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Does Foreign Direct Investment Affect Labour Productivity in the Automotive Industry?

The Czech Republic Case Study

diplomová práce

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Prohlašuji na svou čest, že jsem diplomovou práci vypracovala samostatně a s použitím uvedené literatury.

Bc. Martina Moravcová

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Abstract

The aim of this thesis is to show effects of foreign direct investment on labour productivity in Czech automotive sector in the period 2004-2009. The effects are measured through horizontal spillovers (technology transfer) representing the influence of foreign firm on Czech automotive sector and through Herfindahl index representing market concentration in the automotive sector. Based on models used in this thesis I have found out that between labour productivity and technology transfer of foreign firms in the automotive sector is not significant relationship, but labour productivity is positively and significantly influenced by market concentration in the sector.

These findings do not correspond fully to widespread opinion that foreign direct investments enhance labour productivity of domestic firms by bringing new knowledge or technology. These findings correspond only to the hypothesis that higher concentration of the sector caused by foreign presence positively influence labour productivity.

Keywords

- Foreign Direct Investment
- Labour Productivity
- Czech automotive industry

JEL Classification

- F23; J24; R38

Abstrakt

Cílem této diplomové práce je analyzovat efekty přímých zahraničních investic na produktivitu práce v českém automobilovém průmyslu v období 2004-2009. Tyto efekty jsou měřeny horizontálními spillovery (technologický transfer), které zastupují vliv zahraničních firem na český automobilový sektor a Herfindahlovým indexem, který vyjadřuje koncentraci trhu v automobilovém průmyslu. Na základě použitých modelů se zjistilo, že produktivita práce domácích firem nesouvisí s technologickým transferem od zahraničních firem, ale je pozitivně a významně ovlivňována vyšší koncentrací v daném sektoru.

Tyto závěry nejsou plně v souladu s hypotézou, že přímé zahraniční investice jsou nositelem nových znalostí a technologií. Závěr pouze odpovídá hypotéze, že vyšší koncentrace trhu v automobilovém sektoru v důsledku příchodu zahraničních firem pozitivně ovlivňuje produktivitu práce v daném sektoru.

Klíčová slova

- Přímé zahraniční investice
- Produktivita práce
- Český automobilový průmysl

List of Abbreviations

AIA Automotive Industry Association CZ (Sdružení automobilového průmyslu)

CEEC Central and Eastern European Countries

CNB Czech National Bank

CZSO Czech Statistical Office

EU European Union

FDI Foreign Direct Investments

MNC Multinational Companies

MPO Ministry of Industry and Trade of the Czech Republic

OECD Organization for Economic Co-operation and Development

R&D Research and Development

SUV Sport Utility Vehicle

TNC Transnational Companies (same as MNC)

TPCA Toyota Peugeot Citroën Automobile

Table of contents

Introduction

Automotive sector in the Czech Republic has a long standing tradition.[1] The beginnings of the largest car producer – Škoda Auto – date back to 1905, when Laurin and Klement set up a small plant in Mladá Boleslav. In early 1990s, Škoda Auto was privatised by Volkswagen Auto and became the biggest Czech exporter, known worldwide. In 2008 Škoda Auto was employing more than 29 000 workers and in 2007 produced more than 630 000 vehicles.

The second largest car producer came in 2005. It is a joint plant of Toyota and Peugeot Citroën Automobile (TPCA) in Kolín, producing about 320 000 vehicles annually and employing more than 3 500 people. More than 99% of the cars are exported mainly to European markets.

The last one is Hyundai, who came in late 2008 to Nošovice. Hyundai has the production capacity of 300 000 cars per year and employs 3 500 workers.

I have chosen the topic of FDI's influence on labour productivity in the Czech automotive industry because of its significance for GDP and also its high share on FDI coming to the Czech Republic. Automotive sector creates more than 20% of the Czech manufacture production, employs 120 000 workers and builds 23% share of the Czech export. With 10%, it is one of the largest contributors to the Czech GDP.

During the search for relevant literature, I have noticed the lack of literature analysing these two topics in one. There exist various papers analysing the effects of FDI on labour productivity in CEEC or other countries[2] and a few studies dealing with Czech car industry, but significant papers considering FDI and Czech automotive sector as a whole are missing. As pioneer study could be consider Guidote (2008) describing Czech car industry since 1990s. Her work focuses on

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[1] The specific information about history and development in Czech automotive industry are from CzechInvest Agency's publication 'Automotive Industry in the Czech Republic', AIA and company's websites.

[2] See Stančík (2007), Djankov and Hoekmann (1998 and 1999) or Javorcik Smarzynska (2004).

FDI inflow to the automotive sector, but brings only brief overview of the situation.

The main aim of the thesis is to show FDI effects (through horizontal spillovers and market concentration) on labour productivity in the automotive sector. I examine the labour productivity as **(a)** a ratio of added value to the number of employees and also labour productivity as **(b)** a ratio of sales to the number of employees.

Labour productivity is appropriate measure to compare the impact of FDI on the host country because of FDI's connection to numerous direct and indirect effects which are reflected in labour productivity. For example training of labour force or gaining new technologies will increase labour productivity. As my thesis shows presence of foreign firms in the Czech automotive sector has insignificant effect on labour productivity through horizontal spillovers, but has significant and positive effect due to higher market concentration in the automotive sector.

This thesis is structured as follows. In the next section, there is subsection including theory base concerning FDI and labour productivity needed for the analysis. The following subsection deals with inflow of FDI to the Czech Republic and also shows main characteristics of the Czech automotive industry. Section 2 deals with positive and negative effects of FDI on labour productivity. In following section 3 are analysed the FDI effects on labour productivity using two approaches of measuring labour productivity. In last section, I conclude my findings.

1 Theory

In this section are introduced the basic terms which are dealt in my thesis relating to FDI and labour productivity as well as the inflow of FDI to the Czech Republic and main characteristics of the automotive industry in the Czech Republic.

1.1 Foreign direct investment

To define foreign direct investment I follow the official OECD (1999, p.7-8) definition, consistent with EUROSTAT and IMF:

'Foreign direct investment reflects the objective of obtaining a lasting interest by a resident entity in one economy ('direct investor') in an entity resident in an economy other than that of the investor ('direct investment enterprise'). The lasting interest implies the existence of a long-term relationship between the direct investor and the enterprise and a significant degree of influence on the management of the enterprise. Direct investment involves both the initial transaction between the two entities and all subsequent capital transactions between them and among affiliated enterprises, both incorporated and unincorporated.'

OECD (1999, p. 8) also defines foreign direct investor:

'A foreign direct investor is an individual, an incorporated or unincorporated public or private enterprise, a government, a group of related individuals, or a group of related incorporated and/or unincorporated enterprises which has a direct investment enterprise – that is, a subsidiary, associate or branch – operating in a country other than the country or countries of residence of the foreign direct investor or investors.'

As direct investment enterprise in OECD (1999) methodology is classified an incorporated or unincorporated enterprise where foreign investor owns at least 10% of ordinary shares or voting power of an incorporated enterprise or the accordant share of an unincorporated enterprise. 10% of the ordinary shares or

voting power reflect the presence of a direct investment relationship and the effective influence or participation in the management of an enterprise. In some cases, a direct investor with 10% of the ordinary shares or voting power has no significant influence, but in other cases a direct investor with less than 10% of the ordinary shares or voting power has effective influence in the management. OECD does not recommend any qualifications to this rule. Some countries could base a direct investment relationship on:

- presence in the board of directors

- participation in policy-making process

- inter-company material transactions

- managerial exchange

- delivery of technical information

- provision of long-term loans at lower than market rates

On the other hand, there are some cross-border transactions which do not fulfil conditions for FDI such as cross-border services (transport, labour, accommodation) or foreign sales (ticket offices).

Foreign direct investment has three main parts as shown below.[1]

FDI = equity capital + reinvested earnings + other capital

Investment into equity capital represents a foreign direct investor's deposit into company's equity capital. Reinvested earnings reflect share of a foreign direct investor on retained profit. Other capital includes loans or lending between foreign direct investors and other in-house firms.

1.1.1 Forms of FDI

FDI could be divided according to the various aspects. In the thesis I am following taxonomy of Srholec (2004) who focuses on four major aspects:

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[1] According to the CNB publication of 2008 'Přímé zahraniční investice 2006'.

Size of control

In associate companies foreign investor has a minority share (10 to 50%) of ordinary shares or voting power. Subsidiary companies are under direct control of foreign investor.

Entry motivation

Market-seeking investments aim to increase market share and decrease distribution costs (custom duty or shipping costs). These investments crowd out domestic production or substitute foreign export. Efficiency-seeking investments target production optimisation through decreasing costs of production and usually are export-oriented. For this type of investment are important production inputs such as inexpensive labour force, suitable natural resources or appropriate education. Asset-seeking investments search for specific assets such as brand name or patent.

Entry method

Although greenfield investments enable to realize specific investor's intentions, they are delayed in terms of time needed for investment realisation. Greenfield investment is usually used by companies that need inputs widely spread in the host country. The decision where to go is also affected by government incentives. Brownfield investments lie in the change of ownership structure and significant investments into restructuring of the acquired company.[2] Other forms of FDI include mergers and acquisitions (M&A) where foreign investor rules over existing company or its assets.

Specialization of controlling company

Vertical FDI are focused on product specialization. In diverse subsidiaries are produced different parts (various phases of production). Investments are export-oriented.

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[2] FDI during Czech privatization have a form of brownfield investment because of its character – buying a state owned firm and followed by restructuring process.

Oppositely, horizontal FDI are based on process specialization where similar processes are held in one subsidiary. This type of FDI is more domestic oriented as trying to increase market share.

Some notes concerning FDI forms

In one type of FDI, we can usually find more than one aspect mentioned above. For example investment of Volkswagen in Škoda Auto is a combination of efficiency-seeking and also asset-seeking investment.

Other types of foreign presence, ranking between internal investments and pure market solutions (such as trade) are international contracts, franchising, joint ventures[3], outsourcing, licensing or strategic coalitions.

1.1.2 Determinants of FDI inflow to the Czech Republic

This subsection concerns decision-making process of foreign investors (the publication of Regionální rozvojová agentura Jižní Moravy (2005)[4] is followed in this subsection). Before realising an investment, investors have to go through a difficult process of decision-making. At first stage investors look for a country and consider factors such as:

- overall economic and political situation

- tax legislation

- size and potential of markets

- geographical position

- industrial tradition and its present state

- quality of labour force

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[3] Joint venture is a legal entity formed for a single business activity. It is formed between at least two parties contributing by capital or assets. All contractual parties share revenues, expenses and control over the joint venture firm.

[4] Although this source is not prestigious, it very well identifies the behaviour of foreign investor in the Czech Republic.

- infrastructure

- natural resources

- sources for R&D

- entrepreneurial costs

- standards of living

- investment incentives

When investor is searching for specific region in the selected country, the main factors are:

- availability of suitable estates

- technical infrastructure

- availability and efficiency of labour force

- prices of estates and services

- support of municipal offices

- quality and promptitude of reaction

- availability and quality of local suppliers

1.2 Labour productivity definition and its measure

The measure of productivity is commonly defined as a ratio of outputs to inputs.[56] In case of labour productivity is widely used **(a)** the ratio of sales to the number of employees or **(b)** the ratio of value added to the number of employees,[7] but there exist also alternative measures (benchmarking process[8] or the measure of living standards[9]). The growth in labour productivity can be described as decrease in employment or as more efficient work of employed people.

I would like to describe more closely several variables which influence labour productivity and are covered in these ratios. Highly relevant is the measure of technology. It is important to identify technical or technological change. Following Griliches (1987, p. 11) technology could be defined as *'the currently known ways of converting resources into outputs desired by the economy'*. Technology is in separate form such as new improvements, new design, new invent, new scientific conclusions or new managerial skills and human capital.

According to Griliches, the other factor influencing productivity is efficiency of the production. Full efficiency basically refers to production process achieving

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[5] This section is developed using mainly OECD's Measuring Productivity (2001; manual).

[6] At the level of total economy is labour productivity defined as output per employee (see CZSO definition).

[7] For example see manual to labour productivity data at CZSO or OECD's Measuring Productivity (2001; manual).

[8] Benchmarking processes towards other firms in the same sector or to the total of that particular sector or economy could detect inefficiencies which could be minimized and so help to increase productivity. Benchmarking process lies in comparisons of number of employees to sales, number of goods produced or other specific measures suitable for all companies. While this kind of measurement process is almost ideal for single firm's profit maximizing it is not able for aggregate productivity measurement.

[9] Living standards could be used for measuring labour productivity while they are calculated as income per capita which is changing according to value added per worked hour. Labour productivity in this case contributes to explanation of changes in living standards.

the maximum output with provided technology and inputs. The efficiency is expressed by efficient allocation[10] that is met when:

- Nobody can be better off without worsening situation of somebody else

- No additional output can be obtained with the same amount of inputs

- The production is produced at the lowest unit costs

For the analysis I suppose that increase in efficiency is connected with minimising of technical and managerial inefficiencies by improved managerial skills, know how, use of production capacity, implementation of 'best practice' and also using of new technical appliances or realising economies of scale.

Labour productivity in my analysis will be measured residually and that is why not only the factors mentioned above but also other changes in learning-by-doing, capacity utilization and errors measurement will be included.

Although most changes in labour productivity probably spill over through technical changes, what is hard to measure separately, I will focus on overall labour productivity spillovers from foreign owned to domestic firms.

Caves (1974) proposes that FDI improve host country productivity through more efficient allocation across the economy (due to higher competition at the market) or by technology transfer from foreign to domestic firm. Technology transfer takes place through the contact between foreign and domestic firms. When technology transfer is more important part of FDI, domestic firms with foreign connections should experience higher productivity than domestic firms without such connections. Domestic firms with foreign linkages are supposed to be direct recipients. Caves also pointed out that FDI improve allocation and technical efficiency through competition. Firms have to compete for factor inputs and customers with new entrants and also these firms reduce market power of previous firms. Less competitive firms (less productive firms) have to exit the market or increase their productivity.

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[10] Modified according to the definition in Business Dictionary.

1.3 Inflow of FDI to the Czech Republic

The total stock of FDI grew rapidly after year 1997 (in 1998 almost by 200% compared to previous year). This development was probably caused by launching investment incentives program, while till 1998 ran free competition at the Czech FDI market. Compared to surrounding countries, Czech Republic experienced high inflow of FDI at the early 1990s due to its stable political situation and relatively low debt of public finance. However, later came to the FDI slowdown as surrounding countries (Poland, Hungary) started to launch their incentive's programs. Afterwards, as seen on the graph 1 bellow, in 2003 the total FDI inflow experienced significant drop (by almost 80% y-o-y). This decrease could relate to overall economic slowdown in 2001. At the end of observed period came to gradual slowdown in the inflow of total FDI to the Czech Republic. It is probably caused by reinvesting of earnings. This development probably does not relate to any specific tendency and is mostly caused by single investing projects that distort the total FDI inflow.

The data do not copy GDP growth rate due to its time lag between planning and realising an investment. From the graph 1 is visible approximately one year delay between FDI inflow and GDP growth. I have conducted a simple correlation analysis and the correlation coefficient between FDI and GDP growth (both in the same period) is 0.35 referring to the low positive correlation between these two values. When lagging FDI growth by one year, correlation coefficient raises to 0.54 representing medium positive correlation. As reflect these results, there exists a link between FDI inflow and following GDP growth. Logically, the causality should be in the direction from inflow of FDI, which boosts GDP growth in the following period. There is also a possibility of reverse direction. In the case when investors are considering an investment and expecting GDP growth (especially by market seeking investment), they realize investment to the Czech Republic.

Graph 1 The total FDI inflow to the Czech Republic and GDP growth
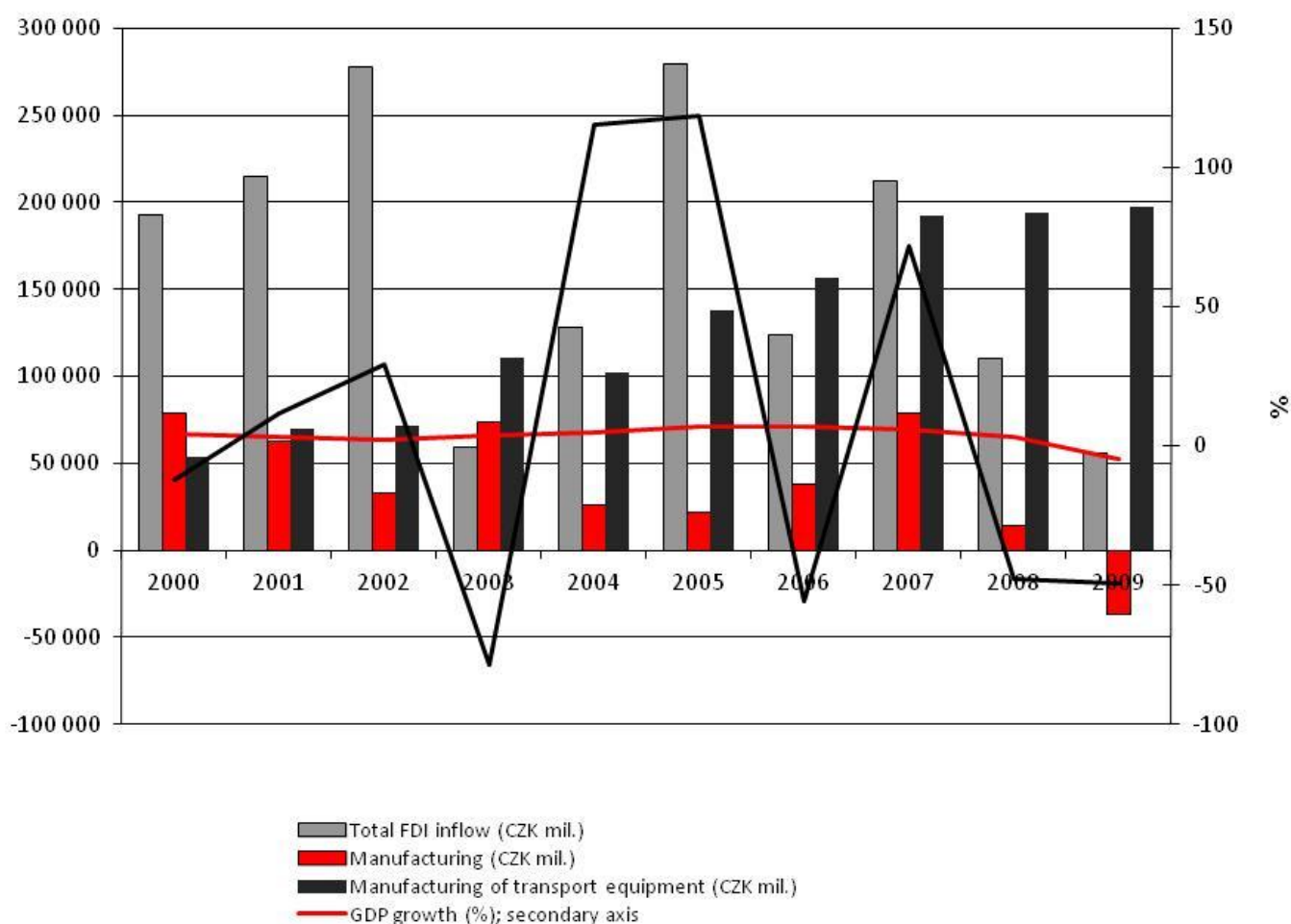
Source: Data CNB, CZSO, own elaboration, in CZK mil.

1.3.1 Investment into the transport equipment manufacturing

As seen from the graph 1, FDI to the Czech transport equipment manufacturing do not show any specific trend. Moreover, they are rather related to single investment projects than to any long-term strategy. Table 1 summarizes the most important investment projects in the Czech automotive industry supported by investment incentives. The data about invested amount are based on investor's investment plans submitted to the CzechInvest Agency at the project launch. The sign 'Decision' corresponds to the date when was decided about investment incentive and does not have to mean the real date of providing the investment.

Table 1 Investment projects in the automotive industry (from 1998 to 2009)

Company	Investor´s country of origin	Investment (CZK mil.)	Region	Decision
Hyundai Motor Manufacturing Czech	KR	34 429	Moravia - Silesia	2008
TPCA Czech	JP+FR	23 500	Central Bohemia	2004
ŠKODA AUTO	DE	18 996	Central Bohemia	1998
Nemak Europe	MX	11 361	Usti	2002
DENSO Manufacturing Czech	JP	9 575	Liberec	2002
BOSCH DIESEL	DE	8 507	Vysocina	2001
VDO Česká Republika	DE	6 271	Central Bohemia	2003
ŠKODA AUTO	DE	6 122	Hradec Kralove	2005
BOSCH DIESEL	NL	3 232	Vysocina	2005
Continental výroba pneumatik	DE	2 999	Zlin	1999
KOITO CZECH	JP	2 634	Usti	2001
Automotive Lighting	DE	2 614	Vysocina	2006
SUNGWOO HITECH	KR	2 358	Moravia - Silesia	2006
Continental Teves CR	DE	2 181	Hradec Kralove	2001
Faurecia Automotive CR	DE	2 120	South Bohemia	2006
RONAL CR	CH	2 021	Pardubice	2006
AUTOPAL	US	2 003	Moravia - Silesia	1999
Lucas Varity	DE	1 979	Liberec	2006
METAL PROGRES Strakonice	FR	1 914	South Bohemia	2001
VALEO AUTOKLIMATIZACE	FR	1 913	Central Bohemia	2001

Source: Data CzechInvest Agency, own elaboration, in CZK mil.

1.4 Main characteristics of Czech automotive sector

In this subsection, I characterize the automotive sector in the Czech Republic. The specific information originates from CzechInvest Agency's materials, AIA materials, Czech Statistical Office and companies' websites.

In 2008, in the Czech Republic there were produced 947 372 passenger cars, meaning an increase only by 1% compared to the previous year. This slowdown was caused by creeping world recession. Behind the sales numbers stay two most important producers – Škoda Auto and TPCA. Third large car manufacturer is Hyundai but it was not open until autumn 2009. Besides passenger cars, in the Czech Republic there are also produced SUVs, trucks, coaches and buses, motorcycles and towed vehicles. Measured by pieces produced, 98.8% from domestic production is covered by passenger vehicles – cars, 93% of them are directed for export.

Czech automotive sector belongs to leading sectors of the whole economy with about 10% share on GDP, more than 20% share of manufacturing and about 23% share of export. Automotive industry covers not only final producers of motor

vehicles but also their suppliers from the same as well as from other sectors (manufacture of rubber and plastic products, manufacture of electric equipment or manufacture of accumulators and batteries) who also received some amount of FDI. The share of final producers and suppliers according to AIA is 42:58 as of 2007. To the TOP 20 belong Nemak Europe (producing engine systems), Denso Manufacturing Czech (starting in 2001 in North Bohemia region and producing automobile air-conditioning units), Bosch Diesel (placing manufacturing and international R&D activities to the Czech Republic), VDO Czech Republic (focused on fuel-injection units and other electrical parts) and Continental (tire producer).

1.4.1 Privatisation in the automotive sector

Czech automotive industry has a long-standing tradition since 19th century. The base for the most famous Czech company - Škoda Auto – is dated back to 1895 to Mladá Boleslav. The production range in post-war period was as limited as the investment provided. In early 60's and in the middle of 80's came to the single investment activity, but the underfunding in early 90's endangered large national companies into which was the automotive industry concentrated. During 90's came foreign investors at the market and started an investment boom. In early 90's took place privatization of Škoda by Volkswagen leading to enlargement of production range and quality improvement. This successful process was followed by other investors, especially in supplier's sector. The result is mostly foreign-owned (78% in 2007) but competitive automotive sector (represented by AIA companies[11]), as illustrates the following graph.

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[11] AIA (Czech Automotive Industry Association) associates about 160 companies operating in the Czech automotive sector (in various NACE sections connected to the automotive sector – CZ-NACE 29, some part of 27 or 22 and others). Its firms have approximately 20% share of total manufacturing production. Thanks to this modification results must not be perfect but for showing the trend should be sufficient.

Graph 2 The development of privatization in AIA companies
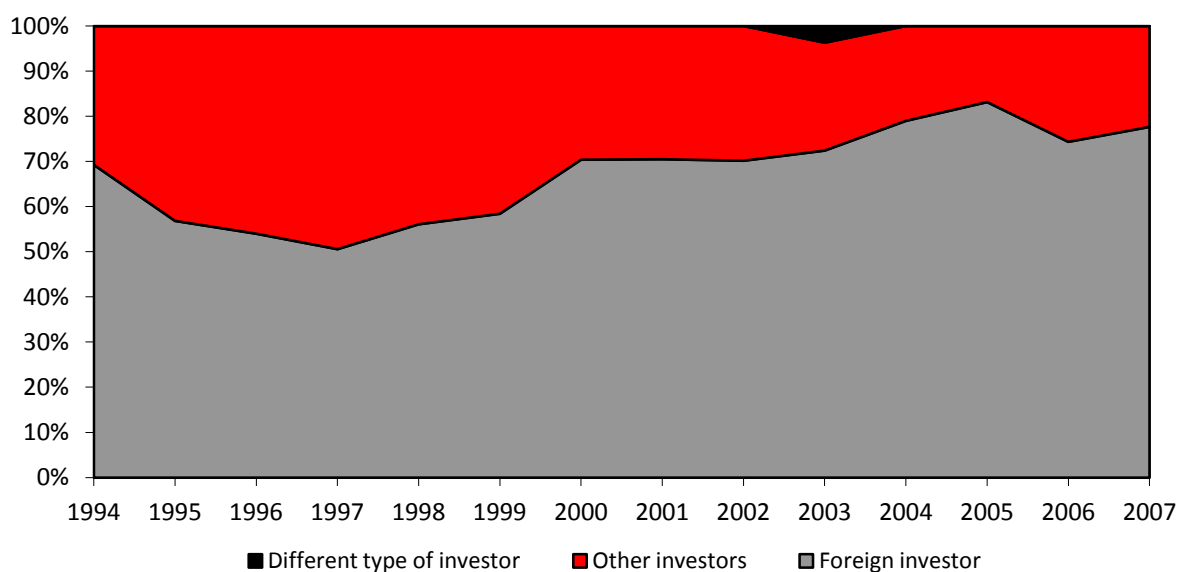
Source: Data AIA, own elaboration

1.4.2 Determinants of FDI inflow to the Czech manufacture of transport equipment

Multinational companies consider various indicators when planning a foreign investment. That process for the Czech Republic described Král (2004). Král used an econometric analysis[12] to show main determinants of FDI inflow to the Czech Republic. As statistically significant in long-term, he considers:

- Competing unit labour costs

- Economic performance in the main EU countries

- Share of CzechInvest Agency's projects in total FDI inflow showing the significance of Czech incentive's system

- Economic stability

For such a small and open economy as Czech one and prevailing export-oriented FDI is overall stability of very high importance. Moreover, the main

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[12] Data range used in the analysis covers period 1994-2002.

advantages of Czech Republic are competitive labour costs, government incentives, macroeconomic stability and geographical location.

As described by Hunya and Geishecker (2005), investment's attracting factors in CEE area are changing over the time. At the first stage of transformation process functioning market economy, the efficiency of public government and size of corruption were the main factors. In the second stage, macroeconomic indicators such as skilled labour force, its productivity, labour costs, exchange rates, inflation and taxation got more significance. At the third stage, agglomeration effect and regional networking became more important.

2 Foreign direct investment and labour productivity spillovers

To follow the aim of explaining the influence of FDI to the labour productivity in the Czech automotive sector, I characterize the FDI effects also on other macroeconomic variables. Understanding to these effects enables better comprehension of factors determining labour productivity.

Economic literature usually distinguishes between positive and negative effects of FDI and further between direct and indirect effects. I categorize positive and negative effects in accordance with Moosa (2002) and further direct and indirect similarly to Hunya and Geishecker (2005).

2.1 Positive arguments about FDI inflow

According to my opinion, the most important positive argument of FDI is bringing foreign capital, technology and other values to the host country and so supports the development of host's economy – especially by transition or developing countries.

FDI are also able to initiate economic growth of the host country through technology spillovers and above mentioned capital transfer that could partially fill missing savings in the host country. FDI can lead to increasing income and social welfare in the host country – especially when building new or enlarge original production capacities and so increase an employment.

New technology brought by investing MNCs and spillovers could lead to a productivity increase through **(a)** deepening of skills of local workers by training, **(b)** support competition on the market, **(c)** having export-oriented direction and enabling to realize economies of scale and **(d)** enabling local firms to participate at new business as local suppliers.

The most questionable argument for FDI is that FDI are stable even if trade slows down due to the stability of FDI flows as a consequence of long-term based projects.

2.2 Negative arguments about FDI inflow

The leading negative argument connected to FDI is crowding-out effect that refers to a diminishing share of investment of domestic firms in favour to foreign ones[13]. Other unfavourable effect is an increase in unemployment by closing down other businesses or mergers of production plants due to restructuring. When FDI have character of too capital-intensive technology or when present cheap technology which could be used by all firms in particular industry, then host country do not realise any technology spillovers. Also training provided to new workers cannot be suitable for whole society because of its briefness and irrelevance compared to domestic working needs.

Positive effect of bringing new financial sources to the host country do not have to take place when **(a)** FDI provides expensive source of financial capital, **(b)** foreign capital flow cannot be large because it could be more efficient to obtain part of capital from local capital market and so crowd-out capital for domestic subjects or **(c)** FDI have a form of non-financial investment (goodwill, know-how).

2.3 FDI and labour productivity spillovers

The industry seems to be very important when considering FDI. When FDI are directed to the less sophisticated industries with low share at value added, it could delay the catching-up process. Key factor for the positive development of host country are R&D activities which are usually concentrated in investor's home countries.

For my analysis I regard FDI (similarly to Romer (1993)) as the bearers of innovations and ideas which are able to provide diffusion of knowledge and

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[13] Further in the thesis is described the problem of FDI: Crowding out effect.

specific techniques or assets from foreign investors to domestic economies. Moreover, Romer shows on automotive industry's experiences over the previous years that FDI are the channel of transfer of ideas such as mass production and later just-in-time methods.

Kosová (2003) analysed Czech firm level data for period 1994 to 2001. She compared firm's activity in sector with or without presence of foreign company. Her results indicate that domestic firms react on foreign presence only in the time of foreign firm's entry. The crowding-out effect takes place only in that time. Afterwards Czech firms do benefit from presence of foreign company. Moreover, she confirmed that Czech firms in sector without foreign presence have higher tendency to leave than firms in sector with foreign firms. Kosová thinks that foreign firms do not primary locate in more growing domestic industries, but foreign presence makes domestic industries better off.

Further, Kosová found out intra-industry technology spillover effect towards domestic firms, the technology leader firms. But there is no significant effect for technology less endowed firms. According to Kosová, Czech firms must be at technologically advanced level to benefit from technology spillovers. She also found out that to major recipients of intra-industry spillovers are pure Czech firms.

Effects on training also increase the labour productivity, so there are no doubts that training of employees is at the high importance of realizing an FDI project. Although, training of employees cannot have huge effect for the host country because of the specialization and only use of obtained skills. Lall and Streeten (1977) described three types of managerial benefits connected with FDI. First benefits come from increased managerial efficiency in operations due to pursuing higher standards and training levels. Second benefits are associated with ability of finding investment opportunities. Third benefits create externalities from employee training such as technical or accounting skills.

Barrell and Pain (1997) tried to find FDI spillovers for host economy. Using Cobb-Douglas production function they proved influence of FDI on technical progress on British and German data between 1980s and the beginning of 1990s.

For Germany they found that each 1% rise in the stock of FDI increases technical progress by 0.27%. For UK it is by 0.26% in manufacturing industry. But in non-manufacturing sector, they have not found any significance even if in UK two-thirds of FDI came to this sector. Barrell and Pain offer an explanation: FDI benefits are more visible and quicker in sectors where domestic producers are experiencing comparative disadvantage and lower production.

Chung, Mitchell and Yeung (2003) carried out an analysis in US auto-component industry in period 1979 to 1991. In this period Japanese automobile assemblers began to produce vehicles in North America and so started to buy inputs from US auto-component manufacturers. These US firms should be direct recipients of any technologies transferred from Japanese firms. They found that FDI were associated with overall productivity growth but they did not find significant direct technology transfer. Productivity growth of US suppliers connected to Japanese plants was not higher than the growth of US suppliers without such linkages. Moreover, they found out that Japanese plants cooperate with low-productivity suppliers which have higher survival rate than low-productivity suppliers who do not cooperate with Japanese firms. According to these findings, Chung, Mitchell and Yeung conclude that increased labour productivity was mainly caused by competition pressure in the automotive sector. This conclusion is due to the lack of evidence of technology transfer to US firms which will signal direct influence from Japanese firms to US ones.

Chung, Mitchell and Yeung think that if increased host productivity is the result of direct technology transfer, then attracting FDI is crucial for productivity growth. Contrary, if increased host productivity is the result of tougher competition, then attracting FDI is conditional to explain why original competition was not able to achieve high productivity. They (Chung, Mitchell and Yeung (2003, p. 200)) find that *the key issue is whether establishing direct commercial linkages with specific productive foreign firms tends to help a firm become more productive itself or, instead, whether the firm must respond to more diffuse competitive pressures in order to gain improved productivity.'*

Chung, Mitchell and Yeung also point out that Japanese firms coming to US market could experience information disadvantage and self-selection bias. This situation is caused by lower ability of Japanese firms to screen out the US suppliers compared to US firms such as Ford, General Motors or Chrysler. Of course, the authors claim that information disadvantage will disappear as Japanese firms operating in the USA gain more experiences over the US suppliers. Under the circumstances of adverse selection, it may happen that Japanese firms will purchase products from less productive US suppliers. I find this thesis particularly relevant even for Czech automotive industry, but unlikely to USA in 1980's, in 2000's there is incomparably higher opportunity to screen the market not only by various market analysing agencies but also internet is a very efficient tool. Nevertheless, personal experience is one of the most appropriate tools to evaluate business partners.

Hunya and Geishecker (2005) draw the line between direct and indirect effects of FDI. One of the direct effects is reducing number of jobs as a consequence of restructuring privatized low-efficient state-owned firms. In formerly state-owned firms there is usually over-employment and therefore emerges a need to reduce it to obtain an efficient entity. Any delay in reducing workforce can lead to productivity problems and is only short-term solution. Therefore, FDI have productivity and competition increasing effect. Other direct effect takes place through increasing number of jobs as a consequence of greenfield investment. Job creation supposes to take place in manufacturing industry, but most of greenfield jobs rise in the service sector (banking, real estate or retail).

Indirect effects are shown through different ways. Firstly, negative spillovers come on by decreasing number of jobs due to cutting former domestic linkages to suppliers and replacing them by imports. Secondly, decrease in number of jobs in the domestic small and medium-size companies through tough competition of large and technology advanced MNCs. Thirdly, increase in number of jobs by building new linkages to domestic suppliers. This increase pushes through cost reduction process - a search for cheap local suppliers or bringing foreign

suppliers to the host country. There has been a tendency to bring up local suppliers and partners to the production or distribution channel.

Hunya and Geishecker (2005) find out that foreign and domestic firms differ in the way of internalization – the former firms are more internalized and have specific linkages and cooperation systems with other firms – foreign or domestic. According to Hunya and Geishecker, foreign owned firms are usually at higher technological level than domestic ones and are able to benefit on it. Foreign owned firms are also less integrated to the domestic supply chain – they rather import components and services than use goods and services from domestic firms. Foreign owned firms are also usually export-oriented.

Stančík (2007), further, categorizes indirect effects at horizontal and vertical spillovers. *Horizontal spillovers* in domestic industry turn up when productivity is increasing by copying foreign technologies or hiring foreign managers. Negative horizontal spillovers take place when domestic firms are not able to gain foreign technology and so increase their productivity. These firms become less competitive leading to crowding out of the market. *Vertical spillovers* refer to inter-industry supplier linkages between domestic and foreign companies. Foreign companies push at high quality standards bringing domestic firms a productivity increase.

According to Javorcik (2004, p. 609) *'spillovers from FDI take place when the entry or presence of multinational corporations increases the productivity of domestic firms in a host country and the multinationals do not fully internalize the value of these benefits. Spillovers may take place when local firms improve their efficiency by copying technologies of foreign affiliates operating in the local market either through observation or by hiring workers trained by the affiliates.'* Finally, Javorcik mentions that MNC's market entry leads to higher competition at the market and pushes domestic firms to allocate their sources more efficiently.

2.4 The problem of FDI inflow: Dual economy

All effects of FDI could lead to dual economy meaning the gap between foreign and rich companies and domestic, former state, under-capitalized and not

restructured firms. As Benáček (2000) thinks, Czech manufacturing sector is as weak as is not able to catch spillovers from foreign companies. Solving this problem sometimes means production of cheap products by domestic firms. It leads to market differentiation at high and low value markets with effects on wages and technology knowledge. From nowadays situation (with converting labour productivity of foreign and domestic companies) I think Czech automotive sector is able to absorb spillovers and so help to reach higher labour productivity.

2.5 The problem of FDI inflow: Crowding-out effect

Crowding-out effect is well analysed by Tomšík (2008). Crowding-out effect refers to a diminishing share of investment of domestic firms in favour to foreign ones. This could be by acquiring existing assets (with no enlargement of capital). The other option is indirectly, by competing at the local financial market for loans to finance the projects. Oppositely, crowding-in effect lies in boosting domestic investment activity by FDI. This process could take place directly by foreign investor or by involvement of other investors (domestic suppliers, government's investments into infrastructure etc.).

Mišun and Tomšík (2002) analysed data of three countries (Czech Republic - period 1993 to 2000, Poland and Hungary – period 1990 to 2000) to show crowding-out or crowding-in effects of FDI. Authors proved strong crowding-in effect in Czech Republic which means that foreign invested capital in domestic country encourages domestic investors to set up new production or enlarge existing one. In Hungary there were proved even stronger crowding-in effect, but on the contrary, Poland experienced crowding-out.

Mišun and Tomšík conclude that the positive impacts of FDI on domestic investment are not guaranteed. In some cases, total investment increase less than FDI or fall with increasing FDI.

2.6 The problem of FDI inflow: Counterfactual

To show the real effect of foreign presence in the automotive sector there is need to deal with the problem of counterfactual. According to Stanford

Encyclopedia of Philosophy, the idea of counterfactual of causation is to explain the terms of counterfactual conditionals in the form of '*If* A *had not occurred,* C *would not have occurred*'[14]. For the purpose of this thesis, I may transform into the following proposition: if foreign investors had not invested to the domestic firms, domestic firms would have been more productive even so.

For my analysis, I define the effect of counterfactual as the difference between the situation of domestic firms that could have stayed domestic firms but have been purchased by foreign investor. It could be also described as what would happen with domestic firms (which were bought by foreign investor) if they had not been bought by foreign investor and remained domestic firms. I would like to verify the assumption that foreign investors are looking for firms in good shape, with promising expectations or some other favourable business plans. This behaviour should explain higher labour productivity in the foreign firms than domestic ones.

My data set covers period from 2004 to 2009 and I do not examine previous years due to no availability of relevant data set. From the total number of firms in automotive sector (CZ-NACE 29) with at least 25% share of foreign presence, I picked up firms that were Czech but in this period were bought by foreign investor (totally or by at least their 25% share). The number of foreign firms in the automotive sector is 135 out of total 320 number of firms in the automotive sector in Amadeus database for Czech Republic.

After detailed review in the Czech trade register, I have identified only six companies converting to foreign investor in examined period with enough data displayed. This result could be surprising, but according to my expectations, the majority of foreign investments to the Czech firms took part in early 90's and then continued across 90's in form of privatization of state companies. In period after 2000, there came only to single acquisitions of Czech automotive firms.

It was not simple to do any particular statistic because of the year of entry – it was spread over the period from 2000 to 2007. I have compared all six companies

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[14] Online available on 16/8/2012 at: http://plato.stanford.edu/entries/causation-counterfactual/.

before and after the entry of foreign investor in the most important measure – labour productivity defined as a ratio of value added to the number of employees. Although five companies showed positive results in terms of profit margin and other financial indicators (returns on shareholder) only two firms in this selection experienced above average (average of domestic firms) labour productivity index. After the entry (horizon of 2 to 5 years) of foreign investor, four companies reached higher than average labour productivity index.

Although it is too small sample, I consider it must be sufficient for very brief simplification of confirmation of the hypothesis that foreign investors really pick up firms with higher labour productivity. Higher labour productivity could also indicate changes at the market and investors could predict these changes and invest in that particular sector. Logically, investors invest into firms which will have good expectations for further development (good geographical position, contacts, machinery or human capital endowment). This is a rational consequence of economically rational entity.

3 Data and analysis

3.1 Data description

In my analysis are covered years 2004 – 2009 due to its availability in database. Number of observations of this time series is six, which can apparently distort all results. For proper statistical analyses at least 50 observations would need to be used.[15]

3.1.1 Automotive industry NACE data structure

Czech automotive industry is in my thesis expressed in various modifications according to data accessibility. Automotive industry by AIA association covers firms related to vehicle production from various NACE sectors (direct car producers and also tire producers, lightning system's producer, brake system's producers and other). CzechInvest Agency defines automotive sector similarly to AIA. According to CZSO, before 2009 automotive sector was referred to as NACE rev.1.1 DM Manufacture of transport equipment including NACE 34 Manufacture of motor vehicles (except motorcycles), trailers and semi-trailers and NACE 35 Manufacture of other transport equipment. In my analysis is covered only CZ-NACE rev. 2 29 Manufacture of motor vehicles (except motorcycles), trailers and semi-trailers. The main difference between NACE rev. 1.1 and CZ-NACE rev. 2 in Manufacture of transport equipment is integration of Manufacture of electrical and electronical equipment for motor vehicles.

The basic sector for the analysis is CZ-NACE 29 Manufacture of motor vehicles, trailers and semi-trailers further dividing into:

- 29.1 Manufacture of motor vehicles (except of motorcycles) and their engines

- 29.2 Manufacture of bodies for motor vehicles, trailers and semi-trailers

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[15] Thus the analysis has rather indicative character.

- 29.3 Manufacture of accessories for motor vehicles

  - o 29.31 Manufacture of electrical and electronical equipment for motor vehicles

  - o 29.32 Manufacture of other parts and accessories for motor vehicles

In 2009, dominant CZ-NACE section was 29.3 Manufacture of accessories for motor vehicles with 50.1% share of sales followed by 29.1 Manufacture of motor vehicles and 29.2 Manufacture of bodies for motor vehicles with combined share 49.9% on total sales in section CZ-NACE 29.

Graph 3 Share of sales in the manufacture of transport equipment, as of CZ-NACE 29 in 2009

29.3 Manufacture of accessories for motor vehicles
50.1%

29.1 Manufacture of motor vehicles (except of motorcycles) and their engines + **29.2** Manufacture of bodies for motor vehicles, trailers and semi-trailers
49.9%
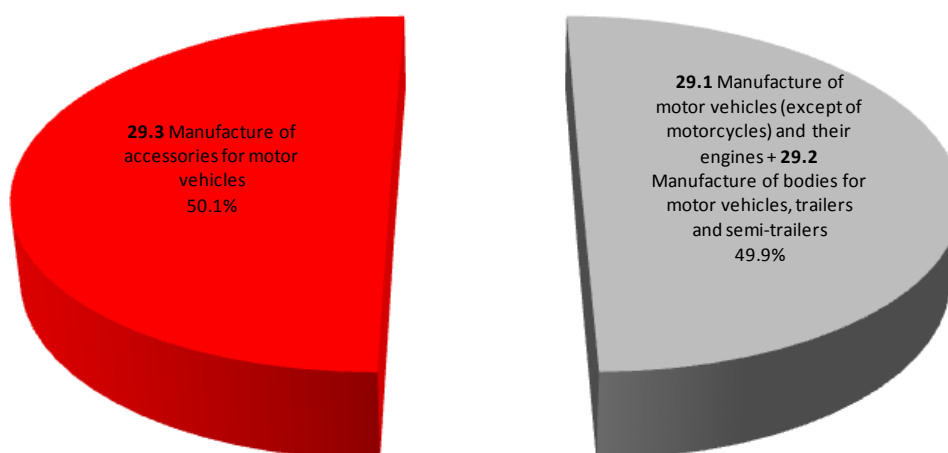
Source: Data MPO and CZSO, own elaboration

As mentioned before, automotive sector is built up by other NACE sectors. Some of them contribute by all production to the automotive sector and some of them by minor part. These sectors are usually connected to transport equipment manufacture sector **(a)** as suppliers operating in CZ-NACE 22 Manufacture of rubber and plastic products, CZ-NACE 27 Manufacture of electric equipment and spare parts, or **(b)** through non-manufacturing activities in CZ-NACE 45 Sales and maintenance of motor vehicles.

It is not possible to get all data needed in the structure as stated above (due to different share of contribution in various sectors), so I decided to use data obtained from Amadeus database[16] that collects data from CZ-NACE 29 section.

3.2 Labour productivity measuring from value added

3.2.1 Analysis

In my analysis I will use methodology used by Geršl (2008) who examined relationship between Czech and foreign firms in the manufacturing industry in period 2000 to 2005. I follow main part but modify it according to specifications for automotive industry and my data set. I use the same structure of firm level data from Amadeus database,[17] but restricted to automotive sector (CZ-NACE Rev. 2 – section 29 Manufacture of motor vehicles, trailers and semi-trailers) in period 2004 to 2009. Geršl examined the total manufacturing industry in the Czech Republic. The data sample includes 92% of firms compared to CZSO's output and 98% of the total sales from CZSO. I find this high rate of data coverage enough for presenting the analysis.

According to the definition for FDI (OECD (1999)) as foreign owned firm is considered each firm with more than 10% share of foreign assets. The Amadeus database allows obtaining data divided into foreign and domestic firms only at 25% and more or 51% and more share of foreign assets. I use the share of 25% of foreign investor to consider the firm as foreign.

Although foreign companies in total manufacturing accounted for 41% of the total number of companies they participate on 64% of the total turnover and even 66% of added value and fixed assets. This distribution indicates that foreign

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[16] Precisely would be described in following section.

[17] Amadeus database is provided by Bureau van Dijk. This database collects data about firm's performance such as profit and loss accounts, balance sheet items, ownership information and others. Firm-level data are divided into NACE Rev. 2 sections. Unfortunately, Amadeus database do not show the history of ownership and the split on domestic and foreign companies is according to valid entry at the time of releasing the sample (June 2012).

owned firms are in average bigger, employ more than half of the total employees in the manufacturing sector, but reach higher turnover than domestic companies. It implicates higher labour productivity in foreign owned firms compared to domestic ones. Foreign owned firms have also higher stock of investment.

Table 2 Total Manufacturing sector (as of 2008, in th. EUR; Employees in number of employees)

	average of total manufacturing	average of foreign manufacturing	average of Czech firms only	% of foreign firms
Number of companies	10 608	4 397	6 211	41,45%
Employees	865 827	462 295	403 532	53,39%
Operating revenue / turnover	113 589 975	73 156 687	40 433 288	64,40%
Fixed assets	34 080 160	22 752 472	11 327 688	66,76%
Added value	16 093 537	10 645 984	5 447 553	66,15%

Source: Data Amadeus database, own elaboration

Focusing only on manufacturing of transport equipment, foreign owned companies account for less than half of all companies operating in manufacture of transport equipment sector, employ almost 63% of workers but bring only 59% of value added. In spite of that, foreign owned companies participate by 73% on the total automotive sector turnover and 79% on fixed assets. These findings suggest that foreign owned firms are definitely more profitable but in 2008 were not more labour productive (according to the share of value added to the number of employees).

Table 3 Manufacturing of transport equipment CZ-NACE 29 (as of 2008, in th. EUR; Employees in number of employees)

	average of total CZ-NACE 29	average of foreign CZ-NACE 29 firms	average of Czech CZ-NACE 29 firms	% of foreign firms
Number of companies included	347	149	198	42,94%
Employees	128 978	80 956	48 022	62,77%
Operating revenue / turnover	22 273 276	16 216 547	6 056 729	72,81%
Fixed assets	7 238 334	5 715 234	1 523 100	78,96%
Added value	2 603 979	1 531 911	1 072 068	58,83%

Source: Data Amadeus database, own elaboration

As shown at following graph, foreign-owned firms experienced in average higher labour productivity compared to domestic firms, but in 2008 came to the break and domestic companies had higher productivity than foreign ones. This

change could be explained through upcoming economic downturn in second half of 2008 which at first influenced more foreign than domestic firms. Higher domestic labour productivity could emerge also through spillovers from foreign to domestic firms or because of higher concentration of the market. The interaction between foreign and domestic firms with impact on labour productivity will be examined in following sections.

Graph 4 Labour productivity development in manufacture of transport equipment CZ-NACE 29 (in th. EUR per employee)

Source: Data Amadeus database, own elaboration

The tested hypothesis

My aim is to show spillovers from foreign firms to the Czech firms via labour productivity. I suppose, according above mentioned authors, that:

- Labour productivity is increasing through technology transfer from foreign to the Czech firms

- Labour productivity is increasing through competitive pressure[18] followed by more efficient allocation of inputs and production process

The tested hypothesis is whether foreign presence or market concentration influence labour productivity in automotive sector.

The hypothesis for technology transfer could be written as:

H_0 : *Horizontal spillovers do not influence labour productivity*

H_1 : *Horizontal spillovers do influence labour productivity*

The hypothesis for market concentration could be written as:

H_0 : *Concentration of the market does not influence labour productivity*

H_1 : *Concentration of the market does influence labour productivity*

3.2.2 Definition of variables

'Labour productivity' is explained variable and is defined as a share of value added on the number of employees for this analysis.

'Employees' represents the number of employees in relevant period in domestic firms. In extended model variable employees is replaced by costs of employees (labour costs) representing wage bill of employees.

'Fixed asset'[19] is defined as long-term, tangible asset which are held for business use of domestic firms and are not expected to be converted to cash,

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[18] Caused by foreign firm entering domestic market.

[19] Definition from InvestorWords.com, 13.11.2010 online available on: http://www.investorwords.com/1988/fixed_asset.html.

such as manufacturing equipment, real estate or furniture. For extended model is variable fixed asset replaced by depreciation (amortization).

'Value added' is book value added[20] and explains how much the domestic firm has added to the purchased inputs (materials, goods, services). Book value added is counted as sum of trade margin, sales of own goods and services, change of state of intracompany stock, activation minus power consumption.

'Horizontal spillovers' (HOR) is explanatory variable and refers to increasing labour productivity when foreign firm is present in the same sector. Unfortunately, for my data there is not possible to get information concerning interaction between foreign and domestic firms. For catching at least a substitute or potential of this interaction I follow the calculation stated by Geršl:

$$\text{Horizontal spillovers}_t = \Sigma \, \text{foreign}_{it} * \text{turnover}_{it} / \Sigma \, \text{turnover}_{it}$$

The variable *foreign* is a dummy variable equals to 1 when the company *i* in time *t* is under foreign control and 0 when is local company. The higher is the turnover produced by foreign firms and the higher is the share of these firms, the higher is the possibility of gaining horizontal spillovers. Horizontal spillovers in the Czech automotive sectors are at level of 75% representing 75% of total turnover in this sector is built up by firms with at least 25% share of foreign investor.

Geršl (2008) focuses also on vertical spillovers[21]. Unfortunately, for my analysis this effect is not relevant because of my focus only on manufacturing of transport equipment sector.

The variables were deflated as follows. The turnover was deflated by the producer price index for CZ-NACE 29 section or total manufacturing sector. The stock of fixed assets and depreciation were deflated by the average of the

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[20]Definition   from   CZSO,   online   available   on   13/11/2010   at: http://apl.czso.cz/iSMS/ukazdet.jsp?fpismeno=%DA&fid=894.

[21] Vertical spillovers are present between foreign and domestic firms in inter-industry linkages.

deflator for CZ-NACE 29 section or total manufacturing sector. Costs of employees were deflated by the consumer price index.

'Herfindahl index' (HI)[22] is explanatory variable and shows the concentration of the market and is counted as the sum of the squared shares of the individual firms on sector output. This index ranges between 0 and 10 000. 0 means no concentration in the market and 10 000 represents one firm which produces the total output. It means that an increase in Herfindahl index decreases competition and increases market power. Herfindahl index is used as an explanatory variable while examination influence of market concentration on labour productivity. Herfindahl index for automotive sector ranges around 3 800 and reflects oligopoly market structure of this sector.

The other index used for market concentration is Concentration Ratio.[23] It measures the size of usually four largest firms on the total output of the industry. It ranges between 0 and 100 percent. 0% means perfect competition in the market and 100% refers to a monopoly. The concentration ratio of 2009 for four largest firms in automotive industry is 53%. This supports the thesis that automotive industry is oligopoly with medium concentration.

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[22] Definition of Herfindahl index could be found in Geršl (2008) or at investopedia.com online available on 14.12.2010 at http://www.investopedia.com/terms/h/hhi.asp#axzz23bzsJmIm.

[23] Definition of Concentration ratio is at investopedia.com online available on 14.12.2010 at http://www.investopedia.com/terms/c/concentrationratio.asp#axzz23bzsJmIm.

Graph 5 The development of Herfindahl index (in % y-o-y)
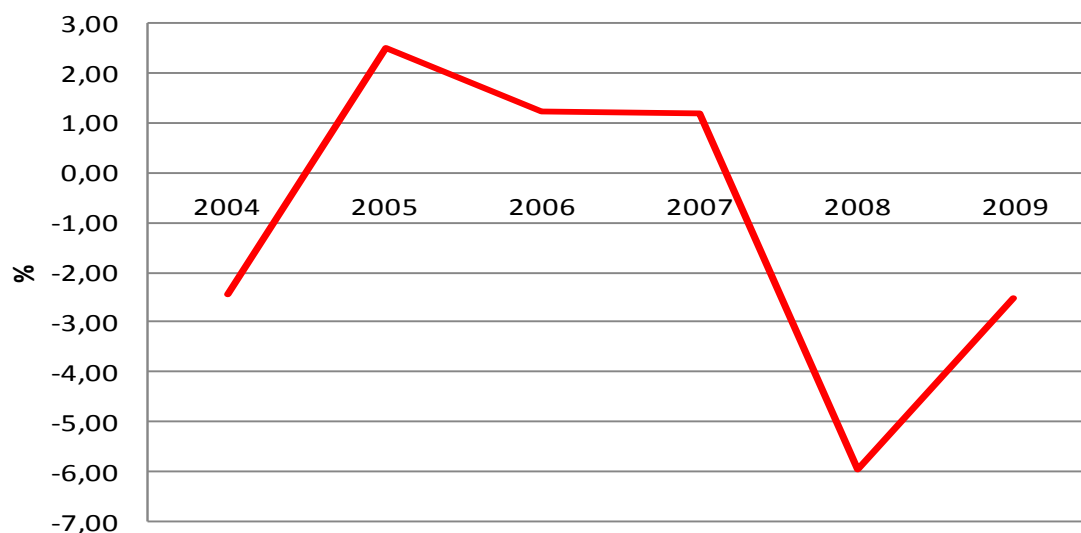
Source: Data Amadeus database, own elaboration

3.2.3 Estimation strategy and analysis

For analysis of productivity is widely used production function.[24] Similarly, I also use the production function in the methodology of Olley and Pakes (1996) and modified by Levinsohn and Petrin (2003).[25] According to this technique, I estimate log-linear transformation of a Cobb-Douglas production function as:

$$va_{it} = \beta_0 + \beta_l * l_{it} + \beta_k * k_{it} + \varepsilon_{it} \qquad (1)$$

where:

va_{it} is the logarithm of the value added of domestic firm *i* at the time *t*

l_{it} is the logarithm of labour input of domestic firm *i* at the time *t*

k_{it} is the logarithm of capital of domestic firm *i* at the time *t*

β_l is the estimated coefficient for labour

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[24] For example see Merlevede B., Schoors K. (2009), Geršl (2008).

[25] More precisely is the method described in Geršl A., Rubene I., Zumer T. (2007) or in Levinsohn J., Petrin A., Poi B.P. (2004).

β_k is the estimated coefficient for capital

Value added is defined as mentioned in previous section. Labour input means number of employees. Capital input equals to the stock of fixed assets. After estimating parameters of first equation, I put the parameters to the second equation to obtain number of total factor productivity function:

$$tfp_{it} = va_{it} - \beta^{\wedge} * l_{it} - \beta^{\wedge} * k_{it} \qquad (2)$$

where:

tfp_{it} is the logarithm of total factor productivity of domestic firm i at the time t [26]

$\beta^{\wedge}$ coefficients are estimated from the first equation

Function of total factor productivity is calculated from estimated parameters and further put in the equation including horizontal spillovers and index of market concentration.

$$tfp_{it} = \alpha_0 + \alpha_1 * horizontal_{it} + \alpha_2 * horizontal_{it}^2 + \alpha_3 * HI_{it} + \varepsilon_{it} \ (3) \ [27]$$

The equation is estimated by the method of ordinary least squares, using statistical software Gretl.

3.2.4 Robustness of the model

To estimate the model I use the statistical estimate of Ordinary Least Squares (similarly to Geršl (2008) or Olley and Pakes (1996)). OLS are also suitable for small data sets (Hušek (1999)). For using OLS the data set has to fulfil several assumptions and dealt with some problems (Hušek (1999), Arlt, Arltová (2007) and Wooldridge (2009)):

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[26] According to Comin (2006) is TFP (Total Factor Productivity) the part of output that is not explained by the amount of inputs which are used in production process. Due to its specification is TFP measured residually.

[27] As explained in analyses later I have added also squared horizontal spillovers because of higher predicative ability of the model. Squared horizontal spillovers are also estimated by Geršl (2008).

- The model is linear in parameters (in my analysis are parameters linear due to logarithmic transformation of Cobb-Douglas function)
- The residuals has normal distribution (use of Jarque-Bera test)
- The number of observation is higher than number of estimated parameters
- The assumption of homoscedasticity (usually fulfilled by time series, but I also use the White test)
- The problem of multicollinearity - explanatory variables are not correlated between each other (this problem in my thesis is measured by correlation matrix)
- The problem of autocorrelation - observations are not correlated between each other (this problem is measured by Durbin-Watson test in my analysis)

The significance of variables in the model is tested by p-value. The tested hypothesis is that the value of parameter equals 0. This hypothesis is rejected at the level of confidence when p-value is lower than requested level of confidence (usually used 95% or 90%). By rejecting tested hypothesis (parameter equals 0) I assume that parameter is statistically significant.

To evaluate the model I use R-squared and adjusted R-squared. R-squared ranges between 0 and 1. Equalling 1 is the total OLS explained by the model. Equalling 0 means the opposite. This measure is suitable for testing significance of the model (see Hušek (1999)). R-squared reaches higher values by adding new variable to the model. For more precise results is better to use adjusted R-squared. Adjusted R-squared could be also negative and decrease by adding new variable to the model. Adjusted R-squared is usually lower than R-squared.

3.2.5 Results

In following section I carry out several regression analyses (according to the above described method – Geršl (2008), Olley and Pakes (1996) and Levinsohn and Petrin (2003)) to find out whether:

- horizontal spillovers (presence of foreign investors) in manufacture of transport equipment sector positively or negatively influence labour productivity
- market concentration in manufacture of transport equipment sector positively or negatively influence labour productivity

In subsections I also introduce alternative variables (depreciation and costs of employees) which should confirm results of main regression of capital and labour.

At first I have to estimate the parameters for capital and labour and than of alternative variables such as depreciation and labour or capital and costs of employees or depreciation and costs of employees based on equation (1). For each combination of variables, I put the estimated parameters to the equation (2) and calculate the total factor productivity function that is used in the last regression analysis. Later, I conduct final regression of these variables based on equation (3).

For first set of variables I test assumptions and problems connected to OLS discussed in previous section. After finding the data suitable I develop the final model and test it. According to economic and also statistic logic I have added squared form of horizontal spillovers (HOR) and also Herfindahl index (HI). According to adjusted R-squared I leave squared horizontal spillovers (HOR2) in the model and use the form of equation (3) also for alternative variables.

TFP calculated from capital and labour

The results of equation (3) are in table below. Both − linear and non-linear horizontal spillovers are not significant but with opposite signs. Significant and positive is for coefficient of Herfindahl index.

Table 4 Results of (3) equation of capital and labour

Parameter	Estimate	P-Value
CONSTANT	367.032	0.32244
HI	0.000262001	0.05287*
HOR	-1036.04	0.30739
HOR2	700.838	0.30761
R-squared		54.5724%
Ad R-squared		13.5691%

*Note: ** parameter is significant at 95% confidence level; * parameter is significant at 90% level*

The equation (3) is described as:

$$tfp_{it} = 367.03 - 1\,036.04 * horizontal_{it} + 700.838 * horizontal_{it}^2 + 0.000262001 * HI_{it}$$

The regression model has high R-squared (54.57%) and also adjusted R-squared (13.57%) making the model valuable.

The model says that the change in market concentration (HI) by one unit would raise productivity by 0.0262001%.

Verification of TFP regression with alternative variables

In this subsection I verify previous results using alternative variables (similarly to Geršl). Instead of fixed assets I use depreciation. Instead of number of employees I use costs of employees (wage bill).

TFP calculated from depreciation and labour

Following table shows the final results of total factor productivity. Parameters have same signs as in estimation with original variables (employment and labour). Horizontal spillovers are again not significant. Positive and significant is the coefficient of Herfindahl index.

Table 5 Results of (3) equation of depreciation and labour

Parameter	Estimate	P-Value
CONSTANT	258.737	0.13669
HI	0.00117825	0.01120**
HOR	-737.468	0.13023
HOR2	505.963	0.12822
R-squared		98.7848%
Ad R-squared		95.1392%

*Note: ** parameter is significant at 95% confidence level; * parameter is significant at 90% confidence level*

The equation (3) is described as:

$$tfp_{it} = 258.737 - 737.468*horizontal_{it} + 505.963*horizontal_{it}^2 + 0.00117825*HI_{it}$$

The regression model has a high R-squared (98.79%) and adjusted R-squared (95.14%) making the model highly valuable.

The model says that the change in market concentration (HI) by one unit would raise productivity by 0.117825%.

TFP calculated from capital and costs of employees (wage bill)

The results of first equation (3) are in table below. The parameters of horizontal spillovers are again not significant. The coefficients of linear and non-linear horizontal spillovers are in the same direction as in previous analyses. The coefficient of Herfindahl index is significant and shows positive influence on labour productivity.

Table 6 Results of (3) equation of capital and costs of employees

Parameter	Estimate	P-Value
CONSTANT	386.912	0.178
HI	0.0002697	0.03671**
HOR	-1054.24	0.17639
HOR2	714.658	0.176
R-squared		76.9308%
Ad R-squared		42.3271%

*Note: ** parameter is significant at 95% confidence level; * parameter is significant at 90% confidence level*

The equation (3) is described as:

$$tfp_{it} = 386.912 - 1\,054.24*horizontal_{it} + 714.658*horizontal_{it}^2 + 0.0002697*HI_{it}$$

The regression model has relatively high R-squared (76.93%) and adjusted R-squared (42.33%).

The model says that the change in market concentration (HI) by one unit would raise productivity by 0.02697%.

TFP calculated from depreciation and costs of employees (wage bill)

Following table shows the final results for total factor productivity. Both linear and non-linear horizontal spillovers are not significant at common 90% level of significance, but they have the same signs as in previous analyses. Significant and positive is again the coefficient for Herfindahl index.

Table 7 Results of (3) equation of depreciation and costs of employees

Parameter	Estimate	P-Value
CONSTANT	439.727	0.26387
HI	0.000972105	0.04052**
HOR	-1199.85	0.26241
HOR2	809.698	0.26253
R-squared		88.5451%
Ad R-squared		54.1805%

*Note: ** parameter is significant at 95% level; * parameter is significant at 90% confidence level*

The equation (3) is described as:

$$tfp_{it} = 439.727 - 1\ 199.85*horizontal_{it} + 809.698*horizontal_{it}^2 + 0.000972105*HI_{it}$$

The regression model has high R-squared (88.55%) and adjusted R-squared (54.18%).

The model says that the change in market concentration (HI) by one unit would raise productivity by 0.0972105%.

Concluding remarks

When concerning the sign adjusted R-squared the best result is for alternative variable depreciation and number of employees. Horizontal spillovers (technology transfer from foreign to domestic firms) have the same signs – negative for linear and positive for squared spillovers. The coefficients are not significantly different from zero. Thus I found no evidence of direct technology transfer from foreign to domestic firms in the automotive industry and accept hypothesis H_0 for technology transfer.

I have found positive and significant relationship between Herfindahl index and labour productivity of domestic firms. This causation means that productivity of domestic firms is positively influenced by higher market concentration and I accept hypothesis H_1 for market concentration.

To verify the results I have estimated the same regressions for firms with 25% share of foreign assets and horizontal spillovers measured by number of

employees. The estimated parameters are again at the same level and direction but with worse levels of adjusted R-squared. From this reason I use rather horizontal spillovers measured by turnover.

I have also estimated the same equation for firms with foreign presence at the level of 51% and more foreign share on firm's assets and measuring horizontal spillovers according to the turnover or even number of employees, but the results stay the same.

The results for firms with 25% and more share of foreign assets and horizontal spillovers measured by turnover (as used in all presented regressions) exhibit best statistical results. Thus I use the share of 25% of foreign investor to consider the firm as foreign. This is difference to Geršl who uses the definition for foreign firm at 51% share of foreign investor.

3.2.6 Summary

As shown in the analyses above, there is insignificant positive effect of squared horizontal spillovers but negative effect of linear horizontal spillovers in the Czech automotive sector. Herfindahl index has positive and significant effect on labour productivity. The unexpected insignificance of horizontal spillovers indicates that presence of foreign firms in the Czech automotive industry has no influence on labour productivity of domestic firms. Positive and significant parameter for Herfindahl index shows that higher market concentration in the automotive sector has positive influence on labour productivity of domestic firms.

Compared to Geršl (2008) horizontal spillovers are not significant and the coefficient of Herfindahl index is lower than the one he has. Geršl´s coefficient is around 0.5 and in my analysis it is on average around 0.0003. This means that in my analysis there is weaker influence on labour productivity through market concentration. It means that the more concentrated the sector is the higher is labour productivity. This situation might be explained by the fact that firms benefit from economies of scale, industry agglomeration or appropriate infrastructure and so improve their labour productivity. These conditions are

fulfilled by Czech automotive sector and so enable realising of economies of scale through market concentration. This way may lead to higher labour productivity through increase in market concentration.

Similarly to Haskel, Pereira and Slaughter (2002), I think that other channel for the increased labour productivity through higher market concentration is that less productive domestic firms have to exit the market (if they are not able to increase their productivity). The way of improving labour productivity by increased market concentration might be also by increased market share of firms which are more productive.

The difference between our results (my and Geršl's) might be also caused by sectors we are focused on. I examine only automotive sector and Geršl examines all manufacturing industry. Especially for automotive sector, which is more capital intensive than total manufacturing on average, higher market concentration might be beneficial.

The explanation of insignificant horizontal spillovers in my analysis could be caused by time delay. It is possible that there is implementation gap between acquiring new technology process or managerial knowledge from foreign firm and their effect on labour productivity.

I would like to explain also the different signs for horizontal spillovers compared to Geršl (2008) even if horizontal spillovers are not significant in my analysis. The difference – opposite sign of linear and non-linear horizontal spillovers and their insignifacance – I compare it to the study of Merlevede and Schoors (2009). They studied the same topic with the same method as Geršl and I but they split manufacturing firms in highly and low exporting firms. Merlevede and Schoors found horizontal spillovers are sometimes negative in linear form and positive in squared form for highly export oriented firms. Automotive sector is considered to be highly export oriented which confirms also the share of export of automotive firms. This could explain the opposite sign of horizontal spillovers of manufacture of transport equipment sector in case they would be significant.

According to Torlak (2004) positive correlation between productivity of domestic firms and regional foreign presence could be caused that foreign firms go to regions with high aggregation of firms and so gain higher productivity.

3.3 Labour productivity as measured from gross output

3.3.1 Analysis

To find out possible effects of FDI on labour productivity I have decided to conduct other analysis measuring labour productivity from gross output (similarly to Haskel, Pereira and Slaughter (2002) who found out positive spillovers to domestic firms in UK manufacturing in period 1973 – 1992) to have deeper look at this issue. This model also serves for verification of first analysis.

Graph 6 Labour productivity development in manufacture of transport equipment CZ-NACE 29 (in th. EUR per employee)
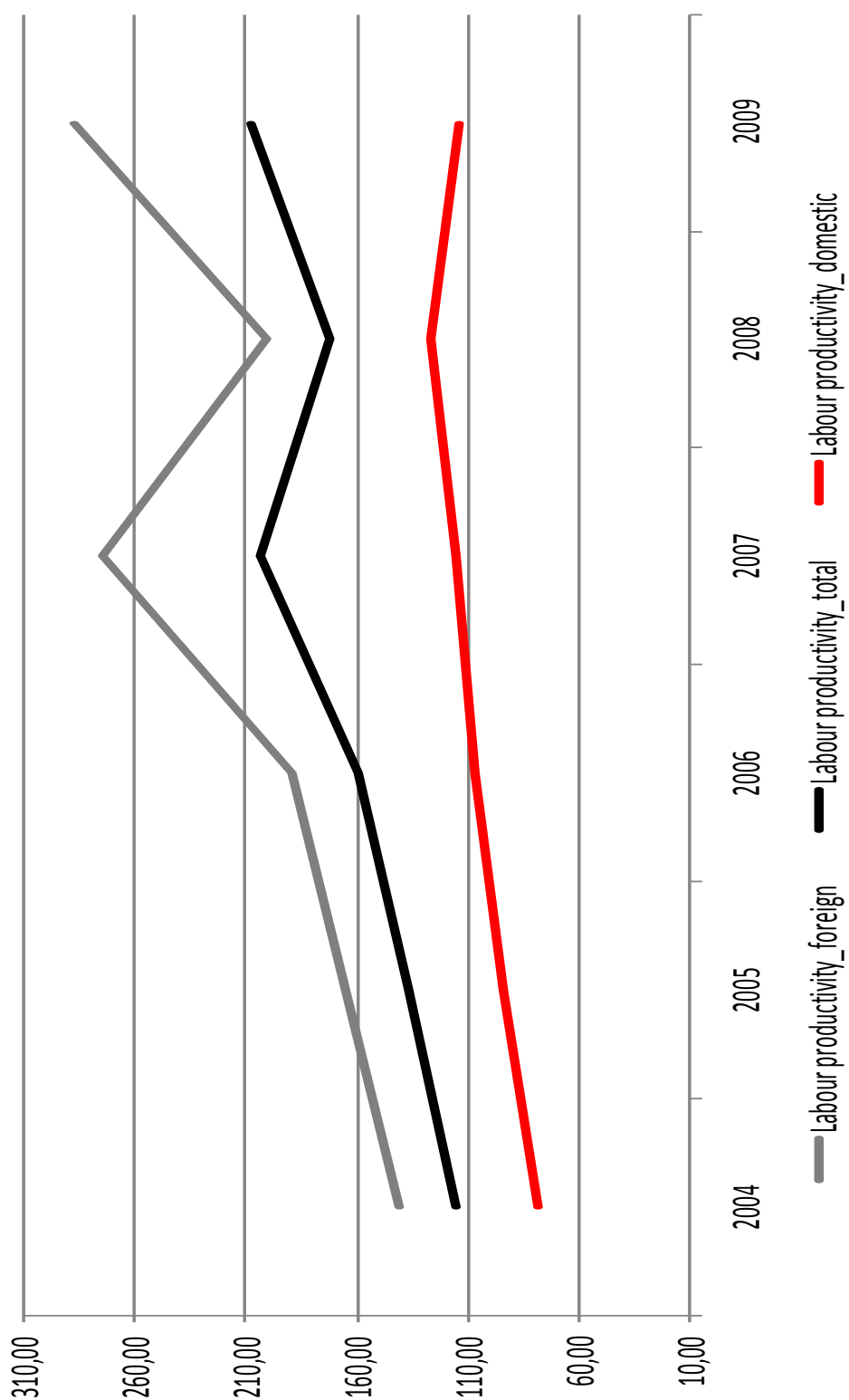
*Source: **Data Amadeus database, own elaboration***

The graph above illustrates the development of labour productivity in the automotive sector. According to the gross output to number of employees ratio there is overall higher productivity in foreign owned firms.

The tested hypothesis

The tested hypotheses stay the same and could be written as follows.

The hypothesis for technology transfer:

H_0 : *Horizontal spillovers do not influence labour productivity*

H_1 : *Horizontal spillovers do influence labour productivity*

The hypothesis for market concentration could be written as:

H_0 : *Concentration of the market does not influence labour productivity*

H_1 : *Concentration of the market does influence labour productivity*

Methodology used

In this analysis will be used also methodology of Olley and Pakes (1996) and developed by Levinsohn and Petrin (2003). According to this technique, I estimate:[28]

$$Ln\ Y^d_{it} = \alpha_1 * lnFIAS^d_{it} + \alpha_2 * lnEMPL^d_{it} + \quad _3 * FOR_t + \alpha_4 * HI_{it} + \varepsilon_{it} \qquad (1)$$

I use the same data set as in previous analyses, but change several variables. The data cover period 2004 – 2009 and are obtained from Amadeus database for CZ-NACE 29 section. The variables were deflated as mentioned before (section 3.2.2).

Ln Y^d_{it} is the logarithm of the gross sales of domestic firm *i* at the time *t* (explained variable)

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[28] Compared to Haskel, Pereira and Slaughter (2002) I have modified some variables.

$lnFIAS^{d}_{it}$ is the logarithm of capital of domestic firm i at the time t

$lnEMPL^{d}_{it}$ is the logarithm of number of employees of domestic firm i at the time t

FOR_{t} represents the share of foreign employment on total employment at the time t (explanatory variable)

HI_{it} represents Herfindahl index and expresses concentration of the market at the time t (explanatory variable)

d represents that it is domestic firm

k is number of lag

3.3.2 Robustness of the model

To estimate the model I use, again, the statistical estimate of Ordinary Least Squares and test the assumptions and problems as described before in section 3.2.4.

The significance of variables in the model is tested by p-value. The tested hypothesis is that the value of parameter equals 0. This hypothesis is rejected at the level of confidence when p-value is lower than requested level of confidence (usually used 95% or 90%). By rejecting tested hypothesis (parameter equals 0) I assume that parameter is statistically significant.

To evaluate the model I use R-squared and adjusted R-squared.

3.3.3 Results

In this section I conduct regression analysis (according to the above described method) to find out the answer for basic question of my thesis, what is whether:

- horizontal spillovers (presence of foreign investors) in manufacture of transport equipment sector positively or negatively influence labour productivity
- market concentration in manufacture of transport equipment sector positively or negatively influence labour productivity

I also try to find extension of the model and add squared foreign presence and squared Herfindahl index, but according to adjusted R-squared I leave the model in original form as stated in equation (1) in this chapter.

The results of equation (1) are in table below. The variable for foreign presence is positive, but not significant. The parameter for Herfindahl index is positive and significant.

Table 8 Results of (1) equation

Parameter	Estimate	P-Value
CONSTANT	-2.20598	0.54876
L__FIAS	0.733442	0.03415**
L__EMPL	0.512942	0.2972
FOR	1.15664	0.15631
HI	0.00028122	0.01902**
R-squared		99.7735%
Ad R-squared		98.8673%

*Note: ** parameter is significant at 95% confidence level; * parameter is significant at 90% confidence level*

The equation (1) is described as:

$$\text{Ln } Y^d_{it} = -2.206 + 0.733 * \ln FIAS^d_{it} + 0.513 * \ln EMPL^d_{it} + 1.157 * FOR_t + 0.00028122 * HI_{it}$$

The regression model has high R-squared (99.77%) and also adjusted R-squared (98.87%) making the model valuable. The significant autocorrelation is not present according to Durbin-Watson test.

The model says that the change in market concentration (HI) by one unit would raise productivity by 0.028122%.

3.3.4 Summary

My results significantly differ from those of Haskel, Pereira and Slaughter (2002). They found positive and significant influence of foreign presence to labour productivity of domestic firms. I found out positive but insignificant relation between foreign presence and domestic labour productivity in the

automotive sector. I also found out positive and significant influence of market concentration on labour productivity.

According to these results I accept the hypothesis H_0, which means that there is no influence of horizontal spillovers on labour productivity and the hypothesis H_1 that there is positive and significant relationship between market concentration and labour productivity of domestic firms.

These results fully correspond with results of my analyses above where labour productivity is measured from value added.

Concerning analytical part

Due to low number of observations, my analyses have rather indicative character than 100% statement. Moreover, it was even not possible to add lagged variables[29] to the model (there would be more estimated parameters than observations).

Other limitation emerges from the definition of Herfindahl index as it measures market concentration through market shares on sector output. For such export-oriented industry as is Czech automotive sector the market shares could be distorted. For example Škoda Auto exports about 83% of its production which means that if measured by different concentration ratios its market share in the Czech market would be significantly lower than what suggests Herfindahl index.

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[29] Lagged horizontal spillovers have positive influence on labour productivity in Haskel, Pereira, Slaughter (2002).

Conclusion

The aim of this thesis was to answer the question whether FDI affects labour productivity in the Czech automotive industry. To answer this question I had to at first define labour productivity as **(a)** a ratio of added value to number of employees or as **(b)** a ratio of sales to number of employees and also FDI. Foreign presence in the automotive sector is measured through horizontal spillovers. According to Javorcik (2004), horizontal spillovers take place when the presence of foreign investor increases labour productivity of domestic firms. Finally, market concentration is measured by Herfindahl index.

I use regression analyses (OLS) based on Cobb-Douglas function to find out the relationship. The analyses are conducted with original and also alternative variables. All results suggest that in the Czech automotive sector there is no significant relationship between presence of foreign firms and domestic labour productivity through technology transfer (horizontal spillovers). The results show significant and positive effect of higher market concentration (Herfindahl index) on labour productivity of domestic firms.

Both models (labour productivity measured from value added and also labour productivity measured from gross output) show that the change in market concentration (HI) by one unit would raise productivity by around 0.03%.

These findings are not in line with prevalent studies about FDI and labour productivity which usually find out positive influence of presence of foreign firms on labour productivity through technology transfer or through stiffer market competition (for example Caves (1974)).

However, the explanation of insignificant horizontal spillovers in my analyses could be caused by time delays. It is possible that there is implementation gap between acquiring new technology process or managerial knowledge from foreign firm and their effect on labour productivity. This (including of lagged explanatory variables) could be possible extension of my analysis for the future research.

The significant and positive coefficient for Herfindahl index means that the more concentrated the sector is the higher the labour productivity. This situation might be explained by the fact that firms benefit on economies of scale and also industry agglomeration or appropriate infrastructure and so improve their productivity. These conditions are fulfilled in the Czech automotive sector which enables to gain economies of scale through market concentration.

Similarly to Haskel, Pereira and Slaughter (2002), I think that yet another channel for the increased labour productivity through higher market concentration is that less productive domestic firms have to exit the market (if they are not able to increase their productivity). The way of improving labour productivity by increased market concentration might be also by increased market share of firms which are more productive.

Due to low number of observations, my analyses have rather indicative character. Moreover, it was even not possible to add lagged variables to the model (there would be more estimated parameters than observations). As I mentioned before, this could be possible extension for further research.

The other point for further research is to show relationship of labour productivity and horizontal spillovers or market concentration to the type of investment (greenfield vs. brownfield). Such type of analysis would require appropriate data set which was not possible to obtain from current sources.

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