Does the Internet foster International Trade? International Economics

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May 09, 2006

Abstract

This paper deals with the impact of the Internet on international trade. Theory suggests that the Internet has the potential to substantially reduce search and information costs by creating global exchanges. We provide a basic theoretical framework to show, through which channels international trade is affected by the Internet. Furthermore, using the gravity equation of trade, we give some empirical evidence that the Internet fosters international trade. Nevertheless we also present some problems which arise in the context of the Internet and international trade.

Contents

1 Introduction

In the last couple of years there has been a steady growth in the trade of services. Nevertheless Freund and Weinhold (2002) mention that, although services account for about 60 percent of world production, their share in world trade is only around 20 percent. There is a vast literature on hurdles for international trade in services.[1] One of the main reasons why international trade in services is limited is the necessity of physical contact between producers and consumers. This condition implies distance costs[2] and also search costs[3]. According to authors like Freund and Weinhold (2002) there is ample evidence that the Internet has the potential to overcome these barriers to international trade by operating as a medium of global exchange, therefore fostering international trade. Furthermore the Internet does not only increase the tradability of services, it also facilitates the introduction of new products like online airline reservation services.

Section 2 starts with a brief explanation of traditional barriers to trade. After this, section 3 tries to give some theoretical insights into how the Internet effects search costs for international trade by using a modified version of the Heckscher-Ohlin-Samuelson model. Section 4 shows some empirical evidence on the effect of the Internet on international trade. Section 5 gives some contemporary counter-arguments to the general optimistic belief on impact of the Internet on regional competitiveness. The final section concludes.

2 Traditional Trade Barriers and the Internet

Many models for international trade like the Heckscher-Ohlin model, the Ricardian model or the specific factor model[4] abstract from distance costs. i.e. it is assumed that countries lie indefinitely close to each other. Even though the fundamental principles of comparative advantage or the gains from international trade are unaffected by transportation or distance costs they still impose barriers on the movement of goods and services.

According to the gravity theory, falling distance costs would imply an increase in international trade. In order to make any predictions on the impact of the Internet on international trade, one has to define the term *distance costs* more precisely. Kleinert and Schuhknecht (2003) argue that distance costs do not only consist of costs for "physical" transportation. The term rather also includes search costs, information costs and costs of adjusting to different market conditions. Hummels (1998) showed that "physical" transport costs have not

[1] e.g. Freund and Weinhold (2000a), Freund and Weinhold (2002), Krugman and Obstfeld (2003), Kleinert and Schuhknecht (2003), Rauch and Trinidade (2003)

[2] e.g. travel costs to meet the business partner

[3] e.g. costs which accrue because of the search by producers for foreign distributors or by assemblers for foreign suppliers

[4] As described in Krugman and Obstfeld (2003)

fallen drastically during the last couple of years. On the other hand there has been a rapid decline in information and communication costs. Figure 1 gives an overview of the decline in distance costs. The decrease in information costs has further been pushed by ICTs[5] especially the Internet, which enabled new means of communication like e-mail or VoIP software[6].

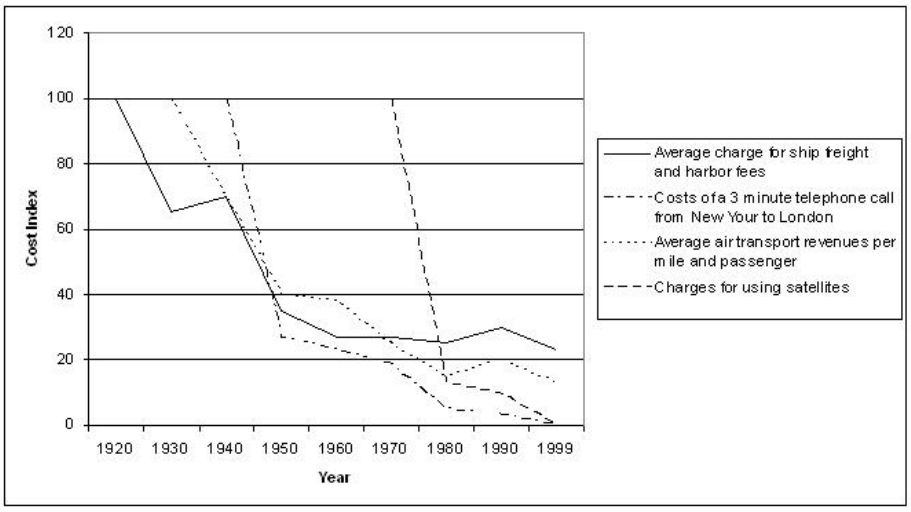

Figure 1: Distance costs, 1920-1999. Adapted from Kleinert and Schuhknecht (2003, p. 966)

Furthermore Kleinert and Schuhknecht (2003) argue that the Internet allows the provision of services, even over long distances, which had in former times been nontradable. e.g. professional services, educational services or medical services. This enables multinational enterprises to operate all over the world. It is even possible to outsource service supply itself. An example for this is described by Freund and Weinhold (2002), Infosys, an indian software consultancy offers its services to international customers including Apple Computers, Lucent Technologies and Microsoft. Kleinert and Schuhknecht (2003) also state that much programming is outsourced to companies situated in India.

[5]Information and Communication Technologies

[6]VoIP (Voice over IP) *"is the routing of voice conversations over the Internet or through any other IP-based network"*. Source: http://en.wikipedia.org/wiki/Voip (viewed May 09, 2006)

3 Search and Transportation Costs - A Theoretical Approach

We have already mentioned in the last section, that one channel through which the Internet can influence distance costs is by facilitating the search by producers for foreign distributors or by assemblers for foreign suppliers. In this section we try to give deeper insights to the channels through which the Internet can foster international trade. In order to do this we give an overview on the standard one-good, two-factor, two-country model of trade in factor services presented in Rauch and Trinidade (2003) which they extend by introducing a matching problem between entrepreneur-firms.

In their model, Rauch and Trinidade basically concentrate on the costs accrued by the search for suitable foreign trading and investment partners. They argue that the Internet improves the quality of the information about foreign firms, which helps to screen the market and make ever better "first cuts" before they start to work out deals for a joint venture. In order to decide whether to engage in a joint venture with a foreign partner or to stick to the domestic market, a firm has to take in account the quality of its match with the foreign partner. For this reason Rauch and Trinidade (2003) argue that *"as the difference between foreign and domestic match quality narrows with improving information, the relative influence of cost differentials and trade taxes on firm decisions grows"*. Therefore an increase in the quality of the information on trading partners will lead to an increase in the elasticity of substitution between domestic and foreign goods/factors. As a result of this, as information improves, wages in the two countries should move closer and closer together.

3.1 Basic Setup of the Model

The main driving force of the model presented by Rauch and Trinidade (2003) are wage differentials, which provide an incentive for producers in labor-scarce countries to search partners in labor-abundant countries. The model consists of two countries, home and foreign. In both countries there is a continuum of types of producers. Those producers are distributed over a circle of unit length (shown in figure 2). Furthermore each type possesses a continuum of producers of unit mass. Rauch and Trinidade (2003) describe this construction as a "unit cylinder". Labor is assumed to be homogenous and internationally immobile. Following condition has to hold for the ratio of labor-producer endowment ratios:

$$L/L^* < 1$$

where L denotes the home labor endowment and $L*$ the labor endowment of the foreign country. Throughout the rest of the paper, variables for the foreign country will always be denoted with an asterisk. Above equation states that the foreign country is the labor-abundant country and home is the labor-scarce

country.

Like mentioned above, this model focuses on partnerships between producers. Therefore in order to generate output, two producers must engage in a joint venture. The gains from this match are indicated by the distance between their types on the unit circle. i.e. the larger the distance, the larger the gains from the match. Furthermore the firms have to hire labor to produce output. The production function F, which is characterized by constant returns to scale is given in equation 1.

$$y_{ij} = F(x, z_{ij}) \tag{1}$$

where x denotes labor and z_{ij} denotes the shortest distance between the producer types i and j on the unit circle. Therefore z cannot exceed $1/2$.

Equation 2 shows the total profits emerging from the match of producers i and j. In this model, producers take the given wage rate w in order to maximise their profits. Like mentioned before, z_{ij} represents the gains from the match, therefore $\delta\Pi/\delta z_{ij} > 0$. Furthermore $\pi(w)$ is decreasing and convex in w.

$$\Pi_{ij} = z_{ij}\pi(w) \tag{2}$$

From the profit function, we can derive the labor demanded by the match of firms i and j. The labor demand is given in equation 3.

$$L_{ij}^{d} = -z_{ij}\pi'(w) \tag{3}$$

3.2 The Matching Process

In the model of Rauch and Trinidade (2003) the matching process goes as follows: Producers from the home country travel to the foreign country to meet one and only one potential trading partner. The type of the partner is not revealed before the meeting. If the potential trading partner is adequate, the match will be confirmed, otherwise it will be broken. If either the firm from the home or the foreign country rejects its international trading partner it establishs a partnership with a domestic firm (i.e. a producer from the home country engages a joint venture with another producer from the home country. The same argument holds for foreign producers).

Rauch and Trinidade (2003) state that the producers know the domestic location of their best match type. Therefore, in the efficient equilibrium, each producer, in order to maximize profits, selects a partner which is situated exactly on the opposite site of the unit circle. After two producers have engaged in a joint venture they have to decide on how the profits are going to be split up. Rauch and Trinidade (2003) assume the Nash bargaining solution, implying that the total profits of each match are divided equally among the two firms.

Because labor is assumed to be internationally immobile a domestic joint venture can only hire domestic labor. Because of these facts the profits for a firm in the home country from matching with another domestic firm are given by $\pi(w)/4$. This value is obtained by using equation 2 and inserting $z_{ij} = 1/2$. Following the same argument for the foreign country yields a profit of $\pi(w^*)/4$

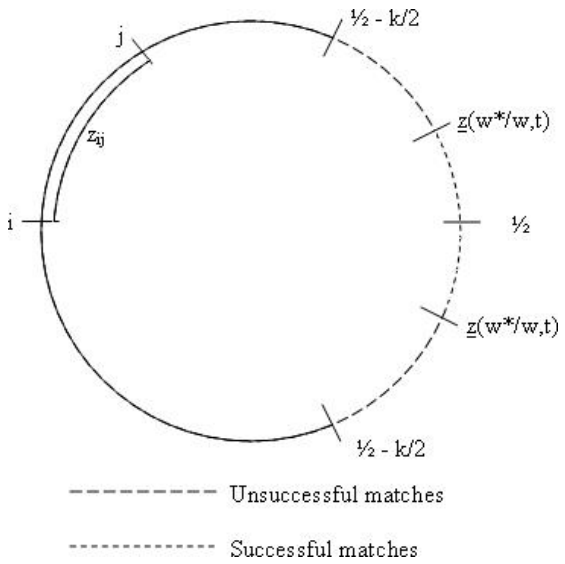

Figure 2: International Matching: Distances between home producer i and foreign producer j. Adapted from Rauch and Trinidade (2003, p. 778)

So far we have shown that profits are achieved through domestic matchings. Now we take a closer look at international matchings. It is assumed that traveling from the home country to the foreign country is free of cost. This ensures that all home producers attempt to find a trading partner in the foreign country. Each producer from the home country selects a set of potential producers from the foreign country. This set of potential producers is distributed over the unit circle with $k \in (0, 1]$ and with the median being the producer type opposite of the firm in the home country. This can bee seen in figure 2, where firm i is searching for a partner in the foreign country. The median in this case is $1/2$. Because the set is distributed equally around the median, it is delimited by $1/2 - k/2$. Therefore we can say that k is an index for the quality of the information available on foreign producers. Kleinert and Schuhknecht (2003) argue that the Internet has lead to a radical reduction in communication and information costs. Applied to this model that means that the Internet facilitates a decrease in k, allowing firms to make ever better first-cuts before meeting with the trading partner and working out a deal. Basically one can say that a firm in the home country can rule out the worst $100(1 - k)$ percent of foreign producer types in advance. Besides imperfect information there are

two further differences between international and domestic matchings. First, as mentioned before, labor is internationally immobile. This implies that firms engaged in an international joint venture can choose where to locate production and hence they do have access to the labor force of either country, whereas domestic matches are restricted to the domestic labor market. Second, international joint ventures have to deal with transportation costs and taxes. Rauch and Trinidade (2003) implement this by reducing the profits by a fraction t or $t^* \in (0, 1)$. The introduction of taxes and transportation costs allows to analyse the impact of government decisions.

3.3 International Bargaining

In the previous subsections we set up the basic framework of this model. Now we take a closer look at the implications and required conditions for international bargaining. Like we have stated before, the profits from a domestic matching are $\pi(w)/4$ and $\pi(w^*)/4$ respectively, where w and w^* are the international trade equilibrium wages. Those two points are considered to be the threat point for international bargaining. One of the advantages of an international joint venture is the fact that the trading partners have access to the labor force of either country. Therefore production will be situated in the low-wage country. The reasoning for this goes as follows: If the production was located in the high-wage country, the partner from the low-wage country would have to get more than half of the profits in order to be better off than with a domestic partner. But if the partner from the high-wage country gets less than half of the total profits, he/she will be strictly worse off compared to a joint venture with a domestic partner. Therefore we can say that the access to cheap labor is the incentive for an international joint venture for producers in the high-wage country. On the other hand, producers from low-wage countries benefit from the increase in bargaining power compared to negotiations with domestic firms. For this reason Rauch and Trinidade (2003) conclude that, considering that the foreign country is labor-abundant, the home country cannot be the low-wage country. Furthermore because of taxes and transport costs (t) we can also rule out $w = w^*$, because otherwise there are no incentives to engage in an international joint venture, hence $w > w^*$. Thus, just like in the standard one-good, two-factor model, international joint ventures enable the transfer of labor demand from the labor-scarce country (home) to the labor-abundant country (foreign).

Starting from this, we can figure out the condition which tells us whether an international matching will be confirmed or not. Like mentioned before, the set of potential producer types is distributed equally around the median. Furthermore the unit circle is symmetric, allowing us to drop the subscripts from z_{ij}. If two producers from home and foreign engage in an international joint venture the Pareto frontier from this partnership can be described as a linear combination of the two points $[0, z\pi(w^*)]$ and $[(1-t)z\pi(w^*), 0]$. In order to have an incentive for an international matching, the before stated threat point

$([\pi(w)/4, \pi(w^*)/4])$ must lie inside the Pareto frontier. This requirement can be described with following condition:

$$\pi(w^*)/4 < -\pi(w)/[(1-t)4] + z\pi(w^*)$$

If we solve above equation for z we get

$$z > \frac{1}{4} + \frac{\pi(w)}{\pi(w^*)} * \frac{1}{4(1-t)}$$

To get to our final condition we replace $\frac{\pi(w)}{\pi(w^*)}$ from above inequality by $(\frac{w^*}{w})^{\varepsilon}$[7] and define $\underline{z}$ to be equal the right hand side of above inequality. Thus we can state:

$$z > \underline{z}(w^*/w, t) \tag{4}$$

It can easily be seen that $\underline{z}$ is increasing in both arguments. The higher ratio of foreign wage to home wage, the smaller are the gains from trade[8]. The same argument holds for t, the higher the conventional trade barriers like taxes and transport costs are, the smaller are the gains from trade, requiring a greater match quality (z). From figure 2 one can observe that the set of types of potential partners also includes producers where $z < \underline{z}$, this implies that some international matches will fail and the producers will return to their country to find a domestic partner.

In the previous subsection we have already stated that in any equilibrium of the model $w^* < w$ holds. Using equation 4 we can put even tighter restrictions on the ratio of foreign wage to home wage. Inserting $(1-t)^{1/\varepsilon}$ for w^*/w yields $z > 1/2$, but from the unit circle we know that the maximum value of z is $1/2$. Therefore we have an upper bound for the wage ratio of $(1-t)^{1/\varepsilon} \equiv \bar{\omega} < 1$. In addition to that we also can define a lower bound $w^*/w < [(1-2k)(1-t)]^{1/\varepsilon} \equiv \underline{\omega} < \bar{\omega}$. These bounds can be summarized by following condition:

$$w^*/w \in (max(0, \underline{\omega}), \bar{\omega}) \tag{5}$$

Furthermore Rauch and Trinidade (2003) state the probability of success of an international matching as follows:

$$P = \frac{\frac{1}{2} - \underline{z}(w^*/w, t)}{k/2} \tag{6}$$

The probability of success of an international joint venture should be higher if the gains from trade are higher. Ceteris paribus, a decrease in k leads to an increase in P. According to Freund and Weinhold (2000a) the Internet has the potential to decrease search and information costs because suppliers can advertise to numerous buyers at once. Furthermore this also predicts that historic

[7] This can be done because of the assumption that $\pi(w)$ is a constant elasticity function.
[8] One has to keep in mind that $w > w^*$

trade linkages should get less important. The importance of the Internet stems from the fact that it differs from other recent innovations like the telephone or the fax because it does not only assist bilateral communication. e.g. Sanders (2000)[9] presents the statement from an executive from a Chemicals site 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"*. A further implication of model model presented by Rauch and Trinidade (2003) is that trade increases with market familiarity. Freund and Weinhold (2000a) argue that innovations like the Internet improve market familiarity by lowering search and communication costs and therefore increase trade.

Furthermore equation 6 also tells us that the probability of success of an international matching decreases in taxes and transport costs t. Rauch and Trinidade (2003) also suggest that traditional trade barriers like tariffs, taxes or transport costs gain in importance with a rise in information quality. This suggestion is also built in in equation 6, because the sensitivity of P to changes in either the wage ratio or the tax/transport costs is higher with a lower k (better information).

In order to get an international trade equilibrium, both home and foreign labor markets must clear. As we have seen before, home is the high-wage country, therefore the labor-force of the home country is only demanded by producers with unsuccessful international matches. In order to get the demand for home labor we have to integrate the unsuccessful matches on the unit circle. The resulting labor demand is given in equation 7[10].

$$L_H = (1 - P)\frac{1}{4}(-\pi'(w)) \tag{7}$$

Equation 7 shows that factors which lower the gains from trade (i.e. an increase in the wage ratio the tax/transport costs) increase the demand for labor of the home country by lowering the probability of success of an international joint venture. The foreign labor demand on the other hand consists of the labor demand of foreign producers whose international matches were unsuccessful and also of the labor demand of successful matches[11]. The demand for labor from the foreign country is given by:

$$L_F = (1 - P)\frac{1}{4}(-\pi'(w^*)) - \frac{\partial Q}{\partial w^*} \tag{8}$$

Where Q is a new quantity representing the profits from all successful international joint ventures. Compared to home labor demand, the demand for foreign labor is decreasing in the wage ratio and taxes and transport costs. Again

[9] Found in Freund and Weinhold (2000a)

[10] The derivation of this result does not provide any deeper insights and is therefore omitted

[11] One has to keep in mind that foreign is the low-wage country.

for the sake of simplicity the detailed derivation of the foreign labor demand is omitted.

3.4 Outcomes of the Model

Using this basic setup of the model Rauch and Trinidade (2003) state several propositions[12].

- *An international trade equilibrium exists and is unique.* Based on this proposition one can carry out comparative statics. e.g. consider an increase in the home labor endowment L. Such an increase leads to a higher w^*/w, because labor market clearing in the home country has to be maintained. An increase in L^* does not only cause both wages to fall but also the wage ratio. Thus we can say that with imperfect information (i.e. $k > 0$) the domestic labor markets of home and foreign are partially integrated.
- *The wage rates in both countries are influenced by the information quality (k) and tax/transportation costs (t) as follows*:
  - $dw/dk > 0$
  - $dw/dt > 0$
  - $dw^*/dk < 0$
  - $dw^*/dt < 0$
- *The probability of a successful match P decreases as either k or t increases.* This results can be derived using equation 7 in combination with above propositions. Above we have shown that w is increasing in both k and t. In order to keep labor demand constant P has to decrease.
- *The volume of trade decreases as either k or t increases.* Thus if the model presented in this section is applied to the question whether the Internet fosters international trade the answer should be *"yes"*. As we have mentioned before technological innovations, especially the Internet facilitates the search for foreign producers or suppliers by reducing search and information costs. This can be reflected by a decrease in k, which, ceteris paribus, suggests an increase in international trade.

To conclude this section one can say that theory suggests that the Internet has a positive effect on international trade. Furthermore Rauch and Trinidade (2003) provide following "convergence" result: *"in the limit as information becomes perfect (k approaches zero), the ratio of national wages becomes a function of only the tax/transport cost and technology, as in the 2 x 2 Heckscher-Ohlin-Samuelson model and the standard one-good,two-factor model of trade in factor*

[12]The formal proof of this propositions is beyond the scope of this paper and is therefore left out.

services. In particular, the ratio of national wages becomes independent of the ratio of national labor supplies". The next section of this paper will cover some empirical evidence on the effects of the Internet on international trade.

4 Empirical Evidence on the Effect of the Internet on International Trade

The last section built up a general theoretical framework to give suggestions through which channels the Internet can affect international trade. In this section we will give some empirical evidence based on a number of papers by Freund and Weinhold[13]. As we have shown in the previous section, a reduction in search and information costs should bolster International trade. The key question which we try to answer in this section is whether electronic sharing of information via the Internet alters the geography of service provision. Some counter-arguments to the positive impact of the Internet on international trade are:

- there are still a large number of services, which have to be tailored to the consumer's needs. It sounds reasonable to assume that this tailoring process is done more effectively if the service provider speaks the same language as the customer.
- even though the Internet may reduce search costs, in the case of a dispute there still arises some risk because of different legal systems.

4.1 Basic Predictions of the Model

In order to determine the effects of the Internet on international trade Freund and Weinhold (2000a and 2000b) estimate a general model of trade in services across countries. Therefore they use a simple model with imperfect information and sunk costs as a framework for their empirical research. From a conceptual point of view the model used to estimate the effects of the Internet on trade is quite similar to the model which we have presented in the previous section. Namely both models include imperfect information (i.e. search is costly). In the two-period model of Freund and Weinhold (2000a) there are n countries, each with m producers. The firms produce one homogenous good and there is a Cournot competition in the market. Furthermore, in this model international trade increases the competition in the market, which results in welfare gains. Unlike in the model of Rauch and Trinidade (2003) firms are not forced to engage in a partnership, but if they want to participate in a certain market, they have to pay a market specific sunk cost.

[13]Freund and Weinhold (2000a), Freund and Weinhold (2000b), Freund and Weinhold (2002)

Freund and Weinhold (2000a) also impose the question whether the Internet has the potential to reduce distance costs, which do not only consist of costs for "physical" transportation but also of information and communication costs[14]. This suggests that the Internet will only be able to reduce distance costs if costs for "physical" transportation are relatively less important than information and communication costs. Based on the basic setup of their model Freund and Weinhold (2000a) state the following four predictions:

- As the number of firms with access to the Internet grows, international trade will increase.
- Access to the Internet reduces hysteresis.
- Countries with a small number of trading partners before the introduction of the Internet will experience the largest boosts in trade.
- Only if distance costs mainly consist of information and hence sunk costs, the Internet will be able to reduce the influence of distance on trade.

4.2 Gravity Equations in International Trade

Freund and Weinhold (2000a) use the gravity equation of trade[15] to carry out their empirical analysis. Although the gravity equation has been the workhorse in the field of international trade empiricism, authors like Anderson and Wincoop (2003) argue that this equations do not have a theoretical foundation and therefore estimations in this context suffer from an omitted variable bias[16].

The basic "gravitational" relationship can be described as follows:

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

where TOT_{ij} is the total bilateral trading volume between the countries i and j. GDP is used to represent the size of the countries and $DIST_{ij}$ is the distance between country i and country j.

In order to carry out their estimations Freund and Weinhold (2000a) use the following, enhanced version of equation 9:

$$\begin{aligned} tot_{ij} =& \beta_0 + \beta_1(gdp_i gdp_j) + \beta_2(pop_i, pop_j) + \beta_3 dist_{ij} + \beta_4 ADJ + \\ & \beta_5 LANG + \beta_6 LINK + \beta_7 FTA + \beta_8(cmass_i cmass_j) + \varepsilon_{ij} \end{aligned} \tag{10}$$

where tot_{ij}, gdp and $dist$ are the log of the variables used in equation 9.

Furthermore:

[14] Also see Kleinert and Schuhknecht (2003)

[15] *Bilateral trade is assumed to be proportional to the size of the markets and inversely related to their geographical distance.* Kleinert and Schuhknecht (2003, p. 964)

[16] A detailed discussion on the theoretical foundation of gravity equations is beyond the scope of this paper and therefore left out.

- $pop_i pop_j$ is the log of the product of the populations of country i and j
- ADJ, dummy variable indicating whether two countries are adjacent.
- LANG, dummy variable indicating whether two countries share a common language.
- LINK, dummy variable indicating whether two countries have colonial links.
- FTA, dummy variable indicating whether two countries are part of the same free trade area.
- $cmass_i cmass_j$, measure of the "cybermass" of two countries.

If the Internet has a positive effect on trade, then one would expect that $\beta_8 > 0$.

4.3 A Way to Measure the Cybermass

The cybermass of a country is not directly observable, therefore Freund and Weinhold (2000a) use the number of registered top-level domain names (e.g. .at or .de). This proxy has two downsides. First, a e.g. .at domain does not imply that the domain really is located in Austria. Nevertheless one can assume that a .at website primarily serves Austrians. Therefore it seems that this is not a huge problem. Second, there are domain names where the hosts could be located anywhere (e.g. .int, .edu, .org, .net). Unfortunately Freund and Weinhold (2000) do not give detailed information on how they handle those "countryless" top-level domains. They just state that *"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."* One could argue that it is possible that those domains account for a large share of top-level domains and leaving them out would therefore bias the estimation results. Unfortunately we were not able to acquire the data to prove this hypothesis. Freund and Weinhold (2000) suspect that the majority of the "countryless" top-level domains are located in the U.S. If this is true, then the U.S cybermass variable would be biased downward. Therefore they included a dummy variable to check for this hypothesis and they coefficient turned out to be statistically significant and negative.

4.4 Data and Estimation Results

Freund and Weinhold (2000) used a sample of 56 countries for the years 1995-1999. The data on GDP, trade flows and population were taken from the IMF. Data on the top-level domains was retrieved from the Internet Systems Consortium[17].

[17] http://www.isc.org

The regression results of Freund and Weinhold (2000) are given in figure 3, where the variable $HOST$ indicates the cybermass of the two countries i and j. From figure 3 one can observe that the Internet had no statistically significant impact in the year 1995. But from 1996-1999 the value of the coefficient and the t-statistics rise, saying that both, the economic and statistical significance have risen. The model is specified in logs, therefore in the year 1999 a 10% increase in the number of hosts in a country would have led to a 1,4% incrase in trade volume. Freund and Weinhold (2000) state that their estimation suffers from multicolinearity because the number of hosts in a country is positively correlated with GDP and $pop_i pop_j$. This suggests that the estimation results in figure 3 overestimate the impact of the Internet und therefore the results should rather be seen as an upperbound.

If one compares the first five columns of $DIST$ in figure 3 with the last five columns, one can see that with the introduction of the $HOST$ variable the coefficient on $DIST$ is becoming more stable. Freund and Weinhold (2000) argue that this could indicate that the Internet has lessened the impact of distance on trade. Nevertheless the coefficients are quite small, suggesting that it could also be that distance costs mainly consist of costs for "physical" transportation and that information costs only account for a small share.

Freund and Weinhold (2000) also analyse whether the impact of the Internet was the same for rich[18] and poor countries. In order not to go beyond the scope of this paper we will not present the detailed regression table. To analyse this effect the variable $HOST$ has been replaced by $HOST_RR$ (for rich country pairs), $HOST_RP$ (one rich and one poor country) and $HOST_PP$ (for poor country pairs). Estimating this regressions shows that by 1999 the Internet seems to have the smallest impact for a pair of rich countries and the largest impact for a pair of poor countries. Therefore Freund and Weinhold (2000) suggest that the Internet reduces the importance of historic trade linkages. The coefficients on $LANG$ and $LINK$ in figure 3 provide some evidence that this really is the case. Freund and Weinhold (2000) conclude by saying that the data strongly supports the prediction that the Internet fosters international trade. Furthermore they state that *"perhaps more importantly, the results suggest that the benefits of the Internet may accrue disproportionately to poorer countries."*

[18] Defined as countries with a per-capita GDP of above $2000 in 1995

Gravity Model of Trade

	Dependent Variable: Log(Total Trade Volume)									
	1995	1996	1997	1998	1999	1995	1996	1997	1998	1999
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Constant	5.157**	5.511**	3.948**	4.395**	4.497**	4.772**	3.257*	0.713	-0.688	-0.047
	(5.90)	(5.84)	(3.72)	(5.58)	(5.55)	(3.70)	(2.22)	(0.45)	(-0.59)	(-0.04)
GDP_{ij}	1.194**	1.217**	1.196**	1.165**	1.191**	1.173**	1.090**	1.003**	0.863**	0.925**
	(36.21)	(35.59)	(35.56)	(36.00)	(37.22)	(21.85)	(17.42)	(16.38)	(15.45)	(17.12)
POP_{ij}	-0.125**	-0.157**	-0.124**	-0.123**	-0.125**	-0.111**	-0.081	-0.018	0.041	0.019
	(-4.40)	(-5.24)	(-4.13)	(-4.77)	(-4.53)	(-2.61)	(-1.75)	(-0.40)	(1.16)	(0.52)
DIST	-0.892**	-0.850**	-0.768**	-0.771**	-0.818**	-0.893**	-0.861**	-0.814**	-0.856**	-0.900**
	(-17.36)	(-13.47)	(-10.46)	(-14.73)	(-14.54)	(-17.34)	(-13.57)	(-11.32)	(-16.12)	(-16.24)
ADJ	0.550**	0.507*	0.383	0.542**	0.547**	0.560**	0.536*	0.371	0.540**	0.504**
	(2.73)	(2.42)	(1.16)	(2.84)	(2.83)	(2.75)	(2.55)	(1.17)	(2.82)	(2.61)
LANG	1.008**	1.135**	1.053**	0.959**	0.995**	1.000**	1.110**	0.984**	0.870**	0.894**
	(7.78)	(8.41)	(7.22)	(7.48)	(7.24)	(7.73)	(8.26)	(7.13)	(6.86)	(6.59)
LINK	0.530*	0.552*	0.561**	0.511*	0.456*	0.533*	0.565**	0.576**	0.517*	0.484*
	(2.34)	(2.44)	(2.56)	(2.37)	(2.01)	(2.35)	(2.56)	(2.65)	(2.34)	(2.08)
FTA	0.076	0.161	0.385*	0.273*	0.303*	0.070	0.131	0.261	0.068	0.124
	(0.60)	(1.14)	(2.26)	(1.99)	(2.18)	(0.55)	(0.93)	(1.64)	(0.52)	(0.93)
$HOST_{ij}$						0.009	0.059*	0.103**	0.161**	0.144**
						(0.43)	(2.12)	(3.28)	(5.82)	(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%

Figure 3: Gravity Model of Trade. Taken from Freund and Weinhold (2000, p. 32

5 The Digital Divide - Counter-Arguments to the Optimistic Role of the Internet

The previous section gave some empirical evidence that the Internet positively influences trade, especially it seems that benefit to poor countries is higher than to rich countries. In this short section we want to give some counter-arguments to this optimistic belief. Although there exists literature[19] which supports the idea that ICTs and especially the Internet are boosting productivity, authors like Camagni and Capello (2005) present a rather pessimistic view. Their work refers to ICTs in general, it seems reasonable to assume that their results are also applicable to the Internet itself. Figure 4 gives more detailed information on how ICTs and therefore also the Internet are supposed to reduce the digital divide.

	Sources of competitiveness	Effects of ICTs on source of competitiveness
Corporate level	Cost reduction	Efficiency effect
	Revenue Increase	Effectiveness effect
Territorial level	Accessibility	Connectivity effect
	Attractiveness	Endowment of location factors

Figure 4: Effects of ICTs on sources of competitiveness at micro and territorial level. Taken from Camagni and Capello (2005, p. 423)

Looking at figure 4 one can say that, ceteris paribus, if a country is endowed with a more advanced communication infrastructure (like widespread access to the Internet), the country will attract more firms and producers than less endowed countries. However Camagni and Capello (2005) state the empirical evidence on the relationship between ICTs and territorial competitiveness is rather contradicting, like Solow said *computers are everywhere but in productivity statistics"*[20]. Using data from the OECD Camagni and Capello (2005) show that high ICT investment levels do not imply high consumption. Camagni and Capello (2005) describe the problem as follows: *"network availability does not necessarily mean use; use does not necessarily mean innovative use; and innovative use at the micro (firms) level does not necessarily mean productivity increase at the macro level"*[21]. Furthermore they state that there are still international discrepancies in the distribution of the Internet. Even if these discrepancies are reduced over time there still exists a so called "network quality gap"[22], meaning that the quality of ICTs is lower in lagging regions.

[19] See Baily and Lawrence (2001)
[20] Found in Camagni and Capello (2005, p. 424)
[21] Camagni and Capello (2005, p. 427)
[22] Camagni and Capello (2005, p. 430)

Apart from the problems mentioned above there are further barriers to the adoption of ICTs. According to Camagni and Capello (2005) the most severe barrier lies on the side of the user. In order to gain benefits from innovations like the Internet, it is not enough to built up the technical infrastructure. Even though in the era of the Internet advanced communication technologies are ubiquitous, the skills and human capital required to generate welfare and growth are not. Therefore Camagni and Capello (2005) predict persistent disadvantages for lagging areas and countries.

6 Conclusion

In this paper we have shown that trade barriers like taxes and transport costs constitute important hurdles to international trade. Even though the costs for "physical" transportation have not fallen substantially during the last couple of years, the Internet provides the potential to drastically reduce information and communication costs.

To give deeper insights through which channels this can be achieved we have presented the model from Rauch and Trinidade (2000) in which output is generated by a partnership of two firms, either with a domestic or a foreign partner. We have seen that with increasing information quality the firms are able to make ever better "first-cuts" and hence international trade will rise. Unlike telephones the Internet does not only facilitate bilateral communication thus one can expect a fairly large reduction of search and information costs.

After building up a theoretical framework we presented empirical evidence for the impact of the Internet on international trade. As Freund and Weinhold (2000) have shown, a 10 percent increase in the number of hosts in the year 1999 would have increased the total amount of trade by 1.4 percent. Furthermore it seems that poor countries take larger advantage of the Internet compared to rich countries.

Nevertheless there is some evidence that the digital divide will still persist. Although the Internet is spread fairly wide nowadays, in poor countries there often is a lack of skills and human capital to use the existing ICT infrastructure to generate growth and welfare.

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