

EXCHANGE RATE CHANGES EFFECTS ON FOREIGN DIRECT INVESTMENT

Roman Hušek, Václava Pánková*

Abstract:

Foreign direct investment (FDI) is an important phenomenon in international economic relations. Generally, FDI is studied from the point of view of capital and technology transfers to the recipient countries while respecting a basic fact that profit is the main investor's interest. In this paper in Part 2, some representative examples of typical FDI models are presented, whereas Part 3 should justify the specification of a model which is formulated and applied in Part 4. Investors can be driven by the expectation of maximum profit which would be obtained by allocating FDI according to the exchange rate volatility, *i.e.* after a sudden large devaluation of the host country currency large FDI inflows will follow as future appreciation is expected. Large exchange rate shocks are described with the help of skewness. Negative skewness means that the appreciations occur more often. Reasoning of the model explaining FDI by mean, standard deviation and skewness of changes of exchange rate is provided. An application to two New EU Members and two ASEAN countries is presented using panel data and seemingly unrelated regression technique.

Keywords: foreign direct investment, exchange rate volatility, panel data

JEL Classification: C23, F21

1. Introduction

FDI is a result of attempts of firms to find profitable production facilities and markets. While weaker economies are primarily FDI recipients, leading world economies exhibit not only FDI outflow but also strong transient FDI inflows. Technology transfer through FDI represents one of the important impacts on the host country. The main interest of the investor is represented by profit.

A particular relation between FDI and economic growth exists, though the direction of causality may not be clear – as shown by Chowdhury and Mavrotas (2003). Other important determinants of FDI usually are labour cost, income difference, purchasing power, export and exchange rate.

* Roman Hušek, University of Economics, nám. W. Churchilla 4, CZ – 130 67 Praha 3 (husek@vse.cz); GA ČR 402/06/0190. Václava Pánková, University of Economics, nám. W. Churchilla 4, CZ – 130 67 Praha 3 (pankova@vse.cz); GA ČR 402/07/0049.

2. FDI in Econometric Models

The role of exchange rate as a determinant of FDI may be examined from different points of view. Studying FDI with regard to one economy only, we can use the exchange rate as one of important explanatory variables. As a representative example, we suggest to pay attention to a VAR structure which is used e.g. by Shan (2002) in the form

$$V_t = A_0 + \sum_{i=1}^k A_i V_{t-i} + u_t \quad (1)$$

where

$V_t = (OUTPUT_t, FDI_t, LABOUR_t, INVESTMENT_t, ENERGY_t, EXPORT_t, INCOME DIFFERENCE_t, LABOUR COST_t, EXCHANGE RATE_t)$

u_t = error term for the variables included

$A_1 - A_k$ – nine by nine matrices of coefficients; A_0 is an identity matrix.

Model (1) can be modified by changing a portfolio of variables used to explain FDI in one country. Should they be used to compare two or more economies, variables would be double-indexed; in addition to time t we also introduce an index i to mark country i .

If we intend to consider the exchange rate as a particular quality of each economy which enables to distinguish for an expected profit and hence effects the decision whether to invest or not in a certain country, the equation should comprise relevant characteristics of both countries to be compared. Such a model is presented by e.g. Ruiz (2005) in the form

$$\begin{aligned} InFDI_{ij}^{kg} = & \beta_0 + \beta_1 ER_{ij} + \beta_2 UNER_{ij} + \beta_3 InGDPpc_i + \beta_4 InGDPpc_j \\ & + \beta_5 InDist_{ij} + \beta_6 [\Delta e_{ij} * Ind_{ik}^q] + \beta_7 Open + \beta_8 CPI_j + u_i \end{aligned} \quad (2)$$

Typical features of (2) are:

- FDI received by country i from country j in industry k to produce good q
- competitiveness of a country proxied by the level of real exchange rate ER and an uncertainty measure $UNER$
- market size determined by *GDP per capita*
- distance $Dist$ between countries implies transportation costs
- quantification of the impact of exchange rate variation Δe for the specific industry Ind
- openness variable $Open$ which controls the nature of FDI
- price level is given by CPI .

A special role of exchange rates applies to the New Members of the European Union. Those countries, still having their own currencies, converge to introducing euro in a horizon of five years approximately. Aiming for the earliest possible European Monetary Union (EMU) accession, their monetary policy is modified to reduce exchange rate uncertainties. Besides, New Members of the EU have a great demand for the new technologies coming along with investment from abroad and due to this fact investment-supporting environment is created. The impact of such policy on the intensity on FDI inflow to EMU – candidate countries is studied by Brzozowski (2003). He mentions empirical

evidence that the very prospect of EU membership contributes to favourable investment climate creation and asks a question whether the reduction of exchange rate volatility would actually be the main alteration of investment conditions in candidate countries after the EMU enlargement. The author concludes that exchange rate volatility may negatively influence decisions to locate investment into transition countries. Nevertheless, the paper does not hide the existence of two theoretical streams leading to contradicting results regarding the sign of the relation between exchange rate volatility and FDI inflow. For details see Brzozowski (2003).

$$FDI_{it} = \beta_0 + \beta_1 GDP_{it} + \beta_2 GDPgrowth_{it-1} + \beta_3 INFL_{it-1} + \beta_4 FISCBAL_{it-1} + \beta_5 RESRV_{it-1} + \beta_6 TELEPH_{it-1} + \beta_7 GDPpc_{it} + \beta_8 variability + u_{it} \quad (3)$$

The logic of (3) is to divide explanatory variables into following groups:

- macroeconomic factors: *GDP* as a level as well as its growth dynamics, rate of inflation (*INFL*), general government balance as per cent of *GDP* (*FISCBAL*)
- country creditworthiness: measured by the change in the reserve assets (*RESRV*)
- physical infrastructure proxied by the number of telephone lines and cellular subscribers *per* 100 inhabitants (*TELEPH*); *GDP per capita* to measure labour productivity
- *variability* of exchange rate.

All papers mentioned in this section also summarize the present state of knowledge and give a broad literature review.

3. Exchange Rate as an Important Determinant of FDI

Exchange rate level and volatility are supposed to play an important role not only in locating capital inflows but also in their composition. They affect the corporate decision where to produce and thus influence future profits. The ambiguous effects of exchange rate changes on FDI are stressed in some recent articles, see *e.g.* Barrell, Gottschalk and Hall (2006) or Sung, Lapan (2000). They mention empirical evidence that exchange rate volatility can effect the competitiveness of plants in different countries by creating both threats and opportunities for foreign firms. Chakrabarti and Scholnick (2006) draw attention to the fact that small shocks and large shocks differ significantly both in their origins and effects. The effect of a large shock does not correspond to a sequence of small shocks. After a sudden large devaluation of the host country's currency, large FDI inflows can be seen because of an expectation of a future appreciation.

Intuitive reasoning of relations between FDI and exchange rate changes and main relevant formulas are provided by Chakrabarti and Scholnick. We summarize them here briefly and try to support their economic reasoning by a necessary mathematical background. The purpose of this part is to show the dissimilar influence of small and large exchange rate shocks on FDI, not to give a complete model of all financial determinants of FDI.

Investor maximizes expected profit

$$\pi = n \left[\frac{R(n) \cdot \hat{e}}{1+r} - C(n) \cdot e_0 \right] \quad (4)$$

where

n is a measure of the scale of the project

$C(n)$ is the cost of the project for unit n

$R(n)$ the revenue, both in a host country currency for unit n

e_0 is current and \hat{e} is expected exchange rate (*usd/hc*)

r is opportunity cost of capital.

Diminishing returns to scale of a project are assumed; as decreasing returns to scale = increasing costs we have $R(n)$ decreasing and $C(n)$ increasing with respect to n and hence $dR(n)/dn < dC(n)/dn$.

It is $\pi = \pi(n)$ and $n^* = \arg \max(\pi) = n^*(r, \hat{d})$ with $\hat{d} = \log e_0 - \log \hat{e}$ as the expected level of depreciation. The logic of the function $n^* = n^*(r, \hat{d})$ is that n^* decreases with increasing r or \hat{d} *ceteris paribus*, so we should have

$$\frac{\partial n^*}{\partial r} < 0, \quad \frac{\partial n^*}{\partial \hat{d}} < 0. \quad (5)$$

Now we want to show that n^* is a decreasing and concave function of e_0 which means that the higher is e_0 , the lower appreciation is expected and an intention to invest falls more rapidly.

Following the economic assumptions of Chakrabarti and Scholnick, we derive

$$\begin{aligned} \frac{\partial n^*}{\partial e_0} &= \frac{\partial n^*}{\partial r} \cdot \frac{\partial r}{\partial e_0} + \frac{\partial n^*}{\partial \hat{d}} \cdot \frac{d\hat{d}}{de_0} = \frac{\partial n^*}{\partial \hat{d}} \cdot \frac{d(\log e_0 - \log \hat{e})}{de_0} = \frac{\partial n^*}{\partial \hat{d}} \cdot \frac{d \log e_0 - d \log \hat{e}}{de_0} = \\ &= \frac{\partial n^*}{\partial \hat{d}} \cdot \frac{(1/e_0)de_0 - (1/\hat{e})d\hat{e}}{de_0} = \frac{\partial n^*}{\partial \hat{d}} \left[\frac{1}{e_0} - \frac{1}{\hat{e}} \cdot \frac{d\hat{e}}{de_0} \right] \end{aligned} \quad (6)$$

as we believe $dr/de_0 = 0$. Supposing future appreciation, we consider $\hat{e} > e_0$; an assumption $d\hat{e}/de_0 < 1$ relates to an empirical evidence that an investor does not reflect all changes of future exchange rate. Combined together, the bracket is positive while $\frac{\partial n^*}{\partial \hat{d}} < 0$ as it was stated in (5). Hence, $\frac{\partial n^*}{\partial e_0} < 0$ and n^* is decreasing with respect to e_0 .

As for the second derivative, an exact analytical form resulting from derivation of (3) does not allow for similar reasoning without additional information. If we do with a rough approximation of

$$\frac{\partial n^*}{\partial e_0} = \frac{\partial n^*}{\partial \hat{d}} \left[\frac{1}{e_0} - \frac{1}{\hat{e}} \cdot \frac{d\hat{e}}{de_0} \right] \quad (7)$$

being a function of $d\hat{e}/de_0$ only (all other members of r.h.s. of (7) supposed as constants), we have

$$\frac{\partial^2 n^*}{\partial e_0^2} \approx -\frac{1}{\hat{e}} \cdot \frac{\partial n^*}{\partial \hat{d}} \cdot \frac{d^2 \hat{e}}{de_0^2}. \quad (8)$$

An assumption about $\frac{d^2 \hat{e}}{de_0^2} < 0$ results from an intuition that the level of inelasticity is more evident upon large shocks. Another approach deals with the facts that $n^* = n^*(\hat{d}(e_0))$, \hat{d} is a logarithmic function concave with respect to e_0 and n^* is decreasing with respect to \hat{d} . If there is a reason to assume n^* being concave with respect to \hat{d} , relevant theorem could be applied stating n^* to be concave with respect to e_0 .

Now, the higher is the current rate e_0 , the lower is

- (i) the expected appreciation
- (ii) the optimal scale of project
- (iii) the expected profit
- (iv) the FDI inflow.

Items (i) – (iv) are a consequence of the fact that n^* is decreasing with respect to e_0 . The contingent concaveness of n^* would show a growing decrease of FDI through high current appreciation (high e_0).

This is a rather straightforward reasoning of the fact that FDI adjusts to large shocks of exchange rate and not to small shocks. A mechanism allowing for distinguishing between small and large shocks is described by Ball and Mankiw (1995) who utilize the skewness of changes as a relevant explanatory variable. Shocks, in fact, are changes in the exchange rate. Skewness is a measure of asymmetry, or more precisely the lack of symmetry. For univariate data y_1, y_2, \dots, y_n we have

$$skewness = \frac{n}{(n-1)(n-2)} \cdot \frac{\sum_{i=1}^n (y_i - \bar{y})^3}{\left(\sqrt{\sum_{i=1}^n (y_i - \bar{y})^2} \right)^3} \quad (9)$$

where \bar{y} is the mean. Any symmetric data should have nearly zero skewness. Negative / positive values of skewness indicate data that are skewed left / right.

When describing the skewness of monthly changes of the exchange rate, negative skewness means that the appreciations occur more often than the depreciations.

4. Model

An econometric model is proposed (Chakrabarti and Scholnick (2006)) in the form

$$FDI_{it} = \beta_0 + \beta_1 D_{it}^{mn} + \beta_2 D_{it}^{sd} + \beta_3 D_{it}^{skw} + u_{it} \quad (10)$$

in which D_{it}^{mn} , D_{it}^{sd} , D_{it}^{skw} respectively are the mean, standard deviation and skewness of differences in monthly exchange rate values of the currency of country i during the year $t-1$. FDI refers to country i and year t . β 's are parameters of the model and $u_{it} \approx N(0, \sigma^2)$ represent disturbances.

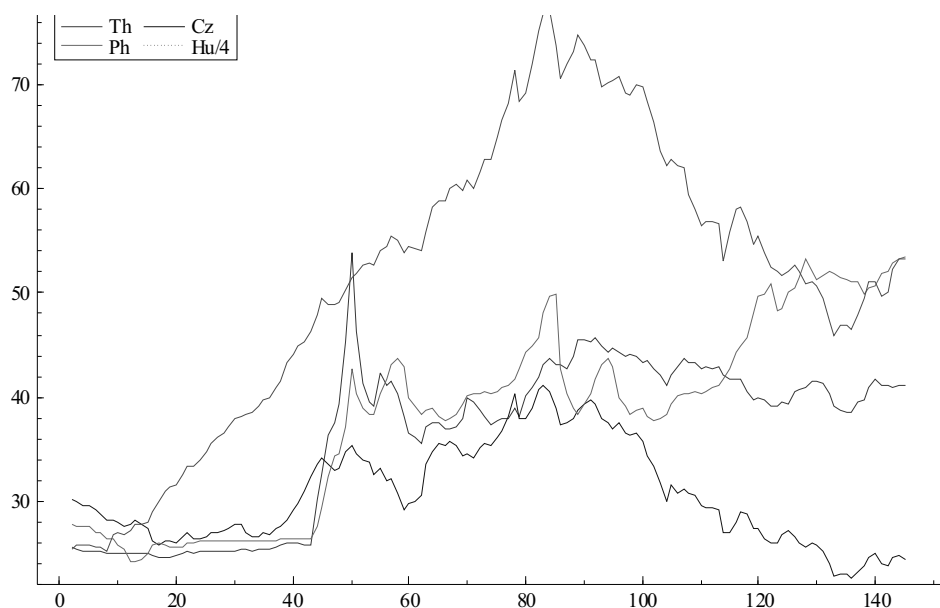
The theory proposed above should result in a stronger influence of D_{it}^{skw} variable than that of the other exogenous variables.

The determinants of FDI and the relations between FDI and economic growth have been a subject of research interest for decades. But the Czech Republic does not appear in any international FDI statistics before the beginning of the 1990s. Now the assembled data, empirical evidence and experiences allow for the attempts to give an econometric analysis of FDI inflows and a comparison with other countries. Data refer to years 1994 - 2005.

Main attention will be paid to the exchange rate, as it seems to be one of the most important factors of an investment decision. Contemporaneously, it is a relevant base for comparative studies among two or more rival economies. FDI inflows to the Czech Republic are the main focus of interest of this paper. The choice of other compared economies has the following logic: Hungary is an economy of comparable dimension and similar historical experience; both countries are New Members of the EU. Both countries represented a new territory first, but with a decreasing risk of political instability an FDI inflow increases as it is documented in Mandel and Tomšík (2006). Thailand is on the move economically; in the BOI Investment Review (2004) there is a suggestive title: International Experts Rank Thailand as the Worlds No.4 in FDI Destination for 2004 - 2007. Besides, the Czech Republic is No.5 on the same list. Another interesting link between these two countries is the fact that at the beginning of the analysed period, the Czech koruna and Thai baht were near to parity. The same applies to the relation between the koruna and Philippine peso. The other reason why our set of countries includes the Philippines is that this country provides a different experience as its FDI inflow is rather weak. Thailand and the Philippines are members of ASEAN.

Monthly exchange rates of respective Thai baht, Philippine peso, Czech koruna, Hungarian forint to US dollar are presented in Figure 1 (for optical convenience, Hungarian exchange rate is divided by 4).

Figure 1
Monthly Exchange Rates



Skewness of monthly exchange rate changes for the individual countries is as follows:

Thailand	Philippines	Hungary	Czech Republic
-0.26392	-0.47054	1.77627	0.74280

A straightforward logic says that there is a lower predisposition of Thailand and the Philippines to FDI inflow than it is in the case of Hungary and the Czech Republic. Nevertheless, evidence exposes a different reality.

Two alternative techniques to estimate parameters of model (10) were applied.

- (i) Panel data allowing for distinguishing in constants for the countries or group of countries. The results correspond to the findings of Chakrabarti and Scholnick (2006) and show no importance of mean and standard deviation of exchange rate devaluations while relevant skewness plays a reasonably significant role. Having Thailand as a reference country, there are shifts in constant computed. The results correspond to the evidence that there is significantly less FDI in the Philippines compared to Thailand. The Czech Republic is in a slightly better position and Hungary is indifferent.
- (ii) Using the same technique but distinguishing for the EU versus ASEAN countries, no difference is found. Hence, we do not confirm the characteristic “New Member of the EU” to be a special quality in gaining FDI inflows.

(iii) Seemingly unrelated regression (SUR), performed under an assumption of common world economic environment, gives a possibility to find individual parameters for each country. In this case we see more detailed and unfortunately also less unambiguous results. Evidently, skewness plays no role in case of Thailand and the Czech Republic which are exemplary FDI acceptors.

The results of (i) and (iii) are summarized in Table 1.

Table 1
Results of Estimates

	Common	Thailand	Philippines	Hungary	Czech Republic
Panel data					
Constant (st.err.)	2826 (303)		-1836 (112)	66 (798)	1826 (185)
t-value (t-prob)	9.33 (0.000)		-16.4 (0.000)	0.083 (0.93)	9.85 (0.000)
Mean (st.err.)	-20.3 (0.177)				
t-value (t-prob)	-0.177 (0.860)				
Stand.dev. (st.err.)	256 (258)				
t-value (t-prob)	0.992 (0.328)				
Skew (st.err.)	533 (283)				
t-value (t-prob)	1.88 (0.068)				
SUR					
Constant (st.err.)		242 (122)	89 (62)	229 (172)	104 (252)
t-value (t-prob)		1.98 (0.057)	1.42 (0.165)	1.33 (0.195)	0.413 (0.682)
Mean (st.err.)		2307 (445)	1035 (339)	156 (124)	-2346 (1299)
t-value (t-prob)		5.18 (0.000)	3.05 (0.005)	1.26 (0.218)	1.81 (0.080)
Stand.dev. (st.err.)		2148 (232)	716 (106)	749 (79)	5801 (691)
t-value (t-prob)		9.26 (0.000)	6.75 (0.000)	9.37 (0.000)	8.39 (0.000)
Skew (st.err.)		-355 (481)	-390 (175)	1618 (468)	94 (753)
t-value (t-prob)		-0.738 (0.466)	-2.22 (0.034)	3.45 (0.002)	0.125 (0.901)

5. Conclusions

Models explaining FDI only upon exchange rate changes clearly do not belong to the main stream of FDI models that are outlined using illustrative examples in Part 1. A strong point of the model proposed by Chakrabarti and Scholnick is a low number of explanatory variables which are based purely on the knowledge of monthly exchange rates. However, many other variables (*e.g.* output, export, energy, labour cost, *etc.*) are also important and we have to admit that it would be difficult to explain FDI inflows in general using exchange rate movements only.

The idea of crucial influence of large changes in exchange rate on the FDI inflow volume is summarized with a target to verify it in the case of two central European New EU Members and two ASEAN economies. Using relevant data, we have found that in general, the hypothesis is not to be rejected. Nevertheless, when analysing the countries

individually with one world economy as a connecting factor, the evidence for Thailand and the Czech Republic implicates that successful FDI recipient countries are probably viewed from more complex perspectives which may hardly be reduced to a small number of quantified variables. We also could not confirm the common premise that being a New Member of the EU represents a special quality in obtaining FDI inflows.

The important but contemporaneously ambiguous effects of exchange rate changes on FDI are stressed in some recent articles; our contribution to the current discussion also finds that there is no unique straightforward way to a clear and strong evidence of such a relation. We would like also to state that as data sources we used *exchange rates*, *monthly averages* published by the Bank of Thailand, Česká národní banka, Magyar Nemzeti Bank, Philippine National Bank and in case of *FDI inflows per year* data released by the OECD and JETRO.

References

- Ball, L., Mankiw, N.** (1995), "Relative Price Changes as Aggregate Supply Shocks". *Quarterly Journal of Economics*, 110 (1), pp. 161–193.
- Barrell, R., Gottschalk, S. D., Hall, S. G.** (2006), "Foreign Direct Investment and Exchange Rate Uncertainty in Imperfectly Competitive Industries", <http://www.niesr.ac.uk/pubs/dps/dp220.pdf>.
- BOI Investment Review** (2004), 13 (3), April.
- Brzozowski, M.** (2003), "Exchange Rate Volatility and Foreign Direct Investment - Consequences of EMU Enlargement". Center for Social and Economic Research, http://www.case.com.pl/upload/publikacja_plik/1521534_sa258.pdf.
- Chakrabarti, R., Scholnick, B.** (2006), "Exchange Rate Expectations and FDI Flows". Faculty of Business, University Alberta, <http://www.prism.gatech.edu/~rc166Ex.FDI.pdf>.
- Chowdhury, A., Mavrotas, G.** (2003), "FDI & Growth: What Causes What". WIDER Conference, Helsinki.
- Mandel, M., Tomšík, V.** (2006), "Přímé zahraniční investice a vnější rovnováha v tranzitivní ekonomice: aplikace teorie životního cyklu". *Politická ekonomie*, 14 (6), pp. 723–741.
- Patrawimolpon Pichit, Pongsaparn Runchana** (2006), "Thailand in the New Asian Economy". Bank of Thailand Symposium.
- Ruiz, I. C.** (2005), "Exchange Rate as a Determinant of FDI: Does it Really Matter?" Medelin, *Ecos de Economía*, 21, pp. 153–171.
- Shan, J.** (2002), "A VAR Approach to the Economics of FDI in China". *Applied Economics*, 34 (7), pp. 885–893.
- Sung, H., Lapan, H. E.** (2000), "Strategic Foreign Direct Investment and Exchange Rate Uncertainty". *International Economic Review*, 41 (2), pp. 411–423.