Trade Costs and Trade Composition: Multi-Country and Product Evidence on Sources of Comparative Advantage

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Abstract

This paper investigates whether differences across countries in overall country-specific trade costs affect comparative advantage and the commodity composition of trade in similar fashion to international differences in factor endowments. Industry export shares across up to 71 countries and 158 manufacturing industries for five year periods from 1972 to 1992 are shown to be greater in factor-intensive industries for countries well endowed with those factors (physical and human capital) and in trade cost sensitive industries for countries with relatively low national trade costs; these relationships being more evident in exporting to global markets than in exporting to local or regional markets.

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1. Introduction

A number of recent studies have indicated that trade costs, especially if defined to include less easily identified and measurable information-related costs of transacting internationally as well as costs of transportation, are greater than we might have believed (Anderson and van Wincoop, 2004; Hummels, 2007). If this is so, there are good grounds for believing that patterns of international trade may be affected not only by relative production costs but also by these trade costs. Deardorff (2004), for instance, shows theoretically that a country may have a comparative advantage (or disadvantage) in a good relative to the world based on the country's costs of production relative to the world average production costs, but if trade costs are sufficiently high the country may import (export) this good.

The literature on international trade has tended to concentrate on the trade volume effects of trade costs (e.g. in the gravity model literature), and on the related issue of traded and non-traded goods (Dornbusch et al., 1977). There has been relatively little consideration in either the theoretical or empirical literature on how trade costs affect trade patterns and the sources of comparative advantage. In the present study we concentrate on how trade costs matter empirically for the pattern of trade; in particular on whether differences in national trade costs are a source of comparative advantage.

The study draws upon that strand of the empirical factor proportions literature that explores the cross-commodity or –industry relationship between export performance and factor intensities of commodities or industries. This strand dates back to correlations established by Keesing (1966) between US export performance and industry skill intensities; a positive correlation for the highest skills and a negative one for unskilled labour. Similarly regressions of US net exports (aggregate and bilateral) by industry reported by Baldwin (1971) showed a range of significant relationships to cross-industry factor intensities.

This strand of the literature was rendered unfashionable, however, by by Leamer's (1980, 1984) critique that cross-commodity or industry comparisons had weak theoretical underpinning. He demonstrated that industry export performance did not depend in a strict Heckscher-Ohlin (H-O) model on the input characteristics or factor intensities of industries. As with that strand of the empirical literature interested in measuring factor content to test the Heckscher-Ohlin-Vanek (HOV) model, the cross industry methodology has been revived. Among other things, this revival has been driven by recognition of and allowance for non-factor price equalization (and cross country differences in production techniques). With the factor price equalization (FPE) requirement removed, the commodity (industry) structure of production and trade can be determined. Romalis (2004), for example, shows that, conditional on factor prices, industry export performance in a quasi-H-O model is determined by industry input characteristics, or more specifically in terms of the interaction of industry factor intensity and relative factor prices (or relative national endowments of factors). The empirical application of the model (US import shares of 123 countries in 370 industries) shows a strong influence in particular of relative skill intensity and abundance on countries' shares of US imports; skill abundant countries capturing greater market share of skill-intensive goods and the exports of low human capital countries being concentrated on low skill-intensive industries.

Although Romalis (2004) model incorporates trade costs, they do not feature in the empirical modelling. With assumed uniformity of trade costs across pairs of trading partners, trade costs do not alter relative (production and trade inclusive) costs across countries. Trade costs in this theoretical set-up serve rather to fashion the incentive to trade or not; the number of non-traded commodities (with intermediate factor intensities) increasing with trade costs. If trade costs differ across pairs of trading partners, any given country will source a particular commodity from the lowest trade cost-inclusive source. But the lowest cost source may now also differ across importing countries. This leads Deardorff (2004) to distinguish between 'local' and 'global' comparative advantage.[1] A country may have a comparative advantage (disadvantage) in a good relative to the world, when one compares its relative costs of production globally, but if trade costs are sufficiently high (or at least for some countries) a global comparison may be inappropriate for determining trade patterns. Rather the appropriate comparison may be with 'local' countries, that is, partners with the lowest costs of trading. Comparative advantage should be defined in this context to explain trade to take into account trade costs, giving greater weight to less distant and lower trade cost countries.

The literature discussed thus far is either concerned with how endowments affect relative international production costs or with how trade costs may modify or alter endowment-driven trade patterns. There is, however, a strand of the literature that considers types of production and/or trade costs as a source of comparative advantage. Nunn (2007) for instance considers whether the ability to enforce contracts (thereby reducing the costs of acquiring intermediate inputs) affects a country's comparative advantage in the production of goods requiring relationship-specific investments. Using data for 1997 for exports by 146 countries in 182 industries, he finds that countries with good contract enforcement

[1] Markusen and Venables (2007) also show that a country's pattern of specialisation and trade is determined by the interaction of its relative endowments and its trade costs.

(good "rule of law" conditions) export more of the goods for which contract enforcement is more important. In similar fashion Levchenko (2007) shows that countries with better institutions specialize in goods that are institutionally dependent (i.e. more complex in terms of the range of inputs used in production). To the extent that institutions, in general or specific types of institutions, affect trade (rather than production) costs, then trade costs are represented as a source rather than modifier of comparative advantage and trade patterns. In this paper we extend on this tradition by considering the whole gamut of institutional and infrastructure characteristics or endowments of countries which induce differences in overall national trade costs.

The remainder of the paper is organised as follows. The concept of national differences in trade costs is explored and illustrated in section 2. In section 3 the theoretical implications of alternative aspects of trade costs are reviewed. This in turn provides the underpinning for the empirical approach set out in section 4. The results of applying this are reported and discussed in section 5. Finally, section 6 offers some conclusions.

2. Country Trade Costs

When defined broadly, trade costs include all costs in delivering a traded good from its producer to a final user overseas (other than the marginal cost of producing the good itself). Anderson and van Wincoop (2004) define trade costs so as to include transport costs (freight and time), costs induced by tariff and non-tariff barriers, information costs, contract enforcement costs, legal and regulatory costs, and local distribution costs in export markets. They review a range of literatures and methodologies to provide direct and indirect (inferred) estimates of the individual components of aggregate or country-wide trade costs. They report an overall (average) *ad valorem* tax equivalent for trade costs for a representative industrial country (USA) of 170%; broken down multiplicatively into local distribution costs (55%) and international transaction costs (74%). It is recognised that there will be variations in overall trade costs across countries (in particular between industrial and developing countries), but also that there are constraints on the systematic measurement of aggregate costs across countries and over time by this type of a bottom-up approach.

Some, but only some trade costs, will vary across products, due variations in policy barriers or in transportability. (We do in part allow for these by measuring differences in the trade cost sensitivity of product groups at the industry level.) There are, however, likely to be systematic differences across countries for all products associated with geographic and developmental differences in the quality and efficiency of countries' institutions, infrastructure, business and policy environments. It is these differences in (average) overall trade costs that we wish to concentrate on. The comprehensive measurement of country trade costs is, however, problematic, in part because data availability constrains measurement across large numbers of developed and developing countries and over time, but also because it is difficult to aggregate across all policy-sources and simultaneously across policy and non-policy sources of trade costs.[2] As a result, we consider alternative proxies, which capture policy and non-policy sources to differing degrees. We build on estimates from Hiscox and Lastner (2008) of trade openness, based on an annual, country specific (fixed) effect estimated from a gravity model of bilateral trade flows which controls for national incomes of, and distance between, any two trading partners. The larger the (overall) country specific effect the more open the economy is viewed to be. There are potential limitations of the proxy, given that a general gravity model is not estimated and trade policy is presumed to be multilateral. However an index (ICY), which correlates quite well with other trade policy indicators and does capture some non-policy sources of trade costs, is available for 76 countries and for each year over the period 1960 to 2000.

We also use adapted measures of access to markets and sources of supply proposed by Redding and Venables (2004); market access (MA) of each exporting country being the distance-weighted sum of the market capabilities of all partner (j) countries, and supply access (SA) of each importing country being the distance weighted sum of the supply capabilities of all partner countries. For the present purpose we express MA_c and SA_c as direct measures of country trade costs, such that:

$$MA_c = \frac{1}{\ln\left(\sum \left(\pi_{cj}\right)^{1-\sigma} M_j\right)} \quad (1)$$

$$SA_c = \frac{1}{\ln\left(\sum \left(\pi_{cj}\right)^{1-\sigma} S_j\right)} \quad (2)$$

where π_{cj} = bilateral transport costs

M_j = market capacity

S_j = supply capabilities

and σ = elasticity of substitution.

[2] Recent work for instance by Kee, Nicita and Olarreaga (2009) aggregates across tariff and non-tariff barriers for a large range of countries, but it does so for one year and abstracts wholly from non-policy sources in measuring trade restrictiveness.

The required elements of MA_c and SA_c are obtained from an estimated gravity model of bilateral trade, which controls for distance, a dummy for a common border, and country and partner fixed effects. The coefficients of the country and partner dummies provide estimates for the market and supply capacities, and coefficients on distance and border dummy variables are used to estimate bilateral transport costs. We use this methodology to estimate MA_c and SA_c for the same sample of countries as that for which the Hiscox-Lastner (H-L) index is available and eighteen additional countries, and for each of the years 1972, 1977, 1982, 1987 and 1992. (See Appendix 1 for the gravity model estimates used to construct $\mathrm{MA_c}$ and $\mathrm{SA_c}$.)

For trade cost intensity or sensitivity, again we explore alternative proxies. One is the share of intermediate inputs in the value of final output (input int); the greater is this in a particular industry, the more transactions intensive and potentially imported input intensive is production assumed to be. The presumption is that there may be a greater incentive to specialise in production of goods that are more dependent on intermediate inputs in low trade cost countries. The alternative indicator of trade cost sensitivity focuses on the direct sensitivity of trade volumes to the effects of trade barriers or costs. We take the import elasticity of substitution (es) estimates reported by Hummels (1999) for each 2 digit import category, from an import demand function estimated (using OLS) for pooled data for US, New Zealand, Argentina, Brazil, Chile and Paraguay. Finally, we use (like Levchenko, 2007) a Herfindahl index of intermediate input use. This allows us to explore whether concentration of intermediate input use on a limited number of inputs is more important in affecting the location of international production than overall input dependency. (The data and data sources for both the measures of country trade costs and trade cost sensitivity or intensity at the industry level are described in section 4 below.)

Differences in country trade costs: Average national trade costs based on each of the measures for the sample period (averages across each of the years 1972, 1977, 1982, 1987 and 1992) are set out in Appendix 2. There are elements of consistency, but also differences associated with different components of trade costs. There is a general tendency for the industrial countries to have relatively low trade costs compared to developing countries, as one might expect. Indeed, from table 1, which records the ten lowest and highest trade cost countries, it is evident that some industrial countries (e.g. Belgium-Lux, France, UK, and Netherlands) are relatively low trade cost countries by all measures. By contrast, there is more heterogeneity of the membership of the high trade cost category, with large developing countries tending to be captured by the ICY indicator and smaller (often more remote or landlocked) countries (e.g. Mauritius, Madagascar and New Zealand) being represented as high trade cost countries by the market access (MA) and supply access (SA) indicators. (Note that the differences in trade costs are masked in part by the scaling of these measures.) We see from table 2 that the rankings of average trade costs by region are relatively stable over time for the ICY indicator, with Europe, Oceania and North America consistently ranked first, second and third lowest cost regions. Indeed, Europe is the lowest at the start and end of the period for all three measures. There are, however, some changes of rank for specific regions according to the measure used, though samples may change and may not be representative. For example, supply access improved markedly over the period for the sample of African countries, while Asia became relatively less costly according to all three indicators. The evidence for Asia is line with its deeper integration into the world economy over this time period.

Table 1: Trade Costs and Country Ranking

Country	ICY	Country	MA	Country	SA
Lowest					
Belgium-Lux	5.29	Germany	0.0457	Germany	0.0451
Netherlands	10.12	Belgium-Lux	0.0460	Belgium-Lux	0.0595
Fm German FR	12.85	Netherlands	0.0465	Netherlands	0.0607
France	13.18	UK	0.0474	France	0.0618
Japan	14.97	France	0.0474	UK	0.0623
Germany	17.94	Denmark	0.0500	Canada	0.0653
Italy	17.99	Austria	0.0503	Denmark	0.0659
United States	18.1	Tunisia	0.0508	Austria	0.0670
Spain	19.11	Norway	0.0508	Norway	0.0671
United Kingdom	19.28	West Germany	0.0509	Korea	0.0674
Highest					
Egypt	53.55	Mauritius	0.0611	Malawi	0.0844
Turkey	53.73	Japan	0.0612	Zimbabwe	0.0845
Mexico	54.23	Argentina	0.0614	Chile	0.0846
Brazil	55.11	South Africa	0.0615	Argentina	0.0846
Colombia	55.15	Chile	0.0616	New Zealand	0.0846
Ethiopia	55.4	New Zealand	0.0619	Mauritius	0.0852
Argentina	56.07	Australia	0.0619	Australia	0.0854
Pakistan	56.2	Tanzania	0.0625	South Africa	0.0861
South Africa	60.48	Zambia	0.0631	Suriname	0.0865
India	63.07	Madagascar	0.0678	Madagascar	0.0903

Notes: The ICY, MA and SA variables are reported at their means for the five years of the sample. Across all three measures higher values are indicative of higher trade costs.

Table 2: Average Regional Trade Costs through Time

Continent	ICY 1972	ICY 1992	MA 1972	MA 1992	SA 1972	SA 1992
Africa	48.77	44.75	.070	.050	.091	.049
Asia	52.23	39.69	.086	.050	.086	.048
Europe	23.30	25.74	.054	.043	.066	.043
North America	39.97	36.00	.071	.050	.082	.049
South America	45.24	43.58	.074	.051	.089	.050
Oceania	35.39	29.23	.075	.052	.094	.051

Notes: The ICY, MA and SA variables are reported at their means for these years. Across all three measures higher values are indicative of higher trade costs.

One would not be surprised to conceive of the low trade cost countries identified above as being relatively high trade countries in volume terms. Gravity modelling has been used extensively to show how different types of trade costs, or reduction of specific sources of trade cost, affect the volume of bilateral trade. Indeed we can show this with our current measures. Figure 1 shows a negative relationship between country export values and country trade costs (using the market access measure) on average; lower (higher) trade cost countries exporting more (less). What may be less intuitive is the idea of a trade composition effect induced by differences in country trade costs. The present data also suggests (see figure 2) that countries with high (low) trade costs export goods that, on average, have a low (high) trade cost sensitivity (based on the elasticity measure). Our analysis explores this relationship in more detail, and assesses whether differences in overall country trade costs is an additional national characteristic or endowment affecting comparative advantage and the commodity composition of trade.

3. Trade Costs in Theory

Countries can have specific attributes (e.g. remoteness or landlockedness, (in) efficiency or customs clearance procedures) that make them relatively more or less expensive in exporting or importing than others. Thus for trade with the same trading partner (and at the same distance and in the same product) there can be trade cost differences across countries. Simultaneously, for each country there are likely to be differences in trade costs, depending on whom it is trading with. An obvious driver is distance between trading partners. However, there will also be country-specific characteristics of each trading partner (e.g. landlockedness, port efficiency etc) that induce differences in trade costs. These differences in trading partner attributes will affect products differentially, depending on the weight, perishability etc. of products.

Figure 1: Average Country Trade Costs and Export Volume (1972-92)

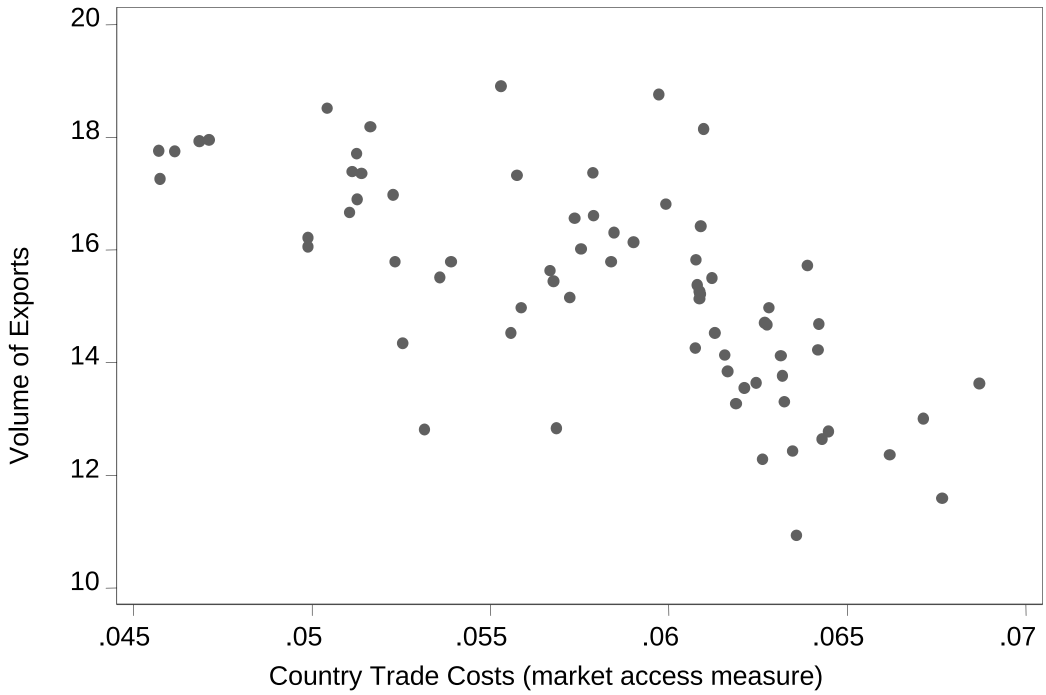
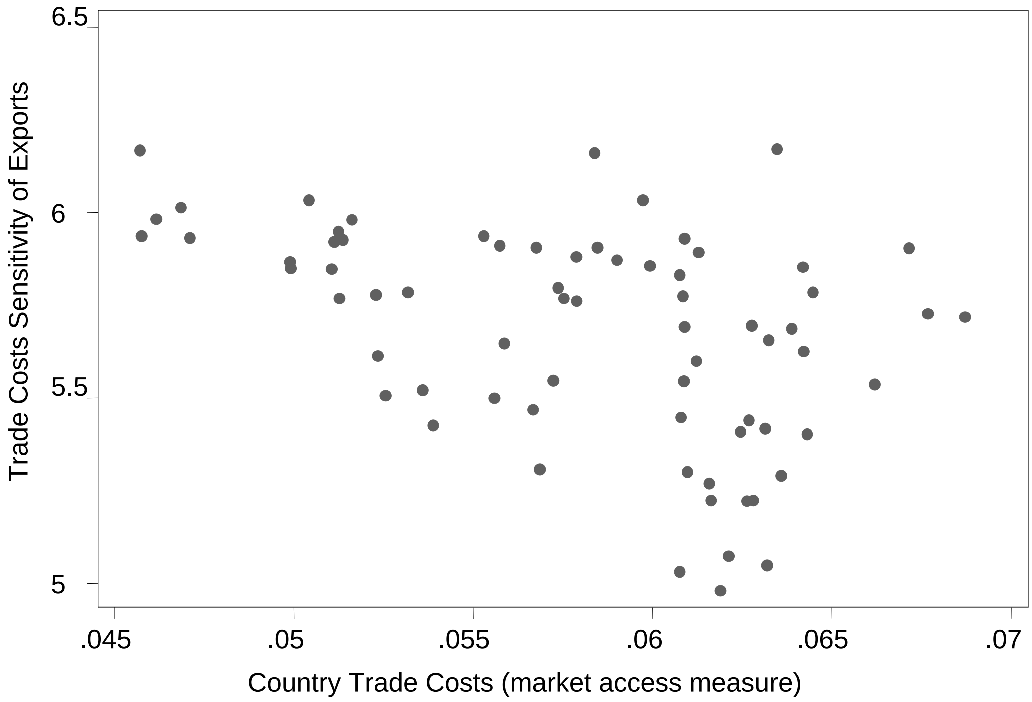


Figure 2: Average Country Trade Costs and Export Composition (1972-92)



Trade cost differences by country: Trade theory does not typically model all aspects of trade costs. Markusen and Venables (2007) for instance incorporate trade costs into an endowments model, but allow trade costs only to vary across countries (trade costs being the same for goods to/from a particular country and a particular country having the same trade costs with all its trading partners).[3] This specification allows for a clearly defined 'world price' for each good (X_i). They develop a model of three goods (produced under constant returns and competitive conditions), using two factors (capital, *K*, and labour, *L*). With zero (country) trade costs the pattern of production across countries would be indeterminate, though with full employment we can make predictions about the overall or average factor content of trade. The addition of trade costs (here country-specific trade costs, *t*) makes the commodity structure of production determinate. Each good X_i is produced in a country only if its unit cost is no greater than the import price; with the equilibrium location of production satisfying the following conditions:

$$p_i t \geq b_i(w,r) \geq p_i / t \qquad [i = 1,2,3] \qquad (3)$$

where $b_i(\cdot\cdot)$ is the unit cost function
and *w* and *r* are the factor prices of *L* and *K* respectively.

If the unit cost for a particular good is (strictly) within the inequality in (3) the country is self-sufficient and the good non-traded, while it may export the good if the unit cost is at the lower end (p_i/t) and import it at the upper end ($p_i t$).

Markusen and Venables (2007) report numerical simulations for countries assumed to be uniformly distributed over trade costs space [from $t=1$ (zero trade costs) → $t=1.37$ (high trade costs)][4] and scaled endowments space (from L=0.1 → L=0.9, where K=1-L), where X_1 is the least labour-intensive in production and X_3 the most. A key message from their modelling is that lower trade cost countries are characterised by partial or complete specialisation, while higher trade cost countries tend to become less specialised in production. Low trade cost countries trade all goods, while the incidence of autarky or non-tradability increases with trade costs. Indeed reduced tradability starts to be a feature of increasing trade costs for countries close to the world average endowments. Further, at

[3] Iceberg trade costs $t>1$, where the domestic price (*p*) of imports of good X_i is t_{pi} and producers receive $p_{i/t}$ if the good is exported.
[4] Strictly marginally greater than $t=1$ to allow production determinacy.

higher trade costs more extreme endowments are required to maintain a country as an exporter of the good intensively using the country's abundant factor.

In the above formulation national trade costs are a modifier of comparative advantage and the pattern of trade, through their influence on tradability. To capture national trade costs role as a source of comparative advantage we need to represent them as analogous to a traditional endowment. In a strand of the literature this has been done in effect by representing national trade costs as the country-specific, fixed cost or additional investment associated with the trade impediments that agents need to overcome in order to transact internationally. This an extension of Levchenko's representation (Levchenko, 2007) of national institutional differences which induce differences in international transaction impediments across countries. In a world of trade cost barriers or frictions a fraction (*f*) of the investment of factor resources (capital and/or labour) required to produce certain units of a tradable good become specific to the particular activity. In a frictionless world (f=0) agents do not need to invest specific resources (ex ante) to acquire information about how the infrastructure and institutional characteristics of the economy affect their ability to recoup their investment. Where f>0 it is harder to induce resources to enter sectors in general (harder relative to countries where trade costs are lower), and the more so in sectors that are more transactions-intensive; the ex post returns to factors being driven down relative to the frictionless case.

Like Levchenko (2007), we can view trade in a two country or bloc ('North'–N and 'South'-S) case as involving differences in national trade costs such that $f^N > f^S$; a lower fraction of factors being specific to transactions-sensitive activities in the North than the South.[5] In this set-up national trade cost differences act much like a normal endowment difference source of comparative advantage in an H-O framework; the North is able to produce transaction-intensive goods, *ceteris paribus*, at relatively lower cost than the South.

Trade costs by trading partner: Implicit in the discussion so far has been the idea that each country has the same trade costs when trading with all other countries. The basis for identifying comparative advantage is global, in just the same way as when there are no trade costs. In the traditional Ricardian context, a country (c) has a global comparative advantage in producing a good (g_1), relative to another good (g_2), compared to some other country (*o*) if:

[5] We rule out here other possible sources of difference across countries, such as technological differences.

$$\frac{a_{cg1}}{a_{cg2}} < \frac{a_{og1}}{a_{og2}} \qquad (4)$$

If, as Deardorff (2004) does, trade costs are represented as the unit labour requirement ($t_{cgc'}$) of country c serving a particular market (c'), then we can amend (4) for trade costs as follows:

Country (c) has a comparative advantage in producing g_1 and delivering it to country *c'*, relative to another good and compared to another country *o* if:

$$\frac{a_{cg1} + t_{cg1c'}}{a_{cg2} + t_{cg2c'}} < \frac{a_{og1} + t_{ogc'}}{a_{og2} + t_{og2c'}} \qquad (5)$$

It follows from (5) that comparative advantage depends now on both production and trade costs. Comparative advantage is possible when there is comparative disadvantage in production costs, if there is a sufficient relative advantage in trade costs.[6] Indeed, if relative trade costs are sufficiently high, comparative advantage may not exist in some (or all) markets in spite of relatively low production costs. The implication of this is that comparative advantage may only be defined locally if relative trade costs are sufficiently high; comparative advantage being specific to the countries from which markets can be served.[7]

4. Empirical Strategy

To test the hypothesis that trade costs are a source of comparative advantage, namely that low trade cost countries have a (global or local) comparative advantage in producing goods for which trade costs are important in either their production or distribution, we estimate an enhanced endowments model of export shares as follows:

$$X_{ic} = \alpha_i + \alpha_c + \alpha_t + \beta_1 t_i T_c + \beta_2 h_i H_c + \beta_3 k_i K_c + \varepsilon_{ic} \qquad (6)$$

where X_{ic} is the share of exports of industry *i* by country *c* (globally or locally)

[6] In a multilaterally setting one would want to compare a country's cost of serving an export market (from production and delivery) compared to an index of all countries costs of serving that market.

[7] The term 'local' implies relative distance is the only determinant of relative trade cost differences, but this may not be the case. Deardorff (2004) suggests use of the term 'locational comparative advantage' rather than 'local comparative advantage' to recognise other influences on relative trade costs.

T_c is a measure of trade costs of country *c*

H_c and K_c are country *c*'s endowments of human and physical capital respectively

t_i, h_i and k_i are measures of the importance or intensity of trade costs, human and physical capital of production in industry *i*

and α_i, α_c and α_t denote industry, country and time fixed effects.

If comparative advantage is determined globally equation 6 can be estimated for a full sample of countries, i.e. irrespective of the geographic or economic distance of a country from other countries. We explore whether low trade cost countries export a greater share of those goods that are sensitive or intensive in trade costs through the sign on β_1; a negative sign being consistent with trade costs being a source of comparative advantage. To explore the possibility of comparative advantage being determined locally, equation 6 can be estimated only for sub-sets of countries clustered according geographic (regions or continents) or economic (developed, developing and least developed) proximity.

Data and sources: A host of sources were used to construct our dataset. The data used in the trade cost regressions, and in the gravity model from which the market access and supplier access variables are constructed, were obtained from the NBER's World Import and Export dataset (available from http://www.nber.org/data). A description of the dataset may be found in Feenstra et al. (2005). Data on exports between 201 countries at SITC (rev. 2) 4-digit industry level are provided for 1972, 1977, 1982, 1987 and 1992.

Country capital and skill endowment data are from Antweiler and Trefler (2002). Capital endowments are measured by the ratio of capital/labour and skill endowments by the ratio of the number of workers completing high school to the number of not completers. The capital and skill intensity variables come from the NBER-CES Manufacturing Industry Database which covers the years 1958-1996 and is described in Bartelsman and Gray (1996). Information is provided for 1972, 1977, 1982, 1987 and 1992 according to the 1997 NAICS classification. Capital intensity is measured as capital per worker in each industry, while skill intensity is measured as the percentage of non-production workers for. It is recognised that the assumption of common and constant factor intensities is a strong one, and although in line with standard H-O theory can be relaxed in subsequent work.

We use the Bureau of Economic Analysis's (BEA) 2002 Input-Output table to calculate intermediate input intensity as the percentage of inputs in an industry's output. As with capital and skill intensity this too is assumed to be constant across countries but does not vary over time. Import demand elasticities of substitution are taken from Hummels (1999). This information is provided at the SITC 2-digit industry level.

Intermediate input intensity is calculated following the BEA's system of industrial classification. Using a concordance provided by the BEA industries are matched to the 1997 NAICS industry classification. This can then be matched with the capital and skill intensity variables provided at the 1997 NAICS level. A concordance between the SITC (rev. 2) 4-digit industry classification system and the 1997 NAICS system is provided by the NBER (at http://www.nber.org/lipsey/sitc22naics97/). This enables us to match the export data to industry-level information on input intensity, capital intensity and skill intensity. The Herfindahl index of intermediate input use is taken from Nunn (2007).

In the regressions an industry is defined according to the SITC (rev. 2) system. We do not aggregate exports up to the 1997 NAICS classification. This provides a greater number of industries. We end up with up to 158 manufacturing industries and 71 countries (for which all the right side variables are available) – see Appendix 3 for details of countries covered. (Not all industries are observed in each country and year.)

Estimation: Equation 6 was estimated in double log form for all instances of positive exports at the industry level. All of the models were estimated using Stata 10.0.

5. Estimation Results

The results of estimating eq. 1 are reported in table 3 for the whole sample; alternative combinations of proxies of country trade costs and trade cost intensity by industry being reported in specifications (columns) 1-4. There is a consistent pattern of signs across all specifications; with positive and generally significant endowment influences ($\beta_2>0$; $\beta_3>0$) and a negative trade cost 'endowment' influence ($\beta_1<0$) with significance at the 1% level throughout. The trade cost 'endowment' influence is in general separable from other country fixed effects, with the β_1 coefficient remaining relatively stable whether or not country fixed effects are included. Table 3 reports for convenience the preferred specification with fixed effects included, but the pattern of signs and significance is not sensitive to the inclusion of fixed effects. (Note also that the magnitudes of the coefficient on the term t_iT_c are not comparable for alternative combinations of proxies because of scaling differences.)

Table 3: Global Comparative Advantage

Variable	Regression (1)	(2)	(3)	(4)
t_iT_c	-.29***	-.25***	-.28***	-.07***
	(-9.54)	(-9.82)	(-14.69)	(-2.57)
h_iH_c	.14***	.14***	.14***	.13***
	(10.01)	(9.48)	(9.19)	(8.98)
k_iK_c	.10***	.10***	.04	.10***
	(3.88)	(4.03)	(1.44)	(3.89)
Country Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
t_i	es	input int	input int	herfindahl
T_c	MA	SA	ICY	SA
Number of Observations	21201	21201	18533	21201
R^2	.46	.46	.46	.46

Notes: The dependent variable is the log of the share of industry *i* of country *j* at time *t* in world exports. Standardised coefficients are reported with robust t-statistics in parentheses. 53 countries are present in the regression when ICY is used as the proxy for trade costs. When market access and supplier access are used there are 70 countries present. ***, ** and * indicate significance at 1 percent, 5 percent and 10 percent, respectively.

The results in table 3 provide support for a trade cost-enhanced, endowments explanation of global comparative advantage. To explore whether comparative advantage is better defined 'locally', we re-estimate specification 1 from table 3 for sub-samples of countries in eight continents – Africa, Asia excluding East Asia, East Asia, Europe, the Middle East, North America, Oceania and South America. Note now that the dependent variable is exports to the specific region, not globally. Results are reported in table 4.

For some regions (e.g. Europe and North America) there is little difference between 'global' and 'local' results; the pattern of signs, coefficient magnitudes and significance is similar in columns (4) and (6) of table 4 to that in column (2) of table 3 (i.e. for the same proxies for t_i and T_c), though the coefficient on the physical capital term is not significant in the latter case. For East Asia and Oceania, however, we find an unexpected, even perverse, positive trade cost effect. This may in part be due to the small sample sizes involved, but it may also reflect the concentration of these countries' exports during the sample period on industrial country rather than regional markets.

Table 4: Local/Regional Comparative Advantage

Variable	Regression (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
t_iT_c	-.21	.11	.48***	-.37***	-.28	-.15**	.91***	.08
	(-1.55)	(.34)	(5.85)	(-7.02)	(-.81)	(-2.27)	(4.41)	(.51)
h_iH_c	.03	-.16**	-.08**	.10***	.39***	.10***	.30***	.13*
	(.45)	(-1.99)	(-2.35)	(3.97)	(4.69)	(2.98)	(4.16)	(1.94)
k_iK_c	-.12	.62***	.20***	.11***	-.05	.11	.28**	.02
	(-1.25)	(4.86)	(3.05)	(2.60)	(-.25)	(1.49)	(2.10)	(.17)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
t_i	input int	input int	input int	input int	input int	input int	input int	input int
T_c	SA	SA	SA	SA	SA	SA	SA	SA
Region	Africa	Asia	East Asia	Europe	Mid East	Nth. Am	Oceania	Sth. Am
Number of Observations	1952	1041	3714	8128	517	2751	1095	2003
R^2	.43	.54	.51	.53	.74	.65	.63	.46

Notes: The dependent variable is the log of the share of industry *i* of country *j* at time *t* in regional exports. Standardised coefficients with robust t-statistics reported in parentheses. ***, ** and * indicate significance at 1 percent, 5 percent and 10 percent, respectively.

Overall, however, the local comparative advantage model does not perform well. Indeed for Africa we find no significant sign on any endowment term. The limited importance of manufactured exports and high intra-regional relative to extra-regional trade costs may be important in this case. It is difficult to conclude, however, on the basis of these results that the 'global' explanation of comparative advantage dominates the 'local' comparative advantage model.

Robustness testing: To check that we are picking up a genuine national trade cost effect we conduct a number of robustness checks. In table 5 we explore a specification which interacts national trade costs with traditional endowment influences. This allows us to explore a weaker hypothesis that trade costs modify, rather than determine, comparative advantage. We find a negative direct effect on export volumes at the industry level for all three proxies of national trade costs. We find mixed interaction effects between endowments and trade costs, with increases in k_iK_c (physical capital) have a decreasing influence on export performance as country trade costs increase, while for human capital we find increases in h_iH_c have a increasing influence on export performance as country trade costs increase. re is, however, less robust support for the comparative advantage-modifying hypothesis than we found for the comparative advantage-determining hypothesis.

Table 5: Alternative Model Specifications

Variable	Regression (1)	(2)	(3)
T_c	-.30***	-.32***	-.22***
	(-14.30)	(-11.88)	(-10.54)
h_iH_c	-.06	-.06*	-.34***
	(-1.35)	(-1.89)	(-6.18)
k_iK_c	.26***	.18***	.33***
	(5.69)	(4.78)	(5.33)
T_c*h_iH_c	.23***	.21***	.51***
	(5.05)	(7.47)	(8.94)
T_c*k_iK_c	-.17***	-.08***	-.21***
	(-4.09)	(-2.96)	(-5.13)
Country Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
T_c	MA	SA	ICY
Number of Observations	21201	21201	18533
R^2	.47	.47	.46

Notes: The dependent variable is the log of the share of industry *i* of country *j* at time *t* in world exports. Standardised coefficients are reported with robust t-statistics in parentheses. 53 countries are present in the regression when ICY is used as the proxy for trade costs. When market access and supplier access are used there are 70 countries present. ***, ** and * indicate significance at 1 percent, 5 percent and 10 percent, respectively.

The direct endowment effects are also signed differently (and generally with significance). It is difficult therefore to view these results as giving support for an alternative model of trade costs as only modifying comparative advantage.

In table 2 we showed that the lower trade cost countries tend to be developed countries. It might be that factors relating to the level of development, other than trade costs, affect the pattern of international specialisation. To explore this we also ran regressions (available from the authors on request) in which we added variables to our base specification (eq. 5) which control for development. Interaction terms between log GDP and a range of measures of industrial complexity (value-added, degree of fragmentation of production, technological upgrading, contract intensity) were added jointly and separately. In all these estimations the coefficient on the term t_iT_c remained negative and significant, even if these additional influences (captured in the earlier regressions through the fixed effects terms) were also significant.

We also explore possible endogeneity. We have assumed so far that trade costs are exogenous and that causality runs only from national trade costs to trade specialisation. But reverse causality is also possible, with countries that specialise in trade cost-intensive or sensitive products having a greater incentive than others to develop and maintain a low trade cost environment. A similar logic must apply also to other endowment terms, with greater or lesser incentives to accumulate physical and human capital depending on initial endowments. The present focus is, however, on national trade costs. Finding suitable instruments – correlated with the endogenous variable and uncorrelated with the error term – is problematic, as found also by others (Nunn, 2007; Levchenko, 2007). We explored first using the GMM estimator of Arrelano and Bond (1991), where lagged levels of variables are instruments for the endogenous (differenced) variables. These results are reported in Appendix 5. The coefficients on the term t_iT_c remain negative (for two of the trade cost measures), though those on the human capital term are now consistently also negative. However the robustness of this is questioned by rejection (by the Sargan identification test) of the validity of the instruments in this GMM estimator. We prefer instead to report estimates in table 6 which use freedom to trade and legal quality indices from the Heritage Foundation (2002) economic freedom index as instruments.

In Table 6 we report results of the first stage regression of the instruments on trade costs and second stage results for instrumented regression. Regressions 1 and 2 show in the first stage regressions the instruments are correctly signed (when separately included) and significant: countries with superior legal institutions and more freedom to trade having lower trade costs. When both co-linear instruments are simultaneously included the instruments are not correctly signed in the first stage regression. In the second stage the estimated coefficient on the instrumented trade cost interaction term is -0.36 (which is significant at the 1% level), though the null of over-identification of the instruments cannot be rejected. We retain some support, therefore, for endogenously modelled country trade costs being, along with physical and human capital, a source of comparative advantage and driver of the composition of countries' exports at the industry level.

6. Conclusions

Rather than explore the effect of inter-country differences in specific types of trade costs as in the Nunn (2007) or institutional quality as in Levchenko (2007) on the pattern or composition of trade, this paper explores whether inter-country differences in overall trade costs can be viewed as a another type of national endowment and source of comparative advantage, like factor endowments. We view these differences in overall country trade costs as reflecting sustained (at least over the medium term) and systematic features of geography and stage of development which may be reflected in cross country differences in the quality of countries' infrastructure and institutions, and in the competitiveness or effectiveness of business and policy environments.

Table 6: Estimates using Instrumental Variables

Variable	Regression (1)	(2)	(3)
Second stage IV estimates			
t_iT_c	-.13	8.36	-.36
	(-.73)	(2.28)	(-2.21)
h_iH_c	.14	-.13	.15
	(8.84)	(-1.00)	(8.97)
k_iK_c	.10	-.04	.12
	(3.68)	(-.38)	(4.30)
Country Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
t_i	input int	input int	input int
T_c	SA	SA	SA
Number of Observations	20505	19011	18741
R^2	.96	.96	.96
First stage IV estimates			
ti * Freedom to Trade$_c$	-.07		-.09
	(-24.11)		(-28.07)
ti * Legal Quality$_c$		-.01	.02
		(-2.56)	(5.70)
F-test	1407.61	1253.98	1340.30
Overidentification test (p-value)	-	-	.00

Notes: The dependent variable in the second stage regressions is the log of the share of industry *i* of country *j* at time *t* in world exports. In the first stage regressions the dependent variable is the interaction between trade cost intensity and the freedom to trade or legal quality variables. Standardised coefficients are reported with robust t-statistics in parentheses. ***, ** and * indicate significance at 1 percent, 5 percent and 10 percent, respectively.

In fact we find support for country trade costs being an 'endowment' which affects the pattern of comparative advantage and export composition as revealed in export performance at the industry level. This is for a sample of up to 71 countries and 158 industries for 5 year periods over the period 1972 to 1992. Countries with lower trade costs are found to export more of those products for which trade costs are more important, having controlled for traditional (physical and human capital) endowment influences on export performance in manufacturing products and for other industry, country and time specific effects. These findings are robust to a range of alternative proxies of country trade costs and trade cost intensity or sensitivity measures at the industry level. Further, we find stronger support for trade costs being a source of global rather than 'local' comparative advantage.

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Appendix 1: Constructing the Market Access and Supplier Access Variables

Redding and Venables (2004) outline a theoretical model which they use to construct measures of market access (MA) and supplier access (SA) that capture geographic sources of trade costs. Estimation of the MA and SA variables necessitates the use of a gravity model. The model used is:

$$\ln x_{ij} = \gamma_i + \gamma_j + \delta_1 \ln dist_{ij} + \delta_2 bord_{ij} + \varepsilon_{ij}$$

where $\ln x_{ij}$ is the natural logarithm of country-level bilateral exports[8], $\ln dist_{ij}$ represents the great circle distance between countries *i* and *j*, $bord_{ij}$ is a dummy variable equal to 1 where trading partners share a common border and zero otherwise and γ is the country (i) and partner (j) fixed effect.

Results from the gravity model are reported in Table A1.

Table A1: Gravity Model Results

Variable / Year	1972	1977	1982	1987	1992
ln $dist_{ij}$	-2.09***	-2.13***	-1.67***	-1.43***	-1.46***
	(-33.01)	(-33.70)	(-26.37)	(-22.06)	(-22.89)
$border_{ij}$	1.01***	-1.24***	-1.01***	-.68**	-.55*
	(3.00)	(-3.56)	(-3.44)	(-2.12)	(-1.79)
Number of Observations	16526	16526	16526	16526	16526
R^2	.82	.83	.84	.80	.66

Notes: Robust t-statistics reported in parentheses. ***, ** and * indicate significance at 1 percent, 5 percent and 10 percent, respectively.

[8] Since export data tends to be left-censored we impute values close to zero for all missing values.

Appendix 2: Average Trade Costs By Country (1972-1992)

Table A2: Average Trade Costs by Country (1972-1992)

Country	ICY	MA	SA
Argentina	56.30644	0.063889	0.085679
Australia	32.49788	0.06076	0.083254
Austria	26.40082	0.0499	0.06624
Bangladesh		0.058385	0.076833
Barbados		0.061889	0.079626
Belgium-Lux	4.915953	0.045755	0.058935
Bolivia	39.71579	0.064474	0.084594
Brazil	55.08095	0.060893	0.084347
Cameroon	37.27403	0.063142	0.083966
Canada	25.14977	0.051627	0.064592
Chile	37.03668	0.062812	0.083669
Hong Kong		0.055738	0.073813
Colombia	55.08167	0.06086	0.080453
Costa Rica	32.5668	0.061641	0.078242
Denmark	18.98315	0.049894	0.065033
Ecuador	41.86111	0.061282	0.084744
Egypt	53.52853	0.056771	0.07698
El Salvador	47.93792	0.062449	0.079319
Ethiopia	55.40265	0.064186	0.087171
Fiji		0.062636	0.081866
Finland	25.84138	0.052277	0.068903
Fm German FR	12.43984	0.050428	0.071942
France	12.61997	0.047113	0.061522
Germany	17.94266	0.04571	0.045067
Ghana	43.09814	0.063185	0.083377
Greece	31.87331	0.053896	0.07108
Guatemala	47.26269	0.061576	0.07928
Honduras	40.87602	0.062115	0.078495
Iceland	29.83466	0.056852	0.073595
India	63.57698	0.058466	0.079265
Indonesia	46.55463	0.057361	0.075976
Ireland	30.64304		
Israel	35.8653	0.055875	0.074867
Italy	17.50283	0.051252	0.069016
Jamaica		0.060754	0.076139
Japan	13.94018	0.059733	0.081976
Korea	41.21132	0.051375	0.066523
Madagascar	50.93211	0.068705	0.091083
Malawi		0.066186	0.086534
Malaysia		0.057889	0.077036
Malta		0.053168	0.072363
Mauritius		0.063244	0.085887
Mexico	54.9619	0.059926	0.077131
Morocco	40.4731	0.05558	0.071858

Table A2.1: Average Trade Costs by Country (1972-92)

Country	ICY	MA	SA
Netherlands	9.579564	0.046166	0.060418
New Zealand	27.28596	0.061219	0.083276
Nigeria	43.16903	0.062768	0.083008
Norway	26.75319	0.051272	0.066496
Pakistan	56.57102	0.059003	0.07964
Panama	0	0.060857	0.078613
Papua N.Guin	0	0.063482	0.083571
Peru	45.24006	0.064211	0.082756
Philippines	48.61396	0.056677	0.073516
Portugal	22.13643	0.052337	0.069444
Singapore	0	0.05787	0.077888
South Africa	61.08685	0.060881	0.082585
Spain	19.15678	0.051057	0.068068
Sri Lanka	44.49413	0.0608	0.081299
Suriname	0	0.063579	0.082393
Sweden	23.4739	0.051125	0.068352
Syria	0	0.057225	0.078591
Tanzania	0	0.067144	0.08842
Thailand	39.94936	0.057536	0.075672
Tunisia	50.73139	0.052547	0.068576
Turkey	54.12278	0.053592	0.071649
UK	18.60567	0.046852	0.062032
USA	17.36915	0.0553	0.076777
Uruguay	37.29793	0.062684	0.083013
Venezuela	39.49646	0.060981	0.07627
Zambia	0	0.067661	0.088214
Zimbabwe	0	0.064307	0.08385

Appendix 3: Country Coverage

Table A3: Country Coverage

Country	ICY	MA	SA
Argentina	yes	yes	yes
Australia	yes	yes	yes
Austria	yes	yes	yes
Bangladesh	no	yes	yes
Barbados	no	yes	yes
Belgium-Lux	yes	yes	yes
Bolivia	yes	yes	yes
Brazil	yes	yes	yes
Cameroon	yes	yes	yes
Canada	yes	yes	yes
Chile	yes	yes	yes
Hong Kong	no	yes	yes
Colombia	yes	yes	yes
Costa Rica	yes	yes	yes
Denmark	yes	yes	yes
Ecuador	yes	yes	yes
Egypt	yes	yes	yes
El Salvador	yes	yes	yes
Ethiopia	yes	yes	yes
Fiji	no	yes	yes
Finland	yes	yes	yes
Fm German FR	yes	yes	yes
France	yes	yes	yes
Germany	yes	yes	yes
Ghana	yes	yes	yes
Greece	yes	yes	yes
Guatemala	yes	yes	yes
Honduras	yes	yes	yes
Iceland	yes	yes	yes
India	yes	yes	yes
Indonesia	yes	yes	yes
Ireland	yes	no	no
Israel	yes	yes	yes
Italy	yes	yes	yes
Jamaica	no	yes	yes
Japan	yes	yes	yes
Korea	yes	yes	yes
Madagascar	yes	yes	yes
Malawi	no	yes	yes
Malaysia	no	yes	yes
Malta	no	yes	yes
Mauritius	no	yes	yes
Mexico	yes	yes	yes
Morocco	yes	yes	yes

Table A3.1: Country Coverage

Country	ICY	MA	SA
Netherlands	yes	yes	yes
New Zealand	yes	yes	yes
Nigeria	yes	yes	yes
Norway	yes	yes	yes
Pakistan	yes	yes	yes
Panama	no	yes	yes
Papua New Guinea	no	yes	yes
Peru	yes	yes	yes
Philippines	yes	yes	yes
Portugal	yes	yes	yes
Singapore	no	yes	yes
South Africa	yes	yes	yes
Spain	yes	yes	yes
Sri Lanka	yes	yes	yes
Suriname	no	yes	yes
Sweden	yes	yes	yes
Syria	no	yes	yes
Tanzania	no	yes	yes
Thailand	yes	yes	yes
Tunisia	yes	yes	yes
Turkey	yes	yes	yes
United Kingdom	yes	yes	yes
United States	yes	yes	yes
Uruguay	yes	yes	yes
Venezuela	yes	yes	yes
Zambia	no	yes	yes
Zimbabwe	no	yes	yes

Appendix 4: Summary Statistics

Table A4.1: Summary Statistics

	Obs	Mean	Std. Dev.	Min	Max
Capital intensity (k)	21614	.14	.20	.01	1.34
Skill intensity (h)	21614	.23	.09	.07	.54
Input intensity (input int)	21614	.69	.09	.53	.90
Elaticity of substitution (es)	21614	5.77	2.23	-1.64	9.44
Capital endowment (K)	21614	.02	.01	.00	.05
Skill endowment (H)	21614	.35	.45	.01	2.91
ICY	18542	31.95	16.96	1.50	80.28
Market access (MA)	21211	.06	.01	.04	.08
Supplier access (SA)	21211	.07	.02	.04	.11

Table A4.2: Correlation Matrix

	k	h	input int	es	K	H	ICY	MA	SA
k	1.00								
h	.32	1.00							
input int	.42	.12	1.00						
es	-.09	-.05	.21	1.00					
K	.06	.11	-.02	.08	1.00				
H	.03	.07	-.01	.04	.48	1.00			
ICY	-.02	-.04	.01	-.04	-.69	-.33	1.00		
MA	-.06	-.14	.05	-.10	-.50	-.17	.43	1.00	
SA	-.04	-.06	.02	-.05	-.34	-.06	.35	.47	1.00

.

Appendix 5: GMM Estimates

Table A5: GMM Estimates

Dependent variable: log Exports	(1)	(2)	(3)
log $Exports_{t-1}$	.27***	.25***	.50***
	(10.51)	(8.99)	(15.79)
t_iT_c	-1.38***	12.51***	-21.32***
	(-11.97)	(16.80)	(-10.79)
h_iH_c	-3.12***	-2.27***	-4.82***
	(-6.26)	(-5.07)	(-9.89)
k_iK_c	1.85***	1.07***	2.17***
	(10.38)	(5.78)	(12.20)
t_i	input int	es	input int
T_c	ICY	MA	SA
$chi^2(5)$	705.56	563.48	625.07
Prob>chi^2	.00	.00	.00
Number of Observations	6752	7482	7482

Notes: Coefficients are GMM estimates computed using a one step Arellano and Bond estimator. Dependent variable is the log of the share of exports. T-statistics reported in parentheses. ***, ** and * indicate significance at 1 percent, 5 percent and 10 percent, respectively.