# THE IMPACT OF INTELLECTUAL PROPERTY RIGHTS PROTECTION ON INTERNATIONAL TRADE: THE CASE OF TRANSITION ECONOMIES

by

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Abstract

# THE IMPACT OF INTELLECTUAL PROPERTY RIGHTS PROTECTION ON INTERNATIONAL TRADE: THE CASE OF TRANSITION ECONOMIES

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The main goal of current study is to estimate the impact of differences in national levels of IPR protection on international trade flows with applications to the countries in transition.

Theoretical analysis based on the dominant-firm model of Maskus and Penubarti (1997) gives no clear predictions about the direction of IPR trade effects. Therefore, we proceed to the empirical analysis based on the Gravity Model of International Trade. The empirical results are strong and provide us with an important set of conclusions. First, strengthening of IPR protection is likely to increase in international trade volumes for countries at the middle level of economic development and decrease the trade of countries at low and high development levels. Second, improvements in the level of IPR protection tend to increase the international trade volumes of countries posing high threat of imitation and reduce the international trade of countries with low threat of imitation. The most important conclusion of current study is that an increase in IPR protection has a strong tendency to increase international trade volumes for countries in transition. Thus suggests that expectations of negative IPR effect on trade in transition countries such as Ukraine are likely to be unfounded.

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# GLOSSARY

**Intellectual Property (IP)**[1]. Direct product of human creative activity, such as new invention, design or work of art, which has market value.

**Intellectual Property Rights (IPR)**[2]**.** The ownership of the rights to intellectual property, being the outputs of creative endeavor capable of being protected under legislation such as that relating to patents, design rights, trademarks or copyright.

**Innovation**. Novel idea presented in the form of new technology, process or product.

**Imitation.** Illegal copying of someone else inventions and products.

**Patent.** Type of IPR protection that excludes anyone except the patent holder from freely using an invention. The holder may choose to license use of a patented invention in exchange for the royalty payment[3].

**Copyright.** Type of IPR protection that protects the property rights of authors, composers and artists as an incentive to creative activity.

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[1] Definitions of IP, Patent, Copyrights, Trademark were taken from Dnes (1996)

[2] Definition of IPR was taken from Earwell at al (2002)

[3] Definition of Petent was taken from Dnes (1996)

**Trademark**. Type of IPR protection that associates company name or symbol with a differentiable product or service and is meant to be easily identified indicator of quality.

*Chapter 1*

# INTRODUCTION

The past few decades of the twentieth and the beginning of the twenty-first century can be characterized as a period of rapid internationalization, worldwide economic integration and development of international trade. Economists all over the world recognize that Intellectual Property Rights (IPR) can have a significant impact on trade flows. That is one reason why the regulation of national regimes of intellectual property rights protection has recently become a contentious issue and is assigned a major importance.

Many governments contend that weak IPR protection distorts natural trading patterns and reduces the ability of firms to transfer technology abroad. Thus the differences in national standards of IPR protection are thought to negatively affect free trade between countries and thus international trade flows. This conjecture is supported by the numerous initiatives from the side of international organizations to harmonize and strengthen the level of IPR protection all over the world. These attempts are reflected in the inclusion of Trade-Related Intellectual Property Rights (TRIPS) agreement in a number of bilateral and multilateral trade policy agreements. For instance, the issue concerning TRIPS agreements was included in the Canada-US Free Trade Agreement (FTA), the North American Free Trade Agreement (NAFTA) and the World Trade Organization (WTO) Agreement.

The developed countries made the upgrading of IPR protection one of their highest priorities for the Uruguay Round of trade talks. Their efforts in those negotiations resulted in the TRIPS Agreement, which was approved as part of a Final Act of the Uruguay Round.

The issue of IPR is especially problematic for the countries with transition economies. The core of the problem lies in the dispute between developed countries on the one hand and developing and transition economies one the other hand.

Obviously, the developed countries consider the lack of IPR protection in developing countries and countries with transition economies to be an extremely unfavorable factor in the trade environment, which leads to a greater possibility of free riding on the part of the local firms which compete with innovating firms from developed countries. That is why developed high-income countries argue for the enforcement of IPR protection. Their main requirements were included in the previously mentioned TRIPS Agreement in the Uruguay Round negotiations, which was approved largely at the insistence of the Unites States (Sherwood 1990).

However the results of the Uruguay Round were extremely controversial for many developing countries. The reason is that from the point of view of developing countries and transition economies strong international standards for IPR protection would increase profitability of the foreign firms at the expense of domestic producers and thus could lead to a decrease in the country's welfare. Moreover, such requirements would substantially restrict the amount of transition countries' exports to the WTO members in "IPR sensitive" industries.

Indeed, the TRIPS agreement, which mainly expressed the views of developed high-income countries, established symmetric worldwide standards in areas of time-limited intellectual property (IP) protection such as patents and copyrights, while the previously developed General Agreement on Tariffs and Trade (GATT) allowed for asymmetric rates of tariff protection across countries, hence, could provide discrimination in favour of developing countries. Conversely to GATT, the only significant concession to developing countries in the TRIPS agreement was longer implementation periods (Gaisford, Richardson (2000)).

The main purpose of my research is to find out in what way the level of IPR protection in the country affects its international trade flows. If the preliminary conjecture about the positive relationship between the level of IPR protection and international trade proves to be true in case of the countries with transition economies then we can conclude that an increase of the level of IPR protection would allow the country to increase its international trade flows.

Such a finding may serve as a support for national governments in deciding upon the national level of IP protection.

The structure of the paper is as follows. Chapter 2 provides a review of the relevant literature concerning the problem of IPR protection and its impact on international trade both on theoretical and empirical levels. Chapter 3 contains theoretical insights in the area of IPR protection and describes the situation with IPR protection in Ukraine. Chapter 4 provides a theoretical framework for the assessment of the impact of IPR protection on trade based on the model developed by Maskus and Penubarti. (1997). However, theoretical analysis does not give clear conclusions about the impact of IPR protection on trade, which induces us to concentrate on the empirical analysis of the issue. Chapter 5 overviews the empirical methodology adopted on the basis of the Gravity Model of Bilateral Trade and provides data description. Chapter 6 includes the results of the empirical estimation and their discussion. Finally, Chapter 7 contains conclusions, policy implications and suggestions for further research.

*Chapter 2.*

# LITERATURE REVIEW

The growing importance of the issue of Intellectual Property Rights (IPR) protection has resulted in an increasing number of empirical and theoretical research papers. Some of them are devoted only to empirical evaluations, others consider only the theoretical side of the issue, and some view both theoretical and empirical aspects. However, the final goal of the majority of theoretical studies is to study the effect of IPR protection on countries social welfare and its impact on international trade is considered only as an intermediate result. In what follows I review the previous theoretical and empirical studies devoted to the issue of intellectual property rights protection and its impact on international trade.

## 2.1 Theoretical developments

As has been already mentioned the issue of IPR protection has become a contentious one approximately in the mid 1980s. Among the first theoretical studies related to the topic was the study developed by Grossman and Chin (1988). The paper studies the welfare economics in a world trading environment and is based on the model of the North-South trade. For simplicity the model considers only two trade partners: North which can conduct research and development to lower its production costs and South which can costlessly imitate northern product if IPR protection is not enforced by the South government. The paper considers a linear-quadratic Cournot duopoly in an integrated world economy where a firm in the North and a firm in the South both produce a homogeneous good at a constant marginal cost. Then two cases are considered. In the first case the level of IPR protection is high in the South and after the Northern firm innovates and decreases its production costs Southern firm can

not imitate the northern product. In the second case there is no IPR protection in the South and a new northern product can be easily infringed by the Southern producer. In both cases the quantity of good exported to the South by a northern firm is calculated by solving the profit-maximization problem of northern producer. In each case the authors also calculate consumer and producer surpluses and social welfare in both countries. The results indicate that quantity supplied to the South by the Northern producer is greater in case when there is IPR protection in the South, thus, driving to the conclusion that enforcement of IPR protection has a positive impact on trade between countries. The social welfare results reflect the conflict between Northern and Southern interests, i. e. social welfare in South will be higher if it eschews rather than enforces protection of Intellectual Property Rights. On the other hand the North benefits from having the IPR of its firms defended in foreign countries.

A similar model is used in a subsequent study by Diwan and Rodik (1989). The main goal of the paper is to estimate the impact of the enforcement of IPR protection on the innovative activity in the North and on the welfare of the both regions. Starting from the model developed by Grossman and Chin the authors arrive at slightly different results. This is mainly the consequence of some differences in the preliminary assumptions. As in the pervious study Northern firms are more innovative but they are involved in a competition with the southern firms for the scarce R&D resources. Another difference is that the two countries are assumed to have different technological needs. The analysis of the model leads to a variety of comparative-statics results, some of which could appear counter-intuitive at first sight. Nevertheless, we can outline the result that the increase in the level of IPR protection has a positive influence on the profitability of innovating Northern firm, which, in its turn, will increase its exports to the South. As far as other conclusions of the paper are concerned the most important one is that an increase in patent protection in any of the two regions would lead to an increase in innovative activity that targets the needs of

this region. Another consequence from the increase in patent protection is an increasing fit between available technologies and consumer's preferences in the region. A third interesting result is that a benevolent global planner would assign identical rates of the patent protection to the North and South only if he/she weighted their welfare levels equally.

For the purpose of exposition I will highlight some of the empirical findings of the paper here. The numerical results obtained from the simulated data support the theoretical findings of the paper, i. e. a benevolent global planner would place a higher level of patent protection in the North if its welfare would be greater than that of South and would assign the identical rates of patent protection to the North and South, if their welfare levels were equal.

Another study of interest is that by Deardorff (1992) where the welfare effects of the enforcement of IPR protection in the country, which only consumes innovative products, are investigated. The results indicate that making the level of IPR protection of this country comparable with that of the developed country in which innovation takes place results in the two opposite effects on the welfare of the consuming country. The first effect is associated with the increase in a country's welfare because of the increase in international trade and technology transfer and the second is associated with losses that domestic producers suffer because of the increase in the level of IPR protection, i. e. it becomes more difficult for them to imitate northern products.

A paper by Helpman (1993) models innovation as a dynamic process and the strength of the IPR regime is associated with the probability that an innovative product protected by a patent in the North will be imitated in the South. The author also estimates the consequences of the marginal changes in the rate of imitation for the country's welfare. In this paper the positive effect of an increase in the level of IPR protection on trade can also be captured as an additional result but not as a main one.

The paper by Taylor (1994a) develops a simple North-South model of unintentional technology transfer to examine how the stringency of IPRs protection affects international trade in R&D intensive products. The influence of IPRs is captured by assuming that imitation costs rise as the tightness of southern patent requirements increase. As in the previous studies the author assumes technological asymmetry between North and South and adopts a leader-follower (Stackelberg) framework where the North is the first to move and to set output. The results of the model indicate that increase in the stringency of IPRs protection in South increases the trade flow and the flow of unintended technology transfers. This increase in the North-South technology transfer would in its turn foster competition and increase the productivity of resources employed in the South, thus, raising southern industry output. Conversely, weak patent protection in South would call for defensive responses from the side of Northern firms, which can limit trade and technology transfer to the South, which would decrease southern industry output.

Another paper by Taylor (1994b) considers a simple two country dynamic model of endogenous growth in order to determine the degree of influence of the IPR protection on the world trade, growth and technology transfer. The analysis of the model leads to the conclusion that difference in the levels of IPRs protection between countries distorts trading pattern in R&D intensive products, i. e. R&D exporting country (North) decreases the volume of its export of R&D intensive products to R&D consuming country (South) because it suffers losses from imitations made by southern firms. Conversely equalization of the levels of IPRs protection across countries would lead to an increase in the volume of R&D intensive goods exported to the South, to the factor price equalization, to improvement in the allocation of the world technical resources and, in many cases, to the rise in the world economic growth. Nevertheless, if countries would provide only partial protection of intellectual property these benefits would fail to occur. Asymmetric protection of intellectual property harms international trade,

forces inventors to implement less than best research methods and lowers aggregate R&D.

The study by Maskus and Penubarti (1995) studies the relationship between intellectual property rights and international trade. The theoretical model developed in the paper can briefly characterized as follows: stronger protection of intellectual property rights grants monopoly power to the exporting firm by assuring the exclusive rights for its products and technologies this in turn allows the firm-exporter to behave more monopolistically and export less to the local markets. This is actually the essence of the *market power effect*. On the other hand, stronger level of IPR protection decreases the level of imitative activity in the importing country thus increasing the demand facing the exporting firm. This increase in demand encourages the exporting firm to export more to the local markets. The latter effect is known as the *market expansion effect*. The results of the paper state that as far as these two effects are offsetting, no unambiguous theoretical prediction can be made about the effects of strengthening of IPR protection on the extent of international trade flows. Preceding work of Maskus and Eby-Konan (1994) also connected with trade-related intellectual property rights (TRIPS) reflects the same result.

A more recent paper by Grossman and Lai (2002) develops an optimal government policy of intellectual property rights protection (determined by the patent length) for the country in the framework of a simple model of endogenous innovation. First, the optimal patent length is derived for a closed economy. It relates the deadweight loss caused by a marginal lengthening of the period of patent protection to the surplus which results from extra innovation. In an open economy the country's optimal patent policy is derived by equating the sum of extra deadweight loss that results from extending patents for domestic firms and the extra surplus loss that results from extending monopoly pricing by foreign firms with the benefits that flow from providing greater incentives for innovation for firms in both countries. The influence of the tighter protection of IPRs in this

paper accounts for a part in the extra surplus loss, which stems from extending monopoly pricing by foreign firms. As we can see in this paper the increase in IPRs protection affects international trade in a negative way, this may be explained by the domination of the *market power effect* in this particular model. The interesting finding of the paper is that harmonization of patent policies is neither necessary nor sufficient for the efficiency of the global patent regime, which is defined as a regime that equalizes the marginal deadweight loss in the two countries and in such a way gives a stimulus to innovation in these two countries.

Another theoretical study is that by Gaisford and Richardson (2000). The study addresses problems caused by the establishment of TRIPS agreement, which requires harmonized world level of IPR protection. This requirement implies asymmetric increases in the level of IPR protection in the countries of different levels of economic development and is opposite to the tariff reduction procedures of GATT. Basing on the results of the theoretical model developed in the paper the authors argues that TRIPS agreement acts in favour of developed countries while developing countries potentially suffer significant losses in their national welfare and would comply with TRIPS requirements only under the threat of WTO trade sanctions. Alternatively, a mutually beneficial efficient solution can be achieved with asymmetric IP protection where lower levels are allowed for developing countries and higher levels of IP protection are required for developed countries.

Summarizing the main findings of theoretical studies we can conclude that there is little consensus. Perhaps, the majority is that a high level of IPR protection positively affects international trade flows, technology transfer and social welfare, even for the country, which only consumes innovative products. Now, let us proceed to the review of empirical studies in the area and look if theoretical conclusions are supported by empirical evidence.

## 2.2 Empirical findings.

The first paper to be considered is that by Ginarte and Park (1997). They develop an index of patent rights for 110 countries for the period of 1960-1990. The importance of the paper is explained by the fact that it outlines the main qualitative determinants of IPR protection, which could be measured on a relative basis for the countries with transitional economies. According to the paper, major factors that influence patent protection level of the country are the country's level of research and development (R&D) activity, international integration and market environment, which correlate with its level of development.

Another interesting study is that by Maskus and Penubarti (1995) that looks at the influence of the difference in the national patent laws on international trade. A positive relationship, which was found between manufacturing exports of OECD countries and level of IPR protection in the countries of import, was stronger in developing countries with significant abilities to imitate and weaker in small developing countries with low incomes. From these results they conclude that for bigger developing countries with stronger imitative abilities the market expansion effect dominates causing exporting country to export more due to the *expansion of market size*. Conversely in small, low-income developing countries, the enforcement of the level of IPR protection enhances the *market power effect*, which in turn stimulates exporting firm to use this market power in the country of export and increase its exporting volumes by the smaller amount than in the first case.

The study by Ferrantino (1993) also provides empirical evidence of a positive relationship between the length of patent rights and trade using US data. The length of patents is used as a proxy for the level of IPR protection.

Lately, Ferrantino's study was updated by Smith (1999). The empirical evidence provided in her paper showed a much stronger impact of the level of IPR protection on trade. Estimating bilateral trade equations that accounted for trade

distortions related to patent rights she also found that U. S. exports are sensitive to IPR protection in importing countries. The relationship is positive for importing countries with strong infringement abilities due to the domination of the *market expansion effect* and negative in case of importing countries with low threat of imitation because in the second case stronger IPR protection enhances *market power effect* stimulating U.S. exporters to reduce their exports to those markets. As can be seen, these results are also consistent with those made by Maskus and Penubarti (1995).

In her more recent study Smith (2000) uses the OLI paradigm in order to analyze the effect of foreign patent rights on the US exports, affiliate sales (of US multinational companies), and licenses. In this study she also accounts for simultaneity in making decisions, i. e. the company may simultaneously export products, setup production units in host countries and give licenses to foreign companies. The author concludes that strong IPR protection increases US exports, affiliate sales and licenses, especially across countries with strong imitative abilities.

Another study similar to those of Smith (1999, 2000) was made by Raquzzaman (2002), in which the impact of national differences in the level of Patent Rights Protection on international trade flows is studied, using Canadian Data. The findings are similar to that of Smith and indicate that stronger IPR protection induces Canadian exporters to export relatively more to high-income countries than to low-income countries due to *market-expansion effect* in the former case and due to *market-power effect* in the latter case.

Thus after becoming familiar with the papers devoted to the topic of the protection of Intellectual Property Rights one can conclude that despite the fact that a lot of efforts have been already made in the area there are still some aspects of the relation between the level of IPR protection and trade that require a more detailed theoretical and empirical investigation. For example, there is still no empirical evidence on the effect of the increase in international trade, which

occurs due to more stringent IPR protection, on the local producers in the technology consuming country. Some theoretical work could also be done within the framework of the model that would account for simultaneity in firm's decisions, i. e., the firms not only produce and export homogeneous goods but are able to simultaneously export, license and make affiliate sales.

As far as empirical papers are concerned, one can easily notice the absence of such papers for the transition economies. This may be explained by the fact that the data sources for the transition markets have long been too imperfect to give reliable results for empirical estimation. Nevertheless, a period of transition becomes longer giving a greater possibility to obtain reliable empirical estimates. This may serve as a stimulus for new research in the area.

In my research I am going to estimate the effect of the level of IPR protection on international trade for a wide set of countries (180 countries), which includes the countries with high level of economic development as well as developing countries and countries with transition economies. Further I intend to estimate how its influence on international trade differs for the countries with transition economies and for developed western countries.

*Chapter 3.*

# BACKROUND INFORMATION.

## 3.1 Theoretical insights.

The twentieth century has been claimed to be a "technological age". Rapidly developing technological environment turned attention of the world community to such invisible form of property as *intellectual property*. According to Dnes (1996)[4] *Intellectual property* is a direct product of human creative activity, such as new invention, design or work of art. At first glance, virtual nature intellectual property puts in question the amount of attention paid to the problems of its protection. So how can we explain sustaining debates over IPR?

It is a well-known fact that *intellectual property* that exists in forms of scientific or technological knowledge has many features in common with public good. In fact, it has such major features of public good as non-rivalry and non-excludability (Gaisford, Richardson (2000)). At first glance it seems to be profitable for society not to protect intellectual property, because this would give everyone the opportunity to freely use the products of other people intellectual activity and contributing to technological progress. However, this argument does not take into account the cost of disturbing the long-run incentives for invention (Dnes (1996)). After accounting for these costs, the absence of IP protection would certainly lead to under efficient levels of investment in R&D activities in fear of infringements (free-rider problem) (Demsetz (1982)). Such kind of argument provides clear evidence in favor of IP protection. Perception of this problem as an important issue led to the establishment of different types of IP protection, which are described as follows:

[4] Definitions of IP, Patent, Trademark and Copyright were taken from Dnes (1996).

*Patents* exclude anyone except the patent holder from freely using an invention. The holder may choose to license use of a patented invention in exchange for the royalty payment. The invention can be excluded from the patentability if it is a purely intellectual discovery, such as scientific theory or creation. Throughout the world with the exception of the USA and Canada the *"first-to-register"* patent system is in operation. According to the system the inventor who registers the patent for an invention first has priority to claim property rights for it (Dnes (1996)). Nevertheless, patents, which appear to be one of the most widely used forms of IP protection, seem to create many disputes among economists. From one side patents encourage the process of innovation by defending the patent-holder from potential imitators, but from the other side patents restrict market competition, thus allowing for monopolistic behavior and higher pricing by patent holders (Dam (1994), Waterson (1990)).

Next IP protection type to consider is *copyright*. Copyright law protects the property rights of authors, composers and artists as an incentive to creative activity (Dnes (1996)). Copyright defends the owner from illegible coping of his creation thus providing him with the monopoly power over his work. In the majority of cases, copyrights last for the lifetime of the creator and for 50 years after his/her death. There is also a lot of controversy associated with the protection of copyrights. The reason is that, for example in case of book publishing, a representative consumer would be indifferent between an original and unauthorized copy. Thus, in this case, cancellation of copyrights protection would lead to unambiguous consumer benefits at cost of inventor.

The last type of IP protection concerns *trademarks* that associate company name or symbol with a differentiable product or service and are meant to be easily identified indicators of quality (Dnes (1996)). The major assignment of a trademark lets the good be easily identified and differentiated by potential buyers in any country of the world and distract them from buying local products substitutes. This idea seems to work fairly well because it does provide a marked

product with an advantage of saving consumers time potentially spent on accessing the quality of unknown good. Again there are a lot of disputes over the trade marks with some economists blaming them to be a tool for supporting monopoly power against consumer benefits (Cowling and Meuller (1978)) and others praising them as an important tool that conveys information from seller to buyer (Littlechild (1981), Demsetz (1982)).

Despite some controversies about IP protection the importance of the issue was widely accepted and led to numerous international alternatives to harmonize and strengthen the level of IP protection all over the world. First was the *Paris Convention for the Protection of Industrial Property* established in 1886 and targeted at coordinating patents. It was followed by the *Berne Convention for the Protection of Literary and Artistic Works*. Established in 1886 the Berne Convention was put in charge of copyrights. Later in 1967, in order to coordinate both Berne and Paris conventions, the *World Intellectual Property Organization (WIPO)* was formed. However, WIPO appeared to be ineffective and consistently suffered form the lack of efficient dispute resolution mechanisms in the area of IP protection. All these drawbacks evolved numerous dissatisfactions from the side of developed countries; that initiated another attempt to resolve the problem with the help of Trade Related Intellectual Property Rights (TRIPS) agreement established during the Uruguay Round. Although TRIPS agreement did not replaces the WIPO, it did impose additional requirements on the WTO members. Each member country must provide other members with national treatment and Most Favored Nations status in matters concerning the protection of IP (Gaisford, Richardson (2000)). According to the TRIPS agreement country standards of patent duration and copyrights protection must lie in compliance with the corresponding world standards, which means correspondence of national standards to those of Berne Convention in case of patent protection and to Paris convention as far as copyrights are concerned. TRIPS agreement requires that computer programs should be treated as literary works (protected by Berne Convention), music

performers and producers keep rights over their masterpieces for 50 years and broadcasters for 20 years. Also, the TRIPS agreement is quite different from previous regulatory GATT agreement in the area. While GATT allowed for asymmetric rates of IP protection in different countries taking into account their levels of economic development the only relaxing difference in favour of least developed countries allowed by TRIPS agreement is longer implementation periods. According to TRIPS, developed countries were given one year to achieve full compliance with TRIPS standards, developing countries had to comply within five years and least developed countries must comply within eleven years (Gaisford, Richardson (2000)).

Such strict nature of TRIPS agreement initiated a lot of complains from the side of underdeveloped and developing countries that accused TRIPS agreement as acting in favour of developed nations hurting their domestic producers of less developed partners. Indeed, previous GATT agreement allowed for "some forms of discrimination in favour of developing countries under general system of preferences". (Gaisford, Richardson (2000)). GATT did not require symmetric rates of IP protection across countries. It tried to achieve trade liberalization through turning non-tariff trade barriers to tariffs and then through sequential tariff reduction. GATT's negotiations were aimed at symmetric tariff reductions and did not require all members to establish equal levels of IP protection. Instead TRIPS requires equal levels of IP protection for all WTO members. There are hot debates over the TRIPS versus GATT agreement in modern economic literature, which tend prove inefficiency of TRIPS agreement (Deardorff (1992), Gaisford, Richardson (2000)).

However, TRIPS remain the main set of standards required from the WTO members in the area of IP protection. So far Ukraine is aiming to become a member of WTO, so that it is necessary that Ukraine's legislation of IP should be harmonized in compliance with the standards of TRIPS agreement. In such

framework it is useful to provide a brief overview of Ukrainian legislation with regard to IPR protection.

### 3.2 Protection of intellectual property in Ukraine.

Regulation of the protection of intellectual property in Ukraine is enforced through the Law "About authors right and adjacent rights" from 23.11.1993. From the moment the law was enforced the protection of the author's right in Ukraine is implemented in the order established by the administrative and criminal legislation of Ukraine. In general, Ukrainian legislation in the area of intellectual property includes not only national legislative acts but also the international agreements that Ukraine has joined, with the priory given to the international standards in favor of national ones.

First, it should be stated that on international level patent protection in Ukraine corresponds to the standards of Paris Convention (1883), of which Ukraine is a current member. On national level patent protection in Ukraine was implemented through the Law of Ukraine "On Protection of Rights in Inventions and Utility Models" (the "Patent Law") until significant changes were made to this Law by adoption of the Law of Ukraine "On Amending Certain Legislative Acts of Ukraine on Intellectual Property Protection" (the Amendment Law) on May 22, 2003. The Law included amendments to Patent Cooperation Treaty (PCT) application procedure and included guidelines to improve enforcement of patent rights.

Legislation on copyright protection in Ukraine exhibits positive progressive development and is now conducted through the Law "On copyright and Neighboring Rights" ("Copyright Law"). The law was developed in cooperation with international IPR community and corresponds to international standards in the area, including TRIPS agreement. On the international level in the area of copyrights protection Ukraine is a current member of the Berne convention (1886), the Geneva (1952) Convention on the protection of Phonogram

Producers; the Rome Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organizations; the WIPO copyrights treaty; the WIPO Performances and Phonograms Treaty.

Ukraine's major problem with IP protection lies in the enforcement of *anti-piracy protection*. National legislation in the area has been conducted through the liberal Law "On Licensing Certain Types of Economic Activity" (*"General Licensing Law"*) until on June 5, 2000 USA and Ukraine signed the Joint Action Plan to combat Optical Media Piracy in Ukraine (Paliashvili (2004)). This plan required corresponding actions in the sphere from the Ukrainian side, which after the two years of comprehensive debate were reflected in the Law "On the Specifics of the Government Regulation of the Activity of Subjects of Economic Activity Associated with the Manufacture, Export and Import of Laser-Readable Discs" *("CD Licensing law"*) was adopted in the middle of January 2002. However, the Law failed to fulfill the requirements of the Joint Action Plan as well as some international standards in the sphere. In fact, "CD Licensing law" is in conflict with more liberal "General Licensing Law". As far as there is no preference about which Law should be primary used it becomes easy to overcome one law with the help of another. Thus attempts of Ukrainian government to restrict local media and optical piracy in the country was unsuccessful and persistent failure to meet the USA requirements concerning the issue led to the trade sanctions for Ukrainian products from the USA side.

"The United States' annual review of global IPR violations once again cites Ukraine for its continued failure to protect media products such as compact discs and digital versatile disks from piracy"[5].

Consistent failures to combat the "media-piracy" cross out all positive changes made in Ukrainian Legislation in the area of IP protection. However, significant trade sanctions from the side of the USA should serve as a powerful stimulus

[5] http://usinfo.state.gov/utils

for Ukraine to enforce the Protection of Intellectual Property and to bring its legislative system in accordance with international standards.

The problem of IP protection becomes even more crucial in light of Ukrainian announced target to accede to the WTO in the near future. However, for now the membership in the WTO with adoption of Trade Related Aspects of Intellectual Property (TRIPS) remains a problem to decide. Should Ukraine raise the level of IP protection up to the international standards, would it necessarily lead to the increase of Ukraine's international trade flows or would strict TRIPS requirements reduce the amount of international trade? This remains a problem to decide.

In lights of such unclear perspectives it is useful to analyze the effect of the enforcement of IP protection in Ukraine and in other countries with transition economies on the volume of their international trade flows, which is done in the rest of the paper.

*Chapter 4.*

# THEORETICAL FRAMEWORK.

In the study that follows I will try to provide systematic evidence as to whether different IPR protecting laws affect bilateral trade flows. The question to be considered is how the importing country's IPR protection helps determine the international distribution of bilateral trade. The approach is a narrow consideration of the broader questions concerning intellectual property protection, trade and economic growth. However these partial results should help us understand the sensitivity of trade decisions to the level of protection of intellectual property.

For the purpose of theoretical analysis we will use theoretical model developed by Maskus and Penubarti (1997), which considers the influence of IPR protection on international trade. In the model a dominant exporting firm competes with a fringe industry in a particular market. The fringe industry is capable of imitating the dominant firm's production process and producing competing goods. We consider a *marginal change* in IPR protecting laws, which operate through the costs of both the firm and the fringe industry. The model shows that the optimal response of such a firm could be either to increase of decrease its exports to that country because of the tradeoff between enhanced market power (market-power effect) and greater market (market-expansion effect) size.

For the purpose of theoretical analysis Maskus and Penubarti discriminate among small importing countries with limited imitative capacities and large importing countries with high imitative capacities.

4.1 Small importing country[6].

The country is small in the sense that the dominant firm exports the good to it at a constant marginal cost of $c_0 + t$, where *t* is a specific tariff imposed by the importer. The market is so small that dominant firm does not need to mask its product's characteristics in order to deter local imitators, as it might do in larger markets.

Formalization of the model in linear terms looks as follows.

Let total demand is given by: $P = a - bQ$

Infringing supply is given by: $P = \alpha + \beta Q_D$, where $Q_D$ is domestic output.

Then the dominant firm faces the residual demand curve given by

$$Q_F = Q - Q_D = \frac{a - P}{b} - \frac{P - \alpha}{\beta} = \frac{a\beta + b\alpha - P(\beta + b)}{b\beta};$$

$$P = \frac{a\beta + b\alpha}{(b + \beta)} - \frac{b\beta}{(b + \beta)} Q_F;$$

Let $\gamma = \frac{a\beta + b\alpha}{(b + \beta)}$ and $\phi = \frac{b\beta}{(b + \beta)}$, then reassigning the values we obtain the residual demand curve facing dominant exporting firm given by:

$$P = \gamma - \phi Q_F$$

The dominant firm chooses the amount of import $Q_F$ so as to maximize its profits given by:

$$\pi = PQ_F - (c_0 + t)Q_F = \gamma Q_F - \phi Q_F^2 - (c_0 + t)Q_F$$

Profit maximization with respect to $Q_F$ yields:

[6] Preliminary set-up and final formulas are taken from Maskus and Penubari (1995). All the intermediate derivations are made by this author to provide a rigorous foundation for the subsequent empirical work.

$$\max_{Q_F} \pi = PQ_F - (c_0 + t)Q_F = \gamma Q_F - \phi Q_F^2 - (c_0 + t)Q_F$$

$$Q_F^* = \frac{\gamma - (c_0 + t)}{2\phi};$$

$$Q_F^* = \frac{\beta a + \alpha b - (c_0 + t)(\beta + b)}{2b\beta}$$

(1)

$$P^* = \gamma - \phi Q_F^*$$

$$P^* = \frac{a\beta + b\alpha}{(b + \beta)} - \frac{b\beta}{(b + \beta)} * \frac{\beta a + \alpha b - (c_0 + t)(\beta + b)}{2b\beta}$$

After some algebra we get to the following result:

$$P^* = \frac{a\beta + \alpha b + (\beta + b)(c_0 + t)}{2(\beta + b)}$$

(2)

Now, consider the infringing domestic supply $P = \alpha + \beta Q_D$. Intuitively we can conclude that increase in the strength of IPR protecting laws and enforcement increases price for local infringements because it makes it more difficult for the local firms to imitate foreign product and forces them to search for the new ways to overcome domestic laws. Thus, from the formula we can conclude that $\alpha$ and $\beta$ are increasing functions of some variable *I,* which indicates the strength of the IPR protecting laws and enforcement.

$$\alpha = f(I); \frac{\partial \alpha}{\partial I} > 0 :$$

$$\beta = f(I); \frac{\partial \beta}{\partial I} > 0$$

Thus, to find the effect of changing the strength of the IPR protecting laws (*I)* on the local price and the volume of the dominant firm's exports we can take total derivatives of (1) and (2) with respect to *I* with prime indicating a derivative with respect to *I*. This procedure yields the following results:

$$\frac{dP}{dI} = \frac{\beta'(I) * b(a-\alpha) + \alpha'(I) * b(b+\beta)}{2(\beta+b)} \qquad (3)$$

From (3) we can see that effect of changing of *I* on the price of the imported product is unambiguously positive, because $a$ is required to exceed $\alpha$ following the assumptions of the model.

$$\frac{dQ_F}{dI} = \frac{\alpha'(I)}{2\beta} - \frac{\beta'(I) * [\alpha - (c_0 + t)]}{2\beta^2}$$

(4)

From (4) we can see that the impact of *I* change on the quantity of export is ambiguous. The first term $\frac{\alpha'(I)}{2\beta}$ is positive and indicates the positive *market-expansion effect*. The second term

$\frac{\beta'(I) * [\alpha - (c_0 + t)]}{2\beta^2}$ is negative if $\alpha > (c_0 + t)$ and indicates *market-power effect*.

Thus, the final sign of (4) is ambiguous and depends upon which of the two effects dominates.

The $\alpha > (c_0 + t)$ condition is very important for the conclusions of the model to hold. Relatively low tariff on the imported product ensures that $\alpha$ exceeds marginal cost of exporting. Sufficient rise in the tariff *t* could reverse the quantity effects of stronger patent protection. If $\alpha \leq (c_0 + t)$ then stronger IPR protection would imply *increase* in the dominant firm exports to the importing country. Thus, the impact of the stronger IPR protection also depends on the trade regime in the importing country.

Now, let us proceed to the graphical analysis and consider a simple partial-equilibrium model adopted following Maskus and Penubarti (1997). The model is presented in figures 1,2 and 3 given in the appendices A1, A2, A3.

The graph depicts the market in a small importing country with limited imitative capacity. Total demand in the market is given by D, with marginal revenue MR. Local competitive fringe is characterized with a positively sloped supply curve ($P = \alpha + \beta Q_D$; not shown at the graph), where $\alpha$ is interpreted as the ability of the local sector to imitate a new product or adapt a new technology to its own production. Higher $\alpha$ indicates a weaker ability to imitation, which also depends on local endowments of skills and the technical specification of the product. In the figures 1 and 2 we assume the country with relatively high cost of imitation: $\alpha > (c_0 + t)$, which reflects the scarcity of imitative skills. We assume that, as IPR protecting laws become stronger, $\alpha$ rises. Parameter $\beta$ of the fringe industry supply reflects rising marginal costs of imitation. We also assume that $\beta$ rises as IPR protection becomes stronger. The dominant firm faces the residual demand given by $D_F$ and marginal revenue curve $MR_F$.

We can see from the graph that in the initial situation the firm chooses to export $Q_F$ units of good to the local market instead of exporting the monopolistic level $Q_M$. Thus, the effect of weak IPR protecting laws in small country with weak imitative abilities is to establish the local competition that induces the foreign firm to export a greater quantity and charge lower domestic price than under full patent protection.

Now assume importing country provides a *marginal* strengthening in its IPR protecting laws. The effect of this change raises parameter $\alpha$ or $\beta$ or both.

Suppose first that $\beta$ rises for a given $\alpha$ (figure 1). The new residual demand curve will be steeper than $D_F$, which leads to a steeper *MR* curve that intercepts $(c_0 + t)$ between points *M* and *F* at point *Z*. Thus, the dominant firm chooses to export *less* to the market with stronger IPR protection. Under stronger and better enforced IPR protection in the importing country the dominant exporting firm find its market power enhanced and operates more monopolistically on the local market as long as $\alpha > (c_0 + t)$, i. e. the country has weak imitative abilities and relatively low tariffs.

Now suppose that $\alpha$ rises for a given $\beta$ (figure 2). This results in a parallel upward shift of the residual demand curve $D_F$, expanding the market for the dominant exporting firm. In the figure 2 $D_s$ indicates larger residual demand that induces the dominant firm to supply more exports to the local market (market-expansion effect).

However, there is a kink in the MR curve of the dominant importing firm below the point of intersection of the residual demand curve and the total demand curve. That is why as $\alpha$ increases and $D_s$ shifts outward. The dominant firm receives the greater share of the local market and returns to the monopolistic behavior decreasing the amount of export to the country (figure 3). Hence, there is only initial expansion of export before the dominant exporting firm begins to perform monopolistically and to cut trade in favor of higher price. There could be no expansion at all if $\alpha$ and, consequently, residual demand in the country of export was already high.

Thus, in general the impact of increase in the strength of IPR protection in the small importing country is ambiguous, depending on the relative shifts of $\alpha$ and $\beta$. It may be, however, that in low-income developing or transition economy countries, which have limited high-cost imitative capacities, foreign firms may choose to act more monopolistically in case of stronger domestic

IPR protecting laws are implemented and reduce the amount of export to such countries.

Two final observations should be outlined from the graphical analysis. First, relatively low tariff on the imported product in the diagram ensures that $\alpha > (c_0 + t)$. But if the tariff is high enough it may reverse the effects of the stronger IPR protection. Hence, graphical analysis also suggests that trade barriers directly affect the monopolist trade decision. Second, it is important to assess the impacts of stronger IPR protection on the value of exports, since it is the variable on which the data could be more easily found.

### 4.2 Large importing country[7].

Now the situation is more complicated, because the importing country is large enough to affect the dominant firm's costs. The importing country is large in two senses. First, the dominant firm experiences a rising marginal cost of supply in this market because it is a perceptible fraction of the firm's global sales. It is assumed that a change in IPR protecting laws does not affect the *MC* curve but only increases residual demand for the product of the dominant importing firm. Second, the local imitative industry has a strong imitative capacity, reflected in a low value for $\alpha$ [$\alpha < (c_0 + t)$], and presents a real competitive threat of imitation.

Now, consider a formalization of the model in case of large importing country.

Let total demand is again given by: $P = a - bQ$.

Infringing supply is given by: $P = \alpha + \beta Q_D$, where $Q_D$ is domestic output.

[7] The preliminary set-up is taken from Maskus and Penubarti (1995). The computations and final formulas are not provided in the article and are made by this author. The article proceeds on the basis of graphical analysis.

The cost structure of the dominant firm is now given by: $C = c_0 + t + \sigma Q_F$ and indicates that costs tend to increase as export to the country expands.

Again, the dominant firm faces the residual demand curve given by

$$Q_F = Q - Q_D = \frac{a - P}{b} - \frac{P - \alpha}{\beta} = \frac{a\beta + b\alpha - P(\beta + b)}{b\beta};$$

$$P = \frac{a\beta + b\alpha}{(b + \beta)} - \frac{b\beta}{(b + \beta)} Q_F;$$

Let $\gamma = \frac{a\beta + b\alpha}{(b + \beta)}$ and $\phi = \frac{b\beta}{(b + \beta)}$, then reassigning the values we obtain the residual demand curve facing dominant exporting firm given by:

$$P = \gamma - \phi Q_F$$

Now, the dominant firm chooses the amount of import $Q_F$ so as to maximize its profits given by:

$$\pi = PQ_F - (c_0 + t)Q_F = \gamma Q_F - \phi Q_F^2 - (c_0 + t + \sigma Q_F)Q_F$$

Profit maximization with respect to $Q_F$ yields:

$$\max_{Q_F} \pi = \gamma Q_F - \phi Q_F^2 - (c_0 + t + \sigma Q_F)Q_F$$

$$Q_F^* = \frac{\gamma - (c_0 + t)}{2(\phi + \sigma)}$$

(5)

$$P^* = \frac{\phi\gamma + 2\sigma\gamma + \phi(c_0 + t)}{2(\phi + \sigma)}$$

(6)

To take total derivatives of the expressions (5) and (6) with respect to change in IPR protecting laws (*I*) and reduce the amount of algebra in the scope of the analysis let us first consider total derivatives of $\gamma$ and $\phi$ with respect to *I*.

$$\frac{d\gamma}{dI} = \frac{\beta'(I) * b(a-\alpha) + \alpha'(I) * b^2 + \alpha^2 b\beta}{(b+\beta)} > 0$$

This expression is positive, taking into account the assumption of the model that $a > \alpha$ and the fact that both $\alpha$ and $\beta$ are increasing functions of the strength of IPR protection in the country *I*.

$$\frac{d\phi}{dI} = \frac{\beta'(I) * b^2}{(b+\beta)} > 0$$

Now we can take total derivatives of $P^*$ and $Q_F^*$ with respect to the strength of IPR protection in the importing country *I* .

$$\frac{dP^*}{dI} = \frac{\gamma'(I) * \phi(\phi+\sigma) + \phi'(I) * \sigma(\gamma+\sigma) + \phi'(I) * \sigma(c_0+t)}{(\phi+\sigma)} > 0$$

The effect of changes in I on $P^*$ is unambiguously positive, provided that all parameter valued are assumed to be positive.

$$\frac{dQ_F^*}{dI} = \frac{\gamma'(I) * (\phi+\sigma) - \phi'(I) * (\gamma - c_0 - t)}{2(\phi+\sigma)^2} ? 0$$

From the expression above we can see that effect of changes in *I* on quantity of product supplied by the dominant exporting firm is ambiguous and its sign depends upon the particular values of the parameters of the model.

Now, let us proceed to the graphical analysis of the model in case of large importing country adopted following Maskus and Penubarti (1997) and depicted in figures 4, 5 (Appendices A4, A5). As has been already mentioned here the situation is more complicated. Now, $\alpha$ is lower than marginal costs plus tariff, which indicates strong imitative capacities of the importing country.

The initial equilibrium under low IPR protection in the point *F* indicated lower imports as compared to the monopolistic outcome at point *M*.

Now, consider the effects of a marginal strengthening of IPR protection. Let us, first, consider a rise in $\beta$ for a given $\alpha$ (figure 4). The new MR curve hits marginal cost curve $C+t$ in point Z between points F and M. Thus, imports expand and domestic price would rise.

On the other hand the rise in $\alpha$ for a given $\beta$ (figure 5) would shift the *MR* curve to $MR_S$, causing an expansion of imports to level $Q_S$, which could be larger or smaller than the monopoly level. The result depends upon the relative shifts of $\alpha$ and $\beta$.

Again, we should note the importance of the trade barriers in determining these effects. In this case, if the tariff is sufficiently low and $\alpha$ exceeds marginal exporting costs, a stronger patent law would be more likely to restrict the quantity of imports.

Thus, the replication of Maskus and Penubarti (1997) theoretical model presented here shows that no unambiguous prediction can be made about the influence of the level of IPR protection on international trade. Such indeterminacy in the effects of IPR protection on trade flows exists in a wide range of static market structures, not only in the simple *dominant-firm model* presented here. Cournot duopoly models with identical goods (Maskus and Eby-Konan 1994; Taylor 1993) arrive at the same results. Even if IPR is interpreted as a product-specific tariff in a monopolistic competition model there also are few unambiguous predictions about their effects on trade. (Flam and Helpman (1987), Brown (1991)).

Such indeterminacy in effects may be explained by a variety of different factors. First of all, the firm's response to the increase in IPR protection depends upon the structure and strength of import protection in the country. For example, the

firm could increase or decrease its volume of trade with the country that strengthens its IPR protecting regime depending upon the size of importing tariffs in this country. Non-tariff restrictions such as import quota could also prevent any increase in trade volume of importing good even if IPR protection is being raised. Another important point to note is that firm's decisions about the volume of export to a particular market are interdependent with its decisions to service the market through licensing or foreign direct investment (FDI) (Horstmann and Markusen, 1987). All this allows us to conclude that this problem is a purely empirical issue, which we will try to resolve or at least clarify empirically in the next chapter.

*Chapter 5.*

# EMPIRICAL ESTIMATION.

## 5.1 Methodology.

The conclusions from the theoretical model presented in the previous chapter indicate that bilateral trade flows depend on: (1) The structure of the residual demand in the importing country, (2) the structure of the marginal costs of the dominant exporting firm, (3) the efficiency of the local imitative production, (4) the structure of trade barriers in the particular market, (5) the strength of patents. Unfortunately, theoretical literature cannot provide us with the clear prediction about the effects of strengthening IPR protection in a particular country on international trade volumes. Despite that fact, it does provide us with some helpful guidelines for interpreting the direction of such distortions namely in terms of the two opposite effects mentioned in the previous chapter: these are market-power and market-expansion effects. Let's provide a brief explanation of the nature of these effects. *Market-expansion effect* means that increase in the national standards in the area of IPR protection to reduce the ability of local firms to imitate the foreign technology thus ensuring exclusive rights to the technologies embodied in the imported goods and expanding international markets available to exporters. The subsequent increase in demand induces the exporting firm to supply more exports in the local market. Alternatively, *market-power effect* means that increase of IPR protection in the importing country ensures temporary monopoly power to the exporting firms by providing exclusive rights over protected products and technologies. This enhanced market power arising from the stronger IPR protection induces the exporting firms to act more monopolistically and reduce the amount of exports to the country (Smith (1999), Rafiquzzamann (2002)). The offsetting nature of these two effects is the main

reason of indeterminacy of the predictions about the direction of trade flows emerging in the world with different levels of IPR protection. As mentioned above, this allows us to conclude that relationship between IPR and trade must be treated as an empirical issue.

As far as it is not possible to identify such market parameters as marginal export costs, local imitation cost, which include costs from avoiding protection and demand elasticity, we have to adopt a suitable alternative approach to estimate the effect of IPR protection on trade.

Such an alternative approach for evaluating the effects of IPR on bilateral trade flows could be adopted on the basis of the Gravity Model of international trade or Helpman and Krugman model of monopolistic competition (1985). Both models basically explain trade with the help of distance between the countries and their incomes, also allowing for the number of other trade distorting factors to be included in the model. Recent theoretical studies in the area demonstrated that they are closely related (Anderson (1979), Deardorff (1998), Bergstrand (1985), (1989), (1990)).

The models have been adopted for empirical estimation by a number of authors (Hejazi and Safarian (1998), Maskus and Eby-Konan (1994), Frankel (1995), Smith (1999, 2000), Rafiquzzamann (2002)).

Maskus and Penubarti (1995) use Helpman-Krugman (1985) bilateral gross imports equations to estimate the effect of IPR protection on trade for a wide range of countries (22 OECD countries in 1984). For this purpose they use the following model structure:

$$\begin{aligned}&\log(x_{ijk}) = \gamma_i + \gamma_{is} D_s + \gamma_{il} D_l + \gamma_{iQ} \log(Q_{ik}) + \gamma_{iY} \log(Y_j) + \\ &+ \gamma_{it} \log(1+t_j) + \gamma_{ib} \log(1+b_j) + \gamma_{iI} I_j + \\ &+ \gamma_{iIS} I_j D_S + \gamma_{iIL} I_j D_L + u_{ijk}\end{aligned} \qquad (1)$$

In this model $\log(x_{ijk})$ stands for bilateral sector exports in sector $i$ to country $j$ divided by the aggregate expenditure in the importing country $j$. $Q_{ik}$ is sector

output of the exporting country. $Y_j$ is per-capita income of the importing country. $t_j$ (tariff revenue as a proportion of dutiable imports) and $b_j$ (percentage black-market premium) are trade distorting factors in the country of import and $I_j$ is the index of IPR protection in the importing country. $D_S, D_L$ stand for dummy variables indicating large and small development countries. The intercept allows for capturing the effects of unmeasured trade distortions.

The authors find strong positive effect (market-expansion effect) of the level of IPR protection on the volume of international trade across all industry sectors. However, it should be noticed that the OECD includes mostly high-developed countries or countries with upper-middle level of development, which expected to have a high level of IPR protection and export a major part of high-tech goods. The results may be different in case when small-income developing countries are included in the sample.

Alternatively, Ferrantino (1993) uses gravity model of bilateral trade to estimate whether countries' IPR regimes have a substantial impact on either volume of U. S. firms' sales overseas or the form of those sales (i. e. FDI or licensing). He finds that overall U. S. trade is unaffected by IPR regimes in different countries, while intra-firm trade is expected to expand in response to the weaker IPR regimes.

The gravity model is also used by Smith (1999, 2000) to assess the sensitivity of U.S. state exports to the level of IPR protection in the countries of export. She applies the commodity version of the Gravity Model following Bergstrand (1989). Her specification of the gravity model for bilateral trade flows arises from the standard specification of the Gravity Model:

$$X_{ijk} = \alpha_{0i}(Q_{j.} / N_j)^{\alpha 1i}(N_j)^{\alpha 2i}(Q_k / N_k)^{\alpha 3i}(N_k)^{\alpha 4i}(D_{jk})^{\alpha 5i}(A_{ijk})^{\alpha 6i} e_{ijk} \qquad (2)$$

Taking logs of equation (1) and adding trade-distorting factors to the model Smith arrives at the following specification:

$$\ln(X_{jk}) = \ln \alpha_{oi} + \alpha_{1i} \ln(Q_j / N_j) + \alpha_{2i} \ln(N_j) + \alpha_{3i} \ln(Q_k / N_k) + \alpha_{4i} \ln(N_k) + \alpha_{5i} \ln(D_{jk}) + \alpha_{6i} \ln(1 + T_{jk}) + \alpha_{7i} P_{jk} D_1 + \alpha_{8i} P_{jk} D_2 + \alpha_{9i} P_{jk} D_3 + \alpha_{10i} P_{jk} D_4 + \varepsilon_{ijk} \quad (3)$$

As we can see from the above specification $X_{jk}$ is a dependent variable that stands for bilateral exports from country j from country k; $P_{jk}$ is the level of patent protection in the region k. Other explanatory variables are used to take into account influence of other trade distorting factors. $(Q_j / N_j)$ and $(Q_k / N_k)$ stand for per-capita incomes of region j and k. $N_j$, $N_k$ - population sizes of regions j and k respectively. $D_{jk}$ - distance between regions j and k. $T_{jk}$ is a tariff rate by region k on imports from region g;, $e_{ijk}$ -log normally distributed error term. $D_1, D_2, D_3, D_4$ are dummy variables developed to assess the level of patent protection. Two model specifications estimated separately include two sets of dummies. First set includes *development dummy variables* and allows for the comparison with Maskus and Penubarti (1997) analysis and the second set includes *threat-of-imitation dummy* variables. *The development dummy variables* identify the level of country development according to its income per capita (high (H), upper-income (UM), lower-income (LM), low (L)). Her estimates of the interactions of these dummies with IPR index show that U.S. exporters respond positively to the level of IPR protection (market-expansion effect) in case countries from LM group and negatively (market-power effect) in case of countries within H, UM, and L group. These patterns prevail in the majority of manufacturing industries and in the aggregate of patent-sensitive industries. Prior to discussing the construction threat of imitation dummy variables we should say that according to Smith under both market-power and market-expansion effects exporters respond to the threat of imitation (or its absence) in the country of import. In her paper Smith summarizes the relationship between threat of imitation and market power and expansion effects suggested by trade theory.

Below I provide table adopted from Smith (1999), which summarizes the relationship mentioned above.

**Table 1. Relationship between threat of imitation and market power and expansion effects.**

| | **Weak IPR Protection** | **Strong IPR Protection** |
|---|---|---|
| **Weak Imitative Abilities** | 2. Moderate Threat of Imitation; Ambiguous Effect (+/-) | 1. Weak threat of Imitation; Market Powr Effect (-) |
| **Strong Imitative Abilities** | 4. Strong Threat of Imitation; Market Expansion Effect (+) | 3. Moderate threat of Imitation; Ambiguous Effect (+/-) |

Sourse: Smith (1999)

As we can see the four cells of the table describe the threat of imitation as an interaction between imitative abilities and level of IPR protection in the country. And the numbers in the cells rank the threat of imitation from weakest (1) to strongest (4). Four such country groupings Smith basing on trade theory suggests that market-power effect would unambiguously apply to low-threat importing country (Group 1) and market expansion effect would apply to high-threat importing countries (Group 4). The trade effects of IPR protection are expected to be more ambiguous for importers with moderate threat of imitation (Groups 2 and 3), since both market power and expansion effects may apply in such case. Imitative abilities of the countries in group 2 may be sufficiently weak and even weak protection of IPR will lead to excess protection of imported foreign products with market power effect dominating instead of market expansion effect. For group 3 IPR protection may be sufficiently strong to protect exporting firms against imitation threat from the side of importing countries with strong imitative abilities. Thus, following Smith (1999) we can conclude that trade distortions from different levels of IPR protection can be positive of negative with the direction of the relationship depending upon the threat of imitation, which can be measured by the level of IPR protection and imitative abilities. For the purpose of estimating the relationship described above Smith includes *threat of imitation dummy variables* in the second model specification. The variables are

constructed in the following way: G1 group indicates weak imitative abilities and strong patent rights, measured by R&D/GNP<0.50 and IPR index 3-5. G2 group indicates weak imitative abilities and weak patent rights, which corresponds to R&D/GNP<0.50 and IPR index 0-2. G3 group indicates strong imitative abilities and strong patent rights, which corresponds to R&D/GNP>=0.50 and IPR index 3-5. G4 group indicates strong imitative abilities and weak patent rights, which corresponds to R&D/GNP>=0.50 and IPR index 0-2. The *estimates* of the variables constructed as interactions of these dummies with the IPR index lie in accordance with theoretical studies and show that market-power effect (decrease in U. S. export with the increase in IPR) applies to the countries with the lowest threat of imitation (G1 group) and market-expansion effect applies to the countries with the highest threat of imitation (G4 group). According to the paper the threshold threat of imitation that divides market expansion and market power effect falls in the range of between G2 and G3 groups. Such results are obtained at the industry level and for the aggregate of the patent-sensitive industries.

Thus, on the basis of this analysis Smith states that generally U. S. exports are sensitive to the level of IPR protection in importing countries and the direction of the relationship depends upon the threat of imitation. She also states that weak IPR protection is indeed a barrier to U. S. export to the countries that pose great threat of imitation. In contrast, Smith finds that increase in the level of IPR protection in the countries with a low threat of imitation contributes to reducing the level of U. S. exports, which is consistent with market-power effect.

Her empirical study was lately adopted by Rafiquzzamann for the case of Canada and led to similar conclusions.

In my study I provide an empirical evidence of the effect of increase in IPR protection on international trade for the sample of countries, which includes transition economies. Due to the lack of the data, transition economies have never been previously included in the empirical studies. *Thus the expected effect of the*

*level of IPR protection on international trade is unclear for these countries.* However, we can make some predictions based on the theoretical backgrounds. The majority of countries with transition economies are low-income countries with low level of economic development and weak imitative capacity, especially comparing to such Asian developing countries as China, Taiwan, Singapore. Thus according to the theoretical predictions we should expect that increase in IPR protection in transition economies would imply market-power effect leading to the reduction of bilateral trade flows.

In order to provide detailed analysis of the issue the empirical study is constructed using the following sequence. In the first part of the analysis gravity equations of trade flows will be estimated for the set of 24 OECD countries[8] plus 24 transition economies[9] for the year 1995, which is the most recent year for which Ginarte and Park IPR index is available. The equations will be estimated on the industry level for 13 industries and on the aggregate manufacturing level. First, I examine the sensitivity of bilateral trade flows to the national difference in IPR protection using basic specification, then following Smith (1999) and Rafiquzzanamm (2002) I use the model specifications with the countries grouped by level of economic development and with country groupings by threat of imitation. Finally, I introduce the model specification with countries grouped as transition economies and non-transition economies, which allows estimating the effect of IPR protection on trade for the countries in transition. In the second stage of analysis gravity equations of bilateral trade flows are estimated for the set of 178 countries, including developed high-income countries, developing countries and transition economies for the five-year periods from 1960-1995 using panel data (fixed effects) analysis (the set then is restricted to correspond to that used in the cross-sectional analysis), which gives us an opportunity to check the robustness of results obtained from the cross-sectional analysis.

[8] Korea and China were excluded because of the unavailability of the data

## 5.2. Model specifications

Following Smith and Rafiquzzaman approaches for the purpose of cross-section analysis of commodity trade flows I adopt the basic structure of the Gravity model given in equation (1) to capture the sensitivity of trade flows to national differences in IPR protection, which leads to the following model specification:

$$\ln(X_{jk}) = \ln\alpha_{oi} + \alpha_{1i}\ln(Q_j / N_j) + \alpha_{2i}\ln(N_j) + \alpha_{3i}\ln(Q_k / N_k) + \alpha_{4i}\ln(N_k) + \alpha_{5i}\ln(D_{jk}) + \alpha_{6i}\ln(1+T_{jk}) + \alpha_{7i}IPR_{jk} + \varepsilon_{ijk} \quad (4)$$

Then I add interactions of development-dummy variables with IPR index to show how this sensitivity depends upon the importing country level of economic development I also include development dummies explicitly to capture country-specific characteristics[10]. This leads to the following model specification:

$$\ln(X_{ijk}) = \ln\alpha_{oi} + \alpha_{1i}\ln(Q_j / N_j) + \alpha_{2i}\ln(N_j) + \alpha_{3i}\ln(Q_k / N_k) + \alpha_{4i}\ln(N_k) + \alpha_{5i}\ln(D_{jk}) + \alpha_{6i}\ln(1+T_{jk}) + \alpha_{7i}IPR_{jk}D_1 + \alpha_{8i}IPR_{jk}D_2 + \alpha_{9i}IPR_{jk}D_3 + \alpha_{10i}D_1 + \alpha_{11i}D_2 + \alpha_{12i}D_3 + \varepsilon_{jk} \quad (5)$$

All the variables have the same interpretation as described earlier.

The second model specification includes set of dummy variables to distinguish between country's abilities to pose threat of imitation (includes four dummies)[11]. This specification includes interactions of each dummy variable with IPR index and threat-of-imitation dummies (explicitly) to capture country specific characteristics. The specification is presented by the equation (6) below:

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[9] Macedonia and Moldova were excluded from the sample because of the unavailability of the data.

[10] The dummies are constructed according to Smith approach described earlier; for the thresholds see Appendix B2.

[11] The dummies are constructed according to Smith approach described earlier; for the thresholds see Appendix B3.

$$\ln(X_{ijk}) = \ln\alpha_{oi} + \alpha_{1i}\ln(Q_j / N_j) + \alpha_{2i}\ln(N_j) + \alpha_{3i}\ln(Q_k / N_k) +$$
$$\alpha_{4i}\ln(N_k) + \alpha_{5i}\ln(D_{jk}) + \alpha_{6i}\ln(1+T_{jk}) + \alpha_{7i}IPR_{jk}D_1 + \alpha_{8i}IPR_{jk}D_2 + \quad (6)$$
$$\alpha_{9i}IPR_{jk}D_3 + \alpha_{10i}IPR_{jk}D_4 + \alpha_{11i}D_1 + \alpha_{12i}D_2 + \alpha_{13i}D_3 + \alpha_{13i}D_4 + \varepsilon_{jk}$$

The last model specification is aimed at estimating the trade effects of IPR protection for the countries in transition and includes interaction variables of IPR index with dummy variables for transition countries and industrialized (non-transition) countries, which represent the rest of countries in the sample (by construction). The specification is presented by equation (7) below:

$$\ln(X_{ijk}) = \ln\alpha_{oi} + \alpha_{1i}\ln(Q_j / N_j) + \alpha_{2i}\ln(N_j) + \alpha_{3i}\ln(Q_k / N_k) +$$
$$\alpha_{4i}\ln(N_k) + \alpha_{5i}\ln(D_{jk}) + \alpha_{6i}\ln(1+T_{jk}) + \alpha_{7i}IPR_{jk}D_{Trans} + \quad (7)$$
$$\alpha_{8i}IPR_{jk}D_{Nontrans} + \alpha_{9i}D_{Trans} + \alpha_{10i}D_{Nontrans} + \varepsilon_{jk}$$

For the panel-data analysis, similar model specifications will be used but with certain alterations because of the data peculiarities. The first change in panel-data analysis is the absence of tariff revenues. The reason is that the data on tariff revenues is available only for the recent years, which is not enough for the analysis. However, the problem with measuring tariff trade effects could be to some extent resolved by the inclusion of dummy variables indicating country's membership in WTO and regional trade organizations. Another change is the absence of specification with threat of imitation dummy variables, which was not implemented because data on R&D expenditures needed to construct these dummies is also available only for the recent years.

Before turning to the analysis, let us provide a brief discussion of the explanatory variables included in the model and their effects on trade flows.

*IPR* is a measure of IPR protection for a given importing country, which can be proxied by Ginarte and Park index (1960--1995), Rapp and Rozek index.

Ginarte and Park index was constructed using five categories of patent laws, such as extent of coverage, membership in international patent agreements, provisions for loss of protection, enforcement mechanisms and duration of protection. They

weight a subset of conditions that describe each criterion. Then each of the categories is assigned an appropriate value from 0 to 1. The final index is constructed as an unweighted sum of these five values. Such method of construction allows the index to capture additional variation in the conditions describing IPR standards. The alternative Rapp and Rozek index is based on the adherence of each country's patent laws to the minimum standards proposed by the US Chamber of Commerce (1987), which include guidelines for patent examination procedures, term of protection, compulsory licensing, coverage of inventions, transferability of patent rights and effective enforcement against infringement. The index itself is constructed as a sum of dummy variables that take the value of one if the standard is fulfilled and zero otherwise. Hence, the index measures the level of patent protection in the country on the range from zero to five.

For the purpose of our analysis the use of Ginarte and Park index appears to be more preferable, because it provides information about national patent rights for more countries and periods than other surveys do. Moreover, by construction Ginarte and Park index exhibits greater variability across countries than Rapp and Rozek index.

However, it should be noticed that both indexes are valuable for the analysis and produce similar results. Actually, there is a strong positive correlation between them. For example, correlations between the Rapp and Rozek index for 1984 and Ginarte and Park index for 1985 and 1990 are 0.75 (Smith (1999)). Smith (1999) makes the analysis using both indexes and finds that the results of the estimation using comparable samples are approximately the same.

$Q_j, Q_k, (Q_j / N_j); (Q_k / N_k); N_j, N_k$ - incomes, per capita incomes and populations of regions j and k respectively are measured by GDP, GDP per capita and population statistics. Previous empirical papers based on the analysis of the bilateral gravity model conclude that estimates of GDP and GDP per

capita of regions *k* and *j* have the same positive sign, thus, increasing volume of bilateral trade flows. The same applies to the countries population.

Now, let us turn to the next section, which provides brief description of the data used in the analysis.

### 5.3 Data Description.

The data series used in the empirical part of my study are presented in the table 1 below.

**Table 2. Data description.**

| Variable | Source |
|---|---|
| 1995 data on bilateral trade flows by industry for the set of 26 OECD countries and 22 transition economies in constant US Dollars. | http://unstat.org/ |
| Annual data on bilateral trade flows by country for 1960-1995 in constant US Dollars (five year periods). | "Direction of trade" CD-ROM by IMF. Covers bilateral merchandise trade between 178 IMF entities between 1948 and 1999. For the list of the countries see Appendix D. |
| Annual data on GDP per capita by country for 1960-1995 in constant US Dollars (five year periods). | World Bank, *World Development Indicators*<br>IMF's *International Financial Statistics* |
| Annual data for the population by country for 1960-1995 (five year periods). | World Bank, *World Development Indicators*<br>Penn World Tables |
| Distance between countries in kilometres | CIA's *World Factbook*<br>http://www.odci.gov/cia/publications/factbook |
| Tariff revenue as a percentage of dutiable imports. | IMF, Government Finance Statistics Yearbook (1995). |
| Index of intellectual property rights protection by country for 1960-1995 (five year periods). | Ginarte and Park (1997) |

* All variables are expressed in logs except IPR index

Summary statistics of the data is presented in the table 3 and 4. Table 3 lists summary statistics for the cross section analysis.

**Table 3. Summary statistics for the cross-section analysis.**

| Variable | Description | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Trade | Export from country j to country k | 19.390 | 2.806 | 6.899 | 25.559 |
| Gdp1 | Gross national income per capita of the exporting country | 10.012 | 0.616 | 5.784 | 10.684 |
| Gdp2 | Gross national income per capita of the importing country | 8.970 | 1.271 | 5.751 | 10.684 |
| Pop1 | Population of the exporting country. | 16.792 | 1.461 | 12.499 | 19.394 |
| Pop2 | Population of the importing country. | 16.332 | 1.379 | 12.499 | 18.813 |

| | | | | | |
|---|---|---|---|---|---|
| Ipr | Ginarte-Park index in the importing country | 3.158 | 0.973 | 0 | 4.57 |
| Tariff | Average tariff revenue in the importing country | 0.988 | 0.792 | 0 | 2.933 |
| Dist | Distance in kilometres between countries of export and import. | 7.586 | 1.049 | 4.133 | 9.417 |

* All variables are expressed in logs except IPR index

An overview of the data for the panel data analysis is presented in the table 4 below.

**Table 4. Summary statistics for panel data analysis.**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| | | | **1960** | | |
| ldist | 2625 | 8.102249 | .8270373 | 4.737697 | 9.416901 |
| ltrade | 2625 | 10.86362 | 2.076027 | 5.312247 | 18.59908 |
| lrgdp | 2625 | 47.3892 | 2.292455 | 40.04779 | 54.83287 |
| lrgdppc | 2625 | 15.3753 | 1.18141 | 11.82185 | 18.34921 |
| ipr | 2625 | 1.52 | 1.02 | 0 | 3.75 |
| | | | **1965** | | |
| ldist | 3361 | 8.102748 | .8217728 | 4.639572 | 9.416901 |
| ltrade | 3361 | 10.72386 | 2.244587 | 3.456869 | 18.93924 |
| lrgdp | 3361 | 47.48039 | 2.421899 | 39.64347 | 55.31726 |
| lrgdppc | 3361 | 15.59412 | 1.322458 | 11.77414 | 20.07277 |
| ipr | 3361 | 1.874558 | 1.079437 | 0 | 3.86 |
| | | | **1970** | | |
| ldist | 4737 | 8.132241 | .8030663 | 4.639572 | 9.421514 |
| ltrade | 4737 | 9.81208 | 2.966646 | 3.248262 | 19.38535 |
| lrgdp | 4737 | 47.41052 | 2.547746 | 38.66786 | 55.96843 |
| lrgdppc | 4737 | 15.7457 | 1.369611 | 11.74009 | 20.02989 |
| ipr | 4737 | 1.905436 | 1.11459 | 0 | 3.75 |
| | | | **1975** | | |
| ldist | 5354 | 8.168451 | .7990186 | 4.016798 | 9.421514 |
| ltrade | 5354 | 10.2895 | 3.07541 | 2.826707 | 19.83697 |
| lrgdp | 5354 | 47.71896 | 2.573382 | 36.12847 | 56.2817 |
| lrgdppc | 5354 | 16.03764 | 1.420899 | 11.75427 | 20.52554 |
| ipr | 5354 | 1.835997 | 1.146352 | 0 | 3.75 |
| | | | **1980** | | |
| ldist | 5895 | 8.176839 | .810574 | 3.782556 | 9.421514 |
| ltrade | 5895 | 10.36211 | 3.246968 | 1.503119 | 19.99866 |
| lrgdp | 5895 | 47.93037 | 2.711641 | 37.36754 | 56.67007 |
| lrgdppc | 5895 | 16.25868 | 1.439329 | 11.94834 | 20.80505 |
| ipr | 5895 | 1.831532 | 1.201646 | 0 | 4.24 |
| | | | **1985** | | |
| ldist | 6232 | 8.189429 | .8006043 | 4.016798 | 9.419 |
| ltrade | 6232 | 9.663303 | 3.740056 | -7.375496 | 20.1351 |
| lrgdp | 6232 | 47.95617 | 2.761775 | 37.75125 | 56.98547 |
| lrgdppc | 6232 | 16.21394 | 1.414002 | 11.85954 | 19.62588 |
| ipr | 6232 | 1.828851 | 1.253678 | 0 | 4.24 |
| | | | **1990** | | |
| ldist | 6620 | 8.230408 | .7936437 | 3.782556 | 9.421514 |

| | | | | | |
|---|---|---|---|---|---|
| ltrade | 6620 | 9.456047 | 3.994597 | -16.09047 | 20.3141 |
| lrgdp | 6620 | 48.07611 | 2.816282 | 37.16784 | 57.33808 |
| lrgdppc | 6620 | 16.2915 | 1.451144 | 12.03252 | 19.70256 |
| ipr | 6620 | 1.783107 | 1.282043 | 0 | 4.24 |
| | | | **1995** | | |
| ldist | 7640 | 8.267232 | .7985041 | 3.782556 | 9.421514 |
| ltrade | 7640 | 9.615719 | 3.748475 | -7.365427 | 20.59434 |
| lrgdp | 7640 | 48.14887 | 2.818892 | 38.66458 | 57.76747 |
| lrgdppc | 7640 | 16.21566 | 1.564573 | 10.93263 | 19.87719 |
| ipr | 7640 | 2.051521 | 1.319806 | 0 | 4.57 |

**Over the whole period**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| ldist | 42464 | 8.168802 | .8047893 | 3.782556 | 9.421514 |
| ltrade | 42464 | 9.973134 | 3.402768 | -16.09047 | 20.59434 |
| lrgdp | 42464 | 47.84247 | 2.688408 | 36.12847 | 57.76747 |
| lrgdppc | 42464 | 16.05719 | 1.454935 | 10.93263 | 20.80505 |
| ipr | 42464 | 1.875777 | 1.210592 | 0 | 4.57 |

As it can be seen from the table, the number of observations increases with time indicating the greater number of countries included in the sample and the development of trade relationships between them. The mean value of logarithm of trade tends to decrease with time. This can be explained with the fact of inclusion of more and more observations with low trade volumes. Mean real GDP and GDP per capita exhibit constantly increasing pattern over the whole sample period. The mean IPR index increases over time and its standard deviation decreases, which means that countries in the sample converge to the higher levels of IPR index over time.

*Chapter 6.*

# EMPIRICAL RESULTS

## 6.1 Cross-section estimation: basic results

This section is aimed at the estimating gravity equations of commodity trade flows for the set of 24 OECD countries plus 24 transition economies for the year 1995. The parameter estimates along with White-heteroscedastisity corrected standard errors for the basic equation including IPR variable are presented in the Table 8 (Appendix B1). The first row represents the estimates for the aggregated trade flows.

Population and income per capita variables of both trading partners are highly significant and exhibit the expected positive signs on the aggregate level and for each industry separately. The elasticity of bilateral trade with respect to the exporting and importing countries incomes are 0.74 and 0.91 respectively[12]. The coefficients of the population variables of both trading partners show expected positive signs and high statistical significance. The coefficient of the variable indicating distance between trading partners is negative (as expected) and highly significant. Thus distance reduces trade. The variables described above (incomes, per capita incomes, population and distance) are basic variables that will be included in each of the estimated specifications. They preserve their signs and statistical significance in each of estimated specifications on the aggregate and on the industry levels. That is why we will pay minor attention to them during further analysis, concentrating only on the variables of interest.

The coefficient on the average tariff revenue is negative and statistically significant on the aggregate level, which indicates that high tariffs hinder overall

[12] Income and per capita incomes of both trading partners are included in the logarithmic form thus their estimated parameters represent trade elasticities with respect to income and per capita income of trading partners respectively.

international trade. However, on the industry level the effect of the tariff revenue is of the wrong sign and insignificant for the majority of industries. This problem, however, may arise due to the low quality of the tariff data. The data measures only the overall tariff revenues and may not suite for the industry level estimation. The exclusion of the tariff variable does not change the signs and statistical significance of the rest of the estimated model parameters. However, we will leave the tariff variable in the model as a control variable on the basis of theoretical considerations.

Finally, to control for the specific characteristics of the transition economies we include transition dummy variable explicitly into the model. This variable appears to be negative and highly significant on the aggregate level and for each of the estimated industries.

Turning to the estimates of the coefficients of the IPR variable, which is the focus of this paper we see that coefficient of IPR variable is statistically significant on the aggregate level and for eight out of thirteen estimated industries. On the basis of these estimates we distinguish between industries that are "sensitive" to IPR protection and those that are "insensitive" to IPR protection and compare our findings to the previous findings in the area.

The summarized results presented in the table 5 below show that in general the current estimates coincide with the results of previous studies in the area. It should be mentioned here that rankings of industries in the "Previous Findings" column are based on the results obtained by Maskus and Penubarti (1997), Smith (1999) and Rafiquzzaman (2002). Rafiquzzaman and Maskus and Penubarti distinguish between sensitive and insensitive sectors on the basis of the estimation results, while Smith base their rankings on the *a priori* expectation of the certain industry to be sensitive to the level of IPR protection[13]. She basically assumes all the industries included in the following table to be *a priori* sensitive to

[13] Smith (1999) makes the choice of industries on the basis of: (1) research and development expenditures as a percent of net sales, (2) industry share in the total patents granted.

IPR protection. Finally, however, she proves only three of them to be sensitive on the basis of the estimation results.

**Table 5. Summary of IPR Sensitive and Insensitive Products**

| Products | Previous findings | | | Current estimates |
|---|---|---|---|---|
| | Maskus and Penubarti (1997) | Smith (1999)[14] | Rafiquzza-mann (2002) | Current findings |
| Food, Beverages, Tobacco. | Sensitive (+) | Insensitive | Sensitive (+) | Sensitive (-) |
| Rubber Manufactures | Insensitive (+) | Insensitive | Insensitive (-) | Sensitive (+) |
| Plastic Products | Insensitive (+) | Insensitive | Sensitive (+) | Sensitive (+) |
| Leather & Related Products | Insensitive (+) | Insensitive | Insensitive (-) | Sensitive (-) |
| Textile Products | Sensitive (+) | Insensitive | Insensitive (+) | Insensitive(+) |
| Furniture | Sensitive (+) | Insensitive | Insensitive (+) | Insensitive(+) |
| Printing and Publishing | Sensitive (+) | Insensitive | Sensitive (+) | Sensitive(+) |
| Iron and Steel | Sensitive (+) | Insensitive | Insensitive (-) | Insensitive(+) |
| Metal Products | Insensitive (+) | Sensitive | Sensitive (+) | Sensitive(+) |
| Non-metal Minerals | Sensitive (+) | Insensitive | Sensitive (-) | Sensitive(+) |
| Machinery & Trans. Equip. | Sensitive (+) | Sensitive | Insensitive (+) | Insensitive(+) |
| Petroleum Products | Insensitive (-) | Insensitive | Insensitive (+) | Insensitive(+) |
| Chemicals | Insensitive (-) | Sensitive | Insensitive (+) | Sensitive(+) |
| Rankings are based on Maskus and Penubarti (1997), Smith (1999), Rafiquzzaman (2002) | | | | |
| Signs in brackets indicate the directions of trade effects: (+) – market expansion effect; | | | | |
| (-) – market power effect. | | | | |

Summarizing the results we should say that current finding supports the view that for the current sample overall and for the majority (six out of eight) of *IPR-sensitive* industries *increase* in the level of IPR protection in the country tends to increase international trade flows through the *market expansion effect*.

### 6.2 Cross-section estimation: development interaction results

Now let us turn to estimating country's export response to the variability in the IPR protection levels in the countries at similar levels of development. For this purpose we apply second model specification[15] including interaction variables of IPR and development dummy variables (Table 9; Appendix B2). Development dummy variables are constructed as described previously following Smith (1999)

[14] Smith does not provide the results of the basic equation, focusing only on estimating threat of imitation interaction variables. That is why we cannot provide the direction of influence in case of her results.

[15] See section 4.2 equation (5) for details.

approach[16]. We also include development dummy variables explicitly in the model to control for specific characteristics of each country group.

The results show that basic model variables such as population, income per capita and distance preserve their signs and statistical significance on the aggregate and on the industry level.

The estimates of the *interaction variables*[17] on the *aggregate level* reveal that volume of international trade demonstrates a significant *negative response* to the strengthening of IPR protection in the countries with *low and high level of economic development,* the response is *positive* and significant for the countries within *middle level of development group*. These estimates show that exporters respond positively (market expansion effect dominates) to the increase in the level of IPR protection in countries of middle level of economic development and negatively (market power effect dominates) – in countries within low and high development groups. Such results coincide with theoretical underpinnings and previous empirical findings (Smith's (1999), Rafiquzzamann (2002)).

Sectoral estimates of the interaction variables show that strengthening IPR protection affects the majority of estimated IPR-sensitive industries (all except one) through the *market power effect* (negative response) for the countries at *low levels of economic development*. For the countries of *middle level of development* the industry estimates also exhibit negative significant impact on trade through *market power effe*t for all except one of the IPR sensitive industries. The estimates of the interaction variables for the countries *of high level of economic development* are positive and significant (*market expansion effect*) for the majority of IPR sensitive industries (except Food, Beverages and Tobacco; Printing and Publishing; Leather and Related Products).

Hence the results of the estimation of IPR interaction with the development dummy variables show that for the sample of countries including transition

[16] See appendix B2 for the construction and shortcuts.

economies after controlling for the group specific characteristics the strengthening of *IPR protection* hinders total trade volumes for the countries in the *low and high development groups*, through *market power effect*. Countries with *middle level of economic development* benefit from the increase in IPR protection through *market expansion effect*. On the *industry specific level* market-power effect prevails for the majority of IPR sensitive industries in low and middle income country groups, and market-expansion effect dominates in high income group.

The results might seem to be counterintuitive at the first glance. It seems reasonable that for the countries at the middle level of economic development IPR protection must positively affect trade through the market expansion effect on industry level and as well as on the aggregate manufacturing level. However, in the framework of present analysis it is not the case. An explanation of such "counterintuitive" results comes from theoretical literature that argues that the main element that influences trade responses to differences in country levels of IPR protection is *the threat of imitation* possessed by country, but not its level of economic development. Following this reasoning Smith (1999) extends the "development" results and empirically demonstrates the connection between threat of imitation posed by country and the effects of IPR protection on trade in each case. In the next section we elaborate Smith approach for the purpose of our analysis.

### 6.3 Cross-section estimation: threat of imitation interaction results

This section discusses the link between the threat of imitation posed by the importing country and exporter sensitivity to the strength of level of IPR protection in this country. As had been already mentioned according to Smith (1999) threat of imitation is and important factor that determines the direction of the trade effects of IPR protection.

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[17] Wald test rejects $H_0$ about the equality of coefficients at less than 1% significance level. Appendix C3.

For this purpose we apply model specification (3)[18], which includes interactions of threat of imitation dummy variables[19] with IPR index[20]. Threat of imitation dummy variables also explicitly included into the model to allow for specific characteristics of each country group. In this section the estimation is made for the industries, determined previously[21] as IPR sensitive, for the total of the IPR-sensitive industries and for the entire manufacturing.

The results of the estimation are reported in Table 10 (Appendix B3) and show a remarkable correspondence with theoretical predictions and with the results obtained by Smith (1999)[22].

First, let me restate that *group 1* represents countries with the lowest threat of imitation (*weak imitative abilities, strong IPR index*), *groups 2 and 3* represent countries with lower and upper moderate threat of imitation respectively (*group 2: weak imitative abilities, weak IPR protection, group 3: strong imitative abilities, strong IPR protection*); *group 4* represents countries with the highest threat of imitation (*strong imitative abilities, weak IPR protection*).

The estimation results reveal that *market power effect* applies for the estimates of all IPR-sensitive industries (it is insignificant for two of them), for the aggregate of the IPR-sensitive industries and for the total manufacturing *for the countries of group 1 (lowest threat of imitation)*. For the countries of *group 4 (highest threat of imitation) market expansion effect* of IPR protection prevails for the entire manufacturing sector, for the aggregate of the IPR-sensitive industries and for the majority (except two) of the industry-specific estimates.

For the countries of *group 2 (lower-moderate threat of imitation) market power effect* of IPR also prevails for the aggregate of IPR-sensitive industries and for the majority

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[18] See section 4.2 equation (6) for details.

[19] See section 4.1 for the methodology of construction. For the shortcuts see Appendix B3.

[20] Wald test rejects $H_0$ about the equality of coefficients at less than 1% significance level. Appendix C3.

[21] See section 4.3 Table (5) for details.

[22] See section 4.1 for details

of the industry-specific estimates (insignificant for two industries). On the level of total manufacturing exports seem to be insignificant to IPR-protection for the countries of this group.

For the countries of *group 3* posing upper-moderate threat of imitation, *the market power effect* prevails for the entire of the manufacturing sector. However for the aggregate of the IPR-sensitive industries we observe the dominance of the market-expansion effect. On the industry specific level the patterns differ across industries with market power effect prevailing for five out of eight industries and market expansion effect prevailing for the rest[23].

For each of the estimated interaction variables the magnitude of export response is larger for the aggregate of the IPR-sensitive industries than for the total manufacturing. This states that exports in IPR-sensitive industries are more sensitive to the changes in IPR protection than entire manufacturing exports.

Summarizing the results of this section we should say that *market power effect* of stronger IPR protection hinders trade of the countries with a low (group 1) or lower-moderate (group 2) threat of imitation. For the countries with high threat of imitation (group 4) stronger IPR protection accelerates trade through market expansion effect. For the countries of with upper-moderate threat of imitation (group 3) the results vary across industries, with market expansion effect applying for the aggregate of the IPR sensitive industries. As have been already mentioned the results coincide with those of Smith (1999) and Rafiquzzamann (2002) and allow to establish and important empirical evidence of the link between IPR protection and trade.

### 6.4 Cross-section estimation: transition countries interaction results

On the next step of the analysis we estimate the impact of IPR protection on international trade for the countries with transition economies. For this purpose we estimate the model specification, which includes interaction variables of IPR

[23] Such results for groups 2 and 3 coincide with theory predicting ambiguous results for these two groups. See section 4.1 Table 1 for details.

variable with dummy variables for transition countries and non-transition countries[24], which are industrialized OECD countries due to the construction of the sample[25]. We also include transition economy dummy explicitly into the model to control for country specific characteristics. The results of the estimation are presented in Table 8 (Appendix B4).

Interaction variables with non-transition dummies estimates have significant positive signs for the aggregate level and for the majority of the IPR-sensitive sectors. This allows conclude that for the *countries with industrialized economies* strengthening of *IPR protection* increases international trade flows through the *market expansion effect*. The finding is consistent with that of section 4.3 indicating that for the countries with high level of economic development strengthening of IPR protection affects trade through the market-expansion effect and gives us one more proof that distinguishing countries by level of economic development does not necessarily reflect the peculiarities of relationship between IPR protection and trade which are captured by threat of imitation interaction variables.

Estimates of the *interactions of IPR with transition dummies* also have *significant positive sign on the aggregate level,* showing, however, slightly lower IPR sensitivity of trade flows of transition countries than those of non-transition. The direction of the relationship varies across industries, however, with the market power effect dominating for three out of eight estimated IPR-sensitive sectors (food, beverages and tobacco products; leather and related products; non-metal minerals) and with market expansion effect dominating for the rest of the estimated IPR-sensitive sectors. The results of the estimation allow us to conclude that transition economies pose quite high imitative threat for the exporters who react to the strengthening of IPR protection in transition countries through the market expansion effect. The dummy for transition economies,

[24] Wald test rejects $H_0$ about the equality of coefficients at less than 1% significance level. Appendix C3.

whose estimate appears to be negative and significant on the aggregate level and for all except one of the estimated industries, captures all the negative influence on trade, which might well be mistakenly attributed to the IPR variable if this dummy is not included in the model[26].

Thus, the results obtained reveal that for the countries with transition economies, an increase in the level of IPR protection would unambiguously lead to an increase of bilateral trade flows on the aggregate level and for the majority of the estimated IPR sensitive industries.

However, OLS analysis used to estimate the impact of IPR protection on international trade in the current and previous sections may fail to capture some of the important unobserved determinants of bilateral trade flows and consequently may lead us to false conclusions. It is possible that findings of the previous chapters are caused not by IPR protection itself but by other unobserved country characteristics that are correlated with the level of IPR protection in the importing country. Hence, to help substantiate reliable conclusions we should check for the robustness of results. Implementation of the panel data fixed effects analysis serves for this purpose.

## 6.5 Panel data analysis results

This section uses fixed effect analysis to estimate the impact of IPR protection on international trade for the set of countries, containing 178 countries including developed, developing countries and transition economies. To allow for comparison between the results of the cross sections estimation we will further restrict the set of countries in the analysis to be the same as that used in the cross section analysis. For comparison purpose I also introduce set of development and transition dummy variables and consider interactions of these dummies with IPR index for the separate model specifications (the same

[25] See section 4.2 equation (7) for details

specifications as for the cross-sections analysis will be used). I also include time dummies in the model for panel analysis as control variables.

In table 12 of Appendix C1 estimates for the fixed effects for the years 1960-1995 (five-year periods) are presented for the three different model specifications. Unfortunately we cannot apply the specification of the model that uses threat of imitation interactions for the panel data analysis due to the previously mentioned unavailability of the R&D data.

The appropriateness of fixed effect analysis for this case has been discussed in many of the recent empirical papers in the area (Smith (1999), Rafiquzzaman (2002)). However, we also ground the choice of this estimation tool on econometric basis. First we compare fixed-effects to pooled OLS for every specification with the help of the F-test, which confirms that fixed effects are preferred to pooled OLS in this case on less than 1% level of significance. I also allow for an alternative that unobserved factors do not correlate with the explanatory variables included in the regression model, which allows for the use of random effects analysis. Nevertheless, Hausman test shows the appropriateness of fixed-effects in current case on less than 1% level of significance[27].

The estimates of the basic model specification (Specification 1) show that for the wide set of 178 countries including countries of different development levels for 8 periods from the year 1960-1995 strengthening of IPR protection has significant positive impact on the level of international trade flows. The estimate of the intercept term is positive and highly significant. The basic parameters of the model such as country's income and income per capita are highly statistically significant and have expected signs. Since we cannot measure countries tariff revenue from international trade for such a broad period of time because the data are unavailable, we include dummy variables to proxy the

[26] Estimation results of the same model specification without transition dummy are available upon request.

strengths of tariff barriers between trading partners. The first one is *regional dummy variable*, which indicates whether the trading partners belong to the same regional trade agreement. The second dummy indicates whether the importing country is a current member of the World Trade Organization (WTO). The estimate of the *regional dummy variable* is significant and has expected positive sign indicating that bilateral trade increases in the presence of regional trade agreement. The estimate of the WTO dummy variable also has an expected positive sign and high statistical significance. Thus, the results of the estimation of the basic specification show that for the large set of countries level of IPR protection has a positive influence on international trade, which coincides with the previous empirical findings.

Switching to the estimation results of the second specification, which includes interaction variables of IPR with development dummy variables[28], we should mention that all the basic variables of the model (income, income per capita) preserve their signs and remain highly significant. Interaction variable estimates show that for the countries within the *low development group* an increase in IPR protection negatively affects bilateral trade on the aggregate level through the *market-power effect*, while for the countries of the *middle and high development groups* strengthening of IPR protection increases international trade through *market-expansion effect*. The results, however, cannot be compared with the results of the cross-section analysis because of different sample size. The regional and WTO dummies preserve their positive signs and statistical significance. The results of the estimation are consistent with the previous results in the area (however all previous results were obtained with the help of OLS analysis fixed effects analysis has never been previously implemented).

The last specification is aimed at estimating how an increase in IPR protection affects bilateral trade of the countries with transition economies. Again basic

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[27] For values of F-test and Hausman test see Appendix C3

variables of the model (income and income per capita) preserve their signs and statistical significance.

Interaction variable of IPR index with dummy for transition economies exhibits a positive sign and high statistical significance meaning that changes in the level of IPR protection for the countries with transition economies increase international trade on the aggregate level through the market expansion effect. Interaction variable of the IPR index with non-transition countries also follows the same pattern having significant positive estimate, which proves that market-expansion effect dominates in the relationship between IPR protection and bilateral trade flows for other countries in the sample[29].

Now we will restrict the size of the sample (to include the same countries as used in the cross-sections analysis) to allow for explicit comparison with the results of the cross-sections estimation (Table 12a; Appendix C1). As it can be seen from the table the results of the restricted sample estimation follow the same pattern as that of the unrestricted sample. Consequently, the results of the restricted sample fixed effects estimation coincide with the results of the estimations obtained from the cross-sections analysis, which strongly suggests the robustness of the results. The main results are summarized in the table 6 below.

*Thus on the basis of the obtained results we can conclude that increase in IPR protection in the transition countries would lead to increase in international trade volume on the aggregate level. The same pattern would prevail for the majority of the IPR-sensitive industries.*

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[28] Wald test rejects $H_0$ about the equality of coefficients at less than 1% significance level. Appendix C3.

[29] Wald test rejects $H_0$ about the equality of coefficients between interaction variables at less than 1% significance level. Appendix C3.

| Table 6[30]. Main results of the cross-section and fixed effects analysis (for the aggregate level). | | |
|---|---|---|
| **Estimated variable** | **Cross-sections results** | **Fixed-effects results** |
| **$IPR_k$** | Market-expansion effect | Market-expansion effect |
| **$IPR_K D_L$** | Market-power effect | Market-power effect |
| **$IPR_k D_M$** | Market-expansion effect | Market-expansion effect |
| **$IPR_k D_H$** | Market-power effect | Market-expansion effect |
| **$IPR_k$ (Group 1: weak imitative threat)** | Market-power effect | Data unavailable |
| **$IPR_k$ (Group 2: moderate imitative threat)** | Market-power effect | Data unavailable |
| **$IPR_k$ (Group 3: moderate imitative threat)** | Market-expansion effect | Data unavailable |
| **$IPR_k$ (Group 4: strong imitative threat)** | Market-expansion effect | Data unavailable |
| **$IPR_k D_{Trans}$** | Market-expansion effect | Market-expansion effect |
| **$IPR_k D_{Nontrans}$** | Market-expansion effect | Market-expansion effect |
| | | |

However, to be sure in the reliability of the results of the fixed effects analysis we would provide some robustness checks in the next section.

## 6.6 Robustness tests

The focus of this section is to check the robustness of results of the fixed effects analysis. For convenience we summarized the tools that we used and the results that we obtained in the table 7 below:

| Table 7. Summary of robustness tests. | | |
|---|---|---|
| **Robustness test** | **Explanations** | **Results** |
| Run RE and compare with FE with Hausman test | Specification check | Robust[31] |
| Compare FE to Pooled OLS with F-test. | Specification check | Robust[32] |
| Run dummy regression and compare to FE results | Specification check: dummy regression must lead to similar results. | Robust[33] |
| Split samples before and after beginning of transition (1990): Run FE separately for both periods | The results may arise mainly due to the rapidly changing environment after beginning of transition period | Robust[34] |

[30] Analysis made for the same samples allowing for the comparison of the results.

[31] See Appendix C3 for STATA outputs of Hausman test.

[32] For test statistic and p-values see Appendix C3.

[33] See Appendix D1 for dummy regression statistical output.

[34] See Appendix D2 for STATA estimation outputs of spited samples.

| Implement IV approach | Potential endogeneity problem | Robust[35] |
|---|---|---|

Unfortunately we cannot check the robustness of results for the choice of IPR measure in case of panel data analysis. We use Ginarte and Park index in the framework of the present analysis because it is the only index available for such a long period of time and for such wide range of countries. Ginarte and Park index is also used by other researches for the purpose of similar analysis (Smith (1999), Rafiquzzaman (2002)) and proved to be a reliable measure to reflect the level of IPR protection. The Rapp and Rozek index is available for one year only[36] and has much lower variability than Ginarte and Park index.

All other tests implemented in the scope of the present analysis proved the robustness of the results, which allows us to be sure in the reliability of our conclusions.

[35] See Appendix D3 for STATA estimation outputs of regressions with IV approach.

[36] See sections 4.1 and 4.2 for details about Rapp and Rozek index.

*Chapter 7.*

# CONCLUSIONS.

Ukraine's failure to confirm to international standards of the enforcement of IP protection especially in the field of "multimedia piracy" has become an ongoing concern in recent years and has caused a number of trade sanctions from the side of the US and other developed countries. Moreover the lack of IP protection remains one of the hottest issues hindering Ukraine's accession to the WTO. However, Ukraine government seems to be satisfied with the current state of affairs. Such a policy stance may be driven by a widely accepted view that increase in the level of IP protection would hinder Ukraine's international trade flows, constituting a significant part of the country's budget revenues.

Thus, the purpose of this study was to investigate the influence of IPR protection on international trade for the countries with transition economies. The theoretical framework presented in the current study (based on the Maskus and Penubarti (1997) theoretical model) does not allow us to make a clear prediction about the response of bilateral trade flows to the increase in IPR protection in the country of import, which turns our attention to the empirical analysis of the issue.

However, the likely empirical effect of IPR protection on international trade is uncertain since previous studies have not included transition countries in their estimation samples.

In the scope of this paper we implement the empirical analysis based on the Gravity Model, which is estimated for the set of 48 countries including 24 OECD country and 24 transition economy for the year 1995 on the aggregate manufacturing and industry specific levels. Further the paper develops FE-analysis for the set 178 countries of various development levels for the time period 1960-1995 (the set of countries is further restricted to allow for comparison with cross-section analysis). FE analysis has never been applied previously, although it has been heavily suggested by a number of researches.

First, the results of cross-section analysis allow us to conclude that *IPR protection increases* international trade in aggregate through *market expansion effect* for the *countries at middle levels of economic development* and *hinders* international trade through *market power effect* in case of *low and high developed countries*. The picture is somewhat different at industry specific levels for the countries of middle and high development groups. The IPR level negatively affects (market power effect) international trade for the majority of IPR sensitive industries of countries at middle development level and positively affects (market expansion effect) international trade for approximately two thirds of the estimated IPR sensitive industries of the countries at high level of development.

We also establish the link between the differences in country levels of IPR protection and trade, for the countries grouped by their ability to pose threat of imitation. In this area our findings exhibit strong consistency to the previous researches in the area showing that *IPR protection reduces* international trade volumes for countries posing *low and lower-moderate threat of imitation* through *market power effect,* and *augments* international trade of countries posing *upper-moderate and high threat of imitation* through market expansion effect on the aggregate level as well as for the majority of estimated IPR sensitive industries.

Further, we investigate the impact of IPR protection on international trade of the countries in transition. The results of the estimation demonstrate that after controlling for country specific characteristics, *IPR* appears to have a *positive effect* on international trade of *transition economies*. The *market-expansion* effect dominates both on the aggregate and on industry-specific level.

Further, to help verify the reliability of the cross-section estimation results we implement FE analysis that shows that for the same set of countries IPR protection has a significant positive impact on international trade, which is consistent with the previous results in the area.

Generally the results of the FE analysis coincide with the results obtained from the cross-section estimation and the last model specification reveals that for the

countries with transition economies an increase in IPR protection exhibits positive and significant influence on the volume of bilateral trade, which also coincides with the result obtained from the cross-section analysis. The set of robustness checks implemented for the FE-analysis proves the robustness of the results.

Thus, current findings allow one to conclude that for country in transition, such as Ukraine, there is a strong evidence that strengthening of IPR protection would lead to the increase in international trade on the aggregate level and for the majority of the IPR-sensitive industries studied in the current analysis.

In general, the findings of the paper seem to be reasonable and provide a strong incentive for further research in the area.

One of the strongest suggestions for further research is to provide panel data analysis of the impact of IPR protection on bilateral trade flows on the industry level. This could not be implemented in the current paper because the data were unavailable. The second significant improvement to the analysis would be the use of updated versions of the IPR measure. It would also be interesting to investigate the interrelationship between the level of IPR in the country and the country's prevailing form of access to technology intensive goods (imports, licensing, FDI).

The final suggestion for further research is to estimate country welfare effects from the increase of the level of IPR protection. The impact on welfare, however, can potentially differ across countries. The difference in the results occurs because the increase in international trade creates two opposite effects. The first is positive effect from the increase in trade flows. The negative effect reflects losses of domestic producers from the increase in the level of IPR protection because it becomes more difficult fore them to imitate. And even if domestic manufacturers would prefer buying licenses national welfare could suffer losses because of the increased royalty payments to foreigners. Thus the welfare effects of the changes in IPR protection are ambiguous. At least in transition countries,

however, government should not worry about a possible negative impact of IPR protection on international trade. The results of this study confirm that positive changes in IPR protection exhibit a strong tendency to increase international trade flows in transition countries.

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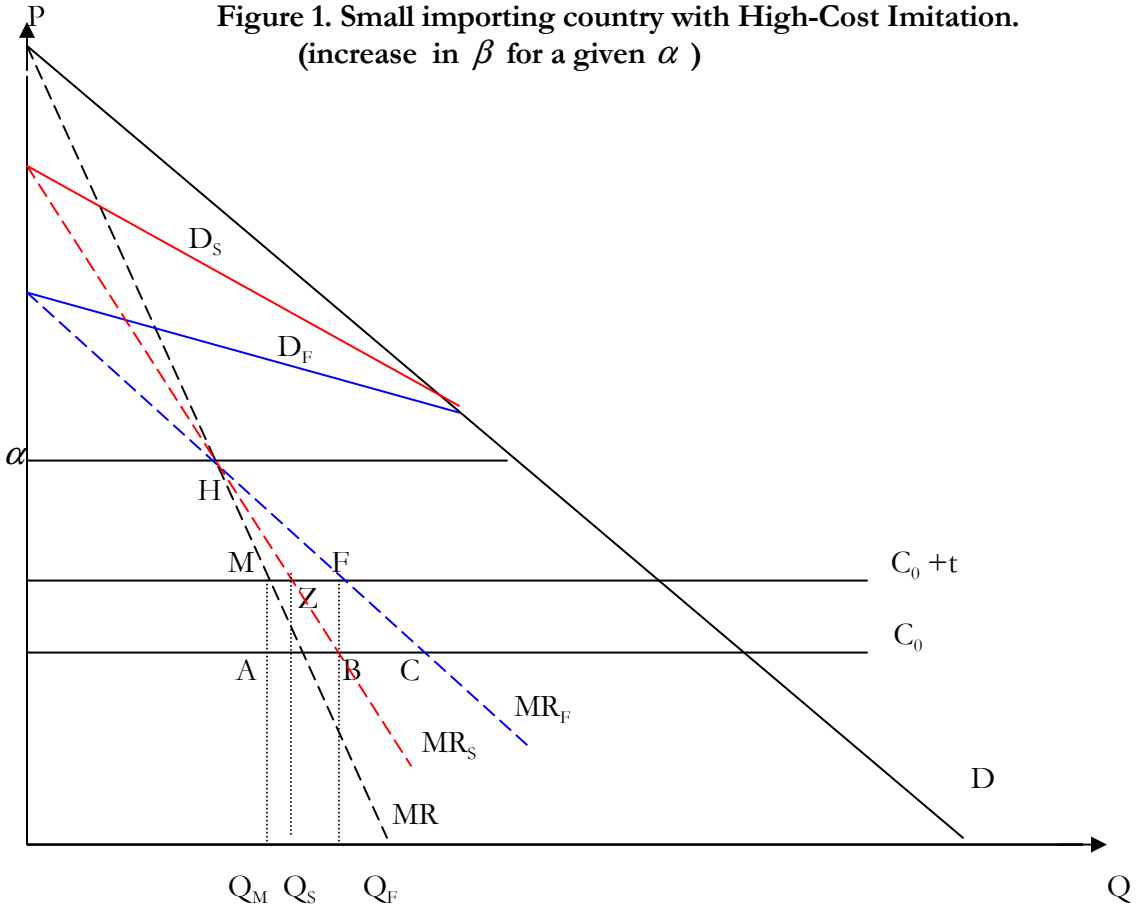
APPENDIX A1

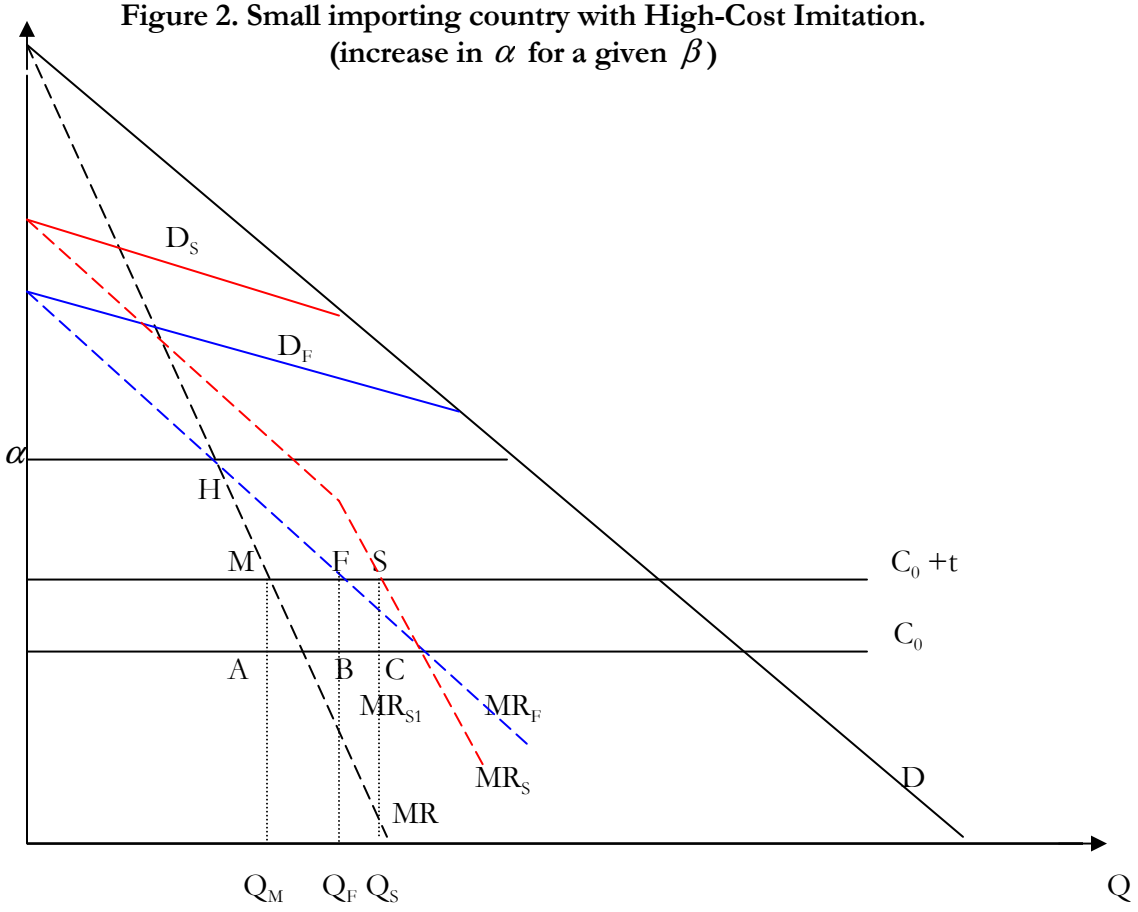
**Figure 1. Small importing country with High-Cost Imitation.**
**(increase in $\beta$ for a given $\alpha$ )**




Source : Maskus and Penubarti (1997)

APPENDIX A2

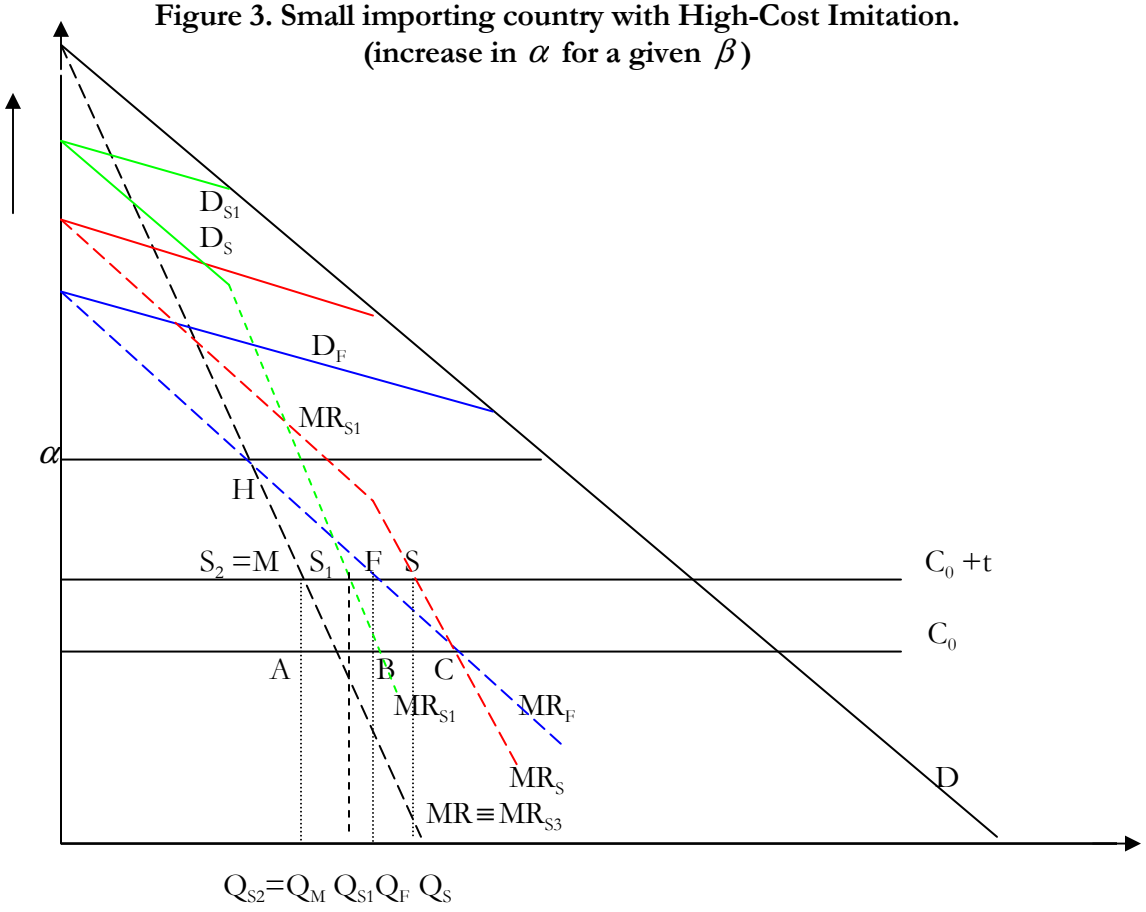
**Figure 2. Small importing country with High-Cost Imitation.**
**(increase in $\alpha$ for a given $\beta$)**




Source: Own graph adopted following Maskus and Penubarti (1997).

APPENDIX A3

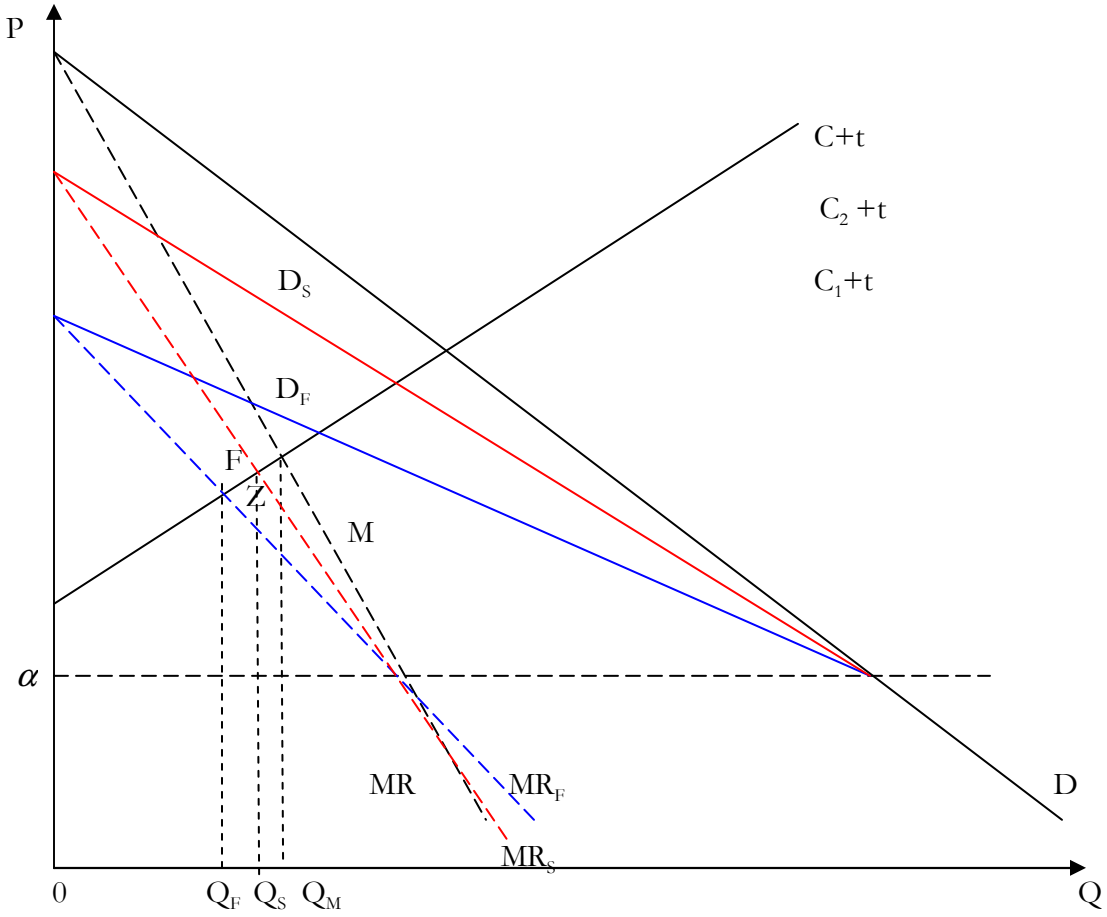
**Figure 3. Small importing country with High-Cost Imitation.**
**(increase in $\alpha$ for a given $\beta$)**




Source: Own graph adopted following Maskus and Penubarti (1997).

APPENDIX A4

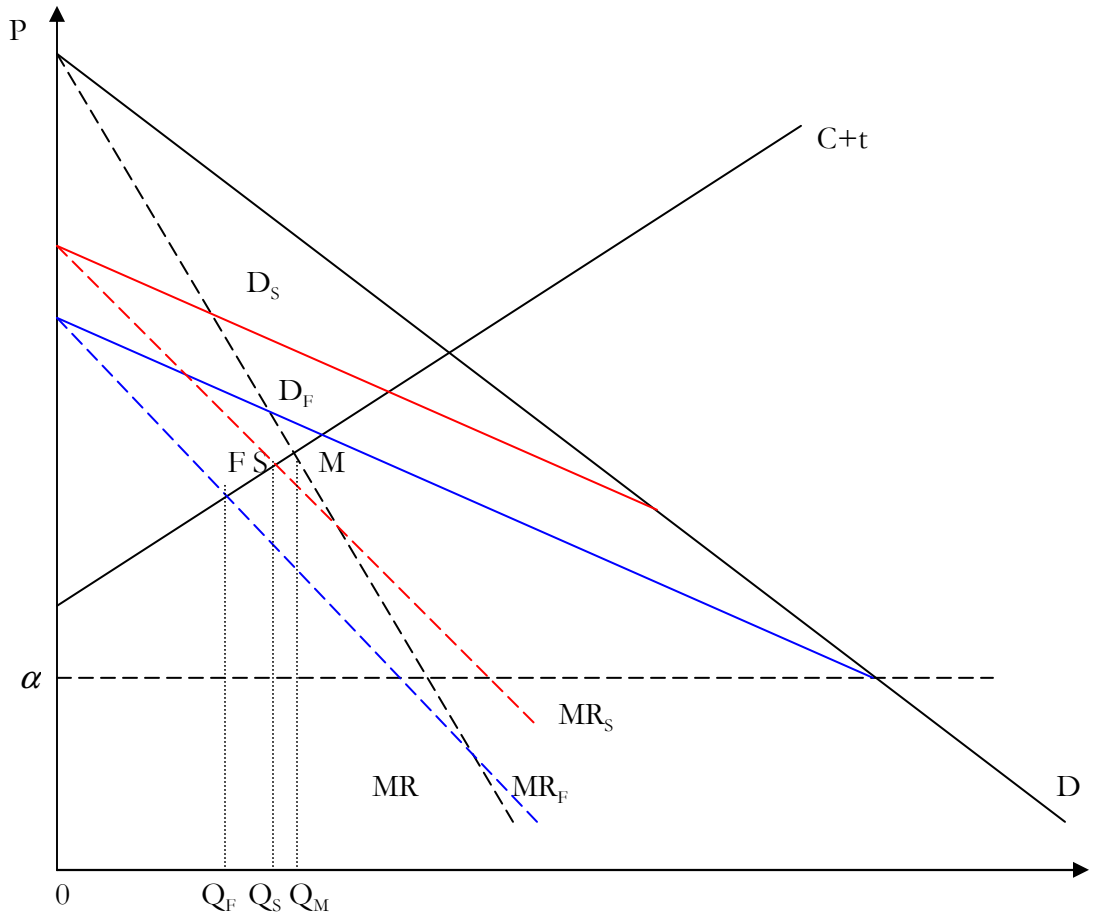
**Figure 4. Large Importing country with Low-Cost Imitation.**
**(increase in $\beta$ for a given $\alpha$)**




Source: Own graph adopted following Maskus and Penubarti (1997).

APPENDIX A5

**Figure 5. Large Importing country with Low-Cost Imitation.**
**(increase in $\alpha$ for a given $\beta$)**




Source: Own graph adopted following Maskus and Penubarti (1997).

# APPENDIX B1

Table 8. Gravity equations estimates for commodity trade flows: basic results

| Industry | Constant | IPR protection $IPR_k$ | Dummy for transition economies $D_{trans}$ | Tariffs | Exporting country income per capita $GDPPC_j$ | Exporting country population $Pop_j$ | Importing country income per capita $GDPPC_k$ | Importing country population $Pop_k$ | Distance between trading partners $Dist_{jk}$ | $R^2$ | Number of observations $N_{obs}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *All Manufacturing* | -20.41*** (0.25) | 0.151*** (0.015) | -0.95*** (0.04) | -0.23* (0.017) | 0.74*** (0.01) | 0.89*** (0.01) | 0.91*** (0.02) | 0.74*** (0.006) | -1.09*** (0.009) | 0.90 | 1597 |
| Food, Bev., Tobacco | -13.57*** (1.31) | -0.1122*** (0.043) | -0.89*** (0.15) | -0.47*** (0.052) | 0.44*** (0.07) | 0.667*** (0.03) | 0.65*** (0.05) | 0.72*** (0.03) | -1.23*** (0.045) | 0.65 | 1100 |
| Rubber Manufactures | -20.062*** (0.29) | 0.3057*** (0.015) | -2.167*** (0.038) | 0.623 (0.37) | 0.733*** (0.015) | 1.21*** (0.06) | 0.787*** (0.018) | 0.609*** (0.007) | -1.538*** (0.009) | 0.725 | 1165 |
| Plastic | -19.68*** (0.291) | 0.418*** (0.015) | -1.52*** (0.039) | 0.055 (0.042) | 0.932*** (0.016) | 1.091*** (0.006) | 0.804*** (0.018) | 0.594*** (0.007) | -1.58*** (0.009) | 0.74 | 1125 |
| Leather and Related Products | -16.78*** (0.319) | -0.277*** (0.017) | -0.141*** (0.04) | 0.031 (0.018) | 0.092*** (0.019) | 0.948*** (0.006) | 1.026*** (0.019) | 0.907*** (0.008) | -1.409*** (0.01) | 0.53 | 1009 |
| Textile Products | -15.59*** (0.279) | 0.10 (0.15) | -0.658*** (0.037) | 0.368** (0.017) | 0.454 (0.014) | 0.99*** (0.005) | 0.977*** (0.018) | 0.707*** (0.007) | -1.452*** (0.009) | 0.73 | 1334 |
| Furniture | -25.51*** (0.29) | 0.039 (0.15) | -0.84*** (0.038) | 1.03 (0.67) | 0.947*** (0.015) | 1.037*** (0.006) | 1.381*** (0.018) | 0.745*** (0.007) | -1.72*** (0.009) | 0.72 | 1253 |
| Printing & Publishing | -17.99*** (0.287) | 0.208*** (0.015) | -1.92*** (0.037) | 0.758 (0.57) | 1.158*** (0.016) | 0.828*** (0.006) | 0.864*** (0.018) | 0.695*** (0.007) | -1.63*** (0.009) | 0.59 | 1226 |
| Primary Metal (Iron & steel) | -14.21*** (0.31) | 0.302 (0.16) | -2.54*** (0.041) | 0.634 (0.48) | 0.819*** (0.017) | 0.95*** (0.007) | 0.611*** (0.018) | 0.72*** (0.007) | -1.707*** (0.01) | 0.65 | 1124 |
| Metal products | -19.06*** (0.279) | 0.3167*** (.0146) | -1.46*** (0.036) | 0.685 (0.67) | 1.055*** (0.014) | 0.884*** (0.006) | 0.89*** (0.017) | 0.672*** (0.007) | -1.468*** (0.009) | 0.78 | 1332 |
| Non-metal Minerals | -19.68*** (0.279) | 0.1199*** (0.015) | -1.247*** (.037) | 0.701 (0.37) | 0.413*** (0.014) | 1.102*** (0.006) | 1.099*** (0.017) | 0.75*** (0.007) | -1.46*** (0.009) | 0.76 | 1318 |
| Machinery & Trans. Eq. | -26.66*** (0 .263) | 0.282 (0.13) | -1.509*** (0.034) | 0.573*** (0 .52) | 1.48*** (0.013) | 1.164*** (0.005) | 0.799*** (0.016) | 0 .726*** (0.006) | -1.27*** (0.008) | 0.81 | 978 |
| Petroleum Products | -9.85*** (0.318) | 0.427 (0.27) | -1.98*** (.043) | 0.525 (0.018) | 0.486*** (0.018) | 1.174*** (0.006) | 0.302*** (0.019) | 0 .654*** (0 .007) | -2.10*** (0.009) | 0.48 | 1000 |
| Chemicals | -24.19*** (0.27) | 0.26*** (0.014) | -1.53*** (0.035) | 0.719 (0.016) | 1.24*** (0.0139) | 1.034*** (0.006) | 0.871*** (0.017) | 0.824*** (0.006) | -1.45*** (0.009) | 0.76 | 956 |

Notes:

*** Significant at 1% level or less; **significant at 5% level or less; *significant at 10% level or less.

Positive significant estimates on IPR variable indicate market-expansion effect; negative significant estimates indicate market-power effect.

# APPENDIX B2

Table 9. Gravity equation estimates for commodity trade flows with development dummy variables and IPR interactions.

| Industry | Constant | Exporting country income per capita $GDPPC_j$ | Exporting country population $Pop_j$ | Importing country income per capita $GDPPC_k$ | Importing country population $Pop_k$ | Distance between trading partners $Dist_{jk}$ | Tariff | Development Interaction Variables | | | Development dummies | | | $R^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | All Countries. | Low development $IPR_k*D_L$ | Middle development $IPR_k*D_M$ | High development $IPR_k*D_H$ | Low development dummy $D_L$ | Middle development dummy $D_M$ | High development dummy $D_H$ | |
| **All manufac-turing** | -21.58*** (0.221) | 1.035*** (0.012) | 0.921*** (0.005) | 0.851*** (0.021) | 0.912 *** (0.006) | -1.136*** (0.008) | 0.030 (0.016) | -0.199*** (0.028) | 0.006* (0.018) | -0.033** (0.016) | (dropped) | 0.249*** (0.068) | 1.50*** (0.094) | 0.86 |
| Food, Beverages Tobacco | -17.61*** (1.50) | 0.464*** (0.07) | 0.652*** (0.03) | 0.84*** (0.110) | 0.834*** (0.034) | -1.179*** (0.044) | -0.108* (0.06) | 2.87 (2.87) | -0.174*** (0.05) | -0.065 (0.117) | -8.79*** (3.40) | -0.104 (0.515) | (dropped) | 0.65 |
| Rubber | -25.16*** (0.28) | 0.738*** (0.015) | 1.18*** (0.006) | 1.00*** (0.022) | 0.803*** (0.006) | -1.38*** (0.009) | 0.425*** (0.017) | -0.396*** (0.040) | -0.260*** (0.021) | 0.09*** (0.017) | -0.230** (0.115) | -0.258*** (0.094) | (dropped) | 0.71 |
| Plastic | -22.84*** (0.28) | 0.946*** (0.016) | 1.075*** (0.006) | 0.923*** (0.022) | 0.697*** (0.007) | -1.46*** (0.008) | 0.039 (0.017) | -0.749*** (0.047) | -0.023 (0.021) | 0.312*** (0.017) | -0.453*** (0.119) | 0.178** (0.095) | (dropped) | 0.74 |
| Leather & Related Products | -14.40*** (0.318) | 0.127*** (0.018) | 0.958*** (0.006) | 0.371*** (0.024) | 0.978*** (0.007) | -1.47*** (0.009) | 0.056 (0.028) | -0.808*** (0.091) | -0.185*** (0.024) | -0.222*** (0.017) | (dropped) | 0.625*** (0.165) | 2.69*** (0.172) | 0.48 |
| Textile Products | -16.42*** (0.246) | 0.505*** (0.014) | 1.00*** (0.005) | 0 .532*** (0.022) | 0.815*** (0.006) | -1.459*** (0.008) | 0.050 (0.017) | -0.186*** (0.037) | 0.128*** (0.02) | -0.028* (0.017) | (dropped) | 0.973*** (0.088) | 3.25*** (0.108) | 0.72 |
| Furniture | -26.59*** (0.257) | 0.966*** (0.015) | 1.01*** (0.006) | 1.53*** (0.022) | 0.834*** (0.006) | -1.67*** (0.009) | 0.938*** (0.017) | -0.633*** (0.038) | -0.128*** (0.020) | 0.064*** (0.016) | (dropped) | -1.917*** (0.092) | -2.07*** (0.11) | 0.67 |
| Paper & Related Products | -21.29*** (0 .282) | 1.202*** (0.016) | 0.804*** (0.006) | 0 .911*** (0.022) | 0.861*** (0.006) | -1.501*** (0.008) | 0.648*** (0.017) | -0.278*** (0.036) | -0.301*** (0.02) | -0.010 (0.017) | -2.03*** (0.11) | -0.626*** (0.092) | (dropped) | 0.62 |
| Primary Metal | -20.45*** (0 .283) | 0.887*** (0.017) | 0.918*** (0.006) | 0 .836*** (0.022) | 0.927*** (0.007) | -1.53*** (0.009) | 0.414*** (0.31) | -1.009*** (0.05) | -0.377*** (0.021) | 0.068*** (0.017) | (dropped) | 0.006 (0.108) | 0.23* (0.123) | 0.65 |
| Metal Products | -22.59*** (0.249) | 1.09*** (0.0147) | 0.862*** (0.006) | 0.998*** (0.021) | 0.795*** (0.006) | -1.37*** (0.008) | 0.566*** (0.017) | -0.57*** (0.033) | -0.030* (0.017) | 0.248*** (0.016) | (dropped) | -0.137 (0.086) | -0.025 (0.106) | 0.76 |
| Non-metal Minerals | -22.21*** (0.252) | 0.427*** (0.015) | 1.082*** (0.006) | 1.108*** (0.021) | 0.859*** (0.007) | -1.38*** (0.008) | 0.626*** (0.017) | -0.522*** (0.04) | -0.249*** (0.02) | 0.073*** (0.017) | (dropped) | 0.477*** (0.091) | 0.522*** (0.109) | 0.74 |
| Machinery & Trans. Equipment | -31.33*** (0.227) | 1.54*** (0.013) | 1.15*** (0.005) | 0.861*** (0.021) | 0.869*** (0.006) | -1.18*** (0.008) | 0.481*** (0.016) | -0.502*** (0.029) | 0.125*** (0.018) | 0.107*** (0.016) | (dropped) | 0.118* (0.071) | 1.23*** (0.096) | 0.81 |
| Petroleum Products | -11.03*** (0.309) | 0.563*** (0.018) | 1.175*** (0.007) | 0.059*** (0.023) | 0.806*** (0.007) | -2.04*** (0.009) | 0.486*** (0.018) | -0.448*** (0.053) | -0.326*** (0.024) | 0.426*** (0.018) | -1.50*** (0.121) | -0.107 (0.103) | (dropped) | 0.49 |
| Chemicals | -28.71*** (0.237) | 1.27*** (0.014) | 1.02*** (0.006) | 0.995*** (0.021) | 0.969*** (0.006) | -1.358*** (0.008) | 0.605*** (0.017) | -0.333*** (0.031) | -0.034* (0.019) | 0.136*** (0.016) | (dropped) | 0.168** (0.074) | 0.648*** (0.097) | 0.77 |

Notes: *** Significant at 1% level or less; **significant at 5% level or less; *significant at 10% level or less.

Positive significant estimates on IPR variable indicate market-expansion effect; negative significant estimates indicate market-power effect.

Development dummy variables:High development:: GDP per capita >$7911; Middle development:: $350<GDP per capita<$7910; Low development:: GDP per capita< $349

APPENDIX B3

Table 10. Gravity equation estimates for commodity trade flows with threat of imitation dummy variables and IPR interactions.

| Industry | Const | Tariffs | Exporting country income per capita $GDPP_j$ | Exporting country population $Pop_j$ | Importing country income per capita $GDPPC_k$ | Importing country population $Pop_k$ | Distance between trading partners $Dist_{jk}$ | Weak imitative capacity, strong IPR protectioniws | Weak imitative capacity, weak IPR protection iww | Strong imitative capacity, strong IPR protection | Strong imitative capacity, weak IPR protection | Weak imitative capacity, strong IPR protection, ws | Weak imitative capacity, weak IPR protection, ww | Strong imitative capacity, strong IPR protection, ss | Strong imitative capacity, sweak IPR protection, sw | $R^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| All manufacturing | -41.2*** (1.50) | 0.13 (0.19) | 1.03*** (0.012) | 0.918*** (0.005) | 1.24*** (0.019) | 0.82*** (0.007) | -1.11*** (0.008) | -0.115*** (0.041) | -0.022 (0.017) | -0.513*** (0.069) | 0.128*** (0.56) | 18.73*** (1.45) | 20.52*** (1.39) | (dropped) | 18.69*** (1.43) | 0.86 |
| Patent sensitive manufacturing | -21.2*** (0.31) | 0.33*** (0.02) | 0.86*** (0.01) | 0.90*** (0.005) | 0.83*** (0.01) | 0.82*** (0.005) | -1.45*** (0.008) | -0.32*** (0.07) | -0.20*** (0.01) | 2.80*** (0.23) | 0.27*** (0.02) | (dropped) | 1.83*** (0.23) | -8.88*** (0.91) | 2.39*** (0.24) | 0.61 |
| Food, Beverages, Tobacco. | -22.3*** (2.03) | 0.079 (0.07) | 0.52*** (0.07) | 0.67*** (0.03) | 0.92*** (0.05) | 0.84*** (0.04) | -1.19*** (0.04) | -0.18 (0.33) | 0.04 (0.07) | 0.62*** (0.22) | 0.88 (0.62) | 2.98 (2.14) | 2.66 (1.69) | -0.104 (1.92) | (dropped) | 0.64 |
| Rubber Manufactures | -13.2*** (1.65) | -.001 (.022) | 0.75*** (0.015) | 1.18*** (0.006) | 1.04*** (0.02) | 0.75*** (0.007) | -1.37*** (0.008) | -0.58*** (0.043) | -0.148*** (0.023) | -0.309*** (0.072) | -4.65*** (0 .616) | -14.19*** (1.59) | -9.84*** (1.52) | (dropped) | -11.33*** (1.57) | 0.71 |
| Plastic Products | -27.6*** (1.65) | 0.159 (0.21) | 0.928*** (0 .016) | 1.06*** (0.005) | 1.103*** (0.021) | 0.68*** (0.007) | -1.44*** (0.008) | 0.064 (0 .042) | -0.123*** (0.023) | 0.059 (0.072) | 1.65*** (0.613) | 4.05*** (1.57) | 4.59*** (1.51) | (dropped) | 4.48*** (1.56) | 0.74 |
| Leather & Related Products | -50.3*** (1.90) | 0.218 (0.25) | 0.104*** (0.02) | 0.933*** (0.006) | 0.894*** (0.024) | 0.76*** (0.008) | -1.45*** (0.009) | -1.37*** (0.045) | -0.38*** (0.03) | -1.52*** (0.073) | 14.50*** (0 .71) | 31.18*** (1.82) | 42.79*** (1.75) | (dropped) | 38.00*** (1.80) | 0.56 |
| Printing and Publishing | -24.5*** (0 .29) | 0.23 (0.22) | 1.19*** (0.016) | 0.798*** (0.006) | 1.25*** (0.021) | 0.814*** (0. .007) | -1.47*** (0.008) | 0 .05 (0.042) | -0.13*** (0.021) | -1.08*** (0.072) | 3.83*** (0.60) | (dropped) | 0.86*** (0.154) | 4.97*** (0 .34) | -8.94*** (1.56) | 0.58 |
| Metal Products | -23.0*** (0.28) | 0.27*** (0.02) | 1.08*** (0.01) | 0 .86*** (0.005) | 1.13*** (0.02) | 0.75*** (0.007) | -1.36*** (0.008) | -0.11*** (0.04) | -0.028 (0.02) | -0.45*** (0.07) | 1.30** (0.58) | (dropped) | 0.58*** (0.15) | 2.86*** (0.33) | -2.93** (1.51) | 0.77 |
| Non-metal Minerals | -22.7*** (0.28) | 0.28*** (0.02) | 0.42*** (0.01) | 1.08*** (0.005) | 1.28*** (0.02) | 0.83*** (0.007) | -1.36*** (0.008) | -0.115*** (0.04) | -0.27*** (0.02) | -0.80*** (0.07) | 3.37*** (0.59) | (dropped) | 0.41*** (0.15) | 3.31*** (0.33) | -8.53*** (1.53) | 0.76 |
| Chemicals | -48.3*** (1.54) | 0.436 (0.32) | 1.27*** (0.013) | 1.016*** (0.005) | 1.332*** (0.019) | 0.875*** (0.007) | -1.34*** (0.008) | -0.176*** (0.041) | -0.012 (0.0186) | -0.351*** (0.070) | 7.35*** (0.575) | 19.32*** (1.48) | 19.00*** (1.46) | 20.39*** (1.42) | (dropped) | 0.77 |

Notes: *** Significant at 1% level or less; **significant at 5% level or less; *significant at 10% level or less.

Positive significant estimates on IPR variable indicate market-expansion effect; negative significant estimates indicate market-power effect.

Threat of imitation dummy variables: Group 1: R&D/GDP<0.0013, IPR 3-5; Group 2: R&D/GDP<0.0013; IPR 0-2;

Group 3: R&D/GDP>=0.0013; IPR 3-5; Group 4: R&D/GDP>=0.0013; IPR 0-2

# APPENDIX B4

Table 11. Gravity equations estimates for commodity trade flows: interaction of IPR protection and transition economy dummy variables.

| Industry | Constant | Tariffs | Exporting country income per capita $GDPPC_j$ | Exporting country population $Pop_j$ | Importing country income per capita $GDPPC_k$ | Importing country population $Pop_k$ | Distance between trading partners $Dist_{jk}$ | Interaction of IPR protection with transition economy dummy $Trans_k$ | Interaction of IPR protection with non transition economy dummy $Tnonrans_k$ | Transition economy dummy $Trans_k$ | $R^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **All manufacturing** | -17.93*** (0 .259) | 0 .346*** (0 .016) | 0 .994*** (0 .013) | 0 .922*** (0 .005) | 0 .867*** (0 .017) | 0 .778*** (0 .007) | -1.19*** (0 .008) | 0.123*** (0 .016) | 0.16*** (0 .016) | -0.926*** (0 .057) | 0.87 |
| Food, Beverages, Tobacco. | -14.07*** (1.36) | -0.021 (0 .056) | 0.446*** (0 .07) | 0 .66*** (0 .03) | 0 .661*** (0.053) | 0 .725*** (0 .034) | -1.23*** (0 .046) | -0.132*** (0 .046) | 0 .029 (0.115) | -0.321 (0 .459) | 0.64 |
| Rubber | -20.26*** (0 .291) | 0.625*** (0 .017) | 0 .724*** (0 .016) | 1.21*** (0 .006) | 0 .79*** (0 .017) | 0 .616*** (0 .007) | -1.543*** (0.009) | 0 .075*** (0.022) | 0 .388*** (0 .016) | -1.207*** (0 .076) | 0.73 |
| Plastic | -19.74*** (0 .291) | 0 .558 (0.57) | 0 .931*** (0 .016) | 1.089*** (0 .006) | 0 .805*** (0.018) | 0 .596*** (0 .007) | -1.58*** (0 .009) | 0 .341*** (0 .023) | 0 .443*** (0 .016) | -1.21*** (0 .077) | 0.74 |
| Leather & Related Products | -16.79*** (0 .32) | 0 .315 (0.28) | 0 .091*** (0 .018) | 0 .947*** (0 .006) | 1.027*** (0 .019) | 0 .907*** (0 .007) | -1.41*** (0 .009) | -0.293*** (0 .032) | -0.275*** (0 .017) | -0.087 (0.106) | 0.53 |
| Textile Products | -15.44*** (0 .28) | 0.358 (0.47) | 0 .458*** (0 .014) | 0 .994*** (0 .006) | 0 .977*** (0 .017) | 0 .702*** (0 .007) | -1.44*** (0 .009) | 0 .234*** (0 .019) | 0 .031* (0 .016) | -1.25*** (0 .069) | 0.73 |
| Furniture | -26.12*** (0 .289) | 1.069 (0.87) | 0 .942*** (0 .015) | 1.02*** (0 .006) | 1.38*** (0 .018) | 0 .761*** (0 .007) | -1.75*** (0 .009 | -0.456*** (0 .02) | 0 .26*** (0 .016) | 1.287*** (0 .07) | 0.72 |
| Paper & Related Products | -17.92 (0 .287) | 0.75*** (0 .017) | 1.157*** (0 .016) | 0 .829*** (0 .006) | 0 .863*** (0 .017) | 0 .693*** (0 .006) | -1.626*** (0 .009) | 0 .264*** (0 .02) | 0 .183*** (0 .016) | -2.15*** (0 .071) | 0.59 |
| Primary Metal | -14.54*** (0 .31) | 0 .648*** (0 .018) | 0 .82*** (0 .017) | 0 .94*** (0 .007) | 0 .612*** (0 .018) | 0 .729*** (0.007) | -1.719*** (0 .009) | 0 .007 (0.023) | 0 .40 (0 .17) | -1.37*** (0 .079) | 0.66 |
| Metal Products | -19.18*** (0 .279) | 0 .693*** (0 .017) | 1.04*** (0 .014) | 0 .879*** (0 .005) | 0 .89*** (0 .017) | 0 .678*** (0 .007) | -1.47*** (0 .008) | 0 .157*** (0 .019) | 0 .396*** (0 .016) | -0.75*** (0.067) | 0.78 |
| Non-metal Minerals | -19.83*** (0 .28) | 0.71 (0 .67) | 0.41*** (0 .014) | 1.09*** (0 .005) | 1.101*** (0 .017) | 0 .755*** (0 .007) | -1.47*** (0.009) | -0.029 (0 .020) | 0.186*** (0.016) | -0.605*** (0.07) | 0.76 |
| Machinery & Trans. Equipment | -26.64*** (0 .263) | 0 .572*** (0 .015) | 1.486*** (0 .013) | 1.16*** (0 .005) | 0 .799*** (0 .016) | 0 .725*** (0 .006) | -1.27*** (0 .008) | 0 .29*** (0 .016) | 0 .275*** (0 .15) | -1.55*** (0 .059) | 0.83 |
| Petroleum Products | -10.67*** (0 .319) | 0 .528 (0 .59) | 0 .501*** (0 .018) | 1.16*** (0 .006) | 0 .31*** (0 .019) | 0 .67*** (0 .007) | -2.11*** (0 .009) | -0.085*** (0.024) | 0 .591*** (0 .017) | 0 .091 (0 .084) | 0.49 |
| Chemicals | -24.32*** (0 .27) | 0 .729 (0 .76) | 1.23*** (0 .014) | 1.03*** (0 .005) | 0 .867*** (0 .017) | 0 .829*** (0 .006) | -1.46*** (0 .008) | 0 .152*** (0 .017) | 0 .341*** (0 .015) | -0.99*** (0 .06) | 0.77 |

APPENDIX C1

**Table 12[37]. Gravity equation for the general volume of trade: Fixed Effects Analysis.**

| Specification 1 | Parameter estimates | Specification 2 | Parameter estimates | Specification 3 | Parameter estimates |
|---|---|---|---|---|---|
| **Constant** | -26.71*** (1.509) | **Constant** | -27.49*** (1.51) | **Constant** | -26.57*** (1.516) |
| **$IPR_k$** | 0 .180*** (0 .034) | **$IPR*D_L$** | -0.216*** (0 .058) | **$IPR*D_{Trans}$** | 0.168*** (0.036) |
| **$GDP_j*GDP_k$** | 0 .632*** (0 .044) | **$IPR*D_m$** | 0.325*** (0.046) | **$IPR*D_{Nontrans}$** | 0.181*** (0.034) |
| **$GDPPC_j*GDPPC_k$** | 0 .427*** (0 .043) | **$IPR*D_H$** | 0.394*** (0.067) | **$GDP_j*GDP_k$** | 0.627*** (0.044) |
| **$Reg_{jk}$** | 0 .545*** (0 .099) | **$GDP_j*GDP_k$** | 0 .675*** (0 .044) | **$GDPPC_j*GDPPC_k$** | 0.432*** (0.042) |
| **$WTO_k$** | 0.039* (0 .022) | **$GDPPC_j*GDPPC_k$** | 0 .355*** (0 .044) | **$Reg_{jk}$** | 0.542*** (0.099) |
| **D65[38]** | -0.167*** (0 .036) | **$Reg_{jk}$** | 0.458*** (0.101) | **$WTO_k$** | 0.039* (0.022) |
| **D70** | -0.721*** (0 .041) | **$WTO_k$** | 0.041* (0.022) | **D65** | -0.166*** (0.036) |
| **D75** | -0.458*** (0 .048) | **D65** | -0.167*** (0.036) | **D70** | -0.72*** (0.041) |
| **D80** | -0.547*** (0 .058) | **D70** | -0.722*** (0.041) | **D75** | -0.456*** (0.048) |
| **D85** | -1.108*** (0 .064) | **D75** | -0.458*** (0.048) | **D80** | -0.543*** (0.058) |
| **D90** | -1.086*** (0 .072) | **D80** | -0.539*** (0.058) | **D85** | -1.103*** (0.064) |
| **D95** | -1.08*** (0 .081) | **D85** | -1.101*** (0.064) | **D90** | -1.058*** (0.078) |
| | | **D90** | -1.08*** (0.072) | **D95** | -1.07*** (0.082) |
| | | **D95** | -1.09*** (0.082) | | |
| ***N obs*** | ***42464*** | ***N obs*** | ***42464*** | ***N obs*** | ***42464*** |
| ***$R^2$(overall)*** | ***0.52*** | ***$R^2$(overall)*** | ***0.50*** | ***$R^2$(overall)*** | ***0.52*** |

Notes: *** Significant at 1% level or less; **significant at 5% level or less; *significant at 10% level or less.

All the variables except ipr are in logarithms.

[37] Here we see that instead of using income and per capita income of trading partners separately their interactions are included into the model. This is done because of the data format, which already gives their products. The author, who used this data for his analysis makes this because these variables are expected to have the same positive influence on trade and interacting them allows for saving some degrees of freedom.

[38] In this model we include time dummies. However, the exclusion of the dummies does not affect the significance and the direction of the estimates of the basic model parameters. Both specifications were implemented.

APPENDIX C2

**.Table 12a. Gravity equation for the general volume of trade: Fixed Effects Analysis (Restricted sample).**

| Specification 1 | Parameter estimates | Specification 2 | Parameter estimates | Specification 3 | Parameter estimates |
|---|---|---|---|---|---|
| **Constant** | -33.87*** (2.79) | **Constant** | -34.93*** (2.81) | **Constant** | -34.59*** (2.87) |
| **$IPR_k$** | 0.178*** (0.040) | **$IPR*D_L$** | -0.21*** (0.035) | **$IPR*D_{Trans}$** | 0.207*** (0.049) |
| **$GDP_j*GDP_k$** | 0.937*** (0.095) | **$IPR*D_m$** | 0.069*** (0.093) | **$IPR*D_{Nontrans}$** | 0.187*** (0.041) |
| **$GDPPC_j*GDPPC_k$** | 0.726*** (0.08) | **$IPR*D_H$** | 0.222*** (0.042) | **$GDP_j*GDP_k$** | 0.961*** (0.097) |
| **$Reg_{jk}$** | 0.488*** (0.057) | **$GDP_j*GDP_k$** | 0.990*** (0.096) | **$GDPPC_j*GDPPC_k$** | 0.360*** (0.082) |
| **$WTO_k$** | -0.062 (0.040) | **$GDPPC_j*GDPPC_k$** | 0.87*** (0.012) | **$Reg_{jk}$** | 0.497*** (0.058) |
| **D70[39]** | -0.187*** (0.031) | **$Reg_{jk}$** | 0.476*** (0.057) | **$WTO_k$** | -0.061 (0.040) |
| **D85** | -0.46*** (0.036) | **$WTO_k$** | 0.088* (0.041) | **D70** | -0.187*** (0.031) |
| **D90** | -0.363*** (0.040) | **D70** | -0.183*** (0.032) | **D85** | -0.464*** (0.036) |
| **D95** | -0.425*** (0.045) | **D85** | -0.467*** (0.036) | **D90** | -0.425*** (0.072) |
| | | **D90** | -0.366*** (0.040) | **D 95** | -0.452*** (0.052) |
| | | **D95** | -0.422*** (0.045) | | |
| ***N obs*** | ***3074*** | ***N obs*** | ***3074*** | ***N obs*** | ***3074*** |
| ***$R^2$(overall)*** | ***0.62*** | ***$R^2$(overall)*** | ***0.65*** | ***$R^2$(overall)*** | ***0.63*** |

Notes:

*** Significant at 1% level or less; **significant at 5% level or less; *significant at 10% level or less.

All the variables are in logarithms.

[39] For the same specifications adopted for the small sample of countries some dummies (D65, D75, D80) appeared to be insignificant so they have been excluded from the model. However, the estimates of other model parameters remain the same regardless of the presence or absence of these dummies in the model.

## APPENDIX C3

**Unrestricted sample.**

| | Test | Statistics | P-value |
|---|---|---|---|
| **Specification 1** | F-test | 11.77 | 0.0000 |
| | Hausman test | 2593.92 | 0.0000 |
| **Specification 2** | F-test | 11.59 | 0.0000 |
| | Hausman test | 2133.61 | 0.0000 |
| **Specification 3** | F-test | 11.58 | 0.0000 |
| | Hausman test | 2335.41 | 0.0000 |

**Restricted (small) sample.**

| | **Test** | **Statistics** | **P-value** |
|---|---|---|---|
| **Specification 1** | F-test | 30.79 | 0.0000 |
| | Hausman test | 739.15 | 0.0000 |
| **Specification 2** | F-test | 28.98 | 0.0000 |
| | Hausman test | 1301.71 | 0.0000 |
| **Specification 3** | F-test | 30.65 | 0.0000 |
| | Hausman test | 378.41 | 0.0000 |

| Cross-sections analysis | **Test** | **Statistics** | **P-value** |
|---|---|---|---|
| **Specification (2): Development interactions** | Wald | 19.20 | 0.0000 |
| **Specification (3): Threat of imitation interactions** | Wald | 83.64 | 0.0000 |
| **Specification (4): Transition economy interactions** | Wald | 625.05 | 0.0000 |
| *Aggregate level | | | |

**Unrestricted sample:**

| Panel-data analysis | **Test** | **Statistics** | **P-value** |
|---|---|---|---|
| **Specification (2): Development interactions** | Wald | 34.40 | 0.0000 |
| **Specification (4): Transition economy interactions** | Wald | 27.77 | 0.0000 |
| *Aggregate level | | | |

**Restricted sample**

| Panel-data analysis | **Test** | **Statistics** | **P-value** |
|---|---|---|---|
| **Specification (2): Development interactions** | Wald | 94.91 | 0.0000 |
| **Specification (4): Transition economy interactions** | Wald | 45.42 | 0.0000 |
| *Aggregate level | | | |

# APPENDIX D1

Dummy regression

| Source | SS | df | MS | | |
|---|---|---|---|---|---|
| Model | 317288.515 | 335 | 947.129895 | Number of obs | = 42464 |
| Residual | 174383.318 | 42128 | 4.13936855 | F(335, 42128) | = 228.81 |
| | | | | Prob > F | = 0.0000 |
| | | | | R-squared | = 0.6453 |
| | | | | Adj R-squared | = 0.6425 |
| Total | 491671.833 | 42463 | 11.5788294 | Root MSE | = 2.0345 |

| ltrade | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| ipr | .1458936 | .0518603 | 2.81 | 0.005 | .0442464 | .2475408 |
| lrgdp | .1071866 | .0642193 | 1.67 | 0.095 | -.0186846 | .2330578 |
| lrgdppc | 1.004024 | .0616119 | 16.30 | 0.000 | .8832634 | 1.124784 |
| regional | 3.723228 | .0997005 | 37.34 | 0.000 | 3.527813 | 3.918643 |
| onein | -.1553318 | .0242552 | -6.40 | 0.000 | -.2028725 | -.1077912 |
| d65 | -.1115362 | .0568103 | -1.96 | 0.050 | -.2228855 | -.000187 |
| d70 | -.8205024 | .0629536 | -13.03 | 0.000 | -.9438928 | -.6971119 |
| d75 | -.5605476 | .0730515 | -7.67 | 0.000 | -.7037299 | -.4173653 |
| d80 | -.5855395 | .0866456 | -6.76 | 0.000 | -.7553665 | -.4157124 |
| d85 | -1.156478 | .0956228 | -12.09 | 0.000 | -1.3439 | -.969055 |
| d90 | -1.250962 | .1071945 | -11.67 | 0.000 | -1.461065 | -1.040858 |
| d95 | -1.17237 | .120377 | -9.74 | 0.000 | -1.408312 | -.9364287 |
| d112 | -.1597495 | .128482 | -1.24 | 0.214 | -.4115767 | .0920778 |
| d122 | -2.533187 | .2412405 | -10.50 | 0.000 | -3.006023 | -2.060351 |
| d124 | (dropped) | | | | | |
| d128 | -2.502005 | .2628804 | -9.52 | 0.000 | -3.017256 | -1.986754 |
| d132 | -.5341517 | .1315639 | -4.06 | 0.000 | -.7920196 | -.2762837 |
| d134 | -.2732643 | .1214381 | -2.25 | 0.024 | -.5112854 | -.0352433 |
| d136 | -.7051097 | .1321492 | -5.34 | 0.000 | -.9641248 | -.4460947 |
| d137 | (dropped) | | | | | |
| d138 | -.8829953 | .2038721 | -4.33 | 0.000 | -1.282589 | -.4834018 |
| d142 | -2.944228 | .2771457 | -10.62 | 0.000 | -3.487439 | -2.401016 |
| d144 | -2.171513 | .2330411 | -9.32 | 0.000 | -2.628278 | -1.714748 |
| d146 | -2.134798 | .2471168 | -8.64 | 0.000 | -2.619152 | -1.650444 |
| d156 | -2.204736 | .1719758 | -12.82 | 0.000 | -2.541812 | -1.86766 |
| d158 | -.2498359 | .1049354 | -2.38 | 0.017 | -.4555115 | -.0441604 |
| d172 | -3.240897 | .2692912 | -12.03 | 0.000 | -3.768713 | -2.713081 |
| d174 | -2.822502 | .2383162 | -11.84 | 0.000 | -3.289607 | -2.355398 |
| d176 | -6.344296 | .4616027 | -13.74 | 0.000 | -7.249046 | -5.439545 |
| d178 | -3.048742 | .2973197 | -10.25 | 0.000 | -3.631494 | -2.465989 |
| d181 | -4.920525 | .4462148 | -11.03 | 0.000 | -5.795115 | -4.045935 |
| d182 | -2.444576 | .2389944 | -10.23 | 0.000 | -2.91301 | -1.976142 |
| d184 | -1.537116 | .1589305 | -9.67 | 0.000 | -1.848623 | -1.22561 |
| d186 | -2.709646 | .1691118 | -16.02 | 0.000 | -3.041108 | -2.378183 |
| d188 | -2.352253 | .1973327 | -11.92 | 0.000 | -2.739029 | -1.965477 |
| d193 | -3.065017 | .202716 | -15.12 | 0.000 | -3.462345 | -2.66769 |
| d196 | -3.909768 | .2970439 | -13.16 | 0.000 | -4.49198 | -3.327556 |
| d199 | -2.215556 | .1968096 | -11.26 | 0.000 | -2.601307 | -1.829805 |
| d213 | -2.885145 | .1806567 | -15.97 | 0.000 | -3.239236 | -2.531054 |
| d218 | -4.816468 | .3051539 | -15.78 | 0.000 | -5.414576 | -4.21836 |
| d223 | -1.494673 | .1237271 | -12.08 | 0.000 | -1.73718 | -1.252165 |
| d228 | -3.227414 | .2438286 | -13.24 | 0.000 | -3.705323 | -2.749505 |
| d233 | -3.439982 | .1948104 | -17.66 | 0.000 | -3.821814 | -3.05815 |
| d238 | -4.39287 | .3369455 | -13.04 | 0.000 | -5.05329 | -3.73245 |
| d243 | -3.464829 | .3017516 | -11.48 | 0.000 | -4.056268 | -2.87339 |
| d248 | -3.958619 | .2772636 | -14.28 | 0.000 | -4.502061 | -3.415177 |
| d253 | -4.296036 | .3220116 | -13.34 | 0.000 | -4.927185 | -3.664887 |
| d258 | -3.698863 | .2869801 | -12.89 | 0.000 | -4.26135 | -3.136376 |
| d263 | -5.294638 | .3172276 | -16.69 | 0.000 | -5.916411 | -4.672866 |
| d268 | -4.14904 | .3318336 | -12.50 | 0.000 | -4.79944 | -3.498639 |
| d273 | -3.534632 | .1511603 | -23.38 | 0.000 | -3.830909 | -3.238354 |
| d278 | -4.34466 | .3523617 | -12.33 | 0.000 | -5.035296 | -3.654024 |
| d283 | -3.732497 | .355375 | -10.50 | 0.000 | -4.42904 | -3.035955 |
| d288 | -4.380496 | .3404042 | -12.87 | 0.000 | -5.047695 | -3.713296 |
| d293 | -3.594613 | .2309467 | -15.56 | 0.000 | -4.047273 | -3.141953 |

| | | | | | | |
|---|---|---|---|---|---|---|
| d298 | -4.521486 | .3203594 | -14.11 | 0.000 | -5.149397 | -3.893575 |
| d299 | -3.605022 | .2247661 | -16.04 | 0.000 | -4.045568 | -3.164476 |
| d311 | -6.499025 | .6034267 | -10.77 | 0.000 | -7.681754 | -5.316297 |
| d313 | -5.662385 | .4769029 | -11.87 | 0.000 | -6.597125 | -4.727646 |
| d316 | -6.628292 | .4710973 | -14.07 | 0.000 | -7.551652 | -5.704932 |
| d319 | -7.226541 | .5597431 | -12.91 | 0.000 | -8.323649 | -6.129433 |
| d321 | -6.691026 | .5833706 | -11.47 | 0.000 | -7.834444 | -5.547608 |
| d328 | -6.591432 | .5729717 | -11.50 | 0.000 | -7.714468 | -5.468395 |
| d336 | -5.278903 | .4256128 | -12.40 | 0.000 | -6.113113 | -4.444694 |
| d339 | -7.452106 | .517476 | -14.40 | 0.000 | -8.46637 | -6.437843 |
| d343 | -5.240684 | .3505132 | -14.95 | 0.000 | -5.927697 | -4.553671 |
| d343 | (dropped) | | | | | |
| d361 | -8.006423 | .7382813 | -10.84 | 0.000 | -9.45347 | -6.559377 |
| d362 | -6.395174 | .6905468 | -9.26 | 0.000 | -7.74866 | -5.041689 |
| d364 | -8.039804 | .5662183 | -14.20 | 0.000 | -9.149604 | -6.930005 |
| d366 | -5.063761 | .4860049 | -10.42 | 0.000 | -6.01634 | -4.111181 |
| d369 | -5.500622 | .3800959 | -14.47 | 0.000 | -6.245617 | -4.755626 |
| d419 | -3.387086 | .4447358 | -7.62 | 0.000 | -4.258777 | -2.515395 |
| d423 | -4.060409 | .408466 | -9.94 | 0.000 | -4.86101 | -3.259807 |
| d429 | -1.8561 | .1840719 | -10.08 | 0.000 | -2.216885 | -1.495316 |
| d433 | -2.433639 | .256235 | -9.50 | 0.000 | -2.935865 | -1.931413 |
| d436 | -3.039036 | .3020156 | -10.06 | 0.000 | -3.630993 | -2.447079 |
| d439 | -2.622285 | .3472153 | -7.55 | 0.000 | -3.302834 | -1.941735 |
| d443 | -3.622516 | .362657 | -9.99 | 0.000 | -4.333331 | -2.911701 |
| d446 | (dropped) | | | | | |
| d449 | -4.374469 | .372903 | -11.73 | 0.000 | -5.105367 | -3.643572 |
| d453 | -5.017264 | .4605831 | -10.89 | 0.000 | -5.920016 | -4.114512 |
| d456 | -2.03731 | .2404856 | -8.47 | 0.000 | -2.508667 | -1.565953 |
| d463 | -3.109649 | .275583 | -11.28 | 0.000 | -3.649797 | -2.569501 |
| d466 | -3.146547 | .3650994 | -8.62 | 0.000 | -3.862149 | -2.430945 |
| d469 | -1.659435 | .1954829 | -8.49 | 0.000 | -2.042585 | -1.276285 |
| d474 | -2.250583 | .3979074 | -5.66 | 0.000 | -3.03049 | -1.470676 |
| d513 | -1.492288 | .1823517 | -8.18 | 0.000 | -1.849701 | -1.134875 |
| d514 | -5.510661 | .6478089 | -8.51 | 0.000 | -6.78038 | -4.240942 |
| d518 | -1.866272 | .2461279 | -7.58 | 0.000 | -2.348688 | -1.383857 |
| d522 | (dropped) | | | | | |
| d524 | -2.426432 | .2502856 | -9.69 | 0.000 | -2.916997 | -1.935867 |
| d532 | -1.34127 | .2797645 | -4.79 | 0.000 | -1.889614 | -.7929261 |
| d534 | .154958 | .1489209 | 1.04 | 0.298 | -.13693 | .4468459 |
| d536 | -1.373128 | .1669172 | -8.23 | 0.000 | -1.700289 | -1.045967 |
| d542 | -1.287301 | .1966729 | -6.55 | 0.000 | -1.672784 | -.9018181 |
| d544 | -5.987925 | .4656569 | -12.86 | 0.000 | -6.900622 | -5.075228 |
| d548 | -1.861999 | .2355814 | -7.90 | 0.000 | -2.323744 | -1.400255 |
| d556 | -5.096797 | .6131105 | -8.31 | 0.000 | -6.298506 | -3.895088 |
| d558 | -3.954418 | .3529298 | -11.20 | 0.000 | -4.646167 | -3.262668 |
| d564 | -.7211127 | .1679166 | -4.29 | 0.000 | -1.050233 | -.3919928 |
| d566 | -2.4191 | .2042707 | -11.84 | 0.000 | -2.819475 | -2.018726 |
| d576 | -1.401657 | .3360612 | -4.17 | 0.000 | -2.060344 | -.7429703 |
| d578 | -.972394 | .1891053 | -5.14 | 0.000 | -1.343044 | -.6017437 |
| d582 | (dropped) | | | | | |
| d611 | -2.512113 | .5780451 | -4.35 | 0.000 | -3.645093 | -1.379133 |
| d612 | -1.595401 | .2439609 | -6.54 | 0.000 | -2.07357 | -1.117233 |
| d614 | -2.033395 | .3320116 | -6.12 | 0.000 | -2.684145 | -1.382646 |
| d616 | -3.686468 | .4729291 | -7.79 | 0.000 | -4.613418 | -2.759517 |
| d618 | -1.943634 | .3782856 | -5.14 | 0.000 | -2.685081 | -1.202187 |
| d622 | -1.435341 | .2935943 | -4.89 | 0.000 | -2.010792 | -.8598901 |
| d624 | -2.80876 | .5536351 | -5.07 | 0.000 | -3.893896 | -1.723624 |
| d626 | -2.962475 | .3919307 | -7.56 | 0.000 | -3.730667 | -2.194283 |
| d628 | -2.408404 | .3790544 | -6.35 | 0.000 | -3.151358 | -1.66545 |
| d632 | -1.994666 | .5622675 | -3.55 | 0.000 | -3.096722 | -.8926106 |
| d634 | -3.279021 | .3824796 | -8.57 | 0.000 | -4.028688 | -2.529353 |
| d636 | -1.313124 | .2707169 | -4.85 | 0.000 | -1.843734 | -.7825133 |
| d638 | -2.924099 | .3618505 | -8.08 | 0.000 | -3.633334 | -2.214865 |
| d642 | -3.878711 | .6276308 | -6.18 | 0.000 | -5.10888 | -2.648542 |
| d644 | -1.732927 | .2696751 | -6.43 | 0.000 | -2.261495 | -1.204358 |
| d646 | -3.790913 | .4310903 | -8.79 | 0.000 | -4.635859 | -2.945967 |
| d648 | -2.656726 | .4638639 | -5.73 | 0.000 | -3.565909 | -1.747543 |
| d652 | -2.029888 | .2893797 | -7.01 | 0.000 | -2.597078 | -1.462698 |

| | | | | | | |
|---|---|---|---|---|---|---|
| d654 | -2.995755 | .509076 | -5.88 | 0.000 | -3.993555 | -1.997956 |
| d656 | -1.900553 | .3816484 | -4.98 | 0.000 | -2.648591 | -1.152514 |
| d662 | -.8718109 | .304147 | -2.87 | 0.004 | -1.467945 | -.2756766 |
| d664 | -.7867603 | .274462 | -2.87 | 0.004 | -1.324711 | -.2488093 |
| d666 | -4.69888 | .5723705 | -8.21 | 0.000 | -5.820738 | -3.577022 |
| d668 | -2.87323 | .4224051 | -6.80 | 0.000 | -3.701153 | -2.045307 |
| d672 | -2.962898 | .3522827 | -8.41 | 0.000 | -3.65338 | -2.272417 |
| d674 | -2.391141 | .3247129 | -7.36 | 0.000 | -3.027585 | -1.754697 |
| d676 | -.8153246 | .3582978 | -2.28 | 0.023 | -1.517595 | -.1130538 |
| d678 | -1.905711 | .3548632 | -5.37 | 0.000 | -2.60125 | -1.210172 |
| d682 | -3.128402 | .4596092 | -6.81 | 0.000 | -4.029245 | -2.227558 |
| d684 | -4.675746 | .4194335 | -11.15 | 0.000 | -5.497845 | -3.853648 |
| d686 | -1.411413 | .2730278 | -5.17 | 0.000 | -1.946553 | -.8762733 |
| d688 | -2.787088 | .3616009 | -7.71 | 0.000 | -3.495833 | -2.078343 |
| d692 | -1.529432 | .3967095 | -3.86 | 0.000 | -2.30699 | -.7518731 |
| d694 | -1.49438 | .2461647 | -6.07 | 0.000 | -1.976868 | -1.011892 |
| d696 | -2.993219 | .6301899 | -4.75 | 0.000 | -4.228404 | -1.758034 |
| d698 | -1.849159 | .3461601 | -5.34 | 0.000 | -2.52764 | -1.170678 |
| d714 | -2.751578 | .4264894 | -6.45 | 0.000 | -3.587506 | -1.915651 |
| d716 | (dropped) | | | | | |
| d718 | -6.045034 | .7028338 | -8.60 | 0.000 | -7.422603 | -4.667466 |
| d722 | -2.822053 | .373021 | -7.57 | 0.000 | -3.553182 | -2.090924 |
| d724 | -4.28779 | .4372933 | -9.81 | 0.000 | -5.144894 | -3.430687 |
| d726 | -1.728132 | .5064189 | -3.41 | 0.001 | -2.720723 | -.7355405 |
| d728 | -4.66628 | .6448327 | -7.24 | 0.000 | -5.930165 | -3.402395 |
| d732 | -1.104181 | .3314921 | -3.33 | 0.001 | -1.753912 | -.4544493 |
| d734 | -4.462579 | .5667435 | -7.87 | 0.000 | -5.573408 | -3.351751 |
| d738 | -1.261241 | .3612674 | -3.49 | 0.000 | -1.969332 | -.5531494 |
| d742 | -2.101983 | .4677356 | -4.49 | 0.000 | -3.018754 | -1.185212 |
| d744 | -2.121409 | .3728608 | -5.69 | 0.000 | -2.852223 | -1.390594 |
| d746 | -2.597939 | .4262394 | -6.10 | 0.000 | -3.433377 | -1.762501 |
| d748 | -3.379706 | .5520391 | -6.12 | 0.000 | -4.461714 | -2.297698 |
| d754 | -3.535991 | .4755102 | -7.44 | 0.000 | -4.468 | -2.603981 |
| d813 | -2.598671 | .6244116 | -4.16 | 0.000 | -3.822531 | -1.374812 |
| d819 | -2.944963 | .4940109 | -5.96 | 0.000 | -3.913235 | -1.976692 |
| d826 | -3.880209 | .9182366 | -4.23 | 0.000 | -5.679971 | -2.080446 |
| d846 | -3.430233 | .7846557 | -4.37 | 0.000 | -4.968174 | -1.892292 |
| d853 | -4.147979 | .460508 | -9.01 | 0.000 | -5.050584 | -3.245374 |
| d862 | -4.02728 | .8495159 | -4.74 | 0.000 | -5.692348 | -2.362212 |
| d866 | -6.627509 | .9418923 | -7.04 | 0.000 | -8.473637 | -4.781381 |
| d911 | -.4369739 | .6269789 | -0.70 | 0.486 | -1.665865 | .7919174 |
| d912 | (dropped) | | | | | |
| d913 | (dropped) | | | | | |
| d914 | (dropped) | | | | | |
| d915 | -1.77838 | .5992668 | -2.97 | 0.003 | -2.952955 | -.6038044 |
| d916 | 1.579446 | .5858109 | 2.70 | 0.007 | .4312449 | 2.727647 |
| d917 | -.0205896 | .668156 | -0.03 | 0.975 | -1.330189 | 1.28901 |
| d918 | -.3169485 | .4581432 | -0.69 | 0.489 | -1.214918 | .5810214 |
| d921 | 1.107915 | .7112424 | 1.56 | 0.119 | -.2861346 | 2.501964 |
| d922 | (dropped) | | | | | |
| d923 | (dropped) | | | | | |
| d924 | 1.492708 | .3930077 | 3.80 | 0.000 | .7224052 | 2.263011 |
| d925 | (dropped) | | | | | |
| d926 | 3.635055 | .71028 | 5.12 | 0.000 | 2.242892 | 5.027218 |
| d927 | (dropped) | | | | | |
| d935 | 1.566508 | .7649601 | 2.05 | 0.041 | .0671704 | 3.065845 |
| d936 | .2343764 | .7776234 | 0.30 | 0.763 | -1.289781 | 1.758534 |
| d939 | -.3490971 | .862445 | -0.40 | 0.686 | -2.039507 | 1.341313 |
| d941 | -1.047005 | .9032336 | -1.16 | 0.246 | -2.817361 | .7233514 |
| d944 | 1.013551 | .5217099 | 1.94 | 0.052 | -.0090108 | 2.036113 |
| d946 | -1.463542 | 1.07378 | -1.36 | 0.173 | -3.568172 | .6410883 |
| d948 | -2.807386 | .8489692 | -3.31 | 0.001 | -4.471383 | -1.143389 |
| d960 | (dropped) | | | | | |
| d961 | -.3981922 | 1.485882 | -0.27 | 0.789 | -3.310552 | 2.514168 |
| d962 | (dropped) | | | | | |
| d964 | .8036025 | .8485625 | 0.95 | 0.344 | -.8595972 | 2.466802 |
| d968 | (dropped) | | | | | |
| dd112 | 5.69217 | .9837296 | 5.79 | 0.000 | 3.76404 | 7.6203 |

| | | | | | | |
|---|---|---|---|---|---|---|
| dd122 | 3.167984 | .7848191 | 4.04 | 0.000 | 1.629722 | 4.706245 |
| dd124 | (dropped) | | | | | |
| dd128 | 3.5875 | .7111093 | 5.04 | 0.000 | 2.193711 | 4.981289 |
| dd132 | 4.452745 | .7625348 | 5.84 | 0.000 | 2.958162 | 5.947329 |
| dd134 | 5.121966 | .7524691 | 6.81 | 0.000 | 3.647111 | 6.596821 |
| dd136 | 4.06768 | .7360743 | 5.53 | 0.000 | 2.62496 | 5.510401 |
| dd137 | (dropped) | | | | | |
| dd138 | 3.568542 | .6810304 | 5.24 | 0.000 | 2.233709 | 4.903375 |
| dd142 | 4.683306 | .6197793 | 7.56 | 0.000 | 3.468526 | 5.898086 |
| dd144 | 5.223094 | .6394604 | 8.17 | 0.000 | 3.969739 | 6.47645 |
| dd146 | 5.285371 | .6285642 | 8.41 | 0.000 | 4.053372 | 6.51737 |
| dd156 | 4.591799 | .6650242 | 6.90 | 0.000 | 3.288339 | 5.89526 |
| dd158 | 5.415717 | .7316445 | 7.40 | 0.000 | 3.981679 | 6.849755 |
| dd172 | 4.34996 | .5983736 | 7.27 | 0.000 | 3.177136 | 5.522785 |
| dd174 | 4.001951 | .6107972 | 6.55 | 0.000 | 2.804776 | 5.199126 |
| dd176 | 2.584365 | .5183881 | 4.99 | 0.000 | 1.568314 | 3.600416 |
| dd178 | 3.382483 | .5803266 | 5.83 | 0.000 | 2.245032 | 4.519935 |
| dd181 | 2.932954 | .5120304 | 5.73 | 0.000 | 1.929364 | 3.936544 |
| dd182 | 4.635644 | .5992056 | 7.74 | 0.000 | 3.461189 | 5.810099 |
| dd184 | 4.911433 | .6676277 | 7.36 | 0.000 | 3.602869 | 6.219996 |
| dd186 | 5.039211 | .6467204 | 7.79 | 0.000 | 3.771626 | 6.306796 |
| dd188 | 5.179514 | .6189878 | 8.37 | 0.000 | 3.966286 | 6.392743 |
| dd193 | 4.26958 | .6302162 | 6.77 | 0.000 | 3.034343 | 5.504816 |
| dd196 | 3.168673 | .5789821 | 5.47 | 0.000 | 2.033857 | 4.30349 |
| dd199 | 5.264984 | .6454751 | 8.16 | 0.000 | 3.999839 | 6.530128 |
| dd213 | 4.208062 | .6354637 | 6.62 | 0.000 | 2.962541 | 5.453584 |
| dd218 | 3.014493 | .563986 | 5.34 | 0.000 | 1.909068 | 4.119917 |
| dd223 | 5.943785 | .6864452 | 8.66 | 0.000 | 4.598338 | 7.289231 |
| dd228 | 4.37359 | .5966912 | 7.33 | 0.000 | 3.204063 | 5.543117 |
| dd233 | 4.558881 | .6199827 | 7.35 | 0.000 | 3.343702 | 5.774059 |
| dd238 | 3.156708 | .5367602 | 5.88 | 0.000 | 2.104647 | 4.208769 |
| dd243 | 3.293133 | .5675347 | 5.80 | 0.000 | 2.180753 | 4.405512 |
| dd248 | 4.127264 | .5711432 | 7.23 | 0.000 | 3.007812 | 5.246716 |
| dd253 | 3.187011 | .556688 | 5.72 | 0.000 | 2.095892 | 4.278131 |
| dd258 | 3.773799 | .5609052 | 6.73 | 0.000 | 2.674413 | 4.873184 |
| dd263 | 2.460537 | .571646 | 4.30 | 0.000 | 1.340099 | 3.580975 |
| dd268 | 3.695911 | .5435317 | 6.80 | 0.000 | 2.630578 | 4.761245 |
| dd273 | 4.894405 | .6574115 | 7.44 | 0.000 | 3.605865 | 6.182944 |
| dd278 | 3.333616 | .5325614 | 6.26 | 0.000 | 2.289785 | 4.377447 |
| dd283 | 4.636263 | .5347913 | 8.67 | 0.000 | 3.588061 | 5.684464 |
| dd288 | 3.027879 | .5417427 | 5.59 | 0.000 | 1.966052 | 4.089705 |
| dd293 | 4.965462 | .5928109 | 8.38 | 0.000 | 3.803541 | 6.127384 |
| dd298 | 3.250204 | .5466029 | 5.95 | 0.000 | 2.178851 | 4.321557 |
| dd299 | 4.976224 | .5954929 | 8.36 | 0.000 | 3.809046 | 6.143402 |
| dd311 | 1.387564 | .5078488 | 2.73 | 0.006 | .3921698 | 2.382958 |
| dd313 | 2.526089 | .4858781 | 5.20 | 0.000 | 1.573758 | 3.47842 |
| dd316 | 1.941656 | .4830464 | 4.02 | 0.000 | .9948757 | 2.888437 |
| dd319 | 1.481923 | .47917 | 3.09 | 0.002 | .5427399 | 2.421106 |
| dd321 | 1.370652 | .4890047 | 2.80 | 0.005 | .4121933 | 2.329111 |
| dd328 | 1.458703 | .4929768 | 2.96 | 0.003 | .4924584 | 2.424947 |
| dd336 | 2.791096 | .5010826 | 5.57 | 0.000 | 1.808964 | 3.773228 |
| dd339 | 1.577956 | .4756653 | 3.32 | 0.001 | .6456429 | 2.51027 |
| dd343 | 3.829622 | .5405301 | 7.08 | 0.000 | 2.770172 | 4.889072 |
| dd343 | (dropped) | | | | | |
| dd361 | 1.041234 | .5089992 | 2.05 | 0.041 | .0435856 | 2.038883 |
| dd362 | 2.096869 | .4957698 | 4.23 | 0.000 | 1.125151 | 3.068588 |
| dd364 | 1.892916 | .4846027 | 3.91 | 0.000 | .943085 | 2.842747 |
| dd366 | 3.290166 | .4847576 | 6.79 | 0.000 | 2.340031 | 4.240301 |
| dd369 | 3.101759 | .5341553 | 5.81 | 0.000 | 2.054804 | 4.148715 |
| dd419 | 2.404182 | .5033344 | 4.78 | 0.000 | 1.417637 | 3.390728 |
| dd423 | 2.592012 | .5092587 | 5.09 | 0.000 | 1.593855 | 3.590169 |
| dd429 | 4.57285 | .6383783 | 7.16 | 0.000 | 3.321616 | 5.824084 |
| dd433 | 4.136946 | .6022102 | 6.87 | 0.000 | 2.956602 | 5.31729 |
| dd436 | 3.921818 | .5724154 | 6.85 | 0.000 | 2.799872 | 5.043764 |
| dd439 | 3.785289 | .5301996 | 7.14 | 0.000 | 2.746086 | 4.824491 |
| dd443 | 2.993343 | .5237092 | 5.72 | 0.000 | 1.966862 | 4.019824 |
| dd446 | (dropped) | | | | | |
| dd449 | 3.111821 | .5157054 | 6.03 | 0.000 | 2.101028 | 4.122614 |

| | | | | | | |
|---|---|---|---|---|---|---|
| dd453 | 2.233969 | .4963493 | 4.50 | 0.000 | 1.261115 | 3.206824 |
| dd456 | 4.575983 | .5851437 | 7.82 | 0.000 | 3.42909 | 5.722877 |
| dd463 | 3.610258 | .5805012 | 6.22 | 0.000 | 2.472463 | 4.748052 |
| dd466 | 3.595138 | .5262938 | 6.83 | 0.000 | 2.563591 | 4.626684 |
| dd469 | 4.806365 | .6274128 | 7.66 | 0.000 | 3.576623 | 6.036107 |
| dd474 | 5.245252 | .6293982 | 8.33 | 0.000 | 4.011618 | 6.478885 |
| dd513 | 4.339464 | .6616456 | 6.56 | 0.000 | 3.042626 | 5.636303 |
| dd514 | .4285963 | .5844294 | 0.73 | 0.463 | -.7168971 | 1.57409 |
| dd518 | 3.792081 | .6060387 | 6.26 | 0.000 | 2.604233 | 4.979929 |
| dd522 | (dropped) | | | | | |
| dd524 | 4.189065 | .6008717 | 6.97 | 0.000 | 3.011345 | 5.366786 |
| dd532 | 4.983901 | .5603283 | 8.89 | 0.000 | 3.885647 | 6.082156 |
| dd534 | 6.323144 | .7470745 | 8.46 | 0.000 | 4.858863 | 7.787425 |
| dd536 | 5.618046 | .6714416 | 8.37 | 0.000 | 4.302007 | 6.934085 |
| dd542 | 5.404412 | .6450069 | 8.38 | 0.000 | 4.140186 | 6.668639 |
| dd544 | .9192561 | .5590028 | 1.64 | 0.100 | -.1764006 | 2.014913 |
| dd548 | 4.803742 | .5974378 | 8.04 | 0.000 | 3.632752 | 5.974732 |
| dd556 | 1.598397 | .5001068 | 3.20 | 0.001 | .6181771 | 2.578616 |
| dd558 | 2.121477 | .5978572 | 3.55 | 0.000 | .9496647 | 3.293289 |
| dd564 | 5.329055 | .6609745 | 8.06 | 0.000 | 4.033532 | 6.624579 |
| dd566 | 4.777298 | .6381265 | 7.49 | 0.000 | 3.526558 | 6.028039 |
| dd576 | 5.195132 | .5433466 | 9.56 | 0.000 | 4.130162 | 6.260102 |
| dd578 | 5.246582 | .6288588 | 8.34 | 0.000 | 4.014006 | 6.479158 |
| dd582 | (dropped) | | | | | |
| dd611 | 2.639642 | .5021451 | 5.26 | 0.000 | 1.655428 | 3.623857 |
| dd612 | 4.232285 | .6155625 | 6.88 | 0.000 | 3.02577 | 5.4388 |
| dd614 | 4.707385 | .5506403 | 8.55 | 0.000 | 3.628119 | 5.786651 |
| dd616 | 1.589982 | .5182067 | 3.07 | 0.002 | .5742867 | 2.605678 |
| dd618 | 2.360913 | .5569734 | 4.24 | 0.000 | 1.269234 | 3.452592 |
| dd622 | 3.367147 | .5713703 | 5.89 | 0.000 | 2.24725 | 4.487045 |
| dd624 | 2.822323 | .4918391 | 5.74 | 0.000 | 1.858308 | 3.786338 |
| dd626 | 2.190854 | .5337584 | 4.10 | 0.000 | 1.144677 | 3.237031 |
| dd628 | 2.394031 | .5565937 | 4.30 | 0.000 | 1.303096 | 3.484966 |
| dd632 | 1.397266 | .5016494 | 2.79 | 0.005 | .4140229 | 2.380509 |
| dd634 | 2.053983 | .5270174 | 3.90 | 0.000 | 1.021018 | 3.086947 |
| dd636 | 4.91215 | .5930929 | 8.28 | 0.000 | 3.749676 | 6.074624 |
| dd638 | 2.375313 | .5492358 | 4.32 | 0.000 | 1.298799 | 3.451826 |
| dd642 | 1.632056 | .515631 | 3.17 | 0.002 | .6214089 | 2.642703 |
| dd644 | 5.009398 | .6024078 | 8.32 | 0.000 | 3.828667 | 6.19013 |
| dd646 | 2.362274 | .5133189 | 4.60 | 0.000 | 1.356158 | 3.368389 |
| dd648 | 2.006222 | .4905075 | 4.09 | 0.000 | 1.044818 | 2.967627 |
| dd652 | 4.013299 | .5792906 | 6.93 | 0.000 | 2.877877 | 5.14872 |
| dd654 | 2.54671 | .4989228 | 5.10 | 0.000 | 1.568811 | 3.524609 |
| dd656 | 3.554943 | .5359341 | 6.63 | 0.000 | 2.504501 | 4.605384 |
| dd662 | 4.058174 | .5689284 | 7.13 | 0.000 | 2.943062 | 5.173285 |
| dd664 | 4.55813 | .5910367 | 7.71 | 0.000 | 3.399687 | 5.716574 |
| dd666 | 1.616943 | .5226222 | 3.09 | 0.002 | .5925933 | 2.641294 |
| dd668 | 3.865655 | .5244537 | 7.37 | 0.000 | 2.837715 | 4.893595 |
| dd672 | 3.68238 | .5313879 | 6.93 | 0.000 | 2.640849 | 4.723911 |
| dd674 | 2.998727 | .5628285 | 5.33 | 0.000 | 1.895572 | 4.101882 |
| dd676 | 3.744358 | .5662423 | 6.61 | 0.000 | 2.634512 | 4.854205 |
| dd678 | 3.171507 | .5579557 | 5.68 | 0.000 | 2.077903 | 4.265112 |
| dd682 | 2.789067 | .5231884 | 5.33 | 0.000 | 1.763607 | 3.814527 |
| dd684 | 1.580064 | .5185796 | 3.05 | 0.002 | .5636376 | 2.596491 |
| dd686 | 4.532141 | .5971274 | 7.59 | 0.000 | 3.361759 | 5.702523 |
| dd688 | 3.945757 | .5639447 | 7.00 | 0.000 | 2.840414 | 5.0511 |
| dd692 | 2.922367 | .5551028 | 5.26 | 0.000 | 1.834354 | 4.01038 |
| dd694 | 4.717491 | .656825 | 7.18 | 0.000 | 3.430101 | 6.004881 |
| dd696 | 2.753196 | .4961827 | 5.55 | 0.000 | 1.780668 | 3.725724 |
| dd698 | 3.576072 | .5690993 | 6.28 | 0.000 | 2.460626 | 4.691518 |
| dd714 | 2.390487 | .5586756 | 4.28 | 0.000 | 1.295472 | 3.485503 |
| dd716 | (dropped) | | | | | |
| dd718 | 1.627679 | .4794034 | 3.40 | 0.001 | .6880387 | 2.567319 |
| dd722 | 3.473534 | .552694 | 6.28 | 0.000 | 2.390242 | 4.556825 |
| dd724 | 2.242092 | .5409989 | 4.14 | 0.000 | 1.181724 | 3.302461 |
| dd726 | 3.122443 | .5508861 | 5.67 | 0.000 | 2.042695 | 4.202191 |
| dd728 | 1.644406 | .5232646 | 3.14 | 0.002 | .618797 | 2.670015 |
| dd732 | 3.752414 | .603273 | 6.22 | 0.000 | 2.569987 | 4.934842 |

| | | | | | | |
|---|---|---|---|---|---|---|
| dd734 | 1.879704 | .51118 | 3.68 | 0.000 | .8777804 | 2.881627 |
| dd738 | 4.708419 | .5961022 | 7.90 | 0.000 | 3.540047 | 5.876791 |
| dd742 | 3.865089 | .5298253 | 7.30 | 0.000 | 2.826621 | 4.903557 |
| dd744 | 4.108468 | .5456611 | 7.53 | 0.000 | 3.038962 | 5.177975 |
| dd746 | 3.768114 | .5800555 | 6.50 | 0.000 | 2.631193 | 4.905034 |
| dd748 | 3.143078 | .5605502 | 5.61 | 0.000 | 2.044388 | 4.241767 |
| dd754 | 3.641131 | .5700396 | 6.39 | 0.000 | 2.523842 | 4.75842 |
| dd813 | 1.021971 | .493642 | 2.07 | 0.038 | .0544226 | 1.989519 |
| dd819 | 1.138415 | .5021429 | 2.27 | 0.023 | .1542048 | 2.122625 |
| dd826 | 1.423725 | .5073759 | 2.81 | 0.005 | .4292578 | 2.418192 |
| dd846 | 1.063402 | .4932152 | 2.16 | 0.031 | .0966899 | 2.030114 |
| dd853 | 2.537626 | .5242695 | 4.84 | 0.000 | 1.510048 | 3.565205 |
| dd862 | -.1785124 | .4918795 | -0.36 | 0.717 | -1.142606 | .7855815 |
| dd866 | .3502795 | .4837646 | 0.72 | 0.469 | -.5979089 | 1.298468 |
| dd911 | 3.227744 | .5891647 | 5.48 | 0.000 | 2.072969 | 4.382518 |
| dd912 | (dropped) | | | | | |
| dd913 | (dropped) | | | | | |
| dd914 | (dropped) | | | | | |
| dd915 | 1.851429 | .614941 | 3.01 | 0.003 | .6461318 | 3.056726 |
| dd916 | 4.151113 | .6339487 | 6.55 | 0.000 | 2.908561 | 5.393666 |
| dd917 | 2.975533 | .6107041 | 4.87 | 0.000 | 1.77854 | 4.172525 |
| dd918 | 3.340485 | .5767948 | 5.79 | 0.000 | 2.209955 | 4.471014 |
| dd921 | 3.980399 | .5951754 | 6.69 | 0.000 | 2.813843 | 5.146954 |
| dd922 | (dropped) | | | | | |
| dd923 | (dropped) | | | | | |
| dd924 | 7.088749 | .7562303 | 9.37 | 0.000 | 5.606523 | 8.570976 |
| dd925 | (dropped) | | | | | |
| dd926 | 5.996512 | .6695171 | 8.96 | 0.000 | 4.684245 | 7.308779 |
| dd927 | (dropped) | | | | | |
| dd935 | 4.193915 | .6028071 | 6.96 | 0.000 | 3.012401 | 5.375429 |
| dd936 | 2.569922 | .5807299 | 4.43 | 0.000 | 1.431679 | 3.708164 |
| dd939 | 2.177393 | .5417432 | 4.02 | 0.000 | 1.115565 | 3.23922 |
| dd941 | 2.344168 | .566065 | 4.14 | 0.000 | 1.234669 | 3.453667 |
| dd944 | 3.606892 | .6023948 | 5.99 | 0.000 | 2.426185 | 4.787598 |
| dd946 | 2.639941 | .567511 | 4.65 | 0.000 | 1.527608 | 3.752274 |
| dd948 | 1.132844 | .5336842 | 2.12 | 0.034 | .0868122 | 2.178876 |
| dd960 | (dropped) | | | | | |
| dd961 | 3.418139 | .5554377 | 6.15 | 0.000 | 2.32947 | 4.506809 |
| dd962 | (dropped) | | | | | |
| dd964 | 4.255806 | .6374509 | 6.68 | 0.000 | 3.006389 | 5.505223 |
| dd968 | 5.105763 | .6037847 | 8.46 | 0.000 | 3.922333 | 6.289193 |
| _cons | -11.89452 | 2.194431 | -5.42 | 0.000 | -16.19565 | -7.593394 |

# APPENDIX D2

**Period 1965-1985**

**Specification (1)**

```
Fixed-effects (within) regression               Number of obs      =     28204
Group variable (i): pairid                      Number of groups   =      7396

R-sq:  within  = 0.1706                         Obs per group: min =         1
       between = 0.4821                                        avg =       3.8
       overall = 0.4949                                        max =         6

                                                F(10,20798)        =    427.94
corr(u_i, Xb)  = 0.2443                         Prob > F           =    0.0000

------------------------------------------------------------------------------
      ltrade |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         ipr |   .5907586   .0498613     1.18   0.023     .3865638    .5680793
       lrgdp |   .4827873   .0584503     8.26   0.000     .3682202    .5973545
     lrgdppc |   .5273566   .0606221     8.70   0.000     .4085325    .6461807
    regional |   .6058562   .1412133     4.29   0.000     .3290672    .8826452
       onein |   .0141912   .0280959     0.51   0.613     -.040879    .0692613
         d65 |  -.1245545   .0351888    -3.54   0.000    -.1935273   -.0555816
         d70 |  -.6167616   .0440632   -14.00   0.000    -.7031289   -.5303943
         d75 |   -.316944    .054938    -5.77   0.000    -.4246268   -.2092612
         d80 |  -.3551189   .0682109    -5.21   0.000    -.4888177   -.2214201
         d85 |  -.8457951   .0771325   -10.97   0.000    -.9969808   -.6946093
       _cons |  -20.93836   1.951339   -10.73   0.000    -24.76313   -17.11358
-------------+----------------------------------------------------------------
     sigma_u |  2.5214857
     sigma_e |  1.1520219
         rho |  .82730687   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(7395, 20798) =    10.55         Prob > F = 0.0000
```

**Specification (2)**

```
Fixed-effects (within) regression               Number of obs      =     28204
Group variable (i): pairid                      Number of groups   =      7396

R-sq:  within  = 0.1720                         Obs per group: min =         1
       between = 0.4743                                        avg =       3.8
       overall = 0.4844                                        max =         6

                                                F(12,20796)        =    360.01
corr(u_i, Xb)  = 0.0617                         Prob > F           =    0.0000

------------------------------------------------------------------------------
      ltrade |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lrgdp |   .5460424   .0596382     9.16   0.000     .4291469     .662938
     lrgdppc |   .4416938   .0624901     7.07   0.000     .3192085    .5641792
      iprlin |  -.2675766   .0805192    -3.32   0.001    -.4254006   -.1097527
      iprmin |   .1183308   .0748191     1.58   0.114    -.0283205    .2649821
      iprhin |   .4874281    .106593     4.57   0.000     .2784976    .6963587
    regional |    .522946   .1420194     3.68   0.000     .2445769    .8013151
       onein |   .0115604   .0280733     0.41   0.680    -.0434654    .0665863
         d65 |  -.1339937   .0352403    -3.80   0.000    -.2030674   -.0649201
         d70 |  -.6365571   .0443358   -14.36   0.000    -.7234587   -.5496554
         d75 |  -.3403925   .0552898    -6.16   0.000    -.4487649   -.2320202
         d80 |  -.3828335   .0688259    -5.56   0.000    -.5177377   -.2479293
         d85 |  -.8792142   .0779162   -11.28   0.000    -1.031936   -.7264924
       _cons |  -22.47975   1.975014   -11.38   0.000    -26.35093   -18.60856
-------------+----------------------------------------------------------------
     sigma_u |  2.4717394
     sigma_e |  1.1511344
```

```
        rho |  .82176453   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(7395, 20796) =    10.45         Prob > F = 0.0000
```

**Specification (3)**

```
Fixed-effects (within) regression               Number of obs      =     28204
Group variable (i): pairid                      Number of groups   =      7396

R-sq:  within  = 0.1706                         Obs per group: min =         1
       between = 0.4821                                        avg =       3.8
       overall = 0.4949                                        max =         6

                                                F(10,20798)        =    427.94
corr(u_i, Xb)  = 0.2443                         Prob > F           =    0.0000

------------------------------------------------------------------------------
      ltrade |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    iprtrans |   .1553318   .0242552     6.40   0.000     .2028725    .1077912
 iprnontrans |   .5907582   .0698613     8.18   0.006     .3656328    .5680793
       lrgdp |   .4827873   .0584503     8.26   0.000     .3682202    .5973545
     lrgdppc |   .5273566   .0606221     8.70   0.000     .4085325    .6461807
    regional |   .6058562   .1412133     4.29   0.000     .3290672    .8826452
       onein |   .0141912   .0280959     0.51   0.613     -.040879    .0692613
         d65 |  -.1245545   .0351888    -3.54   0.000    -.1935273   -.0555816
         d70 |  -.6167616   .0440632   -14.00   0.000    -.7031289   -.5303943
         d75 |   -.316944    .054938    -5.77   0.000    -.4246268   -.2092612
         d80 |  -.3551189   .0682109    -5.21   0.000    -.4888177   -.2214201
         d85 |  -.8457951   .0771325   -10.97   0.000    -.9969808   -.6946093
       _cons |  -20.93836   1.951339   -10.73   0.000    -24.76313   -17.11358
-------------+----------------------------------------------------------------
     sigma_u |  2.5214857
     sigma_e |  1.1520219
         rho |  .82730687   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(7395, 20798) =    10.55         Prob > F = 0.0000
```

**Period 1990-1995**

**Specification (1)**

```
Fixed-effects (within) regression               Number of obs      =     14260
Group variable (i): pairid                      Number of groups   =      8536

R-sq:  within  = 0.0351                         Obs per group: min =         1
       between = 0.4371                                        avg =       1.7
       overall = 0.4290                                        max =         2

                                                F(6,5718)          =     34.71
corr(u_i, Xb)  = -0.1956                        Prob > F           =    0.0000

------------------------------------------------------------------------------
      ltrade |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         ipr |   .6024543   .1576677     2.04   0.062     .3328051    .8929591
       lrgdp |   1.156149   .2546822     4.54   0.000     .6568759    1.655423
     lrgdppc |   .4279689   .2512789     1.70   0.089     .9205708    .0646331
    regional |   .0374055   .2305429     0.16   0.871    -.4145459    .4893569
       onein |   .0398504   .0553528     0.72   0.472    -.0686621    .1483629
         d95 |  -.0275075   .0529591    -0.52   0.603    -.1313273    .0763123
       _cons |  -39.24803   8.555794    -4.59   0.000    -56.02063   -22.47543
-------------+----------------------------------------------------------------
     sigma_u |   3.012653
     sigma_e |  1.2031728
         rho |  .86244151   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
F test that all u_i=0:     F(8535, 5718) =     6.62          Prob > F = 0.0000
```

**Specification (2)**

```
Fixed-effects (within) regression               Number of obs      =     14260
Group variable (i): pairid                      Number of groups   =      8536

R-sq:  within  = 0.0353                         Obs per group: min =         1
       between = 0.4378                                        avg =       1.7
       overall = 0.4293                                        max =         2

                                                F(8,5716)          =     26.14
corr(u_i, Xb)  = -0.1926                        Prob > F           =    0.0000

------------------------------------------------------------------------------
      ltrade |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lrgdp |   1.151534   .2555132     4.51   0.000     .6506311    1.652437
     lrgdppc |  -.4282239   .2532472    -1.69   0.091    -.9246843    .0682365
      iprlin |  -.7777856   .2834617     4.07   0.094     .2169162    .4324719
      iprmin |   .1023208   .0725043     1.41   0.158    -.0398152    .2444568
      iprhin |   .1052162   .0254282     3.08   0.083     .2564097    .5353665
    regional |   .0610009   .2344247     0.26   0.795    -.3985603    .5205621
       onein |   .0387105    .055555     0.70   0.486    -.0701984    .1476193
         d95 |  -.0262926   .0530561    -0.50   0.620    -.1303028    .0777176
       _cons |  -39.00378   8.569673    -4.55   0.000    -55.80359   -22.20397
-------------+----------------------------------------------------------------
     sigma_u |  3.0092066
     sigma_e |  1.2032843
         rho |  .86214766   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(8535, 5716) =     6.58          Prob > F = 0.0000
```

**Specification (3)**

```
Fixed-effects (within) regression               Number of obs      =     14260
Group variable (i): pairid                      Number of groups   =      8536

R-sq:  within  = 0.0352                         Obs per group: min =         1
       between = 0.4328                                        avg =       1.7
       overall = 0.4246                                        max =         2

                                                F(7,5717)          =     29.83
corr(u_i, Xb)  = -0.2241                        Prob > F           =    0.0000

------------------------------------------------------------------------------
      ltrade |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    iprtrans |   .762964    .0169567     4.24   0.002     .2445349    .7971276
 iprnontrans |   .629804     .057789     6.09   0.027     .2503079    .7626878
       lrgdp |   1.185706   .2578234     4.60   0.000     .6802746    1.691138
     lrgdppc |  -.4586169    .254699    -1.80   0.072    -.9579234    .0406896
    regional |    .051762   .2313717     0.22   0.823    -.4018142    .5053382
       onein |    .046615   .0561091     0.83   0.406    -.0633802    .1566102
         d95 |  -.0102584   .0578915    -0.18   0.859    -.1237477    .1032309
       _cons |  -40.20424   8.653727    -4.65   0.000    -57.16882   -23.23965
-------------+----------------------------------------------------------------
     sigma_u |  3.0385415
     sigma_e |  1.2032207
         rho |  .86444984   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(8535, 5717) =     6.62          Prob > F = 0.0000
```

# APPENDIX D3

```
Fixed-effects (within) IV regression         Number of obs      =        31096
Group variable: pairid                       Number of groups   =         6955

R-sq:  within  =      .                      Obs per group: min =            1
       between = 0.0031                                     avg =          4.5
       overall = 0.0018                                     max =            7

                                             Wald chi2(11)      = 520223.58
corr(u_i, Xb)  = -0.9661                     Prob > chi2        =    0.0000

------------------------------------------------------------------------------
      ltrade |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         ipr |   11.14221   4.816078     2.31   0.021     1.702874    20.58155
       lrgdp |    .156201   .2931392     0.53   0.594    -.4183412    .7307432
     lrgdppc |    1.70962   .6192062     2.76   0.006     .4959982    2.923242
       onein |   -.050599   .0603058    -0.84   0.401    -.1687963    .0675982
    regional |   3.358831   1.256056     2.67   0.007     .8970067    5.820655
         d65 |  (dropped)
         d70 |  -.3764129   .0871422    -4.32   0.000    -.5472086   -.2056172
         d75 |    -.24813   .0930534    -2.67   0.008    -.4305113   -.0657487
         d80 |   .1923921   .2570159     0.75   0.454    -.3113498    .6961339
         d85 |   .1695661   .4720955     0.36   0.719     -.755724    1.094856
         d90 |   .3146369   .5410017     0.58   0.561    -.7457069    1.374981
         d95 |   2.275454   1.390614     1.64   0.102    -.4500987    5.001008
       _cons |  -3.917915   12.48104    -0.31   0.754     -28.3803    20.54446
-------------+----------------------------------------------------------------
     sigma_u |  14.762731
     sigma_e |  2.6043092
         rho |  .96981841   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F  test that all u_i=0:     F(6954,24130) =     2.13      Prob > F    = 0.0000
------------------------------------------------------------------------------
Instrumented:   ipr
Instruments:    lrgdp lrgdppc onein regional d65 d70 d75 d80 d85 d90 d95
                L5.lrgdp L5.lrgdppc
```