, export and import demand elasticities are critical parameters in the assessment of real exchange rate fluctuations on the trade balance.

The higher the income elasticity of the export demand, the more powerful exports will be as an engine of growth.[1] The higher the price elasticity, the more competitive is the international market for exports of the particular country, and thus the more successful will a real devaluation be in promoting export revenues.

The recent literature is divided on how a real devaluation affects imports and exports. Rose (1990, 1991) and Ostry and Rose (1992) find that a real devaluation has generally no significant impact on the trade balance, while Marquez and McNeilly (1988) and Reinhart (1995) find that it does affect the trade balance. Using much larger samples than previous studies, this paper and its companion paper on import demand elasticities (Senhadji, 1998) offer new evidence on this issue. Section I briefly presents the export demand function and discusses the estimation strategy, and Section II presents the results. Concluding remarks are contained in Section III.

I. The Model

The model is derived from dynamic optimization (for details, see Senhadji and Montenegro, 1998). More specifically, the export demand equation has the following form:

$$\log(x_t) = \gamma_0 + \gamma_1\log(x_{t-1}) + \gamma_2\log(p_t) + \gamma_3\log(gdpx_t^*) + \varepsilon_t, \qquad (1)$$

where x_t is real exports of the home country; p_t is the export price of the home country relative to the price of its competitors; and $gdpx_t^*$ is the activity variable defined as real GDP minus real exports of the home country's trading partners. Thus, the model yields an export demand equation that is close to the standard export demand function except that the correct activity variable is real GDP minus real exports of the trading partners, rather than the trading partners' GDP.

In the model outlined in Senhadji and Montenegro (1998), four cases are discussed depending on which of the three variables entering equation (1) contains a unit root. The model predicts a cointegrating relationship between the I(1) variables. As will be seen in the next section, most countries cannot reject the unit root for all three variables. Consequently, equation (1) will be estimated by Phillips's Fully Modified estimator (FM), which takes into account the nonstationarity in the data as well as potential endogeneity of the right-hand side variables and autocorrelation of the error term.[2] The presence of the lagged dependent variable in the export

[1]The trade linkage between growth in industrial countries and growth in developing countries is analyzed in detail in Goldstein and Khan (1982).

[2]For details about the FM method, see Phillips and Hansen (1990), Phillips and Loretan (1991), and Hansen (1992).

demand equation introduces some econometric issues in the context of a cointegration framework. Pesaran and Shin (forthcoming) show that the autoregressive specification retains its usual properties even in a cointegration framework.[3]

II. Estimation Results

The national account data come from the World Bank national accounts database. The data for the trade shares used to compute the activity variable were taken from United Nations Statistics Office's COMTRADE, a disaggregated trade flow database. The sample includes 75 countries for which the required data are available for a reasonable time span. The list of countries is given in Table 1. In general the data are available from 1960 to 1993, with some exceptions.[4] The variables in equation (1) will be proxied by the following: x_t will be measured by total exports of goods and services in real terms. The activity variable ($gdpx_t^*$) is computed as the weighted average of the trade partners' GDP minus exports. The weights are given by the share of the home country exports to each of its partners:

$$gdpx_t^* = \sum_{i=1}^{N} \omega_t^i \left(GDP_t^i - x_t^i \right), \tag{2}$$

where GDP_t^i and x_t^i are real GDP and real exports of trade partner i in year t, and ω_i refers to the share of exports to country i in total exports.

The choice of a proxy for p_t is not straightforward. Ideally, a relative price should be included for all potential competitors of the home country exports, namely the export price of the home country relative to the domestic price of each importing country, as well as the export price of the home country relative to the export price of each potential competitor. Obviously, this strategy cannot be implemented econometrically because the equation will contain many highly correlated relative prices leading to the usual multicollinearity problem. Instead, researchers have constructed one relative price that extracts most of the information contained in all the relative prices mentioned above.[5] One possibility is to use the weighting scheme for the activity variable, described in equation (2), for the construction of a composite price index that captures closely the potential competitive pressures facing the home country's exports. The home country's exports compete not only with the domestic market of each trading partner, however, but also with other potential suppliers to these markets. The world export unit value, used in this paper, implies that the threat imposed by each country in the world to the home country's exports is measured by each country's share in world exports. The export unit value index has been retained not because it is necessarily the most appropriate one from a theoretical point of view, but because it is readily available.

[3]See Senhadji and Montenegro (1998) for a discussion.

[4]The following countries have a shorter data range: Cameroon, 1965–93; Ecuador, 1965–93; Tunisia, 1961–93; and Yugoslavia, 1960–90.

[5]The reduction of the number of prices included in the equation can be justified from a theoretical point of view by assuming that consumers' preferences are *separable* leading to multi-stage budgeting. See the discussion in Goldstein and Khan (1985), pp. 1061–63.

Table 1. Augmented Dickey-Fuller Test for Variables Entering the Export Demand Equation

Country	*x*	*k*	*p*	*k*	*gdpx**	*k*	*nobs*
Algeria	–5.44**	1	–2.04	1	–1.31	1	34
Argentina	–3.16	1	–2.09	1	–2.54	1	34
Australia	–1.96	1	–2.15	1	–2.99	1	34
Austria	–0.82	1	–1.77	1	–1.33	1	34
Belgium-Luxembourg	–1.62	1	–1.89	1	–1.45	1	34
Benin	–2.18	1	–2.50	1	–2.44	1	34
Bolivia	–1.79	1	–2.52	1	–3.34*	1	34
Brazil	–3.08	1	–2.42	2	–5.40**	1	34
Burundi	–5.33**	1	–2.24	1	–3.26	1	34
Cameroon	–1.28	1	–1.59	1	–2.34	1	29
Canada	–2.62	1	–2.64	2	–2.86	1	34
Central African Republic	–2.21	1	–1.25	1	–2.63	1	34
Chile	–1.89	1	–2.17	1	–2.24	1	34
China	–1.56	1	–2.16	1	–2.24	1	34
Colombia	–1.63	1	–2.56	1	–2.59	1	34
Costa Rica	–1.46	1	–2.60	1	–3.31	1	34
Côte d'Ivoire	–1.49	1	–1.99	2	–3.75**	1	34
Denmark	–3.06	1	–1.97	1	–1.74	1	34
Dominican Rep.	–3.99*	1	–2.63	1	–2.56	1	34
Ecuador	–1.75	1	–4.08*	1	–2.32	2	29
Egypt	–2.94	2	–1.88	1	–2.22	1	34
Finland	–1.75	1	–2.13	2	–2.94	1	34
France	–0.95	1	–1.97	1	–1.46	1	34
Gambia	–2.83	1	–1.95	2	–3.95*	1	34
Germany	–2.08	1	–1.97	1	–1.45	1	34
Greece	–1.63	1	–1.69	1	–4.21*	1	34
Guatemala	–2.55	1	–2.59	1	–3.11	1	34
Haiti	–2.29	1	–2.64	1	–3.00	1	34
Iceland	–1.67	1	–2.26	1	–1.75	1	34
India	–0.74	1	–2.35	1	–2.66	1	34
Israel	–1.57	1	–2.47	1	–0.88	1	34
Italy	–2.23	1	–2.17	1	–1.31	1	34
Jamaica	–2.61	2	–2.57	1	–3.32	1	34
Japan	–1.26	1	–2.65	1	–1.65	1	34
Kenya	–1.18	1	–2.17	1	–0.97	1	34
Korea	–0.71	1	–2.37	1	–2.66	1	34
Malawi	–2.73	1	–2.23	1	–3.60*	1	34
Malaysia	–1.27	1	–2.30	1	–2.97	1	34
Malta	–1.55	1	–1.37	1	–0.91	1	34
Mauritania	–5.41**	1	–1.84	1	–2.14	1	34

Table 1 *(concluded)*

Country	*x*	*k*	*p*	*k*	*gdpx**	*k*	*nobs*
Mauritius	–2.05	1	–2.66	1	–2.52	2	34
Mexico	–1.80	1	–2.62	1	–2.28	1	34
Morocco	–3.45	1	–1.78	1	–2.96	1	34
Netherlands	–1.49	1	–1.87	1	–2.13	1	34
New Zealand	–3.37	1	–2.24	2	–4.17*	1	34
Niger	–2.62	1	–1.77	1	–2.69	1	34
Nigeria	–2.07	1	–2.60	1	–0.90	1	34
Norway	–2.42	1	–2.14	1	–1.63	1	34
Pakistan	–1.49	1	–2.24	1	–3.82*	1	34
Panama	–2.31	1	–2.59	1	–2.21	1	34
Niger	–2.62	1	–1.77	1	–2.69	1	34
Nigeria	–2.07	1	–2.60	1	–0.90	1	34
Norway	–2.42	1	–2.14	1	–1.63	1	34
Pakistan	–1.49	1	–2.24	1	–3.82*	1	34
Panama	–2.31	1	–2.59	1	–2.21	1	34
Paraguay	–3.00	1	–0.88	1	–5.08**	1	34
Peru	–2.55	1	–2.30	3	–2.68	1	34
Philippines	–2.31	1	–2.42	1	–2.20	1	34
Portugal	–2.25	1	–1.97	1	–1.03	1	34
Rwanda	–6.12**	1	–2.18	1	–1.87	1	34
Senegal	–4.40**	1	–1.49	2	–2.55	1	34
Somalia	–2.33	1	–1.99	1	–2.77	1	30
South Africa	–2.92	2	–2.13	1	–1.53	1	34
Spain	–1.73	1	–1.83	1	–1.72	1	34
Sweden	–1.99	1	–2.16	1	–1.75	1	34
Switzerland	–1.02	3	–2.01	1	–2.06	1	34
Togo	–1.19	1	–1.10	1	–3.53	1	34
Trinidad & Tobago	–1.88	1	–2.65	1	–0.83	1	34
Tunisia	–1.82	1	–1.31	2	–2.96	1	33
Turkey	–1.87	1	–2.06	1	–2.00	1	34
United Kingdom	–1.35	1	–2.20	1	–1.44	1	34
United States	–2.69	2	–1.51	2	–2.81	1	34
Uruguay	–2.40	1	–1.82	1	–2.72	1	34
Yugoslavia	–1.74	1	–2.28	1	–2.08	1	31
Zaire	–2.56	1	–2.73	1	–6.80**	1	31

Note: Variables are as follows: real exports of goods and nonfactor services, *x*; a weighted (by the share of exports) average of the trade partners' GDP minus exports, *gdpx**; and the real exchange rate, *p*, computed as the ratio of the exports deflator to the world export unit values index. These three variables are tested for the existence of a unit root using the Augmented Dickey-Fuller (ADF) test. The optimal lag selected by the Schwarz Criterion in the ADF regression is given by *k*. Critical values are a linear interpolation between the critical values for $T = 25$ and $T = 50$ given in Table B.6, case 4, in Hamilton (1994) (where T is the sample size). Significance levels at 1 percent and 5 percent are indicated by ** and *, respectively. The number of observations is given by *nobs*.

Unit Root Test

To determine the nature of the relationship described by equation (1), the three variables in the export demand equation—that is, real exports of goods and services of the home country, *x*; the relative price of exports, *p*; and the activity variable, $gdpx^*$—must be tested for the presence of a unit root. The unit-root hypothesis is tested using the Augmented-Dickey-Fuller (ADF) test. The lag length, *k*, in the ADF regression is selected using the Schwarz Criterion (SIC). The results are reported in Table 1. For *x*, only 6 out of the 75 countries reject the unit root at 5 percent or less (Algeria, Burundi, Mauritania, Rwanda, and Senegal at 1 percent; Dominican Republic at 5 percent). Similarly, the null of a unit root in *p* is rejected only for one country (Ecuador at 5 percent). Finally, as for $gdpx^*_t$, the unit root is rejected for 10 countries (Brazil, Cote d'Ivoire, Paraguay, and Zaire at 1 percent; Bolivia, Gambia, Greece, Malawi, New Zealand, and Pakistan at 5 percent). These results show that for a large number of countries, the unit root hypothesis cannot be rejected at conventional significance levels. This may simply reflect the low power of the ADF test, especially considering the small sample size.

Export Demand Equations

The results in Table 1 underscore the presence of nonstationarity in the data. For most countries (53 of the 75) the unit-root hypothesis cannot be rejected for all three variables in the export demand equation, and for the remaining 17 countries the unit-root hypothesis can be rejected for only one of the three variables. The export equation has been estimated for the 75 countries in the sample using both ordinary least squares (OLS) and FM.

Table 2 reports the results for the 53 countries that show the correct sign for both the income and price elasticities. Columns labeled x_{-1}, *p*, and $gdpx^*$ give, respectively, the coefficient estimates of the lagged dependent variable (log of exports of goods and nonfactor services in real terms), the short-term price elasticity γ_1 (i.e., the coefficient of the log of the relative price), and the short-term income elasticity γ_2 (i.e., the coefficient of the log of $gdpx^*$). The long-run price and income elasticities are defined as the short-term price and income elasticities divided by one, minus the coefficient estimate of the lagged dependent variable. These are given by E_p and E_y for the FM estimates. Their variance and hence their *t*-statistics are computed using the *delta method*. The column labeled *ser* reports the standard error of the regression. Finally, column *AC* gives Durbin's autocorrelation test. For the OLS regressions, AR(1) autocorrelation is detected (at 10 percent or less) for 6 of the 53 countries. Another potential problem with the OLS estimates is the possible endogeneity of p_t. The FM estimator corrects for both autocorrelation and simultaneity biases.

Even though Table 2 reports both the OLS and FM estimates of the export demand equation, this paper focuses only on the FM estimates, since both estimation methods yield relatively similar results. The short-run price elasticities vary from –0.0 (Peru) to –0.96 (Paraguay), with a sample average (over the first 53 countries) of –0.21, a median of –0.17, and a standard deviation of 0.19. The long-run price elasticities vary from –0.02 (Peru) to –4.72 (Turkey). The sample average is

–1.00, the median is –0.76, and the standard deviation is 0.97. Exports are much more responsive to relative prices in the long run than in the short run. The short-run income elasticities vary from 0.02 (Ecuador) to 1.15 (Finland). The sample average is 0.41, the median is 0.33, and the standard deviation is 0.31. Thus, the average short-run income elasticity is significantly less than 1. The long-run income elasticities vary from 0.17 (Ecuador) to 4.34 (Korea). The sample average is 1.48, the median is 1.30, and the standard deviation is 0.85. Thus, exports respond significantly more to both relative prices and income in the long run than in the short run.

The columns E_p^c and E_y^c give the long-run, bias-corrected price and income elasticities. The correction is generally small. As discussed in Senhadji and Montenegro (1998), the bias is negligible when the relative price and the activity variable are either exogenous or weakly endogenous, as is the case for most countries. Since unit-price and unit-income elasticities are widely used as benchmark values, a formal test for long run unit-price and unit-income elasticities is provided in columns labeled $E_p = -1$ and $E_y = 1$, respectively. This test uses exact critical values of the t-statistic computed by Monte Carlo methods. Twenty of the 53 countries reject a long-run, unit-price elasticity, and 18 countries reject a long-run, unit-income elasticity at 10 percent or less. The fit as measured by $\bar{R}^2$ is good.

Estimates of price and income elasticities are meaningful only if the I(1) variables are cointegrated. Table 2 shows the results of the Phillips-Ouliaris (P-O) residual test for cointegration. Even with a relatively small sample size (thus low power), the null of non-cointegration is rejected for 51 (at 1 percent in most cases) of the 53 countries.

To test whether these elasticities differ significantly across geographical regions, the 53 countries in the sample were classified in five regions—Africa (*af*), Asia (*as*), Latin America (*la*), and Middle East and North Africa (*me*)—and OLS regressions were run on regional dummies (t-statistics are given in parentheses):

$$\underset{}{|E_p|} = \underset{(3.56)}{0.79} - \underset{(-0.05)}{0.02}d_{af} + \underset{(2.38)}{1.39}d_{as} - \underset{(1.05)}{0.37}d_{la} - \underset{(1.51)}{0.67}d_{me}, \quad \bar{R}^2 = .07, \quad N = 53; \tag{3}$$

$$E_y = \underset{(9.00)}{1.74} - \underset{(-1.73)}{0.51}d_{af} + \underset{(0.98)}{0.50}d_{as} - \underset{(-2.12)}{0.65}d_{la} - \underset{(-0.57)}{0.22}d_{me}, \quad \bar{R}^2 = .07, \quad N = 53; \tag{4}$$

$$|E_p| = \underset{(3.44)}{0.79} - \underset{(1.26)}{0.35}d_{ldc}, \quad \bar{R}^2 = .01, \quad N = 53; \tag{5}$$

$$E_y = \underset{(8.81)}{1.74} - \underset{(-1.73)}{0.42}d_{ldc}, \quad \bar{R}^2 = .04, \quad N = 53; \tag{6}$$

where E_p and E_y are the long-run price and income elasticities; and d_i (i = *af*, *as*, *la*, and *me*) are the regional dummies. The latter take a value equal to one if a country belongs to the region, and zero otherwise. The dummy d_{ldc} takes a value equal to one for developing countries, and zero otherwise. Interestingly, Asia has significantly higher price elasticities than both industrial and developing countries, and also has higher income elasticities than the rest of the developing countries.

Table 2. Export Demand Equations

Country	Ordinary Least Squares (OLS) estimates					
	x_{-1}	p	$gdpx^*$	AC	ser	R^2
Algeria	0.13	–0.07	0.99	–0.24	0.08	0.93
	0.96	–2.02	6.52	–1.42		
Argentina	0.33	–0.14	0.94	0.12	0.10	0.95
	2.15	–2.06	3.90	0.63		
Australia	0.82	–0.20	0.19	–0.13	0.05	0.99
	6.57	–1.93	1.20	–0.70		
Austria	0.67	–0.08	0.88	0.10	0.03	1.00
	9.96	–1.41	4.58	0.55		
Benin	0.73	–0.29	0.49	0.43	0.19	0.93
	5.55	–1.04	1.56	2.76		
Burundi	0.04	–0.22	0.98	–0.09	0.16	0.79
	0.26	–2.21	4.07	–0.46		
Cameroon	0.71	–0.08	0.94	0.09	0.14	0.96
	4.96	–0.50	2.05	0.37		
Chile	0.81	–0.21	0.28	–0.04	0.08	0.99
	10.07	–2.39	2.04	–0.21		
China	0.69	–0.78	0.46	0.42	0.11	0.99
	10.44	–4.30	4.34	2.46		
Colombia	0.72	–0.25	0.48	0.11	0.07	0.98
	6.07	–1.72	2.74	0.55		
Côte d’Ivoire	0.64	–0.16	0.54	0.09	0.11	0.96
	4.91	–1.80	2.01	0.50		
Denmark	0.78	–0.05	0.37	0.22	0.03	1.00
	10.21	–0.85	2.56	1.16		
Dominican Republic	0.40	–0.47	0.86	0.09	0.14	0.94
	3.07	–3.75	4.06	0.48		
Ecuador	0.77	–0.57	0.24	0.31	0.14	0.96
	8.34	–4.11	0.73	1.54		
Egypt	0.78	–0.26	0.33	0.26	0.09	0.97
	8.84	–2.41	2.20	1.34		
Finland	0.38	–0.64	1.30	0.18	0.04	0.99
	3.76	–5.05	6.08	1.00		
France	0.76	–0.01	0.57	0.37	0.03	1.00
	9.97	–0.05	3.09	2.17		
Gambia	0.38	–0.51	0.53	0.25	0.15	0.89
	2.32	–2.42	3.31	1.36		
Greece	0.55	–0.31	1.32	0.18	0.07	0.99
	4.44	–1.40	3.46	0.94		
Guatemala	0.85	–0.12	0.05	0.02	0.09	0.94
	11.46	–0.62	0.40	0.11		
Haiti	0.72	–0.02	0.37	0.01	0.18	0.84
	5.69	–0.13	1.53	0.06		

Fully-Modified estimates

x_{-1}	p	$gdpx^*$	E_p	E_y	E_p^c	E_y^c	*ser*	R^2	*P-O*	E_p=–1	E_y=1	*nobs*
0.27	–0.07	0.83	–0.09	1.15	–0.09	1.14	0.04	0.93	–6.62[a]	30.42[a]	2.83[c]	34
2.91	–3.26	7.60	–3.08[b]	22.32[a]								
0.56	–0.11	0.56	–0.24	1.28	–0.24	1.28	0.08	0.95	–5.11[a]	6.45[a]	1.75	34
4.33	–1.94	2.73	–2.04[c]	7.90[a]								
0.90	–0.17	0.08	–1.73	0.80	–2.24	0.79	0.04	0.99	–4.93[a]	–0.52	–0.36	34
9.58	–2.13	0.64	–1.22[c]	1.45								
0.75	–0.04	0.65	–0.15	2.59	–0.15	2.49	0.03	1.00	–5.25[a]	4.41[a]	12.99[a]	34
11.44	–0.70	3.37	–0.75	21.16[a]								
0.80	–0.26	0.31	–1.32	1.55	–1.24	1.55	0.11	0.93	–4.13[c]	–0.50	1.07	34
10.14	–1.58	1.59	–2.07[b]	3.00[b]								
0.28	–0.19	0.74	–0.26	1.03	–0.25	1.02	0.15	0.77	–6.61[a]	5.81[a]	0.13	34
1.71	–2.01	3.08	–2.00[c]	5.07[a]								
0.84	–0.04	0.36	–0.24	2.29	–0.17	2.26	0.11	0.96	–3.84[c]	1.10	0.82	29
7.48	–0.30	0.91	–0.34	1.46[b]								
0.85	–0.17	0.20	–1.08	1.31	–1.39	1.29	0.06	0.99	–5.47[a]	–0.21	0.73	34
14.60	–2.61	1.87	–2.99[a]	3.14[b]								
0.80	–0.63	0.24	–3.13	1.20	–3.55	1.15	0.12	0.99	–13.33[a]	2.77[a]	0.38	34
10.29	–3.08	1.71	–4.08[a]	2.24[b]								
0.86	–0.21	0.19	–1.52	1.39	–1.73	1.39	0.06	0.98	–4.61[b]	–0.63	0.88	34
7.76	–1.70	1.12	–1.86[b]	3.13[b]								
0.84	–0.03	0.25	–0.16	1.52	–0.16	1.46	0.09	0.96	–5.64[a]	1.89	0.89	34
7.58	–0.32	1.10	–0.35	2.62[b]								
0.85	–0.06	0.23	–0.36	1.51	–0.41	1.51	0.02	1.00	–4.44[b]	2.05	2.43	34
11.77	–1.13	1.70	–1.14	7.22[a]								
0.56	–0.36	0.59	–0.81	1.34	–0.85	1.29	0.12	0.93	–5.73[a]	0.93	1.36	34
4.91	–3.41	2.97	–3.96[a]	5.38[a]								
0.87	–0.43	0.02	–3.21	0.17	–2.51	0.16	0.14	0.95	–4.34[b]	–0.86	–0.33	29
8.95	–2.98	0.06	–1.25	0.07								
0.84	–0.24	0.18	–1.44	1.12	–1.43	1.12	0.07	0.97	–9.80[a]	–0.67	0.29	34
11.33	–2.68	1.37	–2.19[b]	2.63[b]								
0.45	–0.58	1.15	–1.05	2.09	–1.20	2.09	0.03	0.99	–4.58[a]	–0.34	21.22[a]	34
5.36	–5.55	6.26	–6.61[a]	40.64[a]								
0.79	0.00	0.49	–0.02	2.28	–0.02	2.18	0.03	1.00	–3.82	2.85[b]	9.17[a]	34
11.42	–0.05	2.90	–0.05	16.31[a]								
0.49	–0.40	0.43	–0.79	0.84	–0.74	0.84	0.11	0.89	–4.26[b]	0.81	–1.72	34
4.02	–2.59	3.56	–3.08[b]	8.96[a]								
0.66	–0.24	0.95	–0.70	2.81	–0.80	2.81	0.05	0.99	–4.77[a]	0.61	4.45[b]	34
7.08	–1.27	3.11	–1.43[c]	6.91[a]								
0.90	–0.09	0.03	–0.87	0.31	–0.92	0.29	0.05	0.94	–4.69[a]	0.11	–1.10	34
20.55	–0.76	0.43	–0.77	0.48								
0.80	–0.07	0.29	–0.37	1.41	–0.44	1.44	0.10	0.83	–5.91[a]	1.55	0.76	34
10.49	–0.93	1.82	–0.89	2.63[c]								

Table 2 *(continued)*

Country	Ordinary Least Squares (OLS) estimates					
	x_{-1}	p	$gdpx^*$	AC	ser	R^2
Iceland	0.61	–0.27	0.57	0.12	0.07	0.98
	4.61	–2.02	2.60	0.67		
Italy	0.58	–0.07	0.95	0.18	0.04	1.00
	4.95	–0.87	3.25	0.93		
Japan	0.82	–0.25	0.46	0.05	0.06	1.00
	10.00	–1.56	1.65	0.27		
Kenya	0.62	–0.34	0.27	–0.29	0.07	0.94
	4.17	–3.64	1.57	–1.43		
Korea	0.72	–0.61	1.21	0.27	0.10	1.00
	8.03	–2.05	2.59	1.51		
Malawi	0.34	–0.18	0.79	0.19	0.11	0.93
	2.03	–1.22	3.38	1.16		
Malta	0.78	–0.12	0.64	0.27	0.08	0.99
	10.80	–0.86	3.19	1.57		
Mauritius	0.78	–0.25	0.45	–0.05	0.15	0.90
	5.96	–1.45	1.66	–0.37		
Morocco	0.63	–0.38	0.43	0.01	0.07	0.97
	6.17	–2.59	3.21	0.06		
New Zealand	0.78	–0.17	0.21	–0.24	0.04	0.99
	5.53	–2.16	1.20	–1.29		
Niger	0.65	–0.32	0.15	–0.15	0.19	0.50
	4.79	–1.42	0.79	–0.80		
Nigeria	0.78	–0.04	0.25	0.09	0.17	0.85
	6.04	–0.45	1.25	0.46		
Norway	0.82	–0.17	0.36	0.22	0.03	1.00
	7.91	–2.10	1.66	1.14		
Panama	0.78	–0.23	0.16	–0.22	0.06	0.99
	7.20	–2.64	0.62	–1.17		
Paraguay	0.57	–0.88	1.21	0.01	0.14	0.96
	6.24	–4.39	5.42	0.09		
Peru	0.62	–0.06	0.13	–0.06	0.09	0.72
	4.19	–0.60	1.19	–0.32		
Philippines	0.52	–0.62	0.59	0.03	0.07	0.98
	6.01	–6.33	4.09	0.15		
Portugal	0.88	–0.25	0.24	0.22	0.11	0.96
	7.01	–1.15	0.80	1.19		
Senegal	0.26	–0.42	0.42	0.00	0.11	0.84
	1.71	–2.58	3.15	0.01		
South Africa	0.59	–0.20	0.26	0.21	0.03	0.97
	6.59	–4.47	4.56	1.11		
Spain	0.60	–0.06	1.18	0.12	0.05	1.00
	4.39	–0.58	2.72	0.62		

Fully-Modified estimates

x_{-1}	p	$gdpx^*$	E_p	E_y	E_p^c	E_y^c	ser	R^2	P-O	E_p=–1	E_y=1	$nobs$
0.70	–0.28	0.41	–0.93	1.37	–1.11	1.39	0.04	0.98	–4.75[a]	0.29	3.16	34
9.71	–3.81	3.39	–3.76[a]	11.78[a]								
0.65	–0.05	0.80	–0.14	2.26	–0.13	2.25	0.03	1.00	–4.83[a]	4.75[a]	13.74[a]	34
6.55	–0.69	3.27	–0.76	24.63[a]								
0.87	–0.17	0.27	–1.27	2.11	–1.33	2.02	0.03	1.00	–9.74[a]	–0.48	2.21[c]	34
19.70	–1.94	1.81	–2.30[b]	4.21[a]								
0.84	–0.33	0.03	–2.07	0.17	–2.36	0.17	0.05	0.94	–7.49[a]	–0.81	–1.22	34
7.66	–4.71	0.21	–1.56[c]	0.25								
0.76	–0.52	1.04	–2.17	4.34	–2.15	4.31	0.08	1.00	–4.95[a]	–1.51	7.58[a]	34
10.52	–2.15	2.73	–2.80[b]	9.85[a]								
0.50	–0.05	0.63	–0.10	1.25	–0.11	1.20	0.06	0.93	–10.70[a]	5.01[a]	1.70	34
4.91	–0.55	4.16	–0.57	8.43[a]								
0.84	–0.04	0.46	–0.22	2.80	–0.21	2.79	0.06	0.98	–3.88[c]	1.18	4.43[a]	34
13.39	–0.33	2.52	–0.34	6.89[a]								
0.89	–0.21	0.34	–1.92	3.17	–1.67	3.24	0.10	0.94	–6.02[a]	–0.46	1.56	34
10.24	–1.82	1.91	–0.96	2.28[c]								
0.81	–0.28	0.22	–1.47	1.12	–1.45	1.11	0.06	0.97	–6.42[a]	–0.45	0.42	34
8.06	–2.19	1.52	–1.41	3.95[b]								
0.90	–0.13	0.08	–1.25	0.78	–1.62	0.80	0.03	0.99	–9.50[a]	–0.19	–0.41	34
9.33	–2.42	0.64	–0.94	1.49								
0.84	–0.28	0.06	–1.74	0.38	–1.83	0.36	0.13	0.46	–7.41[a]	–0.49	–0.82	34
8.60	–1.80	0.47	–1.16	0.50								
0.91	–0.04	0.15	–0.50	1.69	–0.43	1.72	0.12	0.85	–5.14[a]	0.44	0.47	34
9.31	–0.65	1.03	–0.43	1.15								
0.90	–0.15	0.17	–1.51	1.65	–1.73	1.65	0.03	1.00	–9.43[a]	–0.46	1.44	34
10.40	–2.32	0.91	–1.36[c]	3.67[b]								
0.85	–0.17	0.07	–1.14	0.47	–1.07	0.47	0.04	0.99	–7.33[a]	–0.20	–0.56	34
12.21	–2.75	0.41	–1.68[c]	0.50								
0.64	–0.96	1.11	–2.67	3.08	–2.80	2.96	0.12	0.96	–4.75[a]	–2.62[b]	7.20[a]	34
7.93	–5.70	5.42	–4.19[c]	10.66[a]								
0.78	0.00	0.12	–0.02	0.53	–0.02	0.54	0.06	0.71	–6.30[a]	3.34[c]	–2.08[c]	34
8.17	–0.05	1.64	–0.05	2.30								
0.59	–0.51	0.49	–1.24	1.20	–1.22	1.19	0.05	0.98	–4.59[b]	–1.32	1.57	34
8.64	–6.60	4.20	–6.92[a]	9.52[a]								
0.93	–0.20	0.09	–2.92	1.30	–2.89	1.29	0.08	0.96	–4.93[a]	–0.33	0.17	34
9.84	–1.21	0.38	–0.50	0.75								
0.45	–0.28	0.32	–0.50	0.58	–0.47	0.58	0.08	0.84	–6.64[a]	2.54[b]	–2.85	34
3.64	–2.27	2.79	–2.59[b]	3.93[a]								
0.65	–0.18	0.23	–0.51	0.66	–0.50	0.65	0.02	0.97	–9.12[a]	4.02[a]	–5.35[a]	34
8.91	–5.45	5.24	–4.15[a]	10.33[a]								
0.67	–0.06	0.94	–0.18	2.86	–0.19	2.75	0.04	1.00	–12.06[a]	3.80[b]	11.71[a]	34
6.05	–0.74	2.64	–0.82	18.01[a]								

Table 2 *(concluded)*

Country	Ordinary Least Squares (OLS) estimates					
	x_{-1}	p	$gdpx^*$	AC	ser	R^2
Sweden	0.55	–0.13	0.76	0.33	0.03	1.00
	5.01	–1.88	3.68	1.84		
Switzerland	0.31	–0.12	1.18	0.34	0.02	1.00
	2.91	–2.42	6.24	2.04		
Togo	0.57	–0.21	0.58	0.13	0.22	0.90
	3.20	–1.21	1.22	0.69		
Trinidad and Tobago	0.24	–0.29	0.91	0.17	0.10	0.96
	1.58	–4.63	4.28	0.91		
Tunisia	0.59	–0.17	1.15	–0.09	0.07	0.99
	5.62	–1.26	3.67	–0.47		
Turkey	0.82	–0.69	0.31	0.09	0.14	0.98
	10.59	–2.50	1.15	0.45		
United Kingdom	0.58	–0.16	0.61	0.03	0.03	1.00
	7.19	–2.59	4.84	0.17		
United States	0.79	–0.19	0.26	0.48	0.05	0.99
	8.41	–1.42	2.20	2.86		
Uruguay	0.66	–0.48	0.21	–0.14	0.09	0.97
	5.70	–2.67	1.12	–0.78		
Yugoslavia	0.47	–0.23	0.67	–0.10	0.07	0.97
	3.45	–3.33	2.92	–0.54		
Zaire	0.50	–0.15	0.58	0.15	0.14	0.91
	3.84	–2.27	2.69	0.72		
Mean	0.61	–0.27	0.59			
Median	0.64	–0.21	0.53			
Stdev	0.19	0.20	0.35			
Min	0.04	–0.88	0.05			
Max	0.88	–0.01	1.32			

[a]Significant at 1 percent.
[b]Significant at 5 percent.
[c]Significant at 10 percent.

Note: The dependent variable is real export of goods and nonfactor services, *x*. The explanatory variables are the lagged dependent variable, x_{-1}; the real exchange rate, *p*, computed as the ratio of exports deflator to the world export unit value index, and the weighted (by export shares) average of trade partners' GDP minus exports, $gdpx^*$. The export demand equation is estimated using both OLS and the Phillips-Hansen's Fully Modified estimator. The long-run price and income elasticities are given by E_p and E_y, respectively. E_p^c and E_y^c give the long run price and income elasticities corrected for bias (see Table 4 in Senhadji and Montenegro, 1998). For each country, the estimated coefficients and their *t*-statistic (below the coefficient estimates) are provided. The following statistics are also provided: Durbin's test for autocorrelation, *AC*; R^2; standard error of the regression, *ser*; and the number of observations for each country, *nobs*. Cointegration between the three variables in the export demand equation is tested using the Phillips-Ouliaris residual test given in column *P-O*. Finally, the columns labeled $E_p = -1$ and $E_y = 1$ report the two-tailed test for unit-price and unit-income elasticities, respectively. The asymptotic critical values for the Phillips-Ouliaris test at 10 percent, 5 percent, and 1 percent are, respectively, –3.84, –4.16, and –4.64. Exact critical values (from Table 8 in Senhadji and Montenegro, 1998) are used to compute the significance level of E_p, E_y, $E_p = -1$, and $E_y = 1$.

Fully-Modified estimates

x_{-1}	p	$gdpx^*$	E_p	E_y	E_p^c	E_y^c	*ser*	R^2	*P-O*	E_p=–1	E_y=1	*nobs*
0.68	–0.09	0.53	–0.29	1.65	–0.30	1.59	0.03	1.00	–4.13[b]	3.20[b]	5.62[a]	34
6.26	–1.37	2.58	–1.29[c]	14.22[a]								
0.42	–0.10	0.98	–0.17	1.69	–0.18	1.62	0.02	1.00	–9.30[a]	12.07[a]	15.92[a]	34
4.36	–2.34	5.65	–2.52[b]	39.10[a]								
0.84	–0.05	0.21	–0.33	1.27	–0.34	1.22	0.17	0.89	–6.74[a]	0.79	0.16	34
5.82	–0.36	0.53	–0.38	0.74								
0.37	–0.25	0.78	–0.39	1.24	–0.31	1.22	0.09	0.96	–5.40[a]	9.49[a]	1.81[c]	34
2.80	–4.58	4.20	–6.13[a]	9.41[a]								
0.78	–0.17	0.54	–0.78	2.43	–0.77	2.42	0.05	0.99	–6.00[a]	0.36	4.50[b]	33
8.60	–1.68	1.93	–1.29	7.64[a]								
0.88	–0.58	0.06	–4.72	0.51	–5.38	0.51	0.10	0.98	–4.72[a]	–1.83[c]	–0.32	34
15.84	–2.96	0.30	–2.32[b]	0.33								
0.66	–0.12	0.48	–0.35	1.43	–0.33	1.42	0.02	1.00	–5.41[a]	4.71[a]	6.86[a]	34
9.38	–2.45	4.29	–2.54[b]	22.81[a]								
0.96	–0.03	0.05	–0.73	1.04	–0.69	1.04	0.05	0.99	–3.53	0.10	0.04	34
9.52	–0.23	0.34	–0.27	0.93								
0.75	–0.39	0.15	–1.55	0.59	–1.77	0.59	0.06	0.97	–5.92[a]	–1.05	–0.87	34
9.35	–3.05	1.02	–2.94[a]	1.24								
0.55	–0.19	0.52	–0.42	1.17	–0.41	1.16	0.05	0.97	–6.03[a]	7.24[a]	1.23	31
5.84	–3.80	3.30	–5.13[a]	8.55[a]								
0.58	–0.15	0.39	–0.37	0.93	–0.37	0.92	0.10	0.90	–4.57[b]	5.08[a]	–0.19	31
6.28	–2.91	2.00	–2.98[b]	2.48[b]								
0.72	–0.21	0.41	–1.02	1.47	–1.07	1.45						
0.79	–0.17	0.32	–0.78	1.30	–0.77	1.29						
0.17	0.19	0.31	0.97	0.85	1.04	0.84						
0.27	–0.96	0.02	–4.72	0.17	–5.38	0.16						
0.96	0.00	1.15	–0.02	4.34	–0.02	4.31						

Developing countries, except Asia, have significantly lower income elasticities than industrial countries. Developing countries also show lower price elasticities than industrial countries. Finally, the lower income elasticities for developing countries in general, and for Africa in particular, are even more forcefully demonstrated by the following weighted least squares regressions:[6]

$$E_y = \underset{(25.77)}{1.83} - \underset{(-6.99)}{1.04}d_{af} - \underset{(-1.14)}{0.40}d_{as} - \underset{(-2.28)}{0.54}d_{la} - \underset{(-3.89)}{0.62}d_{me},\ \bar{R}^2 = .90,\ N = 53; \quad (7)$$

$$E_y = \underset{(24.71)}{1.83} - \underset{(-6.69)}{0.78}d_{ldc},\quad \bar{R}^2 = .89,\ N = 53. \quad (8)$$

While developing countries' income elasticities are lower, they remain larger than one. Consequently, growth in their partner countries will translate into growth of at least the same magnitude of their exports. Thus trade remains an important engine of growth for all developing countries.

III. Conclusion

The paper provides income and price elasticities of the export demand function for 53 industrial and developing countries, estimated within a consistent framework and taking the possible nonstationarity in the data into account.

The long-run price and income elasticities generally have the expected sign and, in most cases, are statistically significant. The average price elasticity is close to zero in the short run but reaches about one in the long run. Twenty-two of the 53 countries in the sample have point estimates of long-run price elasticity larger than one, and for 33 countries the unit-price elasticity cannot be rejected. It takes six years for the average price elasticity to achieve 90 percent of its long-run level. A similar pattern holds for income elasticities in that exports react relatively slowly to changes in trade partners' income. The short-run income elasticities are on average less then 0.5, while the long-run income elasticities are on average close to 1.5. Thirty-nine countries have point estimates of long-run income elasticity that are larger than one, and for 35 countries the unit-income elasticity cannot be rejected. Thus, exports do significantly react to both movements in the activity variable and the relative price, though slowly.

A comparison with Reinhart (1995), who uses a similar methodology, shows that her estimates of the price elasticities are significantly lower. Her mean estimate (over the 10 developing countries showing the right sign) is –0.44, while it is –1.14 in this paper (where the mean is over the 37 developing countries in the sample). Conversely, her average income elasticity is 1.99 compared to 1.32 in this paper. These differences may simply reflect the difference in the periods of analysis and sample sizes.

While developing countries show, in general, lower price elasticities than industrial countries, Asian countries have significantly higher price elasticities

[6]All the variables in the equations have been weighted by the inverse of the standard error of the corresponding elasticity.

than both industrial and developing countries. Furthermore, Asian countries benefit from higher income elasticities than the rest of the developing world, corroborating the general view that trade has been a powerful engine of growth in the region. Africa, in contrast, faces the lowest income elasticities.

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