The long-run impact of monetary policy uncertainty and banking stability on inward FDI in EU countries

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Abstract

In the present paper, we assess the long-run relationship between FDI inflows and the financial environment in 16 EU countries. For this purpose, we use a cointegration technique for heterogeneous panels and the FMOLS and DOLS estimators, over the period 2001 to 2015. We show that financial conditions are important for FDI inflows. More precisely, the monetary uncertainty, calculated as the difference between the recorded and the forecasted interest rate values, negatively affects the FDI inflows. In addition, the banking stability, measured through different Z-score specifications, positively influences the foreign investment. However, this result is influenced by the way the Z-score is calculated. We further report a positive relationship between the business cycle and the FDI entrance. The robustness analyses based on alternative specifications of monetary uncertainty and banking stability confirm our findings. These results are also supported by a PMG estimation. Therefore, authorities must pay special attention to monetary policy predictability and to banking stability in order to facilitate the investors' access to finance and their investment decision.

Keywords: FDI inflows, monetary uncertainty, banking stability, Z-score, cointegration, EU countries

JEL codes: F21, E52, E32, C23

1. Introduction

The stock of foreign direct investment (FDI) as percentage in GDP has continuously increased in the European Union (EU) countries during the last decades, supporting thus the theory of their higher economic integration. However, the FDI inflows started to decrease just before the outburst of the recent financial crisis, and they did not recover as expected up to now. In addition, the credit market does not function very well, even if the monetary conditions were relaxed over the last years.[1] In this context, a better understanding of the relationship between FDI inflows and the financial environment of the host economies is absolutely necessary.

We posit that the traditional inward FDI determinants, as the structure, the size and the institutional quality of the host economy, which are put into question nowadays[2], cannot explain the fluctuations in FDI inflows on a long-time horizon. The role of this category of determinants is usually investigated in relation with the stock of investment, given their reduced variability. However, FDI inflows have fluctuated a lot during the last years, and these fluctuations could be explained by the change in the financial environment characterizing the host countries, and in particular by the access to finance and by the financial costs associated with investment. Indeed, for an international investor it is important to know if the business will benefit from financial support abroad, and if the financial costs can be anticipated and sustained. A sound banking system can ensure the access to finance, and the predictability of the monetary policy offers information about the financial costs generated by borrowed funds. At the same time, the FDI inflows might influence in their turn the banking activity and the conduct of the monetary policy.

Therefore, our purpose is to investigate the long-run relationship between FDI inflows as percentage in GDP, monetary policy uncertainty and banking stability for a panel of 16 EU countries over the period 2001-2015, using the Organization for Economic Co-operation and Development (OECD) statistics. However, the uncertainty and instability tend to increase during economic downturn periods, and both FDI inflows and financial conditions are likely to be driven by the business cycle. Consequently, in order to isolate the effect of the financial environment on FDI inflows, we introduce in our long-run relationship the economic growth rate.

[1] Officially, the European Central Bank (ECB) has adopted in January 2015 a quantitative easing policy in order to provide additional money injection in the banking system through covered bonds and asset-backed security purchasing. However, monetary easing actions were conducted by the ECB immediately after the 2009 crisis, but the quantitative effects, even significant, were modest in magnitude (Gibson et al., 2016).

[2] For an analysis of robust FDI determinants please refer to Eaton and Tamura (1994).

The FDI determinants literature is very extensive. According to Eicher et al. (2012), the FDI determinants can be grouped in elements associated with the attractiveness of the national economy, the economic performance, and the quality of host countries economic policies. The first category of factors is related to the size of the host market (Botrić and Škuflić, 2006), the human resources quality and labor market characteristics (Castellani et al., 2006; Siedschlag et al., 2013; Villaverde and Maza, 2015), the institutional quality and reforms (Morisset and Pirnia, 2000; Wernick et al., 2009; Walsh, 2010; Tintin, 2013), and the proximity to research excellence centers (Siedschlag et al., 2013). The economic performance is assessed through investment's profitability (Gwenhamo, 2011), trade integration (Clausing, 2000; Lehmann, 2002), employment (Andersen and Hainaut, 1998), international agreements (Neumayer et al., 2016), and economic growth (Wernick et al., 2009; Tang et al., 2014). The third category covers elements associated with the quality of macroeconomic policies, namely the fiscal and the monetary policies. The effect of fiscal policy on inward FDI is assessed through fiscal incentives and competition (Haaparanta, 1996; Hines, 1999; Morisset and Pirnia, 2000; Ramb and Weichenrieder, 2005; Egger et al., 2008; Arbatli, 2011; Rădulescu and Druica, 2014; Albulescu and Ianc, 2016). The monetary policy effectiveness is associated with the performance of the exchange rate regime (Bénassy-Quéré et al., 2001; Aubin et al., 2006; Choi and Jeon, 2007) and with lower inflation and interest rates (Coskun, 2001; Dabla-Norris et al., 2010). Only few studies underline the importance of macroeconomic stabilization (Wint and Williams, 2002; Albulescu and Ianc, 2016; Chenaf-Nicet and Rougier, 2016), of systemic financial stability (Albulescu et al., 2010), and of uncertainty (Tang et al., 2014) in influencing FDI inflows. However, no previous papers investigate the long-run relationship between monetary uncertainty, banking stability and FDI inflows in the EU countries.

Moving beyond traditional FDI determinants, and building upon previous studies, this paper has two primary contributions to the literature. First, we focus on the role of financial environment in sustaining FDI inflows. Different from previous works (i.e. Tang et al., 2014), we focus on the conditions which influence the access of multinational companies to finance, namely the banking stability and the monetary policy uncertainty, without considering the role of the financial development of host countries, an element with a small variability during the analyzed period. While the banking stability is measured through different Z-score specifications for the national banking systems, we assess the monetary uncertainty comparing the level of the short-term interest rates and their forecasted values, using OECD data (OECD Economic Outlook). According to the OECD definition, the short-term interest rates are generally averages of daily rates, or 3-month money market rates where available. Comparing the recorded level of interest rates and their forecasted values is a common approach to assess the monetary uncertainty.[3] However, money market rates do not differ much across the Euro area countries. Moreover, their forecasted values are the same for the Euro area members. Thus, a small variability appears when we use this statistic as a *proxy* for the monetary uncertainty. Therefore, we use a set of robustness analyses to check the validity of our findings. On the one hand, we use both 1-year and 2-years forecasts. On the other hand, we use the level and the forecasted values of long-term interest rates as a new measure for the monetary uncertainty. Indeed, there is a large variability between the EU countries regarding the uncertainty computed using long-term rates. However, in this case, the uncertainty is related to government bond yields, which are influenced by the sovereign risk. Thus, in this case, the uncertainty is also associated with the quality of the macroeconomic policies. Finally, we use the slope of the yield curve (the difference between the long- and short-term interest rates) as a measure of uncertainty. Woodford (2010) shows that interest rate spreads reflect liquidity conditions within the financial system, and a high spread can be associated with inconsistent expectations. Hence, economic agents became interested in financial investment with a short maturity. Therefore, an inverted yield curve might be viewed as an indicator announcing an economic downturn.

The second contribution of the present paper relies in the employed empirical approach. Different from other studies that perform panel data analyses and use simple regressions without addressing any endogeneity issues (exceptions are Ahmed and Zlate, 2014; Tang et al., 2014), we show that our variables are not stationary in level. Thus, we address the long-run relationship within a cointegration framework, which takes into account the potential endogeneity of the involved variables by using adequate models, as the fully modified ordinary least square (FMOLS) estimator and the dynamic ordinary least square (DOLS) estimator. In particular, we use the cointegration analysis for heterogeneous panels, as proposed by Pedroni (1999, 2001). Given the structure of our sample (old and new EU members), the probability to have a heterogeneous panel is high. Further, for robustness purposes, we use the Pool Mean Group (PMG) estimator (Pesaran et al., 1999). Given the multitude of FDI inflows' determinants, this estimator helps us to address both reverse causation and omitted variable bias. Moreover, the structure of our sample offers good reasons to expect a similar relationship for the long-run equilibrium across groups.

[3] According to Husted et al. (2016), the monetary policy uncertainty can be measured using survey-based and market-based approaches, like the CBOE Volatility Index (VIX) or Baker-Bloom-Davis uncertainty indexes. Alternative measures imply the spreads between the policy rate and rates facing nonfinancial borrowers, or the spread between lending and deposits rates.

The remainder of the paper is structured as follows. Section 2 presents a brief review of the literature on the role of financial environment in sustaining FDI inflows. Section 3 describes the data and the methodology. Section 4 shows the main empirical findings while Section 5 is dedicated to robustness checks. The last section concludes.

2. Review of the literature on financial environment and FDI inflows

The relationship between FDI inflows and financial environment is not intensively debated in the literature. The main strand of studies in this category deals with monetary issues. While the role of exchange rate regime and exchange rate volatility is usually investigated, an increased importance is recently awarded to lower inflation and interest rates environments. In this line, in the case of Turkey, Coskun (2001) argues that lower inflation and interest rates, but also the full membership in the EU and a high economic growth increase the FDI inflows. Dabla-Norris et al. (2010) report similar results for a set of low-income countries.

The second strand of literature highlights the role of financial development in encouraging FDI inflows. In general, researchers show that a more developed financial system facilitates the absorption of foreign investment (Edison et al., 2002; Hermes and Lensink, 2003; Ezeoha and Cattaneo, 2012). For example, Alfaro et al. (2004) state that a developed financial system is essential to ensure positive FDI spillovers inside the host economy. More recently, Lee and Chang (2009) investigate the dynamic relationship between inward FDI, financial development and the economic growth rate in a panel setting for 37 countries and report a strong long-run relationship. Along similar lines, Lin et al. (2015) apply a smooth transition regression model to a panel of countries over the period 1976 to 2005, and discover that financial development defines the interactions between FDI and inequality in the level of income.

As far as we know, the monetary uncertainty was not considered as a potential FDI determinant so far. Indeed, Maswana (2010) tests the causal interactions between FDI and banking intermediation in China, and shows that the interest rate spread (which can be considered a *proxy* for the monetary uncertainty) and FDI mutually influence each other. However, they do not explicitly investigate the implications of monetary uncertainty for FDI inflows. Similar, Tang et al. (2014) include the financial development and the macroeconomic uncertainty between the FDI determinants in Malayesia. However, the macroeconomic uncertainty in their paper does not refer to monetary uncertainty.

We posit that monetary uncertainty provides signals about the efficiency of the macroeconomic policy and about the confidence of the private sector in the policymakers' decisions. In addition, if uncertainty increases, the access to finance becomes difficult, and it is hard for investors to accurately estimate their investment costs.

Further, only few studies take into account the access to finance, as a determinant of FDI inflows. For example, Girma et al. (2008) investigate the link between inward FDI and innovation in China, and underline the importance of a good access to domestic finance, for attracting FDI. Manova et al. (2015) provide evidence that credit constraints negatively affect the multinational activity, using a firm-level analysis for a set of Chinese firms, while Albulescu et al. (2010) posit that systemic financial stability is a reliable determinant of inward FDI in the selected EU countries. Nevertheless, at macroeconomic level, the access to finance is ensured by a stable banking system. Because the financial system in Europe is bank-oriented, the banking stability is essential for the firms' access to finance. The probability of bank default is assessed through the Z-score (a high Z-score value means a low default probability). If the instability of the banking sector increases, the access to finance is hampered. Further, regulatory agencies may impose additional capital requirements, which diminish the banks' capacity to grant loans (Noss and Toffano, 2016).

Therefore, we argue that the banking stability, as well as the monetary uncertainty are reliable determinants of FDI inflows in the long-run. At the same time, the long-run relationship between monetary uncertainty and banking stability can be explained by the fact that banks business strategies are sensitive to monetary uncertainty. Adequate and transparent interest rate forecasts help banks to better mitigate financial risks.

3. Data and methodology

3.1. Data

Our panel contains 16 cross-sections (EU countries)[4] and covers the period 2001-2015, resulting in 240 observations (balanced panel). Data on banking stability are available in the OECD database over the period 1999 to 2009. Consequently, the EU countries retained in our sample are OECD members. Starting with 2010, the data used for the Z-score calculation namely the Capital Adequacy Ratio (CAR) and the Return on Assets (ROA) are extracted from

[4] Austria, Belgium, Czech Republic, Denmark, France, Finland, Germany, Ireland, Italy, Luxembourg, Netherlands, Poland, Slovakia, Spain, Sweden, United Kingdom (data are not available for other EU countries which are OECD members, like Estonia and Hungary).

the Financial Soundness Indicators database – International Monetary Fund (IMF).[5] Because the Z-score calculation supposes a rolling window of three years, the starting point of our sample is 2001. Another motivation for the starting point of our sample (the year 2001) is the absence of interest rates forecasts for a large number of EU countries in the OECD economic outlook before 2001 (these forecasts are available for large EU members only).

Our focus is on the EU countries and the EU financial environment, and indeed, this sample can be considered too small. However, the EU countries are integrated and characterized by high economic and financial flows between them, and by common business cycles. Therefore, it is not recommended to add to this sample other countries for which data are available in the OECD database, like Australia, Canada, Japan and the United States, given their specificities in encouraging FDI inflows. In conclusion, for the selected variables, we have obtained the largest data panel possible for the EU countries.

For the computation of monetary uncertainty we use the absolute value of the spread between the recorded interest rate and their forecasted values. We consider that both positive and negative deviations of the recorded interest rates, as compared to their forecasted values, represent a source of uncertainty. Therefore, the uncertainty is computed as follows:

$$\text{uncertainty } 1a_t = |\text{short-term interest rate}_t - \text{forecasted short-term interest rate}_{t-1}| \quad (1)$$

$$\text{uncertainty } 1b_t = |\text{short-term interest rate}_t - \text{forecasted short-term interest rate}_{t-2}| \quad (2)$$

where: $\textit{short-term interest rate}_t$ is the 3-month money market rate; $\textit{forecasted short-term interest rate}_{t-1}$ is the forecast made in the year $t\text{-}1$ (the last economic outlook, released in autumn), for the year t; $\textit{forecasted short-term interest rate}_{t-2}$ is the forecast made in the year $t\text{-}2$ (the last outlook, released in autumn), for the year t.

For robustness purposes, we use alternative specifications for uncertainty, discussed in the introductory section (Eqs. (3)-(5)):

$$\text{uncertainty } 2a_t = |\text{long-term interest rate}_t - \text{forecasted long-term interest rate}_{t-1}| \quad (3)$$

$$\text{uncertainty } 2b_t = |\text{long-term interest rate}_t - \text{forecasted long-term interest rate}_{t-2}| \quad (4)$$

$$\text{uncertainty } 3_t = |\text{long-term interest rate}_t - \text{short-term interest rate}_t| \quad (5)$$

where: $\textit{long-term interest rate}_t$ is the government bond interest rate with a 10 years maturity.

[5] For the United Kingdom, CAR and ROA data are not available in the OECD database. Consequently, over the timespan 1999-2009 we have used the World Bank data (World Economic Indicators) for CAR, and FED St. Louis (FRED database) data for ROA.

Several details should be known in relation with the Z-score calculation. The Z-score represents the reverse of the probability of banks' default (high Z-score is thus equivalent with a sound banking system), and its general formula is (Lepetit and Strobel, 2013):

$$\text{z-score}_t = \frac{CAR_t + ROA_t}{\sigma_{ROA,t}} \text{ or } \text{z-score}_t = \frac{\mu_{CAR,t} + \mu_{ROA,t}}{\sigma_{ROA,t}} \quad (6)$$

where: CAR represents the capital-to-assets ratio, ROA is the return on assets, μ is the moving mean and σ the standard deviation.

Lepetit and Strobel (2013) discuss five different metrics of the banking sector Z-score. In this paper, given the volatility of FDI inflows during the last period, we use three different metrics of the Z-score, which allow for a strong variability in data. In all the cases, a rolling window of three years is applied for the computation of moving means ($n = 3$). First, we use the Boyd et al.'s (2006) approach (*z-score 1*), which relies on the moving means $\mu_{CAR,t}(n)$, $\mu_{ROA,t}(n)$ and the standard deviation $\sigma_{ROA,t}(n)$, calculated for each period $t \in \{1 \ldots T\}$. Second, the approach of Yeyati and Micco (2007) is employed (*z-score 2*), where the moving mean $\mu_{ROA,t}(n)$ and the standard deviation $\sigma_{ROA,t}(n)$ are calculated for each period $t \in \{1 \ldots T\}$, and are afterwards combined with the current value of CAR_t. Third, Boyd et al. (2006) propose an alternative, "instantaneous" approach $\sigma_{ROA,t}^{inst} = |ROA_t - \mu_{ROA}|$, where the mean profitability $\mu_{ROA,t}$ is calculated over the full sample$\{1 \ldots T\}$. In the second step, the estimates $\sigma_{ROA,t}^{inst}$ are combined with the current values of CAR_t and ROA_t (we obtain thus *z-score 3*).

3.2. Methodology

Pedroni (1999, 2001) proposes several cointegration tests for heterogeneous panels, which are less restrictive as compared to those employed for homogenous panels. Different from the Kao (1999)'s test constructed for strictly homogenous panels, the Pedroni's tests allow for cross-section interdependence with different individual effects, and relax the homogeneity assumption, condition which hardly feats the macro-panel analyses. In the case of a 2-variable cointegration model, we have:

$$y_{i,t} = y_{i,t-1} + \vartheta_{i,t}$$
$$x_{i,t} = x_{i,t-1} + \varepsilon_{i,t}$$

We consider the following general regression:

$$y_{i,t} = \propto_{i,t} + \beta_{i,t} x_{i,t} + u_{i,t} \quad (7)$$

where: $i = 1, \dots, N$ are the cross-sections; $t = 1, \dots T$ are the observations (years in our case); $\propto_{i,t}$ are the individual constant terms; $\beta_{i,t}$ is the slope parameter; $\vartheta_{i,t}$, $\varepsilon_{i,t}$ are the stationary disturbance terms and therefore, $y_{i,t}$ and $x_{i,t}$ are the integrated process of order 1 for all i.

The null hypothesis of no cointegration ($\rho_i = 1$) is tested performing a unit root test on residuals:

$$u_{i,t} = \rho_i u_{it-1} + w_{it} \quad (8)$$

For the estimation of the cointegration relationship in our study, we propose a modified version of the general equation, which allows for the cointegration of more than two variables:

$$fdiflows_{i,t} = \propto_{i,t} + \beta_{1,i} uncertainty + \beta_{2,i} z\text{-}score + \beta_{3,i} gdp + u_{i,t} \quad (9)$$

where: $fdiflows$ are the FDI inflows; gdp is the economic growth rate and $u_{i,t}$ are the error terms.

Pedroni (2000) shows thus that the group mean panel estimator presents minor distortions in small samples. Building up on Kao and Chiang (2000), Pedroni also proposes a between-dimension group means panel DOLS estimator that incorporates corrections for endogeneity and serial correlations parametrically. Consequently, after the documentation of the cointegration relationship, we first estimate the non-parametric FMOLS for heterogeneous cointegrated panels, following Pedroni (2000). The model is:

$$fdiflows_{i,t} = \propto_{i,t} + \beta_{1,i} uncertainty + \beta_{2,i} z\text{-}score + \beta_{3,i} gdp + u_{i,t} \quad (10)$$

Second, we use the group mean panel DOLS estimator:

$$fdiflows_{i,t} = \propto_{i,t} + \beta_{1,i} uncertainty_{i,t} + \sum_{k=-k_i}^{k_i} \gamma_{1ik} \Delta uncertainty_{it} + \beta_{2,i} z\text{-}score_{i,t} + \sum_{k=-k_i}^{k_i} \gamma_{2ik} \Delta z\text{-}score_{it} + \beta_{3,i} gdp_{i,t} + \sum_{k=-k_i}^{k_i} \gamma_{3ik} \Delta gdp_{it} + u_{i,t} \quad (11)$$

In order to avoid an omitted variable bias, but also for robustness purposes, we use in the final step of our empirical exercise the PMG estimator (Pesaran et al., 1999). This estimator is based on the maximum likelihood method and allows the intercept, the short-run coefficients, and the error variances to differ across groups. However, the estimator constraints the long-run coefficients to be equal across groups. As in the case of FMOLS and DOLS estimators, the PMG is adapted for I(1) series.

The PMG estimator assumes an Autoregressive Distributive Lag (ARDL) framework, designed for dynamic panel specifications:

$$\text{fdiflows}_{i,t}=\sum_{j=1}^{p}\lambda_{i,j}\text{fdiflows}_{i,t-j}+\sum_{j=0}^{q}\delta_{i,j}^{'}X_{i,t-j}+\mu_i+u_{i,t} \quad (12)$$

where: i is the number of countries and t is the number of years; $X_{i,t}$ is the $k \times 1$ vector of explanatory variables (*uncertainty*, *z-score* and gdp); $\delta_{i,j}'$ are coefficients; $\lambda_{i,j}$ are scalars; μ_i are group effects; $u_{i,t}$ is the error term.

Following Blackburne III and Frank (2007), we transform Eq. (12) into an error term equation:

$$\Delta\text{fdiflows}_{i,t}=\phi_i\left(\text{fdiflows}_{i,t-j}-\theta_i^{'}X_{i,t}\right)+\sum_{j=1}^{p-1}\lambda_{i,j}^{*}\Delta\text{fdiflows}_{i,t-j}+\sum_{j=0}^{q-1}\delta_{i,j}^{*}\Delta X_{i,t-j}+\mu_i+\varepsilon_{i,t} \quad (13)$$

where: ϕ_i is the error-correction term which shows the speed of the adjustment term (negative and significantly different from zero for a long-run relationship), θ_i is the long-run relationship vector of variables.

4. Results

4.1. Cross-sectional dependence and panel unit root tests

The panel unit root tests from the first generation are based on the assumption of independent cross-section units, which is usually rejected in the case of macro-panel estimations. We check this assumption by applying three cross-sectional dependence tests (Friedman, 1937; Frees, 1995; Pesaran, 2004). In all the cases the null hypothesis of the cross-sectional independence is rejected (Table 1).

Therefore, we test the presence of panel unit roots using a second-generation unit root test, namely the Pesaran cross-sectional Augmented Dickey–Fuller (pCADF) test (Pesaran, 2007). Table 1 shows that the pCADF test does not reject the null of the unit roots presence (a small exception is recorded for the uncertainty 1b in the model without trend). Our series are then I(1) and we can use a cointegration analysis to identify the long-run relationship between them.

Table 1. Cross-sectional dependence and panel unit root tests

Cross-sectional dependence tests							
	Pearson CD Normal	Friedman Chi-square	Frees Normal				
			test	10%	5%	1%	
Level	8.299 (0.00)	52.36 (0.00)	1.144	0.171	0.226	0.335	

Pesaran pCADF panel unit root test								
	Without trend				With trend			
	t-bar	10%	5%	1%	t-bar	10%	5%	1%
fdiflows	-2.219	-2.110	-2.220	-2.450	-2.138	-2.640	-2.760	-2.980
uncertainty 1a	-1.312	-2.110	-2.220	-2.450	-1.704	-2.640	-2.760	-2.980
uncertainty 1b	-2.478	-2.110	-2.220	-2.450	-2.129	-2.640	-2.760	-2.980
z-score 1	-0.878	-2.110	-2.220	-2.450	-1.622	-2.640	-2.760	-2.980
z-score 2	-0.927	-2.110	-2.220	-2.450	-1.767	-2.640	-2.760	-2.980
z-score 3	-1.761	-2.110	-2.220	-2.450	-1.569	-2.640	-2.760	-2.980
gdp	-1.544	-2.110	-2.220	-2.450	-1.772	-2.640	-2.760	-2.980

Notes: (i) the cross-sectional dependence tests are computed using uncertainty 1a and z-score 1; (ii) pCADF test with two lags; (iii) p-values in brackets.

4.2. Cointegration tests

Table 2 presents the cointegration results for the Pedroni's tests. In the case of the homogenous panel hypothesis, only two out of four tests proposed by Pedroni (1999, 2001) indicate a cointegration relationship. However, the probability to have a heterogeneous panel is high, and in this case, two out of three tests indicate the existence of a long-run relationship. The results remain the same in this case, whether we use *uncertainty 1a* or *uncertainty 1b.*

Table 2. Panel cointegration tests

Uncertainty 1a					
Pedroni	Within-dimension (homogenous)			Between-dimension (heterogeneous)	
	Tests	Statistic	Weighted Statistic	*Tests*	Statistic
	Panel v-Statistic	-2.178	-1.599	*Group rho-Statistic*	0.502
	Panel rho-Statistic	-0.775	-0.588	*Group PP-Statistic*	-13.31***
	Panel PP-Statistic	-12.71***	-8.421***	*Group ADF-Statistic*	-3.104***
	Panel ADF-Statistic	-4.134***	-3.641***		
Uncertainty 1b					
Pedroni	Within-dimension (homogenous)			Between-dimension (heterogeneous)	
	Tests	Statistic	Weighted Statistic	*Tests*	Statistic
	Panel v-Statistic	0.705	-1.130	*Group rho-Statistic*	0.538
	Panel rho-Statistic	-1.722**	-0.428	*Group PP-Statistic*	-8.443***
	Panel PP-Statistic	-6.217***	-6.625***	*Group ADF-Statistic*	-1.972**
	Panel ADF-Statistic	0.888	-3.403***		

*Notes: (1) *, ** and *** mean statistic relationship significant at 10%, 5%, 1%, respectively; (2) Schwarz information criterion for lags selection is used; (3) z-score 1 is used in the cointegrating equation.*

4.3. FMOLS and DOLS results

We continue our analysis with the estimation of the long-run relationship, based on FMOLS and DOLS estimators (Table 3). Three models are proposed for each estimator, corresponding to the three measures for the Z-score (Model 1, 2 and 3). Further, we test the models 'a' for *uncertainty 1a* and 'b' for *uncertainty 1b*. Several findings can be highlighted. First, the coefficients' sign for all the variables is the expected one. On the one hand, the monetary policy uncertainty negatively influences the FDI inflows in the selected EU countries, and the effect is very significant. On the other hand, the banking stability and the economic growth positively impact the investment inflow. Second, when we compare the FMOLS and DOLS results, we see a very good correspondence between these estimators. Third, the banking stability has a positive and significant impact on FDI inflows only when the *z-score 3* measure is used (a small exception is recorder for *uncertainty 1b* and DOLS estimator). Different from the other two measures of the banking stability, *z-score 3* relies on the "instantaneous" level of stability, and does not suppose the computation of moving means for CAR and ROA . Forth, the economic growth has a smaller impact on FDI inflows as compared to the monetary uncertainty. The impact is significant with one exception (*uncertainty 1a* and DOLS estimator). This result is not surprising given the fact that the drop in FDI inflows started before the economic downturn, and the economic recovery recorded in several EU countries, was not followed by a similar increase in FDI inflows.

Table 3. Panel FMOLS and DOLS

	Uncertainty1a			**Uncertainty1b**		
	Model 1a1	Model 1a2	Model 1a3	Model 1b1	Model 1b2	Model 1b3
FMOLS						
uncertainty1a	-6.499***	-6.561***	-4.893***			
uncertainty1b				-3.636***	-3.588***	-2.909***
z-score 1	0.004			0.009		
z-score 2		0.006			0.009	
z-score 3			0.082***			0.065***
gdp	0.989***	1.057***	0.553***	0.981***	0.910***	0.519***
DOLS						
uncertainty1a	-8.678**	-8.616**	-4.183***			
uncertainty1b				-3.533***	-3.512***	-1.558**
z-score 1	0.016			0.014		
z-score 2		0.017			0.017	
z-score 3			0.142*			0.097
gdp	0.767	0.768	0.189	0.835*	0.869**	0.426*

*Notes: (i) *, ** and *** mean statistic relationship significant at 10%, 5%, 1%, respectively; (ii) group mean panel estimator for heterogeneous panels is used; (iii) Schwarz information criterion for lag and lead selection in the case of DOLS is employed; (iv) the Bartlett kernel and the Newey-West automatic bandwidth for the FMOLS is used, given the non-parametric feature of this model; (v) 224 observations (16 cross-sections).*

The investment decisions are nevertheless made considering a large spectrum of factors and the fact that banking stability has no categorical influence on FDI inflows requires supplementary investigations. Therefore, in order to test the robustness of our results, we perform a series of additional tests, using the long-term interest rate and the interest rate spread to estimate the monetary uncertainty, and also a PMG estimator which deals with the omitted variable bias.

5. Robustness analyses

5.1. Alternative specifications for the monetary uncertainty

Using alternative specifications for the monetary uncertainty, as defined by Eqs. (3)-(5), we obtain similar results for the Pedroni's cointegration tests (Table 4).

Table 4. Panel cointegration tests – robustness analyses

Uncertainty 2a					
Pedroni	Within-dimension (homogenous)			Between-dimension (heterogeneous)	
	Tests	Statistic	Weighted Statistic	*Tests*	Statistic
	Panel v-Statistic	-1.165	-1.870	*Group rho-Statistic*	0.555
	Panel rho-Statistic	-2.556***	-0.656	*Group PP-Statistic*	-10.62***
	Panel PP-Statistic	-14.67***	-7.530***	*Group ADF-Statistic*	-8.452***
	Panel ADF-Statistic	-12.98***	-7.604***		
Uncertainty 2b					
Pedroni	Within-dimension (homogenous)			Between-dimension (heterogeneous)	
	Tests	Statistic	Weighted Statistic	*Tests*	Statistic
	Panel v-Statistic	-0.752	-0.835	*Group rho-Statistic*	0.326
	Panel rho-Statistic	-2.154**	-0.619	*Group PP-Statistic*	-9.150***
	Panel PP-Statistic	-8.254***	-6.952***	*Group ADF-Statistic*	-7.330***
	Panel ADF-Statistic	-8.191***	-5.931***		
Uncertainty 3					
Pedroni	Within-dimension (homogenous)			Between-dimension (heterogeneous)	
	Tests	Statistic	Weighted Statistic	*Tests*	Statistic
	Panel v-Statistic	8.662***	-0.766	*Group rho-Statistic*	-0.292
	Panel rho-Statistic	-3.090***	-1.177	*Group PP-Statistic*	-15.21***
	Panel PP-Statistic	-14.67***	-8.918***	*Group ADF-Statistic*	-2.794***
	Panel ADF-Statistic	-2.529***	-3.839***		

*Notes: (1) *, ** and *** mean statistic relationship significant at 10%, 5%, 1%, respectively; (2) Schwarz information criterion for lags selection is used; (3) z-score 1 is used in the cointegrating equation.*

We mention that the use of long-term interest rates results in a smaller number of observations. More precisely, the OECD economic outlook does not provide forecasts for the long-term rates for Poland, while for the Czech Republic the forecasted data are available starting with 2006. Consequently, for the robustness analysis using *uncertainty 2a* and *uncertainty 2b*, the two countries are excluded from the sample.

We continue thus with the results of the FMOLS and DOLS estimators (Table 5). Nine models are tested, out of which six are related to *uncertainty 2a* and *uncertainty 2b* (Models 2), and three to *uncertainty 3* (Models 3). The findings confirm the main results of our analysis. We notice that in almost all the cases (the estimator DOLS for Model 33 represents an exception), the monetary uncertainty, associated with the performance of economic policies and the access to finance, negatively affect the FDI inflows in the selected EU countries. The flows of FDI increase during economic boom periods, result in agreement with those reported by Burger and Ianchovichina (2017) for a set of developing countries. This result is obtained in all the cases for the FMOLS estimator, but not for *uncertainty 2a* and *uncertainty 2b* under the DOLS estimator. Practically, this is the single discordance between the two estimators. As in the case of the main results, the banking stability has a positive and a significant impact on FDI inflows when *z-score 3* is employed.

Table 5. Panel FMOLS and DOLS – robustness analyses

	Uncertainty 2a			**Uncertainty 2b**			**Uncertainty 3**		
	Model 2a1	Model 2a2	Model 2a3	Model 2b1	Model 2b2	Model 2b3	Model 31	Model 32	Model 33
FMOLS									
uncertainty 2a	-2.898***	-2.979***	-2.960***						
uncertainty 2b				-2.481***	-2.534***	-2.208***			
uncertainty 3							-1.419***	-1.417***	-0.776*
z-score 1	0.007			0.004			0.004		
z-score 2		0.006			0.003			0.002	
z-score 3			0.091***			0.068**			0.167***
gdp	1.010***	0.996***	0.620***	0.628***	0.619***	0.451**	1.076***	1.126***	0.686***
DOLS									
uncertainty 2a	3.412***	-3.399***	-2.551***						
uncertainty 2b				-3.015***	-2.944***	-1.327**			
uncertainty 3							-1.275***	-1.285***	-0.276
z-score 1	0.006			-0.001			0.009		
z-score 2		0.004			-0.000			0.011	
z-score 3			0.185***			0.205***			0.188***
gdp	0.628	0.644	0.323	0.322	0.339	0.241	1.878***	1.908***	1.056***

*Notes: (i) *, ** and *** mean statistic relationship significant at 10%, 5%, 1%, respectively; (ii) group mean panel estimator for heterogeneous panels is used; (iii) Schwarz information criterion for lag and lead selection in the case of DOLS is employed; (iv) the Bartlett kernel and the Newey-West automatic bandwidth for the FMOLS is used, given the non-parametric feature of this model; (v) 196 observations (14 cross-sections) for Models 2 and 224 observations (16 cross-sections), for Models 3.*

5.2. The PMG estimator

In order to deal with the non-stationarity characteristic of our series, to solve the omitted variable bias and to provide additional robustness evidence, we continue the analysis using the

PMG estimator proposed by Pesaran et al. (1999). When *uncertainty 1a* is used, the results are even better compared to the FMOLS and DOLS estimators. For the long-run relationship, for all the models, the sign is the expected one and the coefficients are very significant. The adjustment coefficient from the short-run relationship is negative and very significant, proving the existence of a long-run relationship between our variables. However, there is no significant evidence that the financial environment and the business cycle impact the FDI inflows in the short-run. When *uncertainty 1b* is employed, the results are not so strong. For the first time the coefficient of the monetary uncertainty is not significant for the long-run relationship.

Table 6. PMG results

	Model 1a1		Model 1a2		Model 1a3	
Uncertainty1a	Long-run coefficients	Short-run coefficients	Long-run coefficients	Short-run coefficients	Long-run coefficients	Short-run coefficients
Adjustment coefficient		-0.967***		-0.964***		-0.932***
uncertainty 1a	-0.736***	-1.237	-0.710***	-1.485	-1.181***	-0.228
z-score 1	0.002***	0.000				
z-score 2			0.002***	0.003		
z-score 3					0.001***	-0.066
gdp	0.382***	0.204	0.374***	0.228	0.383***	0.005

	Model 1b1		Model 1b2		Model 1b3	
Uncertainty1b	Long-run coefficients	Short-run coefficients	Long-run coefficients	Short-run coefficients	Long-run coefficients	Short-run coefficients
Adjustment coefficient		-0.991***		-0.987***		-0.947***
uncertainty 1b	-0.070	-1.194**	-0.078	-1.236**	-0.033	-0.269
z-score 1	0.001***	0.006				
z-score 2			0.001***	0.003		
z-score 3					0.000	0.088
gdp	0.354***	0.168	0.344***	0.181	0.307***	0.021

*Notes: (i) *, ** and *** mean statistic relationship significant at 10%, 5%, 1%, respectively; (ii) maximum 1 lag is selected for dependent and explanatory variables, which is accepted for annual data with a limited T (15 years); (iii) 224 observations (16 cross-sections).*

All in all, we conclude that both the financial environment and the business cycle have a long-run impact on FDI inflows in the EU countries. More precisely, the uncertainty regarding the monetary policy negatively impacts the FDI inflows in the long-run, while the banking stability and the business cycle have a positive influence. The banking stability has however a smaller influence on inward FDI in the EU countries, as compared with the other variables. Further, this influence is observed only when a particular method is used for the Z-score calculation. Our robustness tests based on different metrics for the banking stability and alternative measures of the monetary uncertainty, sustain the main findings.

6. Conclusions

The FDI inflows to GDP ratio diminished in the EU countries even before the outburst of the recent crisis. In this context, the role of traditional FDI determinants in explaining the volatility of investment's inflows is questioned. We argue that financial aspects, and especially the firms' access to finance and the transparency of the monetary policy, are very important nowadays to attract FDI. Therefore, we investigate the long-run influence of monetary policy uncertainty and banking stability on FDI inflows in 16 EU countries, over the time span 2001 to 2015, isolating the impact of the business cycle.

Using a cointegration approach for heterogeneous panels, we discover a significant long-run relationship between FDI, monetary uncertainty, banking stability and economic growth. The FMOLS and DOLS estimators show that financial conditions are significant determinants of FDI inflows. While monetary uncertainty negatively affects the FDI inflows in the selected EU countries, both the banking sector stability and the business cycle have a positive influence. These findings are supported by a series of robustness checks and by the use of an alternative estimator to assess the long-run relationship.

Our results have several policy implications. On the one hand, for the national authorities it is noteworthy to know that a stable banking system, and especially a performant and transparent monetary policy, ensure the access to finance and a reliable estimation of investment costs. Therefore, a sound financial environment encourages the FDI inflows. In addition, by promoting the FDI inflows, the national authorities may benefit and obtain *inter-alia* job creation and fiscal balance equilibrium. On the other hand, our findings offer information for international investors, who generally decide to invest abroad in economic boom periods and in countries with sound financial systems.

Our estimations also have some limits. First, the results are obtained using a reduced data sample. Second, the effects of the recent economic crisis are not taken into account. However, the limited amount of observations after 2008 prevents the exclusive use of post-crisis data. Therefore, nonlinear estimators are recommended to further explore the long-run relationship between FDI inflows, financial environment and business cycle. Because the split of our data sample is not recommended to assess the effect of the crisis, a panel cointegration analysis with structural breaks (i.e. Banerjee and Carrion-i-Silvestre, 2015) might represent a solution for addressing this issue.

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