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Determinants of FDI in Czech manufacturing industries between 2000-2006

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Determinants of FDI in Czech Manufacturing Industries between 2000-2006

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Abstract:
The Czech Republic has been a successful recipient of foreign direct investment over recent years. Therefore, it is important to understand the decisions made by foreign investors where to place their investments and how to decide about their location between alternative industries. The aim of this paper is to _nd and estimate an econometric model describing the determinants of foreign direct investment (FDI) in manufacturing industry of the CR between 2000-2006. Our model includes several basic economic variables (for example labor, physical capital, R&D, pro_ts per labor. Together with simple techniques of estimation (OLS, _xed e_ects) we used generalized method of moments (GMM). As an additional technique we used also least trimmed squares estimator (LTS) as a diagnostic tool for the heterogeneous pattern of data.

Keywords: Foreign direct investment, Czech Republic, manufacturing industry, panel data, GMM

JEL: C01, C23, C51, C82, F21, F40

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1 Introduction

It is important to understand the decision making process of foreign investors as to where to place their investments. Foreign direct investment (FDI) can provide a firm with new markets and marketing channels, cheaper production facilities, access to new technologies, products, skills and financing. For the host country or the domestic firm which receives the investment in form of M&A, it can provide a source of new technologies, capital, processes, products, organizational technologies and management skills, an increase in employment and competition. Therefore, FDI's can give a strong impetus to economic development. On the other hand, the presence of a FDI can bring some hazards: hostile takeovers with the aim to damp domestic production in that field so that the foreign parent company would not have competition, crowding out of domestic savings by foreign savings, the forced transfer of domestic savings abroad under unfavorable conditions, the increase of wages in sectors with foreign ownership overspill to sectors with domestic firms in which the labor productivity grows at slower pace, and many others.

The Czech Republic has been an intensive recipient of foreign capital during the last 15 years. In 1995, FDIs in the Czech Republic reached 195,5 billion CZK, in 2000 it was 818,3 billion CZK and in 2005 it was 1491,6 billion CZK. For years the manufacturing industry was a leading recipient of FDIs even as in recent years the share of manufacturing decreased. In 1995, the share of manufacturing was 64%, while after 2000 the share of inflows of FDI moves around 38%. Data describing flows of FDI to Czech Republic are summarized in Table 1.

In this paper we will analyze the data about 23 sectors of manufacturing industry between 1999-2006. Our aim is to describe history of FDI in Czech Republic and in Czech manufacturing industry in over 10 years, analyze important historical events and describe the relevant literature. Finally, we will find and estimate an econometric model describing the determinants of FDI in Czech manufacturing.

The paper is organized as follows. Section 2 describes important historical events in Czech manufacturing. Section 3 summarizes the related theoretical and empirical literature. Section 4 describes the data and methodology of estimation. Section 4 reports results and section 5 concludes the paper.

Table 1: Stock of FDI in Czech Republic and in manufacturing industry, 1995-2008. Source: CNB, own calculation.

Year	Total FDI stock (billions CZK)	Annual increase (billions CZK)	Share of manufacturing (%)
1995	195,5	-	64 %
1996	234,3	39	65 %
1997	319,8	86	55 %
1998	429,2	109	46 %
1999	631,5	202	39 %
2000	818,3	187	38 %
2001	982,3	164	38 %
2002	1165,5	183	46 %
2003	1161,8	-3,7	42 %
2004	1280,6	119	40 %
2005	1491,6	211	38 %
2006	1666,8	175	36 %
2007*	1852,0	185	37 %
2008*	1990,2	138	37 %

2 FDI in the Czech Republic between 1999-2006

In 1998, a System of state investment incentives was established and in 2000 a law for investment incentives was ratified. These measures introduced criteria for an award for incentives, for example income-tax abatement limit for a specific period for newly established or for already existing companies,support for the buildup of infrastructure and/or subsidies for staff training. These incentives have been awarded under certain conditions - especially if the investment targeted some preferred sectors of the manufacturing industry or some underdeveloped regions.

According to the Annual Reports of CNB, the end of 90s is characterized by extraordinary flows of foreign capital to the Czech Republic. Many large companies were privatized and large foreign trading companies have expanded to the Czech Republic. Privatization - especially of financial institutions - and infrastructure contributed substantially to FDI growth.

At the beginning of millennium, the dominant manufacturing sectors were motor vehicles, electric machines, petroleum products, chemicals, and non-metallic mineral products. In addition, investments into business machines, computers, paper and food industry have been high.

Unlike the previous years, 2004 saw no major one-off large-scale investment projects, while in 2005 more than half of the increase of FDI flows was due to investment in equity, of which the sales of state-owned stakes in Český Telecom and Unipetrol were the largest investment transactions. However, the expansion of existing foreign investments also accounted for a considerable share of the foreign capital income.

At the end of the period under our considerations there were no major investment projects in 2006. In regards to the sector structure of capital invested into the Czech Republic, the situation was the same for several previous years: the most dominant were services, following by manufacturing industry. The largest investments in manufacturing were allocated into motor vehicles, petroleum and chemical products.

In the period under consideration, in terms of geographical breakdown the Netherlands, Germany and Austria accounted for the largest share of FDI. The CNB statistics recorded between 3000-4000 foreign owned companies, about 70 companies of them accounted for around half the total FDI.

3 Literature review

Many authors of economic papers and empirical studies are interested in the problem of foreign direct investment and their determinants. Many analyses have considered the problem of determinants of FDI in the Czech republic and have played an important role in the previous literature (Zamrazilová, 2007; Kadeřábková, 2007; Blonigen, 2005; Benáček, 2000; Benáček and Zemplinerová, 1997; Smarzynska and Spartareanu, 2004; Mody, 2004; Mody, 2007). In the case of determinants, the thrust of the research has focused on why foreign investors prefer some countries than others (cross-country analysis) or why some sectors dispose of higher flows of foreign capital (cross-industrial analysis) (Benáček, 2000). The second approach has most of its hypotheses in microeconomic theories of production allocation. Many takes the classical approach of the application of theories of comparative advantages. However, a substantial part is derived from the new theories of allocation and trade, theories of industry organization and economic geography (Krugman and Obstfeld, 1997 or Dunning, 1980, 1998 and 2000).

An econometric model for the analysis of FDI can therefore explain FDI as a function of many factors. One of these factors is the size of the market. Such result was presented in the studies by Lankes and Venables (1997), Savary (1997), Pye (1998) and Altzinger (1999). In another empirical study, the authors show the important role played by foreign investors in the expected growth of a market (Barrell and Holland 1999) or access to a market (Amiti and Smarzynska Javorcik, 2005).

The size of foreign capital can be influenced also by the labor costs (Savary, 1997; Pye, 1998; Holland and Pain, 1998; Bevan and Estrin, 2000; Benáček and Víšek, 1999). Additionally, Pye (1998) also specified other important factors: profitability, political and economic stability of country or access to market. Stability was important also in the study of Lankes and Venables (1997).

The decision of foreign investors also depends on the level of research and development of domestic firms. Benáček and Víšek (1999) presented in their study that foreign investors preferred investment into manufacturing sectors with higher expenditures in research and development. This contradicts Altzinger (1997) who showed in an earlier study that human capital and know-how were not significant factors in investors' decisions. In contrast, Savary (1997) and Pye (1998) described expert knowledge as very important. It is possible

that research and development did not play such important role as it does today.

Another deciding element can be the process of privatization. In the countries of Central and Eastern Europe three different privatization processes were employed. The first (mostly used in the Czech Republic and Slovakia) were based on the principles of coupon books and the sale of state enterprises to domestic residents was preferred. The second (mainly in the Balkan states) was the sale of state firms to the hands of their managers. The alternative (almost exclusively in Hungary) was the sale of state enterprises to the hands of strategic partners and the implementation of certain restrictions for foreign agents. Savary (1997) showed that the regions of Central and Eastern Europe were more advantageous for inflows of FDI than the Southern Europe. On the other hand, Holland and Pain (1998) declared that most important was the way of privatization.

There is a number of other important determinants for presence of FDI; for example distance from the countries of Western Europe (Bevan and Estrin, 2000 or Holland and Pain, 1999). Lankes and Venables did not confirm the importance of this factor. Other influences can be natural resources (Kinoshita and Campos, 2003), total factor productivity (Benáček and Víšek, 1999 or Savary, 1997) or bureaucratic obstructions (Pomery, 1997).

There exist two studies describing determinants of FDI in the Czech manufacturing industry: Benáček and Víšek (1999) and Benáček and Víšek (1999a). In the first study the authors described the determinants of FDI in the manufacturing sector in 1994, while in the second, they analyzed determinants between 1991 and 1997. The authors concluded that it was not possible to find a universal econometric model describing all determinants of all sectors in the manufacturing industry. In the Czech economy, there existed two or three groups of industries where the investors behaved differently because their perspectives were different. With the help of robust estimation techniques, they managed to find in both studies that possible determinants of FDI could be, for example, price increases in the industry, total factor productivity, skilled labor force and/or the profitability of sectors.

4 Data and methodology of estimation

In this paper, we used a panel of 23 sectors from the manufacturing industry (classified according to Industrial Classification of Economic Activities – NACE-CZ divisions, the

complete list of industries can be found in the Table 2) between 2000–2006. The number of observations is 161 (=23x7). The time-series aspect of our analysis is very important. Self-reinforcing effects of FDI can be addressed only if there is a time series of FDI. Industries can go through comprehensive reforms during long time periods and a newly made investment could be a follow-up function of the past investment. The cross-sectional aspect of this study can be also important due to difficulty of obtaining sufficiently long FDI data (Kinoshita and Campos, 2003).

The data used in this paper come from different sources. The information about foreign capital flows (as a part of information about balance payment) is from the Czech National Bank (CNB). Direct investment according to the CNB includes equity capital, re-invested earnings and other capital covering the borrowing and lending of funds, including debt securities and trade credits, between direct investors and their subsidiaries, associations and branches. Information about the rest of variables is from the Czech Statistical Office (CSO). On this point it is important to stress the fact that data from the CSO each year undergo many methodological changes and revisions. Some data published by the CSO are classified only into NACE-CZ subsections, which are not so detailed as NACE-CZ divisions. Another problem is that some of the data are not accessible to the public. Moreover some data are not available and must be computed by the help of other data. In comparison with the CSO, information about FDI from the CNB is stable and the numeric data do not change over time.

Our dependent variable is the intensity of FDI. This intensity in the given industry i in time t is measured by the volume of foreign capital per value added: FDI/VA for each year and sector (Benáček and Víšek, 1999), avoiding thus the problem of industry size.

4.1 Regression variables

Regression variables were chosen on the basis of the main economic theories of location in an open economy. This allocation can be explained primarily by the pure theory of trade. The location of FDI is closely related to comparative advantages of the industries provided the FDI enters a tradable sector of the economy. A foreign investor would not enter into an industry which has no comparative advantage or where returns are low. In our model we will commence with the test of factor usage: capital and labor intensities

Table 2: List of industries

	name of industry		name of industry
1	food products and beverages	13	basic metals
2	tobacco products	14	fabricated metal products
3	textiles	15	machinery and equipment n.e.c.
4	wearing apparel	16	office machinery and computers
5	tanning and dressing of leather	17	electrical machinery and apparatus n.e.c.
6	wood and products of wood and cork	18	radio, television and communication
7	pulp, paper and paper products		equipment
8	publishing, printing	19	medical, precision and optical instruments
	and reproduction of recorded media	20	motor vehicles, trailers
9	coke, refined petroleum products		and semi-trailers
10	chemicals and chemical products	21	other transport equipment
11	rubber and plastic products	22	furniture; manufacturing n.e.c.
12	other non-metallic mineral products	23	recycling

of the production, human capital, requirements of natural resources. We will also include into our analyses indicators for the cost of production - total factor productivity. The changes in relative prices use the Stolper-Samuelson theorem. We will also include a variable describing profitability or wages. Following explanatory variables will be used in our tests:

Physical capital and Labor

In this paper we will use the combination of the physical capital per unit of net production (K/VA) and of the labor per unit of net production (L/VA). This variable used in our study is denoted K/L (for each year and sector). Since there has been a general assumption that the presence of relatively skilled labor in post-Communist countries is a comparative advantage that attract FDI, we expect positive sign of L/VA: the higher the labor intensity of production is, the more competitive is the production in international markets and the more attractive is the industry for FDI. Physical capital per unit of net production, as an alternative for labor intensity, is a scarce and too expensive factor and

we expect it to be a statistically significant variable with a negative sign[1]. By the combination of these two factors, we expect negative sign of estimated parameter of K/L, provided the assumption that the post-Communist economies in Central Europe have comparative advantage in labor is valid.

Total factor productivity (TFP)

This variable is used as a proxy for the technical efficiency of factor usage: the higher TFP is, the lower volume of factors is necessary to produce a unit value of output (Benáček and Víšek, 2000). This means that we expect a positive sign of this variable. There are numbers of ways how to estimate TFP. By considering aggregate Cobb-Douglas production function we will get

$$TFP_{it} = \frac{VA_{it}}{K_{it}^{a} L_{it}^{b}}$$

where a denotes the capital's share of the value added and b denotes the labor share of the value added. We suppose that $a + b = 1$. It is often assumed that the reasonable estimate for a is between $0,25$ (Prescott, 1998) and $0,35$ (Collins, Bosworth and Rodrik, 1996) or a is set to $0,3$ (Caselli, 2005 or Hall and Jones, 2003). We will take the labor's share in the value added in industry as a proxy parameter b.

Change of nominal producer prices in time (PPI)

This inflationary indicator measures price changes by the producers for their output. The higher is this index, the higher is the potential for the growth of the industry and investments into this industry. The autonomous industrial price "hikes" can be explained by growing market power (e.g. due to the FDI entry) or the increase in the quality (or the image) of products or simply by faster world-wide boost in demand for products in the given industry. Thus, a positive sign is expected. The Stolper-Samuelson theorems for a location of trade and growth are consistent with this hypothesis.

[1] On condition that there is no multicollinearity. We checked for the multicolinearity using a correlation matrix. Although multicollinearity does not bias the coefficients, it does make them more unstable and standard errors may be larger (Wooldridge, 2003).

Research and development (R&D)

The quality of the labor or quality of the production and products can be also important factor for potential foreign investors. CSO offers different sources of information about R&D: the number of people employed in R&D, the number of research workers or the total amount of the expenditures on research and development. We decided to use the number of people employed in R&D. The role of R&D has become more important in recent years, the high expenditures in R&D or higher number of workers employed in R&D can also be a sign of high quality. We expect a positive sign for this factor.

Profits per labor

This variable was included as a proxy for general competitiveness. FDI should be attracted by more profitable firms or the presence of FDI can spill over to higher profits. Thus, a positive sign of this variable is expected. This variable was measured as profits per number of employees.

Energy intensity

Energy intensity was included as a proxy for natural resources. We have information about different energy requirements: coal, gas, oil, electricity and petrol. In last ten years, the worldwide price of these sources of energy have risen.[2]. We suppose that Czech Republic still has a comparative advantage in natural resources. Thus, we expect a significant parameter of this factor with positive sign. The variable was measured as energy consumption in gigajoules (GJ) and normalized by value added.

Wages

A higher profitability in industries with higher FDI could spill over to higher wages, especially if there is an inelastic labor supply because of low mobility due to a shortage of flats (Benáček and Víšek, 1999). We expect a significant parameter of this factor with a positive sign. This variable was measured as gross monthly wage in thousands CZK.

[2]The prices of energy grew especially at the end of our period under consideration. Nevertheless, for example in 2001, the prices of electricity for industry in Czech Republic belong to the lowest in EU and this trend continued until 2004. The prices in 2005 were by far not so high like in some countries in Europe. After 2005, situation has changed.

4.2 Methodology of estimation

Among the different possibilities how to organize and estimate an econometric model we decided to choose the approach of Kinoshita and Campos (2003) or Cheng and Kwan (2000) and to relate current values of FDI to past values of FDI along with other explanatory variables. According to the previous studies, the role of past FDI values is formulated as the process of the partial stock adjustment and it takes time for FDI to adjust to equilibrium or desired level:

$$\begin{aligned} Y_{it} - Y_{it-1} &= \alpha(Y_{it}^* - Y_{it-1}) \\ Y_{it} &= (1-\alpha)Y_{it-1} + \alpha Y_{it}^* \end{aligned} \tag{1}$$

where Y_{it}^* is an equilibrium level of the FDI stock and α is less than 1 for stability. The equilibrium level of the FDI stock is determined by X_{it}, a vector of $k \in 1...K$ explanatory variables described upwards in the previous subsections:

$$Y_{it}^* = \beta X_{it} + \upsilon_{it}$$

where υ_{it} is an error term including the individual (industry) specific effect and the time specific effect. By reformulating the econometric model (1) we will get:

$$\begin{aligned} Y_{it} &= \delta Y_{it-1} + \lambda X_{it} + \varepsilon_{it} \\ \varepsilon_{it} &= \mu_i + \eta_t + u_{it} \end{aligned} \tag{2}$$

where $\delta = 1-\alpha$ and $\lambda = \alpha\beta$ are coefficients to be estimated (β is a vector of dimension $1 \times K$); $\varepsilon_{it} = \alpha\upsilon_{it}$, μ_i is individual (industry) specific effect and η_t is time specific effect.

However, we must take into account the possibility that our data set is a mixture of industries with heterogeneous behavior of investors (Benáček and Víšek, 1999). This means that it would not be possible to estimate our data by using a simple OLS estimator (which includes all observations into one model)[3]. Thus, we will use one of the robust techniques of estimation that solve the problem of heterogeneous patterns in data sets.

[3]For example, Benáček and Víšek (1999b) analyzed 92 industries of the Czech economy and realized

Among more possibilities we will use a simple Least Trimmed Square estimator (LTS). We can describe an algorithm of this estimator as follows. We consider standard linear regression model

$$Y_i = \beta X_i + \varepsilon_i$$

For an arbitrary $b \in R^p$ we shall denote by $r_i(b) = Y_i - bX_i$ the i-th residual at b. Further, we shall use $r^2_{(i)}(b)$ for the i-th order statistics among the squared residuals. Finally, let us define the LTS estimator by the extremal problem

$$b^{LTS} = arg\min \sum_{i=1}^{h} r^2_{(i)}(b)$$

where $n/2 \leq h \leq n$ and the minimization is performed over all $b \in R^k$ (Rousseeuw and Leroy, 1987, Víšek, 1996 and Víšek, 2000). In other words, in this extremal problem we are looking for such an argument $b \in R^p$ for which sum of h smallest squared residuals is minimal. Finally, we built an OLS estimator for these h observations. Unfortunately, we are limited by the dynamic form of model (2). Because of the presence of lagged value of response variable on the right side of the equation it is not so easy to exclude some observations out of the data set. Instead of this, we decided to exclude a whole industry or industries. Therefore, we will use this technique only as a diagnostic tool and we will ascertain if the LTS estimator would systematically exclude (almost) a whole industry or industries in (almost) all years.

There is one serious problem with estimation of model (2) by OLS. The lagged variable Y_{t-1} and time invariant industry specific attribute μ_i might be correlated and OLS estimate of such model will be then inconsistent. Therefore, we should then estimate the model with first differences:

$$\Delta Y_{it} \quad = \quad \delta \Delta Y_{it-1} + \lambda \Delta X_{it} + \Delta \varepsilon_{it}$$

Since ΔY_{it-1} and $\Delta \varepsilon_{it}$ might be still correlated we will use the generalized method of moments (GMM). Arellano and Bond (1991) proposed the GMM (sometimes called difference, DIFF-GMM) estimator that treats the model as a system of equations, one for

that this population appeared to consist of two segments. The first segment contained industries in which the majority of firms behaved like in a functioning market economy while the second segment contained industries where firms behaved still like under socialist paternalism.

each time period. The equations differ only in their instrument/moment condition sets. The predetermined and endogenous variables in the first differences are instrumented with suitable lags of their own levels. Arellano and Bover (1995) or Blundell and Bond (1998) proposed the System GMM (SYS-GMM) estimator to give considerable improvements over DIFF-GMM in small samples. SYS-GMM is based on a system compound of first-differences instrumented on lagged levels, and of levels instrumented on lagged first-differences. Since we have a small sample we decided to use in a third step of estimation system GMM[4] estimator. The validity of instruments is checked by the Sargan test and the second-order correlation of the error term in the first-differenced equation is checked by Arellano-Bond statistics, which are asymptotically distributed as $N(0,1)$ (Kinoshita and Campos, 2003). An additional empirical check for small-sample bias is to compare estimated panel GMM with the corresponding estimates from OLS and simple fixed-effects regression.

5 Results

Table 3 reports panel regressions. In a first step, we report OLS estimation and fixed-effects panel estimates. However, both pooled OLS and fixed effects of an autoregressive panel model are subject to biases in the estimation of all model parameters. Thus, we also report the results of system GMM. Finally, besides results of GMM estimator we will also comment results of OLS and fixed effects in an effort to compare the results in the terms of an economic interpretation. In all regressions response variable is FDI/VA.

All regressions include time dummies to control for time variation due to changes in economic environment common across industries. We report pooled OLS and fixed effects models in column (a) and (b) and GMM model in column (c). The coefficient of determination for model (a) and (b) is satisfactory high (85% and 50%, respectively). We present three specification tests for GMM. The Sargan test does not reject the null hypothesis that the over-identifying restrictions are valid. The Arellano-Bond test for AR(2) determined that there is no second order serial correlation. It implies that model is correctly specified.

The results of models (a) and (c) indicate that physical capital and labor play an

[4]All GMM estimations are carried out using command "xtabond2" for Stata.

Table 3: Notes: * significant at 10%; ** significant at 5 %; *** significant at 1 %. Standard errors in brackets. Times dummies are included in regressions. Hausmann test rejects the random effects model. Response variable: FDI/VA

	OLS (a)	FE (b)	GMM (c)
lagged FDI/VA	0.51***(0.07)	0.22**(0.088)	0.37***(0.09)
Capital per labor	-0.094***(0.032)	-0.075 (0.097)	-0.12***(0.03))
Profits per labor	0.0004***(0.0001)	0.0004**(0.0002)	0.0006***(0.00009)
R & D	6.47**(2.63)	39.21***(6.02)	7.55***(2.56)
Energy intensity	0.12***(0.03)	0.11***(0.04)	0.10***(0.03)
Wage	0.038***(0.01)	-0.01(0.03)	0.081***(0.02)
PPI	-0.0074 (0.004)	0.0008 (0.005)	-0.00033(0.007)
TFP	-0.08 (0.107)	-0.164(0.13)	-0.20 (0.15)
N	161	161	161
adj. R^2	0.85	–	–
within R^2	–	0.50	–
Sargan test (p-value)	–	–	0.072
AB 1 (p-value)	–	–	0.003
AB 2 (p-value)	–	–	0.209

important role in the decision of foreign investors where to place an investment. It seems that in recent years they invested into labor intensive sectors while physical capital is expensive and scarce for foreign investors. This result agrees with findings of other studies (Benáček and Víšek, 1999 or Savary, 1997) and also is consistent with our expectations.

The variable describing profits in sectors is significant in all regressions with positive signs. According to our hypothesis, profits in industries attracting FDI should be greater than profits in industries with indigenous enterprises. The results of our testings are consistent with these expectations. In all regressions, foreign investors put an accent on research and development. The results corresponds to our expectations: higher expenditures on R&D means higher investments from the side of foreign investors[5].

The variable describing energy requirements is significant with the positive sign of the estimated parameter. The prices of energy have risen in recent years, but these changes

[5]or higher foreign investments can spill over to higher expenditures on R&D

concerned countries in the whole world. The Czech Republic was characterized by lower prices of energy at the beginning of our period than other European countries and the continued tradition of investments into energy-intensive industries. On that account, we conclude that the Czech Republic has a comparative advantage in the energy requirements.

The variable describing gross monthly wage is significant for the model for the models (a) and (c). Also this results conforms to our expectations.

The variable describing the efficiency of factor usage, total factor productivity, is not significant in any model. Neither variable PPI, describing inflation rate, is not significant in any regression. Our data and these results can be mispresented by some heterogeneous pattern of foreign investors in some industries. We will try to eliminate this influence by using LTS.

As we mentioned above, there exists the certain possibility that our data comes from two or more different sectors where investors behave differently. Thus, we tried to apply least trimmed square estimator on our data and we were monitoring which industries there were deleted the most of observation by the algorithm. Pursuant to the results, it comes into question to drop subsequently basic metals (industry 13) or motor vehicles, trailers and semi-trailers (industry 20)[6]. Afterwards we estimated these reduced data sets by using pooled OLS, fixed effects panel estimator and system GMM. Results of these estimates are in Tables 4 and 5.

After excluding industry 13 (basic metals) results of regression (a) and (c) have improved in some details while the results of estimation of model (b) are worse. The coefficient of determination for the model (a) remains high (85%). On the other hand, the coefficient of determination for the model (b) has fallen. As well as in previous analysis

[6]LTS estimator also indicates that another possibility is to exclude tobacco (industry 2) or radio, television and communication equipment (industry 18). In terms of economic explanation, the manufacture of tobacco products is specific: there have been no workers employed in research and development, on the other hand the ratio K/L and profits per labor are very high compared to other industries. In a case of basic metals the flows of FDI in last years has risen. The sector has gone through certain growth, the incomes and the number of new contracts have risen. Similar changes are characteristic also for the sector of radio, television and communication equipment. Growth of employment and high productivity has been typical for this sector in recent years. The last sector (motor vehicles, trailers and semi-trailers), has a specific position in the Czech Republic and has a cardinal importance for the whole Czech economy. The flows of FDI in this industry are extremely high as this sector put on accent on the research and development, and the profits are higher than in other industries.

Table 4: Industry 13 (basic metals) is excluded. Notes: * significant at 10%; ** significant at 5 %; *** significant at 1 %. Standard errors in brackets. Times dummies are included in regressions. Hausmann test rejects the random effects model. Response variable: FDI/VA

	OLS (a)	FE (b)	GMM (c)
lagged	FDI 0.51***(0.07)	0.21**(0.09)	0.372***(0.09)
K/L	-0.13***(0.04)	-0.11(0.09)	-0.13***(0.03)
profit	0.0005***(0.0001)	0.0003*(0.0002)	0.0006***(0.00009)
R & D	6.26**(2.59)	38.64***(5.97)	7.85***(2.55)
Energy intensity	0.16***(0.04)	0.12***(0.04)	0.13***(0.03)
Wage	0.04***(0.01)	-0.01(0.03)	0.06***(0.02)
PPI	-0.012**(0.004)	0.003(0.005)	-0.004*(0.002)
TFP	0.11*(0.0.06)	0.18*(0.10)	0.18*(0.10)
N	154	154	154
adj. R^2	0.85	–	–
within R^2	–	0.47	–
Sargan test	–	–	0.003
AB 1	–	–	0.000
AB 2	–	–	0.109

according to the Arellano-Bond test, a second order correlation is not detected while the Sargan test rejects the null hypothesis. It means that the validity of instruments is questionable. Overall, a comparison between OLS and GMM results shows a bias that in most variables is not great as seen in similar sizes of coefficients in both specifications. Due to the small sample, GMM estimates may be asymptotically biased.

The variable describing the efficiency of factor usage (TFP) is significant on the level of 10% in all regressions and this variable has a positive sign. These findings are consistent with our expectations: the higher is the TFP, the lower volume of factors is necessary to produce a unit-value of output and the industry is more attractive for foreign investment. The rest of results are similar to the previous.

The variable describing inflation (PPI) is significant for regressions (a) and (c). However, estimated parameters have negative sign. According to our expectation, the sign should be positive. By a pure look at the data, we can see that this price index is decreasing for several industries, especially those where FDI flows are high during recent years. In industries with higher FDI, the prices can be pressed down and the negative sign can be the effect of presence of FDI.[7] In any case, we will monitor carefully the results of estimating this parameter in the following regression (without industry 20).

We can conclude that excluding industry 13 (basic metals) from our data set brings certain improvement, at least in a question of significance of PPI and TFP. On the other hand, the estimation by fixed effects became a little worse.

Now we will comment on brief results of last estimated model where industry 20 (vehicles, trailers and semi-trailers) is excluded. Results are summarized in table 5.

Coefficients of determination of model (a) and (b) are 86% and 52%. Two specification tests of the GMM show a satisfactory result. With the Sargan test we do not reject the null hypothesis that the instruments are well specified and the Arellano-Bond test does not detect second-order serial correlation. In other words, the model is correctly specified.

Let us control the most problematic variables - PPI and TFP. These variables are significant in regression (a) and (c) on the level of 10%, TFP in model (c) is significant on the level of 5%. Moreover, PPI is significant as in previous case with a negative sign. This

[7]There is also statistical explanation of this problem. In general, if the sign of estimated parameters does not correspond to our expectation, this variable could compensate the non-linearity of some other (usually non-significant) variable. It means that the "bad" sign of parameter does not need to be a problem and we should not rely only on signs of estimated parameters.

Table 5: Industry 20 (motor vehicles, trailers and semi-trailers) is excluded. Notes: * significant at 10%; ** significant at 5 %; *** significant at 1 %. Standard errors in brackets. Times dummies are included in regressions. Hausmann test rejects the random effects model. Response variable: FDI/VA

	OLS (a)	FE (b)	GMM (c)
lagged FDI	0.51***(0.07)	0.24***(0.09)	0.29***(0.09)
K/L	-0.09***(0.03)	-0.08(0.09)	-0.09**(0.03)
profit	0.0004***(0.0001)	0.0003*(0.0002)	0.0004***(0.0001)
R & D	6.23**(2.61)	41.54***(6.181)	6.96***(2.361)
Energy intensity	0.13***(0.03)	0.11***(0.04)	0.08***(0.03)
Wage	0.03**(0.01)	-0.02(0.03)	0.08***(0.02)
PPI	-0.007*(0.004)	-0.009**(0.004)	-0.005*(0.002)
TFP	-0.05* (0.03)	0.14(0.13)	0.13** (0.06)
N	154	154	154
adjusted R^2	0.86	–	–
within R^2	–	0.52	–
Sargan test	–	–	0.067
AB 1	–	–	0.000
AB 2	–	–	0.429

result supports our conclusion about competitive effects of FDI. Total factor productivity is significant with a positive sign. This finding agrees with our hypothesis. This variable is significant also in regression (b). In general, we can conclude that the efficiency of factor usage is important for foreign investors. The remaining variables are significant, mostly on level of 1%. The only exception are variables capital per labor and wages in model (b), where the parameters are significant. On the other hand, these variables are highly significant in both models (a) and (c). Hence, we tend to the opinion that this variable plays important role for foreign investors.

6 Conclusion

This paper analyzes some aspects of the behavior of foreign investors in the Czech manufacturing industry. We estimated a panel data of 23 sectors of manufacturing industry over 7 years (2000-2006) by using different techniques of estimation: OLS, fixed effects and primarily by using GMM estimator. Together with GMM estimator, we provided several statistical tests controlling the validity of used instruments.

One of the most important results is the suggestion that the abundance of labor with technical skills is still a comparative advantage in the Czech Republic while the physical capital is relatively more scarce and thus a more expensive factor. Foreign investors prefer industries with a higher quality of labor and flows of foreign capital are closely associated with the number of workers employed in research and development. We conclude that the higher number of these employees effects the higher flows of FDI. Foreign capital is also positively associated with the energy usage as foreign investors tend to invest into industries with higher energy requirements. In addition, our hypotheses about profits in these industries was also confirmed in all regression models: industries with higher profits per labor have higher flows of FDI. We suppose that higher profit is the effect of the presence of FDI in industry, which has a circular effect of attracting further investments.

Although there would be more possibilities how to exclude the industries out of our data set (we could take into account also industry 2 - tobacco or industry 18 - radio, television and communication; on the other hand, after excluding one of these industries the results would not change and are very similar to previous two following regression models), in our analyses we tried to drop 2 different industries out of the model: basic

metals (this industry has risen in recent years) and transport equipment (where flows of FDI were extremely high). This exclusion brings a certain improvement of the results as the PPI index and TFP (as a proxy for efficiency) became more significant. However, the parameter of variable PPI is negative. We can conclude that the effect of higher flows of foreign capital is the higher competitiveness in these sectors and prices are kept down. The significance of the parameter TFP supports our hypothesis about efficiency of factor usage.

In conclusion, it is very important to note that at the present time the conditions of the Czech economy are changing. These changes will probably also cause changes in the structure of industries and the drain of foreign capital.

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