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HELENA BOHMAN

Trade, Knowledge and Income Distribution
Acknowledgement or It takes a department

I was offered a position as a PhD candidate in Jönköping in 2001, and to be completely honest, moving to Jönköping could in my mind only be interpreted as a result of bad karma. Clearly, I had to have done something horrible in order to deserve to end up in this, to my mind, godforsaken place. But, the job sounded very appealing and also I was enticed by the possibility to work in an environment which felt more dynamic than the traditional Swedish university setting. It didn’t take much thinking to decide that the pros clearly outweighed the cons. And as it turned out, my karma was perhaps not that bad after all. My time at JIBS has in many ways exceeded my expectations. This is to a large extent thanks to the people at the Department of Economics and the open-mindedness which to an increasing extent has become a characteristic feature of the Department. As the head of department, Börje Johansson has managed to create an academic atmosphere that I think is quite unique in Sweden. Although it may be a bit of a cliché to say that ‘I could never have done this on my own’, as most clichés, it holds a lot of truth. As the old saying says, it takes a village to raise a child, and it clearly takes more than a PhD student to finish a thesis. I am indebted to many people, especially my friends and colleagues at the Economics department at JIBS.

My two supervisors, Charlie Karlsson and Per-Olof Bjuggren, have both contributed to this process. Charlie Karlsson is a clear advocator of ‘the devil is in the detail’, and over the years Charlie has done an active job in fighting the devil who seems to have been a frequent visitor to my papers. Per-Olof, who always claims people are selfish, never seems to live according to his theories and is remarkably generous. I am grateful to both for their help over the years.

I am also very grateful for the Hamrin Foundation for financial support during the whole PhD programme.

Agostino Manduchi has hold the role of an informal supervisor and has always provided the best type of moral and intellectual support a person could ever receive.

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Having knowledgeable statisticians within a handy distance has been a true life-saver in the thesis writing process. Thomas Holgersson and Ghazi Shukur have always taken time to listen to questions and problems arising in the line of progress, and as statisticians they have provided a healthy ‘less is more’ attitude to econometric tools. Problems that at first seemed insurmountable often turned out to be relatively easy to understand after a discussion with Thomas or Ghazi.

I also received a lot of help from Joakim Gullstrander, University of Lund, who did an impressively thorough work as the discussant during my final seminar, and his comments have been of great help in finishing the thesis.

Finally but perhaps most importantly, my family has provided relentless support and helped me to maintain a balance in my life. David has always been there for me and has provided endless love and patience over the years, even in times when clearly he has been forced to make some real sacrifices on my behalf. It is thanks to him that our relationship has grown stronger over the years, despite the trials posed by my work and us becoming parents during the same period. Our daughter Esmeralda has always kept her priorities straight; research may be of interest only when it comes in pink wrapping, and she has always demonstrated a healthy skepticism. When asked what her mum does at work she once responded: “Blah blah blah”. Her little brother Dante seems to share her attitude, although he literally has digested parts of the thesis. Also my parents have provided unconditional support, moral as well as practical not just during the PhD program, but through my whole life.

So, thank you all for making this journey not only worthwhile, but even enjoyable.

Helena Bohman
September 2008
Abstract

This thesis consists of four independent essays which address two main areas of research. The first area deals with the role of income distribution in economic transactions. The first paper in the thesis, Knowing me, Knowing you, suggests a new method of incorporating income distribution into international trade analysis. The method suggested provides a way to compare the distribution of income between two countries, and this is used to proxy demand similarities between the countries in question. The article Income Distribution and the diffusion of networks analyzes the impact of income distribution on the diffusion of fixed telecommunications in Brazil by showing how income distribution affects aggregate demand.

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Chapter I

Introduction and Summary of the thesis

Helena Bohman

1. Introduction

Anybody who has taken a course in introductory economics knows that great emphasis is put on the role of markets. When perfect markets exist, the price will provide all necessary information about a product, and buyers and sellers do not need to interact with each other. As long as products are considered to be homogeneous, buyers only need to know the price of a good in order to decide which good to buy. Who he or she buys it from is irrelevant. It is therefore not necessary for economic actors to interact directly with each other, and transactions can take place in an anonymous market. Although this is a very useful simplification in order to provide some basic understanding of how economies work, many transactions do require some degree of contact between buyers and sellers. For many types of goods, the economic actors need more information than price in order to find, evaluate and compare different goods and also to finally complete the transaction. Insufficient information results in what may amount to considerable costs, so-called transactions costs. Efforts to improve information also generate transaction costs. In order to minimize the costs, it may be preferable to stick to well-known partners. When this is the case, it may be more appropriate to talk about networks rather than anonymous markets, and therefore this thesis will begin with discussing the role and characteristics of different types of networks in the economy. In international trade, the concept of networks is primarily used for differentiated goods (Johansson and Westin, 1994, Rauch, 1999) and trade of goods is often analyzed for homogenous and differentiated goods separately. Differentiated goods require higher transaction costs since they are not so easily evaluated and therefore trade patterns reveal path dependence in which trading partners are already familiar with each other.
The main focus here will lie on the role of economic networks in international trade, but also physical networks will be discussed. Two main tracks can be identified in the thesis. The first is the role of social factors in networks. Specifically, it investigates the role of information flows and international migration respectively in international trade. The second track deals with the role of income distribution in networks. The role of income distribution has been a relatively neglected area in economics during the last decades, although there seems to have been a recent surge in the literature (One example of this is Bertola et al., 2006 who provides a comprehensive analysis of income distribution in macroeconomics). The reason behind this confined interest of economists has partly to do with practicalities. First, using the full distribution of any variable and modeling it is a messy business and requires getting your hands dirty. Using only the average values is a much easier process. Secondly, data on income distribution has been hard to come across and often of poor quality. Recent initiatives, such as the World Income Inequality Database and the Luxembourg Income and Wealth Studies, have reduced these problems. Still, the role of income distribution in international trade is to a large extent virgin territory, and it is an area where there remains a lot to be done, including measurement and methodology. Also the area of social networks and incomplete information in international trade is a relatively new area of research. Recent initiatives where economists and sociologists collaborate, such as Rauch (2007) have provided new insights in mechanisms underlying economic exchanges, and research within this area is increasing.

The introductory chapter will focus on network theory. The discussion here is by no means an attempt to provide a coherent analysis of networks; it would be a far too ambitious approach. Instead, the purpose is to provide a background to the different chapters of the thesis and highlight some aspects that may be of interest to the reader. There are broadly speaking two different types of networks discussed in this thesis, telecommunications and international trade-related networks. Whereas telecommunications is a typical network industry with characteristics like network externalities, networks associated with international trade are somewhat different in character. The next section is therefore a general discussion on networks which includes issues associated with network industries. Subsequently, there is a section devoted to networks in international trade, an area in which the concept of network may not always be used explicitly (some exceptions such as Rauch (1999, 2007) and Johansson and Westin (1994) exist). Three of the chapters focus on international trade. After this, some methodological concerns are addressed. Although international trade research rarely addresses networks explicitly, one of the most commonly applied tools to estimate trade flows is the gravity model. This model provides a method to estimate networks and is used in three of the chapters. A brief discussion on the theoretical background behind the model and some issues related to the application is therefore included. Finally, each of the four articles
Introduction and Summary of the Thesis

is addressed individually with a brief summary and a discussion of the contributions of the respective papers.

2. **Networks in International Trade and Infrastructure**

Networks have had a central role in human interaction throughout history and are fundamental in understanding human behavior. It has been used metaphorically as a way to characterize complex behavior between members of a social group. The earliest research on networks is sometimes attributed to Euler and his paper *Solutio problematic ad geometriam situs pertin* (Euler, 1735) in which he showed that it is impossible to walk around Königsberg crossing the seven bridges across the river Pregel exactly once. His proof was built on what in modern terminology would be called nodes and links and he showed that with an uneven number of links, it is necessary to cross one bridge twice in order to walk across the whole city.

Networks consist of nodes tied together by links, and they can be interpreted as physical entities such as transportation or telecommunications networks in which there are observable links and nodes. The concept of networks may also refer to intangible channels for interaction and behavioral patterns of actors, such as firms or consumers. This has shown to be a useful tool in understanding and explaining how markets work. Sociologists traditionally picture networks as a different type of organization than markets. In economics, networks are sometimes portrayed as a hybrid form between market and hierarchies rather than a separate organization form in itself (Williamson, 1996). Sincere efforts in bridging the two disciplines have been made by e.g. Rauch (2001b, 2007) who focuses on networks and incomplete information in international trade. One definition of an economic network is

\[\text{any collection of actors (} N \geq 2 \text{) that pursue repeated, enduring exchange relations with one another and, at the same time, lack a legitimate organizational authority to arbitrate and resolve disputes that may arise during the exchange}\]

(Podolny and Page, 1998)

Clearly, this definition seems more appropriate for social networks than for physical networks, where property rights often are defined. A perhaps more general approach is to consider four characteristics of a network (Cappelin, 2003). First, the link can consist of either a mutual or a unidirectional relationship. Second, the nodes have different roles in the network which may be a result of node specific characteristics and their position in the network. Third, networks are often related also to other networks. For example, social networks may affect trade networks, and transportation relies on infrastructure. Fourth, networks often have a strong element of path dependence, so that the
network in its present shape is strongly related to the structure of the network in previous periods, and a high degree of cumulative learning (Nelson and Winter, 1982).

Variational inequality may serve as a starting point for analyzing flows in networks (see e.g. Nagurney, 1993). Variational inequality models were developed theoretically and applied to diverse fields, not least interregional trade and transportation networks, e.g. Samuelson (1952). It is primarily a theoretical approach to analyze and characterize equilibrium and optimality properties of network flows, and it provides a means to summarize the four different chapters of the thesis. The theory can be expressed in its most basic form as an expression telling under which conditions a flow will exist, namely

\[ x_{ij} > 0 \text{ if } P_j(x) - P_i(x) > t_{ij}(x, N) + \tau_{ij}(x, N) \] (1)

where \( x_{ij} \) can be interpreted as the flow of a good (i.e. the strength of the link) from node \( i \) to node \( j \), and \( P \) denotes the price levels in the respective nodes. On the right hand side there are two friction variables: \( t_{ij} \) is the transport costs associated with the flow, and \( \tau_{ij} \) denotes the transaction costs associated with the same flow. Both friction variables may be expressed as functions of the size of the flow and the network characteristics, \( N \). In words, this simply implies that there will be a positive flow between two nodes as long as the price difference outweighs the costs that are connected to the flow. These costs can be incurred both from the characteristics of the node (such as institutional features or endowment structures in the node) or from the link (such as transport costs which are generally assumed to be a function of the distance between the two nodes).

One of the areas in which variational inequality has been used and developed is within the area of international trade theory. Spatial price equilibrium is an application which is used for calculating demand prices, commodity supply prices and trade flows, and it basically states that demand prices minus commodity supply prices should equal the cost of transportation. It has been applied to international trade by e.g. Samuelson (1952) who showed that prices and flows can be calculated by solving a mathematical programming problem. The fundamental idea of separated geographic markets was not a new concept but was modeled already by Cournot (1838), stating that a competitive price is determined by the intersection of supply and demand, which was presented in a setting of two geographically separated markets and the outcome also depended on transportation costs. The spatial price equilibrium approach and the subsequent provision of a solution based on linear programming was however the contribution of Samuelson and later developed by e.g. Takayama and Judge (1964).


Introduction and Summary of the Thesis

2.1 Layered Networks

One of the characteristics of networks is that they often interact with other networks. Figure 1 illustrates what is sometimes referred to as layered networks; the co-existence and dependence between different types of networks.

A prerequisite for humans to interact over space is the presence of a physical infrastructure that enables interaction. Physical communication systems allow for communication between individuals which opens up for social interaction. The shaping networks has generally, if not to say always, been a slow process. That applies both to physical infrastructure such as roads and railways, as well as economic transaction networks. Physical infrastructure has been subject to rapid technological development over the last couple of decades, especially in the sector of telecommunications where e.g. satellites have replaced copper wires and capacity has increased manifolds and is continuously increasing. This has contributed to rapidly declining prices, which in turn has changed the fundamentals of communications; nowadays even poor people in developing countries may have access to internet and mobile phones.

The social links that evolved by means of established physical networks have often evolved slowly and contributed to patterns in interaction that can be observed today. The repeated contacts have in many cases shaped institutions that have facilitated economic transactions. Many social networks can benefit from modern communication and maintain networks that previously were too costly to maintain.

But the links are not necessarily unidirectional. The social networks also provide feedback in shaping infrastructure. In the long run, political and economic development will also combine in shaping infrastructure; infrastructure is improved because people see good reasons to interact.

Links need to be maintained in order not to de depl eted, and are often strengthened by social ties. For social networks, links are maintained and strengthened by using the channels, as opposed to roads which eventually become depleted by usage.
Figure 1. Layered networks in economic transactions

2.2 Node characteristics

The unit of analysis will differ depending on the type of network in focus, and hence a node may for example be a country (as is often the case in international trade studies), individuals belonging to an ethnic group (Rauch, 2001a, Rauch and Trindade, 2002), or a product (Benjamin and Podolny, 1999). Each node contains certain characteristics which in turn may influence how the network develops.

Classic trade theories, as expressed in e.g. Ricardo and Heckscher-Ohlin based theories, rely on a macro perspective in which the nodes typically are countries. Endowment structures of each country are in both Ricardian and Heckscher-Ohlin models of trade fundamental in explaining why countries trade and also in explaining with whom they will trade. In the Ricardian models, technology differences of trading countries are the driving force whereas in Heckscher-Ohlin models, what matters are the comparative advantages that depend on located resources of a country.

Some contributions to the newer trade literature, sometimes referred to as network-related theories of trade, study the existence of layered networks; specifically the influence of social networks on international trade networks (Rauch, 2001b). This literature is often micro-founded; nodes are here often constituted by firms or individuals. For example, having a Chinese background may influence the way you do business and with whom you choose to trade (Rauch and Trindade, 2002) since the Chinese background provides access to a social network which can work as a lubricant in doing business.
Table 1 shows variables used to capture node characteristics in international trade models. Some of these variables have a widespread use, others are introduced in the subsequent chapters of this thesis.

Table 1. Variables describing attributes of node $i$.

<table>
<thead>
<tr>
<th>Explanation</th>
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<tr>
<td><strong>GDP$_i$</strong></td>
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<tr>
<td><strong>GDPcap$_i$</strong></td>
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<tr>
<td><strong>Pop$_i$</strong></td>
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<tr>
<td><strong>Remote$_i$</strong></td>
</tr>
<tr>
<td><strong>Gini$_i$</strong></td>
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<td><strong>Headcount$_i$</strong></td>
</tr>
</tbody>
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One central characteristic of nodes in most models is the level of income within the node. Both the total income of a node as well as the average level are often used and can measure the size and level of economic activity within the node. Furthermore, they are measures that are easy to come across and undoubtedly, they may serve as proxies of e.g. consumer behavior. However, when average income is used to proxy demand patterns, it is clearly a simplification. One of the most stable empirical findings in economics is what is known as the Engel curve; a phenomenon which is based on household consumption studies in the 19th century (Engel, 1857 and 1881) which states that consumers change their relative consumption as their income increases. As income grows, consumers tend to shift their consumption from necessities to luxury goods. This non-homotheticity implies that aggregate demand is affected not only by the average level of income, but it also matters how income is distributed (a comprehensive overview is presented in Bertola et al., 2006). Even though consumer studies generally find consumer preferences non-homothetic, most trade models still assume the opposite. One of the exceptions is the theoretical contributions by Mitra and Trindade (2005) in which they introduce a model where countries differ solely in terms of income distribution and that this is a sufficient condition for countries to start engaging in trade with each other. Furthermore, income distribution has an impact on both the exporting country and the importing country. Francois and Kaplan (1996) and Hunter (1991) show that, given different demand structures in the respective countries, income distribution can be used to explain why countries trade. Other studies that focus on the role of non-homotheticity include Stokey(1988) Matsuyama (2000), Foellmi and Zweimüller (2005) and Hallak (2006).
2.2  Link characteristics

Links in a network can be studied from different perspectives; is it the start-up of a link that reveals some interest or is it the flow that takes place on an already existing link? In international trade it is often the observed flows that are being analyzed, but there are also studies focusing on the start-up, such as the decision of firms to enter or not enter an export market (e.g. Helpman et al., 2007). Just like in the case of nodes, the unit of analysis of the flow differs. The flow may be trade flows, information flows or flow of people, i.e. migration. A large part of international trade studies are devoted to explaining how node characteristics may determine the strength of the flow between nodes. This is also true for the three trade-related articles in the thesis; by using a gravity model the strength of the trade flows are estimated in different contexts. Chapter 4 instead focuses on how networks are established: How can we explain the size of a network given the income structure in a region?

Table 2 lists a number of examples used to describe link characteristics between different nodes. As in Table 1, some are very commonly applied in the literature, whereas others will be introduced in this thesis.

Table 2. Variables describing attributes of links between node $i$ and node $j$.

| Explanation |
|---|---|
| Dist$_{ij}$ | Geographic distance between node $i$ and node $j$ |
| D$_{Border,ij}$ | Common border between node $i$ and node $j$ |
| D$_{Language,ij}$ | Common language in node $i$ and node $j$ |
| Immi$_{ij}$ | Number of immigrants from node $j$ to node $i$ |
| Media$_{ij}$ | News flow from node $j$ to node $i$ |
| DO$_{ij}$ | Demand overlap estimated as overlap of income distribution between country $i$ and country $j$ |

Distance is used in trade models in order to capture transport costs but are also often interpreted to include other trade-related costs. In addition to this, there exists a plethora of variables used to capture friction on the link, such as common border or common history (as captured by e.g. colonial relationships). In this thesis, variables measuring immigration, news flow and demand similarity will be used in order to analyze trade flows and to what extent the mentioned variables can reduce friction.

2.2.1  Start-up and persistence of links

A good way to understand some of the characteristics of networks is by posing the question: Would you be interested in subscribing to a telephone if there were no other users? Obviously, few people would be interested in doing so.
The network externalities, i.e. that the decision to join a network affects not only the person joining but also the previous members of the network, is a prominent feature of network industries such as telecommunications, and imply that the start-up of the network is critical. Once the network reaches a critical mass, diffusion gathers momentum (an overview of diffusion models is provided by Geroski, 2000). Hence, one of the first characteristics of networks that may be observed is that the value of a network increases with the size of the network, and a successful diffusion of a technology is often described by a logistic curve.

For certain networks there may be high fixed costs associated with starting up a link. A typical example of this is the high start-up costs of firms deciding to enter new markets. Andersson (2007) and Roberts and Tybout (1997) find a significant impact of sunk costs in entering new markets in their study of Colombian exporting firms. Plausibly as a result of high entry costs, firms typically trade with partners in a few countries. This is noticeable also at the aggregate level; Helpman, Melitz and Rubinstein (2007) find that only half of the country pairs, created from a data set of observations from 158 countries, actually trade with each other. When actors are not able to recover the incurred costs, there are strong incentives to i) only commit to projects when the costs can be covered by the profits and ii) make sure that the links are maintained. High fixed costs can therefore be expected to create path dependence; links that are already established can be expected to remain over a long period of time.

Transaction costs matter not only for the start-up of a network; they matter also for the flows on the existing links, and the strength of these flows. The next section will therefore deal with friction on the links.

2.2.2 Friction on the links

The distance between two nodes is often used to proxy transport costs, but in many cases it is also interpreted as a proxy for other types of costs that constitute frictions on the flow between the nodes. It seems that even in the case of low formal trade barriers, there are additional costs associated with international trade. There is a well documented phenomenon in international trade which can be called the ‘border puzzle’ – as soon as goods need to pass a national border, trade is significantly reduced (McCallum, 1995). Home bias is not unique for goods trade; countries have also been found to invest ‘too much’ within their own borders (Feldstein and Horioka, 1980). It may even be possible to observe the home bias phenomenon within and country as is the case of Coval and Moskowitz (2001) who found that investors often prefer to invest locally even within a country. A possible explanation for this is that the

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1 The observation that diffusion follows an S-shape is often attributed Griliches in his pioneering work on hybrid corn (Griliches, 1957).
access to information is significantly reduced even when compared to other parts of the country. Frictions are therefore not only relevant in an international setting but should be considered a very general spatial phenomenon.

Since the issue of the ‘border puzzle’ was raised by McCallum (1995) there have been different solutions suggested to solve the puzzle through better specifications of the gravity model and control for what can be called multilateral resistance. Multilateral resistance is by now frequently included in models of international trade, and several ways of taking this into account have been suggested. One common method is using country fixed effects (Rose and Van Wincoop, 2001, Anderson and van Wincoop, 2003), or to calculate remoteness variable as suggested by Baier and Bergstrand (2002) and Carrère (2006), or by using a price index as described in Anderson and van Wincoop (2003). A fourth method of taking multilateral resistance into account is by using the method suggested by Mundlak (1978), in which he argues that fixed effects are functions of explanatory variables in the model, and therefore it is possible to calculate average values of trading parties’ characteristics and include them as explanatory variables.

Another strand of literature more directly focusing on identifying what types of costs that may lie behind ‘the border puzzle’ and put them into trade models. Clearly, any type of economic exchange requires some sort of transaction costs, or what Coase in his early works referred to as “costs of using the price mechanism” (Coase, 1937). There is good reason to believe that transaction costs should be especially important in cases when exchanges take place between individuals that are far away from each other; no matter if the distance is geographic or social in nature. The term transaction costs may not always be referred to specifically in network theory or international trade theory, but it nevertheless is a most fundamental element for transactions across national border.

Transaction cost theory has been developed by among others Coase (1937) and Williamson (1979). North and Thomas (1973) divide transaction costs into three parts: (i) search costs, (ii) negotiation costs and (iii) monitoring and enforcement costs. Recent studies have focused on the role of social networks in international trade. Search or information related costs can be exemplified by a firm considering entering a new market (i.e. opening up a new link). In a world of zero transaction costs, finding the ideal export market, or for that matter the ideal export partner within that market, should be straight-forward. However, empirical findings clearly suggest that firms face high entry costs associated with entering new markets.

The second type of transaction costs refers to negotiation costs. These costs can be significantly increased by the lack of knowledge of the local culture and business environment in a country. Clearly, trading with a country with which you have a lot of contact, perhaps share a common language with or have similar cultural background, may make negotiations easier.
Also enforcement and monitoring costs may be greatly reduced by social ties and mutual trust (Hart and Holmström, 1987). In an article on contract enforcement, Dixit (2003) shows that honesty can be expected to be self-enforcing only in cases where trading partners are sufficiently close, since the information of cheating has a local bias. Proximity implies that it is more likely for transactions to be repeated between agents, and therefore the incentives not to cheat are higher than in the case of very remote partners. In our context, an exporter may prefer to trade with countries in which they are familiar with enforcement procedures. In general, contract enforcement may become very complicated in the case of international relations (Yarbrough and Yarbrough, 2003). At the same time, certain international initiatives such as the foundation and evolution of the European Union may imply a considerable reduction of these costs.

To summarize, all three types of transaction costs can be expected to be lowered by trading with familiar partners.

2.3 The Gravity Model

Gravity models provide a method for the study of flows within networks and a frequently used tool in international trade analysis, but also in other areas such as finance (see e.g. Flavin et al., 2002, Portes and Rey, 2005). The name of the gravity model stems from The Law of Universal Gravity as developed in Philosophiae Naturalis Principia Mathematica by Newton (reprinted in Newton, 1972), which states that a point mass attracts another point mass by a force which is proportional to the product of the two masses, and inversely proportional to the square of the distance between the masses. In economics, the power of gravity has become the attraction between two regions (nodes). In international trade, the gravitational force translates to trade flows and thus the prediction is that trade flows can be expressed as a function of the economic masses of the countries:

\[ X_{ij} = F(Y_i, Y_j, \tau_{ij}) \]  

\( X_{ij} \) is the flow between the countries (nodes), generally measured as the volume of trade. The flow is directed by attraction of the masses, \( Y_i \) and \( Y_j \), which are often proxied by using the gross domestic product of country \( i \) and \( j \) respectively. \( \tau_{ij} \), is a friction component which contains a vector of trade-related costs, \( Z_{ij} \) often expressed as

\[ \tau_{ij} = \exp (-Z_{ij} \beta) \]  

\( 2 \)
Tinbergen (1962) and Linnemann (1966) were among the earliest to introduce this type of large-scale modeling which has subsequently become standard in interregional trade studies. Due to its empirical success, the gravity model has become perhaps the most commonly used to model in international trade. There has been criticism concerning the theoretical underpinnings, or rather the lack of theoretical underpinnings, to the model (see e.g. Feenstra et al., 2001). After the 1970s a great emphasis was put into showing that the gravity model is consistent with a micro-economic foundation (Bröcker, 1989). The gravity model has been shown to be consistent with various economic frameworks, such as Ricardian (Eaton and Kortum, 2002), Heckscher-Ohlin (Evenett and Keller, 2002) and increasing returns (Anderson, 1979, Bergstrand, 1985). The compatibility of the gravity model and several alternative economic theories makes it a very useful analytical tool. Furthermore, the gravity model can be derived from entropy maximization as developed by e.g. Wilson (1967). It can be illustrated by a trade matrix where exporters are on the vertical axis and export destinations on the horizontal axis. Entropy maximization is then used to calculate the most probable distribution of exports and fill each cell with the export value of the corresponding exporter and importer, so the rows summarize to total export from a country and the columns summarize total imports.

To summarize, the current state of research suggests that the gravity model can provide a general framework for estimating trade flows and does not per se require a specific theoretic framework. The gravity model is consistent with several different theoretical frameworks, but it can also be derived from entropy-maximizing principles.

The gravity model is often ‘augmented’ by adding a number of explanatory factors. One of the most common types of augmentation is the inclusion of the log of per capita income, often as a way to capture the effect that richer countries tend to trade more. One explanation of this is the better quality of infrastructure available in richer countries. There are however also factors acting in the opposed direction since richer countries have a higher share of service to GDP, and services are to a large extent considered to be non-tradable goods. An alternative to using per capita income that exist in the literature is the use of population size. Baier and Bergstrand (2002) contend:

‘Populations (or alternatively per capita incomes) now have a straightforward interpretation in the gravity equation. Higher populations (for given incomes) reduce the capital-labor endowment ratios of the two countries, tending to reduce the capital-intensive industry’s share of national output in both countries. If goods are capital intensive, then goods trade should fall (relative to national outputs)’

(Baier and Bergstrand, 2002)
Furthermore, variables capturing trade frictions are often included. The trade-related costs are often captured by geographic distance, but also other factors affecting costs of trade have become commonly employed. These factors may increase costs (such as tariffs and non-tariff barriers) or decrease costs (such as affinity measures and free trade agreements).

3. Methodological aspects

As the application of gravity models in international trade is at the same time extensively used and yet has remained questioned from a theoretical perspective, one section will be devoted to the background and role of the model (or rather, the group of models referred to as the gravity model).

The final section will be devoted to a discussion on data; availability, application and quality of the data used in this thesis. It is often said that necessity is the mother of invention, and anybody interested in distributional aspects will very soon realize that research in this area is restricted by the availability of the data. It is true that the quality and availability has been greatly improved, but the restriction is still noticeable for the empirical researcher. In three papers, Knowing me, knowing you, Everybody knows?, and Income distribution and the diffusion of networks: An empirical study of Brazilian telecommunications, this lack of data resulted in the application of methods that perhaps are unorthodox, but that seemed intuitive and useful for the purposes of the papers. In two chapters, kernel estimates have been applied to make relatively crude income data more applicable to the circumstances. In Everybody knows?, the number of newspaper articles written about countries serve as proxies of information flows.

3.1 Data

The theoretical foundations of the papers are similar in the sense that they rely on micro-founded theory, but are empirically tested at the aggregate level. All chapters in the thesis are empirical works and as such highly dependent on the availability and quality of statistics. Furthermore, most chapters contain some type of cross-country analysis which implies that methods and measurement and methods for collecting the data may differ.

Data on international trade are collected from two sources; for the full gravity models, i.e. when both imports and exports of all countries are included in the study, the data are collected from UN Comtrade. The two papers focusing on Swedish exports use Swedish export data from Statistics Sweden.

Income distribution data have historically suffered from both poor quality as well as poor availability, but the quality of the data have improved greatly over
the last decade. The problems of the data arise from the fact that income distribution is calculated from household surveys, which are expensive to conduct and therefore not collected as frequently as many other types of socioeconomic data. In addition to this, although several initiatives exist aiming for international standards for collecting income and expenditure type of data, the quality of data still differs over time and across countries which complicates international comparison. Expenditure data are often considered as more advantageous than income data (Deaton, 1997) for different reasons. First, there is less incentive to lie about expenditure than about income. Secondly, consumers tend to smooth their expenditure and expenditure data are therefore less volatile and sensitive to timing than is income data. However, expenditure data are difficult to find, especially for cross-country comparisons. One exception is Luxembourg Income Study, but a drawback of this data set is that it covers relatively few, and especially, it has little data on developing countries. Instead, income distribution data are collected from the UNU-WIDER data base (UNU-WIDER, 2005) and in the case of the last paper, from a joint national Brazilian project organized by UNDP, IPEA and Fundação Getulio Vargas (UNDP, 2000). All data and estimates are based on disposable per capita income. In the case of the UNU-WIDER data set, some national data sets have been excluded due to poor quality.

3.2 Methodological aspects of income distribution

There are several reasons to expect the distribution of income within an economy to affect the overall performance of the economy, but in this thesis the issue in focus is how the distribution affects the consumption behavior of households or individuals. The study of non-homothetic preferences and its effect on aggregate demand has received a lot of interest lately, and a comprehensive overview is provided by Bertola et al. (2006).

The most common method by far in measuring and comparing different types of distributions is the use of one of the aggregate indices such as the Gini coefficient and the Theil index. The Gini index is calculated from the Lorenz curve and is defined by the area between the Lorenz curve and perfect equality. Since it is expressed as a ration, it takes a value between 0 and 1 where 0 is perfect equality and 1 is perfect inequality. The Theil index is an entropy measure and can be explained as the probability of one dollar randomly drawn comes from a particular individual.

They both have an important quality in that they provide ways of comparing the distribution between countries or regions, a quality which probably is the explanation of their widespread popularity. The Theil index
may be more difficult to interpret\footnote{Amartya Sen (Foster and Sen, 1996) even wrote that the Theil index "is not a measure that is exactly overflowing with intuitive sense".}. However, any attempt to capture a lot of information in a single index will imply some loss of information. An example of this is the problem that the same Gini coefficient may be calculated from two different Lorenz curves.

Applying an empirically valid distribution function to develop a model is a complicated task not only because of analytical complexity, but because income data may simply not allow itself to be fitted into a single functional form. Empirical studies often find income distribution characterized by two different types of distributions: one for the lower end of the stratum and one for the upper one. For example, in their study of Brazilian income inequality in the 1980s, Cowell et al. (1998) use the log-normal kernel density estimates to model the lower tail of incomes and Pareto distribution for the upper tail. Bohman and Nilsson (2007) perform formal testing of deciles of disposable income in 47 countries and find that none of the Pearson family type of distributions provide a good fit of the data. For that reason, a non-parametric approach like kernel smoothing may be more appropriate for empirical studies rather than forcing data into a specific functional form.

4. **Summary and contributions of the chapters**

A general idea in the literature on social networks is that similarities can serve as a social glue and reduce some of the costs associated with economic transactions. This idea is also present in several chapters of this thesis. Chapter 3 and 4 follow this tradition and investigate the role of international migration and information flows on Swedish trade patterns. Chapter 2 is also concerned with similarities between trading partners, but the focus is on similarities in terms of income structure. The idea is that similarity of demand may induce trade between countries, a hypothesis which in the economic literature has become known as the Linder hypothesis (Burenstam Linder, 1961). Income characteristics are also the focus of Chapter 5, but in this case the concept is used as an explanatory factor to how networks are created. The chapters are presented in the order they appear in the thesis.
4.1 Knowing me, Knowing you: A new approach of assessing the Linder hypothesis

Although most explanations to why countries trade and with whom they trade rely on supply side explanations, there are also theories focusing on the demand side. One of the most famous demand-side theories is the so-called Linder hypothesis, based on the seminal work by Bureanstam Linder (1961). The hypothesis states that countries trade with other countries that have the same demand structures. The first chapter of the thesis, ‘Knowing me, Knowing you’, is co-authored with Désirée Nilsson and presents a new method of comparing income distribution between countries. This is used to perform a test of the Linder hypothesis. Rather than using average measures of income, the implicit point of departure of the paper is Engel’s law, which states that consumers shift their consumption when their income changes. Consumption studies reveal that there are some very general patterns to consumer behavior that seem to prevail in developed and developing countries alike (Bohman and Nilsson, 2007). Once this conjecture has been accepted, this implicitly assumes some type of hierarchical preferences that affects aggregate demand. In an international trade setting, this implies that we should not only consider the average income but also the distribution of income when interpreting the Linder hypothesis. In order to do so, we use kernel estimates on disposable income data in order to compare two countries cumulative distribution functions and from this it is possible to calculate the overlapping demand between the two countries. This generates an index between 0 and 1 which increases the more similar income distribution between two countries are, and this can then be interpreted as a market overlap index. The index is then used in an augmented gravity function to test the Linder hypothesis.

The contribution of the article can be divided into an empirical and methodological context. The empirical analysis confirms the Linder hypothesis at a sectoral level and it seems to be especially important for differentiated products, which is in line with expectations. In terms of methodology, the article provides a framework for including more information on income or expenditure patterns within a country, although for now the limited availability of data restraints the application. Nevertheless, the availability and quality of income data is continuously being improved and therefore methods using the information available through this type of data should become of increasing interest.
4.2  Stranger in a Strange Land: The effect of international immigration on Swedish trade

The starting point of the third chapter is the role of individual networks as a potential source of knowledge in export activities. In this chapter the role of networks is somewhat different than in the previous chapter in that it focuses on the role of networks as a rationale for trading. The networks in question here are networks stemming from a common national background, and how these in turn may affect trade flows when people migrate across international borders. There are some previous studies on how international migration affects international trade (Gould, 1994, Head and Ries, 1998, Wagner et al., 2002), and this paper adds to the literature by focusing on the Swedish case which has had a different type of immigration-related institutions than the US or Canada, which have been in focus in previous studies. Immigration to Sweden during the last couple of decades has consisted to a large extent of refugees rather than labor-market motivated migration. The large flow of refugees in the 1990s coincided with one of the worst economic crisis of Sweden in modern history which made integration into the labor-market a complicated matter. Many immigrant groups have faced difficulties in their integration into the labor market and unemployment levels have been high. A natural question that follows is therefore: Has the labor-market oriented problems off-set potential effects of immigration to Sweden?

The results suggest that even though Sweden has faced labor-market-oriented problems, the positive results of migration on especially exports remain.

4.3  Everybody knows? Media, Information, and Exports

The third chapter is similar to the second in that the focus lies on the role of information in international trade, and the underlying idea is that countries export to countries they are familiar with. Here, the focus lies on the role of information flows. The chapter contains two main contributions. First, it is suggested that rather than treating information flow as a symmetric concept between countries, it is an asymmetric concept. Most measures used on familiarity such as common language (Rose, 2005) or colonial heritage (Rauch, 1999, Freund and Weinhold, 2004) or even measures of information such as telephone traffic (Portes and Rey, 2005) are symmetric; i.e. they implicitly assume that inhabitants of country A know as much about country B as inhabitants of country B know about country A. In this paper, instead of taking information as given, the determinants of information flows are estimated in a gravity model and found to be highly correlated to the size of the economy and distance. Secondly, the information model in inserted in a trade model to create
a two-stage model and the result is that information flows are one of the most important explanatory factors in the model. GDP and distance are important in a direct sense and in an indirect sense; the indirect contribution being a result of the fact that the larger and the closer the economies, the more familiar they are.

4.4  **Income distribution and the diffusion of networks: An empirical study of Brazilian telecommunications**

The final chapter focuses on how physical networks are built and the role of demand in the diffusion process. Specifically, the paper focuses on the role of income distribution in the diffusion of fixed telecommunications in Brazil. Based on the assumption that a household will need a certain level of income in order to be able to afford installing a fixed telephone in their house, it follows that not only the average income in a region but also the distribution of income matters in shaping aggregate demand for access. Previous work (Milne, 2000) predicts that diffusion in poor regions should be faster for regions with an unequal distribution of income since the skewed distribution implies that at least a few households are able to afford access to telecommunications. For an equally poor region with a more even distribution of income, even the richest households may not be able to afford it. The results suggest that the opposite is true for higher income regions: For richer regions, a more even income distribution helps to speed up the diffusion process whereas the more unequal regions demonstrate significantly lower penetration ratios.

In this paper, the share of population above a calculated critical income level are estimated from kernel estimates based on quintiles of disposable per capita income. From these estimates, it is possible to use elasticities in order to show the link between income distribution and the percentage of people above the estimated threshold. This confirms the predictions by Milne and provides a link between the theoretical framework and the application of standard measures such as the Gini index. The empirical calculations are based on Brazilian data for fixed telecommunications at municipality level. The findings support the predictions of the role of income distribution in the process and the findings are robust to different model specifications.

The contribution of this paper is first of all the analysis of the role of income distribution in network diffusion applied on empirical data. Secondly, it provides a simple theoretical framework which is linked to the empirical section and which provides a rationale for the use of relatively easily obtained measures such as the Gini index, and third, it provides a thorough discussion dismissing the claim that causality should be reversed.
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Chapter II

Knowing me, Knowing you:
A new approach of assessing the Linder hypothesis*

Helena Bohman
Désirée Nilsson**

Abstract
The Linder hypothesis states that countries will trade more intensively with countries that have similar structures of demand. Previous measures of the Linder hypothesis rely only on average values of income, hence ignoring the fact that also the distribution of income may affect aggregate demand. We suggest a new method of comparing the income distribution between two countries, and use the suggested measure as a measure of the demand overlap between the two countries. This variable can then be used to assess the Linder hypothesis. Results show that similarity in structure of demand boost trade flows between countries and similarities in preferences are more important for differentiated goods than homogenous goods. The created demand overlap variable is also contrasted to previous Linder variables.

Keywords: Linder hypothesis, income distribution, hierarchical preferences, overlapping demand, quantile regressions

JEL Codes: F10, D31

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Chapter III

Stranger in a Strange Land: The effect of international immigration on Swedish exports and imports

Helena Bohman*

Abstract
There is a relatively large literature discussing the role of networks in international trade. Since export features high fixed costs and uncertainty, countries tend to trade with countries they are familiar with, and there is a high level of path dependence. One way to increase familiarity is through international mobility of labor; previous research focused on Canada and the US confirms that migration may have a significant impact on the on trade. Migrants may provide knowledge of their home countries and also contribute with their own existing networks which can be useful for export activities. This paper addresses the effect of immigration on Swedish trade. The Swedish case differs somewhat from experiences in North America in that immigration during the last three decades primarily has been constituted by refugees rather than labor immigrants. The purpose of the paper is to analyze whether this link has an impact on the strength of the trade links. Still, the results show a clear and consistent positive contribution of immigration to exports. Contrary to previous research, the effect of immigration on imports is at best weak.

Keywords: migration, international trade, ethnic networks

JEL: F22,F23

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Chapter IV

Everybody knows?
Media, Information, and Exports

Helena Bohman

Abstract
This paper focuses on the role of information in international trade. Recent literature has acknowledged the role of social networks for understanding trade patterns. This paper focuses on the determinants of media flows, which are used as a proxy for the information received from different countries. The results suggest that information flows depend highly on the population size of the market in question, as well as income level and distance to the market. Secondly, international trade is estimated in a structural equation model showing that information is important to explain trade flows. Traditional indicators, such as income level and distance, turn out to have a direct as well as an indirect effect, since these indicators also determine how familiar the countries are. The findings are robust to several different specifications and estimation techniques.

Keywords: familiarity, information flows, media coverage, international trade

JEL: D80, F10

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Chapter V

Income Distribution and the Diffusion of Networks: An Empirical Study of Brazilian Telecommunications*

Helena Bohman

Abstract
Telecommunications is often considered to be an important contributor to economic growth, and most countries have therefore adopted several initiatives to improve coverage of fixed as well as mobile telephones. This paper focuses on the role of income distribution on the diffusion of fixed telecommunications in Brazil. The focus is on how the distribution of income may affect affordability and thereby the market size. The result is that an uneven income distribution may result in higher coverage for the poorest municipalities in the study since the uneven distribution allows for at least some consumers to reach the critical level of income. For municipalities above a certain average income level, the effect is reversed and coverage will be adversely affected by high inequality. The findings are robust to different measures of inequality.

Keywords: Income distribution, telecommunications, Universal access, Affordability

JEL Classification: D12 D31 L96

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