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Arslan Razmi
University of Massachusetts - Amherst

Robert A. Blecker

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Working Paper

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Working Paper 2005-02
Revised version, May 2006

UNIVERSITY OF MASSACHUSETTS AMHERST

forthcoming, *Journal of Development Studies*

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ARSLAN RAZMI* & ROBERT A. BLECKER**

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ABSTRACT

This paper tests for a 'fallacy of composition' by analysing the demand for exports of the 18 developing countries that are most specialised in manufactures in the markets of the 10 largest industrial countries. Estimated export equations (both time-series and panel data) suggest that most developing countries compete with other developing country exporters rather than with industrialised country producers. A smaller number of countries that export more high-technology products compete with industrialised country producers and also have higher expenditure elasticities for their exports. Thus, the fallacy of composition applies mainly to the larger group of countries exporting mostly low-technology products.

JEL Codes: O19, O14, F14.

Keywords: Developing country exports of manufactures, intra-developing country competition, fallacy of composition, real exchange rates, technological ladder, adding-up constraint.

*University of Massachusetts, Amherst, MA, USA, **American University, Washington, DC, USA

Correspondence Address: Arslan Razmi, Department of Economics, University of Massachusetts, Amherst, MA 01003, USA. Tel. 413-577-0785; Fax 413-545-2921; Email: arazmi@econs.umass.edu

I. Introduction

The proportion of manufactures in the total merchandise exports of low- and middle-income developing countries to high-income industrialised countries increased to almost 75 per cent in 2003, representing an almost four-fold increase since 1980 (see figure 1). One important motivation for this dramatic shift is the perception that these products offer better prospects for export expansion without inducing the negative or destabilising effects on prices that have been observed in global markets for primary commodities. In this optimistic view, less developed countries can move up the development 'ladder' by initially specialising in and exporting low-technology, unskilled-labour-intensive manufactures. As these countries graduate to the rank of middle- or higher-income countries by exporting more technologically sophisticated, skill-intensive products, they allegedly expand export opportunities for other developing countries further down the development ladder in what is sometimes called the 'flying geese formation'.[1]

Support for trade liberalisation and export promotion policies is also grounded in the classical economists' vision of raising productivity through increasing specialisation and division of labour. Crucial to this vision is the assumption that the growth of reciprocal demand between trading economies creates ever-expanding markets for all countries' exports, so that no country need fear a demand-side constraint on its export growth. In contrast, critics of an export-led growth strategy focused on manufactures have suggested the hypothesis of a 'fallacy of composition', that is, if a number of developing countries simultaneously try to increase their exports in a range of similar products, many of them could end up losing from insufficient foreign demand and possibly depressed international prices (see, for example, Kaplinsky, 1993, 1999; Blecker, 2002; Mayer, 2003). In this view, the classical liberal vision does not apply

because the developing countries sell most of their exports in industrialised country markets, in which case the former countries do not provide the assumed reciprocal demand for each other's exports.[2] Of course, access to the markets of the industrialised countries can be viewed as providing an additional or 'external' source of demand for individual developing countries, but the fallacy-of-composition argument holds that this external demand does not generally grow fast enough to accommodate the desired or targeted rates of export expansion of all developing country exporters in the aggregate.[3]

If the industrialised countries' markets do not grow fast enough to accommodate the developing countries' targets for the growth of their exports of manufactures, as a result of either trade barriers or macroeconomic policies, then—unless South-South trade among the developing countries expands fast enough—the latter countries as a group will not all be able to achieve their respective export objectives. Put differently, if the total desired export growth of the developing nations exceeds the absorptive capacity of the industrialised country markets, then the success of some developing countries in export promotion must come at the expense of failure for others. Excess supplies in global markets can lead to falling terms of trade for developing country exports of manufactures, similar to what has happened historically for exports of primary commodities (Grilli and Yang, 1988; Ocampo, and Parra, 2003). In such a competitive environment, developing country exporters may feel pressured to hold down their export prices through currency depreciation or wage repression, thus foregoing some of the potential income gains from increased exports (and, effectively, transferring part of the productivity gains to importers in the industrialised countries). Thus, developing country exporters of manufactures are alleged to face an 'adding up constraint', which limits the potential gains from this development strategy. Although many economists (for example, Riedel, 1988; Balassa, 1989)

have dismissed such concerns in the past, the emergence of China as a major global exporter and the growing number of developing countries seeking to expand manufactured exports (for example, through preferential and multilateral trade agreements) have revived interest in this topic among both economists (for example, Lall, 2004; Kaplinsky, 2005) and policy makers.

There have been several empirical approaches to testing for fallacy-of-composition effects, as discussed in more depth in the next section. This paper follows the small number of studies (beginning with Faini *et al.*, 1992; Muscatelli *et al.*, 1994) which have focused on testing for intra-developing country price competition in industrialised country markets for manufactured exports as a means for investigating whether developing countries face significant adding-up constraints in their export-promotion efforts. More specifically, this paper estimates demand functions for manufactured exports for a sample of 18 developing countries that have above-average proportions of manufactures in their merchandise exports. (The econometric reasons for believing that the estimated export equations are capturing demand rather than supply relationships are discussed in sections III and IV, below.) Similar to a few previous studies, we first estimate export demand equations for the individual countries in the sample, although using more up-to-date data and other innovations described below. However, none of the previous studies of this type has tested econometrically whether the determinants of export demand differ systematically between countries that export products on different rungs of the technological ladder, as suggested by Lall (1998, 2000). To address this issue, this paper divides the sample into two panels of countries that are specialised in traditional and non-traditional ('low technology' and 'high technology') exports, in order to determine whether the countries that have moved 'up the ladder' to more advanced types of exports have escaped from the intense price competition faced by the countries that are concentrated mainly in traditional exports, such

as textile and apparel products.[4]

To test for whether the developing countries in the sample compete mainly with each other or with domestic producers in the industrialised countries in markets for manufactures, this paper constructs carefully designed, country-specific price indices using dual weighting schemes that better reflect the relative importance of particular industrialised country markets and developing country competitors for each developing country, as compared with simple bilateral trade shares. One set of dual weights is used for the index of the industrialised countries' domestic prices and a different set is used for the index of other developing countries' export prices. These weights are time-varying, not fixed, in order to reflect the changing country composition of developing country manufactured exports over time. We then calculate the ratios of each of the two (country-specific) dual-weighted price indices to each country's own export price index; in other words, we construct relative prices of domestic products in the industrialised countries and exports of rival developing countries with respect to each developing country's own exports.

These two relative prices are entered separately in the export demand functions, along with the total (trade-weighted) industrialised country expenditures on imports of manufactures (from the 18 developing countries in the sample) as a scale variable.[5] A significant positive coefficient (elasticity) on the relative price of other developing countries' exports is taken as evidence for price competition between developing countries for export sales in the industrialised country markets (and hence supports the existence of an adding-up constraint or fallacy of composition), while a significant positive coefficient on the relative price of the industrialised countries' goods is taken as evidence for price competition with domestic producers in the latter countries (and hence does not support an adding-up constraint). Although the primary focus here

is on these estimated price elasticities, the results also suggest interesting findings regarding differences in the expenditure elasticities of the industrialised countries' demand for the exports of developing countries with different export profiles.

In addition to the use of panel data for high- and low-technology exporters and the construction of dual trade-weighted price indices, this paper makes a number of other contributions. First, unlike some recent studies, the present paper uses econometric estimation techniques instead of simulation methods based on assumed parameter values. Second, compared with the few earlier econometric studies, this paper uses more recent data including the period following the establishment of the World Trade Organisation (WTO) in 1995, the Asian crisis of 1997-1998, and the emergence of China as a large exporter throughout the 1990s. Third, the econometric analysis in this paper includes a reparameterisation of an autoregressive distributed lag model originally suggested by Bewley (1979), which allows for the parsimonious estimation of long-run equilibrium relationships in the presence of possibly nonstationary data. Fourth, unlike some previous analyses, this paper does not confine itself to a small number of east and southeast Asian countries, but rather includes all developing countries for which the share of manufactures in total goods exports is above the average for all developing countries. One limitation, however, is that this study considers developing country exports of manufactures only to the major industrialised countries. A more complete analysis that would also incorporate South-South trade in manufactures will have to be the subject of future research.

II. Literature Review

The Prebisch-Singer hypothesis in its traditional form has been interpreted to predict falling

terms of trade for primary commodities versus manufactured products. However, Singer (1975) emphasised differences between industrialised and developing *countries*, as opposed to primary versus manufactured *commodities*. More recently, Sapsford and Singer (1998) explicitly mentioned the possibility of a 'fallacy of composition' in the pursuit of manufactured exports (or at least the low-technology, labour-intensive ones) in the context of the structural adjustment policies promoted by the World Bank and International Monetary Fund (IMF).

The literature that empirically tests the fallacy-of-composition hypothesis is relatively small (see the survey in Mayer, 2003). Two of the earliest empirical studies of adding-up constraints were by Cline (1982), who concluded that the rapid export-led growth of the east Asian 'four tigers' (South Korea, Taiwan, Hong Kong, and Singapore) in the 1970s could not plausibly be generalised to a larger set of developing countries without provoking protectionist responses by the industrialised countries. More recently, several studies have used simulations of computable general equilibrium models to investigate the adding-up problem. An early example was Evans *et al*. (1992), which focused only on agricultural products. Two more recent examples are Walmsley and Hertel (2000) and Eichengreen *et al*. (2004), both of which modeled on the effects of China's entry into the global economy. These two studies both found negative effects of Chinese export growth on developing countries that export competing types of manufactures (mainly, labour-intensive consumer goods), although they also showed gains for other countries (for example, exporters of primary commodities and capital goods). Some economists have focused more specifically on competition over shares of the US import market. For example, Blecker (2002) and Palley (2003) both found that more rapid growth of US imports from new entrants (such as Mexico and China) was correlated or associated with slower growth of US imports from previously dominant exporters (such as Japan and the four tigers).

Only a few studies have tested econometrically for intra-developing country price competition in manufactured exports. Faini *et al*. (1992) estimated export demand functions for 23 developing countries for the period 1967-1983. Their results showed that, for most of the countries in the sample, price competition was more significant with other developing countries than with industrialised countries, as inferred from the higher price elasticities of individual countries with respect to other developing countries compared with the industrialised countries. However, Faini *et al.* included a number of countries that were not heavily specialised in manufactured exports; for some, manufactures constituted less than one-third of total exports. Muscatelli *et al.* (1994) conducted econometric tests for price competition among a sample of five newly industrialising economies (NIEs) in east and southeast Asia. They tested for intra-Asian price competition by including a price index for each country's competing NIEs (within the sample) along with the price indices for domestic and rest-of-world prices in export demand equations. The results generally supported those of Faini *et al.* in that intra-developing country competition was found to be strong among these countries. However, these results were based on a limited sample of five countries in a single region. Neither Faini *et al.* nor Muscatelli *et al.* applied the dual-weighting procedures used here to construct price indices, nor did they utilise pooling techniques to create panels of countries based on the technological level of their exports.

More recently, Duttagupta and Spilimbergo (2004) found econometric evidence for competitive devaluations as a major factor underlying the slow recovery of export volumes following the Asian crisis of 1997-1998. Specifically, the authors found that the elasticity of substitution between goods from individual east Asian countries was much higher than that between east Asian goods and those produced in other countries. However, Duttagupta and Spilimbergo's sample was limited to six east and southeast Asian countries, not including China

or Taiwan. Taking a more historical/evolutionary approach, a few studies have argued that there has been a process of 'commoditisation' of labour-intensive manufactures, in the sense that countries exporting these products are subject to the same problems of declining terms of trade and pressures for competitive devaluations or wage cuts that have been found historically among primary commodity exporters (see, for example, Kaplinsky, 1993; UNCTAD, 2004). This has been taken to imply the desirability of individual countries striving to move up the technological ladder, in order to avoid competing through lower prices. However, to the present authors' knowledge, no previous study has formally tested for differences in export behaviour between developing countries that are specialised in exports at different levels on the technological ladder.

III. Empirical Framework and Econometric Methodology

Data Set and Measurement Issues

Disaggregated data on industrialised country imports from developing countries by country and industry were taken from the Organisation for Economic Co-operation and Development (OECD) trade database in current dollar terms; the sum of Standard International Trade Classification (SITC) categories 5 through 8 was used to represent exports of manufactures. Converting these current dollar series into real (volume) terms as well as constructing the relative price variables requires the use of appropriate price indices. Unfortunately, disaggregated price indices for manufactured exports for these countries were not available.[6] Instead, we used aggregate export unit values (measured in US dollars) for the

developing countries included in the sample to deflate the nominal export series (see the appendix for details on all variable definitions and sources).

In order to restrict the sample to countries for which manufactures would have a preponderant influence on the aggregate export price indices, we limited the sample to countries for which manufactured products constituted at least 70 per cent of their exports in at least one of the two years, 1990 and 2001. This percentage corresponds to the average of 68 per cent over 1999-2003 reported by UNCTAD (2005), rounded up. The 18 developing countries that fit this criterion were: Bangladesh, China, the Dominican Republic, Hong Kong, India, Jamaica, South Korea, Malaysia, Mauritius, Mexico, Pakistan, the Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Tunisia, and Turkey (Nepal also met this criterion, but was excluded because of its tiny size). This list of countries goes well beyond the original four east Asian tigers, and includes a variety of newer exporters in other regions. The sample period consists of annual data for 1983-2001 for most countries, except Bangladesh and Mauritius for which the first available year was 1985, and the Dominican Republic and Tunisia for which the last available years were 1998 and 1999, respectively. The average share of manufactures in total exports from these 18 countries was 83 per cent as of 2001.

The sample of industrialised countries consists of the 10 largest importers of manufactured products from developing countries as of 1990, which were: Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Switzerland, the UK, and USA. Using data for these individual countries, rather than a total for all industrialised countries, allows for the construction of the country-by-country trade weights (which match individual developing country exporters with individual industrialised country markets) described below. Little is lost by restricting the industrialised countries group to these ten nations, because they accounted for almost 93 per cent

of total industrialised country imports of manufactures from 17 of the 18 developing countries in our sample (excluding Taiwan) as of 2000.[7] Also, exports to these ten countries represented almost 60 per cent of the *total* manufactured exports of the developing countries in our sample (again, excluding Taiwan).

As noted earlier, some previous studies have used simple bilateral trade weights to compute both price indices and a scale variable (such as total industrialised country import expenditures). However, each exporting country competes not only with domestic producers in the importing country, but also with other developing countries that export similar products to the same market. This intra-developing country competition complicates the construction of appropriately weighted price indices. This distinction, which becomes particularly important when there are variable movements in exchange rates across countries, suggests the use of dual weights for the prices of both the industrialised countries' manufactures and competing developing nations' exports.

The desirability of dual-weighted price indices is best explained by some examples. Suppose that certain countries such as Mexico and China sell higher shares of their manufactured exports to the US market than other developing countries, such as India or Turkey, which sell relatively more of their exports to European nations. If one simply uses bilateral trade weights reflecting the actual US share of each country's exports in weighting US prices, however, one ignores the fact that the large US market remains an important target for manufacturing exporters from all developing nations, including those that do not yet have large exports to the US. Therefore, US prices should have a greater weight for countries such as India and Turkey than their current export shares to the US market would suggest, because they may be able to increase their exports to the US if their prices fall relative to US prices. As a benchmark, we use each

industrialised country's share of total industrialised country imports of manufactures from all the developing countries in the sample as an indicator of the overall importance of that country's market for the latter countries, and we interact that share with the bilateral share for each pair of countries (developing exporter and industrialised importer) to construct the dual weight for the index of industrialised country prices.

Similarly, in evaluating the prices of the competing developing countries, it is necessary to take into account both the share of each developing country's exports going to a certain industrialised country market and the shares of other developing countries' competing exports going to that same market. For example, although the US may not be a very large export market for, say, Turkey, to the extent that Turkish exports are sold in the US market they compete more with Mexican and Chinese products rather than with Indian products, and hence the index of Turkey's competitors' export prices should reflect both the relative importance of the US market for Turkey and the relative importance of the other developing countries in that market. Details on the construction of these price indices (and the scale variable) are presented in the appendix.

Econometric Specification of Export Demand

The focus of this study is on the long-run determinants of the industrialised countries' demand for developing countries' exports of manufactures. In theory, export prices and quantities are simultaneously determined by a system of two equations for supply and demand (see Goldstein and Khan, 1985). This implies that each country's export price may be endogenously determined, and thus correlated with the error term, which would create a simultaneity bias in estimating a demand function by itself. However, estimation of the export supply function is

seriously hindered by the scarcity of consistently available data on variables such as labour costs and capacity utilisation for developing countries. As Spilimbergo and Vamvakidis (2003: 342) point out, 'there is a trade-off between estimating the demand equation with potential simultaneity bias, and estimating a system of two equations with potential misspecification of the supply curve'. Faini *et al.* (1992) note that, given uncertainty about the correct specification of export supply, estimating supply and demand equations simultaneously may make the estimated demand functions subject to significant misspecification bias.

Also, estimating the demand function only does not raise simultaneity-related concerns if the supply curve is perfectly price-elastic so that the price can be treated as exogenous. Therefore, we used a version of Hausman's specification error test (see Gujarati, 1995) to check our treatment of each country's export price as a predetermined or 'weakly exogenous' variable. As shown in table 1, the Hausman tests show that none of the countries (with the exception of Sri Lanka) exhibited a simultaneity problem at the 5 per cent significance level.[8] For Sri Lanka, therefore, we used lagged export prices as an instrument for contemporaneous prices. In addition, our specification of export demand will take *lagged* supply-side effects into account through the inclusion of a lagged dependent variable. Potential supply-side effects (for example, quality enhancements) are likely to come into effect over a relatively longer period of time than demand-side effects, and hence should be reflected in lagged exports. We therefore proceed by treating the export price as exogenous and estimating demand equations only.

The basic export demand function we wish to estimate for each country *i* is an autoregressive distributed lag (ARDL) model of the following form

$$\begin{aligned} X_{i,t} = \beta_{i0} + \beta_{i1} Z_{i,t}^{N} + \beta_{i2} PP_{i,t}^{N} + \beta_{i3} PX_{i,t}^{L} + \beta_{i4} PX_{i,t} + \beta_{i5} Z_{i,t-1}^{N} \\ + \beta_{i6} P_{i,t-1}^{N} + \beta_{i7} PX_{i,t-1}^{L} + \beta_{i8} PX_{i,t-1} + \gamma_i X_{i,t-1} + \upsilon_{i,t} \end{aligned} \tag{1}$$

where $X_{i,t}$ is the volume of exports of manufactured goods from developing country *i* at time *t*,

$Z_{i,t}^{N}$ is the scale variable (the weighted index of industrialised country total expenditures on imports of manufactures from all the developing countries in the sample for each country *i*), $PP_{i,t}^{N}$ is the dual-weighted producer price index in the industrialised country markets (for each developing country *i*), $PX_{i,t}^{L}$ is the dual-weighted price index for exports from other developing countries (also for each country *i*), and $PX_{i,t}$ is country *i*'s own export price index (details on the construction of these indices are given in the appendix), and $\upsilon_{i,t}$ is the error term. Only one lag is used for both the independent and dependent variables due to limited degrees of freedom with relatively short annual time-series. All variables are measured in natural logarithms so that the coefficients can be interpreted as elasticities. This equation is thus a log-linear Cobb-Douglas demand function, which assumes that exports from each developing country and domestic products in the industrialised countries are all 'imperfect substitutes' for each other. The lagged dependent variable is included because the quantity exported at one point in time is likely to be partially dependent on previous export performance (for example, because of learning about product quality), as well as on possibly persistent effects of previous shocks.

Assuming homogeneity of degree zero in prices,[9] we can use the two relative prices (expressed as log differences) $RPX_{i}^{N} = PP_{i}^{N} - PX_{i}$ for industrialised country (*N*) manufactured goods and $RPX_{i}^{L} = PX_{i}^{L} - PX_{i}$ for competing developing country (*L*) exports, each relative to country *i*'s exports, in place of the three separate price indices in equation (1). Note that the two *RPX* variables can be thought of as real exchange rates for exports. Under this assumption, (1) becomes:

$$\begin{aligned} X_{i,t} = \beta_{i0} + \beta_{i1} Z_{i,t}^{N} + \beta_{i2} RPX_{i,t}^{N} + \beta_{i3} RPX_{i,t}^{L} + \beta_{i5} Z_{i,t-1}^{N} \\ + \beta_{i6} RPX_{i,t-1}^{N} + \beta_{i7} RPX_{i,t-1}^{L} + \gamma_{i} X_{i,t-1} + \upsilon_{i,t} \end{aligned} \tag{2}$$

Analysis of the time-series properties of our data shows that most of the variables are nonstationary (that is, have unit roots), both for the individual country series and in the panel data (see appendix). For this reason, we base our econometric specification on the Bewley (1979) transformation, which is a reparameterisation of an ARDL model that is robust to the inclusion of variables with unit roots (see the appendix and Patterson, 2000), and which controls for short-run dynamics in order to get consistent estimates of the long-run parameters of interest. Applying the Bewley transformation to equation (2), the dependent variable is regressed on both the levels and first differences of each independent variable and the contemporaneous differenced dependent variable:

$$\begin{aligned} X_{i,t} = \alpha_0 + B_{i1} Z_{i,t}^{N} + B_{i2} RPX_{i,t}^{N} + B_{i3} RPX_{i,t}^{L} - B_{i4} \Delta Z_{i,t}^{N} \\ - B_{i5} \Delta RPX_{i,t}^{N} - B_{i6} \Delta RPX_{i,t}^{L} - \Gamma \Delta X_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{3}$$

where the coefficients and error term in (3) are transformations of the coefficients and error term in (2) (see appendix for details). In this transformed equation, the coefficients on the variables in (log) levels (B_1, B_2, and B_3) can be interpreted as long-run coefficients (elasticities), while the coefficients on the differenced variables (B_4, B_5, B_6, and Γ) capture short-run adjustment dynamics. A priori, we expect all the long-run coefficients in equation (3) to be positive, assuming that domestic exports are substitutes for both types of foreign goods (N and L).

Because the $\Delta X_{i,t}$ variable on the right-hand side is endogenous, equation (3) must be estimated using instrumental variables. Following typical practice with the Bewley procedure, the lagged dependent variable $X_{i,t-1}$ along with the other exogenous variables on the right-hand side are used as instruments (see Wickens and Breusch, 1988). Two different instrumental variables methods are used to estimate equation (3) for the individual countries. First, the two-stage least squares (2SLS) method is applied to the individual country equations separately.

However, as noted by Muscatelli *et al.* (1994), possible similarities in the evolutionary patterns of exports from the developing countries in the sample and their exposure to similar shocks suggest that the residuals from the 2SLS equations may be correlated. After tests for such correlations show them to be significant, we re-estimate equation (3) as a system of simultaneous equations for all 18 countries using three-stage least squares (3SLS), which essentially combines 2SLS with 'seemingly unrelated regression' (SUR) to control for cross-equation correlation of the residuals.

IV. Econometric Results

This section presents the 2SLS and 3SLS estimates of the transformed export demand equation (3) for all the developing countries in our sample individually, as well as the 2SLS estimates for various groups of these countries using panel data. As noted earlier, the data set consists of annual observations for 1983-2001 for all but four countries, but the sample periods used in the regressions start one year later due to differencing. The estimation strategy employed is the general-to-specific (GTS) modeling approach (see, for example, Cuthbertson *et al.*, 1992; Charemza and Deadman, 1997). Starting from a dynamic specification of the joint properties of the data in the general model expressed by equation (3), the estimates were subsequently tested and reduced to more specific forms by eliminating insignificant or redundant variables for each country. Each restriction was based on the significance levels of the reported estimates, and the reparameterisation was subjected to Wald tests for both the omission of individual variables and the joint omission of two or more variables. A significance level of 10 per cent was consistently used throughout.[10] The final 'preferred' model in each case was subjected to a battery of tests in

order to gauge the validity of the functional form chosen and the stability of the results obtained.

Two-Stage Least Squares Estimates

The results of the 2SLS estimates of the export demand equation (2) for individual developing countries are reported in table 2. The corresponding diagnostic test statistics, including the adjusted R^2s, standard errors of the regressions (SE), and the *p*-values of the Wald test, Jarque-Bera statistics, Breusch-Godfrey tests, autoregressive conditional heteroskedasticity (ARCH) tests, Chow forecast error tests, and RESET tests, are reported in table 3 (see notes to table 3 for explanations of these tests). The last column in table 2 (containing the estimated parameter values for the differenced dependent variable) indicates that the equations for Sri Lanka, Malaysia and Tunisia do not yield stable estimates (the negative estimated coefficients indicate that the long-run multiplier is either greater than one or negative). These countries are, therefore, excluded from our discussion in the remainder of this section. All the long-run parameter estimates in these equations are within expected ranges of magnitude (although a few estimates have 'incorrect' signs, as discussed below, and are excluded in calculating average coefficients).

Except for Hong Kong, Mauritius, and Pakistan, the expenditure (Z^N) elasticities are all about 0.9 or higher, and range up to 2.51 for China. Moreover, all the long-run expenditure elasticity estimates have a positive sign and are statistically significant. The average expenditure elasticity is 1.17 (1.31 if the two lowest cases, Hong Kong and Mauritius, are excluded). Comparing regions, the average expenditure elasticity is the highest for the east and southeast Asian countries (1.32 including Hong Kong, and 1.51 excluding it) and the lowest (0.59) for the two African countries (Mauritius and Tunisia), with the south Asian and western hemisphere

countries falling in between. This broad pattern is consistent with previous studies regarding the dynamic nature of the east Asian countries' exports in terms of non-price competitive effects.

Turning to the relative price effects, in none of the cases are *both* of the *RPX* elasticities significant at the 10 per cent level *and* positively signed. In four countries (India, South Korea, Singapore, and Taiwan), both relative price variables are significant but have opposite signs, which could be a result of collinearity between those variables for those countries. In another four cases (Hong Kong, Mauritius, the Philippines, and Thailand), neither of the price elasticities is significant at the 10 per cent level. Out of the remaining 11 countries that yield stable estimates, eight including Bangladesh, China, the Dominican Republic, India, Jamaica, Pakistan, Singapore, and Turkey have positive, and statistically significant coefficients on RPX^L; the magnitude of this parameter (elasticity) varies between 1.13 for Bangladesh and 4.42 for Jamaica, with an average of 2.26. Only three countries, South Korea, Mexico, and Taiwan, have significant and positively signed coefficients on RPX^N, with an average coefficient of 1.38.[11] Thus, price competition with other developing countries seems to be more widespread than that with industrialised countries. Moreover, the degree of substitutability between developing country products seems to be higher on average, suggesting more intense competition.

The diagnostic statistics in table 3 reveal a few scattered problems. None of the Wald test statistics are significant, indicating that all the exclusion restrictions are valid. The model fits the data quite well, with the sole exception of Hong Kong (which also reports extremely low parameter estimates, possibly due to data reporting problems in a small entrepôt country). The Breusch-Godfrey (BG) tests generally do not indicate significant serial correlation, except for Bangladesh, Sri Lanka, Thailand, and Turkey at the 5 per cent level (but not at 1%). The ARCH statistics do not reveal any problems except for Turkey, again at the 5 per cent level (but not at

1%). The RESET test does not raise any misspecification concerns at the 1 per cent level, except for Sri Lanka and Mexico. None of the Chow forecast test statistics reject the null hypothesis of no structural change in the export demand function at conventional levels of significance. Following the logic developed in Hendry (1988), this finding provides further support for the weak exogeneity assumption regarding export prices.

Three-Stage Least Squares Estimates

As discussed earlier, the developing countries in our sample are likely to have had some similarity in the patterns of evolution of their manufactured exports, and may be affected similarly by international shocks. Confirming this hypothesis, the correlation matrix of the residuals from the 2SLS estimates for all 18 developing countries indicates that many of those residuals are highly correlated.[12] More formally, the null hypothesis of a diagonal residual correlation matrix (indicating no correlation) can be tested using the LM statistic

$$\lambda = T\sum_{i=2}^{M}\sum_{j=1}^{i-1} r_{ij}^2 ,$$

where T is the sample size, M is the number of equations, the r_{ij} are the elements of the residual correlation matrix, and under the null hypothesis λ has an asymptotic $\chi^2[0.5M(M-1)]$ distribution (Breusch and Pagan, 1980). Calculating λ for the residuals from the 2SLS estimates reported above, the null hypothesis can be rejected at the 12.2 per cent significance level.

Given this evidence for significant correlations between the residuals of the 2SLS regressions, we next estimate the export equations as a system using 3SLS (see table 4). The lower standard errors obtained for most individual coefficients, when compared to the 2SLS

ones, indicate efficiency gains from taking into account cross-equation correlations between residuals and provide further justification for the resort to 3SLS. The estimates for the same three countries (Sri Lanka, Malaysia, and Tunisia) yield invalid results, and are therefore again excluded from the remainder of this discussion. The equations fit well with the exception of the one for Hong Kong, which has a low R^2. We focus on the contemporaneous variables in levels since their coefficients represent the long-run effects.

The long-run expenditure (Z^N) coefficient (elasticity) is statistically significant and has a positive sign for all countries in table 4. In terms of magnitudes, the average long-run expenditure elasticity varies from 0.22 for Hong Kong and Mauritius (recall the similarly low numbers for these countries in the 2SLS estimates) to 4.16 for China. The overall average expenditure elasticity is 1.33 including Hong Kong and Mauritius, and 1.50 excluding them. The average expenditure elasticity for the East and Southeast Asian countries is again the highest (1.64 including Hong Kong, 1.87 excluding it); the comparable averages for the south Asian and western hemisphere countries are 1.03 and 1.19, respectively.

Turning to relative price effects in table 4, again in no case are both of the long-run *RPX* coefficients positive and statistically significant, suggesting possible collinearity problems between the two relative price variables. The long-run coefficient for RPX^N is positive and statistically significant only for South Korea, Mexico, and Taiwan. In contrast, the long-run coefficient for RPX^L is positive and statistically significant for nine countries (Bangladesh, China, the Dominican Republic, India, Jamaica, Pakistan, Singapore, Thailand and Turkey). Thus, in the 3SLS estimates, nine of the 12 countries that have at least one statistically significant and positively signed relative price coefficient show evidence of competition with other developing countries, while only three show evidence of competition with industrialised

country producers. The estimated coefficients on RPX^L range from 1.04 for Bangladesh to 6.21 for China, with an average of 3.32. The estimated coefficients on RPX^N range from 0.42 for Taiwan to 1.88 for South Korea, with an average of 1.22 (among the three countries that have positive long-run coefficients for this variable). Again, competition amongst rival developing country exporters seems to be more intense and widespread than that between developing country exporters and producers in the industrial countries, although the results have to be qualified with possible collinearity-related concerns. It is also not surprising that the three countries that show evidence of competition mainly with the industrialised countries are the two largest 'tigers' (South Korea and Taiwan) and a country that sells about 90 per cent of its exports to the US (Mexico).

Comparing the long-run elasticities obtained by the two methods (2SLS and 3SLS), as shown in tables 2 and 4, respectively, the qualitative results from the two estimations are quite similar with a few exceptions. For example, comparing expenditure elasticities, there are noticeable differences between the two sets of estimates for Thailand and China (for both countries the 3SLS estimates were higher). Individual relative price elasticities are generally higher in the 3SLS estimates. For Thailand, which had no significant relative price effects in the 2SLS regression, there is a significant positive coefficient on RPX^L in the 3SLS results.

Panel Data Estimates of Export Demand Equations

As suggested earlier, the estimated individual country export demand equations may suffer from collinearity between the relative price variables. This suggests that there are possible gains from pooling the data, which increases the available degrees of freedom and makes it more feasible to

test homogeneity restrictions. Moreover, apart from providing more reliable parameter estimates (Baltagi, 2001), pooling generally reduces collinearity among the regressors, thus increasing the efficiency of the estimates (Hsiao, 2003). The downside of pooled estimates, of course, is the imposition of the rather stringent restriction that the coefficients must be the same for all panel members.[13] Nevertheless, estimating the model as a panel offers an important check on the robustness of the overall results, and allows us to construct separate panels of countries grouped by level of technological sophistication of their exports.

The first column in table 5 reports the results for the panel consisting of all 18 countries. We used a fixed effects model and applied the 2SLS method, again taking a GTS approach. The fixed effects model allows the intercept to be estimated separately for each country, while the slope coefficients are constrained to be the same across countries.[14] White cross-section standard errors were used to allow for general contemporaneous correlation between residuals. Wald tests could not reject the restriction of long-run homogeneity of degree zero in prices for any of the panel data estimates, and at any of the conventional levels of significance.

The long-run expenditure (Z^N) coefficient (elasticity) for all developing countries is positive and statistically significant, although its magnitude (0.69) is lower than that typically found for the individual countries earlier. This relatively low estimated elasticity is probably attributable to the assumption of identical parameter values across the panel. The coefficient on RPX^L is positive and significant, a finding that tends to confirm the hypothesis of significant intra-developing country competition. This elasticity is estimated to be 0.99 for all countries, which is toward the low end of the individual country estimates, but which makes sense because this parameter was not significant in the results for several of the individual countries. The coefficient on RPX^N, however, is statistically insignificant (and was eliminated by the GTS

procedure), suggesting the absence of significant competition between developing country exporters as a group and industrialised country manufacturers.

Given the wide range of results for the individual countries and the heterogeneous nature of developing country exports of manufactures, and to investigate the effects of moving 'up the ladder' of technological sophistication, we split the sample into two groups of developing country exporters, which we call 'low technology' (LT) and 'high technology' (HT). The World Bank data in table 6 indicate that relatively high-technology products made up more than one-third of the export baskets of Korea, Malaysia, the Philippines, Singapore, and Thailand by 2000,[15] while the corresponding percentages for Bangladesh, the Dominican Republic, India, Jamaica, Mauritius, Pakistan, Sri Lanka, Tunisia, and Turkey are all in single digits. Although this appears to create a clear separation, there are three in-between countries: China, Hong Kong, and Mexico all have high-technology shares in the range of about 20 per cent by 2000, and for China and Mexico these shares are dramatically higher in 2000 relative to earlier years. Given their intermediate position on the World Bank's technological scale and the fact that their shares were rapidly rising during the sample period, these three countries are included in both the LT and HT categories on the assumption that they compete with producers in both groups of countries.[16] Thus, the two sub-panels are defined as follows:[17]

- Low-technology (LT): Bangladesh, China, the Dominican Republic, Hong Kong, India, Jamaica, Mauritius, Mexico, Pakistan, Sri Lanka, Tunisia, and Turkey.
- High-technology (HT): China, Hong Kong, S. Korea, Malaysia, Mexico, Philippines, Singapore, Thailand, and Taiwan.

The last two columns in table 5 present the 2SLS estimates for these two panels. The homogeneity restriction for prices could not be not rejected for either group (panel). The

expenditure elasticity (coefficient on Z^N) is positively signed and statistically significant for the HT group, and positive but smaller and significant only at the 19 per cent level for the LT group.[18] Moreover, the long-run expenditure elasticity is much greater for the HT group compared with LT (1.08 versus 0.34), although the coefficients for both groups are again smaller than those obtained for many individual countries. The long-run coefficient on RPX^N is positive and statistically significant only for the HT group, with an estimated value (elasticity) of 2.03. The long-run coefficient on RPX^L, on the other hand, is statistically significant and positively signed only for the LT group (with an elasticity of 1.64), indicating competition with other developing countries. The long-run coefficient on RPX^L for the HT group is negative and statistically significant, possibly supporting the view that other developing countries' exports act mainly as complements in production of HT exports (especially in east Asia, as suggested by Lall, 2004), or else indicating the continued presence of collinearity problems among the two relative prices for the HT group. Thus, only the LT exporters provide evidence of price competition with other developing countries, while the HT exporters show signs of significant price competition only with industrialised country manufacturers. Finally, the diagnostic statistics for the two sets of estimates indicate that the hypothesised determinants of export demand do a much better job of explaining variation in exports for the HT group than for the LT group, perhaps reflecting greater heterogeneity of economic structures within the LT group or the weak explanatory power of the Z^N variable for this panel.

Comparing the panel data results (table 5) with the 3SLS regression results (table 4), the two sets appear to be broadly consistent. Out of the 11 LT countries that yielded valid results in the 3SLS regressions, seven (Bangladesh, China, the Dominican Republic, India, Jamaica, Pakistan, and Turkey) had positive and significant long-run coefficients on RPX^L. Out of the HT

group, only Korea, Taiwan, and Mexico had positive and statistically significant coefficients on RPX^N in the 3SLS estimates, while China, Singapore, and Thailand had positive and statistically significant coefficients on RPX^L.

V. Conclusions

The main conclusions of this paper can be summarised as follows. In the individual country export equations, estimated expenditure elasticities are statistically significant and positively signed for all countries, implying that industrial countries' total expenditures place significant limits on the growth of exports of manufactures from developing countries. The estimated coefficients on relative prices suggest that most developing countries in the sample for which valid estimates of price effects could be obtained compete mainly with other developing country exporters, rather than with producers of manufactures in the industrialised countries.[19] Notably, we found evidence that China—which was not included in the previous econometric studies of this topic from the 1990s—is significantly in competition with other developing countries. However, the individual country estimates suggest substantial variation between regions and countries. For example, most of the east and southeast Asian countries have higher expenditure elasticities than countries in other regions, while the results for Mexico, South Korea, and Taiwan show significant competition with industrialised country producers (not with other developing country exporters).

Our findings differ from the results of Faini *et al.* (1992) for Korea and Muscatelli *et al.* (1994) for Korea and Taiwan, who found that these countries had significant competition with other developing countries using earlier data. Since our results are based on later data, they

support the view of a structural change in the technological level of Korea and Taiwan's exports since the mid-1980s. Our findings for Korea and Taiwan may be explained by evolution of these two countries into major industrial manufacturers with a substantial presence in the markets for technologically sophisticated goods (Lall, 2000). Our findings are also consistent with those of Landesmann *et al.* (2002), who concluded that the growth of imports from the South (mainly the Asian tigers) had an adverse effect on Northern employment in the 1980s but not in the 1990s, while other Southern countries (including China) penetrated Northern markets mainly during the 1990s (when the more industrialised Asian tigers were already well-ensconced in those markets). The results for Mexico may be due in part to its proximity to the US and the strong vertical integration of production between these two countries, as well as Mexico's entry into higher-technology export sectors such as automobiles and electronics (see Gereffi, 2003).[20]

To explore further whether exporting more technologically advanced products relieves countries from the adding-up constraints implied by a fallacy of composition, we grouped the countries into two panels of low-technology (LT) and high-technology (HT) exporters and compared the results for these two separate panels as well as a panel consisting of all 18 developing countries. The results from the panel estimation show that the LT countries have significant price competition only with other developing countries, while the HT countries compete mainly with industrialised country producers. For the HT group, only the relative price of industrialised country goods has a significant positive effect on their exports, while the relative price of competing developing country exports has a significant negative effect, indicating either complementarity of their exports (possibly due to vertically integrated production) or else collinearity problems with the relative price variables. These results imply that the effects of currency devaluations are likely to vary according to the technological level of

a country's exports: the HT countries can boost their exports by devaluing relative to the industrialised countries, while the LT countries can only boost their exports if they devalue relative to other developing countries exporting LT goods (and only if offsetting competitive devaluations do not follow). Also, the HT countries have a much higher elasticity of their exports with respect to the industrialised countries' total expenditures on imports than the LT countries.

However, the HT panel is a relatively small group of countries, and in the individual country regressions (as noted above) we found only three countries that individually competed mainly with the industrialised countries. These results thus suggest caution in evaluating the gains to be reaped from moving up the 'technological ladder' in the development process, as these gains appear to be limited so far to a narrow stratum of countries, and it is not clear if those gains would persist if many more countries were able to join them. The much larger group of countries that remains specialised in low-technology, labour-intensive manufactures (or assembly operations) shows significant evidence of price competition with other developing country exporters, which suggests that they suffer from a serious adding-up constraint on their exports. Moreover, their problems are likely to be exacerbated in the near future as more and more developing countries seek to expand exports of the same types of low-technology exports.

In summary, our results indicate that the majority of developing countries typically face demand-side constraints on their export growth both in the sense that the growth of industrialised country expenditures on their products places constraints on their exports, and in the sense that at least the less technologically advanced of these countries produce highly substitutable manufactured products and are, therefore, in active price competition with each other. The implications are sobering. As an increasing number of developing countries attempt to export similar types of low-technology manufactures to the same industrialised countries in the early

twenty-first century, it is likely that demand-side constraints on export growth will only tighten.

Any export-led growth strategy that does not take these factors into account may be open to failure for many countries, although others may still succeed. Indeed, the success of some countries may impede the success of others, and no developing countries gain from competitive devaluations and wage suppression when these are pursued simultaneously by too many competitor nations. At the same time, however, our results also indicate that there is some meaning to the idea of a technological 'ladder', and that the few countries that have succeeded in exporting more advanced types of products have thus far been able to relieve themselves from intense price competition with other developing countries, while also achieving higher expenditure elasticities for their exports. Whether more countries can join the HT group and what will be the consequences if they do is hard to predict.

One limitation of this study, however, is that it does not take into account intra-developing country trade in manufactures. An important counter-argument to the idea of demand-side constraints on developing country exports has come in the belief or hope that these countries will begin to provide more reciprocal demand for each other's exports through South-South trade, and such trade has indeed been growing in some regions, especially east Asia. An important future extension to the present study, therefore, would be to incorporate data for such trade in order to test for the extent to which it relaxes the adding-up constraints on Southern exports imposed by limited markets in the North. Another limitation of the present study is the use of aggregate data on manufactured exports and aggregate export prices indices. Therefore, another useful future extension of this research would be to estimate the degree of intra-developing country competition using more disaggregated, industry-level data.

Appendix

Data Definitions and Sources[21]

X_i: Annual exports of manufactured products (SITC categories 5-8) by each developing country *i* to the industrialised countries included in the sample. Nominal exports for each country were obtained from the OECD trade database and deflated by that country's export price index (PX_i) to obtain real exports for the regression analysis.

PX_i: Export price index (measured by the unit value of exports in US dollars) for each developing country *i*. Most of these were obtained from the IMF, *International Financial Statistics* (IFS) database, except the Chinese index was obtained from the World Bank, the Taiwanese index from the Taiwanese Directorate-General of Budget, Accounting, and Statistics, and the Mexican index was constructed using data from the Banco de México. See below for further discussion of the Mexican export price data.

E_i: Nominal exchange rate series for each country *i* (period average in domestic currency per US dollar), from the IFS. Used for converting currency units as needed in other calculations.

PP_i: A dual-weighted index of industrialised country producer price indices (PPIs) converted to US dollars, specific to each developing country *i*, defined as:

$$PP_{i,t}^{N} = \sum_{j} \frac{\pi_{ijt}^{1}\pi_{jt}^{2}}{\sum_{j}\pi_{ijt}^{1}\pi_{jt}^{2}} \left(\frac{PPI_{jt}}{E_{jt}} \right)$$

where π^1_{ijt} is the share of industrialised country *j* in developing country *i*'s exports, π^2_{jt} is the share of industrialised country *j* in total industrialised country imports from developing countries, PPI_{jt} is the producer price index for industrialised country *j* in its own currency, and E_j is country *j*'s exchange rate in domestic currency per US dollar (all measured at at time *t*). PPIs (obtained from the IFS) were used instead of export price indices for the industrialised countries on the presumption that developing country exports sold in industrialised country markets compete mainly with domestically produced manufactures in the latter countries, rather than with the specialised exports of the industrialised countries.

PX_i^L : A dual-weighted index of competing developing country export prices in US dollars, specific to each developing country *i*, defined as:

$$PX_{i,t}^L = \sum_j \pi^1_{ijt} \left[\sum_{k \neq i} \pi^3_{kjt} PX_{kt} \right]$$

where π^3_{kjt} is the share of industrialised country *j*'s imports originating in (*i*'s competitor) developing country *k* (where $k \neq i$) at time *t*, and PX_{kt} is the export price index of developing country *k* ($k \neq i$) at time *t* (with π^1 and *PX* as defined above). Five countries (Bangladesh, the Dominican Republic, Jamaica, Mauritius, and Tunisia) were excluded in calculating this index due to the shorter export price series available for these countries and/or missing data.

Z_i^N : A weighted index of real industrialised country expenditures on imports of manufactures (SITC categories 5-8) from the 18 developing countries in the sample. Each index is specific to a particular developing country *i*, and is defined as:

$$Z_{i,t}^{N} = \frac{\sum_{j} \pi_{ijt}^{1} M_{jt}}{PP_{i,t}^{N}}$$

where M_{jt} is the nominal value (in US dollars) of imports of manufactured products by industrial country *j* from all the developing countries in the sample at time *t*. These imports are weighted by the share of developing country *i*'s exports sold in industrialised country *j* (π_{ijt}^{1}) to reflect each developing country's potential export volume.[22] Total weighted nominal import expenditures for each country *i* were then deflated by the corresponding price index for industrialised countries $PP_{i,t}^{N}$, as defined above, to obtain real expenditures.

Problems with the Mexican export price index

The Mexican export price index turned out to be especially problematic. The IFS does not report a unit value of exports series for Mexico, and although the Banco de México website (www.banxico.gob.mx) reports an export price index in US dollars, this index has several difficulties. First, Mexico was still predominantly an oil exporter in the early 1980s, which suggests that its export price index for the 1980s predominantly reflected changes in prices of oil rather than manufactures. Second, the Banco de México's export price index exhibits an anomalous increase between 1994 and 1995, in spite of the dramatic (roughly 40%) depreciation of the peso at that time. In contrast, the export price indices for most Asian countries show declines in 1997-1998, when many of that region's currencies depreciated during the Asian financial crisis. The anomalous behaviour of the Mexican index in 1994-95 could reflect the high proportion of imported inputs used in producing the country's manufactured exports, or it could result from those exports being priced in dollars or heavily influenced by transfer pricing policies

of multinational firms. Of course, these problems with the Mexican export price index may apply to other developing countries' indices to some extent, but Mexico is likely to be a special case because of its close economic integration with the US.

Because Mexico is one of the largest developing country exporters of manufactures to the US, and also because it is the only large Latin American country in our sample, it is an important country to include in our data set. Therefore, we constructed an alternative price index for Mexican manufactured exports by using the country's non-oil PPI (also taken from the Banco de México website) as a proxy for the price of Mexican manufactured goods in pesos, and converted it to US dollars using the period average peso-dollar exchange rate (*E*) from the IFS. This measure of Mexico's export price shows a large decline in 1995, unlike the officially reported export price index. As a sensitivity test, we used both measures of Mexican export prices (the PPI for non-oil products converted to dollars and the export price index reported by the Banco de México) in the regression analysis. The results obtained using the PPI series are reported in this paper, while the results obtained using the export price index are available from the authors on request. Although the overall results are qualitatively similar, the estimates using the PPI show that relatively more countries have significant price competition with other developing countries than the estimates using the official export price index.

Time-Series Issues: Stationarity Tests and the Bewley Transformation

To test for the stationarity of our time-series variables, we carried out Augmented Dickey-Fuller (ADF) unit root tests on all the variables for each individual country. Lag length selection was based on the Schwarz Information Criterion. The results (which are not reported here, but are

available from the authors on request) indicated that an overwhelming number of individual country series were non-stationary, and integrated of order one, that is, $I(1)$, at the traditional levels of statistical significance. In fact, only three country series—the export price indices for the Dominican Republic, Jamaica, and Mauritius—were found to be stationary. For the panel data, we conducted three alternative tests: the Im-Pesaran-Shin W-stat, the augmented Dickey-Fuller (ADF)-Fisher χ^2, and the Phillips-Perron-Fisher χ^2. All three tests indicated that all the (pooled) series were nonstationary and $I(1)$ at traditional levels of statistical significance.

To obtain valid estimates in the presence of nonstationary data, an ARDL model can be reparameterised to yield an error correction model (ECM). However, the particular form of the ECM yielded by such a reparameterisation is not convenient to estimate when the cointegrating parameters are unknown, given the non-linear estimation required (see Wickens and Breusch, 1988). In contrast, the Bewley (1979) transformation allows asymptotically valid inferences using the *t*-statistics on the long-run coefficients, and yields estimators with improved characteristics (Inder, 1993). More details on this method are given in an unpublished appendix, which is available on request.

Equation (2) in the text is an ARDL(1,1) model, that is, it has one lag of both the independent and dependent variables. Therefore, the Bewley transformation can easily be performed by adding zeros to equation (2) in the forms

$$0 = \beta_{i4} Z_{i,t}^{N} - \beta_{i4} Z_{i,t}^{N} = \beta_{i5} RPX_{i,t}^{N} - \beta_{i5} RPX_{i,t}^{N} = \beta_{i6} RPX_{i,t}^{L} - \beta_{i6} RPX_{i,t}^{L} = \gamma_i X_{i,t} - \gamma_i X_{i,t},$$

and rearranging terms to obtain equation (3). The parameters (and error term) in the transformed equation (3) are related to the parameters (and error term) in equation (2) as follows: $\alpha_{i0} = \beta_{i0}/(1-\gamma_i)$, $B_{i1} = (\beta_{i1}+\beta_{i5})/(1-\gamma_i)$, $B_{i2} = (\beta_{i2}+\beta_{i6})/(1-\gamma_i)$, $B_{i3} = (\beta_{i3}+\beta_{i7})/(1-\gamma_i)$, $B_{i4} = \beta_{i5}/(1-\gamma_i)$, $B_{i5} = \beta_{i6}/(1-\gamma_i)$, $B_{i6} = \beta_{i7}/(1-\gamma_i)$, $\Gamma_i = \gamma_i/(1-\gamma_i)$, and $\varepsilon_{i,t} = \upsilon_{i.t}/(1-\gamma_i)$.

Acknowledgements

The authors would like to acknowledge helpful comments on previous drafts from Duncan Foley, Tom Hertz, Juan Carlos Moreno-Brid, Peter Skott, Lance Taylor, participants seminars at the Schwartz Center for Economic Policy Analysis at The New School and the University of Massachusetts, Amherst, and two anonymous referees. The usual disclaimers apply.

Notes

[1]The flying geese concept traces back to Akamatsu (1935), who used it as a metaphor for the industrial catch-up of developing economies. This concept envisions a hierarchically structured formation in which a dominant economy (for example, Japan in east Asia) acts as the growth leader, followed sequentially by other economies at lower levels of development; the formation is widest at the lowest end of the technological/developmental spectrum. As the less developed countries increase their industrial sophistication, they move ahead into the more advanced tiers of the formation, while the smaller number of countries in the lead continue to move further ahead. See Erturk (2001-2002), Kasahara (2004), and Furuoka (2005) for critical discussions.

[2]According to UNCTAD (2005: 134), an average of only 37.9 per cent of developing country exports were destined for other developing countries over the entire period 1970-2003, and this percentage has shown only a gradual increase from 36.5 per cent in 1980-1990 to 41.9 per cent in 2000-2003.

[3]This external constraint on export-led growth in the developing nations can be relieved to some extent if the industrialised nations pursue more accommodating macroeconomic and monetary policies, as emphasised by Davidson (1992: 203-221). Lower trade barriers in the 'North' and increased 'South-South' trade amongst the developing nations can also relieve this constraint.

[4]As a baseline, a panel consisting of all countries in the sample is also estimated. The alternative method of using data disaggregated by commodity type was not used due to the lack of available price indices at such a disaggregated level. Instead, the approach adopted here is to distinguish *countries* by the percentage of high-technology products in their exports of manufactures.

[5] Since manufactured exports from developing countries have grown much faster than total world output over the last two decades, the expenditure elasticities estimated here are likely to be notably smaller than conventional income elasticities of demand for the same exports. Or, to put it another way, income elasticities calculated using a GDP-based scale variable would also incorporate the impact of shifts in the composition of the industrialised countries' demand towards tradable goods imports overall, in addition to how the demand for each developing country's exports responds to overall industrialised countries' total demand for similar types of traded goods.

[6]The UN reports manufacturing unit value indices for a small number of individual developing countries, but those indices do not cover enough countries for this study. The UN disaggregated indices used by Faini *et al*. (1992) for earlier years have been discontinued (e-mail correspondence from Riccardo Faini, 20 February 2005). The present authors checked a large number of sources that report disaggregated international trade data, but none of them had disaggregated price indices for enough countries and years to be useful for this paper.

[7]The statistics in this and the following sentence are based on the authors' calculations from the UN COMTRADE database.

[8]This is similar to the earlier findings of Muscatelli *et al*. (1994) for a more limited range of countries. One possible explanation for the weak exogeneity of export prices for most countries could be that imperfectly competitive exporters set their prices as a mark-up over costs, possibly adjusting those mark-ups to lessen the impact of exchange rate changes (so-called 'partial pass-through'), but not allowing prices to fluctuate freely in response to demand changes. Other possible explanations include bad data, incorrect specification, or inadequate degrees of freedom.

[9] In the context of equation (1), zero homogeneity implies $\beta_{i2} + \beta_{i3} + \beta_{i4} = 0$ and $\beta_{i6} + \beta_{i7} + \beta_{i8} = 0$. This restriction was tested for our panels and could not be rejected in each case; for the individual country time-series, we simply assumed homogeneity due to the small number of degrees of freedom.

[10] There are, of course, sound reasons to increase the significance level as the sample size increases. See Leamer (1978), for example.

[11]This was one of the main differences in the alternative estimates (sensitivity tests) using the official Mexican export price index (see appendix). In these alternative estimates, Mexico had a significant positive coefficient on RPX^L instead of on RPX^N. In contrast, the Dominican Republic, Jamaica, and Turkey switched in the opposite direction. More details on these alternative estimates are available from the authors on request.

[12]For example, the correlation coefficients for China's residuals with those of India, Singapore, Thailand, Mexico, Turkey, and Sri Lanka are all quite large. There are also high correlation coefficients among the residuals for the four east Asian tigers with each other and with those for Thailand, as well as for certain other bilateral pairs (for example, Mexico and Jamaica). The complete residual correlation matrix is available from the authors on request.

[13]A Chow test was used to investigate formally whether the panel data are 'poolable'. This test was applied separately to the entire sample of countries and to the low-technology (LT) and high-technology (HT) groups (see definitions below). The null hypothesis of poolability was rejected in all three cases. However, although pooled estimates may introduce some bias in this situation, this does not imply that pooling is less efficient. As Baltagi (2001) notes, if the objective is to derive more precise parameter estimates, one may prefer a biased estimator with low variance to an unbiased estimator with high variance. Sensitivity tests showed that eliminating some countries from the different panels (LT and HT) could make them poolable

without substantially changing any of the results. We therefore provide the results using the complete panels since they are based on the most information.

[14]A Hausman specification test rejected the null hypothesis that the individual effects are uncorrelated with the regressors at the 5 per cent level of significance, thus supporting the use of the fixed effects specification.

[15]Taiwan, for which the World Bank does not report data, presumably falls in the same group.

[16]Sensitivity tests (available from the authors on request) show similar results for the LT and HT panels if these three intermediate countries are omitted from each group. Therefore, none of the qualitative conclusions of this paper depend on the inclusion of those countries in both groups.

[17]The SITC-category specific trade data from OECD indicate that several east and southeast Asian countries are specialised in SITC category 7, which includes electrical and electronic equipment, while most other developing countries tend to export products in category 8, which includes apparel and footwear. Therefore, as another sensitivity test, we grouped the developing countries into those specialised largely in SITC 7 versus 8. The results, which are available on request, were qualitatively quite similar to those using the LT and HT panels.

[18]The estimated coefficient does become greater (0.68) once the 'incorrectly' signed but statistically significant differenced value of the import expenditures variable is eliminated. In this case, the coefficient of determination also increases to 0.83.

[19]It should be noted that the Multifibre Arrangement (MFA) was still in place during our sample period. Insofar as individual developing country exports of textile and apparel products to industrialised country markets were restricted by the MFA, our econometric estimates may therefore be likely to underestimate the degree of intra-developing country competition, especially among lower-technology exporters.

[20] For Mexico, however, this result is sensitive to the measurement of export prices, as discussed in the appendix and note 11 above.

[21]Scattered missing values were filled using geometric averaging.

[22] Dual weights are not used in constructing Z_{it}^{N} because the scale variable should only reflect the potential size of the market for each developing country, and the shares of other developing countries in that potential market are not directly relevant for that purpose. However, M_{jt} already incorporates the degree to which each industrialised country j is open to overall imports of manufactures from developing countries.

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Table 1. Hausman tests for weak exogeneity of own export price

Country	Coefficient	*p*-value	Country	Coefficient	*p*-value
Bangladesh	-0.83	0.62	Mexico	-1.07	0.15
China	-1.34	0.45	Pakistan	-1.71	0.18
Dominican Rep.	-1.16	0.42	Philippines	-0.69	0.71
Hong Kong	-0.53	0.78	Singapore	-0.50	0.92
India	-0.72	0.74	Sri Lanka	-0.99	0.05
Jamaica	-1.99	0.39	Taiwan	1.00	0.54
Korea	-0.10	0.92	Thailand	-0.62	0.75
Malaysia	-0.41	0.84	Tunisia	-0.28	0.86
Mauritius	0.39	0.54	Turkey	-1.18	0.52

Table 2. Two-stage least squares (2SLS) estimates of individual country export equations (dependent variable: X)

Country	Constant	Z^N	RPX^N	RPX^L	ΔZ^N	ΔRPX^N	ΔRPX^L	ΔX
Bangladesh	-11.235	1.509		1.129				0.306
	(0.019)	(0.001)		(0.038)				(0.573)
China	-19.604	2.506		1.839		-1.908		2.268
	(0.000)	(0.000)		(0.014)		(0.094)		(0.023)
Dom. Rep.	-8.453	1.301		1.632	1.467			0.163
	(0.000)	(0.000)		(0.000)	(0.008)			(0.494)
Hong Kong	9.339	0.204						0.354
	(0.000)	(0.005)						(0.407)
India	-4.005	1.186	-3.460	2.801		-3.963		2.739
	(0.071)	(0.000)	(0.068)	(0.079)		(0.034)		(0.052)
Jamaica	-8.426	1.153		4.423				1.428
	(0.039)	(0.001)		(0.000)				(0.036)
Korea	-2.355	1.126	2.108	-2.122				0.436
	(0.052)	(0.000)	(0.000)	(0.000)				(0.090)
Malaysia	-16.576	2.130	-1.358		2.198	1.389		-3.462
	(0.000)	(0.000)	(0.086)		(0.039)	(0.056)		(0.021)
Mauritius	5.558	0.214				-2.108	0.544	0.641
	(0.000)	(0.001)				(0.000)	(0.073)	(0.006)
Mexico	-6.106	1.333	1.315	-0.377				0.038
	(0.000)	(0.000)	(0.000)	(0.056)				(0.788)
Pakistan	3.838	0.467		1.798				0.130
	(0.000)	(0.000)		(0.000)				(0.303)
Philippines	-9.903	1.536			-1.797	-3.381		2.386
	(0.000)	(0.000)			(0.086)	(0.007)		(0.041)
Singapore	-8.478	1.568	-3.355	2.474				1.343
	(0.010)	(0.000)	(0.004)	(0.026)				(0.030)
Sri Lanka	-11.304	1.538	-3.867	4.740				-0.070
	(0.003)	(0.000)	(0.037)	(0.010)				(0.940)
Taiwan	0.789	0.898	0.717	-1.535				0.753
	(0.538)	(0.000)	(0.081)	(0.007)				(0.018)
Thailand	-7.473	1.428						1.548
	(0.006)	(0.000)						(0.203)
Tunisia	-1.353	0.958	0.357					-0.447
	(0.013)	(0.000)	(0.030)					(0.032)
Turkey	-2.056	1.067		2.000		-4.936	2.664	2.909
	(0.275)	(0.000)		(0.092)		(0.031)	(0.085)	(0.041)

Notes: *p*-values in parentheses. All variables are measured in natural logarithms. The sample period for most countries is 1983-2001 (before differencing), except for Bangladesh and Mauritius the sample period is 1985-2001, for the Dominican Republic 1983-1998, and for Tunisia 1983-1999. ΔX is treated as endogenous and lagged X is used as an instrument.

Table 3. Diagnostic statistics for two-stage least squares (2SLS) estimates

Country	Wald	Adj. R^2	SE	JB	BG	ARCH(3)	Chow	RESET
Bangladesh	0.992	0.930	0.207	0.630	0.021	0.737	0.526	0.064
China	0.583	0.957	0.259	0.436	0.205	0.653	0.526	0.345
Dom. Rep.	0.809	0.984	0.102	0.794	0.672	0.680	0.851	0.948
Hong Kong	0.911	0.290	0.125	0.267	0.138	0.797	0.195	0.717
India	0.805	0.886	0.217	0.945	0.317	0.646	0.956	0.938
Jamaica	0.700	0.814	0.397	0.828	0.722	0.084	1.000	0.047
Korea	0.447	0.975	0.087	0.853	0.752	0.608	0.162	0.776
Malaysia	0.655	0.946	0.230	0.689	0.059	0.832	0.842	0.727
Mauritius	0.517	0.910	0.064	0.503	0.223	0.653	0.995	0.648
Mexico	1.000	0.991	0.068	0.816	0.090	0.261	0.823	0.005
Pakistan	0.375	0.952	0.087	0.504	0.543	0.635	0.764	0.132
Philippines	0.656	0.896	0.246	0.577	0.161	0.783	0.437	0.013
Singapore	0.679	0.954	0.158	0.025	0.433	0.757	0.983	0.500
Sri Lanka	0.164	0.847	0.224	0.457	0.023	0.606	0.378	0.001
Taiwan	0.845	0.937	0.091	0.772	0.062	0.457	0.835	0.478
Thailand	0.956	0.873	0.330	0.661	0.015	0.353	0.941	0.050
Tunisia	0.662	0.987	0.071	0.961	0.116	0.675	0.589	0.127
Turkey	0.968	0.842	0.302	0.796	0.030	0.017	1.000	0.881

Notes: Numbers reported are *p*-values, except for the adjusted R^2 and standard error of the regression (SE). These diagnostic statistics are for the corresponding individual country 2SLS equations reported in table 2. The Wald test of the statistical validity of parameter restrictions has a $\chi^2(n)$ distribution, where n is the number of restrictions under the null hypothesis. The Jarque-Bera (JB) test statistic has an asymptotic $\chi^2(2)$ distribution under the null hypothesis of normality. The Breusch-Godfrey (BG) LM test statistic (TR^2, where T is the number of observations in the sample) has an asymptotic $\chi^2(m)$ distribution under the null hypothesis of no serial correlation between the residuals up to the order m; we specified $m = 3$. Under the null hypothesis of no structural change, the likelihood ratio test statistic for the Chow forecast error test has an asymptotic χ^2 distribution with degrees of freedom equal to the number of forecast points. We used the four years 1998-2001 as the forecast period for most countries, except the four for which only shorter sample periods were available (we used 1999-2001 for Bangladesh and Mauritius, 1996-98 for the Dominican Republic, and 1996-99 for Tunisia.). Ramsey's RESET test, which tests for specification errors such as incorrectly specified functional forms or missing variables, has a $\chi^2(2)$ distribution because we tested for the significance of the squared fitted values.

Table 4. Three-stage least squares (3SLS) systems estimates for individual country export equations (dependent variable: X)

Country	Const.	Z^N	RPX^N	RPX^L	ΔZ^N	ΔRPX^N	ΔRPX^L	ΔX	Adj. R^2	SE
Bangladesh	-10.80	1.478		1.042				0.251	0.929	0.209
	(0.001)	(0.000)		(0.003)				(0.481)		
China	-39.07	4.155	-6.142	6.206		-9.221		7.944	0.854	0.477
	(0.002)	(0.000)	(0.039)	(0.031)		(0.014)		(0.019)		
Dom. Rep.	-9.022	1.340		1.349	1.280			0.031	0.985	0.101
	(0.000)	(0.000)		(0.000)	(0.000)			(0.850)		
Hong Kong	9.136	0.219						0.128	0.394	0.116
	(0.000)	(0.000)						(0.681)		
India	-3.699	1.164	-4.026	4.004		-2.990		2.554	0.881	0.222
	(0.024)	(0.000)	(0.002)	(0.000)		(0.012)		(0.010)		
Jamaica	-4.785	0.891		5.210		-2.076		2.416	0.685	0.516
	(0.283)	(0.006)		(0.000)		(0.032)		(0.005)		
Korea	-2.289	1.122	1.875	-1.914				0.439	0.974	0.088
	(0.009)	(0.000)	(0.000)	(0.000)				(0.023)		
Malaysia	-12.47	1.803			1.016	0.857		-1.311	0.957	0.207
	(0.000)	(0.000)			(0.008)	(0.012)		(0.003)		
Mauritius	5.439	0.223				-2.131	0.611	0.588	0.913	0.063
	(0.000)	(0.000)				(0.000)	(0.003)	(0.000)		
Mexico	-6.047	1.333	1.345	-0.335	0.369			0.027	0.992	0.068
	(0.000)	(0.000)	(0.000)	(0.002)	(0.021)			(0.784)		
Pakistan	4.018	0.452		1.866		-1.025	0.739	0.166	0.953	0.087
	(0.000)	(0.000)		(0.000)		(0.006)	(0.052)	(0.178)		
Philippines	-9.587	1.514			-1.524	-3.110		2.250	0.902	0.239
	(0.000)	(0.000)			(0.034)	(0.0000		(0.002)		
Singapore	-8.070	1.527	-3.160	2.642				1.063	0.959	0.150
	(0.000)	(0.000)	(0.000)	(0.000)				(0.002)		
Sri Lanka	-10.06	1.377	-3.608	1.470	4.400	7.907	-2.316	-6.318	0.816	0.275
	(0.000)	(0.000)	(0.001)	(0.100)	(0.000)	(0.001)	(0.076)	(0.000)		
Taiwan	0.636	0.907	0.424	-1.341				0.502	0.948	0.083
	(0.481)	(0.000)	(0.102)	(0.000)				(0.015)		
Thailand	-14.10	2.016	-2.894	5.483				5.402	0.642	0.554
	(0.002)	(0.000)	(0.089)	(0.042)				(0.020)		
Tunisia	-1.225	0.946	0.357				0.284	-0.588	0.989	0.065
	(0.000)	(0.000)	(0.000)				(0.021)	(0.000)		
Turkey	-2.538	1.101		2.040		-4.923	2.843	2.535	0.866	0.278
	(0.080)	(0.000)		(0.013)		(0.002)	(0.007)	(0.011)		

Notes: Same as for table 2.

Table 5. Panel estimates of aggregated and disaggregated export demand equations (dependent variable: X)

Panel	All countries	Low-technology (LT) group	High-technology (HT) group
Total observations	328	214	171
Constant	2.359	6.861	-2.618
	(0.178)	(0.050)	(0.003)
Z^N	0.686	0.337	1.083
	(0.000)	(0.185)	(0.000)
RPX^N			2.032
			(0.000)
RPX^L	0.990	1.640	-1.556
	(0.001)	(0.003)	(0.000)
ΔZ^N	-2.421	-3.346	
	(0.011)	(0.020)	
ΔRPX^N	-6.673	-10.991	
	(0.000)	(0.000)	
ΔRPX^L			
ΔX	7.464	11.016	0.487
	(0.000)	(0.000)	(0.263)
R^2	0.720	0.409	0.917
Adjusted R^2	0.700	0.361	0.911
SE of regression	0.910	1.328	0.293
Durbin-Watson stat	1.085	1.204	0.305
Mean dependent variable	10.939	10.372	12.128
SD dependent variable	1.662	1.661	0.982
Sum of squared residuals	252.725	347.380	13.602
Instrument rank	27.000	21.000	18.000
Wald Statistic*	0.844	0.987	0.105

Notes: p-values in parentheses. The estimation method is 2SLS (ΔX is treated as endogenous and lagged X is used as an instrument). White cross-section standard errors and covariances were used. All variables are measured in natural logarithms.
LT countries: Bangladesh, China, Dominican Republic, Hong Kong, India, Jamaica, Mexico, Mauritius, Pakistan, Sri Lanka, Tunisia, and Turkey.
HT countries: China, Hong Kong, Korea, Malaysia, Mexico, the Philippines, Singapore, Thailand, and Taiwan.
* The Wald test statistic is the p-value for the joint exclusion of the excluded variables. Likelihood ratio tests for redundant variables also supported these restrictions.

Table 6. Percentage of high-technology products in each developing country's total exports

Country	1990	1995	2000	Country	1990	1995	2000
Bangladesh	0.13	0.03	N/A	Mexico	8.29	15.08	22.40
China	N/A	10.05	18.58	Pakistan	0.06	0.04	0.39
Dom. Rep.	N/A	N/A	1.30	Philippines	N/A	34.94	72.58
Hong Kong	N/A	20.40	23.28	Singapore	39.87	53.92	62.56
India	2.40	4.30	5.01	Sri Lanka	0.53	N/A	N/A
Jamaica	N/A	0.03	0.06	Taiwan	N/A	N/A	N/A
Korea	17.84	25.87	34.82	Thailand	20.72	24.42	33.28
Malaysia	38.18	46.10	59.53	Tunisia	2.12	1.60	3.42
Mauritius	0.54	0.94	1.03	Turkey	1.19	1.25	4.86

Notes: High-technology exports are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery. "N/A" denotes missing data.
Source: World Bank, *World Development Indicators*.

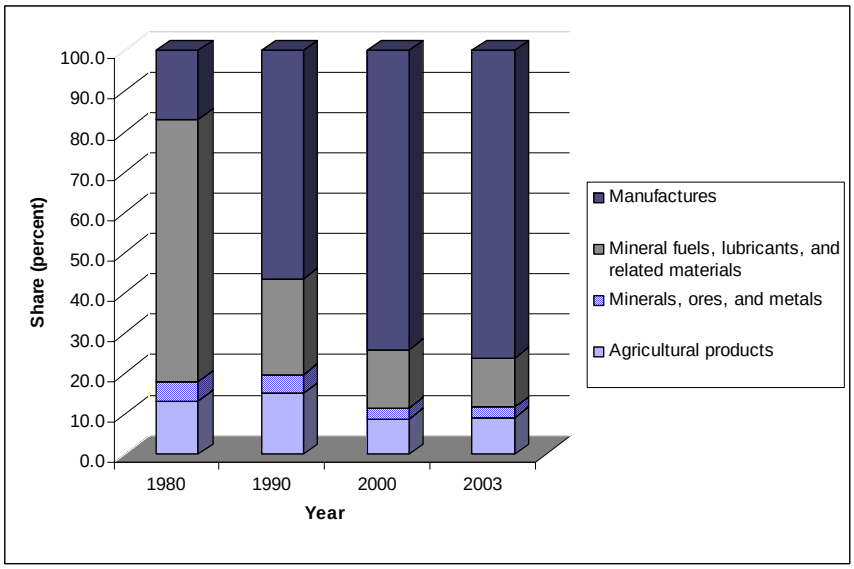

Figure 1. Composition of merchandise exports from developing countries by major product group, 1980-2003. *Source*: UNCTAD (2005).