Does monetary integration affect FDI between EU Member States?

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Abstract

My paper contributes to the discussion about the influence of monetary integration on international flows between EU Member States. A fundamental goal of my paper is to check whether monetary integration affects FDI flows and stocks between EU Member States. As analytical tools I use gravity models of foreign direct investments.

In models I include standard variables such as: gross domestic products (total and per capita) of home and host economy and distance between them. Additionally, my model encompasses variables illustrating monetary issues such as: exchange rate volatility, establishing and existence of euro zone. On one hand, my gravity models include time invariant variables, so the models with fixed effects are not proper. On the other hand, as individual effects might be correlated with some independent variables, models with random effects can be also not adequate. Consequently, I use Hausman-Taylor estimator. FDI gravity models are based on statistics concerning two last decades and coming from OECD, WDI and IMF databases.

According to the estimation results, the influence of establishing and existence of euro zone on intra EU–27 FDI flows and stocks appears to be neutral or slightly in favour for states which adopted common currency. But even if monetary integration has positive impact on bilateral FDI flows and stocks between EU Member States, it is probably not due to reduction of exchange rate volatility. I prove that exchange rate volatility does not affect bilateral FDI flows and stocks between EU Member States.

Keywords: FDI, gravity models, monetary integration

JEL codes: F21, F15
1. Introduction

My paper contributes to the discussion about the influence of monetary integration on international flows of goods, services and production factors between EU Member States. A fundamental goal of my paper is to check whether monetary integration affects FDI flows and stocks between EU Member States. As analytical tools I use gravity models of foreign direct investments based on flows as well as on stocks.

In models I include standard variables such as: gross domestic products (total and per capita) of home and host economy and distance between them. Additionally, my model encompasses variables illustrating monetary issues such as: exchange rate volatility, establishing and existence of the common European currency. FDI gravity models are based on statistics concerning two last decades and coming from OECD, WDI and IMF databases. Apart from empirical study based on gravity models, my paper includes summary of theoretical framework of interdependence between exchange rate volatility and FDI, but also presentation of statistics concerning the role of intra EU and intra euro zone direct investments in global FDI.

2. Exchange rate, monetary integration and foreign direct investments

One of the many influences on FDI activity is the behaviour of exchange rates. Exchange rates matter both in terms of their levels and their volatility. Level of exchange rate affects relations between domestic and foreign production costs, especially affects relative wages. By this “relative wages” (or “relative costs”) channel exchange rate depreciation or appreciation determines the rate of return from FDI [Goldberg 2006].

Moreover, exchange rate volatility generates air of uncertainty as the variance of expected profits from FDI rises and its net present values falls. This can discourage investors to commit significant resources to FDI. Contrary to the risk aversion arguments, there are production flexibility arguments. According to them, FDI will be higher when exchange rate volatility is higher. This regularity concerns long-run production and issues such as: sunk costs in capacity (the extent of FDI irreversibility) and competitive structure of industry. By the production flexibility arguments, more volatility is associated with more FDI ex ante, and more potential for excess capacity and production shifting ex post, after exchange rates are observed. Critics of production flexibility arguments underline the appropriateness of risk-
aversion approach in the short-run with no possibility of adjusting the production factors after the exchange rates are observed [Goldberg 2006].

One of the fundamental benefit of establishing monetary union is the elimination of exchange rate volatility among the currencies of participating countries. According to the risk-aversion approach, monetary union intensifies bilateral FDI between participating countries. Additionally, due to more rapid economic and financial integration of participating nations, abilities to conduct a more expansionary monetary policy by common central bank, the supply of money in the monetary union is raised. Consequently, costs of borrowing money are reduced which also accelerate domestic as well as foreign investments. On the contrary, in the monetary union all financial and economic turbulences arise more rapid what can be significant for FDI which are heavily vulnerable to negative economic performance [Salvatore 2004, p. 713].

3. FDI gravity models and monetary integration

Gravity models appear as an adaptation of the law of universal gravitation\(^1\) for socioeconomic phenomena. In 1960s gravity models were applied to analyzing international trade flows. Pioneers in these studies were: Linemann [1966], Pöyhönen [1963], Pullainen [1963] and Tinbergen [1962]. They were conducting independent and simultaneous studies which brought similar results. However the most known is Tinbergen’s study. Author himself was announced as a discoverer of gravity law (gravity equation) in international economics. Since Tinbergen’s study, the gravity equation has been one of the most popular empirical equations that have been successfully used to analyze the wide spectrum of interactions in international economics. The gravity equation postulates that the amount of flow between two locations increases in their economic sizes and decreases in the cost of transportation between them as measured by the distance between economic centres of locations.

Gravity models have become one of the most popular and successful analytical tool in international economics, especially due to its high explanatory power and easily available data in studies concerning international trade of goods. However, recently gravity models have become popular also in explaining bilateral flows and stocks of capital, especially in

\(^1\)In 1687, Newton proposed the law of universal gravitation which states that every point mass in the universe attracts every other point mass with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.
explaining determinants of foreign direct investments. Therefore, there are also a few studies concerning theoretical foundations of FDI gravity models.

For example, Bergstrand and Egger [2007] recalls gravity equation based on global GDP, economic size of countries and their similarity (see equation (A)).

\[
(A) \quad \text{Flow}_{ij} = \frac{GDP_i GDP_j}{GDP_{ij}^{W}} = \frac{(GDP_i + GDP_j)^2 \cdot (s_i s_j)}{GDP_i^{W}},
\]

where:
\( \text{Flow} \) – flow of direct capital between countries \( i \) and \( j \),
\( GDP \) – Gross Domestic Product,
\( s_i = \frac{GDP_i}{GDP_i + GDP_j} \) and analogously for \( j \),
\( i, j, t \) – subscripts for countries and year.

When countries \( i \) and \( j \) are identical (\( s_i = s_j = 0.5 \)), \( s_i s_j \) is at maximum. In log-linear form, (A) is:

\[
(B) \quad \ln \text{Flow}_{ij} = -\ln(GDP_i^{W}) + 2\ln(GDP_i + GDP_j) + \ln(s_i s_j)
\]

On one hand, monetary integration causes faster economic growth and countries participating in monetary union become more similar to each other (nominal and real convergence). Consequently, when \( GDP_i \), \( GDP_j \) and \( s_i s_j \) rise, bilateral flow of direct capital between countries \( i \) and \( j \) also will increase. On the other hand, in the monetary union all financial and economic turbulences arise more rapid. During economic crisis, the pace of GDP growth in the monetary union can be slower than global average. This will diminish bilateral flow of direct capital when global \( GDP_i^{W} \) increases faster than \( GDP_i \) and \( GDP_j \).

Moreover, Head and Ries [2007] develop a control-based model of FDI. They use discrete choice theory to solve for the expected amount of corporate assets in one country that will be controlled by a management team based in another country. This yields an expression for expected bilateral FDI stocks (see equation (C)).
\[ E[F_{in}] = \exp[\frac{\mu_i}{\sigma} - D_{in}\theta] s^m_i K_n B_n^{-1}, \]

where:

- \( F_{in} \) – FDI stocks stored in country \( n \) coming from country \( i \),
- \( K_n \) – asset value of the entire stock of targets in the host country (proximate measure of the role of host country as FDI recipient in the world economy),
- \( B_n \) – proximate measure of the strength of competition for targets in the host country,
- \( s^m_i \) – proximate measure of the share of the home country GDP in the world GDP (the role of home country as investor in the world economy),
- \( D_{in} \) – proximate measure of geographic and cultural distance between home and host country,
- \( \alpha \) – proximate measure how distance impedes FDI,
- \( \mu, \sigma \) – parameters of Gumbel’s cumulative density,
- \( i, n \) – subscripts for home country and host country.

This expression resembles the gravity equation in that expected bilateral stocks are increasing in the product of origin and destination size variables (\( s^m_i \) and \( K_n \)) and decreasing in measures of bilateral distance. Higher competition (\( B_n \)) in \( n \) implies that a higher fraction of assets in \( n \) will be taken by rivals from other countries, thereby reducing the expected bilateral stocks of headquarters from country \( i \). In log-linear form, (C) is:

\[ E[F_{in}] = \exp(\frac{\mu_i}{\sigma} + \ln s^m_i + \ln K_n - \ln B_n - D_{in}\theta) = \exp(\ln O_i + \ln I_n - D_{in}\theta), \]

where:

- \( O_i = \frac{\mu_i}{\sigma} + \ln s^m_i \) is the outward direct investment effect for origin \( i \),
- \( I_n = \ln K_n - \ln B_n \) is the inward direct investment effect for destination \( n \).

In monetary union, due to reduction of transaction costs and exchange rate volatility as well as due to economic convergence, geographic and culture distance matters less. In consequence, parameter \( \theta \) decreases and \( E[F_{in}] \) increases. Additionally, thanks to integration and faster economic growth, outward direct effect for origin \( i \) becomes stronger (\( s^m_i \uparrow \)). However, the impact of monetary integration on inward direct investment effect for destination \( n \) is ambiguous (\( K_n \) increases due to integration and faster development but more fierce competition makes simultaneously \( B_n \) higher).
4. Euro zone in global and intra European Union FDI flows and stocks

Euro zone\(^2\) plays important role as a host region in the world economy. During 1999–2010 it allured yearly around 27.5% of global FDI inflows (the highest share of euro zone in word FDI inflows was 39.5% (2003) and the lowest 17.5% (2004) – see figure 1). Analogical share of euro zone in FDI inflows to developed economies is about 42.5% and in FDI inflows to the EU–27 about 68%. Just after establishing euro zone, the share of euro zone in FDI inflows to the EU–27 was increasing (from 62.5% in 1999 to even 84.5% in 2003). But during next years it fell to level less than 60% and since 2007 it has been again growing (from 64% in 2007 to even 79.5% in 2010).

Figure 1. FDI inflows to developed economies, EU–27 and euro zone during 1999–2010, million USD

![Figure 1](http://unctadstat.unctad.org)

Source: Own study based on UNCTAD, [http://unctadstat.unctad.org](http://unctadstat.unctad.org), [access: July 2012]

Figure 2. FDI inward stocks in developed economies, EU–27 and euro zone during 1999–2010, million USD

![Figure 2](http://unctadstat.unctad.org)

Source: Own study based on UNCTAD, [http://unctadstat.unctad.org](http://unctadstat.unctad.org), [access: July 2012]

The position of euro zone in FDI inward stocks is similar: twelve-year average share in global FDI inward stocks is around 27%, in stocks accumulated in developed economies about 37% and in EU–27 stocks about 70% (see figure 2). The share of euro zone in FDI stocks stored in the EU–27 has been more stable than analogical share in FDI inflows. Since 1999 it has been fluctuating around 70% (the highest – almost 73% in 2004, the lowest – 67.5% in 2006).

Figure 3. FDI outflows from developed economies, EU–27 and euro zone during 1999–2010, million USD

Source: Own study based on UNCTAD, http://unctadstat.unctad.org, [access: July 2012]

Figure 4. FDI outward stocks from developed economies, EU–27 and euro zone during 1999–2010, million USD

Source: Own study based on UNCTAD, http://unctadstat.unctad.org, [access: July 2012]

Euro zone is also significant home region of FDI flows and stocks. During 1999–2010, yearly, about 38% global FDI outflows came from euro zone (see figure 3). Analogical share of euro zone in FDI outflows coming from developed economies is around 45.5%. Moreover, majority of FDI outflows originating from EU–27 Member States comes from euro zone.
Twelve-year average is about 74.5% (the highest share was in 2001 – almost 81.5% and the lowest in 2000 about 62.5%).

In the case of FDI outward stocks position of euro zone is also strong. Namely, twelve-year average share in global FDI outward stocks is almost 33% and in stocks originating from developed economies almost 53% (see figure 4). Since 2007 the share of euro zone in FDI outward coming from the EU–27 has been growing (almost 75.5% in 2010) as at the beginning of decade used to oscillate around 70%.

After analysing the investment position of euro zone in global FDI, it is worth to scrutinize the position of euro zone in intra EU–27 flows and stocks of direct capital. I divide all bilateral flows and stocks between EU–27 Member States into three groups:

- intra euro zone flows and stocks (both host and home state use euro as legal tender) – denoted as **intra euro zone** in figures,
- extra euro zone flows and stocks (both host and home state do not use euro as legal tender) – denoted as extra euro zone in figures,
- other flows and stocks (only host or home state uses euro as legal tender) – denoted in figures as intra-extra or extra-intra (in the case of inflows or inward stocks the first denotation concern host state, but in the case of outflows and outward stocks the first denotation refers to home state).

The average share of intra euro zone FDI inflows in intra EU–27 FDI inflows, during 1999–2010, is around 59.5% (see figures 5a and 5b). Just after establishing euro zone it rose from 38% in 1999 to 56.5% in 2001. During 2002–2007 it oscillated around 50% and since 2008 it has been growing (almost 69% in 2008 and 82.5% in 2010). Additionally, during 1999–2010 the one-year average change in intra euro zone FDI inflows was almost 19.5% – higher than analogical change rate for extra euro zone and other FDI inflows (12.5%).

Figure 6a and 6b. Intra EU–27 FDI inward stocks during 1999–2010 (million USD)

Source: Own study based on OECD database, http://stats.oecd.org, [access: July 2012]
In the case of FDI inward stocks the dominance of intra euro zone stocks in total intra EU–27 stocks is slightly weaker – twelve-year average share is around 54% (see figures 6a and 6b). Therefore, this share during 1999–2010 was quite unstable (the highest value – 63.5% in 2009 and the lowest – 36.5% in 2003) and there is lack of even a few-year trend. Again during 1999–2010 the one-year average change in intra euro zone FDI inward stocks was around 26.5% – much higher than analogical rate for extra euro zone and other FDI stocks (14%).

**Figure 7a and 7b. Intra EU–27 FDI outflows during 1999–2010 (million USD)**

The average share of intra euro zone FDI outflows in intra EU–27 FDI outflows, during 1999–2010, is around 61% (the highest share in 2010 – 110.5%\(^3\) and the lowest in 2000 – 26%; see figures 7a and 7b). Additionally, during 1999–2010 the one-year average

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3 Extra euro zone and other outflows were negative.
change in intra euro zone FDI outflows was almost 19.5% – again higher than analogical rate for extra euro zone and other FDI outflows (13%).

Figure 8a and 8b. Intra EU–27 FDI outward stocks during 1999–2010 (million USD)

In the case of FDI inward stocks there is no dominance of intra euro zone stocks in total intra EU–27 stocks—twelve-year average share is around 46.5% (see figures 8a and 8b). Therefore, this share during 1999–2010 was quite unstable (the highest value – 58% in 2008 and the lowest – 22.5% in 2003). Again during 1999–2010 the one-year average change in intra euro zone FDI outward stocks was around 32% – much higher than analogical rate for extra euro zone and other FDI outward stocks (13%).

To sum up, according statistics presented in figures 5–8, the influence of establishing and existence of euro zone on intra EU–27 FDI flows and stocks appears to be neutral or slightly in favour for states which adopted common currency. There is no noticeable increase
of the share of intra euro zone flows and stocks of direct capital in total intra EU–27 FDI flows and stocks. The investment position of euro zone seems to be rather stable. Additionally, intra euro zone flows and stocks of direct capital are characterized by higher average change (per year) than extra euro zone and other intra EU–27 FDI flows and stocks. In next section, using gravity models I continue considerations concerning the influence of monetary integration on intra EU–27 FDI flows and stocks.

5. The influence of monetary integration on bilateral FDI flows and stocks: gravity models for the European Union

In my studies, I use gravity models of bilateral direct investments flows and stocks between EU–27 Member States. The sample covers the period 1995–2010. Gravity models are estimated in terms of natural logarithms (ln) – see equation (1).

\[
\ln FDI_{ijt} = \alpha_0 + \alpha_1 \ln GDP_i + \alpha_2 \ln GDP_j + \alpha_3 \ln D_{ij} + \xi Z_{ijt} + c_{ij} + \eta_{ijt}
\]

where notation is defined as follows:

\(i, j, t\) – indexes respectively for: states (in the case of inflows and inward stocks: \(i\) – host economy, \(j\) – home economy; in the case of outflows and outward stocks: \(i\) – home economy, \(j\) – host economy) and year,

\(FDI_{ijt}\) – bilateral FDI flow or stock between states \(i\) and \(j\) in year \(t\),

\(GDP_{i(j)t}\) – Gross Domestic Product of state \(i (j)\) in year \(t\),

\(D_{ij}\) – geographic distance between economic centres of states \(i\) and \(j\) (constant for EU Member States during 1995–2010),

\(Z_{ijt}\) – vector of other variables which determines bilateral FDI flows and stocks;

\(c_{ij}\) – individual state-pair specific effect,

\(\eta_{ijt}\) – error term.

The usage of logarithms generates problems with zero and negative FDI flows and stocks. I take into consideration four possible solutions (more solutions see Gomez-Herrera [2011]):

(1) elimination of zero and negative FDI flows and stocks,

(2) two-stage estimation (Heckman model),

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4 More studies concerning FDI gravity models see Baldwin [2008].
(3) to use absolute value of dependent variables,
(4) to use ln(FDI+k), where k guarantees that FDI+k is positive value.

Firstly, elimination of zero and negative FDI flows and stocks may lead to falsifying the results of empirical studies (zero flows and disinvestments account for 10–20% of all observations). Secondly, two-stage estimation is complicated procedure, needs additional assumptions and is more effective in the case of the large number of zero flows (stocks) – for example trade flows. In the case of FDI flows and stocks, the major problem concerns disinvestments, not zero observations. Thirdly, using absolute value of dependent variable distort basic equation of gravity model\(^5\). Consequently, I apply fourth solution, which is quite simple and save logarithms as well as zero and negative FDI flows and stocks.

In my studies concerning the EU, additional variables in specification encompass variables linked with European monetary integration and exchange rate volatility – see equation (2).

\[
\ln FDI_{ijt} = \alpha_0 + \alpha_1 \ln GDP_{it} + \alpha_2 \ln GDP_{jt} + \alpha_3 \ln D_{ijt} + \xi_1 \ln |gdp_{it} - gdp_{jt}| + \xi_2 EU_{ijt} + \xi_3 EZ_{ijt} + \\
\xi_4 Duration_{ijt} + \xi_5 Volatility_{ijt} + c_{ijt} + \eta_{ijt}
\]

where notation is defined as follows:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDI</td>
<td>Foreign direct investments flows or stocks (current prices, USD)</td>
<td>OECD, <a href="http://stats.oecd.org">http://stats.oecd.org</a>, [access: July 2012]</td>
</tr>
<tr>
<td>D</td>
<td>Geographic distance between capitals (km)</td>
<td>CEPII, <a href="http://cepii.fr">http://cepii.fr</a> [access: July 2012]</td>
</tr>
<tr>
<td>EU</td>
<td>Dummy variable: 1 if both states belong to the EU and 0 otherwise</td>
<td>-</td>
</tr>
<tr>
<td>EZ</td>
<td>Dummy variable: 1 if both states use euro as legal tender and 0 otherwise</td>
<td>-</td>
</tr>
<tr>
<td>Duration</td>
<td>min (duration of membership in euro zone of state i; duration of membership in euro zone of state j)</td>
<td>-</td>
</tr>
</tbody>
</table>

\(^5\) \[ X_{ij} = \alpha_0 + \beta_1 Y_i + \beta_2 Y_j - \beta_3 D_{ij} + c \] stems from equation: 
\[
X_{ij} = C \frac{Y_i^*Y_j^*}{D_{ij}^*}
\]
Including in specification state-pair effect \( (c_{ij}) \) suggests application one of the typical panel data based estimators, namely fixed or random effects approach. However, the fixed effects approach is not adequate for models including time invariant variables – for example distance, which is one of the fundamental variable. On the contrary, random effects approach is available also for models with time invariant variables. Additionally, this approach needs zero correlation between the individual effects and the independent variables in the model. Unfortunately, in specification illustrated by equation (2) this assumption probably does not hold. Models encompass independent variables such as: \( EU_{ijt}, EZ_{ijt}, Duration_{ijt} \) and \( \ln|gdppc_{it} - gdppc_{jt}| \) which characterize the pair of states. These variables are potentially correlated with individual effect, consequently approach based on random effects can be also not proper. In this situation there is still one solution to be applied – Hausman-Taylor estimation method. It allows using of both time-varying and time invariant variables and some of them can be endogenous in the sense of correlation with individual effect, but remain exogenous with respect to error term [Czarny et al. 2010, pp. 10–12].

Consequently, firstly I estimate gravity models using Hausman-Taylor method (endogenous variables: \( EU_{ijt}, EZ_{ijt}, Duration_{ijt} \) and \( \ln|gdppc_{it} - gdppc_{jt}| \), as it is, I believe, the most appropriate method in this case. Secondly, I also use random effects approach as the most basic and simple (but probably worse than H-T method) which allows to use time invariant variables.

### Table 1. Estimations results of FDI gravity models

<table>
<thead>
<tr>
<th>Dependent variable: FDI inflow</th>
<th>Dependent variable: FDI outflow</th>
<th>Dependent variable: FDI inward stock</th>
<th>Dependent variable: FDI outward stock</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H-T</strong></td>
<td><strong>Random effects</strong></td>
<td><strong>H-T</strong></td>
<td><strong>Random effects</strong></td>
</tr>
<tr>
<td>( \ln GDP_{it} )</td>
<td>0.0019</td>
<td>0.0029 ***</td>
<td>0.0070</td>
</tr>
<tr>
<td>( \ln GDP_{jt} )</td>
<td>0.0024 **</td>
<td>0.0030 ***</td>
<td>0.0026</td>
</tr>
<tr>
<td>( \ln D_{ij} )</td>
<td>-0.1976 ***</td>
<td>-0.1785 ***</td>
<td>-0.0057</td>
</tr>
<tr>
<td>( \ln [gdppc_{it} - gdppc_{jt}] )</td>
<td>-0.0006</td>
<td>0.0001</td>
<td>-0.0043</td>
</tr>
<tr>
<td>( EU_{ij} )</td>
<td>-0.0013</td>
<td>0.0006</td>
<td>-0.0019</td>
</tr>
<tr>
<td>( EZ_{ij} )</td>
<td>0.0070 **</td>
<td>0.0072 **</td>
<td>0.0166</td>
</tr>
<tr>
<td>( Duration_{ij} )</td>
<td>0.00003</td>
<td>0.0003</td>
<td>-0.0011</td>
</tr>
<tr>
<td>( Volatility_{ij} )</td>
<td>-0.0012</td>
<td>-0.0013</td>
<td>-0.0004</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>24.8517 ***</td>
<td>24.4305 ***</td>
<td>24.3271 ***</td>
</tr>
<tr>
<td><strong>Number of state-pairs</strong></td>
<td>513</td>
<td>513</td>
<td>511</td>
</tr>
<tr>
<td><strong>Number of observations</strong></td>
<td>5417</td>
<td>5417</td>
<td>5493</td>
</tr>
</tbody>
</table>

***p<0.01, **p<0.05, *p<0.1

Source: Own study based on estimations conducted in STATA
The positive values of the coefficients on the GDP of both host and home economy show that bilateral FDI flows and stocks are bigger between larger economies (see table 1). Therefore, the value of coefficients on the GDP of home economy is higher than value on the GDP of host economy. It suggests the stronger magnitude of home economy in bilateral FDI flows and stocks. As expected distance has negative impact on bilateral FDI flows and stocks. The impact of difference in GDP per capita should be negative and should prove that between similar economies FDI flows are more intensive. However, as the majority of coefficients are negative, the variable \( \ln|gdppc_{it} - gdppc_{jt}| \) is not statistically significant.

According to the estimation results (see table 1) the impact of monetary integration on bilateral FDI stocks and flows is ambiguous. In five out of eight gravity models dummy variable illustrating euro zone is not statistically significant. Therefore, in two cases it is statistically significant with positive coefficients and in one case with negative coefficient. Additionally, in all four models explaining bilateral stocks the variable Duration \(_{ijt}\) is statistically significant and coefficients suggest positive impact of monetary integration on bilateral FDI stocks between EU Member States. To sum up, the influence of establishing and existence of euro zone on intra EU–27 FDI flows and stocks appears to be neutral or slightly in favour for states which adopted common currency.

(3)

\[
\ln FDI_{ijt} = \alpha_0 + \alpha_1 \ln GDP_{it} + \alpha_2 \ln GDP_{jt} + \alpha_3 \ln D_{ij} + \xi_i \ln Volatility_{ijt} + c_{ij} + \eta_{ijt}
\]

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<td>D</td>
<td>Geographic distance between capitals (km)</td>
<td>CEPII, <a href="http://cepii.fr">http://cepii.fr</a> [access: July 2012]</td>
</tr>
<tr>
<td>Volatility</td>
<td>Exchange rate volatility measured as a standard deviation of first differences of natural logarithms of bilateral exchange rates (based on monthly average exchange rates in SDR or monthly average of nominal effective exchange rates)</td>
<td>IFS, International Monetary Fund, <a href="http://elibrary-data.imf.org/">http://elibrary-data.imf.org/</a>, [access: July 2012]</td>
</tr>
</tbody>
</table>

Monetary integration is strictly linked with reduction (ERM II) or elimination (euro zone) of exchange rate volatility. However, in all gravity models the variable illustrating volatility is not statistically significant. In order to scrutinize these quite surprising estimation
results, I construct additional gravity models. They include only four independent variables: GDPs and distance, and exchange rate volatility based on SDR rate exchanges as well as on nominal effective exchange rates (see equation (3)). I use the simplest approach with random effects.

Table 2a and 2b. Estimations results of FDI gravity models

equation (3), coefficients and significance

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Random effects</th>
<th>Random effects</th>
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</tr>
</thead>
<tbody>
<tr>
<td>ln GDP$_i$</td>
<td>0.0034 ***</td>
<td>0.0096 ***</td>
<td>0.2288 ***</td>
<td>0.0891 ***</td>
</tr>
<tr>
<td>ln GDP$_j$</td>
<td>0.0038 ***</td>
<td>0.0046 ***</td>
<td>0.1301 ***</td>
<td>0.0523 ***</td>
</tr>
<tr>
<td>ln D$_{ij}$</td>
<td>-0.0176 ***</td>
<td>-0.0056 ***</td>
<td>-0.3347 ***</td>
<td>-0.1567 ***</td>
</tr>
<tr>
<td>Volatility$_{ij}$ (SDR)</td>
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<td>0.0005</td>
<td>0.0012</td>
<td>-0.0002</td>
</tr>
<tr>
<td>Constant</td>
<td>24.7544 ***</td>
<td>24.2717 ***</td>
<td>15.9007 ***</td>
<td>21.8740 ***</td>
</tr>
<tr>
<td>Number of state-pairs</td>
<td>513</td>
<td>511</td>
<td>514</td>
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<tr>
<td>Number of observations</td>
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<td>5109</td>
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</table>

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Random effects</th>
<th>Random effects</th>
<th>Random effects</th>
<th>Random effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln GDP$_i$</td>
<td>0.0031 ***</td>
<td>0.0114 ***</td>
<td>0.2705 ***</td>
<td>0.1047 ***</td>
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<tr>
<td>ln GDP$_j$</td>
<td>0.0036 ***</td>
<td>0.0044 ***</td>
<td>0.1414 ***</td>
<td>0.0601 ***</td>
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<tr>
<td>ln D$_{ij}$</td>
<td>-0.0207 ***</td>
<td>-0.0050 ***</td>
<td>-0.4094 ***</td>
<td>-0.1932 ***</td>
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<tr>
<td>Volatility$_{ij}$ (NEER)</td>
<td>-0.0170</td>
<td>-0.0172</td>
<td>0.0833</td>
<td>0.0259</td>
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<tr>
<td>Constant</td>
<td>24.7910 ***</td>
<td>24.2224 ***</td>
<td>15.9102 ***</td>
<td>21.3104 ***</td>
</tr>
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<td>Number of state-pairs</td>
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<tr>
<td>Number of observations</td>
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<td>4895</td>
<td>4516</td>
<td>4664</td>
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</table>

***p<0.01, ** p<0.05, * p<0.1

Source: Own study based on estimations conducted in STATA

In all estimated gravity models all standard variables are statistically significant and coefficients have expected signs (positive by GDPs and negative by distance – see tables 2a and 2b). And also in all models exchange rate volatility, based on SDR exchange rates as well as based on nominal effective exchange rates, is not statistically significant. These results suggest that in the case of bilateral FDI flows and stocks between EU Member States the regularity „reduction of exchange rate volatility intensifies international flows of trade and capital” does not hold. Consequently, even if monetary integration has positive impact on bilateral FDI flows and stocks between EU Member States, it is probably not due to reduction of exchange rate volatility.
6. Conclusions

Using gravity models I prove that bilateral FDI flows and stocks between EU–27 Member States are determined by variables such as: gross domestic products of home and host economy and distance between them. According to the estimation results, the influence of euro zone on intra EU–27 FDI flows and stocks appears to be neutral or slightly in favour for states which adopted common currency. But even if monetary integration has positive impact on bilateral FDI flows and stocks between EU Member States, it is probably not due to reduction of exchange rate volatility. I prove that exchange rate volatility does not affect bilateral FDI flows and stocks between EU Member States.

Moreover, there is no noticeable increase of the share of intra euro zone flows and stocks of direct capital in total intra EU–27 FDI flows and stocks. The investment position of euro zone seems to rather stable. However, intra euro zone flows and stocks of direct capital are characterized by higher average change (per year) than extra euro zone and other intra EU–27 FDI flows and stocks. Consequently, the statement of neutral or slightly positive impact of the European monetary integration on bilateral FDI flows and stocks seems to be the most adequate.
References

6. Gomez-Herrera E. [2011], Comparing alternative methods to estimate gravity models of bilateral trade, University of Granada, Granada