Exchange Rate Effects on Foreign Direct Investment Focusing on Central European Economies[1]

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Abstract

An explanation of short-run fluctuations in foreign direct investment (FDI) flows by exchange rate movements is based on a belief that investing foreign companies can buy another country's assets and technologies cheaply when its currency is weak. The idea of a simple model of FDI depending on higher moments of exchange rates is completed by evidence of the dynamic effects of the process in question. Relevant panel data techniques are briefly recapitulated and then applied. Data of four central European countries show results which confirm the theory proposed.

Keywords: *foreign direct investment, exchange rate, Central European economies*

JEL Classification: C23, F21

1. Introduction

Most foreign direct investment (FDI) models deal with variables such as output, energy exports, labour costs, income and exchange rate, and many of them are doubled or tripled if a comparative model of two, three or more countries is formulated (Brzozowski, 2003; Ruiz, 2005 or Shan, 2002). In such a context, the proposal by Chakrabarti and Scholnick (2002) for explaining FDI solely by the exchange rate's statistical moments is a very impressive one, as it fulfils the requirement of parsimony in an econometric model. An explanation of short-run fluctuations in FDI flows by exchange rate movements is based on a belief that investing foreign

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companies can buy another country's assets and technologies cheaply when its currency is weak (Froot and Stein, 1991 or Klein and Rosengren, 1994).

In this paper, the relations between FDI and exchange rate are summarized by using a model approach with results found through applications during the last two decades. The model described in Chakrabarti and Scholnick (2002) is briefly recapitulated and its dynamic widening is presented. Moreover, some useful panel data techniques are mentioned and then applied on the data of four central European countries which happen to be new members of the EU (Czech Republic, Hungary, Poland and Slovak Republic). The proposed theory is confirmed by data from these countries in spite of their short market economy history. The paper is organized as follows: section 2 presents a literature survey; section 3 deals with the definition of the model explaining its theoretical background and the expected signs of its coefficients; section 4 presents the econometric methodology to be used and section 5 contains its application to the data of four central European countries, and last section concludes.

2. Foreign Direct Investment and Exchange Rate

Exchange rate changes usually lead to real effects on the economy. During the last two decades, many studies have attempted to examine whether exchange rate is a determinant of FDI to host countries. At a theoretical level, many papers show a straightforward logic of exchange rate changes influencing the profits raised from FDI. Reviewing FDI determinants Bloningen (2005) mentions exchange rate as one of two (the other being taxes) fundamental external factors that drive FDI behaviour.

The sensitivity of FDI to exchange rate changes is based in Buch and Kleinert (2006) on the following reasoning. An appreciation of home country currency increases profits through cheaper imported inputs and also makes FDI cheaper. On the other hand it reduces profits through lower export receipts. As it is shown in Chen, Rau and Lin (2006), the depreciation of a host country´s currency tends to stimulate FDI activity of cost-oriented firms and to deter FDI activity for market-oriented firms.

Chakrabarti and Scholnick (2002) argue that, after a sudden large devaluation of the host country's currency, large FDI inflows can be expected because of an anticipation of a future appreciation. The authors draw attention to the fact that small 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.

On the other hand, there is a stream in the relevant literature which rejects any link between exchange rates and FDI flows, based on the argument that the price of one country's assets should not matter, because only their rate of return matters (Healy and Palepu; Ray, 1989). In general, the ambiguous effects of exchange rate changes on FDI are stressed in Barrell, Gottschalk and Hall (2003), and Sung and Lapan (2000). Exchange rate level and volatility are assumed to play an important role not only in the location but also in the composition of capital inflows. They affect a firm's decision as to where to produce, and its future profits. The papers mentioned present empirical evidence of the effect of exchange rate volatility on the competitiveness of plants in different countries by creating both opportunities and problems for foreign firms. However, an unambiguous connection between exchange rate and FDI under imperfect capital markets condition is presented in Froot and Stein (1991) and generalized in Blonigen (1997).

Special experience related to developing countries, e.g. BOI (2008) and Kiyota and Urata (2004), usually speaks in favour of an evident exchange rate effect which can be viewed in three separate parts. (i) As for an exchange rate level, FDI goes to countries where the currency is weaker as a given amount of foreign currency can buy more investment. (ii) High exchange rate volatility discourages FDI. (iii) Exchange rate expectations of depreciation of the currency of the host country attract FDI.

In industrialized countries, the importance of exchange rate volatility for investment flows was one motivating theme in designing the exchange rate mechanism operable over the European Economic and Monetary Union (EMU). Related to FDI and other economic activities, the topic is discussed in Goldberg and Kolstad (1995).

A special role of exchange rates applies to the new members of the European Union. Those countries still having (with the exception of the latest addition, Slovakia) their own currencies converge to introducing Euro in a horizon of five years approximately. Aiming for the earliest possible 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 which come along with investment from abroad. The impact of such a policy on the intensity of FDI inflow to EMU-candidate countries is studied in Brzozowski (2003), the author of which concludes that exchange rate volatility may negatively influence decisions to locate investment into these countries.

3. Model

The idea of a simple model of FDI depending on higher moments of exchange rates is adopted from inflation models which, in general, like FDI, can be influenced by a variety of different variables such as wages, capital costs, unemployment, supply or price shocks in various commodities (Assarsson, 2004) and co-integrated movements of changes in such variables (Adamca, Marček and Panciková, 2004). Ball and Mankiw (1995) study the short-run behaviour of inflation, and thus propose and test a new theory of supply shocks, i.e. changes in certain relative prices. They argue that large shocks have a disproportionately large impact on the price level in the short-run and changes in price level are positively related to the skewness of relative price changes. The reasoning is as follows: a symmetric distribution of relative price shocks means that relative price increases are balanced by other relative price decreases, which combination does not cause inflation. This is also the main argument in the well known article by M. Friedman (1974). However, a positively skewed distribution results from many small relative price decreases which cannot offset larger relative price increases and in this case inflation rises. By contrast, in the case of negative skewness large negative shocks outnumber the unusually large positive price shocks, hence inflation falls. The above reasoning together with three alternative ways of explaining the causality of relative price skewness in inflation are given in Assarsson and Riksbank (2002). Strong statistical evidence for such models is given in Ball and Mankiw (1995) by analyzing some well known historical episodes, e.g. the OPEC oil shocks.

As an analogy, Chakrabarti and Scholnick (2002) assume a positive skewness of exchange rate changes to be a cause of increases in FDI and find robust empirical evidence for it. They view this result as consistent with the hypothesis of investors' adjustment to small changes in exchange rates but different treatment of larger shocks when forming their expectations about future exchange rate levels. In this way large shocks lead to expectations of movements in the opposite direction in the future.

Chakrabarti and Scholnick (2002) first formulated a function of expected profit with current and expected exchange rates as its arguments. Incorporating some standard economic assumptions, and mathematically reformulated in Hušek and Pánková (2008), it is derived that the higher the current exchange rate is, the lower are (i) expected appreciation of a local currency, (ii) optimal scale of project, (iii) expected profit, and (iv) FDI inflow, and vice versa.

An econometric model is then proposed in Chakrabarti and Scholnick (2002) in the form

$$FDI_{it} = \beta_0 + \beta_1 D^{mn}_{i,t-1} + \beta_2 D^{sd}_{i,t-1} + \beta_3 D^{skw}_{i,t-1} + u_{it} \tag{3.1}$$

where $D^{mn}_{i,t-1}$, $D^{sd}_{i,t-1}$, $D^{skw}_{i,t-1}$ respectively are the mean, standard deviation and skewness of monthly exchange rate devaluations of the currency of country *i* in the year $(t-1)$. FDI_{it} refers to the flow of foreign direct investment into country

i in year t and β′s are parameters of the model. The error term u_{it} is assumed to be distributed i.i.d. $N(0,\sigma^2)$.

An application of the model to a small group of four and rather heterogenous countries (Czech Republic, Hungary, Thailand and the Philippines) in Hušek and Pánková (2008) gives rather uncertain results. We therefore decided to use a panel of more homogeneous countries (Czech Republic, Hungary, Poland and Slovak Republic) and more refined methods. We seek to validate the importance of exchange rate for FDI with the help of a more general model than that presented in (3.1).

A model of the Phillips curve from Assarsson and Riksbank (2002) respects the dynamics of the inflation process by comprising the lagged inflation variable. The effect of supply shocks is then expressed with the help of statistical moments of the exchange rate movements. A similar approach can be found in Gottschalk and Hall (2008), which gives an overview of recent research on FDI and exchange rate uncertainty.

The basic proposal underlying our model is defined in Cushman (1985), where a firm′s utility is a positive function of expected profit and a negative function of the variance of profit. This model has been used before, e.g. in Bénassy-Quéré, Fontagné and Lahrèche-Révil (2001), and Gottschalk and Hall (2008). Following this stream of literature we assume that changes in FDI flows into a location depend on the profitability of that location and the risks associated with it, represented by the moments of exchange rate movements. We also add to this model a GDP variable adopted from gravity models (e.g. Mariel, Orbe and y Rodríguez, 2009). Subsequently, the model we estimate is based on Gottschalk and Hall (2008) and defined as

$$FDI_{it} = \beta_0 + \beta_1 FDI_{i,t-1} + \beta_2 RR_{i,t-1} + \beta_3 GDP_{i,t-1} + \beta_4 D^{mn}_{i,t-1} + \beta_5 D^{sd}_{i,t-1} + \beta_6 D^{skw}_{i,t-1} + \mu_i + u_{it} \quad (3.2)$$

where FDI_{it} is the log of FDI flows into country i in time period t, RR_{it} is the real return reported by affiliates at location i in time period t, GDP_{it} is the gross national product of country i in time period t, variables D are defined in (3.1), μ_i is the individual effect and u_{it} is the error term. Following Gottschalk and Hall (2008) net income reported by affiliates (represented by gross net profit from local corporate taxes) in time period t divided by investment in the previous year is taken as a measure of the rate of return on investment. The expected signs of the first three coefficients are positive because (i) FDI inflows usually present high inertia, (ii) the real return reported by affiliates at the host country location is a direct incentive for higher future FDI and, (iii) positive GDP effect is considered to be the key effect in the vast majority of the FDI literature. Moreover, we expect a positive coefficient β_4 because it is consistent with the view that investing companies expect mean reversion in future exchange rates. The coefficient β_5 captures investors' attitude towards risk and therefore its expected sign is negative. The third moment represents the effect of relatively large exchange rate shocks predominantly in one direction (e.g. a few relatively large devaluations would lead to a positive value of skewness) and that is why the expected sign of β_6 is positive.

4. Dynamic Panel Data Models

Adding dynamics to panel data model, in both the fixed and random effects settings, raises questions about the autocorrelation of the error term and about handling the correlation of the lagged dependent variable with the disturbance. Let us assume a dynamic panel data model

$$y_{it} = \delta y_{it-1} + x'_{it}\beta + u_{it} \tag{4.1}$$
$$u_{it} = \mu_i + v_{it}\,,\ \ \mu_i \approx NID(0, \sigma^2)$$

in which x_{it} is a vector of *it* observations of *k* exogenous variables and μ_i, v_{it} follow the usual rules

$$E(\mu_i) = E(v_{it}) = E(\mu_i v_{it}) = 0, \quad E(v_{it}v_{is}) = 0, \quad i \neq t\,,\ i = 1, \ldots, N,\ t = 2, \ldots, T$$

Lagged variable *y* will be correlated by construction with the effects μ and with lagged *v*, but it may also be correlated with contemporaneous *v* if *v* is serially correlated, which happens quite often in empirical applications. Thus, lagged *y* is effectively an endogenous explanatory variable in equation (4.1) with respect to both μ and *v*.

Lagged dependent variables are introduced into panel data model to account for dynamic effects and can obviously be introduced to either fixed or random effects models. But, as stated above, even if one assumes no autocorrelation of the error term, problems from the correlation of the lagged *y* and the error term cause problems with classical estimation methods. Especially when the sample is finite or small the bias of these methods can be large. That is why general methods of moments (with instrumental variables), the use of the proxy variables or instruments are usually applied here.

The dynamic panel data model defined in (4.1) is usually estimated by an instrumental variables technique. However, to remove the group effects, the classical techniques of de-meaning are not very helpful here. The trouble is that $\overline{y}_{it-1} = y_{it-1} - \overline{y}_i$ will be correlated with $\overline{u}_{it} - u_{it} - \overline{u}_i = u_{it} - \mu_i$ via the group mean $\overline{y}_i$. To produce consistent estimates of $(\delta, \beta)'$ we take the first differences of (4.1):

$$\Delta y_{it} = \delta \Delta y_{it-1} + \Delta x'_{it} \beta + \Delta v_{it} \tag{4.2}$$

As v_{it-1} can influence both Δv_{it} and Δy_{it-1}, the IV technique is needed to get consistent estimations. The method of Arellano and Bond (1991) improves an estimator proposed by Anderson and Hsiao (see e.g. Cottrell and Luchetti, 2008). The idea of Arellano and Bond (1991) is to use (4.2) as a system

$$\Delta y_{i3} = \delta \Delta y_{i2} + \Delta x'_{i3} \beta + \Delta v_{i3} \tag{4.3}$$

$$\Delta y_{i4} = \delta \Delta y_{i3} + \Delta x'_{i4} \beta + \Delta v_{i4} \tag{4.4}$$

$$\vdots$$

$$\Delta y_{iT} = \delta \Delta y_{iT-1} + \Delta x'_{iT} \beta + \Delta v_{iT} \tag{4.5}$$

For Δy_{i2} in (4.3) only one instrument y_{i1} is used. In (4.4) both y_{i1} and y_{i2} are instruments for Δy_{i3}. Following this reasoning, in period T, there are $T - 2$ instruments available. So the Arellano – Bond technique estimates the system (4.3) – (4.5) with an increasing number of instruments, according to T, which offers not just consistency but also higher efficiency than the Anderson-Hsiao algorithm. A comprehensive description of different methods of estimating dynamic panel data models and their historical evolution is given in Lai, Small and Liu (2008). Hsiao (2007) himself has recently published an overview of panel data analysis in which he also treats dynamic models.

The most commonly used methods for detecting serial correlations of the error term in a dynamic panel data model are the m_2 statistic and Sargan tests (see Arellano and Bond, 1991) nevertheless, poor performance of these two tests in the presence of AR(1) disturbances is shown in Jung (2005).

A serial correlation of u_{it} cannot be tested directly with the help of

$$\widehat{u}_{it} = \rho \widehat{u}_{it-1} + \varepsilon_t \tag{4.6}$$

because the specific effects μ_i are included in residuals $\widehat{u}_{it}$. Jung (2005) suggests starting with the first differenced disturbances in levels

$$\Delta u_{it} = u_{it} - u_{it-1} = v_{it} - v_{it-1} = \Delta v_{it}$$

and applying a t-test with $H_0 : \rho = 0$ instead of (4.6) to

$$\Delta v_{it} = \rho \Delta v_{it-1} + \Delta \varepsilon_{it} \tag{4.7}$$

where ε_{it} is independent and homoskedastic with respect to i and t. The test of significance of ρ in (4.7) is then an autocorrelation test for the classical error term in (4.1).

A more general approach for testing autocorrelation is proposed by Arrelano and Bond (1991). An estimator that uses lags as instruments such as that by Arellano and Bond based on the system (4.3) – (4.5) would lose its consistency if the errors were serially correlated. It is then necessary to apply an appropriate test for serial correlation after the estimation to confirm the validity of instruments used. Arellano and Bond (1991) propose a direct test on the second-order residual serial correlation coefficient; however, a Sargan test of over-identifying restrictions or a Hausman specification test can also be used here. The definitions of these tests are different nevertheless they are asymptotically equivalent.

5. Application

We use the data of four central European countries with a relatively short market economy history (Czech Republic, Hungary, Poland and Slovak Republic). The mean values of the variables used in our estimations corresponding to these four countries for the period from 1998 to 2004 are listed in Table 1. The data on inward FDI flows (mn USD), gross national product (bn USD), gross net profit from local corporate taxes (mn USD) and exchange rates of local currency to the USD were collected from the International Monetary Fund´s International Financial Statistics. The last three columns stand for the variables $D^{mn}_{i,t-1}$, $D^{sd}_{i,t-1}$, $D^{skw}_{i,t-1}$ from equation (3.1) which are mean, standard deviation and skewness of monthly exchange rate devaluations defined as $log(\frac{e_t}{e_{t-1}})$, where e_t is the exchange rate in month *t*.

T a b l e 1
Mean Values

	FDI	**Corporate taxes**	**GDP**	**Mean**	**St. deviation**	**Skewness**
Czech Republic	5 103.39	3 065.38	72.64	–0.00045	0.02828	–0.06119
Hungary	3 239.88	1 425.82	63.29	0.00329	0.02143	–0.31367
Poland	32 866.97	85 860.97	125.66	–0.00359	0.02446	–0.26066
Slovak Republic	1 561.48	732.80	25.97	0.00074	0.02250	–0.34889

Source: International Monetary Fund´s International Financial Statistics.

Table 2 presents estimations of the dynamic model (3.2) and the simple model based only on statistical moments of exchange rate changes (3.1). Foreign Direct Investment, rate of return and GDP variables are included in natural logarithms. The dynamic model (3.2) is estimated by the Arellano and Bond (1991) instrumental variable estimator (4.3) – (4.5) and the simple moments model is treated as a fixed effect model estimated by weighted least squares.

The limitation of the simple model is immediately apparent. Note that there is no significant variable at 5% significance level in the last three columns of Table 2. The inclusion of only three explanatory variables leads to a very parsimonious model, but there is a serious danger of omitting relevant variables and dynamics usually inherent in the FDI variable. It is well known that such an omission can cause inconsistency of weighted least squares estimator.

T a b l e 2

Panel Data Model Estimation

Variable	Dynamic Model			Simple Moments Model		
	Coefficient	Standard error	p-value	Coefficient	Standard error	p-value
FDI(–1)	–0.018	0.042	0.677			
RR(–1)	0.357	0.192	0.063			
GDP(–1)	4.613	0.479	< 0.001			
Mean	15.133	7.463	0.043	2.388	9.999	0.813
St. error	–37.142	9.213	< 0.001	23.834	17.109	0.176
Skewness	–0.752	0.152	< 0.001	–0.145	0.211	0.499

Notes: *RSS = 4.248 Num. Obs. = 16* *RSS = 21.582*
AR(1): p-value = 0.168 *Num. Obs. = 28*
AR(2): p-value = 0.222

Source: Own calculations.

Adding dynamics to the model through a lagged endogenous variable and two more variables (rate of return and GDP) improves the fit of the model significantly as indicated by residual sum of squares (RSS). The first order correlation in the error term does not affect the consistency of the Arellano and Bond estimator, but the second order autocorrelation does. However, *p*-values of the Arellano and Bond (1991) test statistic of residual serial correlation presented in the last line of Table 2 show absence of first and second order autocorrelation in both samples.

Five of the six variables included in the dynamic model are now significant at the 10% level. The rate of return and GDP variables are significant and positive signs are to be expected. The lagged FDI variable is neither significant at a 5% nor a 10% level indicating small inertia of the FDI flows to the analyzed countries. This is a reasonable result, taking into account the short history of these market economies with the additional problem of rapidly changing laws which can affect FDI.

The remaining three coefficients related to the variables based on exchange rate are significant at 5%. The Mean and Standard Error variables have expected signs confirming the above-stated theory. The last coefficient variable based on the third moment of exchange rate presents an unexpected negative sign. This would indicate that the hypothesis of investors' different treatment of larger and smaller shocks of exchange rate is not applicable in this case of central European economies.

However, taking into account these estimations, two conclusions can be drawn. Firstly, exchange rate devaluations have a clear impact on FDI and therefore comprise an important variable which must be considered in any FDI analysis. Secondly, the use of a simple, parsimonious model for FDI can lead to misleading results

Conclusions

The analysis of these four central European countries with short market economy histories shows results which basically confirm the theory proposed. For these countries the time period analysed was one of important economic and social changes characteristic for young democracies. Furthermore their expected and subsequently achieved accession to the EU could have played an important role in the decisions of investors. Moreover, reliable macroeconomic variable data on central European countries are available only for a relatively short period of time which causes the data sample to be rather limited. In spite of that the estimated model confirms the validity of the exchange rate as an important determinant of FDI flows.

Our results are in line with Klein and Rosengren (1994) and Blonigen (1997), confirming that exchange rate depreciations matter for FDI and therefore our results reverse the argument that an appreciation of a firm´s home country´s currency would lower the cost of assets abroad but also the expected nominal return. Our conclusions show that this argument is only one of many to take into account when analyzing exchange rate effects and aspects, for example, the type of FDI and time horizon must be also considered. Last but not least, the contribution of this paper to the FDI literature is that the effect of exchange rate has been tested predominantly with US FDI data and our sample is based on young European market economies.

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