Mendel University in Brno
Faculty of Business and Economics

The impact of exchange rate on manufacturing industry in Czech Republic

Bachelor Thesis

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Hereby I would like to thank my thesis supervisor Ing. Miroslav Radiměřský for his assistance, valuable advices, and professional guidance. His comments and recommendations have been really helpful while working on this thesis.

Also I want to thank the firm which was willing to provide me data and knowledge.

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Abstract

Březinová, K., The impact of exchange rate on manufacturing industry in Czech Republic. Bachelor thesis. Brno: Mendel University, 2015.

Bachelor thesis evaluates the development of exchange rate of the Czech crown with the respect to the euro and its impact on manufacturing industry of the Czech Republic. The main methods used in this thesis are correlation matrix and coefficient of elasticity of time series exchange rate and manufacturing production or turnover from export of manufactured goods. The work also includes a case study, where the findings are applied on given manufacturing factory. The operational aim is the determination of possible protection against exchange rate volatility, so called hedging.

Keywords

Exchange rate, manufacturing industry, manufacturing production, coefficient of correlation

Abstrakt

Březinová, K., Vliv měnového kurzu na zpracovatelský průmysl České republiky. Bakalářská práce. Brno: Mendelova univerzita, 2015.

Bakalářská práce hodnotí vývoj měnového kurzu české koruny vůči euru a jeho vliv na zpracovatelský průmysl České republiky. Hlavní metody použité v této práci jsou korelační matice a koeficient elasticity časových řad devizového kurzu a produkce nebo obratu zpracovatelského průmyslu. Součástí práce je také aplikace poznatků na podnik zabývající se výrobou. V souladu s cílem je také v práci uvedena možnost, jak se proti výkyvům kurzu zajistit, tzv. hedging.

Klíčová slova

Měnový kurz, zpracovatelský průmysl, průmyslová produkce, koeficient korelace

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1 Introduction, aim and methodics of thesis

1.1 Introduction

The faster globalization of markets worldwide increases the importance of foreign-exchange rate in international trade. The international trade enables the exchange of capital, goods, and services across international borders or territories. For the Czech Republic, the export of numerous manufactured goods that are used in the production of automobiles, furniture, and electrical appliances is completely determinative. In January 2010, the machinery and transport equipment formed a share of 54.3% on export; behind them were industrial and consumer goods creating 11.1% (Czech Statistical Office). Hence, the industry forms a major sector of the Czech economy – its share is 35%. Moreover, It has been employing over 40% of the economically active population. This share ranks the Czech Republic on the first place among member states of European Union (The World Factbook). Currently, the Czech industry is dependent on exports especially to Germany, then to Slovakia and France.

However, the development and growth of manufacturing industry in Czech Republic is influenced by many factors, I have decided to analyze the effect of exchange rate specifically on this sector, because at the end of 2013, the Bank Board of CNB has commenced the foreign exchange interventions. For a small open economy with a long-term excess of liquidity in its banking sector, which the Czech Republic for sure is, this is a more effective instrument to ease the monetary conditions than any other. Moreover, using of foreign exchange interventions as an appropriate tool for countering deflation risks was recommended by an International Monetary Fund in 2013. A weakening of the exchange rate of the Czech crown leads to increase the import prices and therefore increase in the domestic price level as well. To a certain extent, it also supports the domestic economic activity. Even though the growth in import prices can be expected to reduce households' purchasing power, the demand of households may be redirected towards domestic goods and services in a greater extent and additionally supported by lower real interest rates as a result of higher inflation expectations. Simultaneously, a weaker exchange rate encourages Czech exports and the profitability of corporations and their willingness to invest. Currently, the Czech economy operates in the so-called managed floating regime. It means that the exchange rate is floating, but the central bank may turn to interventions if there will be any extreme fluctuations. All of these settings in Czech economy create a business environment for producers and exporters and influence their performance.

Thus, the exchange rate volatility and regimes are crucial factors to be observed by exporters to properly determine and set their business strategy or optionally ensure hedging. Since the exchange rate´s impact on Czech industry sector is being richly discussed recently, the single researches have not provided definite and suffi-

cient results. The importance of relationships between exchange rate and manufacturing sector´s indicators have been motivation to work out this thesis.

1.2 Aim of thesis

In my thesis, I am going to analyze the impact of exchange rate on manufacturing industry in the Czech Republic. I am going to evaluate the exchange rate development of Czech crown and Euro, and find out whether the exchange rate is influencing the manufacturing sector. I will compare my results and findings with existing theories concerning this topic and eventually justify why results differ. Moreover, these impacts will be shown on particular firm, which is trading on EU market and considers exchange rate of CZK/EUR as key for its production and functioning. Individual testing will be performed on the basis of correlation matrix and elasticity coefficient, where the interrelationship of examined variables will be identificated. Results of calculations will be processed and will serve to set the conclusion of this thesis. At the end will be mentioned possibilities how to secure against the exchange rate volatility.

1.3 Methodics of thesis

The methodology of this study is mainly based on correlation coefficient, which enables to identify the interdependence of studied variables. There will be introduced several correlation matrices which outlines the mutual dependence between exchange rate volatility and manufacturing industry. I will test both manufacturing production index and turnover from manufactured goods. Otherwise, another tool for demonstration of dependence between variables is used the midpoint elasticity coefficient, which determines how elastic or inelastic is manufacturing sector to exchange rate shocks.

A first section in theoretical part discusses the exchange rate, its basics and development during recent years. Also there will be mentioned determinants of the exchange rate and the exchange-rate regimes. Hereafter, I will introduce several theories dealing with impact of exchange rate on manufacturing sector and mention their methodics used and results. These studies will further serve for comparison with determined results of analysis. The next part of thesis continues with specifics, description and structure of manufacturing industry in Czech Republic and its link with Germany and European Union. I will show in the foreign direct investment as an indicator influencing manufacturing industry as well.

Every result of each analysis will be compared with resolutions of yet known theories concerning impact of exchange rate volatility on manufacturing sector. Data about the exchange rate are taken from statistics provided by Czech National Bank and are measured to end of months. Values of industrial production from manufacturing sector are taken from Czech National Bank´s database system of time series called ARAD and are measured as percentage change against year 2010. The turnover data from

export of manufactured goods (SITC groups 5-8) are provided by Czech Statistical Office. For calculations of correlation coefficient is used GRETL software, and many results are adjusted about own calculations. Within testing is considered 5 % level of significance.

To outline the impact of exchange rate on manufacturing companies in practice, I will introduce a manufacturing company and the impact on its production. Furthermore, I will introduce possibilities how the company can protect itself against exchange rate volatility risk.

2 Theoretical basis

A monetary policy and a foreign trade policy are influencing each other by its importance. Any change of exchange rate may be or may not be projected into future development of international trade with manufactured goods. As was already mentioned in Introduction part, in last years more than a 50% of share on export of Czech Republic is being created by exporting of manufactured goods (Czech Statistical Office). Manufactured goods exported by Czech Republic are especially machinery and transport equipment and their production has a long history since many years. Therefore, the importance of selling this kind of goods abroad is crucial for Czech economy. The following text will help to understand the mutual connections between exchange rate and its impact on manufacturing sector.

2.1 Theory of Exchange Rate

Exchange rate, also known as foreign-exchange rate, forex rate or Agio is a price for which the foreign currency is bought and sold and can be according to Kalínská (2007) defined as the ratio in which the individual national a supranational currencies are exchanged. In other words, this is the price of one currency expressed through another currency. On the exchange rate as a price may be viewed from two sides:

- Nominal, at current prices, is characterized by validity at a given moment and impressibility of situations on foreign exchange market. It expresses how many units of domestic currency must be expended to obtain one unit of foreign currency (ČNB, 2010).
- Real, constant prices, is on the contrary expressed as a ratio in which the estates of foreign country are bartered for home country´s estates. Is defined as a share of price level abroad and of a domestic price level, where the foreign price level is converted into units of domestic currency over the current nominal exchange rate. The real exchange rate basically says, how much more of goods or services is possible to buy for given price abroad (after exchange for given foreign currency) than on domestic market.

According to Jurečka (2010), this rate determines how the country stands in foreign trade. Most often you can meet just the nominal exchange rate, because the real exchange rate is monitored primarily by experts. The real exchange rate can be computed based on the knowledge nominal rate, as follows:

$$E_R = E_N \cdot \frac{P^*}{P}$$

where E_R is a real exchange rate;
E_N is a nominal exchange rate;
P^* is a foreign price level;
P is a domestic price level.

Nominal exchange rate can be recorded in two ways:

- By direct quotation, that expresses how many units of domestic currency must be released to gain one unit of foreign currency. For example, 27 CZK/EUR, where in the first place is domestic currency and in the second position is foreign one.
- By indirect quotation, when we express a price of domestic currency through foreign currency. For example, 0,027 EUR/CZK

The Czech Republic exercises a registration in form of direct quotation towards the all the important currencies.

2.2 The Exchange Rate Systems

An exchange-rate regime determines how an authority approaches to determination and management of exchange rate in certain country (Kalínská, 2007). Relating to existence of Bretton Woods system of exchange rates, there were asserted regimes of fixed exchange rates, which essence was a binding of domestic currency on one key foreign currency, namely US dollar. After dissolution of this system in 1972, some of world countries (especially the European) opted for own systems of exchange rates, which have been gradually developed and have been obtaining its form and shape. As time went on, also the systems of floating exchange rates got a word in edgeways. Currently, there exists no globally institutionalized system.

2.2.1 Currency convertibility

General classification of currencies is their division of convertible currencies and nonconvertible currencies. According to Kalínská (2007) it is not possible to trade on international currency market with nonconvertible currencies, since they are created based on the decision of the central authority. On the contrary, the convertible currencies are created on international currency market and completely reflect the action of supply and demand on this market. The currency convertibility is from viewpoint of Kalínská (2007) a basic assumption for a realization of free trade. We further distinguish an internal and external convertibility of convertible currencies. The internally convertible currencies are traded only on domestic foreign exchange market, while an entrance of foreign entities is restricted or completely banned. On the other hand, the external convertibility means that the currencies are tradable on international currency market, since the access to currency is available to domestic, either foreign entities.

A Czech crown is considered as a currency, which is freely convertible on foreign exchange market. Its external convertibility was introduced by foreign exchange act on 1.10.1995. This issue is more analyzed by Neumann, Žamberský (2010).

Within convertible currencies, we may distinguish several exchange-rate regimes:

- a fixed exchange-rate system
- a floating exchange-rate system

2.2.2 Fixed exchange-rate system

In fixed exchange-rate regimes is a value of nominal exchange rate determined through a central authority. This announced value of exchange rate is then maintained by official interventions within given regime (Jurečka, 2010). Within implementation of interventions, the monetary authority must be ready to buy or sell a domestic currency on foreign exchange market anytime in order to keep the exchange rate on stated level. Currently, there exists number of variants of exchange-rate regimes. For example currency board, crawling pegs, fixed exchange rate with band of oscillation or basket-of-currencies.

- **Currency board** – Is the only system of fixed exchange rates without band of oscillations (Kalínská, 2007). It represents a regime, which is based on fixations stipulated by law of the domestic currency to another foreign currency or to individual basket of foreign currencies. In publication of Kalínská (2007) is stated as a basic premise of this system a liability of the central bank to issue more money into circulation, and only in case of keeping the exchange rate on the level of officially defined exchange rate. However, by this commitment the state loses its autonomy in the area of monetary policy. In 2005, 7 countries exercised this system, for example Bulgaria, Estonia and Latvia.
- **Crawling peg** – According to Kalínská (2007), it is a system when occurs a regular changes of value of exchange rate. These changes are performed based on changeovers of crucial macroeconomic variables in order to keep a stability of exchange rate. This system was applied in period of transformation in Hungary and Poland for example.
- **Fixed exchange rate system with band of oscillation** – Within this regime occurs a situation, when a value of exchange rate is fixedly determined on a certain level, however is allowed its free movement in terms of determined oscillation band. Intervention by the central authority occurs when value of the exchange rate exceeds the boundary of oscillation band.

2.2.3 Floating exchange-rate system

Floating is characterized by absence of interventions from a central authority. The value of exchange rate is design purely by supply and demand of private entities on foreign exchange market. Advantage of this system is that central banks do not have to keep large foreign exchange reserves to intervene in behalf of domestic currency (Jurečka, 2010). Nowadays, there exists a certain permutation within floating, which is called managed float regime, also known as dirty float. This managed floating has similar properties as a free floating, but a central authority can intervene into development of exchange rate. This situation occurs when the authority tries to prevent from significant fluctuations of the exchange rate´s value, usually to preclude significant appreciation of the currency.

2.3 Determinants of exchange rate

The exchange rate (i.e. price of currency) is similarly as prices of other commodities a volatile variable, since it is influenced by movement and level of supply and demand on foreign exchange market. Identification of factors that have considerable influence on development and level of exchange rates is more difficult for countries participating in float exchange-rate regime, because the exchange rates are still moving in real time. These factors can be divided according to a period in which the exchange rate operates – short term, medium term and long term. Many of determinants have its origin in macroeconomics, especially in fiscal and monetary area.

In short term, the level of exchange rate is affected mainly by speculations or psychological factors arising from foreign exchange market. Important is also the impact of unexpected events and political aspects, like various threats of conflict or statements of political leaders. Moreover, a significant influence on exchange rate development have also declarations of important economic representatives, as Central Bank Governor, since their verbal expression may cause appreciation or depreciation of currency during certain period. Jurečka (2010) or Brčák (2005) comprise as short term factors influencing the exchange rate for example changes in interest rates, level of inflation, changes in money supply, changes in real GDP, or expectations of future development of exchange rates. Therefore is evident, that volatility of exchange rate in short run is caused by a number of political, economic and speculative aspects.

In long term we can remit from expected development or short term fluctuations of products, since in such period the biggest impact on exchange rate development have mainly structural changes in the economy, purchasing power parity, different progression of prices or changes of international trade of given country.

This time, many economies are linked to each other. Therefore, a cause of volatility of certain state may be just a volatility of state, with which is the certain economy strongly tied. As example can be shown a strong connection of Czech Republic with countries it trades the most (Germany, Russia, China, and countries of EU). The slight-

est sign of negative economic development in these countries can thus cause even a slight change in the exchange rate (Jurečka, 2010).

One of the reasons why exchange rate fluctuates may be also an exchange-rate regime, which given economy applies to manage the exchange rate (Flood and Rose, 1999). Generally, countries which selected a float regime face to higher volatility of exchange rate than countries which determine ex. rate fixedly within fixed exchange-rate regime.

A way how to reduce a volatility of exchange rate is the security of exchange rate risk with help of financial instrument, so called hedging. However, hedging brings additional costs, which may be one from reasons for its omission. Thus, it is needed to select this tool with respect to financial options of certain country.

2.4 Theories of Exchange Rate Determination

2.4.1 Purchasing Power Parity

Using the absolute purchasing power parity we can identify a relative value of different currencies. According to Krugman and Obstfeld (1991), the theory of purchasing power parity says that the exchange rate between two states´ currencies is equal to the rate of the states´ price levels. In Krugman´s and Obstfeld´s publication, they state that the domestic purchasing power of a country´s currency is projected in the price level of country. This theory thus foretells that a drop in a domestic purchasing power of currency (as signified by an increase in the domestic price level) will be affiliated with a corresponding depreciation of currency in the foreign-exchange market. Similarly, the PPP forecasts that an increase in the currency´s domestic purchasing power parity will be connected with a proportional appreciation of the currency. However, the very simplicity of this model is redeemed by its limited validity only in the long term. By the time, there were created 2 versions of PPP – absolute and relative.

This absolute purchasing power parity is based on the idea that nominal exchange rate of the country should respond to the ratio of domestic and foreign price level. Mathematically, this relationship can be expressed as follows:

$$E = P / P^*$$

where E represents nominal exchange rate;

P^* represents average price level abroad (in foreign currency);

P represents average price level on domestic market (in domestic currency)

Relative version of purchasing power parity does not deal with determination of absolute exchange rate, but only with its change in certain period. Thus, the aim of relative PPP is not to explain an amount of exchange rate, but how the ex. rate changed during certain period. According to this model is a percentage change of nominal exchange rate (a depreciation of domestic currency in percentage) defined by difference

of inflation rates in two observed countries. Mathematical expression of given model is following:

$$\%\Delta E = \Pi - \Pi^*$$

where Π and Π^* mean percentage inflate rate in observed economies.

Basically, this equation indicates that if domestic price level grows faster than foreign price level, the depreciation of domestic currency occurs. Otherwise there occurs an appreciation of domestic currency. In Krugman´s and Obstfeld´s publication (2003) is this issue described in more details.

2.4.2 Interest Rate Parity

As another theory for determination and prediction of exchange rate the interest rate parity lays on certain assumptions which must be fulfilled to create an exchange rate. This theory assumes a capital on international capital market which is mobile and an existence of two currency deposits. According to this theory, the nominal exchange rate adapts a level, which matches a balance of investors in the international currency market (Plchová, 2007). This balance can be reached only within condition, that investors are entirely satisfied with their investment portfolio and do not want to adjust it further. If the amount of revenues from investment assets in all countries was not the same, as to Kráľ (2003), every investor would then place his assets to countries with the highest yields and borrow the assets in countries with the lowest interest yield. Interest rate parity theory influences the exchange rate mainly in short term.

Mathematically can be this relationship formulated as:

$$R_j - R_i \cong increment\ \varepsilon_j - increment\ \varepsilon_i$$

where R_j is an inflation rate in country j;

R_i is an inflation rate in country i;

$\varepsilon_j - \varepsilon_i$ represents a difference of change in exchange rate of currency j towards currency i.

2.5 Volatility of exchange rate

Currently, there does not exist any unambiguous way for measuring of exchange rate volatility, since the rate is influenced by a variety of factors. The problems of exchange rate risk measurement summarizes in his book, for example, Coté (1994). It is a way of measuring risk, which is based on the standard deviation or percentage change of exchange rate. Excessive exchange rate volatility is particularly harmful for small open economies. According to CNB (2008), it is decisive whether the ex. rate deviations are caused by random shocks or are just consequence of political actions.

2.5.1 Exchange rate trend of Czech crown against euro

Since the creation of euro in 1999, the trend in exchange rate development of Czech crown against euro has been, except for minor fluctuations, continuously strengthening. The main reason of this development was a convergence with the rest of the euro area and high flow of foreign trade investment, which increase the productivity of domestic economy. Until 2013, we could observe a systematic trend appreciation of the crown. However, by the start of year 2013, the Czech National Bank released its interventions with aim to keep exchange rate around 27 CZK/EUR. Purpose of these interventions is to keep price stability, increase foreign trade investment, revive foreign demand and thereby contribute to the stable development of the Czech economy. In the case of monetary policy inaction would enliven the economy much more slowly.

There occurred 2 significant deflections in the trend, and that in 2001-2002 and in 2007-2008. In first case appeared an exchange rate bubble created due to too slow reduction of interest rates by Czech National Bank in time, when European Central Bank significantly decreased its rates. By the entrance into European Union in 2004, the notable strengthening stopped and appeared an appreciation trend again. In 2008 was the appreciation of exchange rate more notable than in crises bubble period. This was caused by a combination of uncertainty on financial markets and increase of interest rates as a result of the coming economic crisis.

A systematic appreciation of the crown has a significant impact on foreign trade, as the appreciation of the koruna strongly supports imports. The strong crown is reducing the price of imported goods and thus directly counteracts inflation.

2.6 Impact of exchange rate on manufacturing

Due to importance of effect of currency development in trade balance, the exchange rate has been focused in creation of economic policy in recent years. According to Abeysinghe and Yeok (1998), policies prescriptions have generally assumed that currency devaluation stimulates export and limit import. Therefore, the devaluation is likely to contribute to inflationary pressures. The devaluation of currency means a reduction in a price of exports. Thus, quantity demanded for these will increase. On the contrary, at the same time the price of import will rise and its demanded quantity will decrease.

Studies exploring the effect of real exchange rate on domestic production brought ambiguous results since various empirical analyses uncover positive, negative or no effect. There exist two alternative theoretical predictions about the effect of real exchange rate on output. The simplest argument is assumes that real depreciation of exchange rate would cause substitution of imports with domestic goods and also make export of domestic goods more competitive, which will induce an expansion of domestic production (e.g. Dornbusch, 1988). The alternate argument says that in a world

where a lot of the manufacturing economies are dependent on imported inputs, a real depreciation would increase the cost of these inputs leading to a contractionary impact on domestic production (e.g. Krugman and Taylor, 1978). Recent empirical investigations have tried to reveal the relation between real exchange rate movements and industry level output. Wang and Rogers (1995) employed a VAR model and find out that real devaluation has led to economic contraction in Mexico. Berument and Pasagullari (2003) and Ahmed (2003) discovered similar results for Turkey and Latin America countries respectively. However, the export/import importance of the various trade partners would vary distinctly across industries.

Speaking about difference in trade partners or in patterns of exported goods, Al-Rashidi and Lahiri (2012) provided a study concerning how for any specific country the importance of the different trade partners as export destinations of one product would vary from the importance of the same trade partners in the context of a dissimilar industry. They found that using of an industry-specific trade weighted real exchange rate indicator is better able to predict movements of industry output compared to the standard real exchange rate. Key part of their research was that when they allow asymmetry in the effects of appreciation and depreciation, the real exchange rate depreciation weighted by the importance of export destinations does have a positive effect on output though the corresponding appreciation does not have a significant negative effect. Since trade partners can vary significantly across industries, a simple average of bilateral real exchange rates is not a good indicator of industry specific competitiveness of observed countries. To correct this, they followed Goldberg's methodology and constructed industry-specific exchange rates for each industry. They used data sample covering the period from 1992 to 2004 and industry output for the ASEAN+3 countries.

Conclusion indicates that the trade weighted real exchange indices have a significant negative relation with output movements. Then they explore if the effects of appreciation and depreciation are asymmetric. They find that for export destination weighted real exchange rate indicator, increase in industry specific competitiveness captured by a real depreciation does increase industry level output while a real appreciation weighted by export destinations is found to have no significant effect on industry production levels. However, the effect of appreciation and depreciation is found to be symmetric for the ASEAN+3 countries while the importance of the origin of the imports is factored into the real exchange rate indicators.

As the pattern of exported goods and trade partners of given country play significant role in export, the picture no. 4 shows an apparent dependency of Czech industrial production on countries the CR most export to (Germany and Eurozone). In picture no. 5 is depicted a commodity structure of exports to Germany.

Testing the differences in the long term and short term relationship between bilateral exchange rate development of the Czech koruna and international trade flows with various groups of industrial products provided by Šimánková and Stavárek

(2014) in their article confirmed that most of product groups related with exchange rate in the long term. A positive effect of depreciation was proved for most of the product categories, which were determined on the basis of SITC classification, but the short term coefficient revealed almost no relationship. Basically, it means that the effect of CZK depreciation is mostly in accordance with theoretical assumptions. Hence, the depreciation is supposed to improve most of the industry-level trade balances. Otherwise, the results shown that there exists almost no short term effects and the significant short term effects cannot be generalized either across countries or product groups.

For testing they used the Johannsen cointegration test to analyze the long term relationship and a vector error correction model to explore the short term effects, cointegration test and a vector error correction model. This research considered the major trading partners of the Czech Republic (Germany, Slovakia, Poland, France, Italy and Austria) and selected product categories from SITC classification over period 1993-2013. Therefore, this study provides additional evidence on the effect of exchange rate development on the different industry-level trade flows in the context of emerging market.

Another theory concerning impact of exchange rate on industry comes from International Journal of Economics and Financial Issues. The authors explored the influence of exchange rate volatility on industrial production before and after the introduction of common currency for eleven European countries included in European Monetary Union and for four European countries that did not adopt 'Euro' as common currency. First group acting in EMU is Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxemburg, Netherlands, Portugal and Spain, the second group consists of Denmark, Norway, Sweden and the United Kingdom. To analyze the impact of exchange rate volatility on the industry, before and after the introduction of Euro, study employs logarithm of industrial production index (LIPI) as an indicator of economic growth and monthly data of exchange rate and macroeconomic variables in period January 1980 – April 2009.

The analysis proved that a trade and government bond yield are positively related with industrial production for both groups of the countries, but before the introduction of common currency, the volatility in nominal exchange rate was negatively related with industrial production for both groups of the countries. However, intensity of the negative impact of the exchange rate volatility on industrial production dropped numerously after the introduction of Euro for both groups of countries. Conclusion is that all the countries enjoyed benefits after the introduction of common currency by reduction in negative impacts of real exchange rate volatility, even some countries also faced to an increase in real exchange rate volatility. [1]

[1] JAMIL, Muhammad, Erich W. STREISSLER and Robert M. KUNST. Exchange Rate Volatility and its Impact on Industrial Production, Before and After the Introduction of Common Currency in Europe. Inter-

Similar study was performed by Ekholm, Moxnes and Ulltveit-Moe (2012) investigating the impact of a change in international competitive pressure on industrial performance and restructuring using an extensive micro data set. Unlike previous studies they were able to account for the heterogeneity across firms in their exposure to foreign competition. They focused on a situation similar to a natural experiment, and examine the impact of a sharp real appreciation of the Norwegian Krone in the early 2000s on Norwegian manufacturing firms which differ substantially in their trade orientation. A change in the real exchange rate affects a firm through in three different ways: firm's export sales, firm's purchases of imported inputs, and import competition faced in the domestic market. Examining all of these three channels, both net exporters and import-competing firms faced to increased competition due to the real appreciation. Both groups reacted by dismissing labor, but only the first group experienced increasing labor productivity. Therefore, the impact of a real appreciation shock on Norwegian manufacturing firms led to reduced employment among all firms exposed to the shock.

2.7 Manufacturing industry in the Czech Republic

As manufacturing we can indicate any industry which creates products from raw materials with use of manual labor or machinery equipment and which is usually performed systematically with a division of labor in manufacturing procedures. Under a more limited meaning, manufacturing denotes the production or assembly of components into finished products on a justly large scale. As a most important manufacturing industries in Czech Republic may be designated those which produce automobiles, aircraft, clothing, chemicals, consumer electronics, computers, electrical equipment, furniture, steel, heavy machinery, ships, tools and dies.

A manufacturing sector of the national economy of Czech Republic produces similarly as agriculture a wide range of products, so called tangible property. These products have either further use in industry and serve as means of production (machine tools, industrial robots, mining machinery, construction machinery, agricultural machinery, etc.) or are destined to direct consumption, as food, furniture or household appliances.

The manufacturing industry belongs to the most traditional branch of national economy. It is also proved by fact that factories are spread over the country and employ the largest amount of workers in whole industry. As well as the rest of the economy, Czech manufacturing passed through problems of nineties in 20th century with a help of many foreign investors. This has led either to strengthening or to extinction of some businesses in certain industrial branches. In long term, to the most prosperous branches of manufacturing belongs a manufacture of transport facilities, specifically

national Journal of Economics and Financial Issues [online]. 2012, 85-109 [cit. 2015-05-05]. Available from: www.econjournals.com

motor vehicles, which share in total revenues of manufacturing industry was in 2013 23,1 %. In the same year, a second place took a production of metal products and fabricated metal products with 8,7 % followed by production of machines and facilities not elsewhere specified with 8,1 %.

Since the industry employs over 40% of the economically active population in the Czech Republic (CIA World Factbook), it represents crucial part of national economy. In 2008, there was recorded 1 462 000 workers, 9 063 business entities with 20 and more employees and 145 977 with less than 20 employees in industry. Wages of employees amounted to a total 352,483 milliards of Czech crowns (Czech Statistical Office). In fourth quarter of 2009, the industry created 97,7 % of industrial production against the fourth quarter in 2008, of which the biggest amount formed again the manufacture of motor vehicles followed by a manufacture of chemicals. In the long term, the very largest share in the Czech economy has the manufacturing sector. According to Ministry of Foreign Affairs, the industrial production to 30.6.2014 contributed to GDP by 28 %, while the key role plays branches of manufacturing industry and assembly factories.

Moreover, the manufactured goods significantly participate on export and import. The biggest share on export in 2010 had a transport equipment (vehicles) with 54,3 % followed by vehicle parts and electronics. The largest share on import and export is held by Germany, 32,9 % on export and 26 % on import (Observatory of economic complexity).

History of industry in Czech Republic

Industrial production in the area of the Czech Republic has a really long tradition. During the Austrian-Hungarian period, the Czech lands used to serve as an industrial base for the whole empire. Before the dissolution of the empire, almost 70 % of industrial production of the Austrian-Hungarian monarchy was focused in Czech Lands. In April 1919, the Czechoslovak crown was introduced.

After 1938, the consequences of the Munich Agreement were devastating for the Czechoslovak economy. Its forced subordination to German economic interests caused that the crown was officially pegged to the mark at a ratio of 1:10, so the Germans immediately started buying Czech goods in large quantities.

Being a part of Soviet Union, the Czechoslovakia was in accordance with development policy of planned interdependence governed by Stalin and was strongly bound to the Union. Even though at that time the Czechoslovakia was the most prosperous country in the Eastern Bloc, it still lagged behind the rest of the developed world. In 1991, when the communist economic alliance disintegrated, Czech manufacturers lost their traditional markets among former east communist countries.

A crucial point in history of Czech industry is a so-called Velvet Revolution of 1989, when Czechoslovakia liberated itself of communist control and arranged an adaptation of its command economy to a free market. Still, the Czech Republic is ranked among the most industrialized countries in the world. In 1995, a final wave of privatization begun. It has resulted in 80 % private stake in industry, though the government

sustains certain control over steel, transport, telecommunications and energy industries. The Czech Republic received in 2001 the highest foreign direct investment in the region, which was dedicated to restructuring of industrial companies. In the same year, 40 % of industrial production came from companies with foreign capital.

The Czech republic´s entrance into European Union in 2004 has brought many advantages to domestic market and industrial companies. Participating in Single market and Schengen area opened a several times larger market with products and services to Czech and with free movement of capital arose new investment opportunities. Trading with manufactured goods became easier since it had removed many trade barriers. In the framework of various subsidies and grants provided by EU funds for purchase of machines or for development of small and medium enterprises, a lot of businesses use this opportunity and thus spread their activity and effectiveness.

2.7.1 Structure of manufacturing industry

Figure 1 shows that manufacturing industry in accordance with a revised classification of economic activities is divided into 24 sections, whose shares are listed in Table 1.

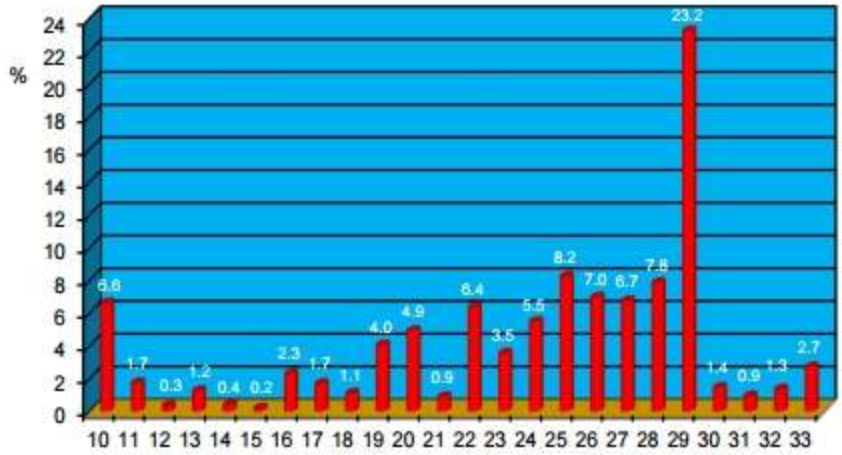

Figure 1 Sections of manufacturing industry (data in common prices)
Source: data of Czech Statistical Office in 2012, own estimation of Ministry of Industry and Trade

Table 1 Manufacturing industry according to NACE-CZ
Source: Ministryof Industry and Trade of the Czech Republic

Section C – Manufacturing industry	
Section	Name
10	Manufacture of food products
11	Manufacture of beverages
12	Manufacture of tobacco products
13	Manufacture of textiles
14	Manufacture of clothes
15	Manufacture of leather and related products
16	Woodworking, production of wood, cork and straw products, except furniture
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
19	Manufacture of coke and refined petroleum products
20	Manufacture of chemicals and chemical products
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
22	Manufacture of rubber and plastic products
23	Manufacture of other non-metallic mineral products
24	Manufacture of basic metals, metalworking, foundry industry
25	Production of metal constructions and metal products, except machinery and equipment
26	Manufacture of computers, electronic and optical devices and equipment
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment not elsewhere specified
29	Manufacture of motor vehicles (except motorcycles), trailers and semi-trailers
30	Manufacture of other transport equipment and devices
31	Manufacture of furniture
32	Other manufacturing
33	Repairs and installation of machinery and equipment

From the Figure 1 is obvious that clear preponderance over other sections henceforward keeps the section CZ-NACE 29 Manufacture of motor vehicles with share on revenues 23,3 %. This share is nearly three times higher than the share of second section in order named CZ-NACE 25 Production of metal constructions and metal products, except machinery and equipment with 8,2 %. Conversely, at the end of the rankings are placed less significant sectors of manufacturing industry, i.e. CZ-NACE 15 and CZ-NACE 14. [2]

[2] CZ-NACE is a Classification of Economic Activities used by European Union since 1970.

2.7.2 Development of manufacturing in the Czech Republic

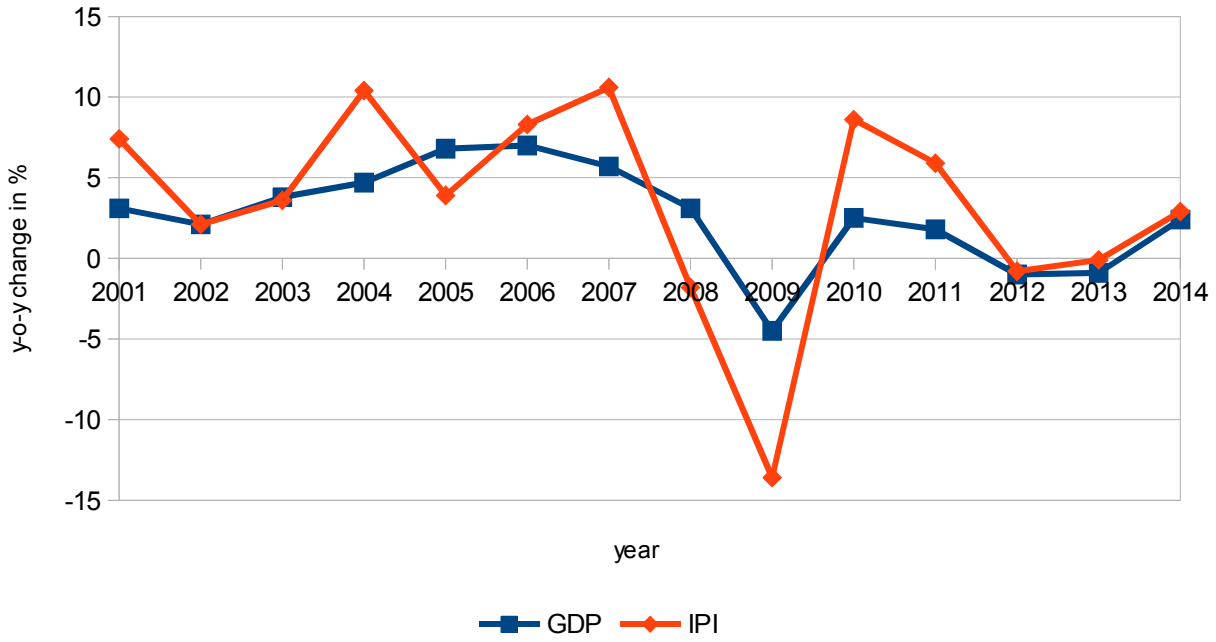

Figure 2 Year on year % change of industrial production index and GDP
Source: Czech Statistical Office, Ministry of Industry and Trade of Czech Republic, own processing

In whole period 2002-2004 was the development of manufacturing production relatively balanced. It was given by faster real growth of gross value added in industry compared to services. The main workhorse within manufacturing then was a production of motor vehicles, computers and office devices.

The highest increase occurred in 2004, when the industrial production index grew by almost ten percent tempo (9,9 % against 5,8 % in 2003). In this year a continuing high performance of private companies under foreign control favorably acted. Many new production capacities were put into operation, especially in electrical engineering and mechanical engineering, as well capacities ensuring parts, components and accessories for the automotive industry. It is obvious that entrance into EU undoubtedly benefited to Czech Republic. We profit from a wave of interests from foreign investors, relatively stable economic environment, from a better access to the EU Single market and the associated breakdown of trade barriers.

Reaching year 2005, the gross investments into manufacturing industry grew more slowly than in 2004. However, the industrial production has been growing for the sixth year in a row, even it slowed down the annual growth to 5.7 %. The structural changes in manufacturing sector, which were related to entrance of other investors from abroad, have continued. In addition, new production capacities in the automotive industry started.

A favorable development of the Czech manufacturing industry in 2007 was closely related to high investment activity, mainly due to FDI (Foreign Direct Invest-

ment) inflows. Likewise, the foreign trade with manufactured goods was also successfully developing.

The crucial milestone in Czech economy happened in 2008, when the annual industrial production decreased about 17,4 %, which was caused by recession of the economy. The recession was on the other hand invoked by U.S. financial crisis and subprime mortgage crisis and by increased oil price. In comparison with previous years when the main workhorse was the production of transport equipment, the main role in 2008 played a manufacture of electronic and optical devices and equipment. Downturn of manufacturing industry reflected in stagnation of FDI inflows as well.

In 2010 appeared obvious signs of recovery. The world economy started to grow due to recovery of international trade. The international trade had a decisive influence on the development domestically, where the result of improvements in the external environment has been double digit growth in manufacturing industry. For the Czech Republic was crucial that among fastest growing countries was ranked Germany as a main trade partner of Czech.

Weakening of economies and decrease in industry growth in countries of Eurozone was resulted as a decline in performance of Czech industry. Under adverse development in the Czech Republic were deepening problems in industry caused by weak foreign demand a drop in domestic demand. Problems of European automotive market invoked by decreased demand have reflected into predominant domestic automotive industry by slowing the manufacturing activity. The total inflow of foreign direct investment (FDI) into the Czech Republic recorded in 2013 compared to the previous year a significant decline (in 2012 foreign investors invested 156.3 billion CZK in the Czech Republic, in 2013 it was only 97.7 billion CZK).

Comparing development of Czech GDP with its industrial production, we can say that GDP is not as sensitive to exchange rate shock as industrial production is.

2.7.3 Foreign direct investment in manufacturing

The favorable development of the Czech economy and the manufacturing industry has been closely connected with the high investment activity, mainly due to the inflow of foreign direct investment (FDI).

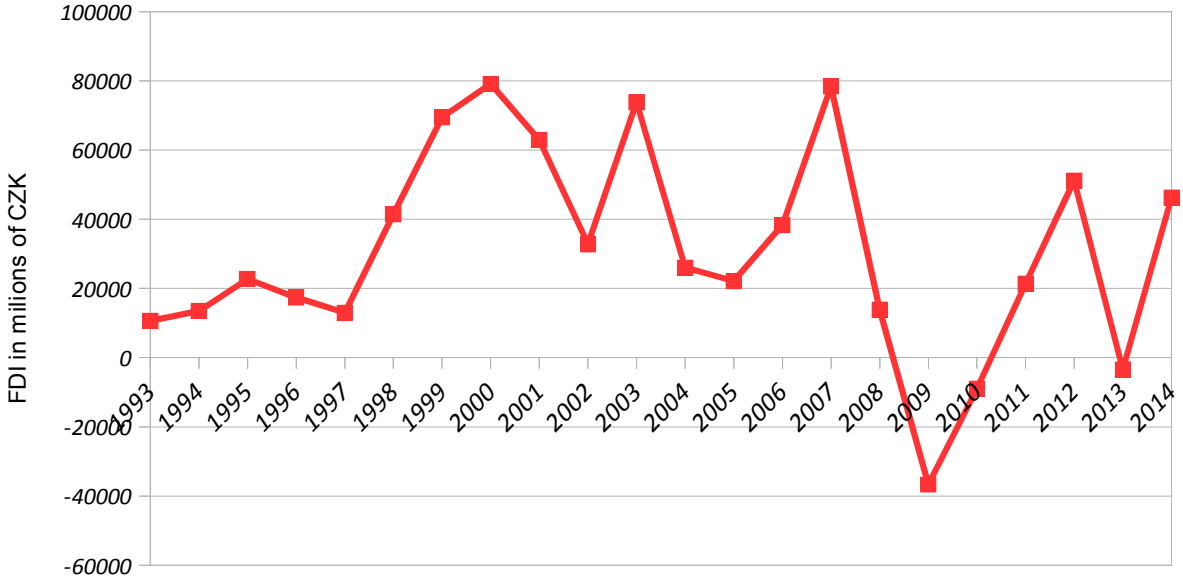

Figure 3 Inward Foreign Direct Investment into manufacturing sector in 1993-2014
Source: Czech National Bank, own processing

The most important foreign investors are Germany, the United States, Austria, Japan and the United Kingdom. A significant portion of FDI inflows into the Czech Republic has been focused in the sector of automotive components, thus it creates the manufacturing industry significantly dependent on foreign investments. The implementation of EU rules and regulations has also helped to improve the manufacturing environment and attract FDI.

One of the most important investments in recent years was realized by Toyota Motors and Peugeot in 2002 when was built a joint factory in Kolín at a cost of USD 0.85 billion. As result, the Czech Republic became one of the most important producers in the automotive sector in Europe. More recently, Hyundai built another large manufacturing plant for more than USD 1.2 billion in Nošovice. Among the other FDI top sectors in manufacturing industry belong textiles, industrial machinery and equipment & tools, food and tobacco, electronic components and plastics.

Comparing a Figure 2 with this above mentioned, we can see a significant dependency of manufacturing industry on foreign direct investment. However, FDI development does not suffer by such fluctuations as manufacturing does. That is also another reason why I have chosen to analyze the impact of exchange rate on manufacturing, since it generates greater oscillations.

2.7.4 Dependency of manufacturing sector

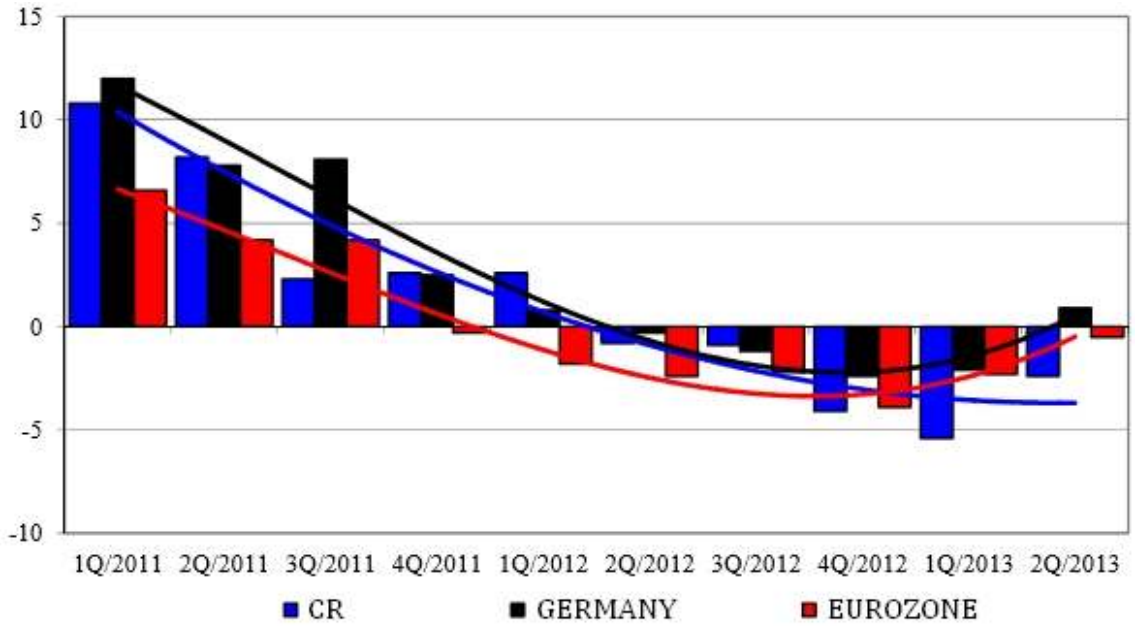

Figure 4 Development of industrial production in the Czech Republic, Germany and Eurozone including trend (year on year change in %)
Source: CSO, Eurostat, calculation of Ministry of Industry and Trade, own processing

For domestic economy is crucial that among fastest growing countries in EU has been ranked Germany as its main trade partner. A growth of German product with traditionally powerful foreign trade and impact of domestic demand including consumption of households in Germany have contributed to the success of the German economy. From this achievement of the largest EU economy chiefly has been benefiting a Czech manufacturing industry, which uses subcontracts to German companies in abundance.

A critical dependency of Czech industry on German economic in 2012 forced the former Prime Minister Petr Nečas and Minister of Industry Martin Kuba to create a new export strategy including export to other countries in order to reduce a dependency on European Union. Tricky is also the dependence of Czech economy on automotive sector that generates almost a quarter of Czech export and 7 % of GDP (2014). That practically means as long as cars and related products are in the center of interest, Czech GDP will rise. But, if there was a decline in demand in Eurozone, the Czech market would slow down. Not only production and employment would dropped, but then even the consumption of households, what will feel also firms from other fields.

2.7.5 Commodity structure of export

Below is demonstrated a commodity structure of exports to Germany, as a great trade partner of Czech Republic. In 2012, almost 30 % of Czech export led to Germany (The Observatory of Economic Complexity). A share of machines and transport equipment on total export of CR made more than 50 % in 2011 (Report on Inflation by CNB).

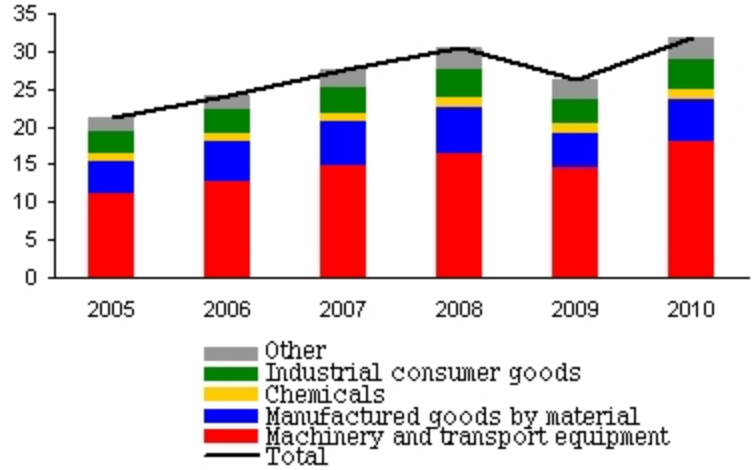

Figure 5 Commodity structure of Czech exports to Germany (in mld. EUR)
Source: CNB calculations based on CSO, own processing

From commodity structure of export to Germany we can see how important the manufacturing sector with machinery and transport equipment is. It has been always significant portion of Czech export followed by other manufactured goods. Pattern of goods plays also very relevant role when analyzing impact of exchange rate on manufacturing, since various goods use various inputs which are influenced also by exchange rate. However, the study by Šimánková and Stavárek (2014) proved a positive effect of currency depreciation for most of the product categories, which were determined on the basis of SITC classification.

3 Analysis of exchange rate effect on manufacturing

3.1 Real Effective Exchange Rate

To analyze the impact of exchange rate, I will firstly correlate the exchange rate with real effective exchange rate to see, how their values differ from each other. Since Al-Rashidi and Lahiri (2012) proved for ASEAN+3 countries that standard exchange rate is not sufficient indicator of impact, they employed real effective exchange rate to correct this. To analyze if this this situation relates to the Czech Republic as well, I will test the mutual dependence through correlation.

The real effective exchange rate, shortly REER is a weighted average of a country's currency relative to an index or basket of other major currencies modified for the effects of inflation. The weights are identified by comparing the relative trade balances, in terms of one country's currency, with each other country within the index. All the currencies within the said index are the major currencies being traded to given day, for example U.S. dollar, Japanese yen, euro, etc.

The World Bank defines REER as a nominal effective exchange rate divided by a price deflator or index of costs. The REER aims to assess a country's or currency area's price or cost competitiveness relative to its major competitors in international markets. Changes in cost and price competitiveness depend not only on exchange rate movements but on cost and price trends as well. The indicator is deflated by the price index against a panel of 42 states – EU 28 + 14 other industrial countries: Australia, Canada, United States, Japan, Norway, New Zealand, Mexico, Switzerland, Turkey, Russia, China, Brazil, South Korea and Hong Kong).

Using of REER instead of nominal effective exchange rate allows to reflect also changes in purchasing power of the currency and to determine the extent of the competitiveness of good produced in the country and showing an export potential changed during a specific period of time. Specifically, for the analysis of impact will be helpful trade-weighted effective exchange rate index, as a common form of the effective exchange rate index compiling a weighted average of exchange rates of home versus foreign currencies, with the weight for each foreign country equal to its share in trade.

Below we can see a development of REER deflated by foreign trade turnover for period 2004-2014 in comparison with CZK/EUR development.

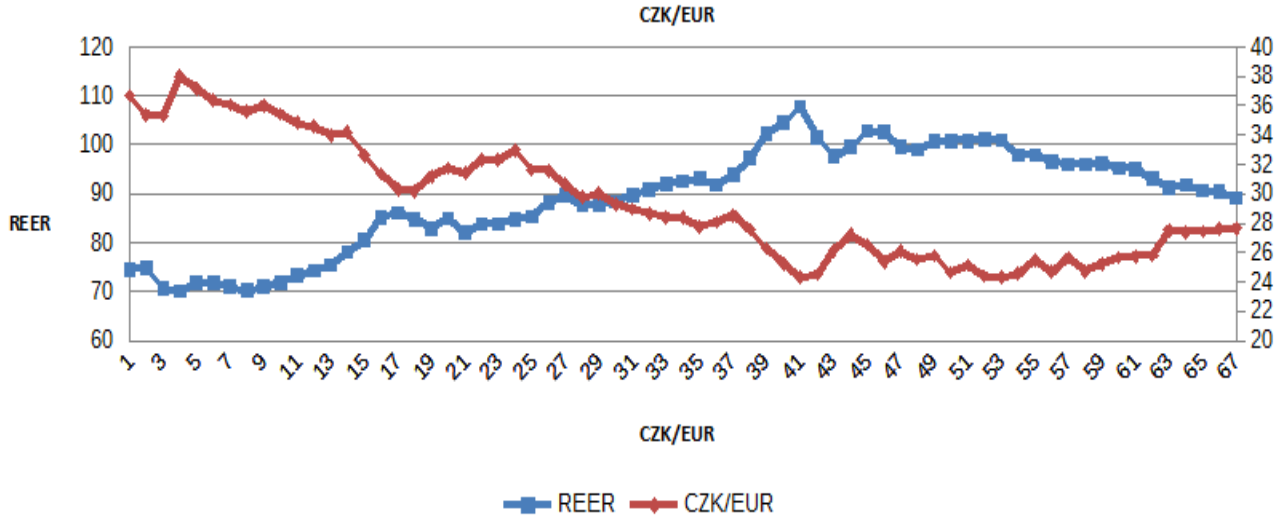

Figure 6 Development of REER of Czech crown in comparison with CZK/EUR exchange rate in 2004-2014, quarterly
Source: CNB, ECB, own processing

Comparing the REER with standard exchange rate of CZK/EUR on the basis of graph, we can see an inverse dependence. That is possibly caused by fact that the Czech Republic trades predominantly with European Union countries. Thus, both variables are strongly dependent on each other. In response with the chart, the inverse correlation is seen especially in year 2008 (point 41 in the graph), when a significant strengthening of Czech crown occurred, therefore the REER jumped on its maximum since 1996. Since 2013 (point 63 in the graph), Czech crown started to weaken due to interventions led by Czech National Bank. Then, the REER then began to fall.

We can prove the negative dependency also by calculating the correlation matrix:

corr(REER, EXCHANGE_RATE) = -0.97336073

Under the null hypothesis of no correlation:

t(66) = -34.4891, with two-tailed p-value 0.0000

Between the exchange rate CZK/EUR (monthly average) and trade-weighted real effective exchange rate deflated by a foreign trade turnover (year 2010=100%) occurs a negative correlation, as was expected based on the pic. no. 6. Simply put, it means that REER of Czech crown increases as the exchange rate CZK/EUR decreases, and vice versa.

This strong negative correlation of REER with exchange rate of CZK/EUR is caused mainly by reason that over 80 % of total turnover from foreign trade is gained from trade activities with European Union (Ministry of Foreign Trade, 2013). The foreign trade with neighboring countries of Czech Republic (Poland, Slovakia, Germany

and Austria) creates over 60 %. Therefore, euro as a currency is very important for Czech exporters and manufacturers. These findings disproved a claim of Al-Rashidi and Lahiri (2012) that within analysis is using of standard ex. rate insufficient. These different results are caused by different structure of trade partners comparing ASEAN+3 countries and Czech Republic.

Secondly, I decided to analyze the correlation of quarter on quarter changes in REER and CZK/EUR exchange rate to find out if this kind of correlation is as strong as the previous correlation with single quarterly data. I will use the REER of Czech crown deflated by foreign trade turnover in SITC groups 5-8, since this REER is oriented on manufacturing sector and thus is more significant for our purposes. [3] Here is an overview of mentioned SITC groups:

- SITC group 5: Chemicals and related products, n.e.s.
- SITC group 6: Manufactured goods classified chiefly by material
- SITC group 7: Machinery and transport equipment
- SITC group 8: Miscellaneous manufactured articles

Predictably, the correlation has proven as not so strong in comparison with previous one. Anyway, the REER deflated by turnover in manufacturing industry still suggests a certain dependence between these two observed variables:

corr(REER, EXCHANGE_RATE) = -0.66148214

Under the null hypothesis of no correlation:

t(65) = -7.11109, with two-tailed p-value 0.0000

Allover, the above-mentioned calculations demonstrated a corresponding dependence between trade-weighted real effective exchange rate and standard exchange rate, so we can continue in analysis using the standard rate.

3.2 Analysis of impact on manufacturing industry

In this key part I will analyze the exact impact on manufacturing sector of Czech Republic with help of above-mentioned finding and theories. Nevertheless, I also supposed that this industry is influenced by other factors as well, like foreign trade investment, significance of trade partners, patterns of goods, the number of industrial orders, etc. Below will be determined a correlation matrix of turnover in export of goods by SITC 5-8 with exchange rate and real effective exchange rate. The correlation represents next to the coefficient of elasticity another tool, how to prove a statistical

[3] Standard International Trade Classification (SITC) is a classification of goods used to categorize the exports and imports of a country to enable comparing different countries and years. This system is maintained by the United Nations. Currently, the SITC classification is at revision four.

relationships involving dependence. Above was proved a strong negative correlation between the REER and nominal ex. rate, so we can conclude that in case of Czech Republic the REER responds to the values of real exchange rate. Thus, the exchange rate should be sufficient indicator for our analysis. An opposite case occurred in study of Al-Rashidi and Lahiri (2012), who proved that for ASEAN+3 is a standard real exchange rate insufficient to determine the impact. It is probably caused by different structure of trade partners of ASEAN+3 countries in comparison with Czech Republic.

Data used in following calculations are provided by Czech National Bank and Czech Statistical Office and are processed in GRETL software.

3.3 Correlation matrix

3.3.1 Impact on turnover using exchange rate

In correlation matrix were used monthly data of Exports of goods by SITC 5-8 in cross-border concept provided by Czech Statistical Office with monthly average of exchange rate CZK/EUR for period January 2005 till March 2015.

corr(TURNOVER, EXCHANGE_RATE) = -0.31810403

Under the null hypothesis of no correlation:

t(121) = -3.69086, with two-tailed p-value 0.0003

As we can see, there is a slight negative correlation between turnovers of export in 5-8 SITC groups and exchange rate of Czech crown with euro. It confirm basic theory that if euro depreciates (Czech crown appreciates), turnover from export declines. On the other hand, when crown weakens (euro strengthens), the turnover increases. P-value is lower than 0,05, so it indicates strong evidence against the null hypothesis, which states that exchange rate does not have any impact at all. However, this effect on turnover is not very strong.

3.3.2 Impact on production index using exchange rate

Above I tried to correlate the exchange rate with turnover in exports of goods by SITC 5-8. Nevertheless, it is worth to state also the impact on the actual production, which is performed by manufacturing factories. Data used are monthly data of industrial manufacturing production (2010=100%) and monthly ex. rate of CZK/EUR (end of month) in period January 2000 - March 2015, all provided by Czech National Bank.

corr(PRODUCTION_INDEX, EXCHANGE_RATE) = -0.79963315

Under the null hypothesis of no correlation:

t(181) = -17.9153, with two-tailed p-value 0.0000

Here is obvious an inverse correlation of these two variables with p-value equal to zero. We can conclude that the real exchange rate negatively affect the manu-

facturing production. In practice it means that with strengthening of Czech crown the manufacturing production declines and vice versa. Therefore, it confirms classical theories assuming that currency devaluation stimulates export, thus the fabrication in given country (Abeysinghe and Yeok, 1998). This result is even with accordance of study by Šimánková and Stavárek (2014), who proved the interdependence of exchange rate and manufacturing performance as well.

Concluding all of these finding, we can admit that more sensitive to exchange rate shocks is the manufacturing production as such, while the turnover from export of manufactured goods is not so responsive. This resolution will be helpful in chapter Case study, where will be shown the impact on production index of particular manufacturing factory and also in following part, where will be measured the significance of this impact. Therefore, a single manufacturing product index is more significant indicator of exchange rate volatility impact, since it is measured in index, while the turnover from export is measured as quantity multiplied by exchange rate. Hence, I will use for further calculations the production index as a better indicator of manufacturing industry.

Many studies have dealt with relationship between exchange rate volatility and manufacturing industry. As was already mentioned in chapter 2.6 introducing the yet known theories, these differ especially in observed countries, observed period and also in the character of the used apparatus. Therefore, the final results and evaluation of these empirical studies and methods might be contradictory. Thus, I will perform an elasticity calculation as another possibility how to confirm certain dependence.

3.4 Coefficient of elasticity

Coefficient of elasticity serves as another tool how to measure a reaction of manufacturing production on exchange rate volatility. It is a numerical measure of the relative response of one variable to changes in another variable. Concretely, here will be used the midpoint elasticity coefficient, which is calculated as a percentage change in variable B (manufacturing production) divided by percentage change in variable A (exchange rate). Formula used for calculation is following:

$$\text{midpoint elasticity} = \frac{(B2 - B1)}{(B2 + B1) / 2} \div \frac{(A2 - A1)}{(A2 + A1) / 2}$$

For calculation were inserted data of year on year changes in manufacturing production and exchange rate of CZK/EUR, both provided by Czech National Bank. Data which were processed are for period 2001-2014. The result of average elasticity within this period is following:

$$\mathbf{COE_{(A,B)} = |2{,}068|}$$

Since the absolute value of the elasticity is larger than 1, the manufacturing production is elastic. Meaning that a change in exchange rate by 1%, will result in a larger change (larger than 1%) in production of manufactured goods. Specifically, if the exchange rate increases with 1% (CZK appreciates), the production decreases with 2%. This resolution is again consistent with empirical research of Šimánková and Stavárek (2014) and Abeysinghe and Yeok (1998), who stated that real exchange rate depreciation stimulates export and support production of manufacturers. Also Ekholm, Moxnes and Ulltveit-Moe (2012) proved this fact on Norwegian economy, where the real appreciation of Norwegian Krone caused an increased competition for exporting manufacturing firms. This appreciation reflected in dismissing the labor among all firms exposed to the shock.

On the other hand, this result is inconsistent with Krugman and Taylor (1978) and Wang and Rogers (1995), who found out that real devaluation has led to economic contraction in Mexico, and with Berument and Pasagullari (2003) as well, since they discovered similar results for Turkey and Latin America countries respectively. The reason why certain exporting manufacturers in certain countries react differently on devaluation of exchange rate may be explained in price of their inputs in manufacturing process. For example, if the manufacturer buys input material in Euro and then sells goods in Euro, depreciation of ex. rate might have double-edged effect on his business. Thus, it depends on currency in which is the input material purchased. That might explain the reverse effect of currency devaluation on manufacturers in Mexico, Turkey or Latin America.

4 Case study

I would like to implement all the received findings from previous chapter and analyze the impact of exchange rate on particular manufacturing factory. As a sample of company I have chosen medium-sized company located in Sudkov in Czech Republic producing child bicycles for Dutch market. I will find out to what extend is this company influenced by exchange rate fluctuations and what kind of protection uses to hedge itself against the exchange rate risk.

4.1 Company description

The observed company has a legal form as natural person, so it is owned by one person who is a main director as well.[4] It manufactures child bikes under brand Alpina for Dutch customer, who then sells them in Netherlands and Belgium to retailers. Alpina is one of the most favourite and well-known bike brand in Netherlands and Alpina bikes are used by many customers all over the Europe. The company produces about 30,000 pieces of bikes per year and employs over 30 workers. Moreover, it has quite long tradition in Czech bike industry - over 20 years of production. The factory ensures a significant share of bikes on Dutch and Belgian market. According to own research of the Dutch customer, Alpina is the third largest bike supplier on the local market and forms approximately 30% of all bikes in Netherlands.

The production process starts with the purchase of material both from EU and from Asia (especially Taiwan and China). After manufacturing of bike, it is packed into box and loaded on truck, then forwarded to Netherlands. Generally, the production process contains several stages – lacing and trueing of wheels, painting of parts in painting room, sticking of decals on frame, forks and other parts. After these preparations, the bike is assembled, wrapped and ready for loading.

4.2 Impact of exchange rate on manufacturing

4.2.1 Correlation matrix

The exchange rate and its volatility plays very important role for this company, because it pays for input material from 80% in U.S. dollar and remaining 20% in Euro. All the revenues from sales are accepted in Euro. Even though the empirical studies and theories point on negative impact of ex. rate on manufacturing industry, in practice most of manufacturers use some kind of protection against exchange rate volatility. This is also applied to case company, has been using several tools of protection against the exchange rate risk, so called hedging. Thus, I suppose that the company will

[4] Company ID: 64111393, www.powerstore.cz

be nowise influenced by ex. rate. Below is available the correlation matrix of exchange rate CZK/EUR with annual production of company for period 2004-2014.

corr(PRODUCTION_INDE, EXCHANGE_RATE) = -0.33476924

Under the null hypothesis of no correlation:

t(9) = -1.0658, with two-tailed p-value 0.3143

As was supposed, in case of this company, there did not appear any correlation between industrial production and CZK/EUR exchange rate. The high p-value indicates that data are likely with a null hypothesis saying that these two variables do not affect each other. It responds to presumption, that in practice companies are hedged. This fact points on cleverness and providence of companies facing to ex. rate risk.

Anyway, the owner himself said, that depreciation of Czech crown helps to factory´s performance since he is able to gain on higher exchange rate of Euro and thus extend his production. For last two years, since the intervention by Czech National Bank started, the company refrained from hedging, because the exchange rate is guaranteed by Czech National Bank. The CNB decided to stick the Czech crown around 27 CZK to the euro by the end of 2012. This ex. rate is going to be kept until end of 2016, what brings certain security for manufacturers and exporters in general. This commitment of CNB is aimed to encourage the Czech exports and to increase the profitability of corporations and their willingness to invest (CNB, 2015).

The intention of CNB is again in accordance with Abeysinghe and Yeok (1998) theory, that currency devaluation stimulates export and limit import and also the theory of Šimánková and Stavárek (2014), who also proved a positive effect of depreciation for most of the product categories determined on the basis of SITC in their study. The observations of the company´s owner are related to the study of Jamil, Streissler and Kunst as well, because they stated that the negative impact of the exchange rate volatility on industrial production dropped numerously after the introduction of Euro for observed countries. Thus, the fact that Netherlands has been a member of European Monetary Union contributes to a certain kind of stability in trade of this company.

As was mentioned above, the main reason why the observed company is not influenced significantly by ex. rate volatility is that it hedges itself against exchange rate risk and widely uses currency forward contracts. Concretely, this company hedges itself using forward rate agreement provided by ČSOB, but these services are offered by many other banks as well. Generally, a lot of manufacturing companies which trades internationally use some kind of hedging to decrease the foreign exchange risk. More about hedging and its types will be described below in separated chapter.

4.3 Foreign exchange rate hedging

The foreign exchange rate hedging, also called a FOREX hedge, is a method used by companies to eliminate or "hedge" their foreign exchange risk resulting from transactions activities in foreign currencies. Foreign exchange risk is the risk that the exchange rate will unfavorably change before the moment when a payment is made or before is received in the currency. Hedging represents the act of entering into a financial contract with the intention to protect against unexpected, expected or anticipated changes in currency exchange rates. The currency hedging is chiefly used by businesses in order to eliminate risks they encounter when conducting business internationally. In principle, companies have to exchange foreign currencies for home currencies when dealing with receivables, and vice versa for payables, in a current exchange rate between the two countries. Thus, hedging is advantageous tool how to cope with risk of exchange rate volatility.

A foreign exchange hedge transfers the foreign exchange risk from the trading company to a business that carries the risk, usually bank institutions. The trading company pays for setting up the hedge to the banks and forgoes any profit if the movement in the exchange rate would be favorable to it. Hedging is usually accomplished by purchasing or booking specific types of contracts that are designed to achieve specific goals. These goals are based on the level of risk the customer is exposed to and seeks protection from. It allows the individual to lock in the future rates without affecting their liquidity in great extent.

4.3.1 Types of foreign exchange rate hedging

1. External techniques

To this group of fixed-term contracts belong forward and futures. Both parties of contract have simultaneously fixed receivable and fixed commitment. Within this group of contracts, neither one of the partners has a possibility of choice after contract conclusion. Conditions of contract are fixed in the sense that all payments are known in advance, eventually, the payments depend only on currency rates development, interest rates, share prices and commodity prices. Furthermore, special groups of external technique are swaps, which allow not using the right to exchange if the ex. rate is not favorable for the client.

- **Forward** – A transaction suitable for clients who need to exchange available foreign money from one currency to another with maturity of more than two working days. Forward is useful as a hedging strategy especially for single-supply large volumes, but not suitable for securing the exchange rate risk during repeating deliveries at regular short intervals. The main benefit lies in that at a suitable time a client can affix a binding rate that he considers as optimum to his future conversion. Forward contracts allow arranging the exchange rate with the bank and its quite fast realization (within

one month). There are not any incidental expenses, thus is very utilized by many manufacturers. However, forward might be risky, since the exchange rate can distinctly change in a month and client can lose. On the other hand, forward can ensure significant gains as well.

• **Futures** – Futures contract is as an agreement between two parties to buy or sell an asset for a particular price at a particular time in the future. It serves to companies or corporations in order to offset their risk exposures and limit themselves from any fluctuations in price. Futures are available in currencies which have within international payments a decisive position.

• **Swaps** – The holder of swap has a right to exchange the currency for a predetermined price, but he is not obliged to exercise this right. He has two choices what to do – use the purchased right or resign from it, if the situation on foreign exchange market is developing differently than he had expected and current exchange rate on the spot market would provide more profitable trade. Therefore, swaps allow minimization of ex. rate risk, but keep "open door" for maximizing profits from the particular trade operation though.

2. Internal techniques

• **Leading and legging** – Leading and lagging is a method of hedging, when a company adapt it payments and debits with respect to expectations of future exchange rate on the spot market.

• **Cross hedging** – Forwards contracts, futures contracts and swaps are available only in a selected group of currencies, which play a decisive role in international payment system. If the company has liabilities or assets in the currency in which the aforementioned instruments cannot be used, it can choose this type of hedging. In this case, the company identifies a different currency, in which is forward or another hedging instrument achievable and which evolves in a similar manner as the original currency. The success of this strategy depends on the tightness of the movement of exchange rates of both currencies against the domestic currency.

• **Currency diversification** – One of the simplest ways how to minimize the ex. rate risk. If the company seeks to diversify its currency portfolio, then a substantial appreciation (strengthening rate) or depreciation (rate decrease) of one currency will not have such an intense effect on the value of foreign currency assets, liabilities and cash flows denominated in the domestic currency.

• **Netting and matching** – Companies which trade among themselves may net their mutual receivables and payables. The only practical problem that can occur is a decision, in which currency equals the resulting balance. While netting is used usually within certain group of companies, the matching can be implemented both within certain group of companies or in relationship to third party.

The forex currency trading market is a risky one, and hedging is just one way that a trader can help to minimize the amount of risk he takes on. Nowadays, many bank institutions are providing services for hedging. However, beyond the indisputable advantages the hedging may bring also disadvantages. Since hedging is aimed to protect entrepreneurs against losses and risks, it does not provide ample flexibility that allows them to quickly react to market dynamics. When it comes to diversification of risks, it is directly proportional to each other. Thus, if the company minimizes the risk, it is reducing its potential profits as well. Another unfavorable fact is that companies must release quite large portion of money at once when concluding a contract about hedging, which might be difficult for firm that do not have sufficient cash reserves. Moreover, tricky is also the very essence of hedging, i.e. fixing the future rate, thereby arises no opportunity to benefit from favorable movements in exchange rates.

Luckily for Czech exporters and manufacturers, the Czech National Bank decided to weaken the exchange rate of Czech crown until the end of 2016 as it should support export and revive Czech economy.

5 Discussion

The exchange rate volatility can at least be perceived as a phenomenon causing uncertainty in domestic and foreign markets. Its extent and impact is being a source of concern not only for the economists and the political community, but also for businesses. The mitigation of ex. rate fluctuation is need and wish of countries that possess national currencies and business entities which enters international market. The exchange rate fluctuations not only increase a potential market risk, but disproportionately increase the costs associated with the implementation of business contracts as well. There exist several possibilities how to hedge against exchange rate risk, but this, however, represents other additional costs. Fortunately for exporters, the Czech National Bank has committed to keep the exchange rate CZK/EUR around 27 Czech crowns until the end of 2016.

Since the Czech Republic has been a member of European Union, the acceptance of Euro as a national currency is being quite discussed for last years. Even though the excessive exchange rate fluctuation has been a threat for Czech exporters, they mention as a main Euro disadvantage a loss of possibility of currency devaluation, which means a tool for increasing of their competitiveness.

According to many experts, the weakening of currency do not have to necessary mean an increase in export, as stated for example Krugman and Taylor (1978). They claimed that if the manufacturing economies are dependent on imported inputs, a real depreciation would increase the cost of these inputs leading to a contractionary impact on domestic production. I suggest that the reason why certain exporting manufacturers in certain countries react differently on devaluation of domestic currency might be explained in price of their inputs in manufacturing process. It does depend on currency in which is the input material purchased. As was proved by Wang and Rogers (1995) in Mexico and by Berument and Pasagullari (2003) in Latin America and Turkey, these countries reacted differently on real devaluation and it led to economic contraction. Thus, we can conclude that strongly depends on structure of manufacturing industry when reacting on exchange rate shocks.

I also proved that a positive development of Czech manufacturing industry is related to foreign direct investment inflow and depends on development of industrial production in Germany and European Union, since the countries of EU are the largest trade partners of Czech Republic. The manufacturing industry is from great portion dependent on automotive sector that generates almost a quarter of Czech export and 7 % of GDP (2014). The automotive sector has been a draft-horse of manufacturing industry for recent year and largely contributes to Czech economy. However, if the industry with vehicles declined, it would cause unpleasant consequences for Czech Republic. As was shown in Finland, where a producer of cellphones Nokia in its most successful time participated by 4 % in GDP (automotive sector in the Czech Republic

by 7 %). After launching of smartphones by Samsung and Apple, Nokia lost its market position. Together with Nokia suffered even whole Finland, whose GDP dropped about 1,3 %. Therefore, the market saturation with vehicles in Eurozone poses a risk for Czech manufacturing.

Since Al-Rashidi and Lahiri (2012) in their study for ASEAN+3 discovered that standard exchange rate is not a sufficient indicator of impact on manufacturing industry, they employed real effective exchange rate instead of standard one. Therefore I performed correlation matrix to find out how these two rates differ from each other. Since the Czech Republic trades from more than 80% with countries of European Union, correlation of trade-weighted REER with exchange rate was predictably strongly negative. It proves that standard ex. rate of Czech crown and Euro is a significant indicator of impact and can be further used for analyzing. Interestingly, the character of the Czech Republic is such that enables using of both rates without any difference in results.

During analyzing of impact, there occurred a few obstacles, mainly connected to data availability within manufacturing industry. I have discovered that the turnover from export of manufactured goods is not so influenced by exchange rate shocks as the production index is. Since the turnover is calculated as a quantity of manufactured goods multiplied by exchange rate, it cannot provide decisive information for analysis. In this case, correlation matrix showed is a slight negative correlation between turnover of export in 5-8 SITC groups and exchange rate of Czech crown with euro. Thus was employed a correlation matrix of exchange rate with production index of manufacturing industry as well, which proved a strong negative correlation between observed variables. This calculation confirmed a classical theories assuming that currency devaluation stimulates export and hence the production in given country (Abeysinghe and Yeok, 1998). This result is even with accordance of study by Šimánková and Stavárek (2014), who proved the interdependence of exchange rate and manufacturing performance as well. It can be stated, that manufacturing production reacts more sensitively on ex. rate shock and is better indicator of impact than the turnover is.

Another key part of this work was the calculation of elasticity coefficient, which showed that production of manufacturing industry is elastic one. As the exchange rate increases with 1% (CZK appreciates), the production decreases with 2%. This resolution is again consistent with empirical research of Šimánková and Stavárek (2014) and Abeysinghe and Yeok (1998), who stated that real exchange rate depreciation stimulates export and support production of manufacturers. Moreover, Ekholm, Moxnes and Ulltveit-Moe (2012) proved this fact on Norwegian economy, where the real appreciation of Norwegian Krone caused an increased competition for exporting manufacturing firms. On the contrary, results of correlations and elasticity are inconsistent with Krugman and Taylor (1978) and Wang and Rogers (1995) who found out that real devaluation may lead to economic contraction, as it happened in Mexico. Similar results proved Berument and Pasagullari (2003) for Turkey and Latin America countries respectively. The reason why certain exporting manufacturers react differ-

ently in certain countries on ex. rate devaluation might be explained in price of their inputs in manufacturing process. The depreciation of ex. rate might have double-edged effect on business, if it purchases input material in the same price as it sells. In this case, devaluation cannot have a positive effect on producers, rather the negative one. However, according to results, the Czech manufacturers react positively on currency devaluation, just as was assumed by most of theories.

Speaking about coefficient of elasticity, for analyses of impact could be also suitable a testing of Marshall-Lerner condition. However, I do not have proper data to calculate this, concretely are missing data of turnover of manufacturing industry in quantity. The narrowness of data did not allowed construction of regression analysis, which would provide significant complex results of impact.

Within case study, where a certain manufacturing factory was tested, I discovered interesting fact that in practice a lot of companies use hedging in order to decrease the exchange rate volatility risk. Also I mentioned the most common forms and types in terms of external and internal hedging techniques. During the thesis I did not forget to remark the recent intervention by the Czech National Bank, which have been stimulating the export and manufacturing production.

6 Conclusion

The objective of this thesis was to evaluate the impact of exchange rate on Czech manufacturing industry. The obtained findings and results were then applicated on particular company operating in manufacturing industry and evaluated as relevant or irrelevant.

The first part of thesis is dedicated to theoretical bases of exchange rate. There were mentioned exchange rate systems, determinants of ex. rate and related theories, as purchasing power parity and interest rate parity. Also was described the exchange rate volatility and the trend of Czech crown against Euro including the commitment of Czech National Bank about interventions. This chapter is followed by empirical part containing the existing studies and theories dealing with impact of exchange rate on manufacturing sector.

To obtain a comprehensive picture of manufacturing industry and its specifics, there was processed structure and development of manufacturing industry in Czech Republic. Within this part, a commodity structure of manufactured goods exported to Germany was developed, since the Germany is considered as a largest trade partner of Czech Republic. In 2012, 30 % of Czech export was intended to Germany. From the commodity structure is obvious that crucial component of industry has been a section with machinery and transport equipment (SITC 7 group) for several years. I also pointed on tight dependence of Czech Republic´s GDP on this section of industry, as its possible slowdown might bring a threat to Czech economy. The dependency of the manufacturing sector was outlined in single chapter, where is depicted a continuity of Germany and other EU countries. Moreover, the favorable development of manufacturing is related to foreign direct investment inflow as well. These dependences are shown in single graphs with detailed comments.

Currently, there cannot be identified a clear dependence between exchange rate volatility and manufacturing industry. The empirical studies diverge in the effect description, observed apparatus and period studied. Thus, it is not surprising that some of theoretical models points on significant impact while other strictly reject it.

The testing of impact was performed on the basis of data provided by Czech National Bank and Czech Statistical Office. I employed data of exports of goods by SITC 5-8 in cross-border concept with monthly average of exchangeate CZK/EUR for period January 2005 till March 2015 into a correlation matrix, which did not confirm the dependence between these two observed variables. As a more significant model showed a correlation matrix of monthly data of industrial manufacturing production (2010=100%) and monthly ex. rate of CZK/EUR (end of month), also in period January 2000 - March 2015. A single production appeared as a better indicator of impact, since it expresses index of production, which is not recalculated by exchange rate as the turnover is. The results of correlation matrices are impersonated with most of theoretical assumptions. As another test of dependence was performed the test of elasticity, which showed the manufacturing production as elastic against ex. rate

fluctuations. This also supports basic theory that devaluation of currency supports manufacturers and exporters.

To state an example from practice, there was tested the impact of ex. rate on particular company operating in manufacturing industry. The correlation outlined almost no impact on the given company, since has been hedged against the ex. rate volatility risk

Finally, according to all performed test, the volatility of exchange rate affects the manufacturing industry in Czech Republic to a certain extent. However, the effect of this extend should be examined by some further analysis, as I was not able to ensure the data in sufficient time series and in proper relevance. Must be considered, that exchange rate changes can be absorbed by the individual entities in the economic environment, as they seek to ensure against exchange rate risk. The last section of this thesis is dedicated to hedging, since it provides various tools to manufacturers how to decrease impact of ex. rate fluctuations.

To summarize the obtained findings, in accordance with the objective of this work was analyzed whether the exchange rate development affects the Czech manufacturing sector of industry. The stated theories and studies in this work were further compared with obtained results and properly commented.

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