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Bakalářská práce

2010 Anežka Fialová

Charles University in Prague
Faculty of Social Sciences

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BACHELOR THESIS

Empirical Analysis of the Linder Hypothesis: The case of Japan (1980-2007)

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Academic Year: 2009/2010

Děkuji panu Vilému Semerákovi PhD. za jeho vedení při psaní této práce.

Děkuji všem svým blízkým.

Prohlášení

Prohlašuji, že jsem bakalářskou práci vypracovala samostatně a použila pouze uvedené prameny a literaturu.

V Praze dne 29.7.2010 podpis studenta

ABSTRACT

The aim of this work is to test empirically the validity of the Linder Trade Hypothesis for the case of Japan in the period 1980-2007. While the theoretical part presents summary of Linder Trade Theory as well as an overview of empirical studies dealing with Linder Hypothesis, for the purpose of the empirical part a gravity type model for panel data was constructed. For estimation in GRETL software the fixed effect method with HAC robust standard errors covariance matrix was used. As the main innovation in the testing approach the author considers two facts. Firstly it is the very nature of Japan itself that, as an island country separated geographically from its trading partners, offers an ideal object to test the Linder Hypothesis, because the main weakness of the precedent tests has been the inability to deal with geographical clustering. And secondly it is the method of testing that uses panel data, which helps to account for individual features of partner countries. The study does not come with any definite results as it tackles low statistical significance of estimates, but it provides reader with thorough theoretical summary of the problem.

ABSTRAKT

Cílem této práce je poskytnout test Linderovy hypotézy na základě empirických dat pro Japonsko v letech 1980-2007. Zatímco teoretická část práce obsahuje shrnutí Linderovy teorie zahraničního obchodu a přehled empirických studií zabývajících se touto problematikou, za účelem testování byl v empirické části práce sestaven gravity model pro panelová data. K testování v softwaru GRETL byla použita metoda fixních efektů s HAC kovarianční maticí s robustními směrodatnými odchylkami. Za hlavní přínos použitého přístupu považuje autorka dvě skutečnosti. Je to za prvé samotný charakter Japonska, které jako ostrovní částečně izolovaná země tvoří ideální objekt k testování Linderovy Hypotézy, protože hlavním problémem předchozích testů byla neschopnost vypořádat se koncentrovanými seskupeními zemí s podobným HDP per capita. Za druhé je to testování za pomoci panelových dat, které napomáhá k zohlednění individuálních charakteristik partnerských zemí. Studie nepřichází s jednoznačnými výsledky, protože se potýká s nízkou statistickou signifikací odhadů, ale poskytuje čtenáři podrobné teoretické shrnutí problematiky.

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1. INTRODUCTION

The theory of international trade had originally concentrated on the supply side, as both the Ricardo and Hecksher-Ohlin trade models are based on factor endowments of the trading countries. It was Steffan Burenstam Linder, a Swedish economist that in his "Essay on Trade and Transformation"[1] hypothesized for the first time that a demand side view should be taken into account as well. Moreover he came with an idea that a similarity of demand structures of different countries could be the basis for trade in manufactures. As a measure of the similarity of demand patterns Linder, based on his notion of representative demand, chooses the differential of the income per capita. The possible instrument to test the hypothesis empirically would be thus according to Linder a comparison of the trade intensities with income per capita differentials.[2]

The Linder Hypothesis[3] was for the first time submitted to a simple empirical testing already by Linder and even though he found some supportive arguments for his thesis, he encouraged pursuing the empirical testing in more sophisticated way. The Hypothesis has been since tested mainly using methods such as rank correlation and linear regression of simple cross-sectional datasets, later also time series. Part of the tests found some support for the Linder Hypothesis such as Fortune (1971), Hirsch and Lev (1973), Sailors, Qureshi and Cross (1975), Kohlhagen (1977) or Thursby and Thursby (1987) and Chow, Kellman and Sachmurove (1999). Others as Greytak and McHugh (1977), Qureshi, French and Sailors (1980) or Kennedy and McHugh (1983) reject the theory completely.

However, most of the tests encountered serious bias when dealing with distorting factors, such as geographic clustering and distance or political and historical ties. Most of all the distance had been perceived problematic, as the countries with similar income per capita are often clustered geographically. It was therefore desirable to account especially for the influence of distance on the trade intensities of countries that were submitted to testing. Regarding the fact that most of the tests were accomplished in 1970's and 1980's before the

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[1] Linder (1961)

[2] Blejer (1978)

[3] By Linder Hypothesis is in this work denoted the inverse relationship between the income per capita difference and bilateral trade intensity as proposed by Linder (1961).

revolution in information technology, it was impossible to use methods that account for individual characteristics of countries or that process larger samples of data.

More recently together with the development of information technologies, gravity models in a multiple regression context have been used in the testing of the Linder Hypothesis. The gravity equation offers an ideal tool to test the Linder Hypothesis as it reflect both the trade creating and trade distorting forces, which posed such problems in early studies.

1.1 Aim of the work

In this work we will analyze the panel data set using a gravity equation for Japan and its 178 potential trading partner countries between years 1980 and 2007 in order to test for Linder Hypothesis. We will also try to divide the data set according to the income per capita in order to test for Hufbauer's proposition that the Linder Hypothesis is more likely to hold for countries above certain level of average per capita income[4]. The econometric method used in both tests is the fixed effect estimation with robust standard errors.

There are mainly two reasons why we consider the Linder Hypothesis to be worth of verifying on the recent performance of Japanese international trade. Firstly none such study known to the author has been published, which is a surprising fact given that Japan belongs among world's leading economic powers. Secondly it is the fact that Japan is an island country, which makes its historic or cultural exposure less intense, as well as it minimizes the effect of geographic clustering. Given the problem of dealing with such distorting factors mentioned above, the sample of trade flows of Japan and its potential trading partners could be an ideal opportunity to test the Linder Hypothesis.

Apart from the empirical study, the goal of this work is to give a detailed theoretical background for the Linder Hypothesis. Moreover because the empirical testing is an important part of the work, we will pay a special attention to the state of the art in testing of the Linder Hypothesis and we will summarize basic theoretical fundaments of panel data testing using GRETL[5] software as well.

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[4] See the Section (2.1).

[5] http://gretl.sourceforge.net/

1.2 Work layout

With regard to the aims of the work presented in the Section 1.1 deals the Chapter 2 with theoretical background of the problem. In the Section 2.1 Linder's trade theory is described. In the Section 2.1.1 Linder's thoughts that led him to hypothesize that there is an inverse relation between income per capita differential and bilateral trade intensity in manufactures are pictured. This section therefore sums up Chapter III of Linder's book "Essay on Trade and Transformation"[6]. The Section 2.2 gives a summary of the basic features and results of the empirical works on Linder Hypothesis as well as it discuss possible imperfections of some of them. As a source for the Section 2.2 mainly original papers of given authors were used. The Section 3.2 briefly explains basic framework of the gravity model that will be used for testing in the Chapter 3. Moreover the Section 3.3 presents an overview of characteristics of Japanese foreign trade in the observed period 1980-2007, such as the development of trade flows, principal trade partners or commodity composition. In the Chapter 3 the empirical part of the work is presented. The Section 3.1 deals with basic econometric methods for panel data testing, having especially the methods used by the GRETL software in sight. In sections 3.2 and 3.3 model variables and data structure as well as data sources are presented. The Section 3.4 describes the finalization of the model, testing for assumptions and it also deals with corrections for possible rejection of assumptions. Finally, in the Section 3.5 results of the testing are given and. Chapter 4 offers recapitulation of the work and comments on the results. There is also the Appendix included in the work, mentioning some details on testing.

[6] Linder (1961)

2. THEORETICAL PART

2.1 Theoretical background of Linder's Trade Theory

2.1.1 Linder's Trade Hypothesis

For Linder there were several reasons why the, until then universally accepted Heckscher-Ohlin model needed a revision. First of all it was the fact that the empirical attempts to sustain the Heckscher-Ohlin theory never reached any definite conclusion. He mentions above all the Leontief's study[7], where he have encountered great difficulties in verifying the hypothesis that comparative advantages in manufacturing industry are due to differences in factor proportions. Leontief's finding that the capital-labor ratio in U.S. exports is considerably lower than in U.S. imports is today known as the Leontief paradox. It clearly runs counter what one would assume based on Heckscher-Ohlin as U.S. were the most capital abundant country in the world. Second reason for dissatisfaction with Heckscher-Ohlin is according to Linder the fact that the factor proportions analysis cannot possibly explain intraregional trade because, by definition, a region has homogenous factor proportions. Intraregional trade, which to some extent may mean international trade since there may be several countries within a region, must therefore be explained by different means such as economies of scale, transport costs etc.

However Linder stresses that even though factor proportions have been overestimated they are not unimportant. This is also why he discusses the principles of trade in primary products and manufactures separately. While he adheres to the supply side factor proportions theory in relation to trade in primary products, his approach to explaining trade in manufactures differs distinctively.

Trade in manufactures

Linder claims that trade with manufactured products is an extension of the domestic market across national frontiers, because in the world of imperfect knowledge, entrepreneurs will react to profit opportunities of which they are aware and these would tend to arise from

[7] W.W. Leontief, „Domestic Production and Foreign Trade; The American Capital Position Re-examined", *Proceedings of the American Philosophical Society*, 97, September 1953, pp. 332-349

domestic needs or in other words from the domestic demand. Moreover a notion of potential exports and imports is of special importance to him.

Export itself is described as the end of typical market expansion path emanating from the domestic market: *"As a successful firm grows, the local market becomes insufficient for further expansion … after what has probably been a considerable period of time producing for the domestic market will the entrepreneur become aware of the profit opportunities offered by producing for foreign countries. However once this stage is reached there is nothing to prevent exports from constituting … (a large) share of total sales…".* [8] Together with this essential argument Linder names an additional reason to believe that the home market demand determines the range of potential exports. It is the intuition that production of a good is based on invention. "*An invention is then most likely to have been the outcome of an effort to solve some problem which has been acute in one's own environment*."[9] The outcome of such an invention will thus suit the needs of the domestic market and will only gradually be tested on the export markets. In the case of exports Linder furthermore limits the home market demand to so called representative demand, which is said to truly determine the potential range of exports.[10]

The range of potential imports is given in a straightforward way also by the internal demand, but not necessarily by the representative one. Clearly all products for which there is a demand at going prices are potential import products. Consequently the range of potential exports is identical to, or included in, the range of potential imports.

It follows that the more similar the range of products demanded in two nations (the demand structures of two countries) the greater the overlap in potential exports/imports and the more intensive potentially is the trade between these two nations. If this is true, the countries with similar demand structures will trade with similar manufactured goods more intensively than with the rest of the world.

Linder's conclusion not only proposes an explanation to high amounts of inter-industry trade that have been recorded and that Hecksher-Ohlin model is not able to clarify but it also turns out that the question of horizontal differentiation of products may be especially interesting in this context. Moreover he even invoke that the elements of

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[8] Linder (1961), p.88

[9] Ibid.

[10] It is a demand sufficiently strong to turn domestic products into potential exports.

monopolistic competition should be incorporated into trade theory,[11] which has been implemented several years later by Krugman.[12]

To determine which types of countries may be able to develop intensive trade among themselves, Linder gives us a concrete measure of the similarity of demand patterns. He claims that it is the level of average income that is the most important single factor that has a dominating influence on the structure of demand. Even though median income would be more likely to be more representative, it would probably be difficult to find and therefore the income per capita is taken. To show the relationship between per capita income and manufactures demanded he divides the manufactures to capital and consumer goods.

Considering the consumer goods, qualitative changes[13] in demand induced by the change in income are described as very common, because *"at higher incomes, products of different kinds, although filling the same basic needs, are likely to replace less sophisticated types … (and) products filling new needs are added."*[14] If the goods are classified in accordance with quality specification (here again reference to horizontal differentiation), income elasticity may change within a small income interval from infinitely positive to infinitely negative. In such cases, small differences in income levels may produce substantial differences in the structure of demand. Outside the income interval there is no demand for the product on the home market and outside even narrower income interval there is no representative demand, which means that at each income level there is a (representative) demand for specific range of consumer goods.

The link between capital goods and income per capita is the fact that per capita income is to a large extent determined by the existing stock of capital goods and additionally the relative amount of capital also determines the qualitative composition of the demand for new capital goods. We might thus expect that the differences in per capita income would tell us at least something about what differences there would be in the structure of demand for capital goods the same as for consumer goods.

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[11] Linder (1961), p.102

[12] Krugman, Paul R., "Increasing Returns, Monopolistic Competition, and International Trade", *Journal of International Economics 9* (4), November 1979, pp.469-79

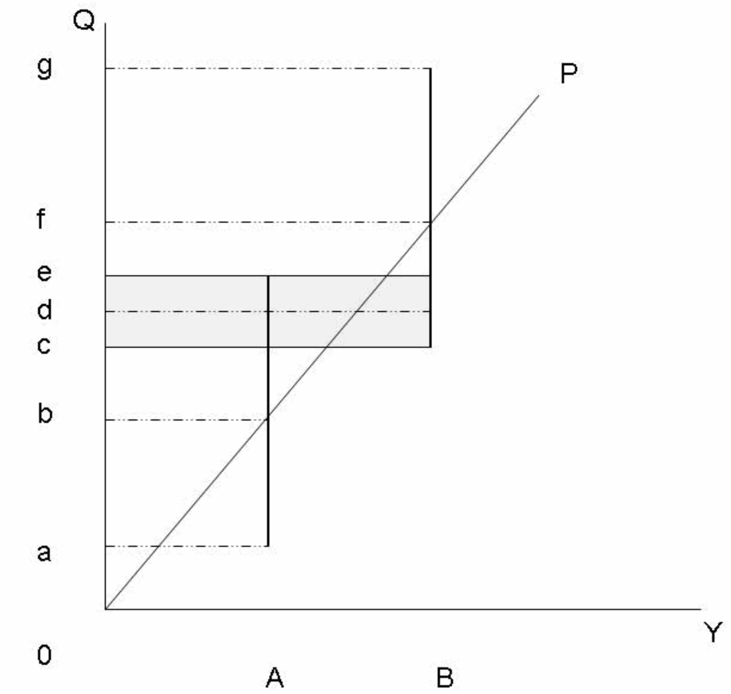
[13] i.e. alterations in the nature of the product

[14] Linder (1961), p.95

Linder himself names some exceptions when the influence of income per capita differentials should not be exaggerated. Firstly it is the case when there is an uneven income distribution that widens the range of potential exports and imports by consumer goods. This means that there would be greater overlapping of demands for consumer goods between countries with different per capita incomes than there would be in the case when incomes would be evenly distributed. Secondly there is a particular reason why unadvanced techniques should be used in capital-abundant countries implied by differences in capacity use by capital goods. The type of capital goods that it is rational to employ in capital-abundant countries for low-capacity use, such as hobby or reserve equipment, might be economically appropriate for high capacity use in a capital scarce country.[15] This again could cause a substantial amount of overlapping demand for capital goods. Still, Linder hypothesizes that it is the per capita income differences that are a potential obstacle to trade and that when they reach certain magnitude, trade can only take place in certain qualitatively homogenous products.

Following figure summarizes the mentioned principles for trade in manufactures.

FIGURE 2.1.1: Principles for trade in manufactures according to Linder



Source: Linder (1961), p.100

[15] E.g. fishing rod in U.S. (capital-abundant country) may be used for low-capacity use as hobby equipment and in the same time it may be perfectly rational to use for high-capacity use in a fishing company in some capital-scarce country.

The horizontal axis Y in the Figure 2.1.1 stands for income per capita, whereas the vertical axis Q describes the degree of quality in ordinal scale of each product demanded the same as of the demand as a whole. The line 0P represents the relationship between the quality and income per capita, i.e. the higher the per capita income, the higher will be the degree of quality characterizing the demand structure as a whole. However opportunities for qualitative variations of single products are, contrary to the demand as a whole not unlimited. This means that step functions for single products together give smooth curve for the whole demand (line 0P), reflecting the average quality of respective single products. Furthermore as the distribution of income is expected to be unequal, consumer products of different qualities will be demanded in one and the same country. Similarly for capital goods, because of differences in capacity use, capital goods of different qualities will be used in one and the same country. This is included in the Figure 2.1.1 by letting a given per capita income to be represented by a range of qualitative degrees of demand around the average degree on the line 0P. Thus, for country A the various product demanded will lie within a qualitative range a-e with b as average and for country B respectively c-g with average f. In the world of only country A and B, these ranges stand for the potential export and import products of these countries. The qualitative range c-e is common to the two countries and it is in such products that trade may take place between them. Introducing representative demand, the ranges a-e and c-g would be narrower for potential exports (as only some of internally demanded goods create the representative demand), while the range for potential imports would not change (imports are given by demand itself not by representative demand) .

Linder concludes that potential trade is most intensive among countries with similar demand structures but still, the actual trade is on one side limited by trade-breaking forces such as distance, transport costs, level of development or man-made trade obstacles (tariffs, etc.) and on other side boosted up by various cultural and political affinities. But even if this is so, per capita income levels are an important determinant of the pattern of actual trade. It will be now useful to review the empirical studies of above explained theory, in order to learn how the individual researchers dealt with simulating both the trade-creating and trade-breaking forces.

2.2 Empirical review of Linder Hypothesis: State of art

Linder[16] himself proposed a tabular form of test comparing the import propensities between similar-income countries with those for dissimilar countries to test his hypothesis. He arrayed the countries vertically and horizontally in order of per capita incomes and tried to find a tendency toward bunching of the high bilateral import propensities[17] around the main diagonal, which would be in favor of the thesis. While there is no test of goodness of fit, neither considers he distorting factors such as geographic horizon and cultural affinities and includes the total export data instead of data concerning only manufactures, the author finds some supportive arguments for his thesis. In the same time, admitting his test to be unsatisfactory, he encourages to pursue the empirical testing in more sophisticated way.

Hufbauer[18] in 1970 has tested a part of Linder Hypothesis concerning Linder's argumentation about the representative demand and his contention that *"range of potential exports is identical to or included in, the range of potential imports"*[19] using aggregate trade data. His results show that the contention seems to be valid for advanced countries above certain level of income per capita.

Fortune[20] however claims that *"bilateral trade data are really required to test the Linder hypothesis"* and proceeds with testing applying the methods suggested by Linder, i.e. trying to isolate the effect of the difference of per capita incomes from other distorting factors. He therefore uses cross-national regressions of a sample of 50 countries, including the absolute GNP per capita difference and geographical distance as explanatory variables. As the dependent variable he chooses the average propensity to import rather than the actual volume of trade because, as Linder points out it will eliminate the effect of the size of the nation.

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[16] Linder (1961)

[17] Import propensity is here defined as $\frac{M_{ij}}{Y_i}$, where M_{ij} stands for imports of country i from country j, and Y_i for GNP of the country i.

[18] Hufbauer, G.C. "The Impact of National Characteristic and Technology on the Commodity Composition of Trade in Manufactured Goods" (*The Technology Factor in International Trade*), ed. R Vernon, The National Bureau of Economic Research, 1970, pp. 154-231

[19] Linder (1961), p. 91

[20] Fortune (1971)

Fortune also limits the data on exports of finished manufactured goods[21], both again supported by Linder's propositions. His results show some support for Linder, however even if there are cases when per capita income variable determines trade intensities, the low coefficient of determination does not point it out to be the main one. Fortune therefore concludes that *"Linder's hypothesis may also be a supplement rather than an alternative to other trade theories".*[22]

Hirsch and Lev[23] in their empirical research experiment with the measure of the differential income per capita, as they use both its relative share and difference in their cross sectional study of individual industry exports. In their regression the authors use logarithms[24] of the above mentioned measure together with logarithms of GNP of trading partners, their distance and a dummy variable denoting their membership in the same trading block as explanatory variables and the logarithm of total exports as the dependent variable. They point out the multicolinearity problem when using the total difference of incomes per capita as an explanatory variable in the same time as income per capita of the trading countries. This was done in some of the previous studies, e.g. Gruber and Vernon (1970)[25] resulting in unsupportive results for Linder Hypothesis. Hirsch and Lev try to correct in their work for this imperfection and their results are in most cases in accordance wit the Hypothesis. Hirsch continued in his research on Linder hypothesis and together with Arad proposed a model combining it with Hecksher-Ohlin model[26] by introducing the notion of transfer costs. They proposed also a empirical testing with positive results.

Sailors, Qureshi and Cross[27] use the rank-order correlation referring to insufficient precision of data especially for developing countries which are thus unsuitable for a regression analysis. The Linder's sample of data about total exports for 30 developed as well

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[21] SITC 7,8

[22] Fortune (1971) pp. 317

[23] Hirsch, Lev (1973)

[24] Log forms are used in order to generate distributions in accordance with the ordinary least-squares model.

[25] W. H. Gruber and R. Vernon, 'The technology factor in a world trade matrix', in R. Vernon (ed.). The *Technology Factor in International Trade,* Universities-National Bureau conference Series, No. 22 , New York: National Bureau *of* Economic Research, 1970, pp. 233-272.

[26] Hirsch, Arad (1981)

[27] Sailors, Qureshi, Cross (1973)

as developing countries has been submitted to the rank correlation considering the absolute GNP per capita difference as the key for ranking. Regarding the fact that there was no meaningful pattern revealed to the authors from such correlation, they proceeded by eliminating countries specializing in manufactures exports requiring nontransportable national resources and those where manufactures exports were a small part of their total export. The results of the additional test already supported the Linder hypothesis, which is in terms with contention, that the Linder hypothesis is only valid for trade in manufactures. Still the authors stress the fact, that similarity in incomes per capita cannot alone explain the patterns in international trade and propose to take other economic factors such as exchange restrictions, tariff barriers, transportation costs or proximity of markets in account. Their work was later submitted to critics by J. Hoftyzer, who claims their results untrustworthy because they omitted the distance as an explaining factor, which distorts the results mainly among the European Countries.[28]

As a reaction to Hoftyzer's critics, Greytak and McHugh[29] implement a test of Linder Hypothesis on a sample of data different to the one of Linder concentrating on manufactured commodities rather than all products. Moreover they focus on US intraregional trade instead on trade between nations. This is a particularly important point because as authors declare "*in an intraregional settings the distance factor is more likely to reflect trade retarding forces…rather than artificial barriers…imposed by political boundaries"*[30]and in addition the political and cultural differences are minimized. Greytak and McHugh test two hypotheses simultaneously, one that relates the intensity of trade, measured by import propensities, and difference in the structure of demand, measured by per capita income, and the second relating differences in the intensity of trade to the geographic distance. Again the rank correlation is used, this time for the set of seven single or multistate regions. The Linder hypothesis is supported by five cases on the 10% level of significance, but none of the correlation coefficients are significant on the 5% level of significance. The second test, strongly in favor of the distance factor importance, implies that "*distance factors rather than income similarities appear to have more explanatory power in the determination of trade patterns of*

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[28] The reader will find further information in Hoftyzer (1975) and Sailors, Qureshi, Cross (1975).

[29] Greytak, McHugh (1977)

[30] Greytak, McHugh (1977), pp. 1386

manufactured goods among regions".[31] The authors however do not appeal to refute Linder's preference similarity thesis as they emphasize that "*the results of their test may reflect differences in determinants of trade between nations and trade between regions within nations."*[32] Their work has been later on extended by Qureshi, French and Sailors[33], who used data with regions that were grouped not only in accordance with geographic contiguity but also with similarity per capita. As they believe, such data should provide more comprehensive and accurate test. Nonetheless Qureshi, French and Sailors find no empirical evidence for Linder hypothesis. They suggest that it "*is perhaps caused by the fact that there is less variation in income among regions in the United States than among nations"*[34] and again encourage further investigation of the problem.

Kohlhagen[35] reacts in his paper to results of Sailors, Qureshi and Cross, whose "*results measured correlation, a substantially weaker test that that intended by Linder, whose analysis implied causality"*. He extended the empirical testing by using various measures of relative demand patterns among countries, aside from income per capita also consumption indices and income distribution data that he again regresses against import propensity. His cross sectional regression for a sample of 50 countries supports the Linder Hypothesis both with income per capita and consumption indices combined with income distribution used as the measure of relative demand structures. Kohlhagen therefore claims that "*the demand on national level cannot be ignored in international trade theory".*[36]

In contrast to previous tests Blejer[37] tests the commodity composition of trade in manufactures, which arises from the concept of Linder's representative demand. According to Linder there is a representative demand for a specific goods at each income level and because it is in such goods that the country has a comparative advantage, it will at each income level export a specific range of goods. Blejer uses income elasticity of demand as a criterion of which commodities are likely to be in the range of representative demand at each level of

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[31] Greytak, McHugh (1977), p. 1388

[32] Ibid.

[33] Qureshi, French, Sailors (1980)

[34] Ibid., pp. 935,936

[35] Kohlhagen (1978)

[36] Ibid, pp.172

[37] Blejer (1978)

income per capita. He argues that *"An increase in income per capita raises the share of high income elasticity goods and reduces the share of low income elasticity goods in total consumption, and consequently more of the former and fewer of the latter are expected to enter the representative demand range. Therefore, if…domestic market structure affects comparative advantage we can expect a positive relationship between income per capita and the share in total industrial exports of high income elasticity commodities and negative relationship for low income elasticity goods."* The author then regresses the share of industrial exports of three groups of industries, divided on the basis of income elasticity[38], and income per capita. His results tend to confirm Linder's claim about the representative demand as the coefficient of income per capita for the high income elasticity group was positive and vice versa.

In 1980 Kennedy and McHugh[39] were the first to propose an intertemporal test of the Linder Hypothesis. In accordance with Hofitzer they are emphasizing the fact that the previous studies have been unable *"to statistically account for the separate influence of distance and the Linder's effect on the intensity of trade"*[40] and as the countries with the same income level also tend to be geographically clustered *"results favoring the Linder trade hypothesis must then be interpreted with some caution"*[41]. The authors are convinced that an intertemporal test that will examine the changes of trade associated with converging or diverging income levels will account for the distance difference. Their test is performed among 17 countries classified by IMF as industrial countries (trade among industrial countries is concentrated in manufactured goods) and examines the changes between years 1960 and 1975. The results of their study revealed no evidence of the Linder-type effect; moreover even results of a cross sectional study in both 1960 and 1970 were not supportive at all. Kennedy and McHugh[42] continued their research on Linder Hypothesis in 1983, when they proceeded with an empirical intertemporal test for US exports. They claim that it would be a significant failure for the theory if it would not be applicable to the case of US, as it is (was) the country with the highest GDP per capita, value of trade and *"its economy relies relatively strongly on*

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[38] For bettter apprehension the reader can refer to Blejer (1978), pp. 558,561.

[39] Kennedy, McHugh (1980)

[40] Ibid., pp. 898

[41] Kennedy, McHugh (1980), pp. 898

[42] Ibid.

the unfettered operation of market forces."[43] To account for the distance they test the Hypothesis in terms of regression of changes in trade propensities against changes in per capita income differences, as *"in so doing, the effects of distance and political factors stay constant through time or vary uniformly across nations over time"*[44]. They also use both total trade data (SITC 1-9) and manufactures trade data (SITC 6-9) to point out the difference if any. The data sample comprises 57 nations for years 1963, 1970 and 1976 to test for two subperiods and one longer period. Again the test of Kennedy and McHugh provided no support for the Linder hypothesis and the results are thus consistent with their previous research. However as the authors suggest, their testing did not support even predictions of the rival Hecksher-Ohlin theory, therefore they see it as a challenge for economists to combine both the supply and demand theories of trade to explain trade patterns.

Thursby and Thursby[45] examine in their paper the Linder hypothesis together with the effect of exchange rate variability (especially the exchange rate risk) in reflecting also distance as an important factor. They derive and estimate an ex ante specified model derived from an underlying demand and supply model for the sample of 17 countries in the time period form 1974-1982 including Japan. In their work they find an overwhelming support for Linder's Trade thesis, which they find interesting, since previous empirical tests using the distance as explanatory variable have tended to reject the hypothesis.[46]

In 1990 Greytak Chow, Kellman and Sachmurove[47] rely in their testing on time-series regressions that hold the specific effects constant. Moreover their innovative approach consists in the usage of the trade complementarity index that reflects the trade patterns similarity and that is constructed as the trade intensity index without trade bias[48] as a dependent variable. The authors test the data for exports of newly industrialized pacific countries to some of the OECD economies between years 1965-1990 and claim that "*because*

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[43] Kennedy, McHugh (1983), pp. 85

[44] Ibid., pp. 89

[45] Thursby and Thursby (1987)

[46] See Deardorff, A. "Testing Trade Theories and Predicting Trade Flows" in R.W. Jones and P.R. Kennen *Handbook of International Economics*, Vol. 1, pp. 467-517 for a review.

[47] Chow, Kellman, and Shachmurove (1999)

[48] For details see Drysdale P. "East Asian and Pacific Trade Interdependence", *International Economic Pluralism: Economic Policy in East Asia and the Pacific,* Chapter 4, Columbia University Press, New York 1988 or Chow, Kellman, and Shachmurove (1999).

the exporters and importers do not share a common historic or cultural exposure and…they do not have a close geographic proximity…(their) sample of trade flows provides a unique test tube for the empirical testing of the Linder Hypothesis"[49]. The model reflecting exports of manufactures dependent on the GDP per capita proportion and exchange rates provides a weak support for Linder taste similarity hypothesis, but this is already surprising for the authors because they suggest that *"time-series tests have almost never provided strong support for Linder's hypothesis"*[50].

We have seen that the measures of main variables were widely discussed and vary from test to test. However more recently, gravity models, reflecting distance as a decisive factor, in a multiple regressions context have been used in the testing for the Linder Hypothesis. Even though two early test using gravity models found little or no support to the Linder theory (Hoftyzer (1984)[51], Kennedy, McHugh (1983)), Jerry and Mary Thursby (1987) found that support for Linder Hypothesis was overwhelming as we have already discussed. Furthermore additional studies by Hanink (1990)[52], Greytak and Tuchinda[53] (1990), Bergstrand (1990)[54], and McPherson et al. (2000)[55] found evidence supporting Linder Hypothesis using a gravity type models.[56] In the empirical part of this work also a gravity type model is used. That is why we will discuss the gravity model framework in the next section.

Prior to doing so, let us refer to one other weakness of the majority of preceding empirical tests of Linder Hypothesis. As Appleyard, Field and Cobb (2008) mention, it has been a common practice to exclude data from countries that have exports or imports worth

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[49] Chow, Kellman, and Shachmurove (1999), p. 176

[50] Ibid., pp. 179

[51] Hoftyzer, J.: "A Further Analysis of the Linder Trade Thesis", *Quarterly Review of Economics and Business*, 24 (2), (1984) , pp. 57-70

[52] Hanink, D. M.: "Linder, again", *Weltwirtschaftliches Archiv*, 126 (2), (1990), pp. 257-267

[53] Greytak, D; U. Tuchinda: "The Composition and Trade Intensities – An Alternative Test of Linder Hypothesis", *Weltwirtschaftliches Archiv*, 126(1), (1990), pp. 50-58

[54] Bergrstrand, J.H.: "The Hecksher-Ohlin-Samuelson Model, The Linder Hypothesis and the Determinants of Bilateral Intraindustry Trade", *Economic Journal*, 100 (403), , (December 1990), pp. 1216-1229

[55] McPherson M. A.; M. R. Redfearn; and M. A. Tieslau. 2002. "A Re-examination of the Linder Hypothesis: A Random-Effects Tobit Approach." *International Economic Journal*, 14(3), pp. 123-36.

[56] Appleyard, Field, Cobb (2008), pp. 180-181

zero dollars with the country under investigation. As a result, important information about potential trading partners is being omitted and this can cause a bias towards acceptance or rejection of the hypothesis. In the empirical part of this work we use the panel data including large set of potential trading partners (even those with zero trade flows) to correct for this bias.

To conclude this section it is necessary to claim that although the Linder Hypothesis was submitted to wide empirical testing, no clear stand-point has been accepted by the academic sphere. Most likely is the similarity of demand structures in the explaining the basis of trade in manufactures perceived significant, but definitely not exclusive.

2.3 Gravity Model Framework

The basic framework of gravity models is to focus on the interaction between the resistance in the form of geographic distance and attraction, which are in the case of testing Linder Hypothesis similar demand patterns. According to Appleyard, Field and Cobb (2008) the gravity model differs from most other theories in that it is trying to explain the volume of trade and does not focus on the composition of that trade. The model itself uses an equation framework to predict the volume of trade on a bilateral basis between any two countries. In its simplest form the gravity equation claims that the bilateral trade between two countries is directly proportional to economic size of the trading partners and inversely proportional to the distance between them:

$$TT_{ij} = \beta^0 \frac{Y_i^{\beta_1} Y_j^{\beta_2} A_{ij}^{\beta_4}}{D_{ij}^{\beta_3}} \qquad (2.3.1)$$

where TT_{ij} stands for trade flows between countries *i* and *j*, Y_i, Y_j for market size of countries *i* and *j*, D_{ij} for distance of countries *i* and *j*, A_{ij} for any other factor either adding or resisting the trade between countries *i* and *j* and β^0 a constant gravity parameter.[57] It is this form of the Equation (2.3.1) that has some similarity to the Newton's law of gravity in physics, which has resulted in the term gravity model being applied.

[57] Bergstrand (1989)

Log-linearizing of the Equation (2.3.1) gives us:

$$\ln TT_{ij} = \ln\beta^0 + \beta^1 \ln Y_i + \beta^1 \ln Y_j - \beta^3 \ln D_{ij} + \beta^4 \ln A_{ij} \qquad (2.3.2)$$

From the Equation (2.3.2) one can easily get the estimates for cross-sectional linear regression.

Regarding the variables, the model is concerned with selecting those that will produce a "good fit", that is, that will explain at least in a statistical sense a substantial portion of the trade that occurs. The variables that are nearly always used in the equation as explanatory variables, for lets say exports[58] between countries I and II are:

I. A national income variable for country II, which is expected to have a positive relationship with the volume of exports from I to II because higher income in II would cause consumers to buy more of all goods, including imported ones.

II. A national income variable for country I, reflecting that greater income in I means a greater capacity to produce and hence supply exports.

III. Some measure of distance between countries I and II as a proxy for transportation costs, with the expectation being that greater distance and greater transportation costs would reduce the volume of exports.

Often other variables are introduced such as population size to reflect the possible economies of scale or set of dummy variables incorporating institutional characteristics such as economic integration arrangements, infrastructure or cultural and linguistic proximity, historical links and various barriers to trade (of spatial and non-spatial dimension).

The gravity model in the form of the Equation (2.3.2) is typically used to analyze cross-sectional data. However fixing the country *j*, it is also possible to apply it on time series or panel data structure, as it will be done in the empirical part of this work. The Equation (2.3.2) then gets a form:

$$\ln TT_{it} = \ln\beta^0 + \beta^1 \ln Y_{it} + \beta^1 \ln Y_{jt} - \beta^3 \ln D_{ij} + \beta^4 \ln A_{ijt}$$

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[58] For equation for imports the same basic variables are used with respective logic.

where TT_{it} stands for trade flows between countries *i* and *j* in time *t*, Y_{it}, Y_{jt} for market size of countries *i* and *j* in time *t*, D_{ij} for distance of countries *i* and *j*, A_{ijt} for any other factor either adding or resisting the trade between countries *i* and *j* in time *t* and β^0 a constant gravity parameter.

As we may find in literature, the gravity model has a relatively long history. The gravity equation as a tool of explaining bilateral trade intensities was for the first time proposed by Tinbergen (1962)[59]. Since then it has been applied in many empirical studies explaining not only the bilateral trade, but also flows of different kind, such as migration, direct investment etc. with very good results. In the early years the main reason for dissatisfaction was the fact that the theoretical foundations were rather weak. However, this was altered after 1980 when Bergstrand (1985, 1989)[60] and Krugman (1985)[61] published their works, each trying more or less to offer some theoretical background for the gravity equation model of international trade. The scope of their findings is however beyond the aims of this work and we will therefore suggest the interested reader to refer to original sources mentioned in footnotes.

2.4 Characteristics of Japanese foreign trade

In our work we deal with Japanese international trade in years 1980 to 2007. It is the period when Japanese economy reached the peak of the economical miracle as well as suffered under the consequences of the bubble economy in the period known as "lost decade"[62]. On the field of foreign trade Japan was confronted with China that emerged as a principal competitor on the regional as well as on the global level. We can therefore say that it was a period anything

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[59] Tinbergen, J: „Shaping the World Economy: Suggestions for an International Economic Policy". New York: The Twentieth Century Fund, (1962)

[60] Bersgstrand J.H: "The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence" *Review of Economics and Statistics*, 67 (3), (1985) pp. 474-481 and Bergstrand, J.H.: "The Generalized gravity Equation, Monopolistic Competition, and the Factor-Proportions Theory in International Trade", *Review of Economics and Statistics*, 71 (1), (February 1989), pp. 143-153

[61] Helpman,, E.; Krugman P.R.; "Market Structure and Foreign Trade. Increasing Returns, Imperfect Competition, and the International Economy", MIT Press (1985)

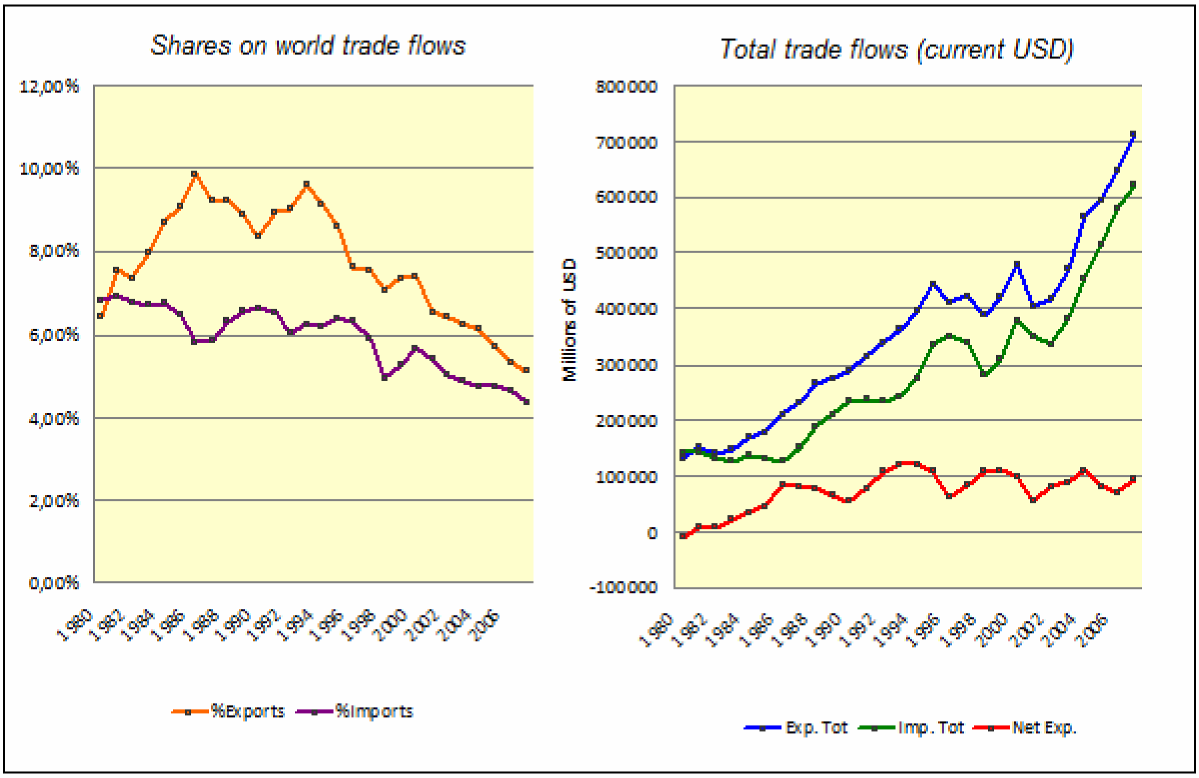
[62] More may be found e.g. in Flat, D.; "The Japanese Economy", Oxford University Press (2005).

but stable for Japanese economy. In this section we will with help of several figures summarize the characteristics and main trends in Japanese foreign trade during this period.

The total flows of exports as well as imports have had growing tendency during the period with two exceptions, when both had decreased given a fall in GDP. It was in years 1995-1998 and 2001 for exports and 1996-1998 and 2001-2002 for imports. The net exports changed from negative numbers in the year 1980 to positive ones, oscillating around hundred billions of US Dollars. After the year 2002 both exports and imports started to grow rapidly. In 2007 they reached 170% of 2002 values by exports and 185% by imports.

In spite of the positive development of total trade flows, the Japan's share of world trade has been decreasing distinctively since 1990 when it peaked on almost 10% for exports and more than 6% for imports. In 2007 the same rates were 5.1% and 4.4% respectively. This can be among others due to the rise of China and Asian tigers as competing markets to Japan. The Figure 2.4.1 pictures the development of Japan's share of world trade and trends in Japanese total trade flows as well as in net exports.

FIGURE 2.4.1: Shares of Japanese exports and imports on world trade flows and Japanese total trade volumes

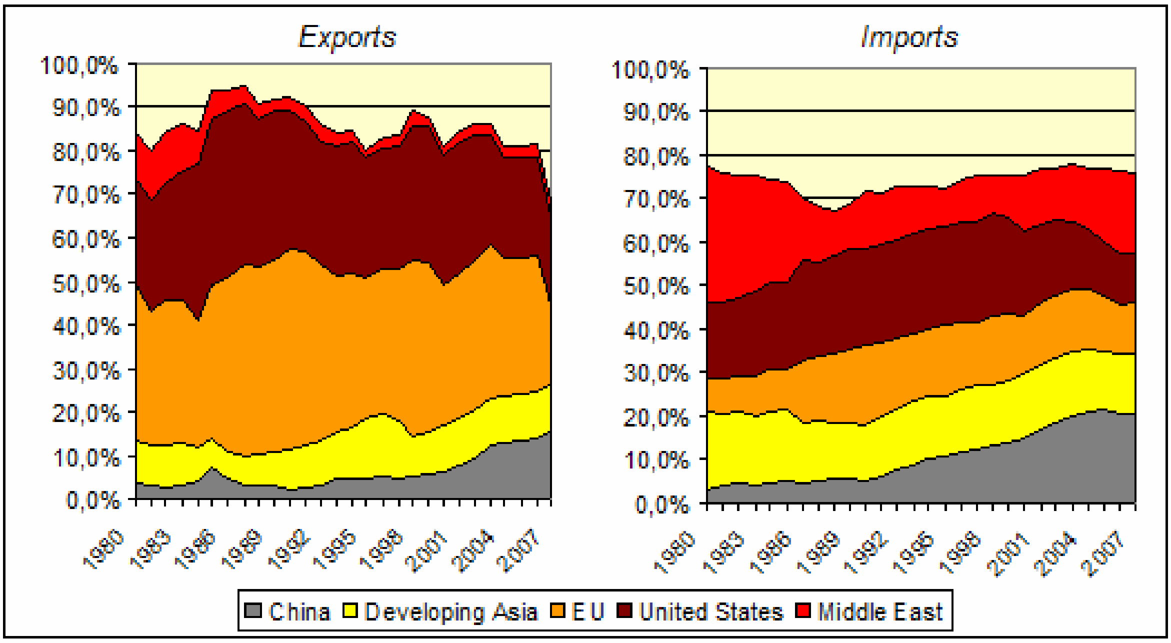


Data Source: WTO Trade Statistics and IMF, The Directions of Trade Statistics

Except growing trends in total trade flows and decreasing share on world trade there is another important characteristic of Japanese foreign trade in observed period. It is the changing pattern of territorial structure. The most important trading partners for Japan are EU, USA, Developing Asia, China and Middle East, who together represent about 80% of all exports and 70% of Imports. Regarding exports EU and USA were dominating as markets for Japanese goods. However their share decreased with increase in share of Developing Asia and especially China, whose relevance for Japanese exports grew from around 4% in 1980's to 15.3% in 2007.

The situation with imports is very similar with the difference of the position of Middle East, which plays an important role here. It is mainly because of the fact, that Japan is a country poor on mineral resources and oil that has been imported in the large part from Middle East. Share of the imports from Middle East decreased from 31% in 1980 to around 10% in 1990's, but it was rising again from 2003 up to 18.4% in 2007. Also here the share of Chinese market was rising permanently from 3.4% in 1980 to 20.5% in 2007. This was given by emerging Chinese economy and afflux of Chinese cheap imports. Furthermore the position of USA weakened by imports in the same way as by exports. The Figure 2.4.2 depicts the major Japanese trading partners and the development of their shares on Japanese trade flows in the observed period.

FIGURE 2.4.2: Share of principal trade partners on Japanese trade flows



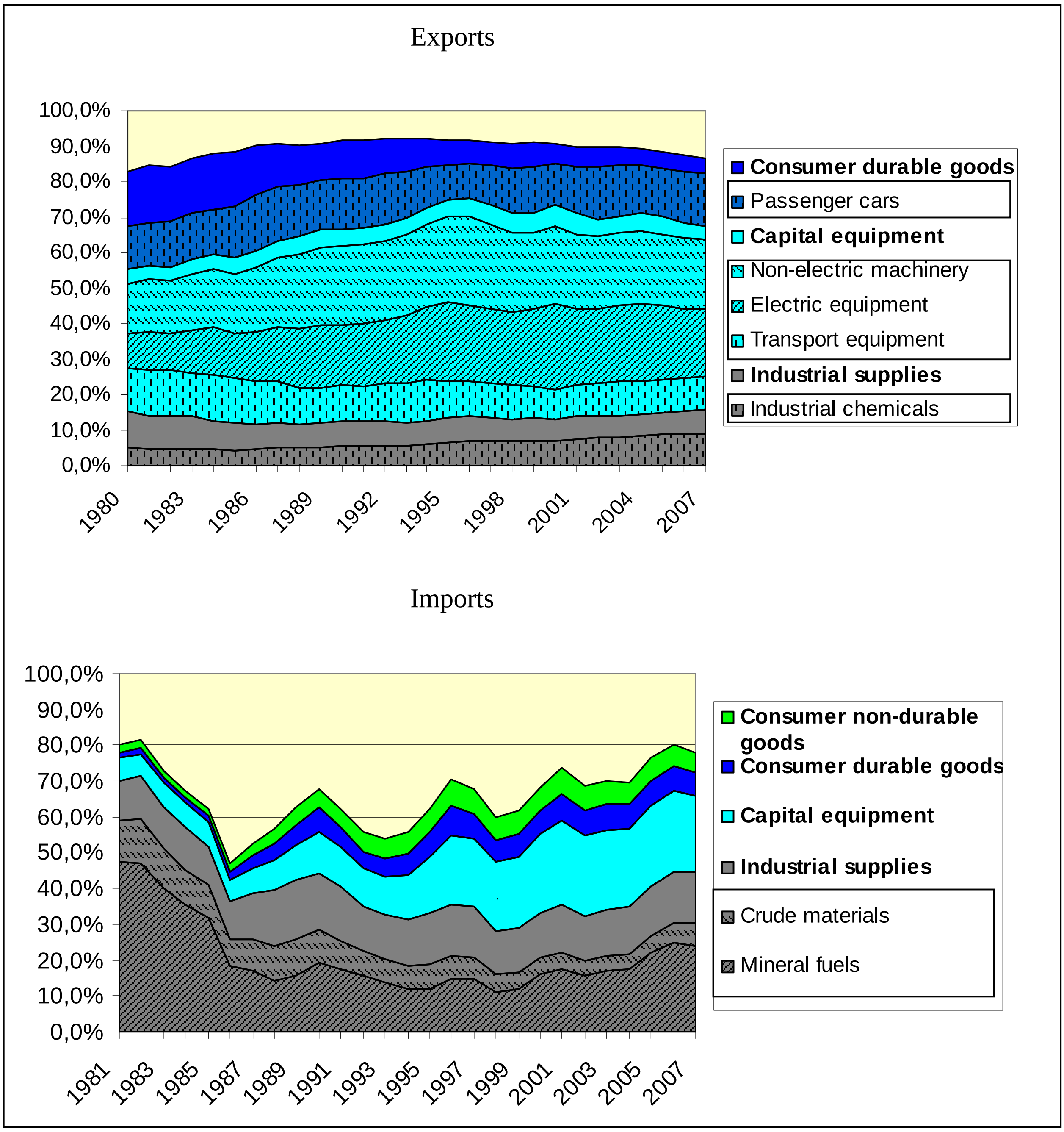
Data source: IMF, Directions of Trade Statistics

Regarding the commodity structure of Japanese trade flows, the composition of exports differs from that of imports in quite significant way. The commodity structure of exports was surprisingly stable between1980 and 2007 and illustrates the industrial character of Japanese economy. The most important group of exported goods is capital equipment whose share varied between 40% and 60% in the last two and half decades. Among sub-groups of capital equipment especially transport equipment, electric equipment and non-electric equipment stand for the most substantial ones, the latter two each forming about 20% of total exports. Consumer durable goods, constituting from 30% to 20% of total exports, form the second relevant group of exports and are mainly formed by subgroup of passenger cars that stood for about 12% of total exports. The group of consumer durable goods also contains household and domestic equipment, motorcycles and bicycles or toys and musical instruments, but these are represented only in insignificant way. The last from the three most important groups of Japanese exports are industrial supplies again with about 20% of total exports. This group constitutes of crude materials, mineral fuels, metals textiles and industrial chemicals, the latter representing about half of the share of industrial supplies on total exports.

While the commodity structure of Japanese exports have been quite stable, there were some changes on the field of imports. The main group of imported goods is industrial supplies, whose biggest share constitutes of mineral fuels and crude materials again because Japan is scarce on natural resources. However the import of mineral fuels decreased significantly in 1980's from 54.2% in 1980 to 15.6% in 1989 and was oscillating since then around 20%. The import of capital equipment was on the other hand rising to reach the value of 21.4% in 2007. In the same way the import of consumer durable goods and consumer non-durable goods grew during the period, even though these two groups do not form fundaments of Japanese imports. The figure 2.4.3 illustrates the commodity structure of Japanese trade flows based on Special Classification of Commodity as it is indicated by Japanese Statistics Bureau.[63]

[63] For details on commodities included in each individual group, consult The Statistics of Japan by Japanese Ministry of Finance on http://www.customs.go.jp/toukei/sankou/code/code_e.htm . The codes listed are in accordance with HS (Harmonized Systems) code designed by World Customs Organization.

FIGURE 2.4.3: Commodity structure of Japanese trade flows (principal commodities)



Data source: Japanese Statistical Bureau

3. EMPIRICAL PART

3.1 Methodology

In this work the Linder Hypothesis in the case of Japanese international trade is tested. To do so the gravity type equation model is used. In the same time panel data structure was chosen as it offers many advantages. First of all it controls for the individual heterogeneity as it contains both cross-sectional and time-series elements. This is very useful for our purpose as we need to deal with country and specific factors such as distance and political or historical ties between countries. Secondly according to Hsiao[64] panel data enable us to reflect both the intertemporal dynamics and individuality of the examined units and thus to control in a better way for missing or unobserved variables. Again we will use this property when testing for the influence of income differentials, as it can be hardly managed to collect a dataset containing all significant variables for the trade intensity. Moreover this property of panel data will be useful when using as large data set as possible (in the dimension of number of countries and time) for which it may be difficult to collect some of the important data.

3.1.1 Fixed and random effects

To get estimates of our coefficients primarily the fixed effects model (FEM) is expected to be the most suitable regarding the nature of the testing (cross-sectional units are countries, not randomly chosen individuals). As it was described in the previous paragraph it may be difficult to account for many factors when having panel data. One way how to use the panel data and minimize the underspecification is the mentioned fixed effect model. As Wooldrige[65] writes, we can view the unobserved factors affecting the dependent variable as consisting of two types, those that are constant and those that vary over time. We can write the model as

$$y_{it} = \beta' x_{it} + a_i + u_{it}, \qquad i = 1,....,N; t = 1,.....,T \qquad (3.1.1)$$

β and x_{it} are vectors of R^K

[64] Hsiao (2003)

[65] Wooldridge (2006)

where i denotes the cross-sectional unit, t the time period and K is the number of explanatory variables. The variable a_i captures all unobserved time-constant factors that affect y_{it} and is therefore called an unobserved or fixed effect for each of the cross-sectional units. The idiosyncratic error u_{it} is varying over time and represents unobserved factors that change over time. Moreover we can write $v_{it} = u_{it} + a_i$ and create thus a composite error. In most applications the main reason for using the FEM is that it allows for the unobserved effect to be correlated with the explanatory variable. However this also causes the ordinary least squares (OLS) to be biased and inconsistent. Therefore we use some alternative methods to make a_i disappear. This is typically the least square dummy variable (LSDV) method that includes a dummy variable for each cross-sectional unit. According to Hsiao[66] We can write the Equation (3.1.1) in vector form as

$$Y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_T \end{bmatrix} = \begin{bmatrix} e \\ 0 \\ \vdots \\ 0 \end{bmatrix} a_1 + \begin{bmatrix} 0 \\ e \\ \vdots \\ 0 \end{bmatrix} a_2 + \ldots + \begin{bmatrix} 0 \\ 0 \\ \vdots \\ e \end{bmatrix} a_N + \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_N \end{bmatrix} \beta + \begin{bmatrix} u_1 \\ \vdots \\ u_N \end{bmatrix} \tag{3.1.2}$$

where

$$y_i = \begin{bmatrix} y_{i1} \\ y_{i2} \\ \vdots \\ y_{iT} \end{bmatrix}, \quad x_i = \begin{bmatrix} x_{1i1} & x_{2i1} & \cdots & x_{Ki1} \\ x_{1i2} & x_{2i2} & & x_{Ki2} \\ \vdots & \vdots & & \vdots \\ x_{1iT} & x_{2iT} & \cdots & x_{KiT} \end{bmatrix}, \quad e \in 1 \times T = \begin{bmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{bmatrix}, \quad u_i = \begin{bmatrix} u_{i1} \\ u_{i2} \\ \vdots \\ u_{iT} \end{bmatrix}$$

Assuming that u_{it} is uncorrelated with $\begin{bmatrix} x_{i1} & \cdots & x_{iT} \end{bmatrix}'$ and can be characterized by an independently identically (i.i.d) distributed random variable with mean zero and variance σ_u^2 we know that the OLS estimator of (3.1.2) is the best linear unbiased estimator.

Because we will carry on our calculations in GRETL software, it is useful to check how it proceeds when dealing with fixed effects models. To estimate the parameters GRETL uses the demeaned data method, which is however numerically equal to the LSDV.

Again according to Hsiao, alternative formulation of the Equation (3.1.2) introduces a "mean intercept" μ so that

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[66] Hsiao (2003)

$$y_{it} = \mu + \beta' x_{it} + a_i + u_{it} \qquad (3.1.3)$$

Because both μ and a_i are fixed constants, they are not separately estimable. Way to identify them is to introduce a restriction $\sum_{t=1}^{N} a_i = 0$. Then the individual effect a_i represents the deviation of the *i*-th individual from the common mean. Equations (3.1.2) and (3.1.3) lead to the same estimator.[67]

Bearing in mind that the gravity type equation also includes the distance, which is time invariant factor, we face a problem using fixed effect method as the inherent transformation wipes out such variables. There are basically two methods how this is solved in empirical literature. Firstly one can estimate the time invariant variables in a second step, running another regression with the individual effects as dependent variable and distance or possible dummies as explanatory variables.[68] Secondly, we can use as Wooldridge proposes[69] another method of estimating models with panel data, the random effect model (REM).

According to Wooldridge[70], equation (3.1.1) becomes a random effects model when we assume that the unobserved effect a_i is uncorrelated with each explanatory variable:

$$\text{cov}(x_{jit}, a_i) = 0 \qquad t = 1,...,T;\ j = 1,...,K; i = 1,..., N \qquad (3.1.4)$$

Because a_i is in the composite error v_{it} in each time period, the v_{it} is serially correlated across time:

$$Corr(v_{it}, v_{is}) = \frac{\sigma_a^2}{\sigma_a^2 + \sigma_u^2}, \qquad \sigma_a^2 = \text{var}(a_i)$$

$$t = 1,...,T; s = 1,...,T; t \neq s; i = 1,..., N$$

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[67] Interested reader will find details in Hsiao (2003), pp 31-33.

[68] Zaros, Lehman (2003)

[69] Wooldridge (2006)

[70] Ibid.

Because the usual OLS standard errors ignore this correlation, they will be incorrect. However we can deal with this autocorrelation using general least squares method (GLS).[71] This is also how the GRETL software deals with REM.

In order for the procedure to have good properties, we should have large N and relatively small T, which suits the needs of this work well. On the contrary, even though REM allows us to use time invariable variables such as distance in our case, the assumption (3.1.4) must hold, which may be not the case having gravity type trade model. Using the REM when having a_i and one or more x_{jit} correlated causes inconsistency in the estimation. To distinguish, which method is more appropriate for the models used in this work, it is useful to use the test for specification proposed by Hausman (1978), which will be described in Section 3.4.2.

3.1.2 Robust standard errors

Furthermore in the testing using the FEM the estimation method using the robust standard errors will be used, as for such number of time-series we expect group heteroscedasticity. This is because the panel data set contains large scale of countries of very different sizes. Heteroscedasticity and autocorrelation consistent (HAC) robust covariance matrix method that is used by GRETL should deal with this issue. In following lines only a brief outline of the problem is offered in the way as presented in the GRETL User's Guide.

If the i.i.d. residuals assumption is not satisfied, the formula for the variance of the OLS estimator is no longer correct and also the OLS conventional standard errors defined by $Var(\hat{\beta}) = \sigma^2 (XX')^{-1}$ do not provide valid means of statistical inference. There are mainly two approaches how to deal with the problem of the violation of the i.i.d residuals assumption, traditionally it is the feasible generalized least squares (FGLS) method. However GRETL offers OLS with computed covariance matrices (and standard errors) that are robust with respect to deviations from the i.i.d. assumption. To use these it is desired that the data set is large enough, that it could be relied on the asymptotic consistency property of OLS. In this work, we use concretely the robust estimator suggested by Arellano in 2003 that is offered in GRETL. This estimator is HAC provided that the sample has large n and small T and it is

[71] Details may be found in Wooldridge (2006), Chapter 10.

designated to datasets, where autocorrelation might be an issue. For interested reader the further information can be found in GRETL User's Guide or any econometric textbook (e.g. Hsiao, 2003).

3.2 Model

As it was described in the theoretical part of this work, the Linder Trade Hypothesis claims that the countries with similar demand structures, measured by income per capita, trade more extensively between each other than with the rest of the world. Therefore the total trade volumes (import and export) will be used as the dependent variables. Even though it was stated that Linder Trade Hypothesis is only valid for trade in manufactures, these will be approximated by the total volumes of trade, because manufactures typically represent high share of total trade flows, especially when speaking about industrialized countries. In case of Japan this is true in the case of exports: according to WTO the share of manufactures to total export volumes in Japan was 93,8% in 2000 and 88,6 % in 2008 (by imports it was only 56,0% and in 2008 44,6% of total flow). Additionally Japan figures on leading positions in both exports and imports of manufactures.[72] Therefore it is presumed that using total trade data instead of manufactures only will not cause an excessive bias, at least by exports model.

Furthermore Hufbauer's suggestion that Linder Hypothesis is said to be valid more likely for the countries above certain level of GDP per capita will be considered. In order to account for this proposition the testing will be simultaneously performed on two data sets. One, larger data set containing all the countries with available data and second, only limited to those countries whose average GDP per capita in the period 1980 – 2007 is higher than median of all average GDP's per capita.

As the explanatory variable that will help to test the Linder Hypothesis, the absolute difference in GDP per capita of Japan and each of the partner countries will be used. If the Hypothesis is to be valid, there will be the negative sign by the coefficient. Consequently the hypothesis that the coefficient is also statistically significant $(\beta_1 \neq 0)$ will be tested.

Furthermore the total GDP of the partner countries will be taken in account to take also their economical size into consideration as it is likely to influence the trade intensity significantly. We would expect the sign of the coefficient to be positive, as countries with

[72] See WTO International Trade Statistics 2009, tables II.31, II.32, II.33.

higher GDP are more likely to trade internationally in higher volumes. For the same reason the GDP of Japan is included as another explanatory variable (identical values for each cross-sectional unit).

To pay attention to exchange rate fluctuations, that are very likely to influence the trade intensity, there will be the real exchange rate of yen to each respective currency as another explanatory variable. This is constructed as $XRATE_{it} = \frac{e_{it} p_{it}}{p_{Jt}}$, where e_{it} is the nominal yearly average exchange rate of the each respective currency i and Japanese yen (units of yen per unit od potential trading partner currency) in time t , p_{it} is GDP deflator in country i in time t and p_{Jt} is GDP deflator in Japan in time t . In the case of imports the expected sign of estimated coefficient would be negative, as the increase in XRATE represents weakening of yen against the foreign imports and thus imports happen to be relatively more expensive which would mostly likely lead to decrease in imports. On the other hand, the exports would be with growing XRATE relatively less expensive for foreign buyers and thus the sign by exports is likely to be positive.

Another explanatory variable to consider would be in our case one that would reflect the volatility of the exchange rate as it is likely to influence the trade intensity. To create such variable it is useful to calculate the coefficient of variation, which characterizes the variability of a random variable. It is defined as $\frac{\sqrt{\operatorname{var} X}}{|E(X)|}$ and to create a time series of coefficients of variation for each year we would calculate them from daily nominal exchange rates for given year. Here however we are tackling with unavailability of data, indicating the daily exchange rates for yen and all the other currencies. We will therefore limit this explanatory variable on variability of exchange rate of yen and American dollar as international currency. This of course could bias the estimations.

The last variable which completes the gravity type model is the geographical distance of the potential trading partners measured as a great circle distance between Tokyo and each respective capital city. This typically represents in the gravity model a measure for transport costs of trading with foreign partners.

The model including all mentioned variables has now following shape:

$$\ln TV_{it} = a_i + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{Jt} + \beta_3 \ln LINDER_{it} + \beta_4 \ln XRATE_{it} + \beta_5 \ln XVOL_t + \beta_5 \ln D_i + u_{it} \qquad (3.2.1)$$

TV_{it}	- trade volume measured either as exports or imports in millions of USD
a_i	- intercept that will account for time invariant (country specific) effects
GDP_{it}	- GDP of country i in time t
GDP_{Jt}	- GDP of Japan in time t
$LINDER_{it}$	- difference (in absolute value) between Japan and country i in GDP per capita in time t
$XRATE_{it}$	- real exchange rate between JPY and currency of the country I (number of units of JPY for one unit of foreign currency) in time t
$XVOL_t$	- coefficient of variation of the exchange between JPY and USD in time t
D_i	- geographical distance between Tokyo and respective capital city
u_{it}	- idiosyncratic error u_{it} representing unobserved factors that change over time

The author is aware that the explanatory variables stated above are not the only explanatory variables significant for the external trade intensity, but it is qualities of the panel data analysis which were mentioned above that will help to account for country specific effects (historical and political ties) and also will lessen the effect of the possible underspecification (missing or unobserved variables).

3.3 Data

For the purpose of this test the panel data set containing time series from 1980 to 2007 for 178 partner countries. Because the panel dataset is large in the time and cross-sectional dimension, it is unbalanced as some of the data were unavailable in the data sources used. The balanced panel would give us 168 observations, that is 29 904 observations for the whole panel set (with some of them no unique, as we have time invariant as we as cross-section invariant explanatory variables). There is in total 2 313 missing observations, which form only a minor part of the dataset. However some of the time series that contained only a very small number of observations were still omitted. Given that the data are usually not available for minor countries, it is not likely to cause any serious bias having the number of observation in consideration.

The data used comes mainly from the sources of International Monetary Fund: total trade flows (IMF Directions of Trade Statistics), GDP, GDP per capita and GDP deflators (World Economic Outlook). Also the Penn World Table published by the Center for International Comparison at the University of Pensylvania was very useful providing us with average yearly exchange rates for JPY and possible partner countries. The daily exchange rates for JPY and USD for calculation of coefficient of variation were found on the Pacific Exchange rate service by the University of Columbia. Concerning the geographical distance of capital cities, the application Google Earth was a useful source. The details about the data and collection methods can be found in manuals to individual data collections. While the total trade flows is recorded in millions of US dollars, GDP is measured in billions of US dollars and the GDP per capita difference is in US dollars. The price indexes are with 2000 base and all the nominal values are adjusted and given in constant 2000 US dollars.

TABLE 3.3.1: Descriptive statistic for entire sample

Variable	Observations	Mean	Median	Std.Dev.	Min.	Max	Units
Imports	4567	2158,5	44,2	6927,8	0	106104,1	Millions USD
Exports	4561	1860,0	91,0	10134,7	0	144009	Millions USD
Linder	4516	25787,6	28449,7	10996,6	33,06	57556,6	USD
GDP_i	4536	155,9	9,58	724,7	0,036	11691,4	Billions USD
GDP_J	28	30984,0	31834,4	8363,3	16570,9	47424,2	Billions USD
Xrate	4422	60,3	14,9	207,5	0,004	8474,4	JPY/ foreign cur.
Xvol	28	0,045	0,042	0,019	0,018	0,082	-
D	178	10337,8	9767,5	3411,0583	1153	18577	kilometers

The Table 3.3.1 represents the summary statistics on all dependent and explanatory variables that will be used in the model. It is worth mentioning that the mean and median of some variables differs significantly. For example by GDP_i it shows that the majority of possible trading partners that are contained in the dataset are relatively less important considering the economical significance (either relatively poorer or smaller).

Now let us divide the set into two parts according to median of GDP per capita to be able to test the Hufbauer's proposition that Linder Hypothesis should be more likely to work for countries above certain level of income.[73] The second dataset is limited on those countries whose average GDP per capita in the period 1980 – 2007 is higher than median of all average GDP's per capita and contains thus only 89 richer countries. The Table 3.3.2 represents the summary statistics on the variables that have changed by the selection.

TABLE 3.3.2: Descriptive statistic for the selected sub-group

Variable	Observations	Mean	Median	Std.Dev.	Min.	Max	Units
Imports	2313	2840,5	205,71	7815,3	0	87707,0	Millions USD
Exports	2307	3625,8	410,77	13499,4	0	144009	Millions USD
Linder	2321	21162,4	2243,3	11341,7	33,06	57556,6	USD
GDP_i	2326	274,7	41,92	988,12	0,100	11691,4	Billions USD
Xrate	2307	86,863	50,75	106,87	0,017	1012,2	JPY/ foreign cur.
D	89	10522,7	9512,0	3131,51	1153	18577	kilometers

Comparing Table 3.3.1 and 3.3.2 we can see, that both mean and median by the selected group are higher in the case of Imports, Exports and GDP. On the other hand they are lower by Linder. This could mean that Linder Hypothesis really is more likely to hold in the context of richer countries.

3.4 Model Properties

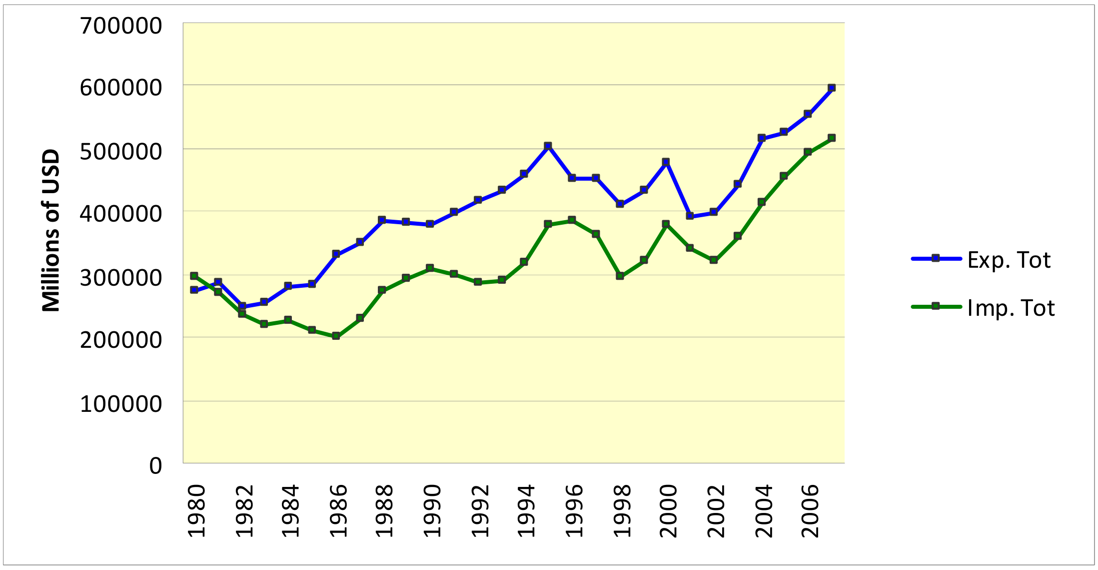
3.4.1 Time dummies

First of all one should look at the dependent variables to see if there are not any visible shocks that we could deal with by including time dummies for the respective year. This can be easily done by designing a graphic showing total Japanese exports and imports. When we look at the

[73] The countries contained in the entire data set, as well as those in the selected sub-group are listed in the Appendix A.

figure of Japanese foreign trade, we can see that there are few observations that could be seen as a shock.

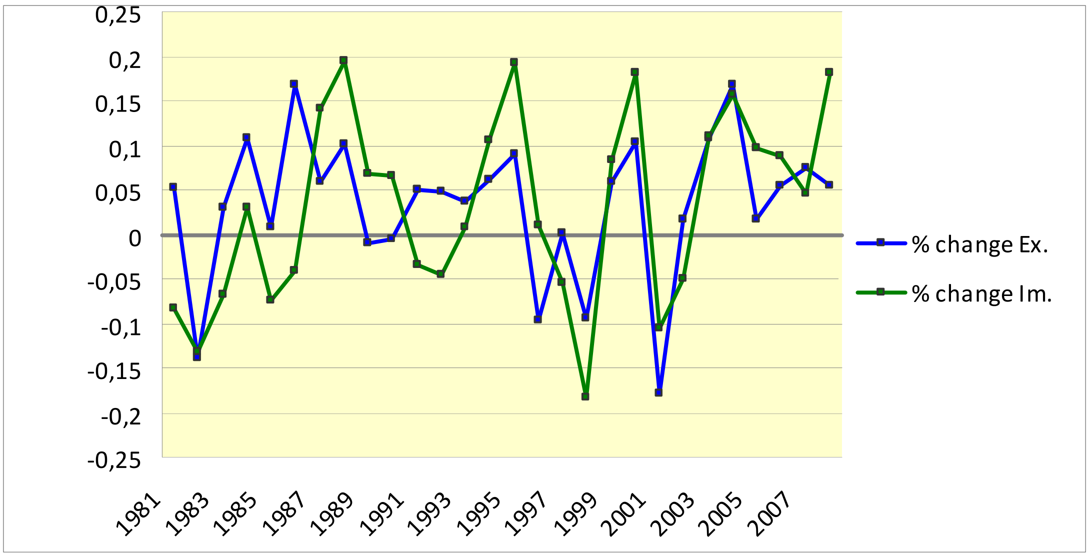
FIGURE 3.4.1: Japanese total trade volumes (in constant 2000 USD)



Data source: IMF, The Directions of Trade Statistics and World Economic Outlook

According to the Figure 3.4.1, years 1998 and 2001 could be seen as a breakaway from the constant growth trend in both exports and imports. The Figure 3.4.2 illustrates the percentage changes in total trade volumes in and gives us even clearer intuition that is the year 1998 by imports and 2001 by both exports and imports where the time dummies may be applicable.

FIGURE 3.4.2: Percentage changes in total Japanese trade flows



Data source: IMF, The Directions of Trade Statistics and World Economic Outlook

If we try to incorporate time dummies for years 1998 and 2001 in the Equations (3.2.1), (3.2.2) and (3.2.3) we get statistically significant results for year 2001 in exports model and for 1998 in imports model by the large dataset. For the data sub-set of the countries with higher GDP per capita, only time dummy of year 2001 for exports model is significant[74]. Mentioned time dummies are therefore included into models so they get the final form. For exports:

$$\ln EXPORT_{it} = a_i + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{Jt} + \beta_3 \ln LINDER_{it} + \beta_4 \ln XRATE_{it} + \beta_5 \ln XVOL_t + \beta_6 \ln D_i + \beta_7 TD_{2001} + u_{it} \quad (3.4.1)$$

For imports in the entire data set:

$$\ln IMPORT_{it} = a_i + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{Jt} + \beta_3 \ln LINDER_{it} + \beta_4 \ln XRATE_{it} + \beta_5 \ln XVOL_t + \beta_6 \ln D_i + \beta_7 TD_{1998} + u_{it} \quad (3.4.2)$$

And for imports in the data sub-set:

$$\ln IMPORT_{it} = a_i + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{Jt} + \beta_3 \ln LINDER_{it} + \beta_4 \ln XRATE_{it} + \beta_5 \ln XVOL_t + \beta_6 \ln D_i + u_{it} \quad (3.4.3)$$

where $TD_{2001} = 1$ for $t = 2001$ and otherwise $TD_{2001} = 0$. For TD_{1998} holds similarly $TD_{1998} = 1$ for $t = 1998$ and $TD_{1998} = 0$ for $t \neq 1998$.

3.4.2 Selecting of the appropriate method (Hausman test for specification)

As a next step we need to test for properties of the data to consider the applicability of either FEM or REM. To test for specification the Hausman test based on a measure of the "distance" between the fixed-effects and random-effects estimates. According to Wooldridge (2005) the Hausman test has the null hypothesis

[74] Mentioned time dummies are significant for both FEM (with or without HAC) and REM.

$$H_0 : \text{cov}(x_{itj}, a_i) = 0 \qquad (3.4.4)$$

which means that fixed effect model would give us inefficient estimator. *"The idea is that one uses the random effects estimates unless the Hausman test rejects the Equation* (3.4.4)*. In practice, a failure to reject means ether that the REM and FEM estimates are sufficiently close so that it does not matter which is used, or the sampling variation is so large in the FEM estimates that one cannot …conclude if practically significant differences are statistically significant. A rejection using the Hausman test is taken to mean that the key REM assumption, the Equation* (3.4.4)*, is false, and then the FEM estimates are used."*[75]

TABLE 3.4.1: P-values of the Hausman specification test

	Entire data set	Selected sub-group
Exports model	2,57172e-014	2,27392e-007
Imports model	6,6324e-009	1,05674e-006

The Table 3.4.1 shows p-values of the Hausman specification test for the models (3.4.1), (3.4.2) and (3.4.3). As it is seen, the p-values take very small values in all the cases, so we can reject the null hypothesis on very small level of significance. This means that REM estimates of all the models would be inconsistent ant thus FEM estimates are more appropriate to use.

[75] Ibid, pp. 502

3.4.3 Testing for model assumptions

In this section the FEM model assumptions, in the way that are suggested by Wooldridge[76], will be tested.

ASSUMPTION 3.4.1

For each *i* the model is

$$y_{it} = \beta_1 x_{1it} + \cdots + \beta_k x_{kit} + a_i + u_{it}, \quad i = 1,....,N; t = 1,.....,T, k = 1,....,K$$

where the β_k are parameters to estimate and a_i is the unobserved effect.

ASSUMPTION 3.4.2

The dataset is a random sample from the cross section.

The Assumptions 3.4.1 and 3.4.2 clearly hold for all the models, as seen from equations (3.4.1), (3.4.2) and (3.4.3) and from the nature of panel data set.

ASSUMPTION 3.4.3

Each explanatory variable changes over time for at least one *i* and no perfect linear relationships exist among the explanatory variables.

The Assumption 3.4.3 is violated in the case of distance D_i that is a time invariable explanatory variable. Therefore we will proceed with the two-step estimation and we get new equations for the FE method. For the exports model:

$$\ln EXPORT_{it} = a_i + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{Jt} + \beta_3 \ln LINDER_{it} + \beta_4 \ln XRATE_{it} + \beta_5 \ln XVOL_t + \beta_6 TD_{2001} + u_{it} \quad (3.4.5)$$

[76] Wooldridge (2006), Appendix 14.A

For the imports model in entire dataset:

$$\ln IMPORT_{it} = a_i + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{Jt} + \beta_3 \ln LINDER_{it} + \beta_4 \ln XRATE_{it} + \beta_5 \ln XVOL_t + \beta_6 TD_{1998} + u_{it} \quad (3.4.6)$$

And for the imports model in the data sub-set:

$$\ln IMPORT_{it} = a_i + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{Jt} + \beta_3 \ln LINDER_{it} + \beta_4 \ln XRATE_{it} + \beta_5 \ln XVOL_t + u_{it} \quad (3.4.7)$$

In the same time we have an equation for the second step for all the models:

$$a_i = \beta_0 + \beta_6 \ln D_i + \varepsilon_i \quad (3.4.8)$$

where ε_i stands for residual.

To check for the linear relationships between explanatory variables we will examine their correlation matrix for both datasets.

TABLE 3.4.2: The correlation matrix of explanatory variables

	Entire data-set					**Data sub-set**				
GDP	1	0,01	-0,25	0,05	-0,01	1	0,02	-0,26	0,08	-0,02
GDP_J		1	0,67	-0,10	-0,9		1	0,58	-0,17	-0,09
Linder			1	-0,18	-0,04			1	-0,29	-0,02
Xrate				1	0,01				1	0,02
Xvol					1					1
	GDP	GDP_J	Linder	Xrate	Xvol	GDP	GDP_J	Linder	Xrate	Xvol

In the Table 3.4.2 we see that the variables Linder and GDP_J have the highest correlation. It is because of the fact that variable Linder is constructed as the difference of local GDP and Japanese GDP per capita, which is derived from GDP_J. Still there is no way that there would be perfect linear relationship between any pair of the explanatory variables.

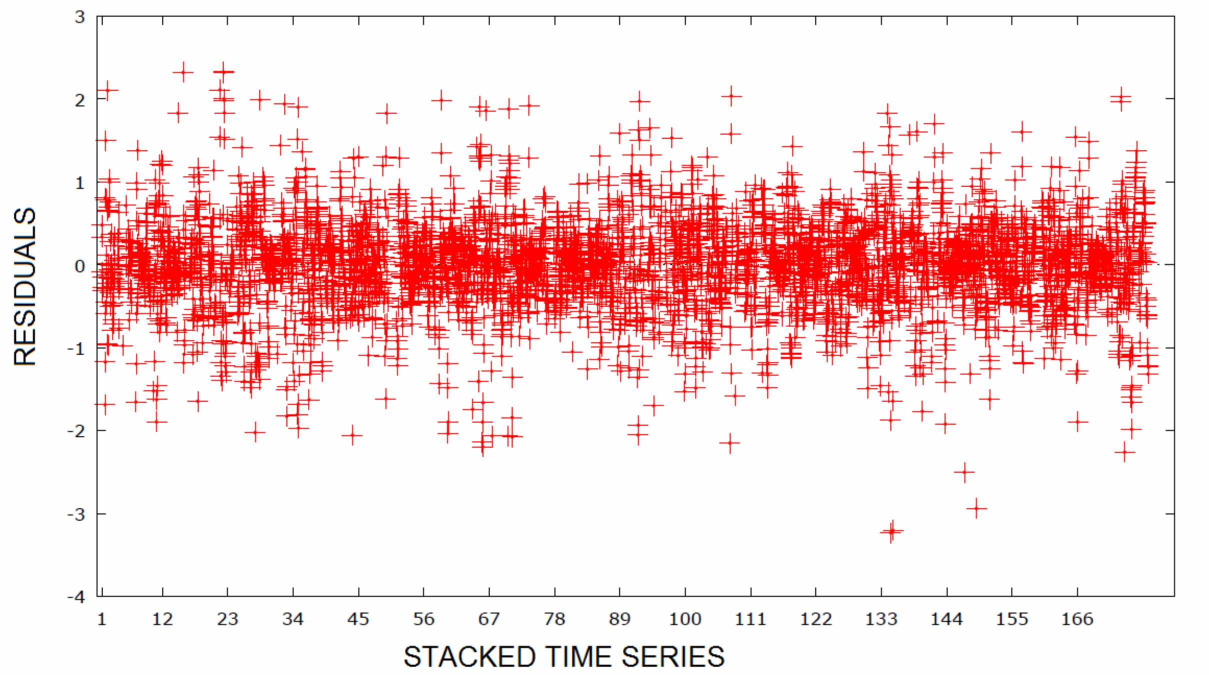
ASSUMPTION 3.4.4

For each t, the expected value of the idiosyncratic error given the explanatory variables in all time periods and the unobserved effect is zero:

$$E(u_{it} \mid X_i, a_i) = 0$$

We can verify the Assumption 3.4.4 by a graphical illustration of residuals by each of the equations (3.4.5), (3.4.6) and (3.4.7). For illustration let us just state one figure for export model of the entire dataset. Figures for other equations may be found in the Appendix B.

FIGURE 3.4.3: Residuals of the regression (3.4.5) for the entire data set



As it is seen from the Figure 3.4.3 the same as from the figures in the Appendix B, the Assumption 3.4.4 could be considered as fulfilled for all our equations.

ASSUMPTION 3.4.5

$$\text{var}(u_{it} \mid X_i, a_i) = \text{var}(u_{it}) = \sigma_u^2 \quad \text{for all} \quad i = 1,...., N; t = 1,....., T$$

In other words, the Assumption 3.4.5 requires so called groupwise homoscedasticity among the cross-sectional units. To test for the groupwise heteroscedasticity we use the Wald test with null hypothesis that $\sigma_i^2 = \sigma_u^2 \quad i = 1,...., N$, i.e., that the idiosyncratic errors are groupwise homoscedastic. Table 3.4.3 summarizes the results for all our equations.

TABLE 3.4.3: P-values of the Wald test for groupwise heteroscedasticity

	Entire data set	Selected sub-group
Exports model	<1,0e-262	<1,0e-262
Imports model	<1,0e-262	<1,0e-262

In all cases the null hypothesis was given to small p-values rejected on any standard level of significance[77]. Therefore the usage of robust standard errors method using HAC robust covariance matrix as described in the Section 3.1.2 is proved to be appropriate. This method does not change the estimates itself. It however alters the results of t-test and consequently the significance of explanatory variables, because it uses such covariance matrix, that the homoscedasticity is reached.

ASSUMPTION 3.4.6

For all $t \neq s$ the idiosyncratic errors are uncorrelated:

$Cov(u_{it}, u_{is} \mid X_i, a_i) = 0$

The Assumption 3.4.6 should be automatically reflected when using the HAC robust covariance matrix as it is heteroscedasticity and autocorrelation consistent.

ASSUMPTION 3.4.7

Conditional on X_i and a_i the u_{it} are independent and identically distributed with normal distribution $\left\langle 0, \sigma_u^2 \right\rangle$.

The Assumption 3.4.7 implies all the Assumptions 3.4.4, 3.4.5 and 3.4.6 but it is stronger as it assumes the idiosyncratic errors to be normally distributed. To bring the u_{it} closer to normal distribution, we have in the first place used logarithmized values of explanatory variables, which is a common transformation method for large data sets. For illustration let us compare

[77] GRETL software only displays limited number of decimal points.

the Q-Q plots for simple and logarithmized data, we can see that we have partly succeeded. Again only the case of export model for the entire dataset is presented.

FIGURE 3.4.4: Q-Q plots of logarithmized and non-transformed data, regression (3.4.5) for the entire data set

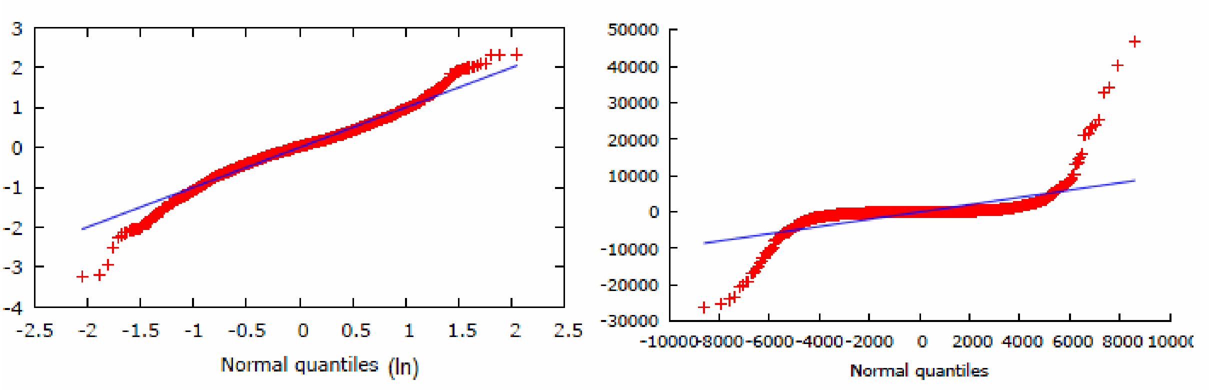


TABLE 3.4.4: P-values of the Doornik-Hansen test of normality of residuals

	Entire data set	Selected sub-group
Exports model	1,12845e-104	6,0414e-111
Imports model	2,49713e-262	<1,0 e-262

Still, if we look at the p-values of Doornik-Hansen normality test, we see that p-values are very small and we are thus forced to reject the null hypothesis about normality of residuals on any common level of significance. This means that the Assumption 3.4.7 is violated. However without the Assumption 3.4.7 it is still possible to rely on asymptotic approximations. These require without any other limitations large N and small T, which can be applicable on our models.

3.5 Results

As it was shown in the previous section the Equation (3.4.5) for both datasets and the Equations (3.4.6) and (3.4.7) fulfill the assumptions of the FEM necessary to estimate best linear and unbiased estimator, when using the HAC robust covariance matrix. The results of the regressions are depicted in the following tables.

TABLE 3.5.1: Estimates for the fixed effect regressions

	Entire dataset		**Data sub-set**	
Dependent var.	*Exports (3.4.5)*	*Imports (3.4.6)*	*Exports (3.4.5)*	*Imports (3.4.7)*
Explanatory var.				
GDP	0,739***	0,707***	0,894***	0,748***
	(0,058)	(0,117)	(0,073)	(0,127)
GDP_J	0,115	0,217	0,005	0,426***
	(0,078)	(0,150)	(0,087)	(0,152)
Linder	-0,034	-0,078*	-0,015	-0,088*
	(0,028)	(0,046)	(0,027)	(0,047)
Xrate	0,056	-0,040	0,052	-0,084
	(0,055)	(0,106)	(0,060)	(0,104)
Xvol	0,093***	0,096***	0,052**	-0,019
	(0,024)	(0,036)	(0,024)	(0,036)
TD_1998		-0,208***		
		(0,070)		
TD_2001	-0,216***		-0,191***	
	(0,043)		(0,049)	
R-squared	0,954	0,926	0,964	0,947
Adj. R-squared	0,952	0,922	0,963	0,945

Further we will proceed with the second step of the estimation to get the coefficients for the explanatory variable Distance. We will use the OLS regression of the Equation (3.4.8) for each dataset. Again robust covariance matrix estimation is used as the data are heteroscedastic in all the cases. Tests for heteroscedasticity of all the regressions may be found in the Appendix B.

TABLE 3.5.2: Estimates for the second-step OLS regression

	Entire dataset		**Data sub-set**	
Dependent var.	*Individual effects*	*Individual effects*	*Individual effects*	*Individual effects*
	(3.4.5)	*(3.4.6)*	*(3.4.5)*	*(3.4.7)*
Distance	-1,162***	-1,778***	-0,967 ***	-2,062***
	(0,180)	(0,295)	(0,271)	(0,098)
R-squared	0,151	0,126	0,098	0,170
Adj. R-squared	0,151	0,126	0,098	0,169

If we look at the results the first surprising fact is the low number of significant explanatory variables. It is interesting to mention that it is the usage of HAC covariance matrix that decreased the significance distinctively. For comparison the p-values for results with and without robust standard errors are listed in the Appendix C. Especially surprising is that the real exchange rate is not significant in either of cases. On the other hand significant explanatory variables are GDP, distance, Linder variable by the imports model, clearly also time dummies (as they were selected based on significance) and in most of the cases the volatility of the exchange rate between USD and JPY. Interestingly significant on 1% level of significance is also GDP of Japan in the imports model for data sub-set, which is not significant in any of other models. Generally it is this model that differs quite substantially from the rest.

The values of the estimated coefficients reflect however the expectations quite well. GDP and GDP_J have positive signs as they are likely to promote the trade. On the other hand distance reflecting transport costs and time dummies considering the negative external shocks influence the trade volumes negatively, according to the estimates. Also the signs of exchange rate coefficients correspond to the logic explained in the Section 3.2. Most importantly for the purpose of this study, the negative signs of the Linder variable in all the cases support the Linder Hypothesis. However any visible difference between the two data sets is not perceptible, which puts the Hubauer's proposition in question. Still we cannot forget that only the coefficients in imports model ale here significant.

Concerning the R-squared listed in the Table 3.5.1 it is clear that they are unusually high. However as Wooldridge [78] points out the R-squared from the dummy variable regression[79] is usually rather high, because we are including a dummy variable for each cross-sectional unit, which explains much of the variation in data. We should therefore not get too excited about this large R-squared, because it is not surprising that we can explain much of the variation using cross-sectional dummies and some of the time dummies. On the other hand in the Table 3.5.2, we are not concerned too much about the low values of R-squared, because the quality of the second-step model is not so much of our interest.

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[78] Wooldridge (2006)

[79] It si the same for the demeaned data method as the estimates, standard errors and other major statistics are identical.

4. CONCLUSION

Linder’s Trade Theory for the first time suggested that in some areas of foreign trade, concretely trade in manufactures, it is not only supply but also demand that should be taken into account when explaining bilateral trade flows. Linder hypothesized and supported his thesis by detailed argumentation that income per capita similarity could be perceived as basis for trade because it represents the similarity in demand patterns between countries. Moreover he pointed out a whole number of topics that have been occupying economists until today and that belong nowadays to mainstream of the theory of international trade. Aside from the demand-side view it was for example the notion of intraregional trade, the importance of horizontal (qualitative) product differentiation or the concept of monopolistic competition in the international trade theory. Still, for his Trade Hypothesis there is no widely recognized formalization and the empirical tests did not record any uniform conclusion. Generally speaking Linder Hypothesis is considered as possible explanation for at least some part of foreign trade, but because of lack of formalization it served more like a “take-off platform” for other demand based theories than as an adequate alternative to Heckscher-Ohlin theory.

In this work, we have tested the Linder Hypothesis on a panel dataset for Japan and its 178 potential trade partners in the period 1980-2007. As it has already been mentioned in the Section 1.1, there are several reasons, why we could believe that Japan is a good example to test the Linder Hypothesis. Firstly it is a country with foreign trade representing about 5% of the world total trade flows. Secondly it is in some way relatively isolated from any tight political, historical and cultural ties by its insular character. This is important, because all these factors are very difficult to include into trade model but they still influence the foreign trade in significant way. Furthermore in the Section 3.4 we have shown that the commodity structure of Japanese exports and imports differs distinctively, because even though Japan is a country of industrial character, it is very scarce on nature resources that it must import in high amounts. This enabled us to test for Linder Hypothesis on trade flow (dependent variable) almost uniquely composed from manufactures (Japanese exports) and with higher amount of primary products (Japanese imports). Furthermore it was also the very nature of panel data that seemed useful for our purpose, as mentioned in the Section 3.1. To account for trade-distorting factor of distance (transport cost) we have also included distance measure among our explanatory variables. We have thus arrived to gravity type panel data equation with income per capita differential as on of the explanatory variables.

For the testing itself we have selected, using an appropriate test, the fixed effect method, which is usually considered as more suitable for panel data with countries as cross-sectional units. Furthermore to account for serial correlation and heteroscedasticity, which are also common when having macroeconomic indicators as explanatory variables, we have used the HAC robust covariance matrix. To account for time invariable distance, which is not compatible with fixed effect estimation, we proceeded with second-step OLS estimation of the respective coefficient.

Our results are however not explicit. Even though the sign of the coefficient of Linder variable is negative having imports as well as exports as dependent variable, significant (on the 10% level) is only by imports. This is in fact in contradiction with Linder's argumentation, as Japanese imports consist from primary products in higher share than exports. If Linder's argumentation was to be supported by our results, the significance should have been higher by exports that consists mainly from manufactures. The signs by other explanatory variables are also in accordance with economic intuition, but it is again the significance that poses problems. Even by such explanatory variable as real exchange rate, it was not sufficient enough to reject the null hypothesis. On the other hand GDP of the partner country and distance proved significant on 1% level of significance. The results for data subgroup that we have selected to test the proposition that Linder Hypothesis is to be valid more likely for countries above certain level of average income are not any more convincing, which puts the Hufbauer's proposition into question.

The problems with significance may be given by the employment of HAC robust covariance matrix that heightened the p-values for all the variables. Still, the author is convinced that it was justified as the groupwise homoscedasticity was rejected. Another possible explanation of the fact that results are more favorable for the imports models is connected with the territorial structure of Japanese imports. In the Section 3.4 we have shown that imports from countries of Middle East play an important role. And they are the same countries that import the majority of natural resources, concretely oil, to Japan. However as the countries of Middle East are traditionally rich on oil, they are also relatively rich and he level of their GDP per capita draws near to those of Japan, which is also very high. The commodity structure of foreign trade which should work against Linder Hypothesis in the case of imports could be thus balanced by the special territorial composition of the trade.

Generally the results of our test give very weak credit to Linder Trade Hypothesis, as in both exports and imports models the coefficients have negative sign, but the results are with poor statistical significance. Our results are therefore in accordance with some of the previous studies such as Kennedy and McHugh (1980). We may argue if the properties of panel data modeling are sufficient to ensure that the model with only six explanatory variables is appropriate. However it is more likely that the weakness lies in the nature of modern international trade, where rich countries tend to trade with developing ones, in order to lower the costs. Consequently the Linder Trade Theory must not necessarily reflect the reality. However, it would definitely be worth to carry on with panel data testing and to improve the given model by include some more, possibly dummy, explanatory variables.

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APPENDIX A

List of the countries contained in the entire dataset

Afghanistan, I.S. of
Albania
Algeria
Angola
Antigua and Barbuda
Argentina
Armenia
Australia
Austria
Azerbaijan
Bahamas, The
Bahrain
Bangladesh
Barbados
Belarus
Belgium
Belize
Benin
Bhutan
Bolivia
Bosnia & Herzegovina
Botswana
Brazil
Brunei Darussalam
Bulgaria
Burkina Faso
Burundi
Cambodia
Cameroon
Canada
Cape Verde
Central African Rep.
Colombia
Comoros
Congo, Dem. Rep. of
Congo, Republic of
Costa Rica
Côte d'Ivoire
Croatia
Cyprus
Czech Republic
Denmark
Djibouti
Dominica
Dominican Republic
Ecuador
Egypt
El Salvador
Equatorial Guinea
Eritrea
Estonia
Ethiopia
Fiji
Finland
France
Gabon
Gambia, The
Georgia
Germany
Ghana
Greece
Grenada
Guatemala
Guinea
Guinea-Bissau
Guyana
Haiti
Honduras
Hungary
Chad
Chile
China
Iceland
India
Indonesia
Iran, I.R. of
Iraq
Ireland
Israel
Italy
Jamaica
Jordan
Kazakhstan
Kenya
Kiribati
Korea
Kuwait
Kyrgyz Republic
Lao People's Dem.Rep
Latvia
Lebanon
Lesotho
Liberia
Libya
Lithuania
Luxembourg
Macedonia, FYR
Madagascar
Malawi
Malaysia
Maldives
Mali
Malta
Mauritania
Mauritius
Mexico
Moldova
Mongolia
Montenegro, Rep. of
Morocco
Mozambique
Namibia
Nepal
Netherlands
New Zealand
Nicaragua
Niger
Nigeria
Norway
Oman
Pakistan
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Poland
Portugal
Qatar
Romania
Russia
Rwanda
Samoa
São Tomé & Príncipe
Saudi Arabia
Senegal
Serbia & Montenegro
Seychelles
Sierra Leone
Singapore
Slovak Republic
Slovenia
Solomon Islands
South Africa
Spain
Sri Lanka
St. Kitts and Nevis
St. Lucia
St. Vincent & Gren.
Sudan
Suriname
Swaziland
Sweden
Switzerland
Syrian Arab Republic
Tajikistan
Tanzania
Thailand
Timor-Leste
Togo
Tonga
Trinidad and Tobago
Tunisia
Turkey
Turkmenistan
Uganda
Ukraine
United Arab Emirates
United Kingdom
United States
Uruguay
Uzbekistan
Vanuatu
Venezuela, Rep. Bol.
Vietnam
Yemen, Republic of
Zambia
Zimbabwe

List of the countries contained in the sub-set

Algeria	Dominican Republic	Libya	Singapore
Antigua and Barbuda	Ecuador	Lithuania	Slovak Republic
Argentina	Estonia	Luxembourg	Slovenia
Australia	Fiji	Macedonia, FYR	South Africa
Austria	Finland	Malaysia	Spain
Bahamas, The	France	Malta	St. Kitts and Nevis
Bahrain	Gabon	Mauritius	St. Lucia
Barbados	Germany	Mexico	St. Vincent & Gren
Belgium	Greece	Namibia	Suriname
Belize	Grenada	Netherlands	Sweden
Bosnia and Herzegovina	Hungary	New Zealand	Switzerland
Botswana	Chile	Norway	Thailand
Brazil	Iceland	Oman	Trinidad and Tobago
Brunei Darussalam	Iran, Islamic Republic of	Panama	Tunisia
Bulgaria	Ireland	Peru	Turkey
Canada	Israel	Poland	United Arab Emirates
Colombia	Italy	Portugal	United Kingdom
Costa Rica	Jamaica	Qatar	United States
Croatia	Jordan	Romania	Uruguay
Cyprus	Korea	Russia	Venezuela
Czech Republic	Kuwait	Saudi Arabia	
Denmark	Latvia	Serbia	
Dominica	Lebanon	Seychelles	

APENDIX B

Graphical illustration of the expected value of the idiosyncratic error

FIGURE B.1: Residuals of the regression (3.4.6) for the entire data set

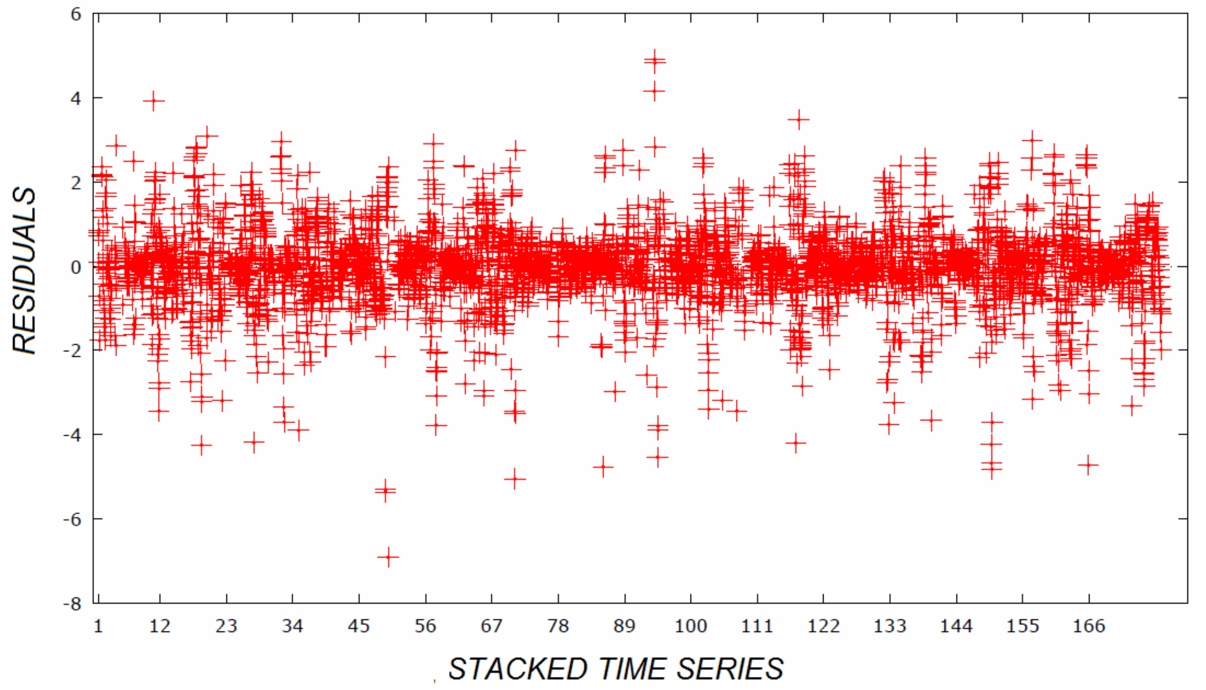


FIGURE B.2: Residuals of the regression (3.4.5) for the data sub-set

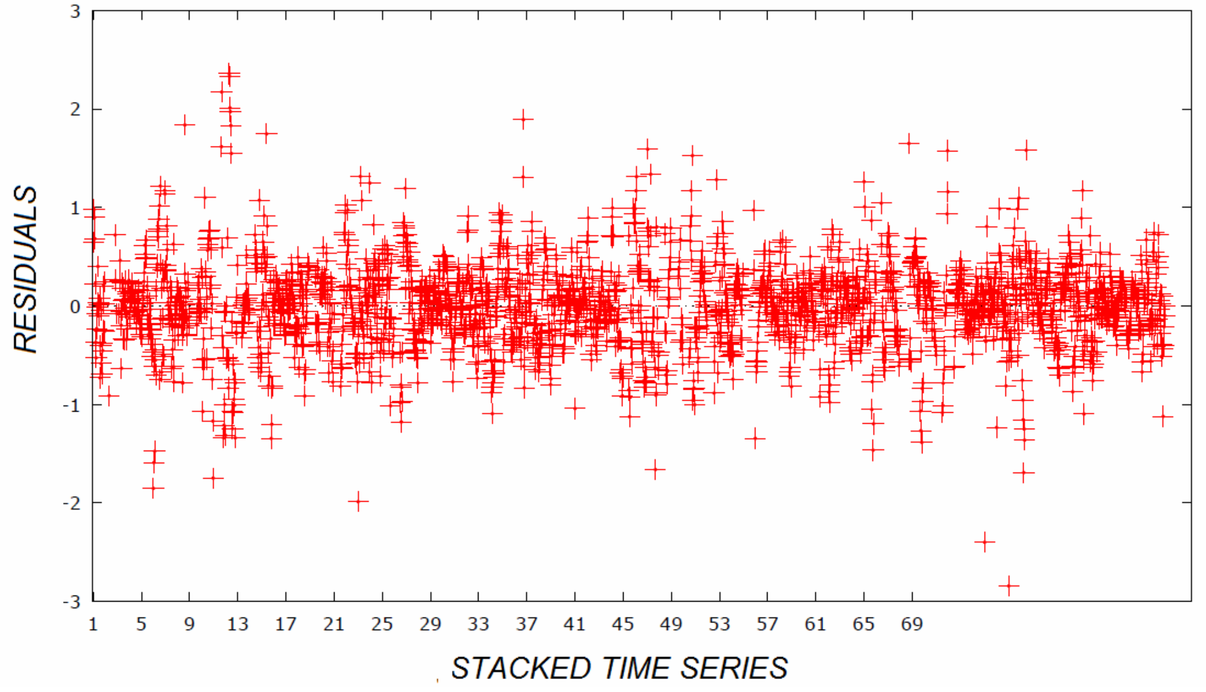
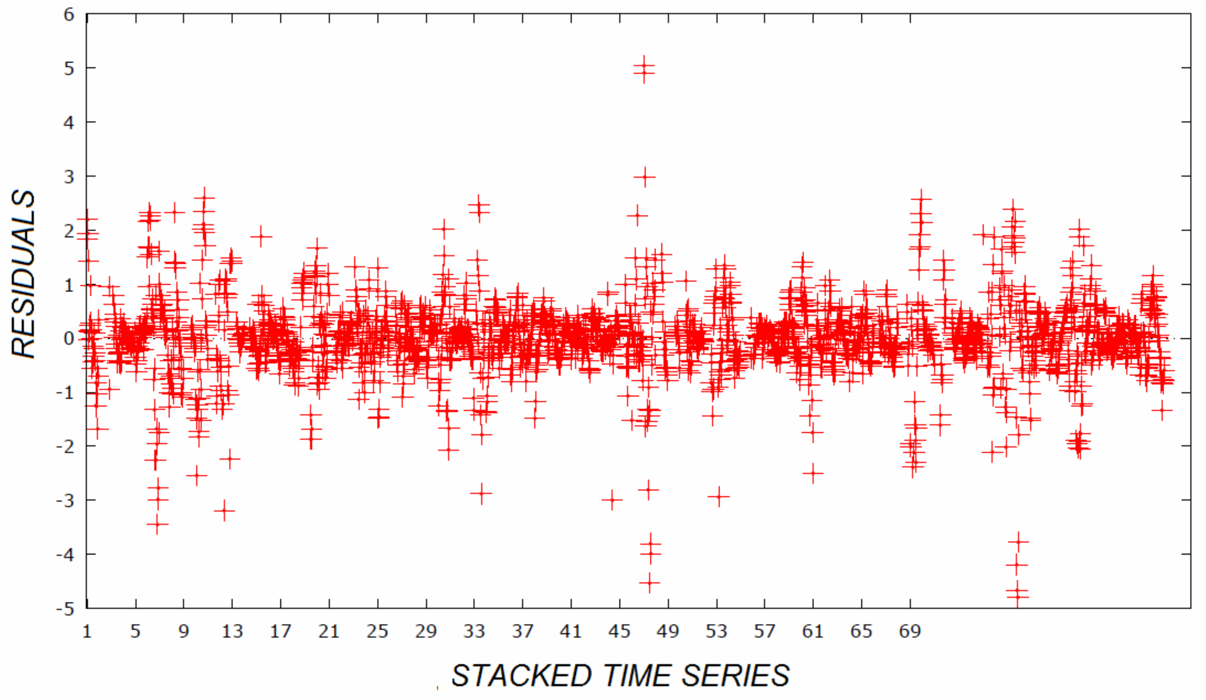


FIGURE B.3: Residuals of the regression (3.4.7) for the data sub set



The effect of logarithmization of the equations

FIGURE B.4: Q-Q plots of logarithmized and non-transformed data, regression (3.4.6) for the entire data set

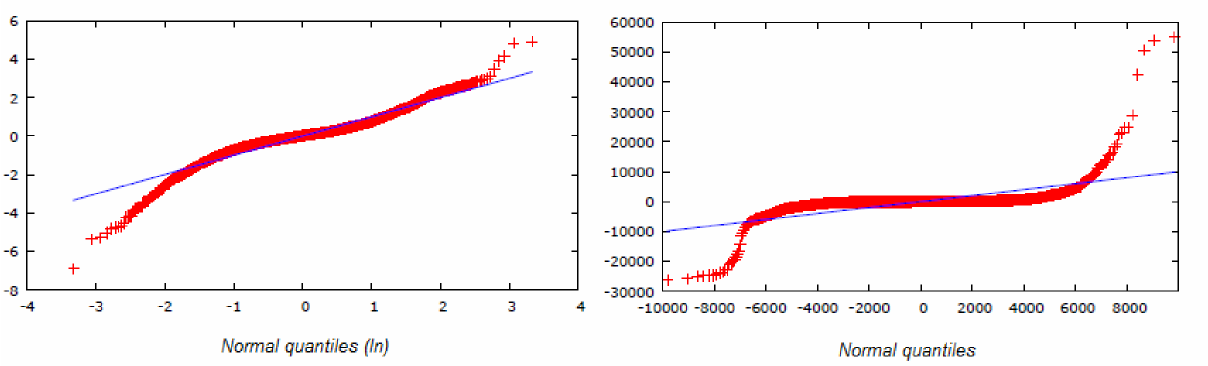


FIGURE B.5: Q-Q plots of logarithmized and non-transformed data, regression (3.4.5) for the data sub-set

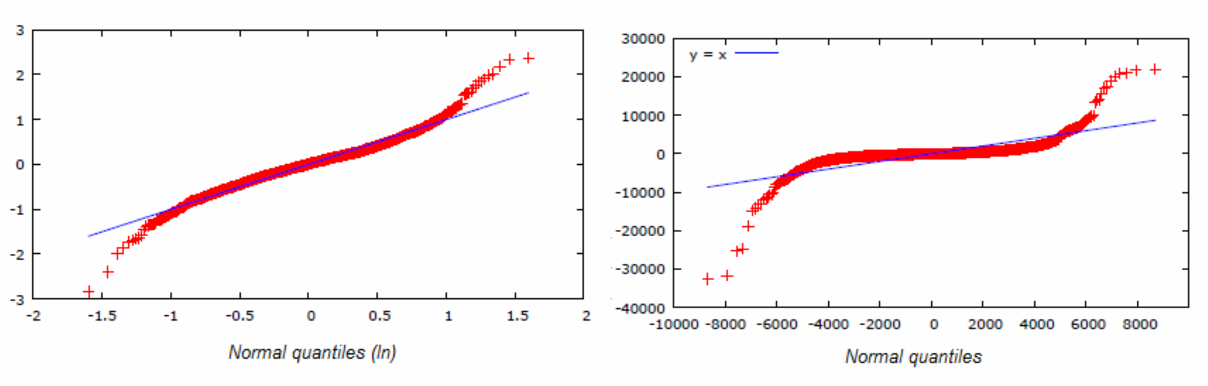
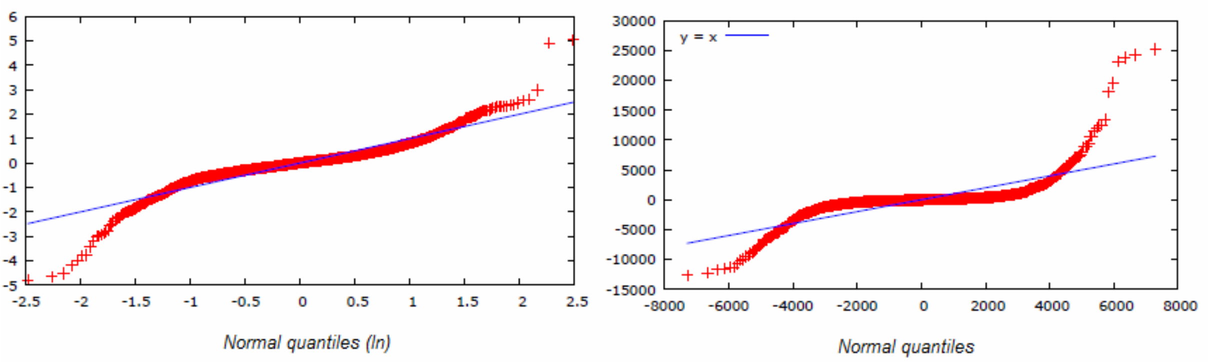


FIGURE B.6: Q-Q plots of logarithmized and non-transformed data, regression (3.4.7) for the data sub-set



Testing for homoscedasticity in the second-step regression

We have cross sectional equations in the form (3.4.8) for each of the equations (3.4.5) for the entire data set as well as the data sub-set, (3.4.6.) and (3.4.7). The following table shows that the use of a covariance matrix with robust standard errors was reasonable, as the White test has homoscedastictity for null hypothesis.

TABLE B.1: P-values of the White test for heteroscedasticity

	Entire data set	Selected sub-group
Exports model	<1,0 e-262	0,000219
Imports model	0,009516	0,000784

APPENDIX C

Influence of HAC robust covariance matrix on the significance of results

TABLE C.1: P-values for results with and without HAC robust covariance matrix

	Entire dataset				**Data sub-set**			
Dependent var.	*Exports (3.4.5)*		*Imports (3.4.6)*		*Exports (3.4.5)*		*Imports (3.4.7)*	
Explanatory var.		HAC		HAC		HAC		HAC
GDP	8,22e-167 ***	3,14e-036 ***	1,56e-059 ***	1,48e-09 ***	7,63e-153 ***	4,15e-034 ***	1,87e-048 ***	5,52e-09 ***
GDP_J	0,0146 **	0,1414	0,0051 ***	0,1485	0,9220	0,9563	2,75e-08 ***	0,0051 ***
Linder	0,1212	0,2257	0,0297 **	0,0920 *	0,4073	0,5818	0,0021 ***	0,0624 *
Xrate	0,0327 **	0,3059	0,3523	0,7043	0,0758 *	0,3869	0,0696 *	0,4242
Xvol	8,50e-06 ***	8,49e-05 ***	0,0061 ***	0,0083 ***	0,0289 **	0,0309 **	0,6057	0,6029
TD_1998			0,0070 ***	0,0030 ***				
TD_2001	2,46e-06 ***	6,31e-07 ***			0,0002 ***	9,21e-05 ***		

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Akademický rok 2009/2010

TEZE BAKALÁŘSKÉ PRÁCE

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Garant studijního programu Vám dle zákona č. 111/1998 Sb. o vysokých školách a Studijního a zkušebního řádu UK v Praze určuje následující bakalářskou práci

Předpokládaný název BP:

Empirical Analysis of the Linder Hypothesis: The case of Japan

Charakteristika tématu, současný stav poznání, případné zvláštní metody zpracování tématu:

“The central proposition of the Linder Hypothesis claims that the pattern of trade in manufactured goods is mainly determined by the demand characteristics of each country. Specifically, Linder argues that the structure of relative prices of industrial goods in each country is determined by the "representative demand" of the country, and that income per capita is the most important single factor influencing the characteristics of the representative demand.”[80]

[80] Mario I. Blejer : *Income Per Capita and the Structure of Industrial Exports: An Empirical Study*, The Review of Economics and Statistics, Vol. 60, No. 4 (Nov., 1978), p. 558

The Linder Hypothesis has been since its publication in 1961 submitted to various econometric analysis, some of them have found some supporting evidence (M.I. Blejer, 1978) and some of them did not (Greytak, McHugh, 1977). The tool of the analysis has evolved from rank correlation analysis to regression analysis, but there is still no consensus about the so called “Linder Effect”. The Linder Hypothesis have been since then extended (W.J. Baumol: The Income and Substitutions Effect in the Linder Theorem) or incorporated into some other theories such as Gravity Model (J.G. Thursby, M.C. Thursby, 1987), New Economic Geography (D.M.Hanink, 1988) or Models of Intra-Industry Trade (J.F.Francois, S.Kaplan, 1996).

Struktura BP:

Abstrakt

The thesis summarizes the economic theories explaining the volume and structure of international trade and gives a detailed description of one of them: The Linder Hypothesis. The Linder Hypothesis will then be tested on the data for Japan.

In the first part the relationship between GDP per capita and volume of trade of Japan with about 90 countries will be examined, taking the overall GDP, exchange rate and time-invariant factors such as distance into consideration.

In the second part the relationship between Japanese GDP per capita and commodity composition of the export in manufactures will be examined. The division of commodities into groups according to their income elasticity will be used to show how the proportion of each changes with the GDP per capita.

Osnova

I. Introduction: Economic Theories in International Trade

II. Theoretical Part: The Linder Hypothesis

i. The original version of the Linder Hypothesis

ii. Further Extensions of the Linder Hypothesis

iii. Empirical tests of the Linder Hypothesis

III. Empirical part: The Empirical Analysis of the Linder Hypothesis in the case of Japan

i. GDP per capita and the volume of trade

ii. GDP per capita and the composition of export in manufactures

IV. Conclusion

Seznam základních pramenů a odborné literatury:

1) Appleyard, D. R.; Field, A. J., Jr; Cobb, S. L.: *International Economics,* (5th edition, 2006)

2) Mario I. Blejer : *Income Per Capita and the Structure of Industrial Exports: An Empirical Study*, The Review of Economics and Statistics, Vol. 60, No. 4 (Nov., 1978), pp. 555-561

3) J.H. Bergstrand: *The Heckscher-Ohlin-Samuelson Model, The Linder Hypothesis and the Determinants of Bilateral Intra-Industry Trade*, The Economic Journal, Vol. 100, No. 403 (Dec., 1990), pp. 1216-1229

4) Francois, J.F. ; Kaplan S : *Aggregate Demand Shifts, Income Distribution, and the Linder Hypothesis*, The Review of Economics and Statistics, Vol. 78, No. 2 (May, 1996), pp. 244-250

5) Thursby, J.G. ; Thursby, M.C.: *Bilateral Trade Flows, the Linder Hypothesis, and Exchange Risk*, The Review of Economics and Statistics, Vol. 69, No. 3 (Aug., 1987), pp. 488-495

Datum zadání:	Leden 2010
Termín odevzdání:	Leden 2011

Podpisy konzultanta a studenta:

V Praze dne