

Forex interventions of CNB in front of the door to Eurozone

Diploma thesis

Thesis supervisor:
doc. Ing. Lubor Lacina, Ph.D.

Author:
Bc. Tomáš Kadlec

Brno 2015

I would like to thank my supervisor doc. Ing. Lubor Lacina, Ph.D. for helpful advices, which significantly improved my thesis. As well to doc. Ing. Svatopluk Kapounek, Ph.D. for help. I would also like to thank my family for unwavering support during my studies and also to my girlfriend for help, when was needed.

Statutory Declaration

Herewith I declare that I have written my final thesis: "Forex interventions of CNF in front of the door to Eurozone" by myself and all sources and data used are quoted in the list of references. I agree that my work will be published in accordance with Section 47b of Act No. 111/1998 Sb. On Higher Education as amended thereafter and in accordance with the *Guidelines on the Publishing of University Student Theses*.

I am aware of the fact that my thesis is subject to Act. No. 121/2000 Sb., the Copyright Act and that the Mendel University in Brno is entitled to close a licence agreement and use the results of my thesis as the "School Work" under the terms of Section 60 para. 1 of the Copyright Act.

Before closing a licence agreement on the use of my thesis with another person (subject) I undertake to request for a written statement of the university that the licence agreement in question is not in conflict with the legitimate interests of the university, and undertake to pay any contribution, if eligible, to the costs associated with the creation of the thesis, up to their actual amount.

In Brno, 22th May, 2015

Abstract

Kadlec, T. Forex interventions of CNF in front of the door to Eurozone. Diploma thesis. Brno: Mendel University, 2015.

This thesis study the foreign exchange intervention of Czech National Bank, launched in November 2013. Under the circumstances have been chosen to use the Marshall-Lerner condition which finds the economy suitable for currency devaluation or not. For reach this goal have been calculated regression analysis with two alternative results for calculating the condition. In the first alternative, full Marshall-Lerner equation, could not be satisfaction of condition proven, but nor was dissatisfaction. In the second one, where was import of Czech Republic calculated with zero value according to regression analysis result, was the condition satisfied. Results have been compared with numbers from United Kingdom and found opposed. In comparison to Slovak Republic was found Czech development of macroeconomic indicators better.

Keywords

Forex, intervention, foreign exchange, monetary policy, central bank, regression analysis, Marshall-Lerner condition, elasticity.

Abstrakt

Kadlec, T. Devizové intervence ČNB přede dveřmi do Eurozóny. Diplomová práce. Brno: Mendelova univerzita v Brně, 2009.

Tato práce studuje devizové intervence České národní banky z listopadu 2013. K hodnocení byla vybrána metoda Marshall-Lernerovy podmínky, která řekne, zda je ekonomika vhodná k devalvaci měny, či ne. Pro úpravu dat byla použita regresní analýza se dvěma alternativami výsledku. V první alternativě, celé Marshall-Lernerove podmínce, nemohla být podmínka splněna, ale ani vyvrácena. Ve druhé alternativě, kde byl import České republiky podle výsledku regresní analýzy započítán s nulovou hodnotou, byla podmínka potvrzena. Výsledek byl porovnán s hodnotami ze Spojeného království a shledány protichůdné. Při srovnání se Slovenskou republikou byla shledána Česká ekonomika v mnohem lepší kondici.

Klíčová slova

Devizové intervence, monetární politika, měnový kurz, centrální banka, regresní analýza, Marshall-Lernerova podmínka, elasticita.

Content

1	Introduction and objectives	11
1.1	Introduction.....	11
1.2	Objectives.....	14
2	Literature overview	15
2.1	What is forex intervention and who is responsible.....	15
2.2	Development of intervening in time.....	18
2.2.1	Mercantilists	18
2.2.2	Physiocrats	19
2.2.3	Classical school	19
2.2.4	Socialists.....	20
2.2.5	German historical school.....	20
2.2.6	Marginalist school.....	21
2.2.7	Neoclassical school	21
2.2.8	Keynesian school.....	22
2.2.9	Why is history important.....	24
2.3	Recent experiences with forex interventions around the world	25
2.3.1	Intervention of Swiss Nation Bank in 2007-2015	25
2.3.2	Intervention of Bank of England in 2009-2012	27
2.4	Foreign exchange intervention of Czech National bank in November 2013	28
2.5	Determination of method for analysis	31
3	Methodology and data	36
3.1	Regression analysis.....	36
3.2	Marshall-Lerner condition	41
3.3	Data.....	42

4	Econometric analysis	44
4.1	Test for a unit root	44
4.2	Regression analysis of model 1	45
4.2.1	Correct specification of the model 1	47
4.3	Regression analysis of model 2.....	52
4.3.1	Correct specification of the model 2	53
4.4	Interpretation of results of regression analysis	57
4.5	Elasticity of export and import.....	58
4.6	Comparison with United Kingdom	65
4.7	Comparison with Slovak Republic	67
5	Discussion	70
6	Conclusion	72
7	Literature overview	75

List of figures

Figure 1	US GDP during Great depression Source: FED, visualized by boundless.com (2015)	23
Figure 2	Export and import of the Czech Republic since 1995 till 2013 Source: Czech Statistical Office (2015), author's visualization	38
Figure 3	Results of Chi-square test, model 1 Source: Author's calculation, output from Gretl software	51
Figure 4	Q-Q plot of normal distribution, model 1 Source: Author's calculation, output from Gretl software	51
Figure 5	Results of Chi-square test, model 2 Source: Author's calculation, output from Gretl software	56
Figure 6	Q-Q plot of normal distribution, model 2 Source: Author's calculation, output from Gretl software	56
Figure 7	Growth of CPI, export and import of Czech Republic from 1996 Q2 to 2015 Q1 Source: Czech statistical office 2015, author's visualization	60
Figure 8	Individual quarterly elasticities of export and import of Czech Republic from 1996 Q2 to 2015 Q1 Source: Czech statistical office 2015, author's visualization	64
Figure 9	Development of sums of elasticities of export and import from every four consecutive quarters from 1996 Q1 to 2015 Q1 Source: Czech statistical office 2015, author's visualization	64
Figure 10	Estimates of the macroeconomic impact of quantitative easing, peak impact on the level of output and inflation Source: Joyce, Tong and Woods (2011)	66

-
- Figure 11** Development of inflation/deflation rate in Czech Republic and Slovak Republic Source: Czech Statistical Office (2015), Statistical Office of the Slovak Republic (2015), author's visualization 68
- Figure 12** Development of GDP of Czech Republic and Slovak Republic in y-o-y index Source: Czech Statistical Office (2015), Statistical Office of the Slovak Republic (2015), author's visualization 69

List of tables

Table 1	Summarization of the crucial studied papers	35
Table 2	Results of ADF test at levels	44
Table 3	Results of ADF test at the first difference of variables	45
Table 4	Expected signs of independent variables	46
Table 5	OLS full model 1	46
Table 6	OLS model 1 without not significant variable	47
Table 7	Results of LM test, model 1	48
Table 8	Results of RESET test, model 1	48
Table 9	Results of DW test, model 1	49
Table 10	Results of White test, model 1	49
Table 11	Results of Breusch-Pagan test, model 1	50
Table 12	Results of VIF test, model 1	50
Table 13	Results of Chi-square test, model 1	50
Table 14	OLS full model 2	52
Table 15	OLS model 2 without not significant variable	53
Table 16	Results of LM test, model 2	53
Table 17	Results of RESET test, model 2	54
Table 18	Results of DW test, model 2	54
Table 19	Results of White test, model 2	55
Table 20	Results of Breusch-Pagan test, model 2	55

Table 21	Results of VIF test, model 2	55
Table 22	Results of Chi-square test, model 2	55
Table 23	Expected and calculated results of regression analysis	57
Table 24	Price elasticity of export and import of Czech Republic	59
Table 25	Average export and import growth during different levels of CPI in Czech Republic	63
Table 26	Price elasticity of export and import of United Kingdom	66
Table 27	Average export and import growth during different levels of CPI in United Kingdom	67

1 Introduction and objectives

1.1 Introduction

When economically educated person asks average people: “What is foreign exchange intervention?”, it usually sounds like magic formula from someone over-educated and the following answer is correct very rarely. This situation ruled in Czech Republic too until 7th November of 2013 when Czech currency accidentally lost a significant part of its value. That day Czech National Bank switched to regime of interventions with goal - devaluation of currency. That day everyone in Czech Republic started to ask: “What is foreign exchange intervention?”

That day gave the Czech National Bank the answer to everyone. It is something extraordinary. Something what central banks do not very often and what Czech National Bank have not done before. Council of central bank approved massive intervention on foreign exchange market against Czech koruna with purpose: devaluate it.

It practically immediately hit the exchange rate of domestic currency and devaluated it about 10 %, which was level, central bank wanted to keep for a not specified period. This move surged a tsunami of mixed emotions of almost everyone, who uses Czech currency for whatever reason, central bank did not inform public about preparations of such a step in monetary policy.

Reasons why was such a move executed have been presented by central bank as support for competitiveness of Czech economy at first, because of quite unsatisfactory economic performance of it in comparison with other EU countries. And then central bank admit also other goal which appeared to be maybe the main one, and that was fight with deflation. This was launched because of very low level of inflation with constantly decreasing trend towards even below zero and colliding with CNB’s goal: keep the inflation on level 2 % p.a. Based on these facts have been determine a set of goals for avoiding a deflation trap and boost small Czech economy into faster recovery pace which was stage where Czech Republic definitely should have been after long stumbling in the shadow of the famous financial crisis, started in August 2007 in United States and then spread across the world and plunge the global economy into four years long recession contributing to the European debt crisis.

But of course when central bank of any country devaluates its domestic currency in such a volume, huge criticism falls upon banker’s heads instantly. The anger of public would be acceptable. Their lying on the beach by the see or ski-

ing in the Alps becomes more expensive and as a not last injustice, their honourable currency has been harmed. But criticism came also from not insignificant number of experts, which on the one side could mean that something wrong happened, but on the other side when was the last time all economists agreed together?

We can see very similar problematics in not very far Switzerland. Their central bank decided to help Swiss economy by pegging Swiss franc to Euro with fixed exchange rate in 2011. SNB (Swiss National Bank) had to deal somehow with extreme appreciation of franc, which was even before crisis considered as safe heaven, which means currency expected to devaluate not earlier than as the last one. Uncomfortably high appreciation was consequence of financial crisis practically everywhere around the globe (later intensified with Ukrainian crisis), during which invested in franc enormous number of investors, trying to avoid losses. Intervention of SNB actually helped to export, which is for Switzerland essential (more than 70 % of GDP). Franc was pegged to Euro and SNB had been forced to print new francs in amount equal to almost half a trillion dollars (value of one year export of Switzerland) to keep their word about fixed exchange rate. So under pressure from several battlefronts SNB suddenly announced in January 2015, that Swiss franc will no longer be hold at a fixed exchange rate with Euro. Of course it caused financial earthquake in form of appreciation of franc about 30 % instantly, but stabilized on appreciation 20 % one month after. This at first definitely disturbed tranquil sleep of many Swiss exporters, but on the other way many investors experienced second Christmas in the middle of January. Costs tied to leaving the intervening regime will not be available soon of course, but for sure the question whether profits from intervention prevailed over costs of leaving it, will lie on the table for long time. Long enough to count it after all.

Even is Czech situation a bit different in some ways, there are basic similarities in evaluation of intervening, basic pros and cons, more economic profits and costs or if someone prefers, pluses and minuses. Switzerland definitely profited from artificial low level of franc and also CNB reports first positive numbers after intervention in Czech Republic, but we just saw the second (and might the negative one) phase of influencing the economy by intervening, which is end of intervening, in Switzerland. CNB plans this move in first quarter of 2016, but in these uncertain times it is like waiting for the bus in blizzard, very easily can happen it will not come.

I heard arguments supporting intervention and those against it as well and that motivated me to create diploma thesis dealing with evaluation of impacts on economy of my country after foreign exchange intervention, because I wanted to know who was right. Of course I will not be able to take into account affairs which still didn't happen, as is the ending of current regime of intervening, but in my opinion is important to understand and describe movements caused by launching whole of this.

I consider very interesting to find out whether central bank was right and made good step and really helped the economy of my country or economic indicators expressed after one year from the time of the first intervention even worse numbers.

1.2 Objectives

Purpose of this thesis is to find out whether the currency devaluation in Czech Republic was for the country beneficial or the condition of economy became worse after. Objectives of this research have to follow original goals of CNB, under which was intervention made, thus:

- Was the main goal of CNB – increase of competitiveness of Czech Republic – accomplished successfully?
- Firstly hidden and later admitted goal – fight with deflation – was accomplished successfully??

Part of thesis will also be devoted to comparison between situations in Czech Republic and Slovak Republic. Slovaks were actually in similar economic situation as Czechs, there also had been indications, which warn that price level could fall into deflation. Nevertheless Slovakian central bank does not have the comfort of possibility of manipulation with domestic currency, because Slovakia is member of monetary union Eurozone and naturally does not have control above currency of whole union. Suitable comparison will be made between main macroeconomic indicators of both countries and should show how development of indicators after intervention differs.

Second country suitable for comparison is United Kingdom, where Bank of England significantly devaluated domestic currency Pound sterling during financial crisis. Compared will be the way of intervention, its volume and whether British economy reacts on changes in exchange rate in the same way as the Czech one or not.

However first of all will be theoretical background collected for understanding studied issue, its system and development, described current situation and found suitable method for reaching determined goals.

2 Literature overview

This chapter of the thesis will summarize information about intervening itself, to find out what it is, what it is for, who can use it and why would anyone use it. Also will cover historical development of opinions of the most prominent schools of the economic thought about intervening into economy. Also will be mentioned some other recently launched monetary interventions from different countries and in detail described that Czech one. Then will be needed research for a suitable method, which will be used for analysis of forex intervention made by CNB. This all should contribute to gather knowledge about this topic and understand the theoretical background of monetary intervening.

2.1 What is forex intervention and who is responsible

Foreign exchange (sometimes shortly called forex) intervention represents moves of central bank against natural development of foreign exchange market and they are the main explanation of operations with foreign exchange funds in relationship with homeland banks and branches of foreign banks. Central bank can use two types of foreign exchange interventions.

- direct interventions – price of foreign exchanges is influenced through selling and purchasing on foreign exchange market in way, when for foreign exchanges is sold or purchased own currency simultaneously with reduction or augmentation of own foreign exchange reserves which is aiming on prevention of unstable exchange rate and on creating more stable economic environment
- indirect interventions – central bank influences price of foreign exchanges through its interest policy or changes in supply of domestic currency; later in this thesis will be described quantitative easing of Bank of England, which is suitable example of manipulation with exchange rate without touching other currencies (Revenda, 2001)

Into foreign exchange operations we do not count just manipulation with amounts of money in foreign currencies, but also loans of central bank in foreign currencies, operations of central bank with securities in those currencies and loans and operations with securities in domestic currency in relations with foreign subjects. (Revenda, 2001)

Different author (Lízal and Schwarz, 2013) defines forex interventions as a tool of monetary policy for controlling national currency. It is tool for operating

on the foreign exchange market and aiming on building reserves, correct misalignments or control the exchange rate to be more stable. Whether would be intervention successful or not, depends mainly on central bank's ability to sterilize the impact of its intervention and the level of cooperation between central bank and government, holding the wheel of macroeconomic policy machinery.

Central bank uses foreign exchange interventions as a way how to reach goals set by foreign exchange policy of central bank. The most important goal is keeping domestic currency as stable as it is possible. Foreign exchange policy is closely related to inner monetary policy which is taking care about domestic currency, because any change or fluctuation in outer balance or foreign exchange rate influences inner currency development.

We can divide foreign exchange policy of central bank into several partial policies according to subjects which policy operates with:

1. foreign exchange rate policy
2. foreign exchange reserves policy
3. policy of balance of payments
4. foreign loans
5. international monetary cooperation
6. others, which are used very rare, for example artificial devaluation of currency for reaching the price stability, when standard tools are exhausted or do not bring the effect

Foreign exchange rate policy depends on a position of domestic currency in international financial world. It matters whether is currency tradable and or not and if it is, what is the level of its tradability, also whether is currency soft or hard and other indicators. It is necessary to set a particular exchange rate regime or system how will central bank with exchange rate operate, which will indicate subsequent volatility of exchange rate. Currently are exchange rates of countries with developed market economies influenced in its movements and levels by purchasing and selling of domestic or foreign currencies made by central banks. These market transactions have form of different types of foreign exchange interventions, for example conversions of spot and forward transactions, swaps and others.

On the other way **foreign exchange reserves policy** lean on handling reserves of foreign currencies on accounts of central bank. The point is in keeping the right amount of reserves, because either too low or too high reserves

harm the economy. Too low reserves can lower possible import and through this cause other problems in the economy or even in some cases cause inflation pressures following from low supply of goods and services. On the other way too high reserves could express transfer of significant part of domestic production abroad while pressuring on increase in money stock and can be source of inflation pressures in domestic economy. Managing of suitable level and structure of foreign exchange reserves consist in distribution of foreign exchange reserves according to degree of disposability: gold, reserve currencies generally considered as international reserves (USD), supranational loan facilities (SDR) and other international or supranational payment instruments. (bankovnictvi-finance.studentske, 2008)

Policy of balance of payments is closely related to foreign exchange reserves policy, because balance of payments should be after counted period (mostly a year) zero. If it is not, central bank usually balances these short divergences by manipulation with reserves in suitable way. When central bank uses fixed exchange rate regime, then the change in its foreign exchange reserves, whether it is positive or negative, is called balance of payment. However it is only capital movements that in a very short time explain the balance of payments or exchange rate regimes. (Wisser, 2004)

Other operations with international or supranational payment instruments realizes central bank with connection to **foreign loans**. Central bank can act in the name of creditors, but also on the other side, the side of debtors, commonly by commissioning. Acceptance of loan in foreign currency increases foreign exchange reserves on the asset side and foreign subject deposits on the side of liabilities of central bank. Providing foreign loans is different for domestic and foreign subject. Domestic subjects receive account in central bank and money will be written off central bank's reserves with pumping money from the account. Foreign subject receives money on their account and central bank writes it off from assets of foreign exchange reserves. (Revenda, 2001)

The biggest example of **international monetary cooperation** is probably the International Monetary Fund (IMF). It was founded in 1944 and works on voluntary membership principle. This financial institution coordinates the monetary policy currently between 184 member countries. Its main purpose is keeping the exchange of national currencies as stable as possible, which would actually stimulate international trade. The system of IMF allows particular countries to cooperate with each other and by that improve and boost their own

economy, which leads to prosperity of not just that particular country, but whole membership. IMF also serves as a big database of statistical data of every member's economy, which are available for every other member. This institution is also able to provide financial help to countries with economic problems, which could be actually seen in recent global financial crisis and following debt crisis in Europe. (imf, 2015)

Other operations are maybe rarely used, but when it happens, it usually does not pass unnoticed. For all can be mentioned fight of central bank with deflation. Inflation or deflation is indicator of movement of domestic price level, but that movement effects also the exchange rate. Thus when central bank fights with deflation through printing of new money, which support inflation grow, have to also count with side effect, which is devaluation of currency, thus increase of exchange rate with others currencies. (Lízal, Schwarz, 2013)

2.2 Development of intervening in time

Opinions on intervening into the economy changed in history many times. It depended on current condition of economy, mentality of society and known and discovered facts and inventions. Schools of economists built their theories how economy works, how to balance it and improve it and what are the main sources of wealth and prosperity.

2.2.1 Mercantilists

If we exclude the Antiquity when even educated people have very limited knowledge about economy and the Middle Ages when were economical laws mainly proof of God's existence, the first school who gathered significant knowledge about economy and its system were Mercantilists in the beginning of Modern times. This stream came to existence in the middle on sixteenth century during economic, political, social and cultural transformation and in situation of intensive import of gold mainly from Americas, which from the monetary point of view meant tripled prices in 1650 compared to year 1500. They believed that wealth is equal to amount of gold you have. That is why they recommended strong government, which will care about import of gold from colonies and active balance of payments, which is actually intervening, because very protective government was artificially increasing amount of money (golden coins) in the economy. Of course they did not speak about monetary or foreign exchange intervention, they did not even know those words at that time, but what we can

say is that they support government interventions into the economy, because they thought free market would make their country poorer. Mercantilism worked quite long time, because rich elites were able to keep power and wealth in their hands, but in 1756 appeared new stream called Physiocratic school. (Screpanti, Zamagni, 2005)

2.2.2 Physiocrats

Physiocrats didn't like represses of ordinary people in favour of land lords and many restrictions of market made by government. Instead of gold, was land the main source of wealth for them. Physiocrats means "rule of nature" and they for first time brought up famous "laissez-faire", which means "let people do as they please without government interference". From these slogans is more than obvious they wanted government to stop intervene into market and let the economy take care about itself. This school lasted just twenty years to 1776 and have been small pre-revolutionary sign of great change in economic thoughts, started when Adam Smith published his book "Wealth of nations", which was base for just founded Classical school. (Vardi, 2014)

2.2.3 Classical school

There have been two revolutions, which influenced Classical school: scientific and industrial revolution. From scientific revolution they took a Newton's theory of natural order, which was a proof for Classics that a system can work automatically, does not need great regulations like Mercantilists said and laissez-faire is the highest form of wisdom in social affairs. Industrial revolution gave Classics the right environment, because England, homeland of Adam Smith, first representative of Classical school, was the most industrially powerful country that time and benefited a lot from free international trade. More and more entrepreneurs started to build their companies and became independent on government subsidies. Competition kept prices low and poor workers from Ireland were migrating to more developed England and by that kept low wages. Perfect conditions for popularization economic liberalism. Classics said that "The best government governs the least", which means they were strictly against intervening of government into the economy. Every subject of market should follow its interests and by that satisfied interests of whole society. Classical school laid foundation of modern economics and a social science. Several of the classical "laws" are now thought as "principles" of economics. This stream of

thoughts ended in 1871, when Jevons, Menger and Walras independently published works expounding demand-based theories, which ultimately became part of Neoclassical school. (Barber, 2009)

2.2.4 Socialists

Socialist economists appeared after industrial revolution accelerated to full speed. In industrial parts of the cities rose slums full of poor workers or those who was trying to find a job in factories nearby. Unions were illegal, poverty of masses increased, misery, diseases and crime spread across slums. Triumph of industrialization for owners of capital, who still believed that the best government is the one that intervene least, like Classics said. From these conditions came up many types of socialism, like Utopian socialism, Anarchism, Marxism, Communism and many others. But they all had common direction of thoughts that there is no harmony of interests, like Classics said, but interests of different classes are contradictory. That means “laissez-faire”, does not work, because it is inefficient and not humane. They support strong government which would represents interests of working class, own all factories, centralize everything under its (people’s) control, intervene every time it is needed.

Now it is known that pure socialism is unreal to implement in society, nevertheless there are countries, even very rich and developed, with strong emphasizes to this ideology (Sweden, Japan, India), where socialist approach obviously works. Also every developed country in the world has included some of laws made by Socialists such as social security, minimum wages, employment compensations and others. (Bhatia 1978)

2.2.5 German historical school

After Napoleonic wars 1840 Germany divided into 39 separated states, become weak and very nationalistic. They did not agree with Classics and said: community has interest of its own, which are different from those of individual. This supports positive role of strong government allowed intervene in the name of higher responsibility. They saw importance in studying the economy historically and they criticized the deductive and unhistorical approach of Classics and Marginalists. They realized, that unrestricted free enterprises do not produce the best possible results for the society as whole, which is lasting contribution into the general knowledge of economy, used till nowadays. Germans hoped that the world can be peaceful and can achieve international cooperation and universal

harmony. German historical approach ended with First World War. (Screpanti, Zamagni, 2005)

2.2.6 Marginalist school

Marginalist school was also found as a reaction to weaker and weaker position of Classic economic school in the middle of nineteenth century. But they did not switch from liberalism, when they saw it does not work optimally, to controlled economy by strong government with almost unlimited power, as others schools, which questioned Classics. They just improved liberalism with their new inventions and ideas, especially with marginal point of view. With their focus or margin, they tend to microeconomic and were concerned with individual person and firm, which they consider as rational in economic behaviour and together form a pure competition with demand, which depends on marginal utility, as a primary force in price determination. They rejected historical methods and said that economic forces generally tend to equilibrium. And if there are plenty of reasonable subjects in pure competition and economy tend to balance itself into equilibrium, why should be there some super power as government to intervene and influence development in economy? Marginalist school claimed that workers should receive wage equal to their contribution on the value of output. In the name of this school were developed many analysis, especially geometric diagrams and mathematical techniques. Economics became more exact social science from that time. (Rhoads, 2008)

2.2.7 Neoclassical school

At the turn of the nineteenth and twentieth century, while living standards rose, firms grew, specialization and globalization started, in this time becomes to be more and more important money and banks and their system. In this situation Classical school evolved into Neoclassical school of economy thought and evolved also their major tenets. They adopt a lot from Marginalists and empathized with decision making and price determination at a margin. However Neoclassics thought for price determination is crucial not only demand, but also supply. Also was for Neoclassics more important role of money and they extended marginal analysis to market structures. They did not believe in pure competition and with imperfect one is the value market price, determined by market equilibrium. This school uses a lot of statistical analysis and mathema-

tized economics a lot, but more importantly for this thesis, they invented a new role for government – monetary policy.

The attention on money led to first tries of stabilizing wholesale prices by controlling discount rate and interest rates, because if banks establish the rate of interest that neither raises nor lowers commodity prices – some normal, natural rate of interest – it would eliminate cyclical fluctuations. Other new idea was to abandon gold coins and start using international paper standard, because there have been worries about growing production and stock of gold, that will cause inflation of currency

According to Neoclassical school should be monetary policy discretionary, regulating the money market just to promote its stability, sometimes to modulate a tendency to expansion or contraction, sometime to reverse it. Recommendations of several ways how to handle the instability of credit and following instability of economic operations were: open market operations of central bank, shifting with interest rate and manipulating with level of reserve requirements for commercial financial institutes, mainly banks.

This stream thus does not support government intervening into economy and recommends to central banks just stabilize situation on monetary field. Thanks to this approach with more microeconomic point of view is Neoclassical school accepted as one of the two streams in mainstream economics which is taught across prominent universities nowadays. The second one, opposite, is Neoclassical synthesis, which is combination of Neoclassical methods and more macroeconomic Keynesian approach. (Brue, Grant, 2013)

2.2.8 Keynesian school

As the name indicates, this school leans on thoughts and opinions of John Maynard Keynes. School practically appeared with publishing Keynes's book "The theory of employment, interest and money" in 1936. His theories rose from the ashes of Great depression in 30s, when till that time used Neoclassical approach failed in predicting or useful recovering from still continuing and endless economic disaster. Keynes on the other way offered perfect way out from depression, when he advocated that the government should intervene actively with using both of fiscal and monetary policies to support price stability, full employment, and economic growth. Either increase government spending or reduce taxes to spur increase in private consumption spending. Paradoxical is that

to his ideology contributed also second world war which started few years after his thoughts become famous. (Sojka, 1999)



Figure 1 US GDP during Great depression
Source: FED, visualized by boundless.com (2015)

Government under the pressure of war had to increase spending a lot, which kicked the economy forward like never before. War needed also rapid increase in numbers of soldiers in the field and workers in homeland, which reduced unemployment from more than 20 % during depression to less than 2 % during the war. (boundless.com, 2014)

According Keynes, a deep and blanket abatement of nominal wages is not good economic policy. He claimed that single company can increase profits and employment through wage reduction because the demand for products of this company will stay still the same. However a whole economy of a country cannot behave like a firm and cut wages across the board easily and increase profits because of that. His macroeconomic and demand oriented approach were helpful in his time, but exactly according his famous words: „In long run we are all dead”, nothing lasts forever.

He died after war in 1946, but success of Keynesian economics remained very popular and in 50s and 60s followed his recommendations almost every capitalist country on the world. Power of this school started to fade in 70s when Anglo-American countries fell into problems and appeared criticism on ability to handle and keep economy in boom with generous fiscal policy forever. Other thing reproached to Keynes was for example his short-run thinking, which led to stagnation in 70s. He also quite underestimated the possibility of development in technology and new inventions and new profitable investments it would attract. (Brue, Grant, 2013)

Countries later started to return back to more Neoclassical way of looking at the economics and appeared many new schools of economic thought, but none of those economists was as revolutionary as Keynes. His followers modified his thoughts with Neoclassical fragments and found Neoclassical synthesis, one of two approaches in current mainstream economics.

2.2.9 Why is history important

Knowing the history of economic thought is very important to understand the behaviour of current economic main subjects with power and responsibility as big as central bank has. It can be seen from history, where have ruled certain approach until some kind of crisis happen, then approach switched to completely different direction. Last big switch in thought about economic approach happened when Keynesian philosophy failed in 70s. From that time Neoclassical point of view prevails and had been used and taught on universities. It seemed Neoclassical school won the competition about the best economical approach after all, but big crisis started in USA in August 2007 again showed something very interesting. Most of the countries hit by economic problems, dealt with it in very Keynesian way even it looked like this way is outdated and overthrown. Central banks pour into their markets colossal amounts of money to save it from depression. Now it looks like it worked and Keynesian way of solving problem by intervening is back in the saddle at least for time of crisis. Currently is between the most developed countries discussed new economic paradigm about function of economy in situation of low or zero growth, which has been facing Japan for a last two decades.

2.3 Recent experiences with forex interventions around the world

Czech National Bank is naturally not the only central bank who made lately currency intervention. As it was said above, central banks do not use manipulation with currency of this size very often, but there are many countries with many currencies around the world that globally is experiencing some significant foreign exchange intervention not such a rare thing.

2.3.1 Intervention of Swiss Nation Bank in 2007-2015

After global financial crisis 2007-2008, also Swiss franc appeared in situation which Swiss National Bank did not like. Everything started with the crisis and the presentation of low Fed fund rates, the USD depreciated significantly. There started the first phase of intervening. Exchange rate EUR/USD moved from 1.36 in the summer 2007 to 1.57 in the summer 2008. Just as gold did, Swiss franc behaved as counter currency to the US dollar. Therefore USD/CHF fell even faster than EUR/USD enhance. Then the rate USD/CHF weakened 1.24 in June 2007 to close to parity 2008. In defiance of depreciation, banks were worried about ability of US dollar to be freely accessible, already in early 2008. SNB then regularly conducted USD repurchase agreements and assets of Swiss central bank increased about with those repos about 50 billion CHF. Second phase of intervening (2008/2009) happened when financial crisis was in outbreak in the end of 2008 and many banks, which borrowed before in Swiss francs, did not have enough of them yet. Then SNB presented swap agreements with different central banks to stable forex markets and lighten a stress there. SNB had gains from those swap agreements, but even that it lost about 4.7 billion francs still in 2008, because exchange rate to euro changed from 1.6 to 1.5. Third phase of intervening took place after two years (2008, 2009), when did Switzerland better than other countries using euro. Its economy rises about 1,5 % faster, but SNB intervened further and said that exchange rate 1.50 CHF/EUR is fair and they need to fight with deflation anyway. Then global economy lightly push itself out from recession mainly thanks to low prices of oil and huge Chinese fiscal intervention. SNB cancelled most swaps, but on the other way foreign exchange investments and sight deposits increased about 50 billion CHF. Fourth phase in 2010 was after Greeks confess in cheating with national statistic and admitted that country has even much higher debts then everybody thoughts. Euro started to fall, but SNB didn't follow it and broke rate held in last years. But till June

SNB increased level of foreign exchange reserves from 100 to 240 billion francs. Inflation in Switzerland was restored to 1 % and SNB then in the name of price stability had to stop intervene and leave franc to market balances. After a year of free floating regime franc naturally appreciated and SNB lost another 20 billion francs and become target of media criticism. But in September 2011 decided SNB that fair value of CHF is 1.2 to EUR and set floor on this level with unlimited purchasing power on forex market. By this step they actually confirmed peg of franc to euro, because development of currency rate to opposite direction was impossible with current power of Swiss economy. (snbchf.com, 2014, [cit. 2015-02-23])

By pegging domestic currency to euro ensured SNB for itself necessity of intervening into the future. They spent about 480 billion dollars, which is like 70 % of Swiss GDP, till 2014 to keep franc on this level. It was necessary because when they peg their currency, investors from all over the world invest in franc, because they consider it as “safe heaven” and not risky way how to deposit money. That fact even more pushed franc to appreciation, which again led to bigger intervening of SNB. Switzerland profited on low level of franc, because 70 % of its GDP is made by export, but it was obvious it cannot last forever. But anyway it was quite shock when SNB in 15th January 2014, dropped the peg policy and let franc appreciate freely. And it did appreciate about 30% from one day to another. There are several things which led SNB to do it. First one was undoubtedly public dislike of creating such a huge foreign exchange reserves. Argument was that it can cause hyperinflation, which did not, but anyway it was enough for media to complicate life of bank board. Second reason was fact that there have been strong expectation of quantitative easing from European Central Bank, which actually happened later and it decreased value of euro, which would require additional amounts of printed money in Swiss central bank’s foreign exchange reserves to keep set exchange rate with euro, if it is still pegged together. And the third reason was because during 2014 experienced euro depreciation and franc had to follow, which helped export to countries with other currencies. SNB then decided that there is no reason to weaken franc if it is not so overvalued and regime can be switched to floating. Fact, that franc will massively appreciate in very short time after switch of regimes, was almost certain, because it usually happens to currencies undervalued for a long time. (economist.com, 2015, [cit. 2015-02-23], snbchf.com, 2014, [cit. 2015-02-23])

2.3.2 Intervention of Bank of England in 2009-2012

Before global crisis, started in August 2007, experienced British currency good times. Pound sterling was appreciating in comparison to other important currencies over the world, which was required due to inflation development in 2006-07. And at the same time was US dollar depreciating, which led in November 2007 to 26-year high in exchange rate development between those 2 currencies. It was needed 2.12 USD to buy a single GBP. With euro kept pound more or less stable exchange rate around 1.45 EUR/GBP. But when financial crisis hit the economy of United Kingdom fully, pound experienced one of the fastest fall in history. This fall reached its bottom with euro in December 2008, when happened almost parity between euro and pound. Exchange rate felt to all-time low 1.02 EUR/GBP. To dollar felt pound to exchange rate 1.38 USD/GBP in January 2009. (ecb.europa.eu, 2015)

In March 2009 announced Bank of England, central bank of United Kingdom, programme for help to suffering economy, which creates 75 billion pounds through policy called quantitative easing. According to governor Mervyn King is better to throw money into wider system, then simply to particular banks. Interest rates cuts Bank of England to all-time low 0.5 % and board did not see other way how to reduce damages caused by financial crisis. Even Britain used quantitative easing for the first time in history and Mervyn King admitted, that he do not know how long it would take to have an effect, he also insisted, that increasing the amount of money in economic machinery was not an experiment and it is crucial in order for the United Kingdom to recover from the recession. (bankofengland.co.uk, 2015)

Bank of England did print new money and purchased assets like government or corporate bonds or other secured commercial papers. Bank had to carefully pick those assets, because they had to follow emergency policy when essential companies are picked and marked as TBTF (too big to fall). Those have been saved even with high costs, because their fall would have massive impact into life of millions British citizens. At first BoE announced to print 75 billion pounds, but Chancellor of the Exchequer permitted creation even 150 billion if necessary. But in November 2009 was the amount of money created through quantitative easing on number 175 billion and started impatient waiting for long term results. In the end of 2011 could BoE not hold anymore and throw into hungry British economy another 75 billion with statement: "In the light of that shift in the balance of risks, and in order to keep inflation on track to meet the

target over the medium term, the committee judged that it was necessary to inject further monetary stimulus into the economy." Not even this was last injection of new money, thus in 2012 climbed the total amount of assets gained by quantitative easing performed last years up to 375 billion pounds. That is equivalent of one third of the whole national debt of United Kingdom. After the crisis were Bank of England reselling obtained commercial papers. Pound sterling was devaluated several times with waves of easing, but without significant lasting contributions. (Oganesyan, 2013) (bankofengland.co.uk, 2015)

2.4 Foreign exchange intervention of Czech National bank in November 2013

After global financial crisis have been many central banks forced to use non-standard tools how to restore inflation and help the economy back in the saddle. Czech National Bank did not need those tools during the crisis, standard way was enough and also have been used. Interest rates have been lowered about four percentage points during the crisis and later in years 2008-2012 and also automatic market mechanisms did its work and "helped" CNB with depreciating Czech crown in those hard times. The need of non-standard "cure" after too long lie around of Czech economy on the bottom of the European economic pool, which did not fill itself with wealth, because of collapse of another bubble – the debt one, appeared in the end of year 2013. Interest rates have been on technical zero and CNB that time realized, it will not be enough for hitting the inflation target (2 %) or at least for avoiding of deflation risks, which strengthened that time, in opinion of CNB, in worrying pace. Bank board of Czech central bank then (7th November 2013) announced that they want Czech koruna's exchange rate to euro on level around 27 CZK per EUR and they are ready to intervene in unlimited amount and for unlimited time to keep this rate and fulfil the inflation target in the future. It was shock for markets even CNB have been warning for a year that it may weaken the koruna as it seeks to prop up economic growth while interest rates are close to zero. But small surprise for market was obviously essential and 200 billion korunas have been printed and released into the market in one day and exchange rate were right there, where CNB wanted it to be. From the first wave on intervention have been no necessity to intervene again, because market knows it is useless to fight with central bank and its (in this case) almost unlimited power. Even it looked like CNB just decided and made this controversial step in very short time and nobody could prepare for it,

bank declared after, that this step was discussed very well. Bank board had this topic on the table from 2009 and from 2012 they discussed it very seriously. It had been taken into account modelling of zero lower bound, how to react to deflation, forward guidance, quantitative and qualitative easing or foreign intervention/exchange rate manipulation. CNB finally decided for using domestic exchange rate in combination with intensive communication to set the inflation expectation in longer horizon, because Czech economy is widely open, transmission of exchange rate is well explored, there is enough of liquidity in bank sector and private debt instruments are not very deep. (cnb.cz, 2014)

But with logic of CNB does not agree many people and not just economically uneducated public, but even authorities. Some of them with their typical criticism like current president of Czech Republic, Miloš Zeman, who said that “Intervening of CNB have never been beneficial to anything” (financninoviny.cz, 2013).

But there were also other critics who came with constructive criticism like Czech economist Pavel Kohout. He translated justify of CNB to intervening as: “Citizens, your money will lose value, so you rather spend it now then later. But do not worry, if you keep spending for nonsenses, which you do not need, wheels of economy will spin again and we all will be richer.” He explains that this way is not satisfying and his opinion based on no worries from deflation is more logical. He said we have to distinguish between price inflation/deflation, counted from basket of products and services, and monetary or credit inflation/deflation. It is important, because price deflation and drop of GDP are just consequences of monetary and credit deflation. Price deflation itself is not cause of economic crisis. This common cause is bank crisis and banks are in Czech Republic healthy. Kohout thinks that support for loan providing would be oppositely to central bank’s strategy some lowering of inflation. Loans would have lower interest with lower inflation risk. He compares CNB’s strategy with example from Norway when Ragnar Frisch said that number of tourist and flies are very closely correlated in Norway’s cost, but no one would support flies to improve tourism in Norway. He tries to point on fact, that CNB maybe support those flies and deflation is not the greatest evil in the universe. Statistics of Bank of England presents that price level in United Kingdom in 1896 was just 53 % of price level in 1813. It means islands experienced deflation during almost whole century and still remained one of the most developed countries in the world.

According to Kohout made CNB monetary mistake, which can be cured by leaving intervention regime. (peníze.cz, 2013)

Another loud criticism have been heard also from former president of Czech Republic, Václav Klaus. He stated in his book “Was the inflation really threat?” that he has doubts about meaningfulness and reasonability of this intervention and he is not alone. Deflation is not as dangerous as CNB thinks or they even had other motives like speed up global inflation spiral to erase unbearable huge debts of current developed world. He wrote that he and people dealing with economy for decades, never spoke about deflation much and if they were, then it was about history. Economical evil is according to him recession, depression and crisis and on the other side high inflation, not deflation, that is just consequence. As example of managed deflation he used try of Alois Rašín to defend koruna from European hyperinflation in 20s. Czechoslovakian GDP dropped in short run, but then made a chance for fresh start with respected, freely changeable currency (in contrast to other currencies in region) and average growth in CSR had been 8 % in next decade. Klaus also point at econometric model of CNB, which is very neokeynesian. Keynes brought much positive into economics, but his thoughts are dead in his short time and even Great depression in 30s was not primarily deflation, it came as consequence. Deflation is not economical malfunction and there is no experience when economy have been destroyed by deflation spiral. He also point at Japanese experience from 90s when cure for deflation has been long and massive quantitative easing, which did not led to economic growth, but to gigantic debt of Japan. Problem in Czech Republic Klaus see in structure. Firstly must be supplied aggregate demand made by government, firms and households. Households have no money now, banks does, but climate is risky for lending to public sphere so firms does not invest much too. Best is to lend money to government, but it have 3 % structural deficit annually and stopped investing (mainly to infrastructure) – magical circle of non-investing. And then after intervention is also very unclear what will happen later. Klaus asks whether is necessary to erase every short-term decreasing in economic cycle, because it is creation huge costs. Maybe it would be better to heal economy form weak subjects by short recession and then prosper more with solid foundations. Our exchange rate have been set to fixed to euro with hidden volatile zone and Klaus said he does not agree with this intervention. (Klaus, 2014)

2.5 Determination of method for analysis

As it is written at the beginning of this thesis, goal of this work is to find out whether foreign exchange intervention of Czech National Bank was simply “good or bad” move and whether Czech central bank hit its target and fulfil its goals.

Impacts of monetary intervention can be measured in many ways and by many methods. And by monetary intervention is now meant also phenomenon of last days – quantitative easing. Problem of identification differences between effects of quantitative easing and foreign exchange intervention tried to solve with method built on an SVAR models, Echavarría, López and Misas (2009). They found that an observed intervention shock depreciates the domestic currency just for one month. Another paper, by Echavarría, Vásquez and Villamizar (2010) identified an effect of intervention, but lasting just for minutes. These findings detected that sterilized foreign exchange intervention is not as effective tool to achieve goals as is long-lasting phenomena such as quantitative easing in developed economies or reduced risk premiums related with quite poor foundations in the developed world, or high prices international commodity. Nevertheless Lízal and Schwarz (2013) stated in BIS paper that is rational choice to use foreign exchange interventions to reduce monetary tension in conditions of an open economy. First reason is zero lower bound and need of some unconventional monetary tool. Second, the central bank has unlimited power when intervene against domestic currency. And third, lowering exchange rate will help to improve net export. They also stated, that in economy with plentiful liquidity in banking sector, as Czech Republic has, foreign exchange interventions are the most efficient way, how to realize quantitative easing. From research can be assumed there are differences in efficiency between non-standard tools of monetary policy, but in case of quantitative easing and foreign exchange intervention, there is the same purpose of tis launch and awaited are effect in the same field and solving the same or at least very similar problems. Therefore the methods, which are supposed to be evaluating and analysing this monetary moves, can be used the same, because for those methods does not matter whether were new printed money released on market in exchange for other currency or for one of many types of securities. Used methods can be sorted from those simplest as observing shape of line on graph of elemental macroeconomic indicators as GDP and estimating whether it moves after intervention in “better” direction then before intervention, to those most complicated and sophisticated econo-

metrical models. Joyce, Tong and Woods (2011) stated in quarterly (q3) bulletin of Bank of England devoted to analysis of running quantitative easing in United Kingdom that quantifying wider macroeconomic effects of quantitative easing is very difficult, because there is a lot of other important factors influencing British economy and it is almost impossible to isolate specific impacts of monetary intervention of BoE. Nevertheless studies on this problematics uses several approaches. A common one is to use structural vector autoregression (SVAR), which used on British economy Bridges and Thomas (2012) with result of positive effect of quantitative easing. On Japanese example counted this model Schenkelberg and Watzka (2011) looking for real effects of quantitative easing made by Bank of Japan and Hayashi and Koeda (2013), using even regime switching SVAR analysis. More complicated approach, multiple time-series models, used for Britain Kapetainos and collective (2012), who used three different time series models of varying complexity to perform counterfactual predictions of the effects of quantitative easing or Lenza, Phill and Reichlin (2010), who compared results of policies of European Central Bank, Federal Reserve and Bank of England. Bridges and Thomas (2012) also used monetary approach for calculate impact of monetary intervention. Outcomes of some of these studies collected Joyce, Tong and Woods (2011) and found, that all methods suggest that the effects of quantitative easing in United Kingdom were positive and economically significant. But they also realised there are just small differences in results and all values come out similar and with high level of uncertainty.

Under more detailed observation of these studies can be realized, these studies are based on development of economic indicators after interventions and all of them have been made at least several years after that intervening. They investigate how intervening changed economic indicators and crucial is to have data from time after this intervention had been launched. Havránek and Rusňák (2013) quoted, that results of their studies suggest that the transmission lags reported in the literature really do vary substantially: the average lag, corrected for misspecification in some studies, is twenty-nine months, with a standard deviation of nineteen months. In developed countries, and Czech Republic can be classified as one, financial institutions have more opportunities to hedge against surprises in monetary policy stance, which causing greater delays in the transmission of monetary policy shocks. In case of devaluation of Czech koruna there is at the time of making this thesis still not enough data from time when happened forex trade of central bank, which was tool for intervention.

Therefore approaches mentioned above cannot be used or results would not reflect impacts of devaluation. In this situation have to be used method which will not count specific causes made by intervening, but tells whether are domestic and surrounding economies in such condition, which would allow improvement in competitiveness of domestic economy after devaluation of domestic currency. Piskin (2014) wrote, that many countries in the world depreciated or devaluated their domestic currency as a way of stabilization policy. This step is usually made in order to improve their balance of trade or current account. This kind of policy became very popular throughout the period, when central bank of holds fixed exchange rate regime. The model formulating the policy maker's action is closely derived from Marshall-Lerner condition. The Marshall-Lerner condition, which states that a currency devaluation will only lead to an improvement in the balance of payments if the sum of demand elasticity for imports and exports is greater than one, is named after English economist Alfred Marshall (1842-1924) and the Romanian born economist Abba Lerner (1905 - 1985) (Fan and company, 2004). The seminal empirical paper by Houthakker and Magee (1969) found in their testing of Marshall-Lerner condition inconclusive evidence. Several subsequent studies using least-squares methods to estimate price elasticities in domestic import and export equations also produced ambiguous results (Khan 1974, Goldstein and Khan 1985, Wilson and Takacs 1979, Warner and Kreinin 1983, Bahmani-Oskooee 1986, Krugman and Baldwin 1987). In later studies, for example Reinhart (1995) studied a sample of twelve developing states and found that although relative prices have a systematic effect on exports and imports of the observed country. All the elasticities tended to be not exactly high and below unity. This suggests large monetary intervening against domestic currency being required to made up appreciable improvements in the trade balance. Also, the elasticities for more industrial states are well above states, which are not very developed, except those of Arica. Bahmani-Oskooee (1998) found support for the Marshall-Lerner condition from cointegration projects about some of developing states. Bahmani-Oskooee and Niroommand (1998) use data, which had been tested for stationarity and later Johansen's cointegration analysis to come up with new trade elasticities for roughly 30 states. Piskin (2014) came up with results, that Turkey should more coordinate its fiscal and monetary policy for more efficient use of currency, which would be profitable even through relatively inelastic import. Caporale, Gil-Alana and Mudida (2012) found Marshall-Lerner condition for Kenya met and pointed out the importance of composition

of export and their problem with high inflation. Eita (2013) stated, that his results indicate that world income has a positive effect on exports, while real exchange rate appreciation discourages exports. Imports respond positively to both domestic income and real exchange rate appreciation. The results indicate that imports and exports respond significantly to a change in the exchange rate and suggest that Marshall-Lerner condition holds for Namibia. Pandey (2013) found, that the sum of export elasticities and import elasticities of the real exchange rate exceeds unity, meaning that the Marshall Lerner condition holds for the Indian case. Also surprising was fact, that rising export indirectly supports import and it grows even through devaluation of currency. The results of Bahmani-Oskooee and Hosny (2013) provided support for the condition in 39 out of 59 industries in trade between Egypt and European Union. But not everywhere the condition holds, Canipe (2012) found in Ghana from historical data, that the effect of a currency devaluation on the cocoa industry is discussed. OLS and panel regressions conclude that the Marshall-Lerner-Robinson condition does not hold, implying a devaluation would lead to worsening the trade account. Also in Malaysia the condition does not work out. Sek and Har (2014) wrote that with applying the Least Square and Fully Modified Least Square approaches, their results fail to show the validity of Marshall-Lerner condition in all five pairs of bilateral trade. Also Loto (2012) concluded that devaluation/depreciation cannot improve the trade balance in the Nigerian economy. He even stated, that devaluation/depreciation can only benefit countries that are originally export based before the devaluation/depreciation of a currency. For Czechoslovakia have been tested Marshall-Lerner condition by Kočárník (1994), who found condition satisfying and devaluation efficient, but his study had been made just with 12 samples of observations, which in his words lowers trustworthiness his study.

As a template for procedure in studying Marshall-Lerner condition in Czech Republic in this thesis have been chosen mix of methods from several studies, mainly from Pandey (2013) and Kočárník (1994)

Chapter 2 (Literature overview) revealed issues of monetary intervening and its analysing. Interventions had been described and studied and later based on those information have been found suitable method for analysis of Czech economy, which tells whether are there optimal conditions for artificial currency devaluation.

Table 1 Summarization of the crucial studied papers

Author	Year	Country	Method	Conclusion
Joyce, Tong and Woods	2011	United Kingdom	SVAR	GDP and CPI increase, high uncertainty
Kapetanios and collective	2012	United Kingdom	Multiple time-series models	GDP and CPI increase, high uncertainty
Bridges and Thomas	2012	United Kingdom	Monetary approach	GDP and CPI increase, high uncertainty
Kočárník	1994	Czechoslovakia	Regression analysis, ML condition	significant, condition met
Loto	2011	Nigeria	Regression analysis, ML condition	not significant, condition not met
Caporale, Gil-Alana and Mudida	2012	Kenya	Regression analysis, ML condition	significant, condition met
Canipe	2012	Ghana	Regression analysis, ML condition	not significant, condition not met
Bahmani-Oskooee and Hosny	2013	Egypt	Regression analysis, ML condition	significant, condition met
Eita	2013	Namibia	Regression analysis, ML condition	significant, condition met
Piskin	2014	Turkey	Regression analysis, ML condition	significant, condition met
Sek and Har	2014	Malaysia	Regression analysis, ML condition	not significant, condition not met
Pandey	2014	India	Regression analysis, ML condition	significant, condition met

Source: Author's research

3 Methodology and data

In chapter methodology is theoretically described in detail the procedure of calculations from the beginning until the final results which supposed to be statement of satisfaction of Marshall-Lerner condition for Czech Republic.

3.1 Regression analysis

Before testing the Marshall-Lerner Condition in Czech Republic (demand elasticity for imports and exports) regression analysis will be used in this thesis to model export and import of the Czech Republic.

Regression analysis is a statistical method, which describes oscillations of one variable (the dependent variable Y) as a function of oscillations of one or more independent variables (explanatory variables or regressors, X) in a single regression model function. Regression analysis is capable of quantifying dependencies between economic variables and, therefore, it is one of the most used statistical methods in Econometrics.

There is very important to define dependent variable and regressors in regression analysis. Relationship between variables dependent variable and independent variables can be described by general regression model:

$$Y = f(X) + \varepsilon \quad (1)$$

Relationship between X and Y variables can be also formulated for the i -th observation in the multivariate dataset:

$$X_i, Y_i = f(X_i) + \varepsilon_i, \text{ where } i = \{1, 2, \dots, n\} \quad (2)$$

Function $f(X)$ denotes a linear function of the explanatory variables and the regression coefficients β and represents the deterministic component of the regression model, the fitted values. In a simple linear regression model dependent variable Y is function of:

$$Y = \beta_0 + \beta_1 X + \varepsilon \quad (3)$$

And multiple regressions with more than one explanatory variable have following form:

$$Y = \beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + \dots + \beta_K * X_K + \varepsilon, \quad (4)$$

where β_0 is a level constant, $\beta_1, \beta_2, \dots, \beta_K$ are the regression parameters and ε is stochastic term. Stochastic residual (error) term ε is variable representing a wide array of factors influencing the dependent variable Y , which are not explained by the explanatory variables X included in the model. (Wooldridge, 2009)

Dependent variable in this thesis will be represented by export which is a function of explanatory variables: gross national income (GNI of trade partners) and real effective exchange rate (REER). Second dependent variable is import which is function of regressors: GNI of Czech Republic and REER of Czech Republic.

$$\text{Export} = f(\text{GNI}_{\text{WORD}}; \text{REER}) \quad (5)$$

$$\text{Import} = f(\text{GNI}_{\text{CZ}}; \text{REER}_{\text{CZ}}) \quad (6)$$

How the export and import of the Czech Republic have grown in time can be seen from the figure bellow. Because both dependent variables Y (export and import) have exponential type of growth (trend) double logarithmic function form will be used.

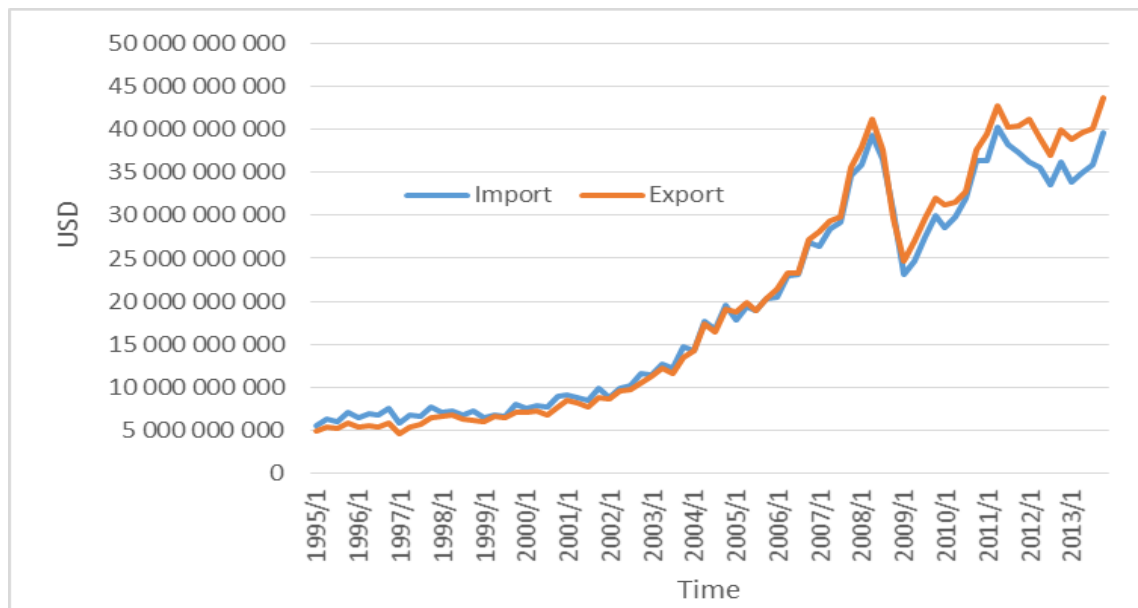


Figure 2 Export and import of the Czech Republic since 1995 till 2013
Source: Czech Statistical Office (2015), author's visualization

Double logarithmic function is a model of constant elasticity, where the dependent and independent variables are present in logarithmic form. Coefficient β_1 shows constant elasticity of Y with respect to X. β_1 gives percentage change in Y corresponding to percentage change in X (Studenmund, 2011).

$$\ln Y = \beta_0 + \beta_1 * \ln X_1 + \beta_2 * \ln X_2 + \dots + \beta_K * \ln X_K + \varepsilon \quad (7)$$

When it comes to function of import and export, models will look like:

$$\ln \text{export} = \beta_0 + \beta_1 * \ln \text{GNI}_w + \beta_2 * \ln \text{REER} + \varepsilon_1 \quad (8)$$

$$\ln \text{import} = \beta_0 + \beta_1 * \ln \text{GNI}_{cz} + \beta_2 * \ln \text{REER}_{cz} + \varepsilon_1 \quad (9)$$

Because thesis deals with the time series data, data need to be firstly tested on stationarity. Stationarity is a stochastic process whose joint probability distribution does not change when shifted in time. Consequently, parameters such as the mean and variance, if they are present, also do not change over time and do not follow any trends. Test for stationarity is Augmented Dickey Fuller Test. Its hypothesis are: H_0 : there is a unit root = non-stationarity. H_1 : there is not a unit root = stationarity.

For estimation numerical values of regression coefficients (β) in the thesis method of ordinary least squares (OLS) is used which is the most frequently used procedure. It is applicable to regression models, which are linear in pa-

rameters or can be linearized by some suitable transformation (logarithmic, reciprocal, etc.). OLS estimates the coefficients of regression models linear in parameters, where the dependent variable Y is modelled as an additive function of the products between the β coefficients and explanatory variables X , the regressors or their function forms. (Hušek, 2007)

However, performing a regression does not automatically give a reliable relationship between variables. Classical assumptions of well specified model must be fulfilled. List of the classical assumptions (Wooldridge, 2009):

- Regression model is linear in parameters, it is correctly specified and it has an additive error term.
- Expected value of the error term is zero.
- All explanatory variables are uncorrelated with the error term.
- Error terms are uncorrelated, there is no serial correlation.
- Error term has constant variance, there is no heteroskedasticity.
- No explanatory variable is a perfect linear combination of other explanatory variable(s). There is no perfect multicollinearity.

Statistical hypothesis is an assumption about the parameters. Hypotheses are formulated in such a way that their interpretation after validation allows decision making with a predetermined risk dispersion consisting in unauthorized rejection of true assumption. For their verification statistical tests are used.

Tests of statistical hypotheses are decision-making procedures, which, on the basis of the results obtained from the random selection, objectively determines decision whether the hypothesis should be rejected or not. The recommended procedure for testing statistical of hypotheses is following one (Budíková et al., 2010):

1. Formulate of the problem
2. Determinate null hypothesis and alternative H_1 hypothesis
3. Choice of significance level α (probability of incorrect rejection of H_0 , for this thesis significance level $\alpha = 0,05$ is used)
4. Obtaining the sample
5. Calculation of test statistics
6. Decision to reject or not reject null hypothesis based on the critical field
7. Interpretation of results

The coefficient of determination is based on the decomposition of the total sum of squares (TSS) on regression (ESS) and residual (RSS) the sums of squares. It measures the variance of empirical observations of the dependent variable around the regression model. The smaller the variance, the more complete is explanation of the changes of the dependent variable due to changes in the independent variables. The coefficient of determination R^2 takes values in the interval from 0 to 1. The closer is coefficient to 1, the more variability is explained, and vice versa. But there is a problem with unadjusted R^2 coefficient: is it may increase in situations, when nonsense explanatory variable(s) are added to the model. Due to this fact adjusted R^2 coefficient of determination is used, which increases only when a statistically significant regressor is added to the model. And of course the higher R^2 adj is the better one.

$$R^2 = \text{RSS} / \text{TSS} = 1 - (\text{ESS} / \text{TSS}) \quad (10)$$

Another indicator of good model is information criteria. There are Akaike information criteria (AIC), Schwarz's (Bayesian) information criterion (BIC) and Hannan-Quinn information criterion (HQC). The criteria are derived from transformed residual variance of the model corrected or sample size (n) and model complexity. Optimum regression model, in each criterion, should produce minimum value of that criterion.

T-test is testing significance of a chosen variable. Hypothesis for a t-test are: H_0 : coefficient is not significant, H_1 : coefficient is significant. H_0 is rejected when p-value of the regressor is lower than level α or when a t-ratio in its absolute value is greater than approximately 2. P-value is used to evaluate any statistical test, which implies known distribution of the test statistics. It is probability of observing more extreme value of the test statistics than that, which was received from the data. (Gujarati, 2004)

Ramsey's RESET test is test used in this thesis for detection of omitted variable in the model or incorrect specification. Their hypotheses are: H_0 : model is correctly specified. H_1 : model is not correctly specified. Evaluation will be based on the p-value; null hypothesis is rejected when p-value is lower than α .

One of the assumptions of the classical linear regression model is linear relationship between variables which can be tested by LM test. The null hypothesis of this test assumes that the relationship is linear. However, if p-value of this test will be lower than the significance level α , the alternative hypothesis is ap-

plied. Test of nonlinearity has two forms. The first is using squares, second works with logarithms.

Classical assumption refers about correlated of error term; there need to be no serial correlation which means error term from one time period should not depends on error term from other time periods. Test for serial correlation is Durbin-Watson test (DW test). DW test's hypotheses are: H_0 : serial correlation does not exist (errors are random), H_1 : serial correlation does exist (errors depend on one another in certain pattern).

Homoskedasticity means that all error terms are generated by single distribution with a constant variance. Heteroskedasticity is a violation of this classical assumption. All tests of variance homogeneity are based on statistical hypotheses. Null hypothesis tells that error term is homoskedastic. Opposite hypothesis H_1 says that error term is heteroskedastic. White test and Breusch Pagan test are general tests of heteroskedasticity which are also used in this thesis.

Classical assumption VI refers about multicollinearity. By the definition explanatory variable is a perfect linear combination of other explanatory variable(s). There is no perfect (multi)collinearity. (Multi)collinearity can be detected by Variance Inflation Factors, $VIF(\beta_j)$. Values > 10.0 may indicate a collinearity problem.

Normal distribution of stochastic error is classical assumption VII. There are many ways to verify normality of the error term. One of commonly used statistical test is Chi-square test of goodness of fit. The null hypothesis is always the same for all normality tests: H_0 : the error term is normally distributed. H_1 : the error term is not normally distributed. Another graphical method how to detect normality of residuals is Q-Q plot. Both tests are used in the thesis. (Gujarati, 2004)

3.2 Marshall-Lerner condition

Condition quotes: currency devaluation will only lead to an improvement in the balance of payments if the sum of demand elasticity for imports and exports is greater than one.

$$|e_{ex}| + |e_{im}| > 1 \quad (11)$$

Here e_{ex} stays for price elasticity of export and e_{im} for price elasticity for import. (Fan and company, 2004)

Thus it is needed to calculate elasticities, for which is used next equation, where percentage change of export is divided by percentage change of domestic price level. For price elasticity of import is equation the same, just the percentage change of export is changed with percentage change of import.

$$e_{ex} = \% ex / \% CPI \quad (12)$$

Where e_{ex} is price elasticity of export, $\% ex$ is percentage change of export and $\% CPI$ is percentage change of consumer price index or price level. (Kočárník, 1994)

For modified chart on Figure 9 called “Development of sums of elasticities of export and import from every four consecutive” is used calculation, where every elasticity in time series is sum of four elasticities of consecutive quarters, according to these equations:

$$e_A = \sum e_{1-4} \quad (13)$$

$$e_B = \sum e_{2-5} \dots \quad (14)$$

3.3 Data

For regression analysis are used quarterly data from 1995 Q1 to 2013 Q4 for each variable. Data about export and import of Czech Republic in USD have been found in database of Czech Statistical Office. Time series of REER indicator provides Czech National Bank. In database of World Bank and several central banks of particular countries, which had been needed, have been collected data of variable GNI_{cz}, which indicate gross national income of Czech Republic and GNI_w, which indicates gross national income of 29 countries, which have the biggest turnover of external trade with Czech Republic according to year 2014. Those countries listed by amount of turnover are: Germany, Slovakia, Poland, China, Russian Federation, France, Austria, Italy, United Kingdom, Netherlands, Hungary, United States, Belgium, Spain, Switzerland, Sweden, Korean Republic, Japan, Romania, Turkey, Ukraine, Norway, Denmark, Azerbaijan, Slovenia, Ireland, Thailand, India, and Finland. Taiwan was excluded due to World Bank, which include its data with Chinese data.

For calculation of elasticities for Czech Republic are used again quarterly data, but this time from 1996 Q1 to 2015 Q1. Export and import are again (or still) from database of Czech Statistical Office and data about price level, more

specifically consumer price index (CPI) values have been also found in database of Czech Statistical Office.

Data for elasticities calculations for United Kingdom are collected annually for the same period of time as for Czech Republic. All three variables (export, import and CPI of United Kingdom) have been provided by databases od Eurostat.

4 Econometric analysis

In this part of the thesis will be economical and statistical theory applied in practice. Data, more precisely time series, about import, export, gross national income, real effective exchange rate of Czech Republic and gross national income of the most significant external trade partners of Czech Republic, has to be stationary for regression. All time series had been converted to logarithms and afterwards tested for stationarity.

4.1 Test for a unit root

For testing stationarity have been chosen Augmented Dickey-Fuller test (ADF test), which is able to reject non-stationarity.

H_0 : there is an unit root = non-stationarity

H_1 : there is not an unit root = stationarity

Table 2 Results of ADF test at levels

Series	p-value	5 % significance level	Inference for series
l_REER	0,9932	0,05	Non-stationary
l_Import	0,7522	0,05	Non-stationary
l_Export	0,8635	0,05	Non-stationary
l_GNIcz	0,6151	0,05	Non-stationary
l_GNIw	0,3918	0,05	Non-stationary

Source: Author's calculation

From results in Table 2 can be seen p-values of all variables are significantly higher than 5 % significance level. This states all examined variables are non-stationary at levels. This fact is unacceptable for regression and there have to be calculated first difference of all logarithmic variables. Then must be ADF test launched again with differenced variables.

Table 3 Results of ADF test at the first difference of variables

Series	p-value	5 % significance level	Inference for series
d_1_REER	$8,26 \cdot 10^{-8}$	0,05	Stationary
d_1_Import	0,0028	0,05	Stationary
d_1_Export	0,0325	0,05	Stationary
d_1_GNIcz	0,0494	0,05	Stationary
d_1_GNIw	0,0456	0,05	Stationary

Source: Author's calculation

ADF test of the first difference of logarithmic variables brought much favourable results than the first attempt of the same test as can be seen in Table 3. All p-values of all five time series are lower than 5 % significant level. Therefore H_0 can be rejected. This means there is not a unit root and variables are stationary at the first level of difference. When time series are stationary, they are ready for regression analysis.

4.2 Regression analysis of model 1

Regression analysis – Ordinary least square method is made to find out volume of dependency of dependent variable on independent one. Method of backward elimination approach will be used. Firstly there are used all independent variables to model export and import and then variables with low significance are removed one by one.. In Table 4 are expected signs of results of regression function, based on basic economic facts. If GNI of trade partners abroad rise, it causes rise of demand for domestic export. If domestic REER rises (rise competitiveness), domestic export rises too, but on the other side falls domestic import. And appreciation in domestic GNI causes logically appreciation in domestic import.

Table 4 Expected signs of independent variables

Equasion	Dependent variable	Independent variable	Expected sign
1	export	GNIw	+
		REER	+
2	import	GNIcz	+
		REER	-

Source: Author's calculation

There are two equations to be calculated in this thesis. The first one has the first difference of logarithmic export of Czech Republic in position of dependent variable. Independent variables are GNI of the biggest external trade partners of Czech Republic and REER of Czech Republic. Formats of both independent variables are first differences of logarithms because first differences were found to be stationary (ADF test).

$$d_1_export = \beta_0 + \beta_1(d_1_GNIw) + \beta_2 d_1_REER) + \varepsilon_1 \quad (15)$$

Table 5 OLS full model 1

	coefficient	sdt. error	t-ratio	p-value	significance
const	-0,002705	0,011714	-0,2309	0,818	
GNIw	2,24241	0,659625	3,4	1,10E-03	***
REER	0,758908	0,297044	2,555	0,0127	**
Mean dependent variable	0,029189		S.D. dependent variable	0,084233	
Sum squared residue	0,410784		S. E. of regression	0,075534	
R-squared	0,217613		Adjusted R-squared	0,19588	
F(23, 23)	10,01303		P-value(F)	0,000146	
Log - likelihood	88,84875		Akaik criterion	-171,6975	
Schwarz criterion	-164,7450		Hannan-Quinn	-168,9214	

Source: Author's calculation

In Table 5 can be seen that not all variables are significant (constant has p-value higher than 0,05 and no *), thus next step is to remove not significant variable, which is constant, and run the model again, expecting better results.

Table 6 OLS model 1 without not significant variable

	coefficient	sdt. error	t-ratio	p-value	significance
GNIw	2,1448	0,5031	4,263	5,94E-05	***
REER	0,750549	0,292912	2,562	0,0125	**
Mean dependent variable	0,029189		S.D. dependent variable	0,084233	
Sum squared residue	0,411088		S. E. of regression	0,075042	
R-squared	0,301987		Adjusted R-squared	0,292425	
F(23, 23)	15,79126		P-value(F)	2,00E-06	
Log - likelihood	88,82098		Akaik criterion	-173,6420	
Schwarz criterion	-169,0070		Hannan-Quinn	-171,7913	

Source: Author's calculation

After second run of the model there can be seen in Table 6 positive direction of movement in results of all indicators made by Gretl automatically. $R^2_{adjusted}$ increased by 9 percentage points (the higher the better) and information criteria which are other indicator of good model decreased (the lower the better). Also all variables still contained in model are significant, which mean we will not remove any of them again and this is the final model of export. Nevertheless modelling a regression does not have to result into reliable relationship between variables. To find out whether is the relationship between export and GNI and REER acceptable or not, it must be tested by seven classical assumptions of a good model.

4.2.1 Correct specification of the model 1

When we have final model with only significant variables, it have to be tested on classical assumptions. There are seven classical assumptions defined and if model pass through these tests, it can be declared as well specified. First tested is linearity with Lagrange Multiplier test (LM test) of linearity.

H_0 : model is linear (function form is fine)

H_1 : model is non-linear (function form is wrong)

Table 7 Results of LM test, model 1

Test statistics	TR ²	with p-value
Polynomic form	2,23594	P(Chi-square(2) > 2,23594) = 0,326943

Source: Author's calculation

Counted results of LM tests came out in value in Table 7, from which it is obvious that model is linear and its function form is correct (p-value are higher than 0, 05, it failed to reject H₀).

Second classical assumption, which has to be tested is detection of omitted variables in the model. This can confirm or rejects Ramsey's RESET test for detection of omitted variable in the model or incorrect specification of the model. Its hypothesis are:

H₀: model is correctly specified

H₁: model is not correctly specified

Table 8 Results of RESET test, model 1

Test statistics	F	with p-value
Values	2,152891	P(F(2,71) > 2,15289) = 0,124

Source: Author's calculation

From p-value in Table 8 can be seen that rejection of null hypotheses failed, therefore model is correctly specified.

Next step in testing classical assumptions is to test model significance. There are several indicators as R²adj and information criteria, which were automatically calculated by Gretl and it can be found in Tab. 5 above. R²adj indicates that regression model in this case explains 29, 24 % of the total variability, in other words almost 30 % of variability of export was explained through the model.

Other classical assumption in relationship between variables, classical assumption number IV deals, with correlation. There could be a serial correlation between time series data, it means error term from one time period depends on error term from other time periods. Time series data are tested for his phenomenon by Durbin-Watson test (DW test), which tests serial correlation of the first order. DW test's hypotheses are:

H₀: serial correlation does not exist (errors are random)

H_1 : serial correlation does exist (errors depend on one another in certain pattern)

Table 9 Results of DW test, model 1

Test statistics	DW statistics	p-value
Values	2,38266	0,952924

Source: Author's calculation

From values, which offers Table 9 can be observed value of Durbin-Watson statistic. That is very close to 2, which means there is almost no autocorrelation in the model. P-value is also higher than 0.05, which indicates also fail to reject H_0 . There is no serial correlation in the model. Error term from one time period does not depend on error term from other time periods. Classical assumption number IV was fulfilled.

By the classical assumption V error term has constant variance. It means there is a requirement of homoskedasticity of the error term. Homoskedasticity means that all error terms are generated by single distribution with a constant variance. Heteroskedasticity is a violation of this classical assumption. First will be used White test for testing heteroskedasticity. All tests of variance homogeneity are based on the same common statistical hypotheses:

H_0 : error term is homoskedastic

H_1 : error term is heteroskedastic

Table 10 Results of White test, model 1

Test statistics	TR ²	with p-value
Values	7,023819	P(Chi-square(5) > 7,023819) = 0,218875

Source: Author's calculation

P-value in Table 10 is greater than significance level 0,05. This fact results in not rejecting the null hypothesis of homoskedasticity, therefore there is no heteroskedasticity of the error term.

The same conclusion gave us Breusch-Pagan test, which tests also presence of heteroskedasticity in error term, but uses different methodology of calculation. Nevertheless hypothesis are the same as in the case of White test.

H_0 : error term is homoskedastic

H_1 : error term is heteroskedastic

Table 11 Results of Breusch-Pagan test, model 1

Test statistics	LM	with p-value
Values	5,492068	P(Chi-square(2) > 5,492068) = 0,064182

Source: Author's calculation

Results of second test of variance homogeneity, Breusch-Pagan test came out with the same deduction, which can be read from p-values in Table 11. It also fails to reject the null hypothesis of homoskedasticity, therefore there is no heteroskedasticity of the error term, confirmed by both tests.

Classical assumption VI refers about multicollinearity, which basically means explanatory variable is a perfect linear function of some or all the remaining explanatory variables. For detection of this phenomenon between variables was used test Variance Inflation Factors (VIF(β_j)).

Table 12 Results of VIF test, model 1

Variables	d_l_GNIw	d_l_REER
Values	1,01	1,01

Source: Author's calculation

Values greater than 10.0 may indicate a collinearity problem. From output of VIF test in Table 12 can be observed that both regressors are lower than 10, therefore collinearity problem can be rejected.

Stochastic error term is normally distributed, is classical assumption VII. There are many ways to verify normality of the error term. One of commonly used statistical test is Chi-square test of goodness of fit. The null hypothesis is always the same for all normality tests:

H_0 : the error term is normally distributed

H_1 : the error term is not normally distributed

Table 13 Results of Chi-square test, model 1

Test statistics	Chi-square(2)	with p-value
Values	1,837	0,39908

Source: Author's calculation

In Table 13 can be read p-value for normality test, which is greater than significance level 0,05 and due to this fact failed rejection of H_0 . Error term is then normally distributed.

On Figure 3 is distribution of stochastic error of model 1, which Chi-square test confirmed as normally distributed.

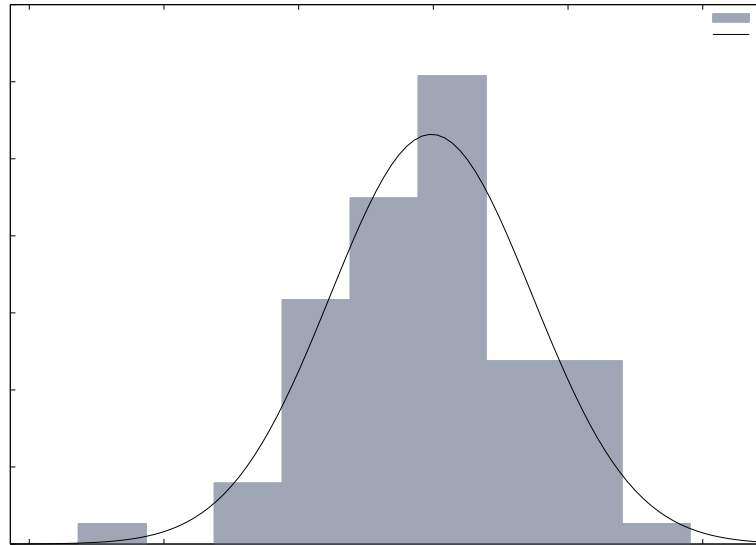


Figure 3 Results of Chi-square test, model 1
Source: Author's calculation, output from Gretl software

Another graphical method how to detect normality of residuals is Q-Q plot. The result can be seen from the Figure 4. When the red points are situated on the blue line or near to the blue line, residuals are normally distributed. Classical assumption number seven was fulfilled.

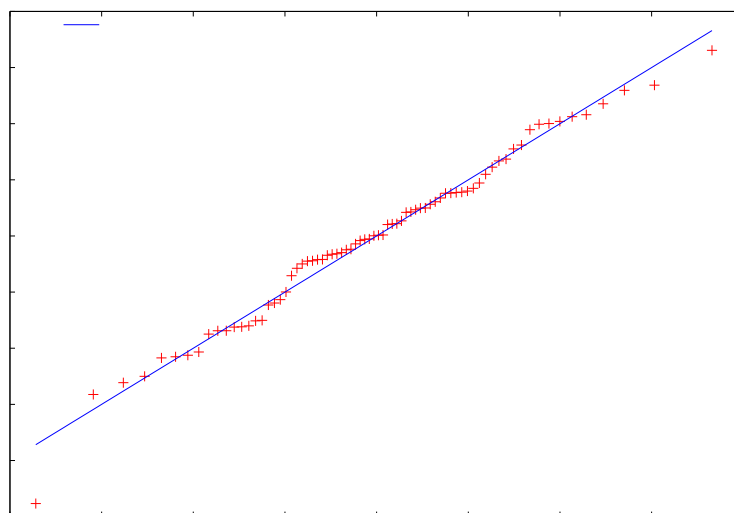


Figure 4 Q-Q plot of normal distribution, model 1
Source: Author's calculation, output from Gretl software

4.3 Regression analysis of model 2

Procedure made with the first equation will be as well applied in the same composition on second equation for regression analysis. There is in position of dependent variable import of Czech Republic. Independent variables are GNI of Czech Republic and REER of Czech Republic. Formats of dependent variable import and both independent variables are also first differences of logarithms because first differences were found to be stationary (ADF test).

$$d_1_import = \beta_0 + \beta_1(d_1_GNIcz) + \beta_2(d_1_REER) + \varepsilon_2 \quad (16)$$

Table 14 OLS full model 2

	coefficient	sdt. error	t-ratio	p-value	significance
const	-0,00322	0,00961	-0,3352	0,7384	
GNIcz	1,23347	0,19043	6,477	1E-08	***
REER	0,66604	0,3035	2,195	0,0314	**
Mean dependent variable	0,026175		S.D. dependent variable	0,099417	
Sum squared residue	0,414004		S. E. of regression	0,075829	
R-squared	0,433949		Adjusted R-squared	0,418225	
F(2, 72)	27,59849		P-value(F)	1,27E-09	
Log - likelihood	88,55589		Akaik criterion	-171,1118	
Schwarz criterion	-164,1593		Hannan-Quinn	-168,3357	

Source: Author's calculation

From values in Table 14 can be seen very similar situation as have been observed in Table 5 regression analysis of the first model. There is one not significant variable with higher p-value than 0, 05 and no * (constant), which will be removed and model will be processed again with the rest of variables.

Table 15 OLS model 2 without not significant variable

	coefficient	sdt. error	t-ratio	p-value	significance
GNIcz	1,21154	0,17775	6,816	2,28E-09	***
REER	0,65064	0,29818	2,182	0,0323	**
Mean dependent variable	0,026175		S.D. dependent variable	0,099417	
Sum squared residue	0,41465		S. E. of regression	0,075367	
R-squared	0,470282		Adjusted R-squared	0,463026	
F(2, 73)	32,40463		P-value(F)	8,46E-11	
Log - likelihood	88,49741		Akaik criterion	-172,9948	
Schwarz criterion	-168,3598		Hannan-Quinn	-171,1441	

Source: Author's calculation

Results of the second run of the model can be seen in Table 15. Positive direction of movement in results of all indicators made by Gretl automatically was obtained, like it was in the first model. R² adjusted increased by almost 5 percentile points and values of information criteria (AIC, BIC and HQC) decreased which is sign of better model of import than model of import with constant. Thus it will be continued in the same procedure as was used in the first model, which was testing of all seven classical assumption of correct specification of the model.

4.3.1 Correct specification of the model 2

Testing classical assumption of model 2 will be perform with shorter comments, because tests are the same as tests in case of model 1.

Classical assumption I – linearity – LM test.

H₀: model is linear (function form is fine)

H₁: model is non-linear (function form is wrong)

Table 16 Results of LM test, model 2

Test statistics	TR ²	with p-value
Polynomic form	2.01468	P(Chi-square(2) > 2.01468) = 0.365188

Source: Author's calculation

According to Table 16 H₀ failed to reject, model is linear, function form fine.

Classical assumption II – omitted variable in the model – RESET test.

H_0 : model is correctly specified

H_1 : model is not correctly specified

Table 17 Results of RESET test, model 2

Test statistics	F	with p-value
Values	0.073841	$P(F(2,71) > 0.0738406) = 0.929$

Source: Author's calculation

From p-value in Table 17 can be seen that rejection of null hypotheses failed, therefore model is correctly specified.

Classical assumption III – model significance - indicators as R^2_{adj} and information criteria can be found in Table 14 above. R^2_{adj} indicates regression model in this case explains 46,3 % of the total variability of import, which better result than result obtained by adjusted R^2 coefficient of determination in model of export.

Classical assumption IV – serial correlation – DW test.

H_0 : serial correlation does not exist (errors are random)

H_1 : serial correlation does exist (errors depend on one another in certain pattern)

Table 18 Results of DW test, model 2

Test statistics	DW statistics	p-value
Values	2.20712	0.840606

Source: Author's calculation

According to Table 18 is DW statistic close to 2, there is almost no autocorrelation and H_0 failed to reject. There is no serial correlation in the model.

Classical assumption V – heteroskedasticity – White test.

H_0 : error term is homoskedastic

H_1 : error term is heteroskedastic

Table 19 Results of White test, model 2

Test statistics	TR ²	with p-value
Values	3.898367	P(Chi-square(5) > 3.898367) = 0.564140

Source: Author's calculation

According to Table 19 H_0 failed to reject, there is no heteroskedasticity.

And second test for heteroskedasticity - Breusch-Pagan test

H_0 : error term is homoskedastic

H_1 : error term is heteroskedastic

Table 20 Results of Breusch-Pagan test, model 2

Test statistics	LM	with p-value
Values	3.079881	P(Chi-square(2) > 3.079881) = 0.214394

Source: Author's calculation

According to Table 12 H_0 failed to reject too, both tests confirmed there is no heteroskedasticity in error term of the model.

Classical assumption VI – collinearity – VIF(β_j) test

Table 21 Results of VIF test, model 2

Variables	d_l_GNIcz	d_l_REER
Values	1.046	1.046

Source: Author's calculation

According to Table 21 are both values lower than 10, therefore there is no multi-collinearity between variables.

Classical assumption VII – normal distribution – Chi-square test

H_0 : the error term is normally distributed

H_1 : the error term is not normally distributed

Table 22 Results of Chi-square test, model 2

Test statistics	Chi-square(2)	with p-value
Values	0.724	0.69634

Source: Author's calculation

According to Table 22 H_0 failed to reject, error term is normally distributed, which is visualized in graphical output of Gretl software in Figure 5.

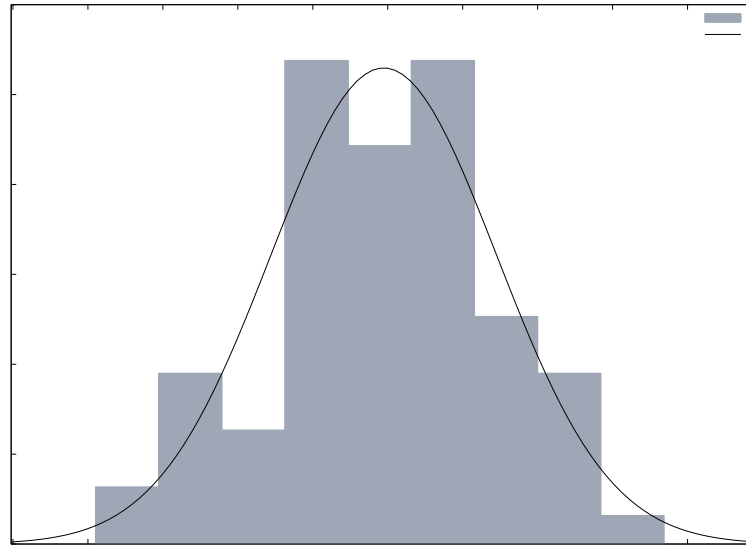


Figure 5 Results of Chi-square test, model 2
Source: Author's calculation, output from Gretl software

Second graphical method for detection normality of residuals - Q-Q plot. According to results in Figure 6, residuals are normally distributed.

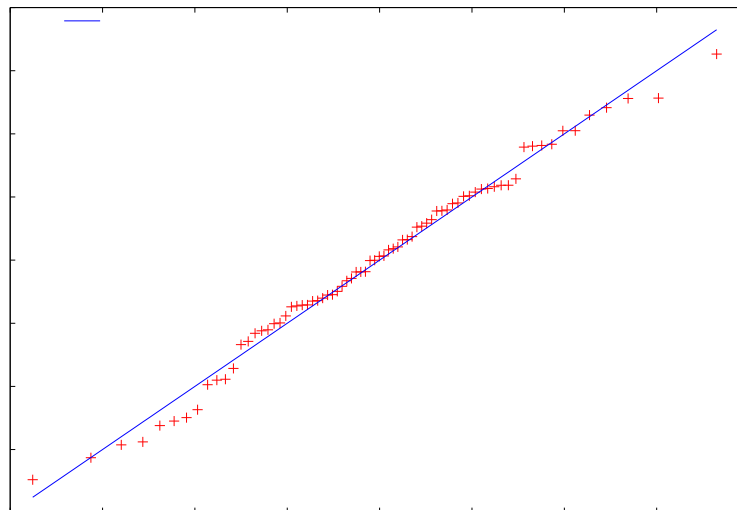


Figure 6 Q-Q plot of normal distribution, model 2
Source: Author's calculation, output from Gretl software

4.4 Interpretation of results of regression analysis

On two models (model of import and export) there had been applied regression analysis calculated by OLS method and those final models had been tested for correct specification with positive results. Their results shown in tables 5 and 14 and summed up in equations bellow however have to be compared to expectation of sign of its results according to economic theory noted in Table 3

$$d_1_export = 2,14 * d_1_GNIw + 0,75 * d_1_REER \quad (17)$$

$$d_1_import = 1,21 * d_1_GNIcz + 0,65 * d_1_REER \quad (18)$$

Table 23 Expected and calculated results of regression analysis

Model and dependent variable	Model 1 export		Model 2 import	
	GNIw	REER	GNIcz	REER
Expected sign	+	+	+	-
Final coefficient	2,1448	0,7505	1,2115	0,6506

Source: Author's calculation

For more transparency are data on one place in Table 23. It is obvious from results of model 1 of export as explained variable that explanatory variables are corresponding with expectation and there can be basically says: when GNI of the biggest external trade partners of Czech Republic rises, it will cause rise of amount of export from Czech Republic. Positive coefficient of REER means: when REER coefficient of Czech Republic rises (competitiveness of Czech Republic rise), it will cause rise of amount of export from Czech Republic.

However in model 2 with import as explained variable there can be observed a deviation in corresponding between results and expected results of regression analysis stated by economic theory. In case of variable GNIcz it is OK and result quote: when GNI of Czech Republic rises, it will cause rise of amount of import into Czech Republic. Nevertheless variable REER was expected to results in negative value, which would quote: when REER coefficient of Czech Republic fall (competitiveness of Czech Republic fall), it will cause rise of amount of import to Czech Republic. But according to result from regression analyses it says: when REER coefficient of Czech Republic rises (competitiveness of Czech Republic rises), it will cause rise of amount of import to Czech Republic. This does not correspond with economic theory. In this situation there are two alternatives how to continue in calculations of elasticity.

- Model 2 will be declared as explanatory, even there is a contradiction with economic theory and elasticity of import will be later counted.
- Model 2 will be declared as wrong and not explanatory, because it results in contradiction with economic theory and elasticity of import will be later counted as zero.

4.5 Elasticity of export and import

This chapter will deal with calculation of elasticity, which is needed for testing of Marshall-Lerner condition. Calculation of elasticity follows the results of regression analysis, where have been proven significance of influence of the exchange rate on export and its correspondence to economic theory. On the other way the results of regression analysis also revealed, that significance of influence of the exchange rate on import is in contradiction with economic theory. Due to this situation, two alternative calculations of elasticity, described earlier in chapter 4.4, will be performed.

First alternative of testing the Marschall-Lerner condition contains both elasticities, thus elasticities of export and import. For finding those, quarterly data of export, import and consumer price index (CPI) of the Czech Republic, had been collected. Quarterly data for CPI are available since 1996 Q1, but on the other way up to 2015 Q1, which are export and import too. Elasticities will be then calculated from data of volume 77 consecutive quarters of the year. Elasticity of export have been calculated as percentage change of export divided by percentage change of CPI and elasticity of import have been calculated as percentage change of import divided by percentage change of CPI. Theory claims that price elasticity of export should result naturally in negative value or in different words in value with negative sign. It is based on fact, witch said: when price level in country rises, its export becomes more expensive for customers abroad, thus the amount of export will fall; on the other way also domestic production will appreciate prices and for customers in observed country is more efficient to buy goods and services made abroad, because its prices stay the same, thus become lower than appreciated prices of domestic production. (Kočárník, 1994)

Table 24 Price elasticity of export and import of Czech Republic

Time series	Export	Import
Resulting elasticity	3,3468	2,8171

Source: Author's calculation

Resulting elasticities can be found in Table 24, but what also can be found there, is another contradiction with the economic theory. Price elasticity of export actually resulted in positive value. Result in fact says that the amount of export is increasing even through increasing price level. In other words: even price level in Czech Republic rises about 1 %, the export of Czech Republic rises too, about 3,35 %. It means although Czech products became more expensive about 1 %, exportation of these products is so powerful and demand for Czech production is abroad so massive, that the export rises anyway, about 3,35 %. Partly in contrast and partly not with price elasticity of export is price elasticity of import. Sign of elasticity resulted also in positive value, but this time it is in conformity with theory. Particularly in statement, which says: when price level in Czech Republic rises about 1 %, import of goods and services from abroad increases about 2,82 %. Resulted elasticity of import seem to be logical, but even when are data of development of export and price level observed in detail, must be concluded, that resulted elasticity of export is logical too, even it is against economic theory. From middle 90s, when time series of this observation started, rose export of Czech Republic totally about more than 600 %, but price level rose totally "just" about roughly 100 %.

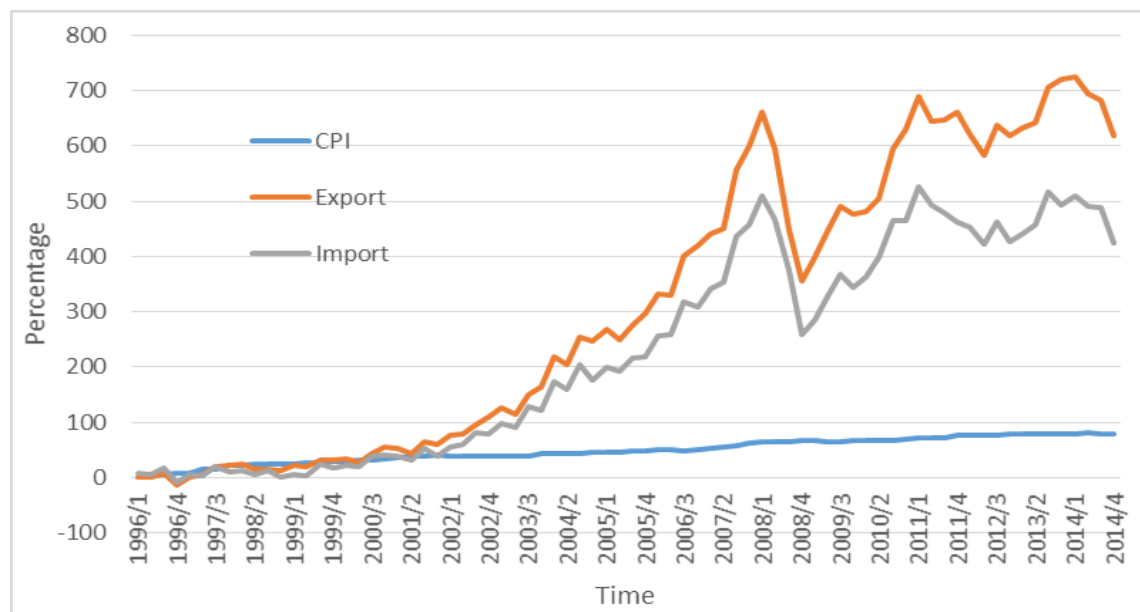


Figure 7 Growth of CPI, export and import of Czech Republic from 1996 Q2 to 2015 Q1
Source: Czech statistical office 2015, author's visualization

This situation actually cannot result in any other output, than: even price level rises, export rises too. However it cannot be interpreted as: when price level rises, export rises too, which would lead in statement, that price level should be artificially increased, because it will cause an increase of export. Increasing of price level of course does not help exporters to better turnover. Oppositely. It complicates their lives of course. But as had been written above, demand for goods and services abroad is so strong, amount of export is getting bigger even through increasing price level in Czech Republic. According to theory can be said that with stable unchanged price level would export of Czech Republic rise even faster, but this calculation does not explain how much faster. Speed of growth of export during different levels of price level growth can be found in Table 25. Such a massive increase in export during last 20 years is probably result of communistic system in Czechoslovakia before 90s, which kept closed borders to the western markets. After fall of this system full of restrictions and after establishing new state of Czech Republic and calming the economical roller-coaster of those days, western markets started to demand cheaper goods and services from country with significantly lower price level. And that catapulted amount of export from Czech Republic into significantly higher levels much faster, then the price level.

Marshall-Lerner condition combines the elasticity of export and import and the condition says that elasticities in absolute value have to give result greater

than 1. Only then will devaluation of currency cause the improvement in balance of trade. At first glance looks condition very easy. Just to count two numbers together and compare to the third number, but the tricky part is to understand why it is like this. The value of elasticity is of the essence. Elasticity is responsiveness of customers in amount of purchased products to change in price of that products. Basically can be said: when is increased or lowered price of shoes, elasticity tells how much more or less of them have been sold after. When price lowers about 1 % and sales increase about 4 %, response of customers is four times greater than change in price by seller. And seller will profit, because he will lose 1 % of profits from price, but gain 4 % more sold goods. Problem is when seller lowers price about 1 %, but sales increase about just 0,5 %. Seller then lose 1 % of profits from price, but gain just 0,5 % more sold goods. Seller lost. Identical situation works in international trade. If the elasticity of export is higher than 1, it is efficient for country to intervene and lower prices of exported products by devaluation of currency, because it will bring more profits than losses. But in international trade we have to count also with opposite direction of trade, which is import. To import press prices of products (price level) oppositely. When prices of products lowers in country and it helps to export, it also hurts import, because products from abroad becomes more expensive and people rather buy domestic cheaper product. It is because exports are profits for a country and imports losses, which moves oppositely as react on one move of price change, it is enough when are its individual absolute values of elasticities lower than 1, but its sum must be greater than 1. Then is sum of higher profits from higher export and saved money from lower expenses for lower import, in total more profitable, than losses from currency devaluation.

It must be realized, our calculation actually does not explain particular decrease in export growth, caused by increase in price level, but in Table 25 shown how export and import rose or fell during periods with certain level of price level growth. Anyway, based on elasticities, which contain whole observed period, can be claimed that the Marshall-Lerner condition in Czech Republic is satisfied, because even only elasticity of import alone is greater than 1 ($2,82 > 1$). To satisfy this condition actually does not bring anything more, than assurance that if country devaluates currency, it will improve its balance of trade, which brings higher profits to the country. In case of alternative 1 can be said, that it is not known the exact effect of price level on export, but lowering price level (by devaluation of koruna) would probably help export to rise even faster than 3,35 %

quarterly, but we do not know how much more. And it would also cause decrease of import about 2,82 % quarterly. According to this calculation can be quoted: monetary intervention against koruna will improve the balance of trade of Czech Republic and profits from intervention will be several times higher than losses.

The second alternative of testing the Marshall-Lerner condition, alternative which emerged from regression analysis, exclude from calculations the elasticity of income (more precisely elasticity of import will be counted as zero), because this variable had been explained by model declared in contradiction with economic theory, thus declared not explanatory. Counted elasticity of export then have to be greater than 1 to satisfaction of Marshall-Lerner condition. As have been mentioned above, elasticity of export was calculated as 3,35. This result would at first glance satisfy the condition, but it does not. This result can be explained as: there is a massive growth of export, which rises about 3, 35 % quarterly even though price level rises quarterly about 1 %. This result actually does not describe damages, which the price level causes to export growth, thus cannot be described the exact percentage of export growth caused by devaluating currency. There is no import elasticity to be added in this alternative, thus it have to be stated: this alternative does not provide enough data to certainly prove that Marshall-Lerner condition is satisfied in Czech Republic. If Czech National Bank intervenes against Czech koruna, it will stimulate growth of export to even steeper growth, nevertheless there is not enough data to be determined how much steeper. Even cannot be satisfied the Marshall-Lerner condition, still can be quoted that intervention will be improving the trade of balance, because export will rise and import will stagnate, but there is no assurance of efficiency of such an intervention.

Different point of view on collected data can bring Table 25. When is not the time series observed as a unit with one elasticity composed from number of pieces, studied quarters can be concentrated into several groups according to level of CPI (price level) growth in those particular quarters. Then can be observed how fast was average growth or fall of export and import in quarters with similar level of CPI growth. There is clear trend in development of averages of export growth, which proves the fact that lower growth or fall of price level stimulates (or less hurts) the speed of export growth. Only the last line with quarters with highest growth of price level does not correspond, but it can be explained by very low number of samples in this category, which can be mis-

leading. On the other way very contradicting to expectation is development of averages of import growth. Theoretically should import grow with the price level, but entirely opposite trend can be observed from these results. Reasons why is growth of import in Czech Republic faster with slower grow or fall of price level can be consequence of composition of Czech industry. A significant car production, leader of Czech export needs more car parts, when export rises, even it is imported.

Table 25 Average export and import growth during different levels of CPI in Czech Republic

Levels of CPI growth in %	Samples	Average price level growth	Average export growth	Export elasticity	Average import growth	Import elasticity
(-0,97 to 0>	17	-0,33%	4,38%	-13,36	6,06%	-18,49
(0 to 0,5>	20	0,26%	3,21%	12,34	3,99%	15,31
(0,5 to 1>	13	0,70%	2,08%	2,98	1,82%	2,59
(1 to 1,5>	12	1,28%	2,22%	1,74	0,15%	0,12
(1,5 to 2>	6	1,68%	0,89%	0,53	1,16%	0,69
(2 to 2,5>	5	2,16%	-2,16%	-1,00	-7,18%	-3,33
(2,5 to 5>	3	4,47%	4,35%	0,97	-1,73%	-0,39

Source: Author's calculation

Other interesting thing to see is development of elasticities in time. On the Figure 8 are elasticities of export and import of every single quarter of the year from 1996 Q2 to 2015 Q1. From the picture can be observed seasonal trend and several massive disturbances. In 2003 Q4 growth export and import roughly about 20 % and price level increased just about 0.1 %, which is why elasticities hiked up so massively. Similar situation happened after the famous financial crisis hit Czech economy. Several other crises and difficulties followed and from that time are almost all economic indicators in Czech economy erratic.

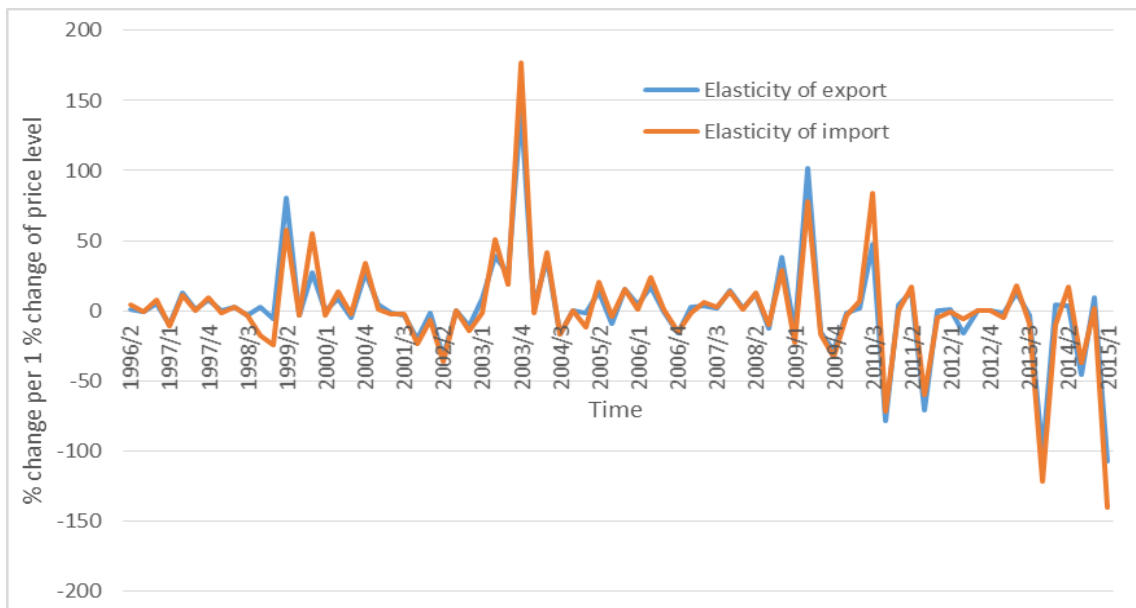


Figure 8 Individual quarterly elasticities of export and import of Czech Republic from 1996 Q2 to 2015 Q1

Source: Czech statistical office 2015, author's visualization

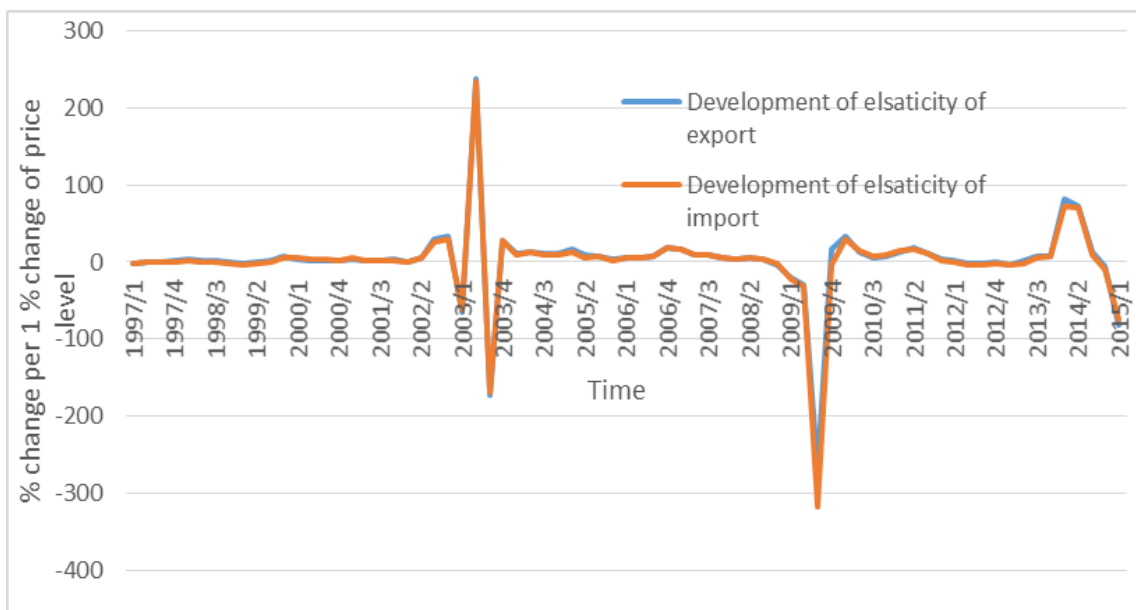


Figure 9 Development of sums of elasticities of export and import from every four consecutive quarters from 1996 Q1 to 2015 Q1

Source: Czech statistical office 2015, author's visualization

Because individual elasticities of every single quarter can be misleading and chaotic, there is a Figure 9, where is shown modified development. Every elasticity value is sum of elasticities of four consecutive quarters (first sum is from 1996 Q1, Q2, Q3, Q4; second sum if from 1996 Q2, Q3, Q4, 1997 Q1; ...). This

should remove not significant deviations and leave in chart only significant development. Now can be seen when ratio of percentage change of export/import and price level in Czech Republic suffered the greatest disturbances. Those are almost the same as in the case of individual quarterly data in Figure 8.

4.6 Comparison with United Kingdom

One of the goals of this thesis is comparison between situation in Czech Republic and United Kingdom. Intervening of central banks from both countries in described in chapters 2.3.2 and 2.4. The main difference between monetary interventions of these countries is in way and time of intervention. Brits intervene in 2009, right at the time, when great financial crisis, which started in 2007, fully impact on economy of European countries. And for monetary intervention they chose the way of quantitative easing. On the other side, Czech central bank decided to intervene quite long time after crisis, at the end of 2013, when was Czech Republic unable to dig itself up from the mug of global financial crisis, followed by crisis of over indebtedness of several European countries and then crisis of EU itself. Czech National Bank however did not choose quantitative easing as a tool for intervention, but used foreign exchange trade. Level of efficiency of both tools can be object of speculation, but truth is that both methods starts in printing machine of central bank, which produce new money and send it to the market. Difference between methods is the way, how bank distributes those money. BoE bought commercial papers with it and CNB euros. But, evaluation of impacts of intervention is complicated in both cases. Czech intervention happened very recently and the effect requires several years to show itself entirely. Whereas British case is in fact heavily influenced by mentioned crisis and even analysts from BoE, Joyce, Tong and Woods (2011), admitted that estimation of some specific numbers is almost impossible. Despite this, they collected results from several studies looking for these effects (Figure 10), but commented, that there is very high level of uncertainty.

Method	Level of GDP (per cent)	CPI inflation (percentage points)
SVAR	1½	¾
Multiple time-series models average impact ^(a)	1½	1¼
Monetary approach ^(b)	2	1
Bottom-up approach	1½–2½	¾–2½
Range across methods ^(c)	1½–2	¾–1½

(a) Kapetanios *et al* (2011) (these estimates are based on the lower variant reported by the authors).

(b) Bridges and Thomas (2011).

(c) Calculated using the mid-point of the reported range for the bottom-up approach.

Figure 10 Estimates of the macroeconomic impact of quantitative easing, peak impact on the level of output and inflation

Source: Joyce, Tong and Woods (2011)

For better possibilities of comparison between both countries in this thesis, the Marshall-Lerner condition had been tested also in United Kingdom. For this calculation have been used annually data, but in the same time range as for calculation for Czech Republic. At first is expected that variables export and import are significantly influenced by indicator of competitiveness REER, as were tested for export and import of Czech Republic with regression analysis and this procedure will not be taken for time series data from United Kingdom. Results, placed in Table 26, are the same by sign as results from Czech Republic, just its value is lower. With satisfying of Marshall-Lerner condition are then the same difficulties in both countries with positive sign of export, which does not explain how great the percentage change of export is, when price level increases about 1 %. In United Kingdom is the difficulty even greater, because import does not reach value 1, thus it is not known whether the sum of elasticities is greater than 1, which would satisfy the Marshall-Lerner condition in United Kingdom.

Table 26 Price elasticity of export and import of United Kingdom

Time series	Export	Import
Resulting elasticity	0,7596	0,8346

Source: Author's calculation

Table 27 is the same as Table 25 with data from Czech Republic, just with data from United Kingdom. And here can be observed entirely opposite trend in development of averages of export growth, than is in Czech Republic. Average export growth is much higher with higher growth of price level in United Kingdom, which is in contradiction with economic theory. However growth of British import has also opposite trend than the Czech one. And this corresponds to economic theory perfectly.

Table 27 Average export and import growth during different levels of CPI in United Kingdom

Levels of CPI growth in %	Samples	Average price level growth	Average export growth	Export elasticity	Average import growth	Import elasticity
(0,78 to 1,5>	7	1,25%	-1,13%	-10,40	-0,99%	-8,89
(1,5 to 2,5>	6	2,02%	1,84%	5,49	2,23%	6,74
(2,5 to 4,39>	5	3,29%	5,05%	0,16	4,95%	6,97

Source: Author's calculation

4.7 Comparison with Slovak Republic

Comparison between Czech Republic and its smaller brother and former second half of Czechoslovakia, Slovak Republic, was included in this thesis, because interesting differences in development of macroeconomic indicators after intervention could be found. Both republics have actually been in very similar situation back in 2013. Expected economic regeneration after crisis still did not come, but what did come, was apprehension from deflation. This phenomenon still did not happened, but very low inflation with slowing trend indicated deflation soon and quite clearly. Interesting rates have been on technical zero in both countries. However the main difference between Czech and Slovaks is in using currency. Czech Republic has its own currency and is also its ruler. Central National Bank has a possibility to work with currency in whatever way is needed, like devaluation for facing the imminent deflation. On the other side Slovaks do not have their own currency anymore, in 2009 entered Slovak Republic the European Monetary Union, shortly Eurozone. That time Slovakian central bank lost all monetary authority above currency in own its country, thus was not able to manipulate with exchange rate for avoiding deflation. From chart on Figure 11 can be observed differences of development of inflation rates in both countries. Inflation rate was calculated as an increase in CPI compared with the corresponding month of preceding year indicates percentage change in price level

between the reference month of a given year and the corresponding month of preceding year. This figure excludes seasonal variations, as always corresponding months are compared. Slovakian inflation rate reached zero and then transformed itself to deflation in the beginning of 2014. Since that time could not the movement of price level reached positive value any more. Czech inflation rate however never fell to zero. Whether it is because of central bank's intervention, launched in November 2013, can be object of speculation. But probably yes, Czech Republic would fell into the deflation too, like Slovak Republic.

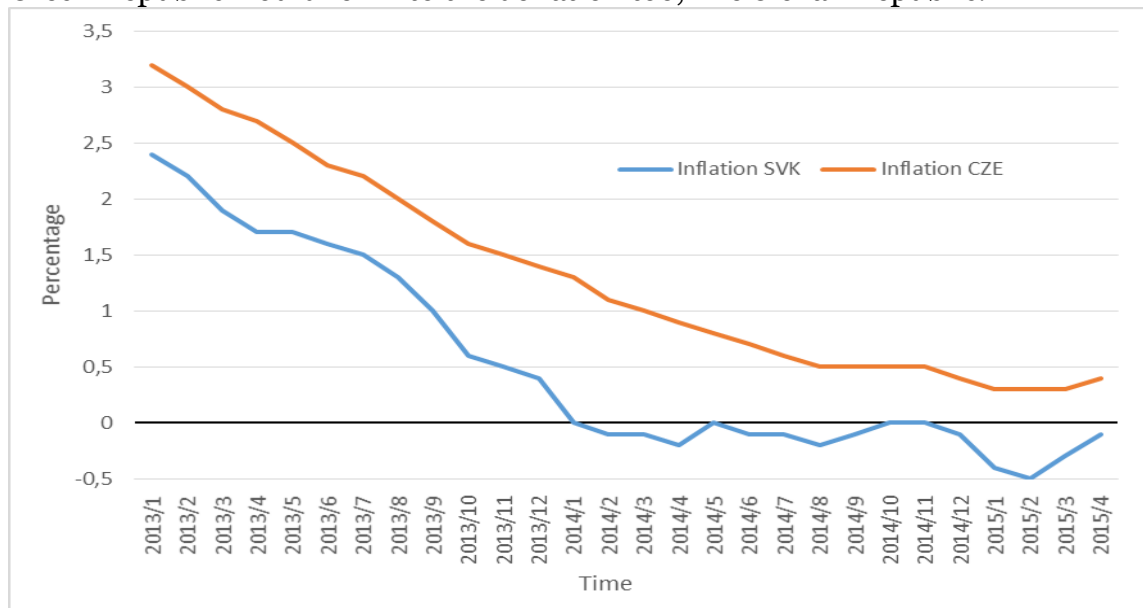


Figure 11 Development of inflation/deflation rate in Czech Republic and Slovak Republic

Source: Czech Statistical Office (2015), Statistical Office of the Slovak Republic (2015), author's visualization

Compared can be these two countries also in latest data about GDP, which stimulation was also secondary goal of monetary intervention of Czech Republic. Figure 12 clearly shows significantly better condition of GDP growth in Czech Republic, however Slovak Republic has problem to keep the growth itself and do not fall to decreasing of GDP. Whether this Czech higher growth of GDP is effect of monetary intervention, can be again just speculated, until there is enough of data after suitable period of time from intervention and proper methods could be used to quantify this influence.

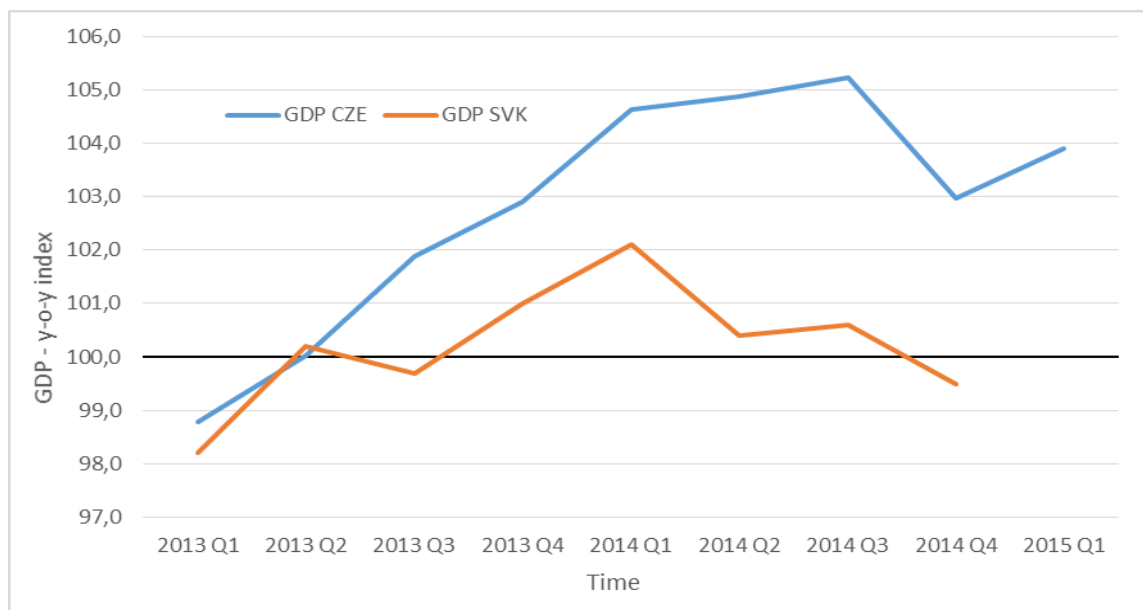


Figure 12 Development of GDP of Czech Republic and Slovak Republic in y-o-y index

Source: Czech Statistical Office (2015), Statistical Office of the Slovak Republic (2015), author's visualization

According to these two charts can be said that Czech Republic is in better economic condition after intervention of CNB than Slovak Republic. However to draw conclusions about size of effect of intervention on Czech economy, would be just speculation.

5 Discussion

In chapter discussion is step by step confronted calculation procedure used in thesis. From the literature research and theoretical background studied in first part of thesis is obvious that thesis cannot calculate direct amount of impacts created by intervention of Czech National Bank, due to lack of data about economic indicators after intervention. Then have been found method called Marshall-Lerner condition for testing whether brings devaluation some improvement into balance of trade in observed economy or not.

Regression analysis was necessary step, taken according to procedures used in other studies with similar purpose in different countries. Thanks to this analysis is calculated whether is development of export and import sufficiently influenced by indicator of competitiveness, REER, and in case of import by GNI of Czech Republic and in case of export by GNI of the greatest external trade partners of Czech Republic. Theoretical background considered this analysis as crucial for finding whether devaluation, which changes exchange rate, which changes REER, will have expected effects on international trade of case of Czech Republic is somehow specific and there is no or opposite influence. Calculation in this thesis proved positive influence of REER on amount of export, but contradictory to theory also positive influence of import. This can be explained as boosting of export followed by boost of import, even it is more expensive. Probably because products for exportation (cars lead Czech export) needs very specific supply, which production does not have to be located in relatively small Czech Republic at all and industry simply cannot react so fast. Nevertheless two alternatives of results was decided to use in further procedure. Count with results about import and without it (actually count with it, but with zero value).

Next step to successful prove or disproof of Marshall-Lerner condition led through calculation of elasticity. Theoretical background expected the elasticity of export be negative and of import positive. In this thesis resulted elasticity of import of whole observed period positive, which explains grow of import during grow of domestic price level but of export negative. This contradiction can be explained by data itself. During the period grown export significantly faster than price level, which could not led to a negative sign of elasticity. To express how of price level influences speed of export growth were particular quarters listed according to speed of growth or fall of price level during those. Quarters in groups with similar price level growth could express then how fast grows export during

different levels of CPI grow. According to table can be estimated the elasticity of export roughly between -1 and -2. This value corresponds with studied theory and would be useful for testing Marshall-Lerner condition. However table also shows import, which behaves very similar to export, maybe even more rapid, which is this time again contradictory to studied economic theory. It seems export and import rise almost constantly even through almost constant price level and rise and fall with export, which reacts to the economic environment according to economic theory. This deviation however is not anything new in the world, for example study in India found similar phenomenon.

According to alternative, which counts to Marshall-Lerner condition both directions thus cannot be satisfaction of condition proven, because computing procedure in this thesis did not generate particular elasticity, just an estimation. Then it is not clear whether give both elasticities together result greater than one or not. On the other way according to alternative 2, when is import count as zero, because regression analysis evaluated import as variable explained against economic theory, left in the equation just export and his absolute value greater than one, thus Marshall-Lerner condition is satisfied for Czech Republic. That is in comparison to studies in other countries quite normal.

This thesis could be further prolong in calculation real impacts of intervention. But this could only be happen after there is enough data about macroeconomic indicators. It would be interesting to compare results of calculations in this thesis with those future ones.

6 Conclusion

The main goals of this thesis were the evaluation of the foreign exchange intervention of Czech National Bank against Czech koruna and comparison Czech Republic with United Kingdom and Slovak Republic. To successful reach of these goals, literature research had been made, which gathered information about this issue. After enough theoretical background have been collected, it was certain that any analysis, which would result in particular relevant values of effects and impacts of intervention, cannot be made yet, because it is still too early after the devaluation and there is not enough data. Subsequent further research shown an method suitable for evaluation of economic environment in Czech Republic, which reveals whether would devaluation of Czech koruna improve balance of trade in Czech Republic or not. This method is called the Marshall-Lerner condition.

For testing the Marshall-Lerner condition had to be calculated elasticities of export and import of Czech Republic. For this were collected quarterly data of Czech export, import, REER, GNI and GNI of greatest Czech partners in external trade. These variables have been in two models testing by regression analysis, which should have explain whether is export and import sufficiently effected by price level and exchange rate, represented by REER index. After data have been made stationary, both models have been calculated and its results tested by seven classical assumptions of correct specification of the model. Tests ended up fine and development of export was found as sufficiently explained by REER. However import was explained with value with opposite sign instead of which was expected. It showed that when rises competitiveness of Czech Republic, rises also import, which is contradictory to theory, because when import is more expensive, it should decrease. According to these findings was decided to calculate two alternatives for Marshall-Lerner condition. First with elasticity of import even results of regression analysis are against theory and second with import elasticity of zero value.

Elasticity of import and export had been counted from quarterly data of import, export and CPI of Czech Republic and its values for whole observed period were 3,35 for export and 2,82 for import. Which are percentage changes of export and import when price level rises about 1 % in Czech Republic. Rise of import when price level rises was expected, but it has to be realized that export does not usually rise when products are for customers abroad more expensive.

This number actually shows that even price level rises about 1 %, export still rise about 3,35%. For better imagination how fast export rises at different highs of speed of price level growth, particular quarters have been separated into groups according to speed of price level growth and then average growths of export in groups have been observed (Table 25). From these results was clear that growth of export is lower with increasing speed of price level growth, which is logical and expected. But as surprising was found the development of import, which was almost the same as export, maybe even more rapid. Elasticities of both variables were according to this separated data estimated somewhere between -1 and -2.

In the situation of the first alternative of Marshall-Lerner condition, where elasticity of import is included, cannot be, according to data computed by used methods, clearly estimated particular value of elasticities. Thus cannot be Marshall-Lerner condition in Czech Republic satisfied, because it is not known whether values of elasticities gives together result greater than one (which is the mathematical interpretation of condition). However the condition can neither be confirmed as not satisfied.

Nevertheless in the situation of the second alternative of Marshall-Lerner condition, when was according to results of regression analysis calculated import with zero value, is the condition satisfied. It is because absolute value of elasticity of export is greater than one. Thus this alternative claims that devaluation of Czech koruna will lead in improvement of balance of trade in Czech Republic.

From the calculated values can be concluded that export of Czech Republic reacts on price level in Czech Republic quite sensitively (with elasticity between 1 and 2) and according to economic theory, but import follows the rise and fall of export, which should be reversely. The possible explanation suggests itself as a composition of both trades. Cars and computers leads the export of Czech Republic and its parts and natural resources leads the import. This means even are prices of import more expensive, Czech export needs for its grown.

Situation in Czech Republic was also compared with situation in United Kingdom, where had been used quantitative easing a few years earlier. Several studies calculated that intervention stimulated GDP growth about 1,5 – 2 % and inflation about 1 %. But Brits used for intervention amount of money equivalent to 30 % of their foreign debt and Czechs just about 7 %, when British debt to GDP ratio was 67 % that time and Czech 46 %. Interesting thing about United

Kingdom is also result of separating years with same inflation rate in groups during calculation of elasticities. Data showed in United Kingdom are rises of export and import also tied together, but under the command of import.

Development of GDP and inflation in Czech Republic after intervention was compared to Slovak Republic. Slovaks have been in similar situation before intervention of CNB, stumbling economy with imminent deflation, but they do not have the same possibilities of monetary moves, because they accepted euro and that is not under their control. Differences in development of GDP and inflation between both countries can indicate effects of Czech intervention. It have to be admitted Czech inflation by y-o-y method did not hit the zero level after intervention, however Slovaks fell into the deflation in the beginning of 2014 and could not get out since then. And in matter of GDP is Czech Republic's performance also significantly better.

7 Literature overview

BAHMANI-OSKOOEE, M. AND F. NIROOMAND. *Long-run price elasticities and the Marshall-Lerner condition revisited*. Economics Letters. 1998.

BAHMANI-OSKOOEE, M. *Cointegration approach to estimate the long-run trade elasticities in LDCs*. International Economic Journal. 1998.

BAHMANI-OSKOOEE, M. *Determinants of international trade flows: the case of developing countries*. Journal of Development Economics. 1986.

BAHMANI-OSKOOEE, Mohsen a Amr Sadek HOSNY. EUROPEAN JOURNAL OF DEVELOPMENT RESEARCH. *Long-Run Price Elasticities and the Marshall-Lerner Condition: Evidence from Egypt-EU Commodity Trade*. 2013. Dostupné také z: <http://www.palgrave-journals.com/ejdr/journal/v25/n5/full/ejdr201242a.html>

BANK OF ENGLAND. *Quarterly Bulletin*. 2011 Q3. Dostupné také z: <http://www.bankofengland.co.uk/publications/Documents/quarterlybulletin/qb1103.pdf>

BARBER, William J. *A history of economic thought*. 1st Wesleyan ed. Middletown, Conn: Wesleyan University Press, 2009. ISBN 978-081-9569-387.

BHATIA, H. *History of economic thought*. New Delhi: Vikas Pub. House, c1978, ix, 496 p. ISBN 07-069-0585-7.

BRIDGES, Jonathan a Ryland THOMAS. 2012. *The impact of QE on the UK economy – some supportive monetarist arithmetic*. Working Paper No. 442. Bank of England. Dostupné také z: <http://www.bankofengland.co.uk/research/Documents/workingpapers/2012/wp442.pdf>

BRUE, Stanley L a Randy R GRANT. *The evolution of economic thought*. 8th ed. Andover: Cengage Learning [distributor], c2013, xvi, 580 p. ISBN 978-1-111-82367-2.

CANIPE, Judith Olivia. UNIVERSITY OF TENNESSEE. *Testing the Marshall-Lerner-Robinson Condition in Ghana prior to 1983: Was a devaluation of the cedi justified in improving the trade balance?*. 2012. Dostupné také z: http://trace.tennessee.edu/cgi/viewcontent.cgi?article=2545&context=utk_gradthes

CAPORALE, Guglielmo Maria, Luis A. GIL-ALANA a Robert MUDIDA. *Testing the Marshall-Lerner Condition in Kenya*. Working Paper No. 12-22. Brunel University, London, 2012. Dostupné také z: http://www.brunel.ac.uk/___data/assets/pdf_file/0009/234279/1222.pdf

Česká národní banka a důsledky intervence. *Penize.cz* [online]. 2013. Dostupné z: <http://www.penize.cz/kurzy-men/275795-ceska-narodni-banka-a-dusledky-intervence>

DAVIDSON, Paul. *The Keynes solution: the path to global economic prosperity*. 1st ed. New York, NY: Palgrave Macmillan, 2009, 196 p. ISBN 02-306-1920-7.

Devizová politika centrální banky. *BANKOVNICTVÍ A FINANCE - STUDIUM* [online]. 2008. Dostupné z: <http://bankovnictvi-finance.studentske.eu/2008/04/devizov-politika-centrln-banky.html>

ECHAVARRÍA, J., D. VÁSQUEZ a M. VILLAMIZAR. *Impacto de las intervenciones cambiarias sobre el nivel y la volatilidad de la tasa de cambio en Colombia*. Ensayos de política económica. 2010.

ECHAVARRÍA, J., E. LÓPEZ a M. MISAS. *Intervenciones cambiarias y política monetaria en Colombia. Un análisis de var estructural*. Borradores de Economía 580. Banco de la República, 2009.

EITA, Joel Hinaunye. INTERNATIONAL BUSINESS & ECONOMICS RESEARCH JOURNAL. *Estimation Of The Marshall-Lerner Condition For Namibia*. 12. 2013. Dostupné také z: <http://www.cluteinstitute.com/ojs/index.php/IBER/article/download/7826/7888>

Euro foreign exchange reference rates. *European Central Bank* [online]. 2015. Dostupné z: <http://www.ecb.europa.eu/stats/exchange/eurofxref/html/index.en.html>

FAN, Jin, Qingwu ZHENG, Yan WANG, Xiaohui YUAN a Junwei LIANG. *Does the Marshall-Lerner condition holds in China?*. Brussels. 2004. Dostupné také z: <https://www.iioa.org/conferences/intermediate-2004/pdf/389.pdf>

FRANTA, Michal, Tomáš HOLUB, Petr KRÁL, Ivana KUBICOVÁ, Kateřina ŠMÍDKOVÁ a Bořek VAŠÍČEK. RESEARCH AND POLICY NOTES 3: Měnový kurz jako nástroj při nulových úrokových sazbách: případ ČR. *Česká národní banka* [online]. 2014. Dostupné z: http://www.cnb.cz/miranda2/export/sites/www.cnb.cz/cs/vyzkum/vyzkum_publicace/rpn/download/rpn_3_2014_cz.pdf

GOLDSTEIN, M. AND M.S. KHAN. *Income and price effects in foreign trade*. R.W. Jones and P.B. Kenen (eds.). *Handbook of International Economics*. North-Holland, Amsterdam. 1985.

GUJARATI, Damodar N. *Basic econometrics*. 4th ed., Tata McGraw-Hill ed. New Delhi: Tata McGraw-Hill, 2004. ISBN 978-007-0597-938.

HAVRÁNEK, Tomáš a Marek RUSŇÁK. INTERNATIONAL JOURNAL OF CENTRAL BANKING. *Transmission Lags of Monetary Policy: A Meta-Analysis*. 2013. Dostupné také z: <http://www.ijcb.org/journal/ijcb13q4a2.pdf>

HAYASHI, Fumio a Junko KOEDA. 2013. *A Regime-Switching SVAR Analysis of Quantitative Easing*. CARF-F-322. CARF Working Paper. Dostupné také z: <http://www.carf.e.u-tokyo.ac.jp/pdf/workingpaper/fseries/F322.pdf>

History of SNB Interventions. *SNBCHF* [online]. 2014. Dostupné z: <http://snbchf.com/chf/chf-history/financial-crisis-snb-interventions/>

HOUTHAKKER, H. a S. MAGEE. *Income and price elasticities in world trade*. *Review of Economics and Statistics*. 1969.

HUŠEK, Roman. *Ekonometrická analýza*. Vyd. 1. Praha: Oeconomica, 2007, 367 s. ISBN 978-80-245-1300-3.

Intervence ČNB ještě nikdy ničemu neprospěly. *Financninoviny.cz* [online]. 2013. Dostupné z: <http://www.kurzy.cz/~nr/tema/1921248.html>

Introduction to the IMF. *International Monetary Fund* [online]. 2015. Dostupné z: https://www.imf.org/external/np/exr/center/mm/eng/mm_intro.htm

JOYCE, Michael, Matthew TONG a Robert WOODS. 2011. *The United Kingdom's quantitative easing policy: design, operation and impact*. Quarterly bulletin 2011 Q3. Bank of England. Dostupné také z: <http://www.bankofengland.co.uk/publications/Documents/quarterlybulletin/qb110301.pdf>

KAPETANIOS, George, Haroon MUMTAZ, Ibrahim STEVENS a Konstantinos THEODORIDIS. 2012. *Assessing the economy-wide effects of quantitative easing*. Working Paper No. 443. Bank of England. Dostupné také z: <http://www.bankofengland.co.uk/research/Documents/workingpapers/2012/wp443.pdf>

KHAN, M. *Import and export demand in developing countries*. IMF Staff Papers. 1974.

KLAUS, Václav. *Byla deflace opravdu hrozbou?*. Vyd. 1. Praha: Institut Václava Klause, 2014, 44 s. Publikace (Institut Václava Klause), č. 7/2014. ISBN 978-808-7806-043.

KOČÁRNÍK, Ivan. MINISTERSTVO FINANCÍ ČESKÉ REPUBLIKY VE SPOLUPRÁCI S ČESKOU NÁRODNÍ BANKOU. *Finance a úvěr*. Praha: Ekonomia, a.s., 1994. Dostupné také z: http://journal.fsv.cuni.cz/storage/2230_199402mm.pdf

KRUGMAN, P.R. AND R.E. BALDWIN. *The persistence of the US trade deficit*. Brookings Papers on Economic Activity. 1987.

LENZA, Michele, Huw PILL a Lucrezia REICHLIN. 2010. *Orthodox and heterodox monetary policies*. Dostupné také z: http://archives.cerium.ca/IMG/pdf/2-_Monetary_policy_in_exceptional_times.pdf

LÍZAL, Lubomír a Jiří SCHWARZ. MONETARY AND ECONOMIC DEPARTMENT. *Foreign exchange interventions as an (un)conventional monetary policy tool*. BIS paper no 73. 2013. Dostupné také z: <http://www.bis.org/publ/bppdf/bispap73i.pdf>

LOTO, M. A. *Does devaluation improve the trade balance of Nigeria?*. 3(11). 2011. ISSN 2006-9812. Dostupné také z: <http://www.academicjournals.org/journal/JEIF/article-abstract/4BEFF5B5788>

OGANESYAN, Gayane. *The changed role of the lender of last resort: Crisis responses of the Federal Reserve, European Central Bank and Bank of England [Working Paper]*. Institute for International Political Economy Berlin, 2013. Dostupné z: <http://hdl.handle.net/10419/70787>

PANDEY, Ritesh. GLOBAL JOURNAL OF MANAGEMENT AND BUSINESS STUDIES. *Trade Elasticities and the Marshal Lerner Condition for India*. 3. Research India Publications, 2013. ISSN 2248-9878. Dostupné také z: http://www.ripublication.com/gjmbs_spl/gjmbsv3n4_13.pdf

PISKIN, Sercan. *SHORT-RUN AND LONG-RUN DYNAMICS OF TRADE BALANCE: TESTING FOR THE VALIDITY OF MARSHALL LERNER CONDITION AND J-CURVE HYPOTHESIS IN TURKEY*. Lund University, 2014. Dostupné také z: <http://lup.lub.lu.se/luur/download?func=downloadFile&recordOid=4648246&fileOid=4648247>

REINHART, C.M. *Devaluation, relative prices and international trade: evidence from developing countries*. IMF Staff papers. 1995.

REVENDA, Zbyněk. *Centrální bankovníctví*. 2. rozš. vyd. Praha: Management Press, 2001, 782 s. ISBN 80-726-1051-1.

RHOADS, Steven E. Marginalism. *Library of economics and liberty* [online]. 2008. Dostupné z: <http://www.econlib.org/library/Enc/Marginalism.html#>

SCHENKELBERG, Heike a Sebastian WATZKA. 2011. *Real Effects of Quantitative Easing at the Zero Lower Bound: Structural VAR-Based Evidence from Japan*. Dostupné také z: http://www.sfm.econ.uni-muenchen.de/forschung/aktuelle_papers/monpol_zlb_2011_10_20.pdf

SCREPANTI, Ernesto a Stefano ZAMAGNI. *An outline of the history of economic thought*. 2nd ed. rev. and expanded. New York: Oxford University Press, 2005, xviii, 559 p. ISBN 978-019-9279-142.

SEK, Siok Kun a Wai Mun HAR. JOURNAL OF ADVANCED MANAGEMENT SCIENCE. *Testing for Marshall-Lerner Condition: Bilateral Trades between Malaysia and Trading Partners*. 2. 2014. Dostupné také z: <http://www.joams.com/uploadfile/2013/1225/20131225040245555.pdf>

SOJKA, Milan. *John Maynard Keynes a současná ekonomie*. Vyd. 1. Praha: Grada, 1999, 156 s. ISBN 80-716-9827-X.

STUDENMUND, A. *Using econometrics: a practical guide*. 6th ed. Boston: Addison-Wesley, 2011, xvii, 616 p. Pearson series in economics. ISBN 01-313-6773-0.

The Economist explains: Why the Swiss unpegged the franc. *The Economist* [online]. 2015. Dostupné z: <http://www.economist.com/blogs/economist-explains/2015/01/economist-explains-13>

The Great Depression and the New Deal. *Boundless* [online]. 2014. Dostupné z: <https://www.boundless.com/political-science/textbooks/boundless-political-science-textbook/economic-policy-16/history-of-economic-policy-101/the-great-depression-and-the-new-deal-539-4247/>

VARDI, By Liana. *The physiocrats and the world of the enlightenment*. New York: Cambridge University Press, 2014. ISBN 978-110-7681-408.

VISSER, H. *A guide to international monetary economics: exchange rate theories, systems and policies*. 3rd ed. Northhampton, MA: E. Elgar, 2004, xii, 259 p. ISBN 18-437-6595-0.

WARNER, D. AND M.E. KREININ. *Determinants of international trade flows*. Review of Economics and Statistics. 1983.

WILSON, J.F. AND W.E. TAKACS. *Differential responses to price and exchange rate influences in the foreign trade of selected industrial countries*. Review of Economics and Statistics. 1979.

WOOLDRIDGE, Jeffrey M. *Introductory econometrics: a modern approach*. 4th ed. Mason, OH: South Western, Cengage Learning, 2009, xx, 865 p. ISBN 03-246-6054-5.