Board of Governors of the Federal Reserve System

International Finance Discussion Papers

Number 693

December 2000

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Abstract: The Internet stimulates trade. Using a gravity equation of trade among 56 countries, we find no evidence of an effect of the Internet on total trade flows in 1995 and only weak evidence of an effect in 1996. However, we find an increasing and significant impact from 1997 to 1999. Specifically, our results imply that a 10 percent increase in the relative number of web hosts in one country would have led to about 1 percent greater trade in 1998 and 1999. Surprisingly, we find that the effect of the Internet on trade has been stronger for poor countries than for rich countries, and that there is little evidence that the Internet has reduced the impact of distance on trade. The evidence is consistent with a model in which the Internet creates a global exchange for goods, thereby reducing market-specific sunk costs of exporting.

Keywords: technology, gravity equation, sunk costs

* International Finance Division of the Federal Reserve Board and Development Studies Institute, London School of Economics, respectively. We would like to thank Bruce Blonigen, Simeon Djankov, Andrew Levin, James Rauch, John Rogers, Andrew Rose, Phillip Swagel, David Weinstein, Kei-Mu Yi and seminar participants at Columbia University, the Federal Reserve Board, the University of Virginia, and the Empirical Investigations in International Trade Conference for helpful comments, and Kathryn Zweig for research assistance. All errors and omissions are our own. Correspondence: Caroline Freund, International Finance Division, Federal Reserve Board, Washington D.C. 20551, e-mail: caroline.l.freund@frb.gov. Diana Weinhold, Development Studies Institute, London School of Economics, Houghton Street, London WC2A2AE, e-mail: d.weinhold@lse.ac.uk.

1. Introduction

Anecdotal evidence that the Internet has affected international trade is everywhere. A recent New York Times article told of women in a remote part of Guyana using the Internet to sell hand-woven hammocks to people around the world (NYT 3/28/2000). A producer of draperies and other goods from Hicksville, Long Island is using the Internet to negotiate deals in Turkey, Saudi Arabia, and South Africa, after years of serving only the domestic market (Long Island Business News, 8/21/2000). Of greater importance for sheer trade volumes, global business-to-business web sites have already been set up in a number of industries. Some examples include, SciQuest, a global marketplace for laboratory and scientific materials; Commerx, a global exchange for plastics, metals, and packaging materials; and e-Steel, which links buyers and sellers of steel products around the world. In one well-known example, Daimler-Chrysler, GM, and Ford are starting COVISINT, an Internet-based market for car parts that is expected to aggregate thousands of suppliers worldwide. Such initiatives are not limited to industrialized countries. For example, a web-based market is being developed in greater China for international suppliers of agricultural products (Chicago Sun Times 9/12/2000). Forrester Research, a leading consulting company, estimates that global e-commerce cross-border trade will be $44.1 billion in 2000, and will grow to $1.4 trillion in 2004, accounting for 18 percent of total exports (Sanders, 2000).

The main purpose of this paper is to quantify the effect that the Internet has had on international trade in recent years. We motivate the analysis with a model with imperfect competition and sunk costs. Evidence suggests that market-specific sunk costs have historically been very important for a large share of trade in goods.[1] The Internet has the potential to reduce

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[1] A large body of empirical work has shown that past linkages and business networks are significant determinants of current trade flows. After controlling for the standard determinants of trade, Eichengreen and Irwin (1998) show that past trade has significant explanatory power in explaining current trade patterns using aggregate trade data. Roberts and

these costs because suppliers can advertise to numerous buyers at once. This has important implications for trade volumes and for bilateral trade patterns. In particular, it implies that the new technology will increase trade, reduce the importance of past linkages on current trade, and is likely to have the greatest impact on exports of countries that have not historically had strong trade ties. The model also shows that the effect of distance on trade will be reduced if distance impacts trade mainly through sunk costs, for example, by improving access to information about distant markets. Alternatively, if distance impacts trade primarily because of transport costs then it is unclear if the development of the Internet will change the way in which distance affects trade.

We use a gravity model of trade among 56 countries over the years 1995 to 1999 and test whether Internet usage can help explain the observed trade patterns. In brief, we do not find evidence of an effect of web access on international trade in 1995, and only very weak evidence in 1996. However from 1997 to 1999, we find a significant and increasing impact of the Internet on trade flows. Specifically, we find that a relative increase of 10 percent in web hosts in 1999 would have led to about 1 percent greater trade. We find that the Internet has had the strongest impact on trade flows among developing countries, which is consistent with the model's prediction that countries *without* established trade links have the most to gain from Internet technology. Surprisingly, we find little evidence that the Internet has reduced the impact of distance on trade, suggesting that distance influences trade patterns mainly as a result of transport costs. We also find evidence that the Internet has reduced the importance of past linkages on trade flows.

It should be noted that while the Internet is likely to impact trade in both goods and services, the effects on the two are likely to be very different. As mentioned above, trade in goods will be affected because Internet technology makes the development of global markets for goods possible.

Tybout (1997) show a similar effect of history using firm level data. Rauch (1999) finds that colonial linkages and language help explain trade flows.

Trade in services will be impacted because new services, which are transmittable via the Internet, can now be traded almost costlessly, irrespective of location.[2] The Internet is therefore likely to have a relatively greater effect on the volume of trade in services and on the way in which distance influences services. In this paper, we focus on goods trade and the market-creating effect of the Internet on goods trade. In a companion paper, we plan to explore the effect of the Internet on services trade.

The paper proceeds as follows: Section 2 reviews related literature and develops a theoretical framework to describe the effect of the Internet on trade. Section 3 briefly reviews the gravity model of trade, Section 4 discusses data and measurement issues, Section 5 presents the results, Section 6 offers a sensitivity analysis of the results, Section 7 discusses alternative interpretations, and Section 8 concludes.

2. A Theoretical Framework for Empirical Tests

The purpose of this section is to provide a theoretical framework for empirical examination of how the Internet is likely to influence trade patterns. The model is meant to be illustrative and highlight the different ways in which the Internet could impact goods trade. The relevant innovation of the Internet is that it has the potential to create large global markets for specific traded goods, both directly via organized exchanges with numerous buyers and sellers and indirectly through powerful search engines, which enable sellers to notify buyers of prices instantaneously. This is very different from other recent innovations, such as the telephone or the fax, which only assist bilateral communication. Indeed, a recent survey of 50 global eMarketplaces finds that the value of these exchanges comes from aggregating buyers and sellers across regions.

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[2] Indeed, Quah (1999) argues that because of this new way of trading information, the Internet will change the way business is done.

One executive from a Chemicals site notes that “If a French chemicals company wanted to sell in China, it would spend a lot of money to expand into Asia. Now the firm can post on our site. The Chinese buyer looking for PVC is one click away from the French seller” (Sanders 2000).

A global exchange effectively reduces sunk costs associated with a particular market because suppliers can advertise to numerous buyers in one place. Several recent papers have emphasized the importance of sunk costs in explaining trade flows. In a seminal paper, Baldwin (1989) shows that sunk costs may be responsible for explaining observed hysteresis in trade flows. Eichengreen and Irwin (1998) find that historical trade patterns play a large role in determining current trade patterns, and interpret this as evidence that sunk costs must be involved in setting up trade networks. Using firm-level data, Tybout and Roberts (1997) also find evidence that sunk costs help explain why Colombian firms export in a particular year. Freund (2000) finds that trade links between original members of the European Union are highly persistent, and hypothesizes that sunk costs are likely to blame.

A related strand of the literature focuses on the costs associated with imperfect information and emphasizes the importance of local networks in overcoming these costs. Rauch (1996) develops a search theory of trade in which networks expand a firm’s possible export markets by increasing the number of draws it obtains when it searches for the best match.[3] He uses this theory to explain the importance of family ties and Asian business groups in establishing trade links. In a companion paper, Rauch (1999) shows that trade links, such as colonial ties or a common language, are important in explaining trade patterns, especially for goods that do not trade on an organized exchange or have reference prices.

[3] In related work, Rauch and Trindade (2000) show that trade is increasing in market familiarity, where more market familiarity is means that finding a joint-venture partner is relatively easier. In this type of model, innovations such as the Internet which improve market familiarity would also increase trade.

In both types of models, trade is distorted and trade flows will be persistent. In models with sunk costs, trade is distorted because some exporters do not enter a market (while others do not exit) as relative prices adjust. In models with imperfect information, trade is distorted because search is costly, implying that the best matches are unlikely to be identified, and that once matches are found they will not change because it is costly to find a new partner.

Next, we develop a minimalist model with imperfect competition and sunk costs to demonstrate the effects of creating a global exchange on trade. We consider *n* countries, each with *m* firms producing a homogeneous good. Competition in this market is Cournot, and welfare gains are a result of the increase in competition that trade introduces (as in Brander and Krugman (1983)). We assume that a firm pays a market specific sunk cost in order to participate in a given market. This includes costs such as: finding out information about the market, advertising the product, and establishing a distribution network. Many of these investments are specific to the foreign country and are unlikely to be recouped if the firm exits.

The model has two periods and there is perfect information. Aggregate utility in each country is assumed to take the form

$$U(K, Q_i, ...Q_n) = N + KQ - Q^2 / 2,$$

where *N* denotes the consumption of a competitively produced numeraire good, Q is total consumption of an oligopolistically produced good, and *K* is a constant.

Demand for the imperfectly competitive good in each country is therefore

$$P = K - Q,$$

where *P* is price. Initially, the markets are assumed to be segmented, that is, it is prohibitively costly to cross-haul output.

Each firm produces with a constant marginal cost, *c*, and there is a fixed cost, *F*, of exporting to a country that varies with the distance between countries. The fixed cost is assumed to be higher for a more distant market because it is more costly to obtain information about that market. In addition, there is a transport cost, *t*, per item that also increases with distance because it is more costly to ship goods over long distances. To solve the problem, we first solve for a firm's optimal exports, given that the firm exports to a certain market, then we check under what condition exporting will occur in equilibrium.

A firm's problem is to maximize the present discounted value of profits

$$\max_{q_{ij}} (1+\beta) q_{ij} (K - q^* - q_{ij} - c - t_{ij}), \tag{1}$$

where q* is the output for sale by other firms and β is the discount factor. The solution to this problem yields the equilibrium quantity that a representative firm from country *i* exports to country *j* as a function of the exports of all other firms. The optimal quantity that a firm exports in each period is

$$q_{ij} = \frac{(K - q^* - c - t_{ij})}{2}. \tag{2}$$

Plugging the quantity from equation (2) into equation (1) and solving, profits are

$$\pi_{ij} = (1+\beta)\frac{(K - q^* - c - t_{ij})^2}{4}. \tag{3}$$

With a fixed cost of exporting, exporting is worthwhile only if the profits exceed the fixed cost of trade. That is, total exports from *i* to *j* are

$$\begin{aligned} XP_{ij} &= 0 \quad if\ \pi_{ij} < F_{ij}, \quad and \\ XP_{ij} &= mq_{ij} \quad if\ \pi_{ij} \geq F_{ij}. \end{aligned} \tag{4}$$

The likelihood that profits exceed the fixed cost depends on the size of the fixed cost, of the transport cost, of the foreign market, and the amount of competition.

In the second period, exports will be the same as first period exports, assuming growth and costs are constant over time.

(6) $XP_{ij} = XP_{ij}(-1)$.

In addition, because of the sunk costs, small change in fundamentals will not affect trade.
Once the fixed cost is paid, a firm will always remain in a market. Similarly, if it was not optimal for a firm to enter a market in the first period, it will not be optimal for a firm to enter in the second.

This yields three hypotheses about trade in the imperfectly competitive good with fixed costs. (i) A firm in a neighboring country is more likely to export and will export more than other firms because the fixed cost and the transport cost are both lower. A lower fixed cost directly increases the likelihood of exporting and a lower transport cost increases profits which also makes exporting more likely. (ii) A firm is more likely to export to a large market, i.e. a market where K is large. (iii) In a two-period model, history is important, the same exporters will always export in both periods.

Figure 1 shows an example of what a market may look like for an imperfectly produced good. Producers sell directly to foreign markets, and some producers do not sell to some markets. Producers are more likely to sell to neighboring markets and to large markets. In addition, because of the fixed cost of entry, firms in a market have significant market power and prices vary across countries.

Next, we consider how trade is different with the Internet. The Internet effectively aggregates world demand and world supply—markets are no longer segmented. World demand for the imperfectly-competitive good is

$$P = K^* - Q .$$

We assume that all of firms with access to the Internet compete on this market and then output is distributed according to demand. Each firm now optimizes its exports over world demand, which yields the following equilibrium quantity:

(7) $$q_i = \frac{(K^* - q^* - c - t^*)}{2},$$

where q^* is the total supply by the rest of the firms in the market and t^* is a firms average transport cost.

Country *i*'s exports to country *j* will be

(8) $$XP_{ij} = \frac{Y_j}{Y^*} mq_i,$$

where Yj/Y^* is the relative income of country *j*. The intuition is that mq_i is total exports from country *i* to the world, and each country *j* imports its relative share of the world supply.

The market now appears as in Figure 2. Countries buy and sell on the international e-market. All importing countries gain because the price is lower. Exporting countries gain from access to new markets and reduction or removal of the fixed cost.

Note that in this basic specification distance no longer matters—exports are only a function of the relative size of the exporter and importer. However, it is more likely that the world market will clear by proximity in order to reduce transport costs. For example, each firm could list a price excluding transport costs, which would have to be the same across countries, and also provide a list of transport costs across markets. In this case, country *j*'s imports from country *i* will depend to a large extent on how close the two countries are and the effect of distance could actually increase. The logic is that with imperfect competition and sunk costs, suppliers from several different countries could have entered a large market provided the sunk costs were not too different across countries. With the Internet, however, all exports should be drawn first from the closest market in order to reduce transport costs.[4] Only if the effect of distance is primarily in the fixed costs, will Internet technology definitely reduce the effect of distance on trade.

The possible effect of the Internet on distance and trade is illustrated in Figure 3. The solid line shows the initial relationship between distance and trade. As distance between two countries increases, trade tends to fall, all else equal. The removal of information costs about distant markets shifts out the distance-trade locus, suggesting that the Internet should reduce the effect of distance on trade. However, because transport costs can become more important, the slope of the line could increase, making the impact of distance on bilateral trade relatively higher.

This yields four predictions about how the Internet will affect trade flows. (i) Overall, trade will expand as the number of firms with access to the Internet increases. (ii) Access to the Internet reduces hysteresis. While trade in the first period and in the second period might be the same with the Internet, this would only be true if relative income and production remain unchanged. (iii) Countries that exported to a small number of countries before the Internet will have the greatest increase in trade. (iv) The effect of distance on trade flows will be reduced if distance mainly influences trade because of information and hence sunk costs. If distance affects trade because of transport costs then the effect of the Internet on this relationship is ambiguous.

The Internet also increases world welfare. Increased competition implies that world prices should fall and converge. Since all countries buy from the world market, prices must be identical; in addition, without the market-specific sunk cost, competition is more intense so prices must be lower. Firms that exported to a lot of countries in the past might lose because they are now forced to sell at a lower price. Similarly, countries that previously imported from only a few countries have a lot to gain in consumer surplus because the new price will be relatively lower. Since the

[4] For example, the oil market is imperfectly competitive and the market is clearly not segmented (there is a single world price), yet observed trade is determined almost entirely by location in order to reduce transport costs.

world price is lower than individual countries' prices had been, the gains must outweigh the losses worldwide.

The remainder of the paper tests some of the positive predictions of the model. Specifically, we first examine whether the development of the Internet has led to increased trade flows. Theory suggests that trade should expand because sunk costs associated with trade are reduced. Second, we explore whether the Internet has altered the effect of distance on trade. While public rhetoric has emphasized the death of distance, theory does not offer such a definite prediction with respect to its fate. Third, we examine whether the effect has been stronger for developing or industrialized countries. Theory suggests that countries with the fewest past trade linkages (most likely poor countries) have the most to gain from the Internet. And finally, we examine whether the Internet has reduced the importance of past linkages on trade flows. The development of global markets via the Internet implies that trade linkages should be less important.

3. Specification of the Gravity Equation of Trade

We use the gravity equation of trade to adjust for the standard determinants of trade. Gravity equations have been used extensively in the literature (see, for example, Deardorff (1995), McCallum (1995), Frankel, Stein and Wei (1995), Helliwell (1996), and Wei (1996)) as a means of empirically describing a "natural" pattern of trade based on the economic sizes (i.e. "mass") and geographic distances between countries. In addition, Deardorff (1998) has shown that a basic gravity specification can be derived from a number of theoretical trade models. The model in the previous section is also consistent with a gravity equation for trade—trade increases with the size of the foreign market and the size of the domestic economy (as measured by the number of firms in the model), and decreases with distance. The empirical fit of the gravity specification tends to be quite good, generally explaining between 60-70 percent of the cross section variance of trade volumes.

The gravity equation is fundamentally based on the underlying "gravitational" relationship

(9) $TOT_{ij} = \omega(GDP_i GDP_j / DIST_{ij}),$

where *TOT* is the total bilateral trading volume between countries *i* and *j*. Taking logs on both sides produces the specification

(10) $tot_{ij} = \beta_0 + \beta_1(gdp_i gdp_j) + \beta_2 dist_{ij} + \varphi i_{ij},$

where $gdp_i gdp_j$ is the log of the product of the GNP's of country *i* and *j*.

Slightly embellishing the basic specification as is common in the literature, we start by estimating the following equation:

(11)

$$tot_{ij} = \beta_0 + \beta_1(gdp_i gdp_j) + \beta_2(pop_i pop_j) + \beta_3 dist_{ij} + \beta_4 ADJ_{ij} + \beta_5 LANG + \beta_6 LINK + \beta_7 FTA + \varepsilon_{ij},$$

where $pop_i pop_j$ is the log of the product of the populations of country *i* and *j*, and ADJ, LANG, LINK, and FTA are dummy variables which take the value 1 for adjacent countries, country pairs which share a common language, countries which share some colonial linkages, and country pairs which are both members of a free trade area, respectively.

Finally, in order to estimate the effect of the Internet on trade, we include a measure of the "cybermass" of the two countries. The appropriate specification of the gravity equation is now

(12)
$$tot_{ij} = \beta_0 + \beta_1(gdp_i gdp_j) + \beta_2(pop_i pop_j) + \beta_3 dist_{ij} + \beta_4 ADJ_{ij} + \beta_5 LANG + \beta_6 LINK + \beta_7 FTA + \beta_8(cmass_i cmass_j) + \varepsilon_{ij},$$

where $(cmass_i cmass_j)$ denotes the log of the product of the cybermasses of countries *i* and *j*. If the Internet has a positive effect on trade then the coefficient on cybermass should be positive.

4. Data

To measure cybermass, we use data from the Internet Software Consortium (ISC) to count how many web hosts are attributed to each country by counting top-level host domain names. A top-level domain name is either an ISO country code or one of the generic domains (com/org/net/etc). However, this is certainly not an ideal measure. ISC notes that, "There is not necessarily any correlation between a host's domain name and where it is actually located. A host with a .NL domain name could easily be located in the U.S. or any other country. In addition, hosts under domains EDU/ORG/NET/COM/INT could be located anywhere. There is no way to determine where a host is without asking its administrator. ... In summary, it is not possible to determine the exact size of the Internet, where hosts are located, or how many users there are" (www.isc.org).

Thus the best we can hope for is that our measure of cybermass, which we call *HOST*, is at least somewhat correlated with the relative quantity of host sites in each country. However, even if a host site with, say, a Venezuelan top-level domain name is located in the USA, it is likely that the content of the web site is aimed Venezuelans. Thus the number of "Venezuelan" sites, regardless of physical location of the computers, should to a large extent reflect the "wiredness," or cybermass, of the country. In all of the specification reported in the paper, we do not attribute hosts under the domains *.org*, *.edu*, *.net*, *.com* or *.int* to any particular country.[5]

Because of the possible problems with the data noted above, we also use estimates of the number of Internet users in each country (as provided in the World Bank, World Development

[5] As the vast majority of sites with *.org, .edu, .net*, *.com* or *.int* domain names could be expected to reside in the United States, we expect the cybermass measure for this country to be biased downward. To check whether this particular bias could have an effect on the results, the analysis was repeated including a dummy variable for any country pair that included the US, interacted with our cybermass measure, *HOST_12*. While this interaction term was statistically significant (and negative) for 1996 and 1997 (but not for 1995), its inclusion in the regression did not significantly change any of the other results. We also redo the regressions assuming that 85 percent of these sites are in the United States (not reported). The results were very similar to the base case.

Indicators), as an alternative measure of cybermass. These data are available for 34 of the 56 countries in our sample.

Data on bilateral merchandise trade flows, GDP, and population are from the IMF. Data on geographic distances between countries was generously provided by Shang-Jin Wei who compiled them from Fitzpatrick and Modlin, *Direct Line Distances* (1986). Data on common linguistic heritage and colonial links were compiled from Rand McNally and Co., *Historical Atlas of the World* (1994) and are available from the author. Data on free trade areas come from the World Trade Organization web site (www.WTO.org).[6] All data were collected for 56 countries for the years 1995-1999.

Table 1 lists all of the countries included in the study. Summary statistics on the number of host sites by top-level domain name, for the 56 countries in the sample, are presented in the top panel of Table 2. Between 1995 and 1997 the number of such host sites approximately doubles each year. In 1998 and 1999 this exponential rate slows slightly, but is still quite high. The lower panel of Table 2 presents the same statistics for developing countries, defined as countries with 1995 per-capita income below $2,000.

[6] The FTAs included are the EU, NAFTA, Mercosur, ECO, Sparteca, Bangkok, ASEAN, EFTA, CEFTA, and the Tripartite agreement.

5. Discussion of the Results

Results from the baseline gravity equation, for 1995 to 1999, are reported in Columns (1) through (5) of Table 3. Columns (6) through (10) include the Internet variable, HOST. In 1995, HOST is not significant, but from 1996-1999, HOST is positive and statistically significant and appears to be increasing in importance as the Internet develops, with a slight drop-off in magnitude in 1999. The coefficient of 0.14 in 1999 suggests that a 10 percent increase in the number of hosts in one country would have led to about 1.4 percent greater trade.

Including the host variable in the Internet regression has a notable impact on the coefficients on GDP and population. This suggests that there is significant multicollinearity between the host variable and these variables, most likely because the number of Internet sites in a country is positively correlated with per-capita income, and GDP and population together capture per-capita income in the baseline gravity equation (log(GDP/POP)=logGDP-logPOP). This implies that our estimate of the coefficient on the Internet variable in Table 3 overestimates its true value, and should be interpreted as an upper bound of the effect of the Internet on trade.

To account for this possible upward bias, we include initial trade patterns from 1995 in the regression equation. Including past trade is important because the model shows that historical exports will be important in determining current exports if sunk costs are important. In addition, this lagged dependent variable will capture all of the country- and pair-specific unobservable characteristics that are time invariant (and a good deal of the time varying characteristics as long as these are changing relatively slowly). Including this variable therefore ensures that our HOST variable is not just picking up the effects of some inherent country traits, such as relative wealth.

Table 4 reports the results when 1995 trade is included in the regression equation for other years. As expected, the statistical significance of population, distance and some other control variables are not longer robust across all time periods. However the HOST variable remains positive and robustly statistically significant from 1996 to 1999.[7] Not surprisingly, the coefficient falls somewhat when past trade is included. The coefficient of 0.043 in 1999, in combination with the coefficient on past trade of 0.515, implies that a 10 percent increase in hosts in one country would have led to about 0.9 percent (0.043/(1-0.515)=0.09) higher trade. This is our preferred estimate of the effect of the Internet on international trade.

In contrast to the coefficients on population and GDP, the effect of distance on trade changes only slightly when HOST is included in the regression equation. In the baseline gravity equation, as shown in the first five columns of Table 3, the coefficient on distance falls slightly over time. When the host variable is included in the regression equation, as shown in the next five columns, the coefficient on distance becomes more stable, providing some evidence that the Internet has reduced the way in which distance impacts trade. This marginal effect could be because it is too early to find more substantial evidence of a decline in the importance of distance.[8] Alternatively, as the model suggests, it could be that distance affects trade primarily through transport costs, not information.[9]

There could be a legitimate concern about the direction of causality between *HOST* and trade flows. Rather than increased Internet usage spurring more trade, it is possible that countries that

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[7] The model also suggests that the Internet should reduce hysteresis in trade. To test this we include an interaction term of the host variable and past trade. The coefficient has the expected negative sign, indicating that in countries with more Internet hosts, past trade does not have as much explanatory power. While these results (not reported) always had the expected sign, they were not always significant at a standard level.

[8] We also try interacting distance with the host variable (not reported) and the sign and significance were not robust across time and across different specifications.

[9] However our results are not conclusive in this regard. In particular, Portes and Rey (1999) find that distance still has an important (negative) impact on international equity flows despite the fact that they are "weightless" and thus do not

trade a lot have greater incentive to launch web initiatives to facilitate that trade. Although we cannot completely control for this possibility, in Table 5 we use two- and four- year lagged values of *HOST* instead of the contemporaneous variable.[10] The results show that the lagged HOST variable is not statistically significant in 1996 in the regression, indicating that the Internet had no or very little systematic effect on trade flows during this time period. The lagged values are significant from 1997 onward. The coefficient in 1999, of 0.09 suggests that a 10 percent increase in the number of hosts in one country would have led to about 0.9 percent more trade in 1999.

The results suggest that during 1995 the Internet had no significant effect on international trade patterns. In 1996 there is some weak evidence of a small effect, but this result disappears with the use of lagged values of HOST. However, by 1997 there is increasing evidence that the Internet is indeed having an impact. The positive and statistically significant effect of the Internet on trade continues through 1998 and 1999. In addition, the fact that these effects remain statistically significant for lagged values of HOST is a strong indication that the direction of causality runs from Internet host sites to trade, rather than the reverse.

In Table 6 we examine whether the impact of the Internet on trade is similar for both industrialized and developing countries. We disaggregate the effect of *HOST* into country pairs of two rich countries (*HOST*_RR), of one rich and one poor (*HOST*_RP), and of two poor countries (*HOST*_PP), where "rich" is defined as a country with per-capita GDP above $2000 in 1995. We do not find a statistically significant effect for any of the groups in 1995, a result consistent with the previous analysis. In 1996, however, we find small but statistically significant effects for pairs of rich countries (although this is significant only at 5 percent level) and rich-poor country pairs,

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entail transport costs in the traditional sense. Using telephone call traffic and international bank branches to proxy for information transmission, their results suggest that distance could be proxying for informational asymmetries.

[10] We use two-year lag because the data on hosts is less likely to persistent on a two year horizon than a one year horizon. We also try various different lag lengths, and the results were qualitatively similar.

but none for poor-poor country pairs. In 1997 the coefficients for the rich-rich and rich-poor country pairs grows in magnitude and statistical significance. Significantly, the coefficient on the poor-poor country pairs is also now significant and its magnitude is not statistically different from the latter two groups. In 1998 the number of host sites in poor-poor country pairs has an even greater impact, both in magnitude and in statistical significance, than either the rich-poor or even the rich-rich country pairs. By 1999 this pattern has further solidified: we see the smallest effect for rich-rich pairs, and intermediate effect for rich-poor pairs and the largest impact on poor-poor country trading partners.

Theory suggests that the Internet should diminish the importance of past linkages on trade flows. In Table 7 we explore this hypothesis by including two interaction terms, HOST with language and HOST with our colonial links variable. If the Internet is making old linkages less important then the interaction terms should be negative. However, the Internet could make the effect of language on trade flows more important if countries with the same language are more likely to access each others web sites. Alternatively, if most businesses are using a single language in web products (eg. English), the Internet should tend to reduce the importance of this bilateral linkage. In 1997-1999, the interaction with LINK takes the expected negative sign but is not statistically significant (note however that LINK also becomes statistically insignificant). Our interaction variable with LANGUAGE is also negative, and is consistently statistically significant in all the years. These results suggest that the Internet is indeed starting to break down old ties (i.e. favoring partners who share one's language), although the overall results also suggest that it is still very early in this process.

The results presented in Tables 3-7 show a clear pattern of increasing importance of the Internet in determining general trade patterns, especially among poorer countries. However, theory focuses on the effect of access to the Internet on the exporters. If exporters pay sunk costs to enter a new market and the Internet removes these costs, then number of firms with Internet access—measured as the number of hosts—should have a greater impact on exports than on imports. In Tables 8-9 we re-do the analysis using exports only, rather than total trade. For these regressions we distinguish between the country of origin (country *i*) and the country of destination (country *j*) in the analysis. Table 8 presents the exports-only gravity equation for 1995 to 1999. The results show a pattern broadly consistent with those from the more general analysis. In particular, in each year we find the impact of the Internet on the exporting country to be significantly greater than for the importing country, and the coefficients for the importing country are not statistically significant until 1997. For both the exporter and importer the impact of the Internet is increasing over time. As in the general total trade results from Table 3, the coefficient estimates fall slightly in 1999 but are still highly statistically significant. The coefficients from 1999 can be interpreted as implying that a relative increase of 10 percent in domestic hosts would lead to about a 2.6 percent increase in exports, and about a 1 percent increase in imports.

In Table 9 we repeat the export-only gravity estimation, but separate out the HOST variable into rich and poor countries in order to investigate whether the Internet is having a differential effect on developing countries. Again the pattern is broadly consistent with previous results, with HOST playing a more important role in determining exports and having a greater effect in poor countries, for imports as well as for exports. The statistical significance of the results for exports in poor countries in not particularly robust in 1995 and 1996, but from 1997 onwards HOST has a significant effect at the 1 percent level of confidence.

6. Sensitivity Analysis

In order to examine the robustness of our results we redo the analysis in a number of ways. First, we run a panel estimation with country-pair fixed effects. Second, we re-estimate the basic specification using Tobit analysis. Third, we estimate the basic gravity equation using an alternative measure of cybermass—the number of Internet users. Finally, we estimate the results on trade openness, as opposed to bilateral trade flows.

First, we estimate a panel regression with country-pair fixed effects. The advantage of this specification is that we remove all of the variation that is a result of fixed-country characteristics, such as distance, preferences, or technology. The disadvantage is that to the extent that the Internet affects trade with a lag, or that relative hosts are changing slowly, this specification will tend to underestimate its effect. In addition, because the trade data is in nominal terms, movements in the observed value of trade may at times be uncorrelated with movements in real trade.

The results are reported in Table 10. The first column shows the results when we include country-pair fixed effects and the host variable. The second column shows the results controlling for both country-pair fixed effects and GDP; we include GDP because it is the only gravity variable that is changing significantly over the time period. These results imply that the magnitude of the effect of the Internet on the time-series variation in trade is smaller than its effect on cross-sectional variation. In particular, in the second half of the 1990s, a 10 percent increase in the number of web hosts in one country would have led to about a 0.3 percent increase in trade.[11] The third column shows the results when we disaggregate the effect of host variable into its value in 1995-1996 and its value in 1997-1999. Again, we find that the host variable only helps to explain the variation in the later years.

[11] Using first differences produces broadly similar estimates.

Second, to take into account of the limited nature of the dependent variable, we re-estimate the results using Tobit analysis.[12] The results are reported in Table 11. They show that our results are robust to this alternative estimation technique.

Next, we use an alternative measure of cybermass—Internet users—to ensure that we are indeed picking up an effect of the Internet. This data (from the World Bank, World Development Indicators) is available for 34 countries of our 56 countries, so the dataset is somewhat smaller. The results are reported in Table 12. They show a similar pattern to the one noted above. There is little evidence of an effect of the Internet on trade in 1995 and 1996, with a greater impact in the next three years.

And finally, we use data on aggregate trade openness. Owing to network externalities the Internet is likely to have the greatest effect on bilateral trade in cases where both countries have significant Internet penetration. Still, it is worthwhile to see if we can find any effect of the Internet on the aggregate trade of the countries in our sample. If we fail to find an impact, this suggests that the relationship we are picking up in bilateral trade is primarily trade reorienting; the Internet has led countries with high Internet intensity to shift some trade to other high-intensity countries.

The results are reported in Table 13. The dependent variable is the natural logarithm of total trade relative to GDP, ROWGDP is the natural logarithm of rest-of-the-world GDP, and REMOTE is a distance-weighted measure of other countries GDP. The results are consistent with our previous analyses in that we fail to find any statistically significant impact of the Internet in the earlier years of the sample. These results do show that the Internet has led to increased openness in recent years. The coefficient of 0.05 on host in 1999, implies that a relative doubling of hosts leads

[12] We also try dropping the zeros, which had very little effect on the estimated coefficients and improved the R-squared slightly.

to a 5 percent increase in openness. This suggests that the Internet has contributed to overall trade growth.

7. Alternative Explanations

The previous section has shown that there is significant empirical evidence of a correlation between increased Internet usage and trade, especially in 1998 and 1999. These results show that the effect is particularly strong for poor countries, and that Internet usage and has reduced the importance of past linkages in explaining trade patterns. We have interpreted this as consistent with our theoretical model presented in section 2, but there could be alternative explanations of the observed correlation. We have directly addressed the question of endogeneity by including lagged Internet measures in the analysis. In particular, we find that the variation in host sites in 1995 is not significant in explaining trade in that year, however, the 1995 host variable is significant in explaining some of the observed trade patterns in later years. This suggests that the Internet has affected trade flows.

A second possible objection to our interpretation is that the Internet HOST measure could be proxying for some other unknown factor that is associated with trade as well as with the Internet, but that the Internet itself does not affect trade. For example, it could be that countries with more Internet hosts trade more because a growing amount of trade is in high-tech products like telecommunications equipment and other technology related products. In this case, countries with relatively more hosts would trade more, simply because they produce and consume a lot of high-tech products. As our data is not disaggregated by commodity we cannot directly rule out this possibility. Nevertheless, the results are not consistent with this particular interpretation. It is reasonable to assume that the countries leading the trade in high-tech goods would be the more developed nations. If our Internet data were simply a proxy for high-technology trading countries, then we would expect to find the strongest results for the richer countries and less or none for the developing countries, the opposite of our actual results. In addition, by 1995 and 1996, countries had already been producing high-tech products for many years, so it would seem unlikely that the Internet variable would be insignificant in those years if the variable is only picking up high-tech trade. Finally, as shown in Table 10, the statistical significance of our HOST variable is robust to the inclusion of country-pair fixed effects, which control for unobservable preferences and other characteristics.

Similarly, countries with more hosts might also have similar tastes and therefore these countries trade more, or the Internet could be proxying for the effect of developed infrastructure on trade. Again, while it is impossible to completely rule out an omitted variable bias, our results are not consistent with these latter hypotheses. In particular, if the presence of Internet sites were in fact just a proxy for similar tastes or better infrastructure then we would expect to see statistically significant and relatively similar results across the sample period. We find no evidence of an effect of the Internet on trade in 1995, only very weak evidence in 1996, and much larger impacts in subsequent years, indicating that we are capturing an effect which has strengthened over time and is not a proxy for some country time-invariant (at least over a 5 year period) characteristics. In addition, the statistical significance of our HOST variable is robust to the inclusion of a lagged dependent variable and country-pair fixed effects, both of which should control for unobservable preferences and other characteristics.

8. Conclusions

This paper has presented a theoretical model of the impact of the Internet on international trade. The theory produces a number of specific implications; first, it suggests that trade should expand because sunk costs associated with trade are reduced. Second, the development of global markets via the Internet implies that historical linkages should be less important. Third, countries with the fewest past trade linkages (most likely the poor countries) have the most to gain from the Internet. Finally, while public rhetoric has emphasized the "death of distance", the theory does not offer such a definite prediction with respect to its fate.

Using recent trade and Internet data we estimate a series of gravity equations that strongly support the predictions of the model. We find no robust relationship between the Internet and total trade in 1995 and 1996; from 1997 onwards, the Internet shows a positive, increasing and statistically significant impact on the global pattern of trade flows. We find little evidence that the Internet has affected the relationship between distance and trade, suggesting that transport costs play a more important role than information costs in determining trade patterns. As predicted by the model, the effect of the Internet is felt primarily through exports, and those countries with relatively more Internet presence also display less dependence on historical determinants of trade such as a common language. Perhaps more importantly, the results suggest that the benefits of the Internet may accrue disproportionately to poorer countries.

Our results reinforce the importance of policies aimed at reducing the "digital divide" between industrialized and developing countries. We have shown systematic and statistically significant evidence that increased Internet access can have positive effects on the exports of poorer countries, and our theoretical model strongly suggests that these movements should be welfare enhancing. If developing countries are limited in their access to the World Wide Web they will not be able to take advantage of the benefits accruing to wealthier countries, and the rise of Net will therefore be associated in increased global inequality. On the other hand, we have argued that given sufficient access to the Internet, the overall effect of the web should be to lessen historically determined inequalities in trading patterns and to increase export opportunities for developing countries, thus reducing global inequality.

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Figure 1: Trade with Sunk Costs

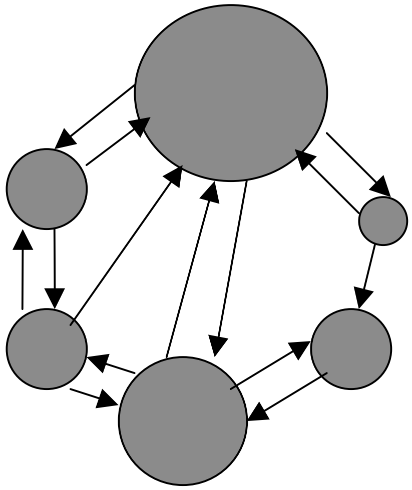

Figure 2: Trade with the Internet

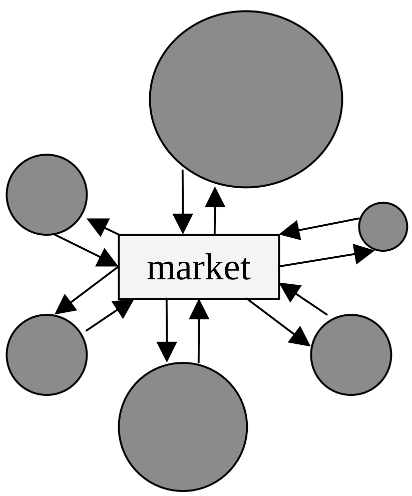

Figure 3: The Internet, Trade, and Distance

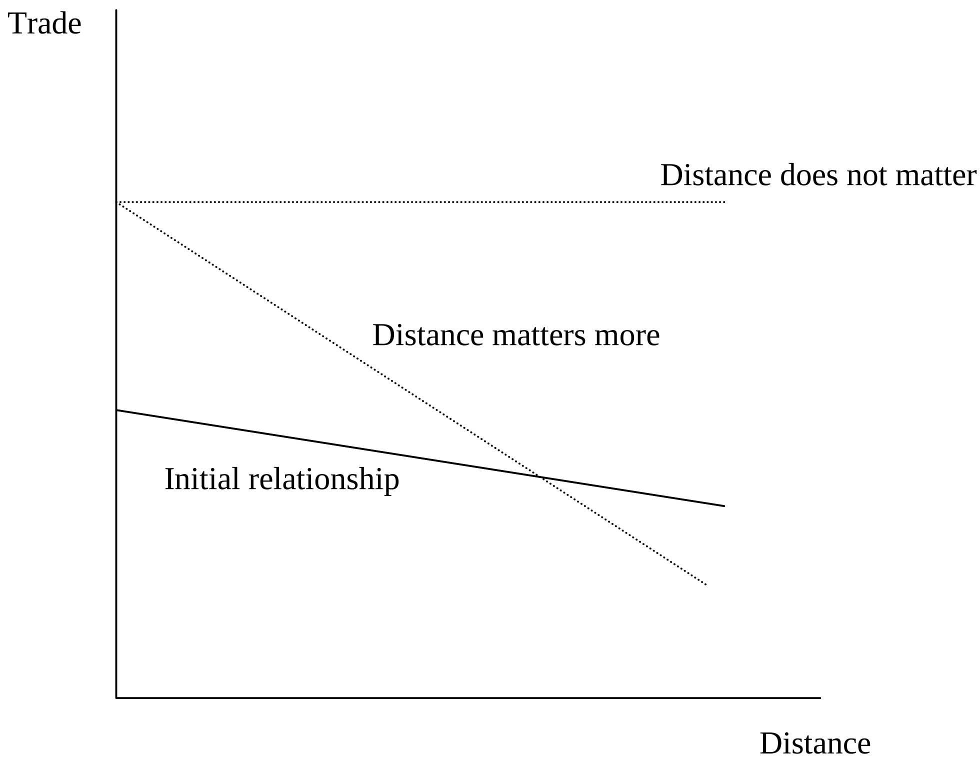

Table 1: List of Countries

Algeria	Kenya
Argentina	Kuwait
Australia	Malaysia
Austria	Mexico
Belgium	Morocco
Bolivia	Netherlands
Brazil	New Zealand
Canada	Norway
Chile	Pakistan
China	Paraguay
Colombia	Peru
Denmark	Philippines
Ecuador	Poland
Egypt	Portugal
Finland	Saudi Arabia
France	Singapore
Germany	South Africa
Greece	South Korea
Hong Kong	Spain
Hungary	Sweden
Iceland	Switzerland
India	Thailand
Indonesia	Tunisia
Iran	Turkey
Ireland	United Kingdom
Israel	United States
Italy	Uruguay
Japan	Venezuela

Table 2: Summary Statistics for Host Sites by Country Top-Level Domain Names

All Countries					
Year	N	Mean	Std Dev	Minimum	Maximum
1995	56	29770.64	54367.70	0	241191
1996	56	63456.91	112886.26	0	452997
1997	56	114035.04	193965.52	0	734406
1998	56	191086.11	329857.61	17	1226568
1999	56	266346.20	460465.73	25	1718935

Less Developed Countries					
Year	N	Mean	Std Dev	Minimum	Maximum
1995	13	150.23	190.20	0	569
1996	13	674.77	851.84	0	2351
1997	13	3114.77	5644.49	28	19739
1998	13	4637.46	6233.80	17	16930
1999	13	6501.62	7505.33	25	18538

Source: Internet Software Consortium (http://www.isc.org/)

Table 3: Gravity Model of Trade

	Dependent Variable: Log(Total Trade Volume)									
	1995 (1)	1996 (2)	1997 (3)	1998 (4)	1999 (5)	1995 (6)	1996 (7)	1997 (8)	1998 (9)	1999 (10)
Constant	5.157** (5.90)	5.511** (5.84)	3.948** (3.72)	4.395** (5.58)	4.497** (5.55)	4.772** (3.70)	3.257* (2.22)	0.713 (0.45)	-0.688 (-0.59)	-0.047 (-0.04)
GDP_{ij}	1.194** (36.21)	1.217** (35.59)	1.196** (35.56)	1.165** (36.00)	1.191** (37.22)	1.173** (21.85)	1.090** (17.42)	1.003** (16.38)	0.863** (15.45)	0.925** (17.12)
POP_{ij}	-0.125** (-4.40)	-0.157** (-5.24)	-0.124** (-4.13)	-0.123** (-4.77)	-0.125** (-4.53)	-0.111** (-2.61)	-0.081 (-1.75)	-0.018 (-0.40)	0.041 (1.16)	0.019 (0.52)
DIST	-0.892** (-17.36)	-0.850** (-13.47)	-0.768** (-10.46)	-0.771** (-14.73)	-0.818** (-14.54)	-0.893** (-17.34)	-0.861** (-13.57)	-0.814** (-11.32)	-0.856** (-16.12)	-0.900** (-16.24)
ADJ	0.550** (2.73)	0.507* (2.42)	0.383 (1.16)	0.542** (2.84)	0.547** (2.83)	0.560** (2.75)	0.536* (2.55)	0.371 (1.17)	0.540** (2.82)	0.504** (2.61)
LANG	1.008** (7.78)	1.135** (8.41)	1.053** (7.22)	0.959** (7.48)	0.995** (7.24)	1.000** (7.73)	1.110** (8.26)	0.984** (7.13)	0.870** (6.86)	0.894** (6.59)
LINK	0.530* (2.34)	0.552* (2.44)	0.561** (2.56)	0.511* (2.37)	0.456* (2.01)	0.533* (2.35)	0.565** (2.56)	0.576** (2.65)	0.517* (2.34)	0.484* (2.08)
FTA	0.076 (0.60)	0.161 (1.14)	0.385* (2.26)	0.273* (1.99)	0.303* (2.18)	0.070 (0.55)	0.131 (0.93)	0.261 (1.64)	0.068 (0.52)	0.124 (0.93)
$HOST_{ij}$						0.009 (0.43)	0.059* (2.12)	0.103** (3.28)	0.161** (5.82)	0.144** (5.33)
No. Obs.	1515	1507	1507	1535	1537	1515	1507	1507	1535	1537
R-square	0.6756	0.6506	0.6320	0.6956	0.7025	0.6757	0.6520	0.6381	0.7090	0.7110

Please note: heteroskedasticity-consistent t-statistics in parentheses.
** indicates statistical significance at 1%, and * at 5%

Table 4: Gravity Model Including Initial Conditions

	Dependent variable: Log(Total Trade Volume)			
	1996	1997	1998	1999
	(1)	(2)	(3)	(4)
Constant	-0.448	-2.689*	-0.050	1.162
	(-0.58)	(-2.27)	(-0.08)	(1.58)
GDP_{ij}	0.097*	0.127*	0.331**	0.446**
	(2.11)	(2.15)	(5.65)	(8.04)
POP_{ij}	0.010	0.064*	0.025	-0.008
	(0.43)	(2.17)	(1.16)	(-0.32)
DIST	-0.082	-0.081	-0.349**	-0.423**
	(-1.61)	(-1.23)	(-8.39)	(-9.27)
ADJ	0.049	-0.021	0.185*	0.116
	(0.62)	(-0.08)	(2.06)	(1.22)
LANG	0.241**	0.331**	0.401**	0.438**
	(5.01)	(4.14)	(5.83)	(5.51)
LINK	0.099*	0.128	0.222*	0.187
	(2.05)	(1.56)	(2.05)	(1.61)
FTA	0.094	0.228*	0.072	0.125
	(1.35)	(2.04)	(1.11)	(1.71)
$HOST_{ij}$	0.032**	0.063**	0.071**	0.043**
	(2.82)	(3.20)	(4.02)	(2.56)
$TRADE_{ij}$ _95	0.860**	0.766**	0.542**	0.515**
	(23.03)	(16.52)	(13.14)	(12.00)
No. Obs.	1507	1507	1512	1514
R-squared	0.8854	0.8299	0.8522	0.8376

Please note: heteroskedasticity-consistent t-statistics in parentheses.
** indicates statistical significance at 1%, and * at 5%.

Table 5: Gravity Model of Trade, Lagged Host

	Dependent Variable: Log(Total Trade Volume)				
	1996[a]	1997	1998	1999	1999
	(1)	(2)	(3)	(4)	(5)
Constant	4.007**	-0.008	-1.464	1.939	0.481
	(2.90)	(-0.00)	(-1.23)	(1.83)	(0.40)
GDP_{ij}	1.133**	0.978**	0.821**	1.031**	0.959**
	(20.51)	(15.49)	(14.32)	(22.24)	(19.98)
POP_{ij}	-0.102*	0.019	0.079*	-0.038	0.026
	(-2.28)	(0.37)	(2.04)	(-1.13)	(0.65)
DIST	-0.854**	-0.773**	-0.812**	-0.867**	-0.839**
	(-13.53)	(-10.68)	(-15.32)	(-15.49)	(-14.96)
ADJ	0.546**	0.485	0.602**	0.512**	0.620**
	(2.56)	(1.53)	(3.16)	(2.68)	(3.14)
LANG	1.101**	0.990**	0.943**	0.936**	0.928**
	(8.19)	(7.03)	(7.30)	(6.96)	(6.81)
LINK	0.564*	0.585**	0.545**	0.473*	0.489*
	(2.52)	(2.66)	(2.58)	(2.10)	(2.14)
FTA	0.138	0.319*	0.165	0.193	0.223
	(0.98)	(1.97)	(1.25)	(1.43)	(1.64)
$HOST_{ij}(-2)$	0.034	0.087**	0.159**	0.086**	
	(1.62)	(3.46)	(6.23)	(4.21)	
$HOST_{ij}(-4)$					0.093**
					(4.99)
No. Obs.	1507	1507	1535	1537	1537
R-squared	0.6513	0.6369	0.7085	0.7071	0.7087

Please note: heteroskedasticity-consistent t-statistics in parentheses.
** indicates statistical significance at 1%, and * at 5%
a. HOST is lagged only one year in this regression.

Table 6: Gravity Model of Trade, the Net's Effect on Rich and Poor Countries

	Dependent Variable: Log(Total Trade Volume)				
	1995	1996	1997	1998	1999
	(1)	(2)	(3)	(4)	(4)
Constant	5.702**	3.266*	1.207	0.913	2.688
	(3.94)	(2.07)	(0.70)	(0.65)	(1.77)
GDP_{ij}	1.207**	1.091**	1.024**	0.927**	1.029**
	(20.97)	(17.23)	(15.48)	(13.98)	(16.87)
POP_{ij}	-0.152**	-0.083	-0.040	-0.030	-0.104*
	(-2.98)	(-1.61)	(-0.76)	(-0.61)	(-2.03)
DIST	-0.887**	-0.858**	-0.811**	-0.840**	-0.875**
	(-17.13)	(-13.61)	(-11.27)	(-15.75)	(-15.88)
ADJ	0.596**	0.564**	0.390	0.586**	0.593**
	(2.87)	(2.68)	(1.23)	(3.04)	(2.99)
LANG	1.020**	1.109**	0.992**	0.919**	0.985**
	(7.76)	(8.21)	(7.15)	(7.07)	(7.03)
LINK	0.506*	0.540*	0.558**	0.490*	0.442
	(2.25)	(2.48)	(2.60)	(2.25)	(1.93)
FTA	0.080	0.162	0.270	0.084	0.126
	(0.61)	(1.13)	(1.67)	(0.64)	(0.95)
$HOST_{ij}$ _RR	0.007	0.058*	0.101**	0.155**	0.141**
	(0.35)	(2.10)	(3.23)	(5.54)	(5.22)
$HOST_{ij}$ _RP	0.025	0.067*	0.109**	0.172**	0.169**
	(1.05)	(2.21)	(3.37)	(6.21)	(6.05)
$HOST_{ij}$ _PP	0.033	0.031	0.104**	0.178**	0.189**
	(0.65)	(0.62)	(2.57)	(5.52)	(5.78)
No. Obs.	1515	1507	1507	1535	1537
R-squared	0.6764	0.6528	0.6383	0.7104	0.7150

Please note: heteroskedasticity-consistent t-statistics in parentheses.
** indicates statistical significance at 1%, and * at 5%.

Table 7: Gravity Model with LINK Interaction Terms

	Dependent Variable: Log(Total Trade Volume)				
	1995	1996	1997	1998	1999
	(1)	(2)	(3)	(4)	(4)
Constant	4.403**	2.684	0.510	-1.014	-0.266
	(3.36)	(1.78)	(0.32)	(-0.86)	(-0.21)
GDP_{ij}	1.181**	1.095**	1.028**	0.884**	0.956**
	(22.00)	(17.53)	(16.81)	(15.71)	(17.50)
POP_{ij}	-0.111**	-0.078	-0.028	0.033	0.007
	(-2.61)	(-1.69)	(-0.63)	(0.94)	(0.19)
DIST	-0.872**	-0.835**	-0.787**	-0.823**	-0.865**
	(-16.81)	(-13.05)	(-10.78)	(-15.33)	(-15.49)
ADJ	0.559**	0.547**	0.382	0.539**	0.501**
	(2.90)	(2.77)	(1.24)	(2.97)	(2.77)
LANG	2.494**	3.478**	4.108**	4.080**	4.783**
	(6.40)	(6.77)	(6.26)	(6.12)	(6.27)
LINK	-0.100	-0.720	0.967	2.209	1.806
	(-0.08)	(-0.44)	(0.50)	(1.25)	(0.86)
FTA	0.078	0.134	0.275	0.097	0.156
	(0.62)	(0.97)	(1.74)	(0.74)	(1.18)
$HOST_{ij}$	0.015	0.071*	0.106**	0.165**	0.145**
	(0.71)	(2.47)	(3.35)	(5.93)	(5.35)
$HOST_{ij}$*LANG	-0.096**	-0.135**	-0.159**	-0.156**	-0.180**
	(-4.01)	(-4.94)	(-5.09)	(-5.06)	(-5.39)
$HOST_{ij}$*LINK	0.042	0.072	-0.017	-0.075	-0.056
	(0.53)	(0.84)	(-0.18)	(-0.91)	(-0.60)
No. Obs.	1515	1507	1507	1535	1537
R-squared	0.6773	0.6546	0.6404	0.7117	0.7140

Please note: heteroskedasticity-consistent t-statistics in parentheses.
** indicates statistical significance at 1%, and * at 5%.

Table 8: Exports Gravity Model of Trade
***i* = country of origin**
***j* = destination country**

	Dependent Variable: Log(Exports from i to j)				
	1995	1996	1997	1998	1999
	(1)	(2)	(3)	(4)	(5)
Constant	3.557**	2.934*	-0.367	-3.757**	-1.837
	(3.22)	(2.14)	(-0.31)	(-3.38)	(-1.65)
GDP[i]	1.209**	1.143**	1.066**	0.831**	0.904**
	(17.95)	(12.97)	(14.16)	(11.64)	(13.72)
GDP[j]	1.211**	1.159**	1.007**	0.934**	1.006**
	(19.94)	(16.13)	(16.17)	(14.97)	(16.01)
POP[i]	-0.070	-0.096	-0.004	0.125**	0.110*
	(-1.33)	(-1.50)	(-0.07)	(2.73)	(2.36)
POP[j]	-0.110*	-0.058	-0.004	0.032	-0.036
	(-2.32)	(-1.06)	(-0.10)	(0.73)	(-0.82)
DIST	-1.037**	-1.074**	-0.943**	-0.915**	-1.003**
	(-21.59)	(-20.48)	(-17.60)	(-15.66)	(-18.13)
ADJ	0.497**	0.325	0.306	0.489	0.530**
	(2.94)	(1.58)	(1.38)	(1.58)	(3.19)
LANG	1.230**	1.390**	1.138**	1.122**	1.105**
	(11.12)	(11.87)	(10.44)	(7.65)	(9.82)
LINK	0.669**	0.688**	0.671**	0.591**	0.583**
	(3.58)	(3.63)	(3.90)	(2.96)	(2.97)
FTA	0.075	0.004	0.188	-0.493*	0.087
	(0.68)	(0.03)	(1.56)	(-2.29)	(0.65)
HOST[i]	0.084**	0.154**	0.164**	0.319**	0.259**
	(3.15)	(4.05)	(4.31)	(8.82)	(7.55)
HOST[j]	-0.029	0.002	0.084**	0.099**	0.096**
	(-1.23)	(0.06)	(2.92)	(3.42)	(3.23)
No. Obs.	3035	3023	3023	3073	3075
R-squared	0.6003	0.5807	0.6078	0.5756	0.6307

Please note: heteroskedasticity-consistent t-statistics in parentheses.
** indicates statistical significance at 1%, and * at 5%.

Table 9: Exports Gravity Model of Trade, 1995-1998,
The Net's Effect on Rich and Poor Countries
***i* = country of origin**
***j* = destination country**

Dependent Variable: Log (Exports from i to j)					
	1995 (1)	1996 (2)	1997 (3)	1998 (4)	1999 (5)
Constant	4.801** (3.38)	1.214 (0.80)	0.799 (0.58)	-2.292 (-1.68)	2.352 (1.66)
GDP[i]	1.213** (15.80)	1.014** (11.79)	1.135** (14.34)	0.933** (11.83)	1.114** (14.72)
GDP[j]	1.291** (17.66)	1.156** (14.11)	1.032** (14.45)	0.949** (12.39)	1.114** (15.05)
POP[i]	-0.075 (-1.06)	0.047 (0.69)	-0.078 (-1.26)	0.017 (0.27)	-0.129 (-1.92)
POP[j]	-0.201** (-3.05)	-0.055 (-0.80)	-0.030 (-0.51)	0.017 (0.26)	-0.157* (-2.54)
DIST	-1.035** (-21.53)	-1.084** (-20.70)	-0.940** (-17.57)	-0.905** (-15.49)	-0.977** (-17.67)
ADJ	0.511** (2.98)	0.300 (1.47)	0.319 (1.43)	0.515 (1.65)	0.625** (3.59)
LANG	1.245** (11.14)	1.349** (11.44)	1.155** (10.53)	1.159** (7.78)	1.222** (10.40)
LINK	0.680** (3.63)	0.689** (3.57)	0.669** (3.93)	0.590** (2.95)	0.578** (2.91)
FTA	0.068 (0.61)	0.012 (0.09)	0.173 (1.43)	-0.507* (-2.36)	0.032 (0.24)
HOST[i]_R	0.083** (2.99)	0.168** (4.50)	0.162** (4.25)	0.309** (8.50)	0.247** (7.14)
HOST[i]_P	0.086* (2.47)	0.078 (1.55)	0.202** (4.66)	0.357** (8.91)	0.353** (9.01)
HOST[j]_R	-0.044 (-1.80)	0.002 (0.07)	0.083** (2.89)	0.098** (3.30)	0.089** (2.95)
HOST[j]_P	0.031 (0.90)	0.002 (0.04)	0.096** (2.73)	0.104** (3.27)	0.141** (4.29)
No. Obs.	3035	3023	3023	3073	3075
R-squared	0.6011	0.5823	0.6083	0.5763	0.6360

Please note: heteroskedasticity-consistent t-statistics in parentheses.
** indicates statistical significance at 1%, and * at 5%

Table 10: Panel Analysis (1995-1999)

Dependent Variable: Log(Total Trade Volume)			
	Country-Pair Fixed Effects		
	(1)	(2)	(3)
GDP_{ij}		0.265**	0.334**
		(2.87)	(3.61)
$HOST_{ij}$	0.029**	0.025**	
	(5.43)	(4.81)	
HOST95-96			0.008
			(1.08)
HOST97-99			0.013*
			(2.00)
No. Obs.	7601	7601	7601
R-Squared	0.92	0.92	0.92

Please note: heteroskedasticity-consistent t-statistics in parentheses.
** indicates statistical significance at 1%, and * at 5%

Table 11: Tobit Analysis

	Dependent Variable: Log(Total Trade Volume)				
	1995	1996	1997	1998	1999
	(1)	(2)	(3)	(4)	(5)
Constant	6.53**	5.21**	3.79**	1.43	1.58*
	(7.92)	(5.82)	(4.81)	(1.86)	(1.98)
GDP_{ij}	1.11**	1.05**	1.01**	0.87**	0.90**
	(31.29)	(26.29)	(30.36)	(26.14)	(25.54)
POP_{ij}	-0.15**	-0.11**	-0.07**	0.00	0.00
	(-5.38)	(-3.87)	(-3.01)	(0.08)	(0.07)
DIST	-0.83**	-0.82**	-0.81**	-0.81**	-0.87**
	(-18.80)	(-17.88)	(-17.30)	(-18.21)	(-18.34)
ADJ	0.54**	0.47**	0.42*	0.50**	0.45*
	(2.84)	(2.38)	(2.13)	(2.62)	(2.37)
LANG	0.83**	0.93**	0.81**	0.78*	0.79**
	(6.04)	(6.47)	(5.62)	(5.66)	(5.73)
LINK	0.57**	0.58*	0.60*	0.55*	0.51*
	(2.26)	(2.18)	(2.23)	(2.14)	(1.99)
FTA	0.18	0.19	0.24	0.18	0.22
	(1.35)	(1.35)	(1.70)	(1.30)	(1.57)
$HOST_{ij}$	-0.02	0.02	0.04**	0.10**	0.10**
	(-1.41)	(1.20)	(3.04)	(7.17)	(6.37)
No. Obs.	1515	1507	1507	1535	1537
Log-liklihood	-2409.7	-2454.8	2470.7	2440.8	2439.3

Please note: heteroskedasticity-consistent t-statistics in parentheses.
** indicates statistical significance at 1%, and * at 5%

Table 12: Total Trade Regressions with User Data

	Dependent Variable: Log(Total Trade Volume)				
	1995	1996	1997	1998	1999
	(1)	(2)	(3)	(4)	(5)
Constant	8.55**	10.20**	8.49**	3.56*	4.55*
	(4.41)	(4.90)	(4.75)	(1.96)	(2.24)
GDP_{ij}	1.00**	1.05**	0.88**	0.43**	0.61**
	(10.09)	(8.68)	(8.13)	(3.45)	(4.19)
POP_{ij}	-0.14*	-0.20**	-0.14*	-0.01	-0.06
	(-2.38)	(-2.88)	(-2.35)	(-0.24)	(-1.02)
DIST	-1.07**	-1.13**	-1.09**	-0.96**	-1.00**
	(-10.43)	(-10.93)	(-11.44)	(-10.38)	(-10.93)
ADJ	0.51	0.28	0.31	0.45	0.40
	(1.90)	(1.00)	(1.14)	(1.72)	(1.47)
LANG	0.98**	1.07**	0.77**	1.01**	0.94**
	(5.03)	(5.47)	(4.28)	(5.07)	(4.58)
LINK	0.96*	0.85*	0.77*	0.37	0.47
	(2.33)	(2.13)	(2.20)	(1.01)	(1.22)
FTA	0.40	0.39	0.39	0.61*	0.61
	(0.39)	(1.34)	(1.39)	(2.07)	(1.95)
$USER_{ij}$	0.14*	0.12	0.22**	0.52**	0.42**
	(2.18)	(1.54)	(2.86)	(5.58)	(3.99)
No. Obs.	555	551	551	559	559
R-squared	0.68	0.69	0.73	0.75	0.77

Please note: heteroskedasticity-consistent t-statistics in parentheses.
** indicates statistical significance at 1%, and * at 5%

Table 13: Aggregate Trade Results

	Dependent Variable: Log(Aggregate Trade/GDP)				
	1995	1996	1997	1998	1999
	(1)	(2)	(3)	(4)	(5)
Constant	-160.12**	-164.08**	-169.62**	-222.81**	-212.08**
	(-4.27)	(-3.79)	(-2.61)	(3.24)	(-3.57)
ROWGDP	5.25**	5.39**	5.57**	7.28**	6.93**
	(4.43)	(3.94)	(2.70)	(3.34)	(3.68)
POP	-0.14**	-0.14**	-0.13**	-0.11**	-0.11*
	(-2.50)	(-2.65)	(-2.36)	(-2.00)	(-1.89)
REMOTE	-0.16	-0.18	-0.19	-0.22	-0.23
	(-0.78)	(-0.91)	(-0.94)	(-1.11)	(-1.08)
HOST	0.02	0.02	0.03	0.04*	0.05*
	(1.32)	(1.31)	(1.04)	(1.83)	(1.88)
No. Obs.	54	54	54	55	55
R-square	0.21	0.22	0.20	0.19	0.18

Please note: heteroskedasticity-consistent t-statistics in parentheses. In all years, the United States is excluded. South Africa is not included in 1995-1997 due to missing data.
** indicates statistical significance at 5%, and * at 10%