Trade Costs, Comparative Advantage and the Pattern of Trade: Multi-country and Multi-product Panel Evidence

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1. Introduction

A number of recent studies have indicated that trade costs, especially if broadly defined to include less easily identified and measurable information-related costs of transacting internationally as well as the costs of transportation, are greater than we had believed (Anderson and van Wincoop, 2004; Hummels, 2007). If this is so, then 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, indeed to even possibly to a greater extent. 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 we focus on whether trade costs modify trade patterns or are a source of comparative advantage, and on how to distinguish empirically between these alternative, possible effects of trade costs.

The remainder of the paper is organised as follows. The relationship of this paper to the existing literature is explored 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 empirical approach are provided and discussed in section 5. Finally section 6 offers the summary conclusions of the study.

2. Relationship to the Existing Literature

This paper draws upon that strand of the empirical factor proportions literature that explores the cross-commodity or –industry relationship between export performance and the 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 the criticism, forcibly made by Leamer (1980, 1984), 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 the factor content of trade 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 the 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 being concentrated on low skill-intensive industries.

Although the theoretical model used by Romalis (2004) incorporates trade costs, there is no consideration of trade costs in the empirical modelling. But 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 costs-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 those 'local' countries, that is those countries having the lowest costs of trading with the country. Comparative advantage should be defined in

[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.

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 are, however, some papers that consider 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 ("rule of law") export more of the goods for which contract enforcement is more important. In similar fashion Levchenko (2004) 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 (as well as or rather than production) costs, then trade costs are represented as a source rather than modifier of comparative advantage and trade patterns.

3. Trade Costs in Theory

In practice trade costs, or particular types of trade costs, will vary by country, by trading partners and by product. Specific countries can have attributes (e.g. remoteness or not, landlockedness or not, levels of port (in) efficiency or customs clearance procedures) that make them relatively more or less expensive in exporting or importing than other countries. 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 of these differences 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.

Trade costs by country

Trade theory does not typically model all the above aspects of trade costs. Markusen and Venables (2007) for instance incorporate trade costs into an endowments model of trade, 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).[2] 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:

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

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 (1) the country is self-sufficient and the good is 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_it).

In figures 1 and 2 we reproduce the graphically summarised numerical simulations that Markusen and Venables (2007) report for countries assumed to be uniformly distributed over the trade costs space [from $t=1$ (zero trade costs) → $t=1.37$ (high trade costs)][3] and scaled endowments space (from L=0.1 → L=0.9, where K=1-L). Figure 1 shows the pattern of production specialisation, where X_1 is the least labour-intensive in production and X_3 the most.[4] While figure 2 reports the corresponding pattern of trade specialisation over country types (by mix of endowments and trade costs).[5] A key message (from figure 1) for the present purpose is that lower trade cost countries are characterised by partial or complete specialisation in production, while higher trade cost countries tend to become less specialised in production. From figure 2 we can see the important interaction between trade costs and endowments in determining the pattern of trade specialisation. Low trade cost countries trade all goods, while the incidence of antarky or non-tradability increases

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[2] 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.

[3] Strictly marginally greater than $t=1$ to allow production determinacy.

[4] The assumed labour and capital shares are respectively (0.3 and 0.7) for X_i, (0.5 and 0.5) for X_2 and (0.7 and 0.3) for X_3.

[5] Preferences are assumed to be Cobb-Douglas with expenditure equally allocated to each good.

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 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.

Figure 1: Regions of production specialization in the three-good model

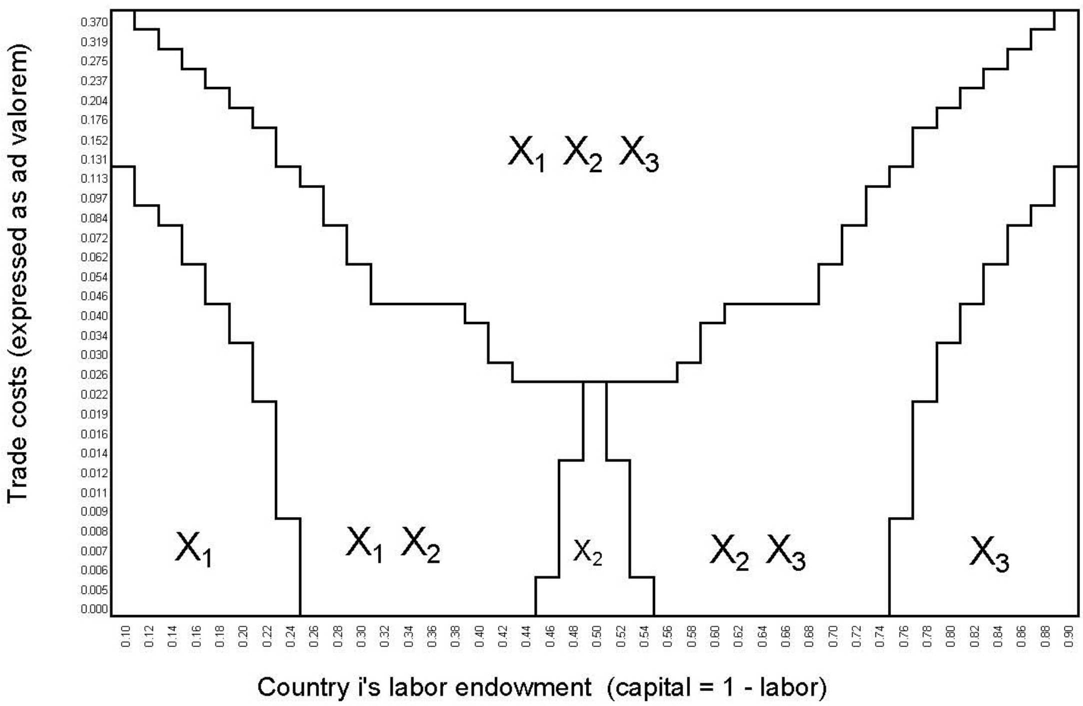
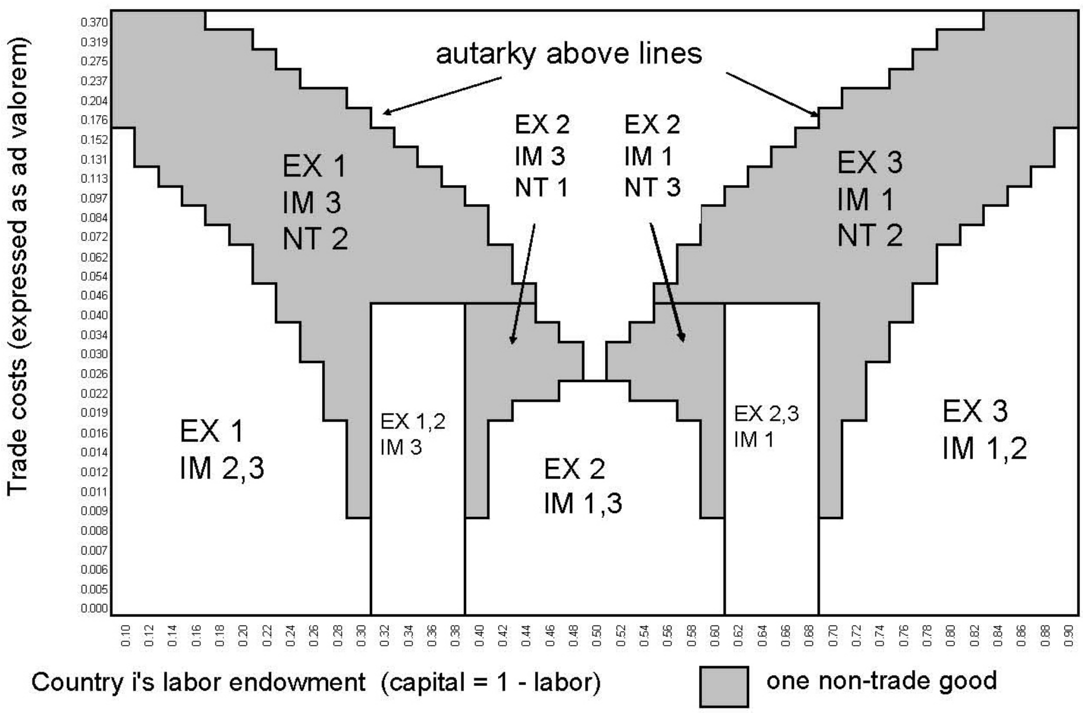


Figure 2: Regions of trade specialization in the three-good model



Source: Markusen and Venables (2007)

Trade costs by trading partner

In the analysis discussed above 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 it is when there are no trade costs. In the traditional Ricardian model 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:

$$\frac{a_{cg1}}{a_{cg2}} < \frac{a_{og1}}{a_{og2}} \qquad (2)$$

If, as Deardorff (2004) does, trade costs are represented as the unit labour requirement ($t_{cgc'}$) of country c serving a particular market (ć), then we can amend (2) 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:

$$\frac{a_{cg1}+t_{cg1c'}}{a_{cg2}+t_{cg2c'}} < \frac{a_{og1}+t_{og1c'}}{a_{og2}+t_{og2c'}} \qquad (3)$$

It follows from (3) 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 latter proposition is that comparative advantage may only be defined locally if relative trade costs are sufficiently high; comparative advantage is specific to the countries from which markets can be served.[7]

4. Empirical Approach

[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.

In order to test the strong 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 exports as follows:

$$X_{ic} = \alpha_i + \alpha_c + \alpha_t + \beta_1 t_i T_c + \beta_2 h_i H_c + \beta_3 k_i K_c + \varepsilon_{ic} \qquad (1)$$

where X_{ic} is total exports of industry *i* by country *c*

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 1 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 more 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 1 can be estimated for sub-sets of countries clustered according geographic (regions or continents) or economic (developed, developing and least developed) proximity.

In order to explore the alternative hypothesis that trade costs modify the pattern of comparative advantage (again globally or locally), we consider the following specification.

$$X_{ic} = \alpha_i + \alpha_c + \alpha_t + \beta_1 T_c + \beta_2 h_i H_c + \beta_3 k_i K_c + \beta_4 (h_i H_c T_c) + \beta_5 (k_i K_c T_c) + \varepsilon_{ic} \qquad (2)$$

We explore whether higher trade cost countries export less of all exports ($\beta_1 < 0$), having controlled for endowment and other fixed effects, but also whether traditional endowment influences on exports are conditioned by trade costs. One may expect a given increase in endowments of human capital (physical capital) to have a smaller influence on exports for a higher cost than lower trade cost country i.e. for $\beta_4 < 0$ ($\beta_5 < 0$). Again the potential modifying influence of trade costs on comparative advantage can be explored in a global or local sense as set out earlier.

Measurement of trade costs and trade cost intensity

The comprehensive measurement of trade costs is problematic. This is in part because data availability constrains measurement across large numbers of developed and developing countries and over time. It is also because it is difficult to aggregate across all policy-sources of trade costs (i.e. across tariffs and non-tariff barriers) and simultaneously across policy and non-policy (e.g. transport and other geography) sources of trade costs.[8] As a result, we consider alternative proxies of trade costs, which capture policy and non-policy sources to differing degrees. We borrow 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 trade policy 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 the measures of access to markets and sources of supply proposed by Redding and Venables (2004); market access (MA_c) of each exporting country being the distance-weighted sum of the market capabilities of all partner (j) countries, and supply access (SA_c) of each importing country being the distance weighted sum of the supply capabilities of all partner countries, such that:

$$MA_c = \sum (\pi_{cj})^{1-\sigma} M_j \qquad (3)$$

$$SA_c = \sum (\pi_{cj})^{1-\sigma} S_j \qquad (4)$$

where π_{cj} = bilateral transport costs

M_j = market capacity

S_j = supply capabilities

and σ = elasticity of substitution.

MA_c and SA_c are predicted from a gravity model of bilateral trade, which controls for distance, a dummy for a common border, and country and partner dummies. The

8 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 wholley from non-policy sources in measuring trade restrictiveness.

coefficients of the country and partner dummies provide the 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 same 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 for each of the years 1972, 1977, 1982, 1987 and 1992. (See Appendix 1 for the gravity model estimates used to construct MA_c and SA_c.)

In equation 2 trade costs are introduced separately and interacted with the endowment terms, but in equation 1 trade costs are interacted themselves with a trade cost intensity or sensitivity variable. Again we explore two possible proxies for trade cost intensity (t_i). One is the share of intermediate inputs in the value of final output (input int); the greater is this in the production of the goods of 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 low trade cost countries in the production of goods that are more dependent on intermediate inputs. 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 elasticity of substitution (es) estimates reported by Hummels (1999) for each 2 digit import category, from an import demand function estimated (OLS) for pooled data for US, New Zealand, Argentina, Brazil, Chile and Paraguay.

Data and sources

A host of sources were used to construct the 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. The dataset is 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 the SITC (rev. 2) 4-digit industry level are provided for the years 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 not completing high school. 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 industry 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 each US industry. It is recognised that the assumption of common and constant factor intensities is a strong assumption, 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 the capital and skill intensity variables 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 the industries are matched to the 1997 NAICS industry classification. This can then be matched with the capital and skill intensity variables which are 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 which may be found at http://www.nber.org/lipsey/sitc22naics97/. This enables us to match the export data to the industry-level information on intermediate input intensity, capital intensity and skill intensity.

In the regressions an industry is defined according to the SITC (rev. 2) system of classification. We do not aggregate exports up to the 1997 NAICS classification system. This provides a greater number of industries. We end up with up to 158 manufacturing industries and 53 countries (for which all the right side variables are available) – see Appendix 2 for details of countries covered.

Estimation

Equations 1 and 2 were 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. Results

Trade costs as a source of comparative advantage?

The results of the estimated enhanced endowments model of exports (eq 1) are reported in table 1 for the whole sample of countries; alternative combinations of proxies of country trade costs and trade cost intensity by industry being reported in specifications (columns) 1-6 (1-3 with country fixed effects and 4-6 without country fixed effects). There is a consistent pattern of signs and significance across all specifications; with positive traditional endowment influences ($\beta_2>0$; $\beta_3>0$), a negative trade cost 'endowment' influence ($\beta_1<0$) and 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 to whether or not country fixed effects are included. In the case of the combination of t_i and T_c respectively based in the elasticity measure (es) and market access (MA), however, the magnitude of the coefficient on β_1 is sensitive to whether country fixed effects are included or not (although the sign and significance are unaltered). (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 1: Trade Costs as a Source of Comparative Advantage

	Regression					
	(1)	(2)	(3)	(4)	(5)	(6)
t_iT_c	-.30***	-.06***	-.02***	-.35***	-.56***	-.01***
	(-17.54)	(-4.31)	(-4.93)	(-45.01)	(-39.99)	(-2.71)
k_iK_c	.07***	.10***	.10***	.17***	.26***	.38***
	(2.69)	(3.69)	(3.72)	(7.08)	(10.38)	(14.46)
h_iH_c	.15***	.17***	.17***	.17***	.20***	.27***
	(10.96)	(11.77)	(11.68)	(23.59)	(28.09)	(38.11)
Country Fixed Effects	Yes	Yes	Yes	No	No	No
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
t_i	input int	es	input int	input int	es	input int
T_c	ICY	MA	SA	ICY	MA	SA
Number of Observations	20457	20457	20457	20457	20457	20457
R^2	.49	.49	.49	.34	.34	.27

Standardised coefficients. T-statistics reported in parentheses.
***, ** and * indicates significance at 1 percent, 5 percent and 10 percent, respectively.

The results in table 1 provide support therefore 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 1 for the sub-samples of countries in each of six continents. These are reported in table 2 below.

Table 2: Trade costs as a Source of Comparative Advantage: Continental Regressions						
	Regression					
	(1)	(2)	(3)	(4)	(5)	(6)
t_iT_c	-.25***	-.18***	-.27***	.14	.05	-.17
	(-9.79)	(-5.30)	(-5.65)	(1.55)	(.50)	(-1.63)
k_iK_c	.08*	.18***	.08	.08	-.15	.46***
	(1.73)	(3.50)	(1.05)	(.69)	(-1.49)	(2.60)
h_iH_c	.11***	.18***	.10***	.16**	-.00	.09**
	(4.45)	(6.00)	(3.06)	(2.47)	(-.05)	(2.36)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
t_i	input int	input int	input int	input int	input int	input int
T_c	ICY	ICY	ICY	ICY	ICY	ICY
Continent	Europe	Asia	N. America	S. America	Africa	Oceania
Number of Observations	9128	4160	2493	2005	1623	1048
R^2	.49	.57	.69	.50	.49	.64

Standardised coefficients. T-statistics reported in parentheses.
***, ** and * indicates significance at 1 percent, 5 percent and 10 percent, respectively.

For some regions (e.g. Europe and Asia) there is little difference between the 'global' and 'local' results; the pattern of signs, coefficient magnitudes and significance is similar in columns (1) and (2) of table 2 to that in column (1) of table 1 (i.e. for the same proxies for t_i and T_c). But as the sample sizes for the continents decline (given the characteristics of our initial sample) the model gains progressively less support. For North and South America physical capital endowments are found to have no effects, though the trade cost 'endowments' effect remains. For three regions (S. America, Africa and Oceania), we also find no trade cost 'endowments' effect. Indeed for Africa we find no significant sign on any endowment. This may well be due in part to the small number of countries, concentration on manufactured exports and importance of policy factors (preferences and regional integration schemes) for African trade. It is difficult to conclude, however, on the basis of these results that the 'global' explanation of comparative advantage is dominated by the 'local' comparative advantage model.

Trade costs as a modifier of comparative advantage?

To explore the alternative hypothesis of trade costs modifying comparative advantage rather than being a source of comparative advantage, we use the three country trade costs (T_c) proxies used in specifications (1), (2) and (3) in table 1 and apply them to a full fixed effects version of equation 2. The results for the full sample (i.e. globally) are set out in table 3 below.

Table 3: Trade Costs as a Modifier of Comparative Advantage

	Regression (1)	(2)	(3)
T_c	-.23***	-.05***	-.04**
	(-12.33)	(-6.34)	(-2.36)
k_iK_c	.35***	.10***	.22***
	(5.98)	(3.72)	(6.47)
h_iH_c	-.34***	.10***	.11***
	(-6.66)	(11.62)	(4.41)
$k_iK_cT_c$	-.21***	-.01	-.12***
	(-5.26)	(-1.26)	(-5.27)
$h_iH_cT_c$	.52***	-.03***	.08***
	(9.90)	(-3.53)	(3.32)
Country Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
T_c	ICY	SA	MA
Number of Observations	20457	20457	20457
R^2	.50	.49	.49

Standardised coefficients. T-statistics reported in parentheses.
***, ** and * indicates significance at 1 percent, 5 percent and 10 percent, respectively.

The estimation using the ICY proxy for country trade costs is problematic, with the sign on the direct human capital endowments effect being negative. We concentrate our assessment of the alternative model therefore on specifications (2) and (3) in table 3.[9] We do find an across-the-board export-reducing effect of trade costs, but the interaction effects between endowments and trade costs are not consistent. In (3), with the market access proxy for trade costs, we find 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. It is difficult therefore to view these mixed results as giving clear support for the alternative model of trade costs modifying comparative advantage. It is only in the case of specification 2 (with supply access measuring trade costs) that we find a negative sign on both β_4 and β_5 (albeit with significance only for β_5) in line with the expected sign for a modifying influence of trade costs on comparative advantage.

We take specification 2 as the basis for exploring the modification of comparative advantage by trade costs locally i.e. for continental groupings of countries. Again small sample size may account in part for the poor performance of the model for S. America, Africa and Oceania. For the other regions there is some support for the modification hypothesis, with the expected signs on β_1, β_2 and β_3 with significant, expected signs on β_4

9 Without country fixed effects the sign on the human capital term is positive and significant.

in the case of Europe and β_5 in the case of Asia. But overall again these results can be viewed as giving mixed support for and against the hypothesis that trade costs are a modifier of comparative advantage.

Table 4: Trade Costs as a Modifier of Comparative Advantage: Continental Regressions

	Regression					
	(33)	(34)	(35)	(36)	(37)	(38)
T_c	-.05***	-.06***	-.07***	-.06	-.02	1.53**
	(-3.97)	(-3.79)	(-4.24)	(-1.41)	(-.63)	(2.21)
k_iK_c	.11**	.19***	.10	.06	-.16	.51***
	(2.36)	(3.66)	(1.34)	(.55)	(-1.64)	(2.85)
h_iH_c	.13***	.21***	.12***	.14**	-.01	-.02
	(5.06)	(6.86)	(3.52)	(2.24)	(-.15)	(-.44)
$k_iK_cT_c$	-.02*	-.01	.01	-.03	.03	.08***
	(-1.88)	(-.67)	(.93)	(-1.30)	(1.15)	(2.61)
$h_iH_cT_c$	-.02	-.11***	-.02	-.06	.03	-.14***
	(-1.30)	(-5.74)	(-.95)	(-1.41)	(.63)	(-2.99)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
T_c	SA	SA	SA	SA	SA	SA
Continent	Europe	Asia	N. America	S. America	Africa	Oceania
Number of Observations	9128	4160	2493	2005	1623	1048
R^2	.49	.57	.69	.50	.49	.64

Standardised coefficients. T-statistics reported in parentheses.
***, ** and * indicates significance at 1 percent, 5 percent and 10 percent, respectively.

6. Conclusions and Directions of Further Research

We find support for country trade costs being an 'endowment' which affects the pattern of comparative advantage as revealed in export performance. 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. Further, we find stronger support for trade costs being a source of global rather than 'local' comparative advantage. But the analysis does not establish a strong distinction between the alternative hypotheses and models. We find some results, but not as consistently as for the source of comparative advantage hypothesis, consistent with the modifier of comparative advantage hypothesis. The difficulty of clearly distinguishing between hypotheses is probably due to a number of factors. The measurement of country trade costs and trade cost intensity or sensitivity is not unproblematic, and we have relied here on a number of alternative, imperfect proxies. Further, the country coverage, especially in some regions or continents, is limited. The testing for 'local' comparative advantage may also be strengthened by distinguishing between intra- and extra-regional exporting. Finally it should be emphasised that the work to-date has focussed on comparative advantage in products rather than tasks or stages of production, and has treated country trade costs as exogenous. But countries that specialise in trade cost intensive or sensitive products may have greater incentive and capacity to reduce trade costs (through infrastructure development and institutional reform).

There are a number of obvious directions for strengthening and extending the work. We could allow for differences in trade costs across industries and for differences in 'technologies' across countries and over time. We can seek to extend the country coverage of the analysis, especially in specific continents. We can distinguish between exports to global and 'local' markets, not just exports to all destinations as at present. Alternative concepts of local markets can also be explored, based on more than simply geographic proximity. Finally, we need to allow for the possible endogeneity of trade costs in our estimation method.

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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:

$$\ln x_{ij} = \alpha_i + \gamma_i + \delta_1 \ln dist_{ij} + \delta_2 bord_{ij} + \beta_1 \ln gdp_i + \beta_2 \ln gdp_j + \varepsilon_{ij}$$

where lnx_{ij} is the natural logarithm of country-level bilateral exports[10], 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 lngdp_i and lngdp_j are the natural logarithm of country *i* and *j*'s respective real GDPs. Specifying the model in this way allows us to calculate MA and SA while abstracting from the effects of distance, proximity and GDP. Results from the gravity model are reported in Table 1.

Table 1: Gravity Model Results

	1972	1977	1982	1987	1992
ln*dist* $_{ij}$	-3.66***	-3.51***	-2.54***	-2.10***	-2.05***
	(-28.21)	(-27.65)	(-20.11)	(-16.63)	(-16.33)
bord $_{ij}$	1.21*	-2.71***	-2.33***	-1.82***	-1.51***
	(1.80)	(-4.11)	(-3.93)	(-2.95)	(-2.61)
ln*gdp* $_i$	-.96***	3.14***	2.90***	-1.33***	3.21***
	(-5.35)	(22.68)	(23.22)	(-10.57)	(27.05)
ln*gdp* $_j$	2.44***	-1.26***	-1.02***	3.23***	-1.36***
	(12.31)	(-9.38)	(-8.46)	(23.36)	(-11.96)
Number of Obs	16274	16274	16274	16274	16274
R^2	.52	.57	.62	.60	.60

T-statistics reported in parentheses.
***, ** and * indicates significantce at 1 percent, 5 percent and 10 percent, respectively.

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

Appendix 2: Country Coverage

Countries in the dataset		
Argentina	Ghana	Philippines
Australia	Greece	Portugal
Austria	Guatemala	South Africa
Belgium-Lux	Honduras	Spain
Bolivia	Iceland	Sri Lanka
Brazil	India	Sweden
Cameroon	Indonesia	Thailand
Canada	Israel	Tunisia
Chile	Italy	Turkey
Colombia	Japan	UK
Costa Rica	Korea Rep.	USA
Denmark	Madagascar	Uruguay
Ecuador	Mexico	Venezuela
Egypt	Morocco	
El Salvador	Netherlands	
Ethiopia	New Zealand	
Finland	Nigeria	
Fm German FR	Norway	
France,Monac	Pakistan	
Germany	Peru	