Time Zones, Communications Networks and International Trade

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Preface

Over the past two decades, communications networks have come to play a crucial role in economic activities in the world economy. Due to communications revolutions, we can transmit voice, graphics, and large volumes of digitized data instantly and at close to zero marginal cost to large populations around the world. Yet relatively little attention has been paid to the relationship between communications networks and international trade. This volume, a collection of essays that represents my work on international trade and communications networks over the past 15 years, intends to fill this gap.

I am indebted to my teachers in Otaru University of Commerce, Kobe University, and Simon Fraser University for kindling my interest in the subject matter of economics. Masao Satake, Hideki Funatsu, Jun-Ichi Itaya, the late Kiyoshi Ikemoto, Kazuhiro Igawa, Masayuki Hara, Seiichi Katayama, the late Koji Shimomura, Junichi Goto, Fumio Dei, Hiroshi Ohta, Tetsuya Kishimoto, Takeshi Nakatani, Noritsugu Nakanishi, John Chant, Richard Harris, Steve Easton, Nicolas Schmitt, and James Atsu Amegashie have been instrumental to my early and continuing interest in the discipline.

Quite a few of the chapters in this volume are drawn from joint contributions I made with several of my teachers and friends. I would like to thank Ngo Van Long, Kazumichi Iwasa, Sugata Marjit, the late Koji Shimomura, and Dao-Zhi Zeng for their kindness. I would also like to thank David Anderson for editing almost every manuscript included in this book. To communicate with overseas teachers and friends via communications networks (with some time zone differences) is one crucial driving force for my research.

Over the years, interactions with many people have benefited me immensely in clarifying my concepts. Notable among them are Kenzo Abe, David Anderson, Mitsuyo Ando, Koji Aoki, Kosuke Aoki, Eric Bond, Kwan Choi, Ichiro Daitoh, Colin Davis, Junko Doi, Masahiro Endoh, Wilfred Ethier, Kenji Fujiwara, Marcelo Fukushima, Taiji Furusawa, Koichi Hamada, Tetsugen Haruyama, Kenichi Hashimoto, Masayuki Hayashibara, Yunfang Hu, Makoto Ikema, Jota Ishikawa, Takatoshi Ito, Takekazu Iwamoto, Naoto Jinji, Ronald Jones, Jiandong Ju, Takashi Kamihigashi, Murray Kemp, Fukunari Kimura, the late Kazuharu Kiyono, Kozo Kiyota, the late Kiyoshi Kojima, Kenji Kondoh, Hiroshi Kurata, Sajal Lahiri, Edwin Lai, Chia-Hui Lu, Mutsumi Matsumoto, Naoki Mitani, Eiichi Miyagawa,

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Teaching international trade theory to both graduate and undergraduate students at Kobe University provided me with quite interesting opportunities. Some of the ideas for the chapters in this book came from casual conversations with my students. I would like to say thank you to my colleagues and my students.

The organization of this volume would not have been possible without the able assistance of Yong-Ling Lam, the Associate Editor for Routledge. Comments from anonymous referees were most helpful. I am also indebted to Routledge for their interest and encouragement.

Finally, I am grateful to my wife Chiharu for all of her help, guidance and support. She also teaches Industrial Organization. Her suggestions on several topics in this book have been quite helpful. I appreciate the comments from my mother and my mother-in-law, Noriko and Chieko, who have checked almost every chapter in this book. I am also grateful to my son Takatoshi who always provides me with inspiration. I thank them all.

Contents

1 Introduction

1.1 Communications networks and international trade

Over the past two decades, communications networks have come to play a crucial role in economic activities in the world economy. Communications networks are the infrastructure through which different parties communicate with each other. Traditional examples include postal and telecommunications systems; more recent examples of communications networks are the Internet and related networks, satellite communications systems, mobile telephone networks, etc., which have raised international business transactions to a new level. Innovations in communications technologies enable us to transmit voice, graphics, and large volumes of digitized data instantly, and at close to zero marginal cost, to large populations around the world. Motivated by these changes, the role of new types of communications networks in the world economy has been widely discussed.

What are the major implications of these new types of communications networks for world trade? Rapid technological change in communications networks has a dual impact on the economics of world trade: it affects both trade in goods and trade in services. The following subsections explain each point briefly.

Communications networks affecting trade in goods

Changes in communications networks can increase the quality and speed of coordination activities between two agents. For example, improved communications networks make communications with a central office or with customers more efficient. These improvements facilitate the cross-border *fragmentation* of production processes. To put it another way, as communication links improve, the incentives for specialization and outsourcing expand.[1] In this context, services provided by communications networks are at the very core of the internationalization of economic activities, providing connections and allowing the coordination of geographically separated production processes.[2]

Several articles have been devoted to the study of various aspects of fragmentation. In their seminal contribution, Jones and Kierzkowski (1990) argued that fragmented technology requires *service links*, which are mainly provided by information and communications networks, to connect separated production

blocks. Deardorff (2001a) argued that liberalizing trade in services facilitates fragmentation, which, in turn, stimulates trade in goods. The link between services and fragmentation of production processes is further explored by Long, Riezman, and Soubeyran (2005).[3]

Communications networks affecting trade in services

Service transactions are often characterized by the requirement that there be a *double coincidence in both time and space* of the proximity of the buyer and the seller. In other words, production and consumption of a service must generally take place simultaneously.[4] This non-storable nature of services implies that production and consumption tend to occur at the same time and in the same location.

However, the new types of communications networks, at reasonably low cost, break the necessity for the buyer and the seller to be in the same location, even though the coincidence in time may not be broken. In a series of articles, Harris provides insightful findings on this aspect.[5] In particular, Harris (1998, p. 146) suggests that the improved communications networks create a form of "virtual mobility" of services and thus enhance the international trade of these services, which was not previously possible.[6] In other words, technological advancement in communications technologies tends to increase the tradability of services to the extent that they make it easier to unbundle the production and consumption of information-intensive service activities: research and development, software development, data entry, inventory management, quality control, accounting, personnel, secretarial, marketing, advertising, distribution and legal services. Grossman and Rossi-Hansberg (2008) called these situations *trade in tasks*.

The above point may be summarized by a classification of service transactions that uses the physical proximity of consumers and providers as a reference point (see Figure 1.1).[7] Most international transactions in services require either the consumer to move to the location of the producer (e.g., tourism) or the factors of production to move to the place of consumption (e.g., the provision of certain business services). In Figure 1.1, the former is classified as Type 2 and the latter as Type 3. As has already been pointed out, however, there are services that can be traded internationally in a similar fashion to goods via cross-border supply (Type 1 in Figure 1.1); neither consumers nor providers move. The improved communications technologies change Type 2/Type 3 service transactions into

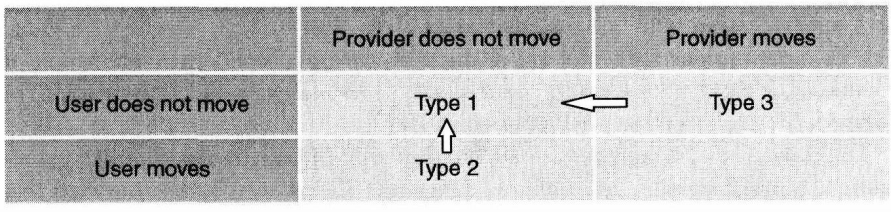

Figure 1.1

Type 1 transactions. The rise of distance education is one of the major examples (Type 2 to Type 1), and the rise in overseas call and help centers is another (Type 3 to Type 1).[8]

Due to communications revolutions, will all service transactions become Type 1 in the near future? Related to this point, Leamer and Storper (2001) emphasize that while the new types of communications networks (e.g., the Internet) transmit simple *codifiable* messages with ease, it is not so with complex *uncodifiable* (context-dependent) messages, by which "close relationships" are made.[9] They also review the impact of innovation in transacting technologies and argue that previous rounds of infrastructure improvement always have had a double effect: (1) permitting dispersion of certain routine activities, but also (2) increasing the complexity and time dependence of productive activity, and thus making agglomeration more important.[10] The coordination of new and innovative activities depends on the successful transfer of complex uncodifiable messages, requiring a kind of closeness between the sender and receiver that the Internet does not allow. Based on their argument, we can predict that, while many service transactions are moving from Type 2/ Type 3 to Type 1, more new service transactions are entering as Type 2/Type 3, or are only provided domestically. Not all service transactions become tradable. Somewhat ironically, as more and more service transactions do become tradable, the value of being close and making "face-to-face" contact becomes higher.

The above argument also suggests that even Type 1 service transactions are *not* automatically made possible by the introduction of new types of communications networks. Leamer and Storper (2001, p. 660) list the limited number of "faraway" countries that have overcome the force of gravity (i.e., distance): the older Anglo-Saxon countries (New Zealand and Australia), and more recently Taiwan, Singapore, and, increasingly, Ireland. The experiences of these countries strongly suggest that there is a long and difficult (though not impossible) process of creating the *relational networks* necessary to become part of the world core.[11] Although interaction via communications networks may help to create and maintain these relational networks, it cannot be a substitute for the relational networks themselves.[12] This might be especially true for the higher order activities of invention, innovation, and management. Related to this, Jones and Marjit (2001) argue that the role of young generations (who are familiar with new types of communications technologies) in developing countries has become more important as a determinant of those countries' development process.

Until now, we have discussed the impact of new types of communications networks on trade in services. Based on the above discussion, one factor emerges as a key driver of world trade: *time zone differences between countries*. The following subsection describes this as an important aspect of new types of communications networks.

Time zone differences as a determinant of service trade

Usually, time zone differences bear significant costs of doing business across countries and have a negative impact on world trade flows. With reference to this

point, Stein and Daude (2007) consider time differences in the context of the location of foreign direct investment. They found that transaction costs associated with time zone differences are important for frequent real-time communications between corporate headquarters and their affiliates.

However, for some kinds of service transactions, the utilization of different time zones enables more efficient production. In a recent contribution, Marjit (2007) argues for the inclusion of time zone differences as a determinant of trade patterns.[13] Here, we would like to indicate two possible sources of service trade with time zone differences.[14]

1 *Continuity effect:* By operating around the clock (i.e., by passing a project electronically from a country whose workday has ended to a country whose workday is just beginning), it becomes possible to take advantage of the full twenty-four hours of the world's workday. This kind of *continuity effect* increases firms' productivity.

   One of the major examples is the "remote maintenance" whereby Indian companies debug software for companies in other parts of the world, often taking advantage of time zone differences to offer overnight service. Another example is the use of the design teams in New Zealand, India, Ireland, and Canada to work on the same project and to "pass it on" westward during the day, a practice that is being used by some software and engineering firms to cut down on development cycle times.[15]

2 *Synchronization effect:* Another important source of trade with time zone differences is related to the "coincidence in time" aspect of service transactions. Trade with different time zones is gainful when *fulfilling nighttime demand in one country by utilizing daytime supply in the other country*. In general, nighttime wage rates are higher than daytime wage rates. Thus, utilizing communications devices makes it possible to take advantage not only of the international wage rate differences but also daytime/nighttime wage rate differences.

It is important to note that these kinds of service trade may be interpreted as new versions of *periodic intra-industry trade*.[16] Traditionally, trade in (perishable) agricultural products, electricity, and similar goods is based on predictable, periodic fluctuations in countries' production of, or demand for, these commodities. As for agricultural products, for example, the cycle is seasonal, based on the *differences in climatic zones*. This book emphasizes that, due to communications revolutions, similar kinds of trade based on the *differences in time zones* emerge. It is also important to note that this type of trade is crucially dependent on the degree of codifiability of service transactions.

These new types of trade in services, made possible by modern communications networks, have drawn a great deal of media attention. However, many economists are quite skeptical about the role of these types of trade. In all likelihood the new types of service trade play a relatively limited role in total world trade. Furthermore, it seems clear that differences in time zones are not the sole

determinant of services trade. The complementary/substitutional effects on building relational networks must be clarified. However, the possibility that trade reducing factors can become trade enhancing via technological changes needs further investigation.

Although there are several restrictions, due to the communications revolution, utilization of both communications networks and time differences may become a primary driving force behind world trade. In the existing literature on trade theory, however, relatively few attempts have been made to address the theme of communications networks and the role of time zones.

One of the main purposes of this book is to explain, with simple trade theory, how the new types of communications networks can affect the nature of world trade. For this purpose, several types of international trade models are built. I also pay special attention to the role of time zone differences as a key driver of new types of world trade (mainly trade in services). Other technological aspects of recent international trade (e.g., competition between international standards, the impact of switching costs on imported products' introduction) are also examined. I hope that the analyses of these trade models will help the understanding of the world economy with rapidly improving communications technologies.

1.2 The book's structure

Part I: Preliminaries

Part I lays some groundwork for the analysis. It begins with a restatement of the conventional Ricardian trade model (Chapter 2). It then describes the basic "new trade theory" model of monopolistic competition, which has been popularized by a series of works by Paul Krugman (Chapter 3).

I also pay special attention to the model of monopolistic competition with iceberg trade costs (Chapters 4 and 5). The reason is twofold. For one thing reductions in *marginal* trade costs (e.g., transport costs and tariffs) and related "Home market effect" are real issues. At the same time, in order to capture the aspects of utilization of time zone differences, the model of monopolistic competition with iceberg transport costs will be useful as a benchmark.

Part II: Communications networks and time zones

Based on preliminary groundwork in Part I, Part II develops approaches to trade with special emphasis on communications networks and time zone differences.

The first three chapters (Chapters 6–8) concentrate on the role of communications networks as a determinant of comparative advantage. The next three chapters (Chapters 9–11) turn to the role of time zone differences as a source of comparative advantage. In the first three chapters I emphasize two aspects of communications networks: (1) *country specificity* of communications networks, and (2) *interconnectivity* of communications networks.

1 *Country specificity of communications networks:* Country specificity reflects the fact that communications services are often provided by national (government-owned) monopolies. In other words, most countries pursue policies of one kind of another that restrict the access of foreign communications service providers to the domestic market. In such a situation, the quality and scale of the communications infrastructure within a country, and the number and sophistication of people using that infrastructure, become ever more crucial factors in determining the performance of the country's economy. Related to this, Roller and Waverman (2001) argue that both developing and developed economies require a healthy, dynamic telecommunications sector if they are to prosper in an increasingly global economy.[17]
2 *Interconnectivity of communications networks:* Interconnectivity allows network users in one country to communicate with users in another country.[18] If a network located in one country is purely country-specific and is not connected to the internationally interconnected networks, users of the former will be at a disadvantage.

   The concept of interconnectivity is also related to Leamer and Storper's "relational networks" as reviewed in the previous section. If cultural, relational, and linguistic barriers continue to hinder the full interconnection of communications networks, then one of the first effects of trade liberalization will be an increase in inequality among nations.[19] Differences in interconnectivity among countries reflect the difficulty of creating relational networks among countries.

Based on these two aspects, Part II examines the relationship between communications networks and world trade. The contents are as follows.

Chapter 6 develops a basic model of monopolistic competition that captures the role of *country-specific* communications networks in determining the comparative advantages of countries. A communications network is characterized by: (1) the existence of a large fixed cost for its construction; and (2) a public monopoly that employs average cost pricing. It is demonstrated that the size of a country, measured by the size of the country's endowment of factors of production, determines its comparative advantage.

Next, in Chapter 7, a multi-country model of trade is developed that captures the role of country-specific communications network interconnectivity, which enhances trade in intermediate business services. The number of countries connected to internationally interconnected networks is found to determine the structure of comparative advantage. That is, countries with interconnected networks have a comparative advantage in the product that requires business services provided via networks. In connected countries, producers of that product benefit from the efficient transmission of business services. This chapter also demonstrates that countries whose country-specific networks are not connected to the interconnected networks may become worse off as the result of trade.

In Chapter 8, I develop a model of trade that highlights the effects of the interconnection of country-specific communications networks as a driving force

behind trade in high-tech products with positive transport costs. By constructing a two-country model of monopolistic competition with two production factors, it is shown that the locational decisions of firms may magnify the influence of interconnected networks. In a reversal of the standard home market effects, the abundance of unskilled labor in the developing countries can attract high-tech firms from the developed countries.

Chapter 9 proposes a three-country model of monopolistic competition that captures the role of time zones in the division of labor. The connectivity of business service sectors via communications networks (e.g., the Internet, satellite communications systems) is found to determine the structure of comparative advantage. In other words, two countries with connected service sectors have a comparative advantage in the good that requires business services.

Chapter 10 proposes a two-country model of service trade that captures the role of time zone differences as a determinant of trade patterns. It is shown that the utilization of communications networks induces dramatic change in industrial structure due to firms taking advantage of time zone differences.

Finally, in Chapter 11, I propose a two-country growth model of intermediate business services trade that captures the role of time zone differences. It is shown that a time-saving improvement in intermediate business services trade involving production in different time zones can have a permanent impact on productivity.

Part III: Network effects and switching costs

Networks are often characterized by the existence of strong *network effects*: the more people who use them, the more useful they are to any individual user. Network effects are *direct* when direct connection between users matters (e.g., telecommunications networks and speakers of a language). On the other hand, a similar network effect, an *indirect network effect*, may arise when individuals consume a system that consists of a "hardware" good and complementary software products.[20] Part III develops new types of trade models with direct/indirect network effects. It also examines other technological aspects of recent international trade (e.g., competition between international standards, the impact of switching costs on imported products' introduction), which are crucially related to communications networks.

Chapter 12 examines how the direct network effects of communications activities and trading opportunities interact to determine the structure of comparative advantage. These interactions are examined by constructing a two-country, three-sector model of trade involving a country-specific communications network sector. The role of the connectivity of network providers, which allows users of a network to communicate with users of another network, is also explored.

Next, in Chapter 13, I examine how trade liberalization affects production structure in the presence of indirect network effects (hardware/software systems). For these purposes I construct a simple two-country model of trade with two

incompatible hardware technologies. It is shown that, given that both types of hardware exist before trade liberalization, liberalization and increased intra-industry trade in software products may reduce the variety of hardware technology via intensified indirect network effects.

In Chapter 14, I consider a two-period model of market entry with homogeneous products and switching costs. It is shown that the pro-competitive effect of a foreign firm's entry (i.e., unilateral trade liberalization) emerges before the entry. In addition, conditions which are conducive to a competitive environment in the second period are shown to yield a less competitive outcome in the first period. In other words, when the marginal cost of the foreign entrant is relatively low, the first-period output of a domestic monopolist is relatively low as well.

The main purpose of Chapter 15 is to illustrate, with a simple monopolistic competition trade model, how trade liberalization (i.e., a decline in trade costs) can affect domestic entrepreneurs' decision between providing domestic or foreign brands, and thus the degree of foreign brand penetration. It is shown that, as trade costs decrease, more entrepreneurs choose to provide foreign brands. Furthermore, the shift to foreign brands is shown to magnify the negative impact of trade liberalization on the profits of firms selling domestic brands.

Part IV: Cost heterogeneity and trade

Finally, Part IV turns to the basic theory of international trade, with special reference to the role of *cost heterogeneity among/within countries*. Although these chapters do not perfectly fit with the "new-new-trade-theory" literature *à la* Melitz (2003), They aim to provide some complementary view on the role of technological heterogeneity.

In Chapter 16, I extend a monopolistically competitive trade model with symmetric costs (reviewed in Chapter 3) to one with asymmetric costs in product diversification. Both the trade pattern and the effects of the opening of trade on welfare are examined. It is shown that: (1) the larger country will be a net importer of differentiated products, which contradicts the result of Krugman (1980); (2) the greater the size of the country, the smaller the share of the intra-industry trade; and (3) the larger the trading partner of a country, the larger the gains from trade of the country.

Chapter 17 presents an extended version of monopolistic competition model with asymmetric costs (Chapter 16). In this chapter I develop a two-factor, three-sector model of international trade in which the monopolistically competitive firms are characterized by different fixed production costs. It is shown that, depending on the pattern of the international distribution of factor endowments, the trade pattern is determined not only by relative factor endowments as suggested by Heckscher and Ohlin, but also by absolute factor endowments via a mechanism of competitive selection in the monopolistically competitive sector.

Chapter 18 provides a simple, many-industry model of trade which emphasizes the interaction between cross-country technical heterogeneity (i.e., a Ricardian

aspect) and monopolistic competition among producers of differentiated products (i.e., a Chamberlinian aspect) as determinants of trade patterns. It is shown that the emergence of intra-industry trade is crucially dependent on the shape of the technology index schedule, which is obtained as a step-function.

The purpose of Chapter 19 is to further explore how optimal export policies are affected by the nature of oligopolistic competition and the structure of demand. It is shown that (1) the more cost competitive the home firm is, the higher the optimal level of export intervention becomes; (2) as the goods become better complements, the optimal level of export intervention increases; and (3) the nature of the effects of strategic export policies on foreign firms depends on both the mode of competition and the structure of demand.

Chapter 20 presents a summary and conclusion.