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Gravity Models Enlarged by Institutional Factors

Bakalářská práce

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Abstrakt

Tato práce se zabývá gravitačním modelem zahraničního obchodu, který je rozšířen o institucionální proměnné. Cílem práce je zjistit, jak se chová švýcarský exportér a to z pohledu průřezových i časových panelových dat. K tomuto účelu je probrán dosavadní vývoj švýcarského zahraničního obchodu. Následně jsou v první části práce diskutované institucionální faktory a jejich vliv na mezinárodní obchod a jak jsou ovlivněny liberalizací. Dále práce představuje gravitační model zahraničního obchodu a jeho vývoj. Druhá část práce je zaměřena na odhad gravitačního modelu pro švýcarský export pomocí fixních a náhodných efektů. Je zjištěno, že institucionální faktory ovlivňují švýcarský vývoz, zejména z pohledu statického rozhodování, přičemž se diskriminuje mezi subjekty z různých zemí, což je modelováno specifikací při použití průřezových dat. Z dynamického pohledu v čase se role institucí výrazně snižuje.

Abstract

This thesis focuses on the gravity model of international trade that is enlarged by institutional factors. The aim is to concentrate on behaviour of Swiss exporter, based on cross-sectional and time series panel dataset. Swiss former foreign trade is analysed for this purpose. Afterwards, institutional factors are discussed in the first part of the thesis, how they can influence international trade and how they are affected by liberalisation. Further, the gravity model of international trade and development of the model is introduced. Second part of the thesis concentrates on the estimation of the gravity model for Swiss export by fixed and random effects. It was found out that institutional factors have impact on Swiss exports, especially from the static perspective while the subjects

between countries are discriminated, which is modelled using cross-sectional data specification. The role of institutions substantially decreases in dynamic point of view.

Klíčová slova:

gravitační model; vývoz; dovoz; instituce; Švýcarsko

Keywords:

gravity model; export; import; institutions; Switzerland

Rozsah práce: 82 586

Prohlášení

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Poděkování

Na tomto místě bych ráda poděkovala vedoucímu mé bakalářské práce doc. Ing. Vladimíru Benáčkovi, CSc. za cenné rady, připomínky a hlavně podporu při psaní této práce.

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Předběžná náplň práce

        Cílem této práce je přiblížení výzkumu používající ekonometrickou analýzu panelových dat – gravitační model a jeho aplikace v rozšíření s institucionálními faktory mezinárodních vztahů.

První části se zaměří na studium gravitačních modelů. Popíše jejich konstrukci, historický vývoj, možné specifikace a rozšíření. Zároveň nastíní některé problémy, se kterými se při používání gravitačních modelů můžeme setkat. Dále je nutné rozebrat, jak může být mezinárodní obchod ovlivněn institucionálními faktory a jak je těmito faktory ovlivněna liberalizace obchodu, zejména ve státech Evropské unie (například jaký vliv má na export a import členství v EMU).

V druhé části se provede ekonometrická analýza gravitačního modelu v aplikaci na Německo a jednu malou zemi (do úvahy připadá Česko, Rakousko nebo Švýcarsko). Provede se odhad výsledků obou modelů v několika variantách (např. metodami fixed effects, random effects, GMM a Mundlak) a provede se komparace:

a) odlišností v chování vývozu subjektů na rozdíl od chování dovozu subjektů v jednotlivých zemích;

b) odlišností v chování uvedených subjektů ve velké na rozdíl od malé země;

c) jaké kvantifikovatelné faktory zjištěné odlišnosti mohou způsobovat.

Na závěr je nutné pečlivě okomentovat ekonomické souvislosti plynoucí z odhadnutých modelů.

Předběžná náplň práce v anglickém jazyce

        The aim of this paper is approximation of research using econometrics analysis of panel data - gravity model and its applications enlarge by institutional factors of international cooperation.

In the first part I will focus on study of gravity models. I will describe its construction, historical development, possible specifications and extensions. Further, I will perform some problems connected with using gravity models. Next I will talk about influence of institutional factors on international trade and liberalisation of trade, mainly in European Union (for example what is the influence of accessing EMU for export and import).

In the second part I will construct an econometric analysis of gravity model with application on Germany and one small country (e.g. Czech Republic, Austria or Switzerland). I will estimate results of both models in several variations (for example

using methods of fixed effects, random effects, GMM and Mundlak) and I will compare:

a) differences in subjects export behaviour in contrast to subjects import behaving in individual countries;

b) differences in subjects behaviour in large country in contrast to small country;

c) which quantifiable factors could cause founded differences.

In conclusion I will carefully comment economic connections following from my models.

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INTRODUCTION

Current account is very important for an economy in each country. Which factors have influence on export and import and which can enlarge its values and discover which factors can affect bilateral trade is appropriate for economic policy all over the world. Gravity models are widely used in order to gain an overview which of these factors has been important for the decision-making of exporters. The aim of this thesis is to use gravity model enlarged by institutional variables in application on Switzerland.

Institutional factors play important role in the international trade cooperation. The question how institutions should be liberalised and coordinated is discussed on many international meetings and by many multinational organisations. Decisions that are taken on such meetings have impact on the whole trade system in the world. Attitude of different countries should be known in order to make efficient decision and to propose effective ideas. Therefore institutional factors that are the most important for enlarging trade should be found. This could help mainly developing countries to organise priority points for further development.

Chapter one summarize institutions in the international trade. It explains how close cooperation between countries can be concluded and what levels of economic integration can be present on the world market. Institutional factors are separated to three different groups: formal, informal and cultural and their particular characteristic are made for them. In addition, goods, services or capital liberalisation is studied.

In second chapter the gravity models of international trade are concerned. What gravity equation means and how it has developed throughout the years is sketched. Baldwin and Taglioni (2006) are used to provide theoretic background for the model.

Closer study of Swiss trade is subject of the third chapter. Analysis of trade volumes, export and import articles is performed for partners who are members of the EU27. Member countries of the European Union are chosen because they are the biggest trade partners for Switzerland.

Next chapter presents theory on panel data. Their advantages and disadvantages are discussed. Estimation techniques such are random and fixed effects models are

mentioned, distinction between them is pointed out. Furthermore various specifications of panel dataset are shown.

Finally, fifth chapter is practical one, employed gravity model is introduced here. Its estimation for Switzerland is done by several methods. Received results are compared to results for Germany and for the Czech Republic from master thesis by Hyžíková (2012) to find out possible differences among big and small countries.

Possible subjects for further research are presented in the last chapter.

1) INSTITUTIONS AND INTERNATIONAL TRADE

This chapter focuses on the part of economic science that can be named political economy. The institutions and their instruments are done by politicians and office workers or by specialist in international offices and departments such is International Monetary Fund. One, who is proposing rules that influence future development, should know about the rule's effect on all fields in the economy. Decision about imposing such a rule should be based on detailed analysis, because the impact of such a rule does not have to be just positive.

Institutions traditionally bring some barriers to trade. All instruments such as quotas, tariffs, export's subsidies bring additional cost for trade across countries. Even though they are able to help consumers, producers or government, they also put other participant of exchange into worse position. Import tariff put consumers into loss, on the other hand producers gain and so do government who receive tariff. On the first glance it may look that consumers must just cope with their new position as it increase wealth of others, the true lies somewhere else. Even though producers and government can achieve from import tariff, it reduces welfare in the whole world, because the loss prevail gains. Analysis like this is very common for quotas and subsidies as well. To conclude, these instruments make trade more problematic, not so profitable and not so effective. Why do not to ask following question – Would the international trade run better without them? The answer is probably yes, so this is the reason for countries to make an agreement on common policies and institutions.

To eliminate institutional differences among countries and boost trade, countries sign international contracts or they enter into international communities. Balassa (1931) divided international economic integration into several stages:

- Free Trade Area – in which countries that are part of this area remove their quotas and tariffs for other members
- Custom Union – it expands FTA by agreements on common tariffs and quotas for outside partners
- Common Market – Custom Union is enlarged by free movements of production factors inside cooperating countries and common regulation of factor movements outside common market
- Economic and Monetary Union – Common market with common currency and policies concerning economic areas are harmonised
- Total economic integration – countries share same economic policy, establishment of international government body that control all countries

So the cooperation differs, depending in which stage of economic integration countries are. Of course, countries do not have to integrate into economic associations, they can cooperate only by mutual contracts, directives or regulations.

We find many examples of such cooperation that was mentioned above when seeking in Europe. The European Union is the closest cooperation with the single market and for members of the European Monetary Union also with common currency euro. Today, EU rules and euro has huge impact on all European countries. Consequences that arise from acceptance of euro and membership in Eurozone is studied and analysed by gravity model in work by Hyžíková (2012), who found that acceptance of common currency has significant impact on Germany exports, results differ from negative influence of common currency on exports by 8% using time series data and positive influence on export by 18% using cross sectional data. Nevertheless the influence of euro and membership in EMU is part of research done by many economists.

Switzerland together with Norway, Liechtenstein and Iceland are not members of European Union, but they formed European Free Trade Area, which make trade between those countries and EU cheaper, faster, open new markets and increase investments opportunities (European Commission website). Central European Free

Trade Agreement is the next community in Europe, connecting south-eastern European countries (Macedonia, Alabania, Croatia, Bosnia and Herzegovina, Moldova, Serbia, Montenegro and Kosovo), which focus not only on providing possibilities for trade development, but also orient on protecting free competition on market and property rights (CEFTA website). These rules that arise from participating in CEFTA are preparing member countries to become part of European Union.

These associations support the idea of liberalisation of institution and its positive results on bilateral trade. Effects of being part of economic organisations are visible not only for domestic market, but it influence external trade with the rest of the world too. This impact should not be forget, because part of trade with external countries can be replaced by the countries inside association as the cost are lower for participating nations.

1.1   *Institutional determinants*

Even though the international trade was always connected to barriers to trade, the effect of institutions was somehow neglected. Researchers work mainly with geographic distance, taxes and tariffs however there are many other factors that influence trade and make it more possible to happen. We cannot overlook also other dimensions of distance in trade, the cultural and institutional distance. What precisely is hidden in cultural distance? It can be taken as cultural dissimilarity of countries, namely language, shared colonial history or religion. Institutional distance covers factors like governance effectiveness, property rights and corruption.

Why are these factors important? The cultural and institutional factors can encourage trade. A lot of government intervention in the trade can be a reason why the level of trade is low. It is quite obvious that shared language, history or religion can help businessmen to understand their partner and therefore communication between them can be easier. It can help them to forecast and control next steps of partner behaviour too. The institutional framework gives people rules how they should behave and what and how rules should be done. By North (1990) the institutions are parallel for rules of game in team sport.

Institutions can be divided to the formal one and informal one. Formal institutions cover legal rules, economical rules that were made by representatives of the government and these rules are enforceable (North 1990). On the other hand, each nation has also informal institutions. This means that there exist unwritten package of rules, customs and habits which are expected in the business partner behaviour. Even though these informal rules are not officially known, they have a huge effect on both personal and business cooperation. Belay Seyoum (2011) stated that: "Informal institutions play an important role in coordinating economic activity via mechanism of trust, reputation and business networks (repeated interactions)".

1.1.1. Informal institutions

Trust and reputation are very powerful assets that can firm or even country held. Our expenditures coming from observation of partner's steps and work can be decreased as well as decreasing number of negotiating appointments when we trust our partner. Reputation can tell us how accountable our partner is and what we can expect from common cooperation. We can in advance choose our partner according to his reputation and reliability. Partner with strong reputation has advantage above others in competition. Both trust and reputation can decrease transaction costs. Informal institutions can help cooperation between partners via agreed standards that both partners will keep, for example one structure of accounting or using the same forms.

Seyoum (2011) discovered that informal institutions have even higher impact on business cooperation than formal institutions which is statistically significant and that formal and informal institutions are closely linked together. But trust and reputation can be even more important for developing countries. They act as the hints about partner's quality if country has very low and poor formal institutional framework. Go further with development, informal rules are sources for formal one or they could be supplementing them.

Informal institutions should not be mixed with the cultural one. They can widely vary among similar cultural nations. They are more connected to expectations. Corporate social responsibility, strength of accounting or personal networks is not depending so much on cultural background.

1.1.2. Formal institutions

Formal rules present the minimum level of performance of trade partners. They join both informal and cultural rules by including some of them and being their superior. They enforce a security on the market. One of the main features of institutional factors is to make traders to be more certain about their steps and their assets and capital. For example, property rights are closely related to this. Their clear statement and security reduces costs of trade as well as it attracts new organisation for trade. It is not just their efficiency and quality, but also their level of similarity across countries. Even though some country has not so high quality of institutional framework, it could be favourite partner for trade with country that has similar quality level.

The importance of institutions is concerned in work by de Groot, Linders, Rietveld and Subramanian (2003), they include six institutional indicators to gravity model, following Kaufmann, Kraay and Mastruzzi (2002). Variables were: voice and accountability, political stability, government effectiveness, regulatory quality, rule of law and control of corruption which control government function and its stability. They found the evidence that similar institutional framework in countries encouraged bilateral trade by 13% on average. They also support the idea that increase in quality of institutions lead to more trade between countries. Another point is that the role of institutions is not included only in the bilateral trade but also in the issues of economic growth and economic development of the country.

Heritage foundation (the educational and research institution in USA) announces each year index of economic freedom, which describes strength of formal institutions in the world. Countries with the highest quality of institutions are also developed countries – Hong Kong, Singapore, Australia, New Zealand and Switzerland – all of them are the best countries in consideration of economic freedom (=right of every person to control his own labour and property). The worst economic freedom can be found in developing countries and in countries with problematic regime – North Korea, Zimbabwe, Cuba, Libya and Eritrea.

When focusing on institutions, the diplomacy should be taken into consideration too. One of the goals of diplomatic bureaus is enlargement of exports to particular country that can be seemed attractive. The work of ambassadors is not limited on political issues but covers trade goals as well. These goals are extremely important for

countries in transition, because they develop their foreign trade. Study by Afman and Maurel (2010) showed positive relationship between number of foreign missions and economic trade.

1.1.3. Cultural institutions

The Mohlmann et al. (2010) suggested another access to cultural and institutional differences in international trade. Their contribution is the exchange between trade and foreign direct investments. The FDI should be more feasible if the cultural distance is small and therefore business partners know each other behaviours and manoeuvres, whereas differences lead to export or imports of products, so the trade itself. The study by Mohlmann et al. (2010) show that cultural distance has a negative impact on products traded on organised exchange whereas the institutional distance has a positive impact. The explanation of these results is coincident with the idea above. On the other hand, both distances have no influence on heterogeneous goods.

Shared values, language or religion can affect if the trade between partners happen. Personal and business negotiations can be more effective, because we know how our partner can react and how we should communicate with him.

1.2   Liberalisation of institutions

Liberalisation is discussed everyday as the modern international trade cannot be without it. It can provide higher degree of cooperation between nations and can made trade more effective. In extra points it can also help emerging market to become part of international market as it opens foreign markets for them and facilitate entrance to competition with already experienced suppliers. There are many institutions that are dealing with the question of liberalisation in international trade.

The World Trade Organisation is the main institution dealing with trade liberalisation in the world. It followed the General Agreement on Tariffs and Trade.[1]It exists for almost fifteen years now, officially starting its activities in 1995. Since then

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[1] GATT (General Agreement on Tariffs and Trade) existed from 1946 – 1993.
[2] We can consider the establishment of GATT as the beginning that means that liberalisation of

the WTO unified 153 out of approximately 196 countries in the world. Goods, services and intellectual property are the issues for the WTO. But the reason why GATT changed to the WTO can be that it is not just tariffs as subjects of negotiations, but also labour standards, competition, transparency or investments. So the main area of the WTO is not only liberalisation but it acts also like a supervisor for the international trade. The agreements on trade are discussed and validated on meetings, known as rounds. The newest one is the Doha development agenda that started in 2001 and last until today. One of the main points of Doha development agenda is the lowering tariffs on imported goods. As the result of negotiations, the custom duties on imported industrial goods fall to less than 4% (WTO).

The main policies for trade are following: non-discrimination, openness, transparency, competitiveness, environment protection and benefits for less developed nations (WTO). The non-discrimination is held by system of most favoured nations that ensures that there will be no difference in trade with these countries. Each country from MFN must be treated as any else of the group. This guarantees that none of them will be in worse position for trade. Emerging markets are given small exceptions, for example time for implementing policies into the rule framework is prolonged. The WTO tries to help to these markets so their trade capacities can be enlarged.

1.2.1   Goods

The liberalisation of goods can be viewed as the traditional, because the GATT was mainly developed to help with merchandise liberalisation and openness to the world market. The barriers that affect trade of goods can be simply divided to tariff ones and non-tariffs ones. The later includes quotas, subsidies, voluntary export restrain and licences. Quota limits the quantity of goods imported to country so it secures consumption of domestic products. It can restrict regions, which are able to produce more goods, but cannot sell more products to the foreign market. Subsidies should help domestic producers to higher output and ensure earnings for them. But the home production can be costly in the contrast to foreign one and therefore the domestic production should be decreased and not supported because of inefficiency. Voluntary export restrain is similar to quota, because it restricts quantity of products that can be exported. It tries to protect home producers again, making inhabitants to consume home

made goods. It also prevent from massive imports from cheaper nations. Trade with licences is unique, often based on bilateral agreements between countries or on contracts with producers.

Liberalisation is very important, because by reducing tariff or non-tariff barriers to trade the world welfare can be increased. By burdening trade with barriers we cannot gain extra profit for the whole world society. Non-tariff barriers to trade are mainly designed to help home producers enlarge profits or volume of traded goods. After wider opening to international cooperation, production of goods can be effectively spread among regions and countries which are able to produce specific type of product with lower costs than anywhere else. The most difficult part in goods sector are agricultural products, because agriculture needs quite a lot of supports as the production depends on wide series and especially on very unstable factor – weather. Liberalisation can be painful for domestic suppliers at the beginning and it can be really tough for farmers, but social welfare will be increased after that.

1.2.2   Services

Even though goods liberalisation is discussed and happening for quite a long time,[2] services were forgotten. But policies on services should be also loosed and they cannot follow the same structure as liberalisation in merchandise. "The framework for services negotiations and commitments is different, since there are no tariffs or other similar barriers" (Hagemejer, Michalek J.J., Michalek T. 2010) and because of heterogeneity of service sector. GATS – General Agreement on Trade in Services was founded in 1995. It was an outcome of Uruguay Round. However, the question on services seems to be more complicated than on goods as GATS was not accepted by all WTO members, main submitters coming from developed countries. GATS bring rules to service sectors, trade in services and to international movements of factors. The main rules are dealing with the Most Favoured Nations, market access and national treatment. Various prohibitions in market access restrictions were implicated, like are limitations on employers, number of service suppliers or limitation on value of transactions and

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[2] We can consider the establishment of GATT as the beginning that means that liberalisation of goods has been existing since 1946.

assets (Egger, Lanz 2008). The Doha Round was the next agreement that enlarged liberalisation in services.

Hagemejer, Michalek J.J., Michalek T. (2010) presented simulation of service liberalisation that comes from the Doha Round. They provide estimation based on that the EU imposes service liberalisation and it can or not have to influence further trade between third parties. The most realistic seems to be scenario where service liberalisation in the EU influence foreign nation and therefore they decrease service tariff by 30% (if the EU decrease tariffs in services by 100%). They found out that with the further influence on the world market and following liberalisation, the GDP of all countries increase. In the most realistic scenario Swiss GDP increase by 0,5%, but if changes in service trade are effecting only the EU, Swiss GDP decrease by 0,02%. The disadvantage of Swiss nonparticipation in the EU is visible here. The Czech Republic as the small open economy would benefit very much from the liberalisation, the real GDP increase in both scenarios above 1% level (1,04% in case of liberalisation just within EU, 1,36% with advanced liberalisation in other countries). Removing trade barriers not only in the EU increases welfare in all observed countries. Even though the effect is positive, it does not exceed 1 percentage point change in majority of nations and therefore the effect is quite small. Estimation also shows that it is not just export which increase, but also import. Further development of trade depends also on other factors: "The changes in the volume of trade correspond to the extent of bilateral trade liberalisation – if a pair of countries experienced a similar initial level of trade barriers, similar trade shares in services and similar extent of liberalisation, they will increase both level of exports and the level of imports," (Hagemejer, Michalek J.J., Michalek T. 2010). The sectors with the previously very high barriers such are communications are the ones with the highest imports after liberalisation. To conclude Hagemejer, Michalek and Michalek (2010) showed that with service liberalisation, exports and imports of services grow significantly.

The EU is the main body in the size of service liberalisation as it implied the most rules and disciplines concerning it.

How can trade in services expand? Walsh (2006) found out that using the gravity model, the most important factors are GDP per capita and common language. In contrast to goods, common language has here a bigger impact as the language affects

services more than trade.[3] The language is found to have also higher effect on services than GDP. Distance plays no role in trade of services.

1.2.3   Capital

After elimination of barriers of trade for goods, the liberalisation of capital is the next step as it is believed that free flow of capital guarantee economic growth and better stability. But it is more complicated than previous one. Policies that focus on it are in divergence and opinions on it differ. Stiglitz, Ocampo,Spiegel et al. (2006) offer another look on capital market liberalisation as they declare that it increases instability of economy in the contrary to the previous idea. They argue that capital flows do not increase investment but they are raising consumption. So the further analysis should be done in this field to be able to decide if the capital liberalisation can make country be better off or not.

The main point of capital market liberalisation is its timing. Edwards and van Wijnbergen (1986) studied this issue and presented that in a country with trade distortion and lower degree of goods trade liberalisation, then removing barriers in capital market can lead to decrease of national welfare if it is not accompanied by usage of world prices rather than domestic prices. On the other hand with well working trade system, capital liberalisation increases social welfare. To concern on speed of liberalisation, gradualism should be preferred.

2) The gravity model of international trade

The gravity model of international trade was firstly introduced by J. Tinbergen in 1962. It takes its basis from the Newton gravity equation. It is considered to be one of the most stable relationships in the economics. The original Newton gravity law is explained with following equation – the power of gravity between two subjects is adequate to the product of the masses of the two objects divided by the distance between them in the power of two. The economic model is quite similar to the Newton

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[3] Services are more linked with the movement of people and understanding foreign language is supposed to be one decision making factors. The cultural distance can play important role here too.

one, but the power of gravity is replaced by bilateral trade and weight of objects is replaced by value of country`s GDP:

$$bilateral\ trade_{ij} = \frac{GDP_i^{\alpha} GDP_j^{\beta}}{distance_{ij}^{\gamma}}$$

In more popular logarithmic form:

$$\ln(bilateral\ trade_{ij}) = \alpha lnGDP_i + \beta lnGDP_j - \gamma distance_{ij}$$

The GDP is used here as the indicator of economic size of the country. Distance is included as a measurement of transaction costs. Coefficients α, β and γ are elasticity measurements. Taking the variable distance into the equation can seem to be unimportant in present globalized world, where distances can be surpassed very quickly, but many gravity model estimations showed that distance has significant effect on international trade. Traditionally, the GDP has a positive effect on bilateral trade, because it is expected that with more income people are encouraged to spend more money on goods. The distance reckons to have negative effect on trade, as the distance is growing, the countries tend to trade less with each other. Another view of the model can be following – the bilateral trade can be understand as the gravity between countries so the equation show an expenditure equation with the assumption that market clear. Anderson and van Wincoop (2003) are convinced about the popularity and wide application by saying: "The gravity equation is one of the most empirically successful in economics."

In the beginning, the gravity model of trade suffered from poor theoretical background that made researchers to doubt its plausibility. As a response many researchers demonstrated foundations of the gravity model. With the contribution of the new trade theory in the 1970s and 1980s the situation changed. Anderson (1979) showed that gravity equation can be based on the model of world trade where goods are distinguished by original country of production.

The gravity model then changed from the model without theoretical background to a model with too many of it. Model is now widely used. The main merit of the model is the possibility to enlarge it by specific factors, which enable author to find out if they really have an impact on bilateral trade. Added variables can be ethnic ties, common

language, common borders, exchange rate mechanism or trade and custom union. This work will concern on international trade and institutional factors that can affect trade.

2.1   How did the gravity model develop

The model was introduced fifty years ago, but it was the following revealing that made it attractive for researchers. It was a new explanation of the theory that lies behind the model and specifications of model which make it more attractive. One of them is the model specification by multilateral resistance effect (Anderson and van Wincoop 2003), that should be included for different countries and which specified the difference in prices in each of them. The contribution of specifications of panel gravity equations, for example by adding variables that control for influence of currency union on trade (Rose 2000, Hyžíková 2012) is very popular too.

The gravity model developed a lot. The most changes were done along with theory foundations. The lack of background of the model leaded to omitted variable bias and no possibility of carrying on comparative static. To make model better applicable, the work by Anderson (1979) applied constant elasticity of substitution preferences and goods to bring theoretical foundation. Anderson and van Wincoop (2003) put down micro-foundation of the gravity in international trade. They continue with the CES explanation and try to transform it to give theoretic background more simplicity. They add price indices of both countries to the equation, because they are depended on all bilateral resistance. As the barriers between trade partner countries extend, price index should grow too. It was very practical but unfortunately not able to use on other estimation than on cross-sectional data.

Baldwin and Taglioni (2006) generalized gravity model so it can be used also for other estimations, especially with time series and panel data. Baldwin and Taglioni (2006) derived theoretic background for Gravity models of international trade in six steps:

1) The first step is the equality of supply and demand. Quantity of exported products from country i to country j multiplied by its price must be the same as is what country j spends on flows from country i (E_j is the expenditure of country j on products from i, $share_{ij}$ is the share of expenditure of i in j)

$$p_{ij}x_{ij} = share_{ij}E_j$$

2) Adding CES demand function when expenditure on imported goods is linked to its relative price, assuming that all goods are traded and expenditure share is depending only on relative prices.

$$share_{ij} = \left(\frac{p_{ij}}{P_j}\right)^{1-\sigma} \text{ where } P_j = \sum_{i=1}^{N} n_i\left(p_{ij}\right)^{1/(1-\sigma)}$$

is ideal CES function price index of country j, N is the number of nations, σ is the elasticity of substitution between varieties which are assumed as symmetrical, n_i is the number of varieties imported to j form i,.

3) Price of imported goods must be equal to producer price in nation i and to trade costs:

$$p_{ij} = p_i t_{ij}$$

4) Getting total bilateral trade T_{ij} between two countries by aggregating across individual products:

$$T_{ij} = n_i share_{ij}E_j = n_i(p_i t_{ij})^{1-\sigma}\frac{E_j}{P_j^{1-\sigma}}$$

5) Adding market clearing assumption, total output in country i in traded goods must be equal to total sales of these goods in all markets:

$$Y_i = \sum_{j=1}^{N} T_{ij} = n_i(p_i)^{1-\sigma}\sum_{j=1}^{N}\left(t_{ij}^{1-\sigma}\frac{E_j}{P_j^{1-\sigma}}\right)$$

We can rewrite equation as:

$$n_i(p_i)^{1-\sigma} = \frac{Y_i}{\Omega_i} \text{ where } \Omega_i = \sum_{j=1}^{N}\left(t_{ij}^{1-\sigma}\frac{E_j}{P_j^{1-\sigma}}\right) \text{ represent the market}$$

potential

6) Finally we are able to obtain gravity equation using point 5 and 4:

$$T_{ij} = t_{ij}^{1-\sigma}\frac{Y_i E_j}{\Omega_i P_j^{1-\sigma}}$$

Baldwin and Taglioni (2006) by their computation above provide an explanation that gravity model is nothing else than an expenditure function with the assumption that market is clearing. The popular form of gravity model is obtained by "taking GDP of nation i as a proxy for traded goods production, and nation j's GDP as a proxy for its expenditure on traded goods" (Baldwin and Taglioni 2006). In the easiest model, bilateral trade depend only on distance between two nations, but of course model can be enlarged.

One of the biggest contributions of Baldwin and Taglioni (2006) is the pointing out biases that are common in gravity model estimation. They are called gold, silver and bronze medal mistakes and covers following problems: correlation of omitted variables with trade-cost term, wrongly adjusted exchange rate because of use US aggregate price index and wrongly averaged trade flows between partners. What are the steps by which we can correct mistakes? We can include nation dummies or pair dummies to our estimation.

The traditional gravity model is based on bilateral trade between countries on all levels. This results in huge datasets, where were captured all bilateral trade relationship. Obtaining and computing with so many observations is quite difficult. This is the reason why number of used countries in model is low. Bussière, Fidrmuc and Schnatz (2005) worked with unusually big sample, with 61 countries that create more than 50 000 observations, expressing that so large data sample earn tightly estimated values and covers similarities in countries development. Such a model is good for finding worldwide patterns and worldwide rules in the trade. The model is general for all countries used in estimation.

New approach that will be also used in this thesis, is the concentration on specific countries. Decision making must differ across nations as they vary so much in cultural, political or even economic issues. Some countries can react totally differently on various factors. Not all bilateral trade flows will be recorded now, but we focus just on one country and all its export or import partners, but not on further relationship between partners. Hyžíková (2012) applied this method in her master thesis to find out specific effect of having common currency euro for Germany and for the Czech Republic. Used countries can be enlarged now, because of lower number of bilateral trade relationship data. Preferably, all trade partners with non zero trade flows (partners

with low values of trade and with zero trade flows in same time periods are expected to have just really minor impact on country decision making) should take part in model. This gives an image about specific country thinking, what parameters are considered to be significant for trade and which are not. We are able to decide what trade partners are preferred and which will be chosen by this type of estimation.

3) POSITION OF SWITZERLAND IN THE INTERNATIONAL TRADE

Switzerland or in full name in Latin Confoederatio Helvetica[4] is quite small country in the central Europe. Even though it is situated in Europe and it is surrounded by strong countries from European Union (Germany, France), Switzerland is not a part of the EU. Despite the fact that Switzerland cannot gain from membership in the EU, the economy of this country is very stable and strong. Many investors use Swiss banks as they are known to be one of the best, the Switzerland reached the top in the banking sector, and traditional Swiss export goods are well-known all over the world (clocks, chocolate) as are the brand names of firms (Nestlé, Novartis, Swatch or Credit Suisse).

It is good trade partner with the 41 285 square kilometres, especially for European countries. The main export and import partner is not surprisingly Germany as it is huge economy and "just around a corner" for Switzerland. Switzerland has its own currency – Swiss franc that is known to be stable. It was also used by Hungarian banks as a currency for saving. This currency is shared with Liechtenstein with which Switzerland concluded custom union. In 2011, Swiss franc faced an appreciation, which could be very problematic for export oriented firms, because, export is expected to fall.

Institutional framework is very strong in Switzerland too. It is the best among European nations concerning an economic freedom index. This index is taken from Heritage Foundation and reaches the 81,1 point that is high among the world average (59,5) and by 15 point above the regional average. The property rights are well defined and secured. The level of corruption is low which indicates that rules are efficient. And

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[4] This title explain the Swiss abbreviation and international identification by CH.

last but not least, Switzerland is wide open to trade with its high values of financial, investment and trade freedom (Heritage foundation). This may explain why Switzerland is so popular for investors and users of banking sector.

3.1 Structure of trade with the EU27

The European Union is the main trade partner for Switzerland, especially for imports. More than three quarters of all Swiss imports come from EU. Other countries in the world represent minor part of trade in contrast to EU 27.

3.1.1. Volume of trade

Trade is important part of Swiss economy. The ratio of export to GDP in 2010 was 54,2%, imports present nearly the same figures –the ratio of imports to GDP was 42,1% (OECD). As was mentioned earlier, European Union is the biggest trading partner for Switzerland. The Eurostat database computed that in 2010 imports from Switzerland to the EU 27 represent almost 78% of total Swiss imports to the world. Other main partners for imports were USA (5%), China (3%), Japan (2%) and Vietnam (1,6%). Exports to the EU 27 are lower, in 2001 it reached 59% of total Swiss exports. On the other hand, other main trade partners had bigger export amount than import. The next big purchaser of Swiss export was USA (10%), China (4%), Japan (3,3%) and Hong Kong (3,2%).

Although Switzerland is not a member of the EU, it is member of the European Free Trade Area, which enables it to closer cooperation with the EU countries, especially Germany and France. Member countries share single market with the European Union within the EFTA. Switzerland was also welcomed to be part of a Schengen area. To conclude, between the EU and Switzerland we have free movement of capital, goods and people and barriers of trade are eliminated.

The volume of bilateral trade between Switzerland and the EU 27 was constantly increasing from 1995 to 2008. The financial crisis in 2009 however hit the bilateral trade between Switzerland and the EU 27. Swiss imports to the EU 27 decrease by 10%,

exports decrease by 8% in 2009. In the following year 2010 can be seen recovery, both export and import are increasing again. The increasing volume of trade is really amazing, between 2000 to 2010 imports from Switzerland to EU27 go up by almost 45%, exports rise by 33% in ten years period.

Chart 1 Volume of Swiss export and import during 1995 -2010.
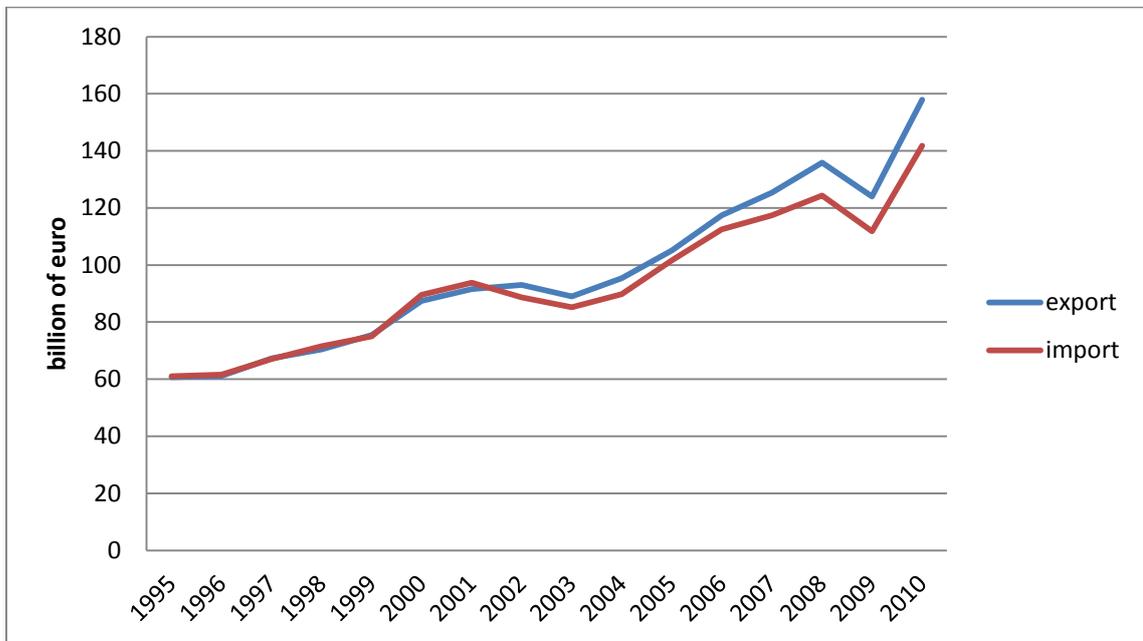
3.1.2.   Products

Concerning on products, Switzerland has three main economically important sectors: chemicals and related products, machinery and transport equipment and miscellaneous manufactured articles. These sectors lead both exports and imports. Manufactured goods classified by material were between the biggest three importing sectors till 2000, but their import decline in the first years after year 2000. Amount of traded manufactured goods classified by material is increasing just very slightly and do not reach the powerful growth as other sectors. The biggest development can be seen in chemical products. Switzerland strengthened very much its position as an exporter of chemicals during last 10 years. Whereas in 2000 Switzerland export "only" 45 billions of euro of chemicals or other related products, in 2010 it extended to 118 billion of euro.

On the other hand, animal and vegetable oil, fats and waxes have the lowest export and import volume.

Focusing on bilateral trade with the EU 27, exports from Switzerland include mainly chemical products, machinery, miscellaneous manufactured articles and manufactured goods. As was mentioned earlier, chemicals play very important role in trade, they present 36% of whole Swiss exports to the EU27. The European Union is depending on Swiss export of chemicals deeply, it represents 20,6% of total EU 27 chemicals import (Eurostat).

Study deeply exported products, we find out that success of chemical sector is specialization in medicaments and in medicinal and pharmaceutical products (10,5 + 7,6 billions of euro are exported in 2010). Especially medicinal and pharmaceutical products increase in their value, during last 10 years, exports of these products increased by 375%. Organo-inorganic compounds are the third biggest amount commodities exported. Exported machinery products fell apart to more specialised sectors. The highest importance for export covers equipments specialized for particular industries and electrical apparatus for switching or protecting electrical circuits.

Chart 2 Export from Switzerland to the EU27 by SITC in 2010
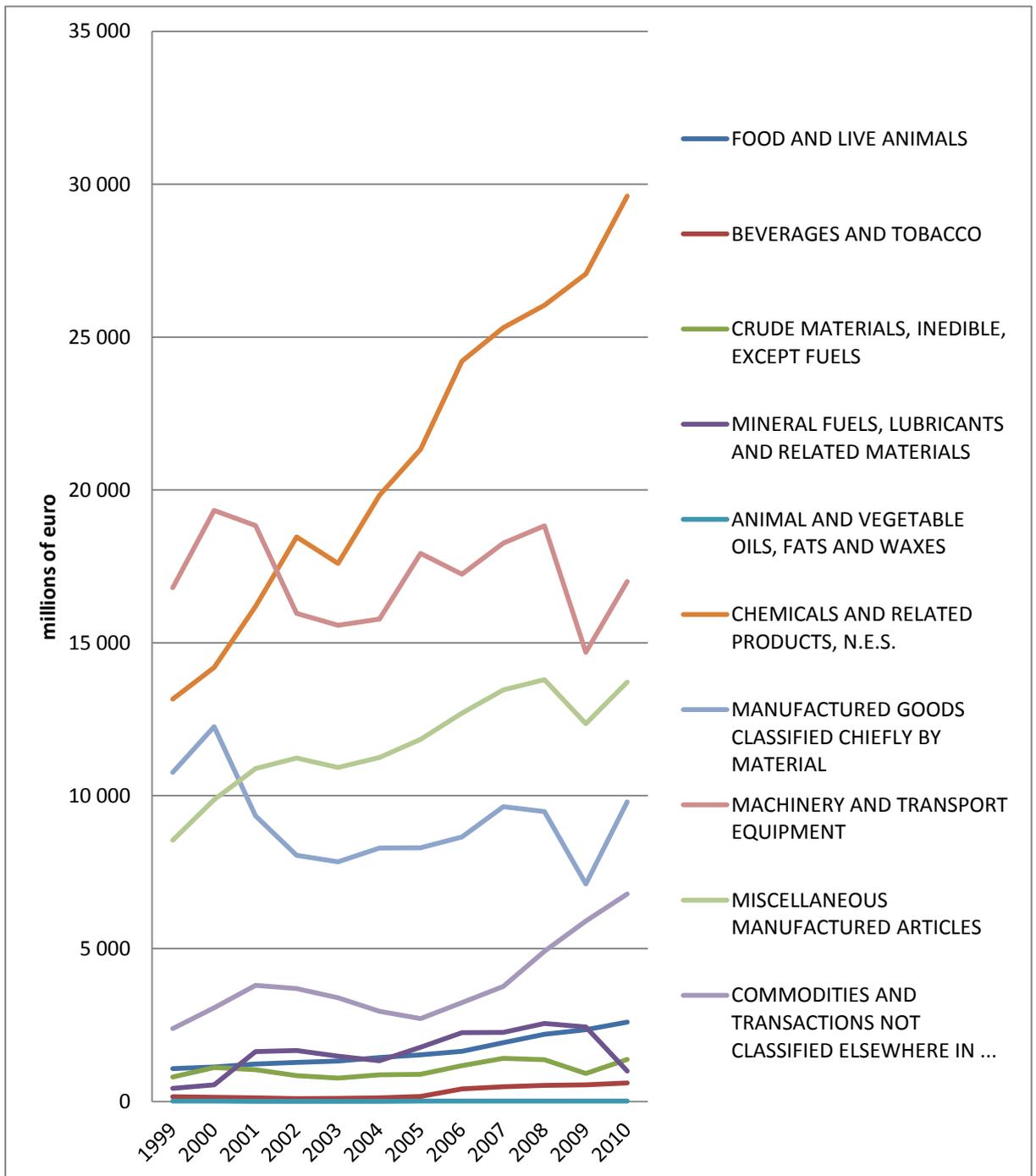
Data source: Eurostat

EU 27 imports to Switzerland can be divided to three groups, based on the amount traded in different sectors. Machinery and transport equipments is definitely leading sector, representing 27% of all imports to Switzerland. Second group is

represented by three high volume trade sectors: chemicals, miscellaneous manufactured articles and manufactured goods. Third group are other sectors that do not reach border of 10 billions of euro per year.

Focusing more deeply on chemicals, Switzerland imports mainly medicaments (both human and veterinary), medicinal and pharmaceutical products and organo-inorganic compounds. These three specialisations cover 62% of all chemicals that were imported to Switzerland in 2010.

Machinery and transport equipment imports are in large volumes, mainly importing personal motor cars and vehicles, telecommunication equipments, aircraft and spacecraft equipment and automatic data processing machines.

Chart 3 Import to Switzerland from the EU27 by SITC in 2010
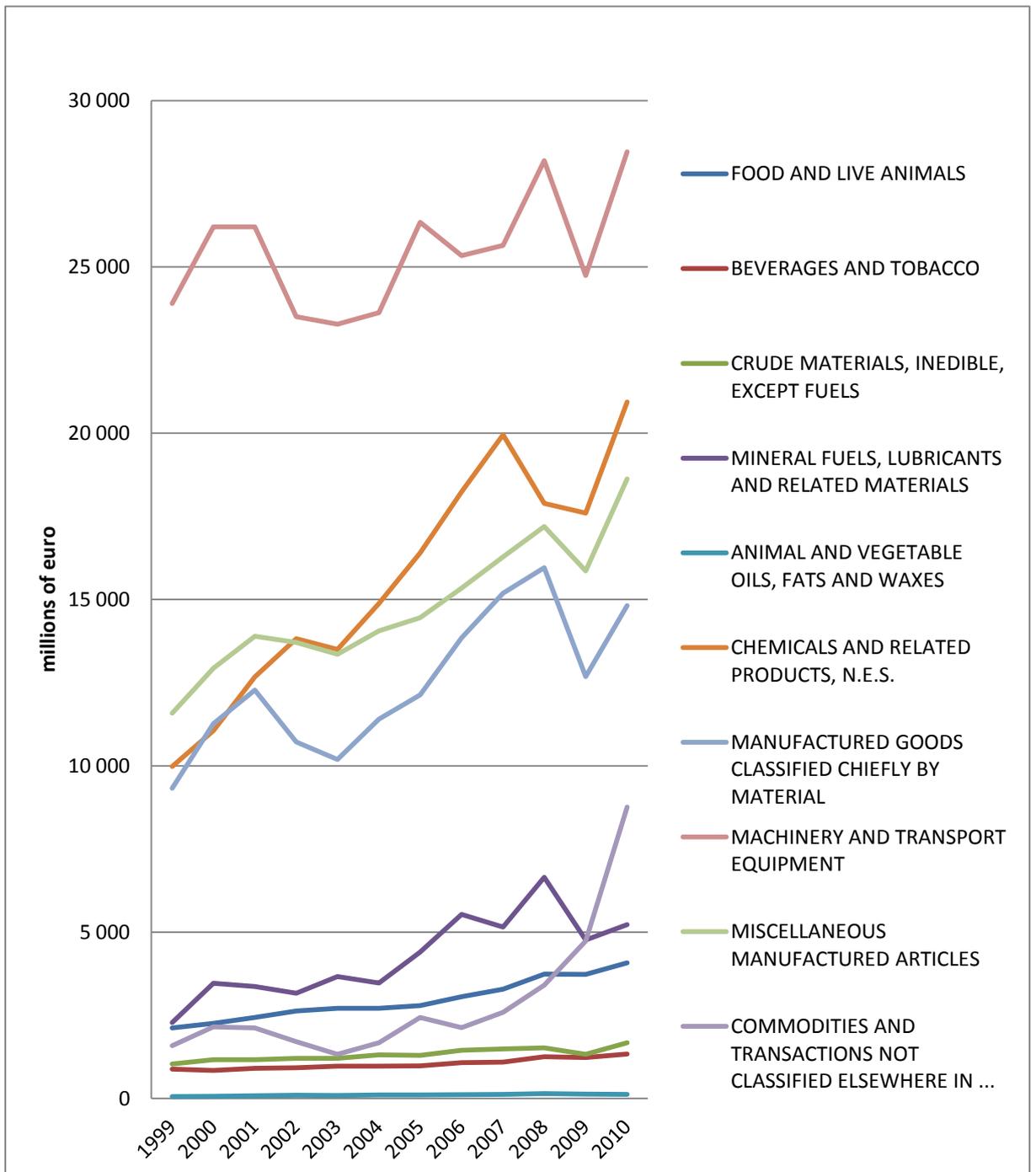
Data source: Eurostat

Making a comparison between Swiss export and imports, we discover that both importing and exporting chemical industry are represented by the same products: medicaments, medical and pharmaceutical product, organo-inorganic compounds. This mean that trade is based on intra-industry exchange. On the other hand, machinery (the second largest exporting and importing industry) is not experiencing such trade.

Closer study of partners for export and import showed that Swiss economy is highly dependent on Germany. Germany shares common border with Switzerland, German language is spoken in Switzerland and EFTA agreement makes bilateral trade between those two countries very preferable among others. Relevant factor also is that German economy is developed, strong and stable, so it is quite reasonable to link Swiss home economy to the German one. The trade with Germany is not balanced, imports greatly overvalued exports. In 2010 Switzerland exported 30,5 billions of euro to Germany and imported 45,2 billions of euro.

Huge trade partners for both export and import are other neighbours of Switzerland, which have strong economy too. These are France with 12 billions of euro exported and 12 bil. of euro imported in 2010 and Italy to which it was 12,4 bil. of euro exported and 14 imported in 2010 from Switzerland. Netherlands and Austria share with Switzerland large amount of imports and exports too, around 6 billion of euro. Switzerland economy strongly benefits from its position in the middle of Europe. To compare, with the other non-European greatest trade partner, USA, export reached value 15,9 bil. of euro on export and 7,7 bil. of euro on imports in the same year. So the importance of Germany for Switzerland is visible. If Germany will be in surplus, Switzerland is probably to be in surplus too, but if Germany economy would sink as would do the Swiss economy.

3.2   Comparison with the Czech Republic

Switzerland has a many in common with the Czech Republic. For example, a close relationship with the Germany offer a comparison of Swiss and Czech economy, as the Czech Republic is either highly dependent on Germany. Further Czech Republic is also small country in the middle of Europe as is Switzerland and it is open to trade. It shares common border with Germany with which has a high volume of bilateral trade too. In contrast to the Switzerland, the Czech Republic is participating in the European Union, however it is not member of the EMU, so the positive effects of being member of the EU can be similar to Swiss membership in the EFTA.

Trade is more important for the Czech Republic as export represent 79,3% of GDP and import 74,5% of GDP, whereas Swiss export as share of GDP is 54,2% and import 42,1% in 2010 (OECD). Volume of traded goods and services are lower for Czech Republic, which can be explained by lower value of domestic GDP and therefore not so big potential on international market. But Czech trade seems to be more diversified across more countries. It has more partners with smaller trade volumes than has Switzerland. The Germany is the biggest trade partner, the Czech Republic exported there 32,5 billion of euro and imported 28,2 billions. It makes almost 40% of total Czech trade with the remaining European states. Switzerland is in very similar position, both countries depend on Germany tightly and both countries shared common border, in case of Switzerland sharing common German language can also be an advantage.

Other main trade partners are not surprisingly countries that share common border with the Czech Republic and in advance they have common cultural Slavonic aspects: Slovakia and Poland. Switzerland trade mainly with its neighbours too, but surprisingly even though nation that shares common border with Switzerland has higher GDP, larger area, more inhabitants (France, Italy) than Czech one (Slovakia, Poland), volume of trade is not so bigger. Slovakia and Poland are almost as important as is Italy and France for Switzerland. In 2010, Czech export to Slovakia and Poland is about 17% of all export, Swiss export to Italy and France is about 29%, Czech Republic imports from Slovakia and Poland 18% whereas Switzerland import to France and Italy almost 26% of all imports. France, United Kingdom or Italy are favourite countries for Czech export too, volume of exported euro is higher than 4 billion. Latter state loses a bit in Czech imports, where Netherlands cross the border of 5 billions of euro. What is quite surprising is that Austria is not included in major export partners for the Czech Republic, while for Switzerland it is. The reason is that it is the sixth major export partner for Czech Republic, volume of export is 5,6% out of total Czech exports in 2010. Interestingly the Czech Republic and Switzerland both import to Netherlands in quite high volume (8,1% and 6,3% of all import in 2010), but none of them share common border with this country. In contrast to Switzerland, the Czech Republic has higher amount of export to Europe than import.

Same like for Switzerland, Czech Republic reaches highest amounts of imports in machinery, it represents 40% of all imported products with the volume of 29,4

billions of euro. Machinery is traditional industry sector in the Czech Republic with famous brand names like Skoda auto or Zetor. Chemicals (14 bill. of euro), even though if they are not so typical for Czech country as for Switzerland, manufactured goods (9 bill. of euro) are following the leading sector. Lowest import volumes are in animal fat and wax and in other commodities.

Machinery is also the main exported article, trade volume in 2010 was 45,4 billions of euro. Manufactured goods (14,4 bill. of euro) and miscellaneous manufactured articles (9,4 bill. of euro) are next high export commodities. The lowest volumes are again registered in animal fat and wax and in other commodities that were not specified before.

So the Czech economy is more specified in machinery, which put it in even closer cooperation with the Germany, which is world–known car maker and supplier, machinery leader in Europe. The previous study predicts that bilateral trade of the Czech Republic with Europe is concentrated on intra-industry trade, especially in machinery and transport equipment. Manufactured products are traded in large volumes in intra-industry trade too, but their import overvalued export.

Table 1 Comparison of the Czech and Switzerland trade in 2010, trade volumes are in percentage of EU total

	Switzerland		Czech Republic	
main trade partners for export	1. Germany	36,2%	1. Germany	38,1%
	2. Italy	14,7%	2. Slovakia	10,1%
	3. France	14,5%	3. Poland	7,2%
	4. Spain	6,0%	4. France	6,3%
	5. Austria	5,9%	5. United Kingdom	5,8%
main trade area for export	Chemicals		Machinery	
	Machinery		Chemicals	
	Miscell. Manuf. Articles		Manuf. Products	

	Switzerland		Czech Republic	
main trade partners for <u>import</u>	1. Germany	43,9%	1. Germany	39,6%
	2. Italy	13,9%	2. Poland	9,3%
	3. France	11,8%	3. Slovakia	8,6%
	4. Netherlands	6,3%	4. Netherlands	8,1%
	5. Austria	5,9%	5. Austria	6,5%
main trade area for <u>import</u>	Machinery		Machinery	
	Chemicals		Manuf. Products	
	Miscell. Manuf. Articles		Miscell. Manuf. Articles	

Data source: Eurostat

4) PANEL DATA

Gravity model estimation can be closely linked with panel data sample. Panel or longitudinal data refers to observations on the same individuals, households, firms or countries over given time period. The basic model should look: $y_{it} = \beta_0 + \beta_1 x_{it} + e_{it}$ where *i* stands for cross sectional unit and *t* for time period.

So for each variable we have two features: time and cross section dimension. In this paper we will follow the same group of countries that trade with the Switzerland over time period beginning in 1995 and ending in 2010. Estimating with the same group of countries we can avoid biases caused by country differentials.

Panel data are reasonable to use, because we can find a lot of benefits. Hsiao (2003) mention them: individual heterogeneity controlling, more informative data, more variable and less collinearity among variables, enabling dynamics of adjustment, better identification and measurement of hidden effects in time series or in pure cross section. So panel data allow us to check whether there exists some modification across countries or across time or not. It also enables us to derive how the trade developed during time period and if this change was caused because of turnover in the economy or not. Cross section data are not capable to estimate changes across time periods. Panel data appears to have a lot of positives, but there are limitations on the other side. Baltagi (2008)

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pointed at panel data dependence on cross-section, selectivity problems or data collection problems. These limitations are more connected with micro panel rather than to panel data for different countries, since we should not have problem with nonresponse of participants, because countries usually show their statistics and attrition is not so frequent phenomenon.

4.1. Panel data models

Estimation of panel data sample is done mainly by fixed effects model, random effects model. The model contains error component e_{it} that is divided to unobservable effect a_i and other disturbance u_{it}.

$$e_{it} = a_i + u_{it}$$

Difference between fixed and random effect models lies in the unobservable error effect.

Fixed effect model assumed that this part of the error term is fixed in time (a_i is constant), whereas random effect model allows it to be random (a_i is uncorrelated with each explanatory variable in all time periods). It is not clear which one is better to use. Fixed effect model however cannot include variables that are constant over time, which make us incapable to use some of the important gravity model variables such is distance between trade partners. Luckily, there is an instrument by which we can measure which of these two models is better – the Hausman test. This test is built on assumption that if an unobservable error effect is correlated with explanatory variable then random effect model is inconsistent and therefore we have to use fixed effect model.

Model can be estimated in two specifications of panel – as cross sectional or as time series. Each of them means distinct approach to economic thinking. The results obtained from each of the model differ very much. For example, depending on model usage, effect of common currency on German export varies from -8% to +18% (Hyžíková 2012).

Cross sectional model is based on the idea that economic decision must be done in particular point in time. Decision is sudden, not following previous steps in trade

activity. Country seeks for the best partner without consideration former cooperation. In this approach, institutional factors can play important role as they represent credibility of possible partner. Common membership with partner in various economic agreements is expected to have its influence on decision making too. In panel data estimation with different trade partners in time sequence, countries are separate to time periods firstly.

Time series model is dynamic one. Trade cooperation with partners is based on long-time experience with partners. Further it enables us to observe effects of variables in time and see how they influence trade. Because some variables can have just short-time effect on trade, or they impact can change from positive to negative (or in opposite way), time series model can be useful to find such variables. Before estimation of trade partners in time period, data must be arranged by years, each year containing observation for the group of all countries.

In the case that nor fixed nor random effect models are find efficient, OLS can be applied. However with the OLS estimation we are ignoring heterogeneity of countries and we are not able to distinguish between cross sectional and time series model.

5) GRAVITY MODEL – APPLIED ON SWISS EXPORT

As was mentioned earlier, bilateral trade between two countries can be estimated by gravity model. Swiss exports must therefore depend on GDP values of trading partner and distance between partners. But institutions affect bilateral trade too by imposing usual barriers to trade such are tariffs and quotas or by unusual barriers such are not effectively determined property rights and high level of corruption. Therefore the gravity model of international trade will be enlarged by these factors to find out how big impact they can have on export or import.

Extended gravity model used in estimation for Swiss export with its partners looks like this:

$$\ln(X_{ijt}) = \beta_0 + \beta_1 \ln(Y_{jt}) + \beta_2 \ln(Y_{it}) + \beta_3 \ln(D_{ij}) + \beta_4 \ln(L_{jt}) + \beta_5 T_{ijt} + \beta_6 G_{jt}$$
$$+ \beta_7 GOV_{jt} + \beta_8 MON_{jt} + \beta_9 INV_{jt} + \beta_{10} PRO_{jt} + \beta_{11} COR_{jt} + \beta_{12} EDU_{jt}$$
$$+ e_{it}$$

where are used following variables:

X_{ijt} - Swiss export to country j. Obtained from the Eurostat database.

Y_{jt} - GDP based on Purchasing Power Parity of country j. Obtained from the IMF. Partner's GDP should have positive effect on bilateral trade.

Y_{it} - GDP based on Purchasing Power Standard of Switzerland. It is obtained from the Eurostat. Just as partner GDP, Swiss GDP should have positive impact on trade between partners.

D_{ij} - Distance between Switzerland and country j. Distance is obtained from the CEPII database. The effect of distance between countries is expected to be negative as it is following theory of the gravity model.

L_{jt} - Population in country j. Population is taken from the IMF.

T_{ijt} – Trade barriers between Switzerland and partner country j. This is a dummy variable of values 0 or 1. Countries which are members of the European Union, European Economic Area or have entered into Agreement on Customs Union, Association Agreement or Free Trade Area Agreement are evaluated by 0, other countries that are not taking parts in these agreements marked with 1.

G_{jt} – Government effectiveness in country j. Data are obtained from the WTO and are in percentiles. The higher the value is the better is the country's governance ratings. Effectiveness is measured as the quality of both public and civil government's services and its freedom from political pressures as well as quality and loyalty of policies (Kaufmann, Kraay, Mastruzzi 2010).

GOV_{jt} - Government spending in country j. It is obtained from the Heritage Foundation and is expressed as an index with values from 100 to 0. Government spending is measured as a level of government expenditures as a percentage of GDP. The value is computed from scheme that allows countries with no expenditures or very low

expenditure to receive high marks, but countries which exceed percentage of expenditure on GDP by more than 58% are getting the worst rating – zero (Heritage Foundation).

MON_{jt} – Monetary freedom in country j. It is taken from the Heritage foundation. Index of 0 to 100 shows activities of monetary policy, especially how prices are controlled and level of inflation in the country. Nations with high level of inflation receive lower index, price controlling mechanism is a penalty that decrease index.

INV_{jt} - Investment freedom in country j. Values are in index (0-100) and are taken from Heritage Foundation website. Total fiscal freedom, where there are not imposing any kind of restriction of investment activities is evaluated by the highest rank, 100. Most countries nevertheless levy some restrictions for example capital and foreign exchange controls, restrictions for foreign investment, sectoral investment restriction or restriction of land ownership (Heritage Foundation).

PRO_{jt} – Property rights in country j. Data source is the Heritage Foundation and is expressed as an index of values from 100 to 0. Defining property rights is one of the most important steps for economic development and for attracting trade partners. Clearly defined property rights with government guarantee that can be enforced are ranked as 100. Zero rank is given to countries, in which all property is state-owned and people cannot use justice.

COR_{jt} – Freedom from corruption in country j. Obtained from the Heritage Foundation. Index for corruption is based on Transparency International's Corruption Perception Index, countries with very low level of corruption receive the highest value of the index, 100, whereas nation totally corrupted is given 0.

EDU_{jt} - Education level index in country j. Education is taken from the Human Development Index, United Nation Development Programme website. Values can vary from 0 to 100, 100 representing the highest possible level of education in country.

The variables were obtained for 176 trade partner countries, to which Switzerland export its goods, in the time period 1995 – 2010, which create panel dataset.

Estimation of the gravity model will be done in several methods. As was mentioned earlier, results should vary depending on which method will be used (cross sectional or time series panel, fixed or random effects estimation, OLS).

5.1 Estimation and results – cross sectional specification of panel

In the cross sectional specification, panel is arranged according to 16 years (1995 – 2010), separating data into 16 groups, for each year one group of all 176 trade partners. This methods show us how Switzerland would decide if it has to make decision in given point in time and consider to which country the given product should be exported. The exporter must discriminate between countries in given moment, considering their wealth per capita, distance and institutional barriers. Estimation will be done by fixed and random effects.

Fixed effects estimation (FE) predicts that unobservable effect that is covered in error term is fixed for a group. Because of this, variables that do not vary between trade partners inside each group are eliminated from estimation. GDP of Switzerland is such a variable and therefore is omitted from regression. Random effects estimation (RE) sees unobservable effect as variable but uncorrelated with each explanatory variable in groups. This allows us to estimate coefficient on Swiss GDP and recognize its effect for export. Results from these models are summarized in following table:

Table 2 FE and RE estimation results for cross sectional specification

	FE $\ln(Xijt)$	RE $\ln(Xijt)$
$\ln(Yjt)$	0.401^{***}	0.404^{***}
	(7.33)	(7.41)
$\ln(Yit)$	.	3.891^{*}
	.	(1.97)
$\ln(Dij)$	-4.757^{***}	-4.750^{***}
	(-12.52)	(-12.51)
$\ln(Ljt)$	2.999^{***}	2.997^{***}
	(58.75)	(58.74)

Tijt	-97.55**	-95.58**
	(-2.79)	(-2.74)
Gjt	0.644***	0.649***
	(11.63)	(11.76)
GOVjt	0.579***	0.571***
	(7.57)	(7.48)
MONjt	0.561***	0.507***
	(6.42)	(6.02)
INVjt	-2.150***	-2.069***
	(-4.50)	(-4.34)
PROjt	2.174***	2.204***
	(4.07)	(4.13)
CORjt	1.910***	1.933***
	(8.96)	(9.13)
EDUjt	1.616***	1.605***
	(23.36)	(23.28)
constant	1089.8***	1111.2***
	(-18.11)	(-18.27)

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: own computation

We can see that for both estimation models has been obtained very similar results. All variables are statistically significant, most of them at 0,1% level, except for trade barriers that are significant at 1% level and Swiss GDP which is significant at 5% level.

Partner's GDP positively influence trade as it was expected. With the 1% increase in value of partner's GDP, exports from Switzerland is going to increase by 0,4%. The effect of this variable is quite low in contrast to others.

Domestic GDP is having more important role for Swiss export than GDP of its partner, with increasing its value by 1%, trade will increase by 3,9%. So increasing home output, Switzerland is expected to enlarge export volumes.

Distance has negative impact on trade, following gravity model theory. With the remoteness of country from Switzerland by 1%, export decrease by almost 4,8%. It

support the analysis of Swiss trade partner in chapter 2. The main partners for trade are the closest one, especially countries which share with Switzerland common border.

Population of partner countries affects export to them positively. With increasing number of inhabitants by 1%, country is expected to be able to accept 3% more exports from Switzerland.

Both GDP and population are parameters for measuring size of the country. GDP is the total income of the country, it measures market value of the country, how much is produced there and which level of living standard can be expected there. Population can be representing possible production factors. More people definitely mean more work (even though some level of unemployment can occur). More people also mean increase in demand for goods. Wealthier inhabitants are more expressed in GDP values, whereas rising number of inhabitants is recorded in population. Results are showing that rising human population supports international trade more than change in their welfare. 1% increase of population in partner country raises export 7,5 times more than does the same change of partner's GDP.

Following variable - trade barrier - is not in logarithmic form, so relationship with exports must be computed by using following formula:

$\%\Delta X_{ij} = 100\big(exp(\hat{\beta}) - 1\big)$. Countries with higher trade barriers (resulting from their nonparticipation in international agreements) have far much lower volume of bilateral trade with Switzerland.

All institutional variables are in indexes in range 0-100. That is why their relationship with logarithmic figure of export is elasticity. They influence strongly trade between countries. Development and improvement in almost all institutional variables has positive effect on export, especially higher value of property rights increase exports from Switzerland very much. Investment freedom is the only institutional variable that has negative impact on export. The reason for this can be explained by substitution of trade by Foreign Direct Investment. If foreigners are encouraged to invest directly to the country, are handled in the same way as inhabitants of the country and their investment is safe, then export of some products to country can be exchanged by foundation of foreign companies inside exporting region.

To find out which of the models is efficient, the Hausman test will be performed. Null hypothesis present consistency of both models, but random effects is more efficient. Alternative hypothesis is consistency of fixed effects, but not random effects (unobservable error term is correlated with exogenous variables under alternative). Chi square statistic reach to the value 8,74 with p value 0,646. This is evidence for not rejecting null hypothesis. Random effects model is labelled as the efficient one.

To be sure that both panel data models are preferred to ordinary least squares, Breusch-Pagan tests are used. For fixed effects model, F statistics reaches 0,75 with p value 0,740. So the null hypothesis that fixed effects are preferable model is rejected in favour of OLS. Results for random effects are similar, statistics obtained is 0,86 and p value is 0,353.To conclude, OLS should be the best model for estimating cross sectional model of gravity.

The model is therefore estimated once more, this time using OLS method. Comparison of all models offers the following table.

Table 3 FE,RE and <u>OLS</u> estimation results for cross sectional specification

	FE	RE	<u>OLS</u>
	ln(Xijt)	ln(Xijt)	ln(Xijt)
ln(Yjt)	0.401***	0.404***	0.367***
	(7.33)	(7.41)	(6.92)
ln(Yit)	.	3.891*	3.567
	.	(1.97)	(1.87)
ln(Dij)	-4.757***	-4.750***	-5.549***
	(-12.52)	(-12.51)	(-14.31)
ln(Ljt)	2.999***	2.997***	3.021***
	(58.75)	(58.74)	(58.16)
Tijt	-97.55**	-95.58**	-50.14
	(-2.79)	(-2.74)	(-1.45)
Gjt	0.644***	0.649***	0.575***
	(11.63)	(11.76)	(10.48)
GOVjt	0.579***	0.571***	0.725***
	(7.57)	(7.48)	(9.59)
MONjt	0.561***	0.507***	0.603***
	(6.42)	(6.02)	(7.22)

INVjt	-2.150[***]	-2.069[***]	-2.047[***]
	(-4.50)	(-4.34)	(-4.41)
PROjt	2.174[***]	2.204[***]	2.519[***]
	(4.07)	(4.13)	(4.83)
CORjt	1.910[***]	1.933[***]	2.055[***]
	(8.96)	(9.13)	(9.86)
EDUjt	1.616[***]	1.605[***]	1.668[***]
	(23.36)	(23.28)	(24.19)
constant	-1089.8[***]	-1111.2[***]	-1082.4[***]
	(-18.11)	(-18.27)	(-15.87)

t statistics in parentheses
[*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$
Source: own computation

All variables have the same direction of impact, just their values are changed and two variables lose significance. The main difference between models is located in Swiss GDP and trade barriers. They are not statistically significant now, which mean that they are not expected to have impact on trade. This is interesting result, even though the significance level was lower for these two variables in previous models too. Coefficient on GDP in partner countries decline for OLS, whereas parameter for population strengthens. This is a support for an idea that larger population increase demand for foreign goods more than higher total output and therefore export is rising its volume. Distance keeps its position as main negative variable for export, its impact is even higher by 1% - according to OLS, 1% higher remoteness of trade partner decrease export there by 5,5%. Almost all institutional variables are found to have larger influence on export and are statistically significant. Just investment freedom fall a little bit in its coefficient value. Property rights are the most influencing factor.

5.1.1 Germany and the Czech Republic compared to Switzerland

Switzerland is considered to be a small country. Estimation can vary for a big country such is Germany. Hyžíková (2012) applied similar gravity model for Germany and Czech Republic export, so we are able to compare results for big and small countries. The estimation methods used in Hyžíková (2012) are the same as used here and there is found the same evidence for OLS method to be the best.

In contrast to Germany and the Czech Republic, Switzerland export's sensitivity to used variables is higher. All coefficients have highly increased values than remaining countries, except for GDP in partner countries.

Domestic GDP seems to be statistically insignificant for Switzerland, but it is important for other countries. Germany export is influenced by domestic GDP almost as most as it is influenced by GDP of country where exports are departed. Both GDP have coefficient about 0,7 what means that whenever domestic or foreign partner GDP increase by 1%, export from Germany to partner country increase by 0,7% what is by 3 tenth of percentage point more than for Switzerland. Domestic GDP of the Czech Republic effect is also higher than German, but lower than Swiss, its figure is just under 1%.

Distance is very important variable influencing trade for small countries. Export from big countries are not affected so much by distance (coefficients on distance for Germany: -0,87 and the Czech Republic with Switzerland above -1,5). Big country gets over geographical difficulties more easily.

Trade barriers are left out due to another specification of this variable in both models.

Institutional variables do not mean too much for German export, they reached just minor values, but their effect on Swiss economy is huge. Switzerland tend closer to institutional specification of partner country when deciding with whom they are going to do business. Very interesting is coefficient on monetary freedom that is negative for Germany and positive for Switzerland and for the Czech Republic. Education level and government effectiveness are the most powerful variables for export in Germany, their influence is moving above 0,014%. Other institutional factors have more likely minor effect. However in case of Switzerland investment freedom and property rights variables are the most influential. Czech export is influenced mainly by government effectiveness, government spending and education. Germany gives the impression that overall development in country matters for bilateral trade, Switzerland aimed its attention to basic set of rules in partner's countries.

Following table summarize difference between Switzerland, Germany and the Czech Republic.

Table 4 Comparison of Switzerland with the Czech Republic and Germany, cross-sectional specification

	SWITZERLAND OLS	GERMANY OLS	CZECH REPUBLIC OLS
$\ln(Y_{jt})$	0.367***	0.690***	0.610***
	(6.92)	(27.83)	(16.05)
$\ln(Y_{it})$	3.567	0.643***	0.970***
	(1.87)	(4.13)	(5.92)
$\ln(D_{ij})$	-5.549***	-0.893***	-1.67***
	(-14.31)	(-24.79)	(-34.06)
$\ln(L_{jt})$	3.021***	0.255***	0.426***
	(58.16)	(10.19)	(10.95)
G_{jt}	0.575***	0.014***	0.013***
	(10.48)	(11.63)	(6.87)
GOV_{jt}	0.725***	0.001	0.008***
	(9.59)	(1.27)	(5.21)
MON_{jt}	0.603***	-0.005***	0.001
	(7.22)	(-3.82)	(0.04)
INV_{jt}	-2.047***	-0.004**	0.002
	(-4.41)	(-3.01)	(1.00)
PRO_{jt}	2.519***	0.006***	0.002
	(4.83)	(3.67)	(0.81)
COR_{jt}	2.055***	0.008***	-0.001
	(9.86)	(5.87)	(-0.02)
EDU_{jt}	1.668***	0.016***	0.032***
	(24.19)	(10.82)	(14.81)
constant	-1082.4***	-6.701**	-8.380***
	(-15.87)	(-3.09)	(-4.54)

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: own computation, Germany, Czech Republic - Hyžíková (2012)

5.2 *Estimation and results - time series panel*

Dynamic model showing how trade partnership develops through years can be captured by time series specification of estimation. "Dynamic" means in this case that we analyse the evolution of the behaviour of Swiss exporters in time, considering that it is applied on their willingness to export to various partner countries. We estimate which

factors were generally important in analysing for the period of 1995-2010 from the point of view of 176 partner countries.

This can tell us which variables are important for long term cooperation. Panel is arranged to 16 groups, each group for one year (1995 – 2010). Each group contain 176 observations, because we have 176 countries. Again, such an organized panel will be estimated by fixed and random effects model.

Because fixed effects model does not allow using constant variables, one variable that is very important for gravity model – distance is omitted. Fixed effects model seems to be a little bit misspecified without distance variable. A lot of variables are found to be insignificant and some of them have surprising impact direction.

Domestic GDP supports export greatly in time. With the increase of GDP by 1%, export rise highly by 16,6%. This is an important element for trade. On the other hand, GDP of partner countries do not have so powerful impact on trade, some institutional factors have stronger effects.

Population influence export negatively now. Such a changeover can be explained by larger domestic market. Increase in population can lead to more labour factors, more human capital and last but not least to creation of larger production in the country. Domestic production can as a next step replace exports in dynamic model. Yet population is insignificant in fixed effects model and therefore strong evidence for this idea cannot be bring out.

Institutional variables reach lower values in time series models. Surprisingly, property rights, which was the strongest institutional factor influencing export in cross section models, is insignificant in dynamic one. Corruption freedom and education are other that are insignificant too. Coefficient on education is even negative. In contrast, monetary freedom remains significant with not so lower value as others (cross-sectional FE is 0,561 and time series is 0,463). Monetary freedom is variable that stay almost unchanged with specifications in models and has steady positive effect on export.

Table 5 Time series – FE and RE models

	FE	RE
	$\ln(Xijt)$	$\ln(Xijt)$
$\ln(Yjt)$	0.126^{***}	0.102^{**}
	(3.40)	(2.66)

ln(Yit)	16.61***	11.04***
	(15.67)	(10.68)
ln(Dij)	.	-5.409***
	.	(-5.94)
ln(Ljt)	-0.103	1.611***
	(-0.43)	(11.16)
Tijt	-64.01**	-91.97***
	(-2.70)	(-3.76)
Gjt	0.0678*	0.109***
	(2.20)	(3.43)
GOVjt	0.196***	0.134*
	(3.44)	(2.30)
MONjt	0.463***	0.481***
	(9.43)	(9.45)
INVjt	0.740**	0.822**
	(2.66)	(2.84)
PROjt	0.153	0.811*
	(0.47)	(2.44)
CORjt	0.144	0.372**
	(1.24)	(3.09)
EDUjt	-0.224	0.523***
	(-1.62)	(4.55)
constant	1066.0***	412.1***
	(9.61)	(3.78)

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: own computation

Random effects can estimate whole model, including distance, which change results a lot. All variables are significant, at least at 5% level.

Distance is significant, with unsurprisingly negative impact on export. Its coefficient is not so different from cross sectional model, just little bit rise to -5,5% change in export with increasing distance between countries by 1%. Impact of both GDP is weaker, mainly for Swiss GDP, they positively influence export. Influence of Swiss GDP is high, at 11%.

Coefficient on population change its sign, so now is consistent with cross section estimations, but still it does not have such a big effect as in cross section models, having its value 1,6.

Impact of property rights and corruption freedom increase and become significant. Monetary freedom defended its position as a steady variable.

Is OLS also appropriate model for time series? To find out the results, Breusch-Pagan tests are done. Fixed effects: Null hypothesis stand for the same intercepts between groups which make OLS efficient estimation, alternative hypothesis establish fixed effects as an efficient, because of difference in intercepts. Figure of statistic is high $F(175, 2627) = 86,53$ with p value 0,000. This is strong evidence against null hypothesis, fixed effects are preferred to OLS. Random effects: Null hypothesis says that variance of disturbances is zero, OLS is given priority. Statistic of chi squared is 12158,85 with p value 0,000. Null hypothesis is rejected, random effects model is a priority to OLS.

Both fixed and random effects models are preferred to OLS, but their results differ. The Hausman test help to discover which one is an efficient estimation. Null hypothesis: both estimation methods are consistent, but random effects model is more efficient. Alternative hypothesis make fixed effect only efficient. Statistic figure is 429,45 with p value 0,000. This is very interesting and surprising result. Fixed effects, which are assumed to be misspecified because of omitted variable distance, are preferred and random effects are inconsistent. Distance therefore appears to be a factor that should not be in model for Swiss exports in time series model, which goes against gravity model.

The best estimator required homoskedasticity assumption to be filled too. Wald test for groupwise heteroskedasticity is used to recognize if heteroskedasticity can be a problem in fixed effects model. Under the null hypothesis homoskedasticity is present, alternative is for heteroskedasticity. Value of statistic is high – 140000 and p value is 0,000. This is strong evidence that heteroskedasticity is an issue in fixed effects model. To get rid of problem with heteroskedasticity, model is estimated once more using robust specification.

Robust estimation adjusted significance of variables. GDP of partner country, trade barriers and most of the institutional variables are newly insignificant in fixed effects

robust model. Government effectiveness, investment freedom, property rights, freedom from corruption and education are unimportant for export destination decision-making in time. Only government spending and monetary freedom is significant. This supports previous idea that monetary freedom is steady variable with significant positive effect on export.

Table 6 Time series estimations, robust models included

	FE	RE	Robust FE	Robust RE
	ln(Xijt)	ln(Xijt)	ln(Xijt)	ln(Xijt)
ln(Yjt)	0.126***	0.102**	0.126	0.102
	(3.40)	(2.66)	(1.78)	(1.42)
ln(Yit)	16.61***	11.04***	16.61***	11.04***
	(15.67)	(10.68)	(6.60)	(4.47)
ln(Dij)	.	-5.409***	.	-5.409***
	.	(-5.94)	.	(-4.39)
ln(Ljt)	-0.103	1.611***	-0.103	1.611***
	(-0.43)	(11.16)	(-0.22)	(4.76)
Tijt	-64.01**	-91.97***	-64.01	-91.97*
	(-2.70)	(-3.76)	(-1.80)	(-2.48)
Gjt	0.0678*	0.109***	0.0678	0.109**
	(2.20)	(3.43)	(1.89)	(2.65)
GOVjt	0.196***	0.134*	0.196*	0.134
	(3.44)	(2.30)	(2.23)	(1.49)
MONjt	0.463***	0.481***	0.463***	0.481***
	(9.43)	(9.45)	(4.40)	(4.33)
INVjt	0.740**	0.822**	0.740	0.822
	(2.66)	(2.84)	(1.45)	(1.51)
PROjt	0.153	0.811*	0.153	0.811
	(0.47)	(2.44)	(0.26)	(1.36)
CORjt	0.144	0.372**	0.144	0.372*
	(1.24)	(3.09)	(0.96)	(2.38)
EDUjt	-0.224	0.523***	-0.224	0.523
	(-1.62)	(4.55)	(-0.71)	(1.74)

Const.	1066.0***	412.1***	1066.0***	412.1
	(9.61)	(3.78)	(4.85)	(1.89)

5.2.1 Switzerland in contrast to Germany and the Czech Republic

Result of time series estimation of gravity model applied on Switzerland can be compared with gravity model applied on Germany and on the Czech Republic by Hyžíková (2012). This brings us knowledge about differences between small and big countries in time horizon.

Switzerland is more sensitive to domestic GDP, distance, population and institutional variables than Germany. Only GDP of partner country push very little for being receiver of Swiss export, it is even insignificant. So the size of home market matters more for increasing export than size of foreign market. Figures for the Czech Republic are similar to German.

Population is not relevant in time both for big Germany and small Switzerland. This variable was significant just in random effects model, but in both countries fixed effects model is efficient while random effects model is found to be inconsistent. Only the Czech Republic recorded population variable to be significant. Another interesting fact is that influence of population variable is negative for Switzerland and therefore with increasing population in partner country export should go down, in case of Germany and Czech Republic influence is positive.

Institutional variables are insignificant in most cases. They reach higher values for the Czech Republic and Switzerland. Factors that affect export differ between countries. Coefficients on these factors are larger for Switzerland therefore small country export should be more impacted by them. The only common significant variable is partner's government spending. German export is significantly influenced by partner's government effectiveness and by partner's property rights, whereas Swiss export is significantly supported by monetary freedom in partner country. The Czech Republic is even more sensitive to institutional variables, freedom from corruption and property rights are added to significant institutional variables that were found for Germany.

Table 7 Comparison of Switzerland with the Czech Republic and Germany, time series specification

	SWITZERLAND FE robust	GERMANY FE	CZECH REPUBLIC RE
ln(Yjt)	0.126 (1.78)	0.547*** (-8.43)	0.722*** (9.62)
ln(Yit)	16.61*** (6.60)	1.077*** (7.17)	1.186*** (8.32)
ln(Dij)			-1.701*** (-16.25)
ln(Ljt)	-0.103 (-0.22)	0.309 (1.72)	0.322*** (4.10]
Tijt	-64.01 (-1.80)	-0.052** (-2.68)	0.081* (2.44)
Gjt	0.0678 (1.89)	0.006*** (4.49)	0.012*** (5.13)
GOVjt	0.196* (2.23)	0.005*** (4.03)	0.008*** (4.02)
MONjt	0.463*** (4.40)	0.001 (0.28)	-0.001 (0.26)
INVjt	0.740 (1.45)	0.001 (0.82)	0.001 (0.26)
PROjt	0.153 (0.26)	0.003* (2.37)	0.007** (2.73)
CORjt	0.144 (0.96)	0.001 (0.4)	-0.006** (-2.77)
EDUjt	-0.224 (-0.71)	-0.006 (-1.92)	0.019*** (4.79)
constant	1066.0*** (4.85)	-16,790*** (-9.66)	-10.665*** (-6.83)

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: own computation, Germany and Czech Republic - Hyžíková (2012)

6) IDEAS FOR FURTHER RESEARCH

Financial crisis affected almost the all world economies, included Switzerland and its partners. The drop in bilateral trade is visible, but in the future European countries will have to face a more serious problem. This is the problem of crisis in Eurozone. Many European countries are not in an enviable position, including Greece, Portugal or Spain. These countries are not the only in problems, because their problems float with the common currency euro to other countries in Eurozone. It is questionable how Germany with other countries will survive this crisis and how much trade will be impacted. In the year 2010 figures showed that trade was restored to increasing volumes, but how future development will look will be shown in a couple of years later. Impacts of crisis could be an interesting for further explored.

In addition, results of gravity models differ widely depending on country size. Institutional variables have larger impact on trade in smaller country, domestic GDP and distance enlarge its effect and GDP of partner country is weaker variable. The comparison is unfortunately based on difference between Switzerland and Germany. Further study of distinction between small and large countries should be done to support this view. The repeated estimation of gravity models for smaller and then for bigger countries can be interesting for another work. It is reasonable variation in size of countries influence country decision making and pointing out this variation and finding it can be a good theme for research.

Moreover, gravity model is estimated for export. Repeating the same research with import can show different results. So the investigation of importer behaviour can be known too.

CONCLUSION

Popular gravity models of international trade enable us to measure how big impact institutional variables have on export or import. The gravity models are adjusted to measure not all bilateral trade transactions between partners, but to explore specific behaviour of one export country. This work study enlarged gravity models by institutional factors applied on Switzerland.

Analysis of Swiss position in international trade was showed to understand its foreign trade better. The biggest trade partners are neighbouring countries, especially Germany and the main trade article are chemical products and manufactured products. Switzerland was compared with the Czech Republic, which is in similar trade position. Both countries are quite dependent on trade with Germany. Major trade partners are the countries which share common border with them.

Gravity model for Switzerland was estimated by two different specifications of data set: cross-sectional and time series. The specification really matters, obtained results differ widely. It was found that domestic GDP is unimportant in short time decision-making and GDP of partner country supports export to the partner country significantly, whereas in dynamic model situation is reversed. Institutional variables have larger impact on export in cross-sectional model, their influence weaken in time. The only variable with steady influence on trade is monetary freedom in partner country.

Moreover, previous work by Hyžíková (2012) allows comparison of Swiss results with results for Germany and for the Czech Republic. Institutional variables support export more in small country, distance has also more powerful effect on trade in small country. Big country seems to be more independent on institutions.

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INTERNET RESOURCES

Heritage foundation: http://www.heritage.org/index/

WTO (World Trade Organisation): http://www.wto.org

Eurostat: http://epp.eurostat.ec.europa.eu

European Commission: http://ec.europa.eu

CEFTA (Central European Free Trade Agreement): http://www.cefta.int/

IMF (International Monetary Fund): http://www.imf.org/external/index.htm

OECD (Organisation for Economic Co-operation and Development):

> http://www.oecd-ilibrary.org

United Nations:

> http://hdr.undp.org/en/media/HDI_trends_components_2009_rev.xls

CEPII: http://www.cepii.fr/anglaisgraph/bdd/distances.html