The effect of macroeconomic instability on FDI flows:

A gravity estimation of the impact of regional integration in the case of Euro-Mediterranean agreements

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Abstract: In order to diversify their risks, firms facing increased demand uncertainty in their domestic market may choose to increase their investment abroad by transferring production to the more stable host economies. Using a gravity model, we test the assumption that foreign direct investment is reactive to macroeconomic instability in both source and host countries in a sample of European and MENA countries for 1985-2009. Using a gravity model form model, we show that the incidence of FDI between two countries increases with source GDP instability and with host GDP stability. We also find that although this reactivity is not conditioned by trade and investment agreements, it must be qualified with respect to the type of FDI, with North-South vertical investment being significantly affected by source country uncertainty. For the same level of cost differential, the incidence of vertical FDI thus tends to be higher when uncertainty is high than when uncertainty is low.

Keywords : Output volatility, FDI, gravity model, source country instability, European Union, Middle-East and North-Africa, regional trade integration, bilateral investment treaties, horizontal FDI; vertical FDI.

JEL codes : F21, F43, F44

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1.Introduction

For the last two decades, attracting FDI from multinational corporations (hereafter MNCs) has become a priority goal for developing countries. FDI is supposed to bring about such positive effects as technological upgrading and trade expansion to developing countries. Quite surprisingly, although the determinants of FDI concerning the host country are now well known[1], those concerning the source country's macroeconomic characteristics have been less well-studied [2] In particular, the sensitivity of inward FDI to uncertainty in the source country has hardly been investigated so far. However, this issue is of considerable importance for those developing countries whose external balance of trade and financing of growth rely heavily on foreign capital inflows. Obviously, governments in developing host countries have no direct influence over source countries' macroeconomic conditions. Trade and investment policies aimed at integrating host and source countries more deeply may, however, condition the extent to which FDI inflows to the former react to the uncertainty to which the latter's MNCs are exposed. Aizenman and Marion (2004: 126) have in particular pointed out that, by increasing the mutual dependency of its members, the NAFTA may have reduced the sovereign risk associated with investment in Mexico and contributed to the observed increase in US firms' vertical investment there. For developing countries, trade integration may therefore increase the attraction of FDI in a global context, combining an increase in offshoring of intermediate tasks (Grossman and Hosni-Hansberg, 2008) with growing macroeconomic uncertainty. Several studies have sought to explain aggregate FDI outflows or inflows by aggregate measures of instability (Albuquerque et al. 2005; Méon and Sekkat, 2012). However, using aggregate macroeconomic measures does not enable dyadic characteristics to be considered, for example geographic or cultural distance or bilateral trade or investment agreements that may condition the reactivity of FDI to the source country's macroeconomic characteristics. By estimating a gravity model of FDI flows from Europe and the Mediterranean region to the four main recipients of FDI in the MENA region, the present paper tests (1) the extent to which FDI inflows are affected by macroeconomic volatility in the source country, and (2) whether regional trade and investment agreements could have increased this FDI sensitivity to external macroeconomic volatility. It may be expected that deeper trade integration between source and host countries, via Bilateral Investment Treaties (BITs) and FTAs, may magnify the positive effect of source country volatility on FDI outflows by reducing the costs of reallocating production abroad and re-exporting from abroad. Furthermore, since theory predicts that vertical and horizontal investment will react differently to increased uncertainty, assumptions (1) and (2) are further tested

[1] Good institutions, a low-cost and highly productive workforce, the availability of natural resources and market size are, among others, key determinants of between-country differences in the attraction of FDI. See Bloningen (2005) for an overview of the literature on the determinants of FDI.

[2] For a recent account of the adverse effects of macroeconomic volatility on economic development, see Loayza, Rancière, Servén and Ventura (2007), or Lensink and Morrissey (2007) who show that economic growth is more reactive to FDI volatility than to FDI levels.

in a gravity model which is more specifically adapted to explaining vertical investment, the type of investment which is expected to be the most reactive to trade integration. Finally, the paper analyses the sensitivity of the positive effect of the source country's macroeconomic uncertainty on FDI flows with a variety of additional elements characterizing source and host countries. The reduced form estimation of this paper shows that FDI tends to flow from the more volatile source countries to the less volatile host countries of our sample. Moreover, we find that the sensitivity of these FDI flows to source country volatility can be affected by trade integration and by the type of investment (vertical or horizontal).

The remainder of this paper is organized in five sections. Section 2 discusses the effects of several kinds of macroeconomic instability on FDI inflows. Section 3 presents the indicators of macroeconomic stability selected for the empirical study, as well as the model and the estimation strategy. In Section 4, we first present and then discuss the results of our gravitational model panel data estimation, paying specific attention to source countries and to several issues relating to the robustness of our results. Section 5 discusses robustness checks and section 6 concludes.

2. FDI, uncertainty and trade integration: an overview

Like domestic investment, FDI can be analysed as an irreversible investment, characterised by positive sunk cost and low convertibility or liquidity (Marschak, 1948). According to the standard option-pricing analysis of investment under uncertainty (Dixit, 1989; Dixit and Pindyck, 1994), the return threshold that is required for performing any irreversible investment increases with uncertainty. In a context of high uncertainty, delaying investment may be optimal for a firm since waiting for new information potentially raises the investment's expected value (Bernanke, 1983; McDonald and Siegelís 1986; Pindyck, 1988). In the specific case of FDI, uncertainty may however concern both source and host countries' macroeconomic and institutional conditions. More specifically, the decision to invest abroad in response to high uncertainty, and the ensuing level of FDI flows between two countries, is the result of two decisions. First, an increase in output volatility in the MNC's home country may increase the risk attached to domestic investment. The MNC may react to the anticipated instability of its expected profits by holding back on all its investment projects, including planned foreign investment (Aizenman, 2003; Wang and Wong, 2007). The option theory of investment has established that, for firms undergoing growing demand volatility in their home market, delaying domestic investment may become an increasingly valuable option[3]. If uncertainty is low abroad, setting up a subsidiary there may nevertheless be a similarly valuable option. In a model of FDI including random demand-side or supply-side fluctuations, Aizenman and Marion (2004) find that, under conditions of high price demand elas-

[3]By applying the option theory of investment to vertical investment, de Mello-Sampayo et al. (2010) show that higher current demand volatility (as well as future demand uncertainty) discourage the offshoring of low-skilled tasks by increasing the option value of delaying FDI.

ticity (manufacturing of goods), MNCs' expected profits from both horizontal and vertical FDI are reduced by demand shocks[4]. By contrast, home country supply-side uncertainty, such as a higher volatility of productivity shocks, can have a positive impact on horizontal investment by inducing "the MNC engaged in horizontal foreign investment to reallocate production and employment from less productive plants to more productive ones" (Aizenman and Marion, 2004: 130). When choosing the localization of its foreign investment, an MNC will therefore consider the host country's characteristics in terms of average growth and instability. In a nutshell, firms will be particularly sensitive to sources of uncertainty in the home country when deciding ex ante if they should invest abroad, and then to sources of uncertainty in the host country when choosing in which country to invest. The home country's main source of uncertainty may be related to supply, demand or price shocks. As for the host country, legal sources of uncertainty, including instability of fiscal rules and various institutional failures that increase transaction costs, may cumulate with macroeconomic supply and demand instability.

These theoretical predictions have hardly been empirically tested to date. Cavalleri and D'Addona (2013) found that FDI between OECD countries over the period 1985-2007 increased when the source country had higher output volatility. They argue that such investor behaviour with respect to source country volatility is consistent with the view that investors choose between investment options at home and abroad on the basis of the volatility differential between the source and host economies. Although these authors do not specify the type of investment for which their results hold, we may assume that it is essentially North-North FDI, which is mostly horizontal. By estimating a gravity model of North-South FDI, however, Levy-Yeyati et al. (2007) have also found that FDI flows tend to be countercyclical with respect to output cycles in the US and Europe, thereby reflecting investors' arbitrage among different investment opportunities according to the volatility differential. Their findings show that, contrary to what would be expected theoretically, recessions in industrial countries are likely to increase FDI flows to developing countries, particularly to those with close ties with the U.S. and Europe. This result calls for two comments. First, North-South investment, typically of a vertical nature, may also show a positive effect of source volatility on the quantity of investment. Second, the result would also suggest that FDI flows between two economies tend to increase with source country uncertainty when these economies are linked by an RTA. The magnitude of the reaction of FDI to source country uncertainty may thus be conditioned by the degree of trade integration between the FDI source and host countries.

It is now well documented that FDI tends to be triggered by global (Büthe and Milner, 2008) as well as by regional trade integration (Daude, Levy-Yeyati

[4]On the one hand, a positive demand shock reduces profits by increasing price, with a detrimental effect on demand, on the other hand, a negative demand shock cuts profits by adversely affecting the amount of sales, despite the mitigating effect of decreasing prices (Aizenman and Marion, 2004: 131).

and Stein, 2003; Busse et al., 2010; Medvedev, 2012)[5]. Stein and Daude (2007) and Jaumotte (2004) have provided convincing evidence of this positive effect in the case of both North-South and South-South trade agreements[6]. This overall effect must be qualified, however, with respect to the type of investment. Lower tariffs and regulatory obstacles between two countries may be more favourable to vertical FDI, since the cost of importing components and re-exporting is minimal, and more detrimental to horizontal FDI, since trade can substitute for FDI (Caves, 1996; Markusen, 1984; Markusen, 2002). As for horizontal investment, it may be differently affected by trade integration (Markusen and Maskus, 2001). First, this type of FDI type is essentially relevant to countries with similar characteristics. Second, it may be adversely impacted by growing trade integration since reduction in trade costs tends to promote the strategy of onshoring and exporting. In Aizenman and Marion (2004)'s model, however, any trend towards the reduction of uncertainty would increase the convexity of the MNC profit function and magnify the positive response of horizontal investment to volatility induced by supply-side shocks. The net impact of free trade agreements on FDI sensitivity to external volatility may therefore depend on the dominant form of FDI. Equally, this impact may well depend upon the level of development of the source country. FDI flows tend to react quite differently to increased macroeconomic risks depending on whether those investments are sourced in countries whose firms traditionally invest abroad or in economies where foreign investment is less common[7]. Andrès, Busse and Nunnenkamp (2012) have, for example, recently found that non-traditional sources of FDI are less risk-averse than traditional ones. Since North-South FDI should be more vertical than horizontal (Bloningen and Wang 2005), European investment to MENA might react differently to source volatility than South-South investment, which is more likely to be horizontal. We control for these two possible regimes in our estimations.

From what precedes, the present paper tests the assumption that, in order to diversify their risks, firms facing increased demand uncertainty in their domestic market may choose to increase their investment abroad by transferring production to more stable host economies (H1). In that case, they may choose to invest in destinations where uncertainty and trade costs are the lowest (H2). From this theoretical model, we can infer that aggregate FDI outflows may be higher from more volatile home countries and FDI inflows may be higher for those host economies where uncertainty is the lowest[8]. In the reduced form

[5]Moreover, it has been established that RTAs offering more liberal rules for admission and provisions for foreign investment logically have a higher positive impact on FDI (Berger et al, 2013).

[6]Similarly, bilateral investment treaties have positive effects on FDI inflows to developing economies in general (Desbordes and Vicard, 2009), and to MENA economies in particular (Mina, 2012).

[7]For an analysis of FDI determinants differentiating developed and developing countries, see Bloningen and Wang, 2005.

[8]More specifically, it can be expected that horizontal investment may increase with source country uncertainty caused by high demand instability, whereas vertical FDI may decrease in response to higher source country demand instability affecting expected revenues from

estimation of this paper, it follows that we can expect capital to flow from the more volatile source countries to the less volatile host countries of our sample (H1). Moreover, we test whether deeper trade integration between source and host countries, via Bilateral Investment Treaties (BITs) and FTAs, may magnify the positive effect of source country volatility on FDI outflows by reducing the costs of reallocating production abroad and re-exporting from abroad (H2). As pointed out by Aizenman and Marion (2004), any trend towards a reduction in uncertainty via increasing mutual dependency between home and host economies would stimulate FDI. It is therefore expected that trade and investment integration may ease production reallocation abroad in the case of increased uncertainty in the home market, therefore increasing FDI outflows to the more stable host economies of the trading zone. Since theory predicts that vertical and horizontal investment will react differently to increased uncertainty, H1 is further tested in a gravity model which is more specifically adapted to explaining vertical investment, the type of investment which is expected to be the most reactive to trade integration.

3. Methodological issues

In order to assess the sensitivity of FDI inflows to source country instability, we use a gravity model that links thirty-two countries that were sources of investment to the four largest recipient countries in the MENA region (Egypt, Morocco, Tunisia and Turkey), during the period 1987-2009[9]. MENA countries are particularly concerned by the trends described above since they had to overcome a significant increase of inward FDI levels after the 1995 Barcelona agreement (Nicet-Chenaf and Rougier, 2014). During the 1990s, MENA countries reformed their institutions and opened up their economies to foreign trade and investment via various South-South (GAFTA, AMU) and North-South (Euro-Mediterranean) trade agreements (Mina, 2012). As a result, FDI inflows have significantly increased for the four main MENA recipient countries, although their share of world FDI has nonetheless declined and FDI instability has increased during the last decade (UNCTAD, 2009). Their economies have become increasingly dependent on FDI sourced in European economies as well as in other countries of the MENA region[10]. We expect that European investment to MENA economies may have become more reactive to source macroeconomic conditions with the extension of regional trade integration, as well with the bi-

re-exports.

[9]Even though Algeria is also a big FDI recipient, this country was not included in the host country sample since inward FDI is highly concentrated on oil and is likely to adopt a very different pattern. MENA Gulf countries are therefore considered neither as host nor as source countries in our analysis, because they are not as closely associated with European trade and investment as the Mediterranean ones.

[10]Even though MENA countries have opened their economy to FDI during the 1990s, they still fail to experience technological spillovers they initially expected. Sadik and Bolbol (2001) explained this fact by the nature of FDI inflows, mostly resource-based, during the 1990s, Nicet-Chenaf and Rougier (2011) have provided evidence based on more recent data that this failure could be due to the low absorption capacities of poorly innovative MENA economies.

lateral trade agreements between these two regions. Insofar as the source countries of our sample include the European Union economies, plus the MENA countries (Mauritania, Morocco, Algeria, Tunisia, Libya, Egypt, Jordan, Syria and Turkey), our sample encompasses both North-South and South-South trade agreements and resulting flows of FDI.

Since cross-sectional or time series studies of FDI determinants are constrained by their framework to use a single average measurement of external conditions, thereby failing to address source-related determinants of FDI[11], we had to use a gravity model to properly assess source-related macroeconomic determinants of FDI levels. Because it allows the effect of host countries' characteristics on FDI to be differentiated according to a series of distance-related factors, the gravity model is increasingly used to explain bilateral flows of FDI[12]. Moreover, various empirical specifications, based on sound theoretical foundations, can be used to explain either horizontal or vertical FDI (Anderson, 2010). Kleinert and Toubal (2010) have for example derived two different empirical specifications from a proximity-concentration model explaining horizontal investment and a model explaining vertical investment by factor-proportions in home and host countries. They test the two models and find foreign affiliate sales data to support the horizontal models, the omission of the two terms specific to the vertical investment model[13] leaving unchanged the results from horizontal gravity models. Our specification is therefore derived from the Baseline model for horizontal investment of Kleinert and Toubal (2011). The standard expression of the gravity model adapted to bilateral flows of FDI can be written as:

$$FDI_{ijt=}A.\frac{Y_i^{b1}.Y_j^{b2}}{D_{ij}^{b3}} \quad (1a)$$

where FDIijt is the annual flow of FDI from source country i to host country j, Yit and Y$jt$are the annual GDP levels of the source and host countries, Dijt is an indicator of the distance between the two countries, and A, b1, b2 and b3 are the parameters to be estimated. When Equation (1a) is log-linearized, it becomes:

Ln(FDIijt) = a + b1Ln(GDPit) + b2Ln(GDPjt) + b3Ln(Dijt) + b4Source instabilityt + b5Host instabilityt + b6RTAsijt + b7IIAsijt + b8Institutional profilejt + ui + uj+ vt +eijt (1b).

where FDIijt represents the value in dollars of the inflows of FDI from a country i (source country) entering country j (host country) at time t[14]. If we now consider the right-hand side of equation (1b), Ln(GDPit) and Ln(GDPjt) stand for the natural logarithm of GDP levels of the source and host countries respectively, and b1 and b2 take a positive sign if there is a "mass" effect operating in determining bilateral direct investment flows. By extension, higher

[11] Méon and Sekkat (2012) is a recent illustration: they proxy external macroeconomic volatility using an aggregate ratio of world FDI to world GDP.

[12] For recent gravity studies of FDI, see Frenkel, Funke and Stadtmann (2004); Bevan and Estrin (2004); Desbordes and Vicard (2009) or Busse, Königer and Nunnenkamp (2010).

[13] Relative factor endowment and a joint size of home and host country terms.

[14] Data sources and definitions can be found in appendix A1.

host country GDP is generally considered to increase horizontal FDI, as the size of the local market is worth being served by a multinational firm's production subsidiary. Dijt is the vector of the various concepts of distance controlling for the most typical sources of transaction and transport costs involved in an investment moving from one country to another. The physical bilateral distance (*Distance*) corresponds to the distance between the countries' capitals; FDI is generally taken as being inversely proportional to the distance between the two countries involved. However, when the host country shares a common border, language, or a former colonial link with the source country, it is generally considered that FDI will be higher. *Adjacency* and *Common* language take the value 1 if the source and host countries respectively share a common border or have a common language; otherwise they take the value 0[15]. The variable *Past colonial links* takes value 1 if the source country had colonized the host country, and 0 otherwise[16].

As argued above, FDI inflows also depend on the characteristics of the source country and source region in terms of GDP growth instability. The expected sign of the *Source instability* coefficient was discussed in the previous section. It may be positive or negative, conditional on the dominance of substitution or income effects. Following the explanation in the previous section, we can anticipate that the coefficient for *Host instability* could be either negative or positive, but the opportunity-driven positive effect seems to be plausible for MENA economies, given the nature of the foreign investments they tend to attract.

For each time period, the standard deviation of GDP growth has been calculated for both host and source country. Mean and standard deviation values at time t have been computed as a five-year moving average over *t-4*, *t-3*, *t-2*, *t-1* and t. We have supposed that investors observe short-term past volatility and compare it for different potential destinations. In order to avoid a null average value, we have chosen to compute absolute values of standard deviations and then to express them in logarithmic form[17]. In the literature, output volatility is generally measured as the standard deviation of the annual growth rate of GDP within a rolling five-year window (Ramey and Ramey, 1995; Blanchard and Simon, 2001; Aghion and Banerjee, 2005; Aizenman and Hito, 2012). Other methodologies exist although they are less common and straightforward. A measure of GDP growth volatility based on the standard deviation of the

[15] Bénassy-Quéré, Coupet and Mayer (2007) and Abderrezak (2008) have provided evidence supporting the view that former colonial links, through the institutional, linguistic and cultural proximities that they produce between source and host countries, may have a positive influence on the creation of international trade or FDI networks.

[16] It should be noted that Past colonial links is a good proxy for legal origin, which appears to be significant in explaining bilateral portfolio investment flows (Lane and Milesi-Ferretti 2008) as well as bilateral FDI flows (Stein and Daude 2007).

[17] Although *Source instability* is not likely to be endogenous to FDI levels, host volatility may theoretically be affected by the contemporary level of incoming FDI. To limit this risk, *Source instability i*n period t is computed as a three-year moving average including periods t-3, t-2 and t-1. The same lags have been used to compute all our average variables: MENA instability, MENA growth and Europe instability.

output gap has also been applied, but it is reported to overestimate short term volatility (Kent et al, 2005). Aizenman and Marion (2004) use the standard deviation of the innovation from a first-order autoregressive process based on twenty years of annual data. This approach requires a sufficiently long series of past data in order to be able to estimate autoregressive processes for the first sample years, which is not our case.

As for the factors associated with trade and investment integration, two variables have been introduced. RTAs (for *Regional Trade Agreements*) is a vector of dummy variables measuring each pair of countries' participation in a free trade agreement. This means that prior to the agreement being enacted, the dummies take the value 0. For each consecutive year, the value 1 is given to the FDI flow whose source and host countries are bound by an active RTA. Since our study uses a sample of both MENA and European countries, we explicitly introduce controls for membership of three regional trade agreements (*GAFTA*, *AMU* and Euro-Mediterranean Free Trade Area, noted as *MED*). The perimeter and content of these three RTAs are fairly different. AMU (for Arab Maghreb Union) is the oldest trade agreement between MENA countries. It was originally designed in 1989 to prepare for an economic and future political unity among the Arab countries of North Africa (Algeria, Libya, Mauritania, Morocco and Tunisia) but has remained fairly ineffective because of political tensions and rivalries. GAFTA (for Greater Arab Free Trade Area) was introduced in 1997 through an initiative taken by the Arab League. The agreement involved progressive reductions in customs duties and was extended to the gradual elimination of trade barriers between seventeen Arab countries (Algeria, Bahrain, Egypt, Iraq, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, United Arab Emirates and Yemen). The Euro-Mediterranean Free Trade Area (EMFTA) is a free trade zone, introduced by the Barcelona agreement adopted in 1995, which is built through (1) a series of bilateral Free Trade Agreements between the European Union and each state bordering the Mediterranean, and (2) horizontal Free Trade Agreements between the non-EU Mediterranean countries themselves, such as the Agadir agreement which came into force in March 2007. The MENA countries involved are Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Palestinian Territories, Syria, Tunisia and Turkey. Here, we focus exclusively on bilateral trade agreements between the European Union and the MENA individual host countries of our sample, as they are often associated with increased export processing FDI. Likewise, IIAs (for *International Investment Agreements*) is a vector of dummy variables measuring each pair of countries' participation in an FDI agreement. These agreements cover both bilateral and multilateral (regional) agreements like those associating the European Union with each MENA host country. Data on both RTAs and IIAs are taken from UNCTAD.

Lastly, since investment decisions made by MNCs generally use a global evaluation of host country business regulations (Ali, Fiess and MacDonald, 2012), any empirical assessment of FDI flows requires the introduction of a variable to control for institutional quality. Moreover, omitting indexes of institutional quality biases typical gravity model estimates of trade, as was shown by Ander-

son and Marcouiller (2002). Accordingly, the ICRG Investment profile comprehensive indicator[18] (denoted *Investment profile*), has been introduced into the estimations to control for these institutional elements of transaction costs[19].

As is now standard in the gravity literature (Mátyás, 1997; Feenstra, 2004; Redding and Venables, 2004), time, source country and host country fixed effects (u_t $u_i$and u_j) have been introduced in order to control for the multilateral resistance terms identified by Anderson (1979) and popularized by Anderson and Wincoop (2003). Since our model does not include time-invariant explanatory factors, the inclusion of country fixed effects would be theoretically possible without causing multicolinearity. Like various recent papers (Kleinert and Toubal, 2010; Cezar and Escobar, 2013; Andres et al. 2013), we have estimated a gravity FDI model including time-invariant country fixed effects[20]. The Hausman tests that were conducted have confirmed that the fixed effect model should be preferred to the random effect model since it is both more consistent and more efficient.

FDI datasets generally contain a large number of zeros. Several methods are used in the panel gravity model literature to deal with the issue of zero value FDI flows in a logarithmic model[21]. Santos Silva and Tenreyro (2006), however, showed that when the model does suffer from heteroscedasticity, the gravity model Poisson estimation is to be preferred. The Breush Pagan tests reported in the lower panel of columns A3.1 and A3.2 (Table A4) show that we cannot reject the hypothesis of heteroscedasticity in our case. As a result, our preferred estimator is the Poisson Pseudo-Maximum Likelihood. Results of our baseline Poisson regression are reported in Table 2 below. Since the coefficients

[18] This index captures the quality of the enforcement of business regulations and property rights by combining ratings of contract viability, risks of expropriation, repatriation of profits and delays in payments.

[19] The definition, source and descriptive statistics of the variables are reported in the Appendix.

[20] For panels with a sufficiently large number of years for the underlying factors of multilateral resistance to be able to change, however, source and host fixed effects can be time-varying (Head and Mayer, 2013). As this would lead time-varying country fixed effects to be collinear to our variables of interest, e.g. source and host country volatility, we could not opt for this strategy. One possible solution to deal with this problem would be to estimate the gravity model with time-varying fixed effects and to use the multiplicative term of source and host country volatility. However, the estimated coefficient for the latter variable is difficult to interpret, which is inappropriate given our purpose of understanding how source and host volatility independently affect FDI flows between two countries. Moreover, for panels with limited time variation, like ours, it is reasonable to assume that sources of multilateral resistance move only slowly (Bergstrand and Egger, 2007).

[21] The most common is the Eichengreen correction, coupled with Random Effect estimation, which consists of using a transformation of the form ln(1+FDI). This method is widely used because it is simple and it enables the coefficient to be interpreted as elasticity when the value of ln (1+FDI) is approximately equal to ln (FDI), which is accepted as a reasonable assumption (Eichengreen and Irwin, 1998). The model can also be estimated by using the Tobit method, which explicitly accounts for zero FDI flows, without excluding them. This increases the variation of the dependent variable, thereby producing higher values and significance for the estimated coefficients of the various determinants of FDI (Eaton and Tamura, 1994; Wei, 2000; Head and Ries, 2008). Our baseline model Random Effect estimations, with the Eichengreen correction, and with the Random Effect Tobit estimator, are reported in Table A4.

of interaction terms in non-linear models like Poisson Pseudo Maximum Likelihood cannot be directly interpreted, as discussed in Gill (2001), we follow the literature (Andrès et al., 2013) by estimating the model in incidence rate ratios (IRR). IRR can be directly interpreted as the odds of a source country choosing to invest in a host country versus the odds of not choosing that host country, instead of in mere probabilities[22]. Note that IRRs less than one reveal a negative impact of the corresponding determinant on bilateral FDI flows, whereas ratios greater than one reveal a positive impact.

4.FDI, macroeconomic volatility and trade integration

4.1 Effect of macroeconomic volatility on FDI

The baseline given by Equation (1b) was estimated first, source instability, host instability and the ICRG investment profile then being introduced step by step. The results are shown in Table 1[23].

First of all, the estimation of the baseline gravity model (Column 1.1) is in accordance with the typical results reported in the literature. Although both *source GDP* and *host GDP* significantly increase FDI flows to the four MENA countries, the IRRs do not permit verification of whether their value is close to one as predicted by the theory (Kleinert and Toubal, 2010; Anderson, 2010). As far as physical distance is concerned, our results are contrasted. Although FDI flows between two countries seem to be unaffected by the existence of common borders, they nevertheless tend to decrease with geographical distance.

As for the cultural and institutional dimensions, a common language shared by the source and host countries, and a higher quality of business regulations (*Host investment profile*) in the latter both increase FDI flows to MENA economies. If lower transaction costs, as measured by a higher institutional profile score, are associated with a higher incidence of FDI to MENA countries, the existence of past colonial links between two countries has no effect.

If we now turn to our variables of interest, i.e. source and host country instability, they have opposite impacts on the incidence of FDI. For a given level of host country instability, higher instability in the source country is associated with a higher incidence of FDI to host countries. Conversely, for a given level of source country instability, higher instability in the host country is associated with a lower incidence of FDI. Column 1.4 nevertheless shows that uncertainty in source and host countries do not cumulate their impact on the incidence of FDI.

[22] According to Gill (2010) and Andrès et al (2013), this transformation renders the specification of interaction terms straightforward as in a linear model, so that they can be estimated with standard numerical procedures as for maximum likelihood.

[23] Time series' stationarity tests for the variables of interest have been reported in the Table A5 of the Appendix. The results of the Levin-lin-chu unit-root test have been confirmed par les Im-Pesaran-Shin unit-root test.

Table 1: Poisson Pseudo Maximum Likelihood model with country and time fixed effects: Baseline model and baseline with controls

Dependant variable	1.1	1.2	1.3	1.4
FDIlevels	IRR	IRR	IRR	IRR
Source GDP	1.754 (16.62)***	1.566 (11.04)***	1.637 (13.28)***	1.639 (13.27)***
Host GDP	1.391 (11.17)***	1.599 (13.21)***	1.2172 (4.46)***	1.216 (4.46)***
Distance	.544(-2.63)***	.597 (-2.18)***	.645 (-1.93)**	.645 (-1.98)**
Adjacency	.715 (-1.20)	.732 (-1.12)	.730(-1.17)	.729 (-1.17)
Past colonial links	.825 (-0.33)	1.056 (-0.09)	.909 (-0.17)	.907 (0.17)
Common language	2.296 (2.95)***	1.957 (2.38)**	1.805 (2.16)**	1.808 (2.16)**
Source instability	-	1.030 (2.29)**	1.037 (2.87)***	1.027 (0.85)
Host instability	-	.214 (-10.66)***	.470 (-4.63)***	.466 (-4.63)***
Host investment profile	-	-	1.089 (10.16)***	1.089 (10.13)***
Source instability*Host instability	-	-	-	1.0407 (0.36)
Constant	.00002 (-6.00)***	$9.47e^{-06}$(-6.20)***	.0001 (-4.42)***	.0001 (4.92)***
Log-Likelihood	-7024.5758	-6011.887	-5960.4606	-5960.3967
Log-Likelihood ratio test	χ^2 =5337.16 ***	χ^2 = 4945.80***	χ^2 =4699.39 ***	χ^2 = 4684.39 ***
Wald test	χ^2=2182.49***	χ^2= 124637***	χ^2=1311.78***	χ^2=1311.89***
CountryFE *vs* pooled	Yes***	Yes***	Yes***	Yes***
Time effects *vs* pooled	Yes***	Yes**	Yes	Yes
Hausman Test	χ2 (6)= 44.45	χ2 (8)= 44.22	χ2 (9)= 85.34	χ2 (9) = 55.93
	Prob>chi2 = 0.0000	Prob>chi2 = 0.0000	Prob>chi2 = 0.0000	Prob>chi2 =0.0000

Notes: *, **, *** significant at 10%, 5% and 1% risk. IRRs of less than one reveal a negative impact of the corresponding determinant on bilateral FDI flows, whereas ratios greater than one reveal a positive impact.

This amounts to saying that although the incidence of FDI is higher from more unstable to less unstable economies than from less unstable to more unstable ones, a higher uncertainty in host countries does not significantly magnify or dampen the reactivity of bilateral FDI flows to source country instability.

4.2 Does trade integration matter?

Now that our baseline model has been estimated and a positive impact on FDI of source country instability, akin to a substitution effect, has been highlighted for our sample of countries, several questions arise, all connected with the intermediary role of trade integration. Whole sample results could hide the fact that European and MENA firms may react differently to host country insta-

bility in terms of their foreign investment decisions. Such a distinct behaviour could be due to differences in their exposure to foreign trade and to trade-led macroeconomic instability. More open economies often suffer from a higher level of macroeconomic instability, and firms from more open economies may also be more internationalized. As a result, the substitution effect observed in the whole sample may well reflect the fact that trade openness of the source country, which is correlated to GDP instability, has an influence on its FDI outflows. Furthermore, trade integration via RTAs may well, under these conditions, intensify the positive effect of source country instability on FDI by increasing trading opportunities. Equally, Bilateral Investment Treaties (*BITs*) may increase FDI by reducing transaction and relocation costs.

When the variables accounting for South-South (here *GAFTA* and *AMU*) and North-South (here *MED*) regional trade agreements are included in the baseline model 1.3, they all show a positive and significant coefficient (Table 2). However, although the *GAFTA* significantly increases the incidence ratio of FDI flows to MENA countries, the ratio is positively, albeit not significantly, impacted by Euro-Mediterranean trade agreements (and *AMU*). On the other hand, having concluded a BIT significantly increases the incidence of FDI flows between the signatory countries.

A second test deals with the specific influence of *RTAs* on the prevalence of substitution or revenue effects in our sample of countries. It was shown above that deeper trade integration between source and host countries*, via BITs and FTAs, may magnify the positive effect of source country volatility on FDI outflows by reducing the costs of reallocating production abroad and re-exporting from abroad (Aizenma*n and Marion, 2004; de Mello et al., 2010). It can therefore be expected that trade and investment integration may ease production reallocation abroad in the case of higher uncertainty in home economies, therefore increasing FDI outflows to the more stable host economies of the trading zone.

Table 2: Poisson Pseudo Maximum Likelihood model with country and time fixed effects: Regional trade agreements and bilateral investment agreements

Dependant variable FDI levels	2.1 IRR	2.2 IRR	2.3 IRR	2.4 IRR	2.5 IRR
Source GDP	1.481 (9.82)***	1.472 (9.39)***	1.481 (9.76)***	1.497 (14.10)***	1.474 (9.66)***
Host GDP	1.213 (3.78)***	1.188 (3.34)***	1.192 (3.42)***	1.203 (3.60)***	1.187 (3.33)***
Distance	.673 (-1.90)**	.668 (-1.90)**	.662 (-1.95)**	.654 (-2.01)**	.667 (-1.91)**
Adjacency	.735 (-1.37)	.729 (-1.42)	.727 (-1.43)	.729 (-1.42)	.729 (-1.42)
Past colonial links	1.278 (0.48)	1.245 (0.43)	1.243 (0.43)	1.212 (0.38)	1.240 (0.42)
Common language	1.058 (0.22)	1.055 (0.21)	1.054 (0.21)	1.083 (0.31)	1.057 (0.22)
Source instability	1.040 (3.02)***	1.043 (3.26)***	1.043 (3.25)***	1.042 (3.22)***	1.057 (3.41)***
Host instability	.589 (-2.69)***	.582 (-2.69)***	.580 (-2.77)***	.584 (-2.73)***	.5691 (-2.87)***
Host investment profile	1.085 (9.38)***	1.079 (8.59)***	1.079 (8.61)***	1.077 (8.40)***	1.078 (8.60)***
MED	1.034 (1.05)	1.043 (0.87)	1.028 (0.85)	1.017 (0.53)	1.035 (1.07)
AMU	1.879 (1.39)	1.893 (1.41)	2.122 (1.64)	1.944 (1.47)	1.896 (1.41)
GAFTA	1.239 (2.97)***	1.202 (2.55)***	1.238 (2.89)***	1.577 (4.91)***	1.202 (2.54)***
IIAs	1.153 (3.69)***	1.153 (3.69)***	1.151 (3.65)***	1.153 (3.69)***	1.160 (3.83)***
Source instability*MED	-	.9401 (-0.22)	-	-	-
Source instability*AMU	-	-	.471 (-1.86)*	-	-
Source instab.*GAFTA	-	-	-	.188 (-4.51)***	-
Source instability*IAAs	-	-	-	-	.9658 (-1.32)
Constant	.0008 (4.07)***	.001 (-3.72)***	.0013 (-3.72)***	.0009 (-3.97)***	.0014 (-3.73)***
Log-Likelihood	-5277.964	-5268.7747	-5267.0546	-5258.4314	-5267.921
Log-Likelihood ratio test	χ^2 = 2572.83 ***	χ^2=2561.87 ***	χ^2 = 2567.23 ***	χ^2 =2566.66 ***	χ^2 =2565.36 ***
Wald test	χ^2 =1076.08***	χ^2 =1084.39***	χ^2 =1085.76***	χ^2 =1103.70***	χ^2 =1086.22***
Country FE vs pooled	Yes***	Yes***	Yes***	Yes***	Yes***
Time effects vs pooled	Yes*	Yes**	Yes**	Yes**	Yes**
Hausman test	χ2 (13) = 41.70	χ2 (13) = 22.25	χ2 (14) = 48.95	χ2 (14)= 36.39	χ2 (14) = 73.73
	Prob>chi2 = 0.0000	Prob>chi2 = 0.07	Prob>chi2 =0.0000	Prob>chi2 = 0.0000	Prob>chi2 =0.0000

Notes: *, **, *** significant at 10%, 5% and 1% risk. IRRs of less than one reveal a negative impact of the corresponding determinant on bilateral FDI flows, whereas ratios greater than one reveal a positive impact

In order to identify the extent to which North-South (here Euro-Mediterranean trade agreement) and South-South RTAs (here GAFTA and AMU) have increased or decreased the sensitivity of FDI to host country macroeconomic conditions, we have successively estimated the baseline model 1.3 augmented by the multiplicative terms *Host instability*MED*, H*ost instability*AMU*, *Host instability*GAFTA* and *Host instability*BITs*. Column 2.2 shows that the magnitude and the positive sign of the source instability term are left unchanged by the introduction of the former interactive term. This means that restricting the impact on FDI of source instability on the pairs of countries (and the years) associated with the Euro-Mediterranean trade agreement does not significantly alter the overall effect of source instability that is measured for the whole sample. On the contrary, *Host instability*UMA* and *Host instability*GAFTA* both exhibit an estimated coefficient of less than one and a very low estimated coefficient (Columns 2.3 and 2.4), signalling that when it is restricted to South-South intraregional trade agreements, the incidence of FDI flows certainly tends to decrease with source instability. Finally, BITs have no significant impact on the

sensitivity of the incidence of FDI to source country uncertainty (Column 2.5).

4.3. Does the type of FDI matter?

Since theory predicts that vertical and horizontal investment will react differently to increased uncertainty, our main result, that FDI flows from highly volatile to weakly volatile countries, must be further tested in a gravity model which is more specifically adapted to explaining vertical investment, the type of investment which is expected to be the most reactive to trade integration. Although vertical investment (efficiency-seeking) is more heterogeneously distributed across source and host countries than horizontal FDI[24], it tends to be stimulated by higher trade integration. Busse et al (2010) claim that vertical FDI should figure more prominently for MNCs based in traditional source countries where wage costs tend to be higher, on average, than in less advanced source countries. Similarly, Andrès et al (2013) have provided evidence that vertical investment tends to be more prevalent for traditional MNCs (from developed source countries) than for new ones (from developing source countries)[25]. It can thus be expected in our sample that North-South FDI flows (from Europe to MENA) will be predominantly of a vertical nature, whereas South-South flows (from MENA to MENA) will be predominantly horizontal[26]. Table A4 in the Appendix shows that, for any two countries related by the Euro-Mediterranean agreements or by international investment treaties, the incidence of FDI flows is less sensitive to the traditional drivers of vertical investment than it is for the whole sample. This means that, for our sample of countries, trade and investment integration ease North-South vertical FDI by reducing the cost gap and the market size that are required to invest.

In contrast, Column A4.5 shows that *Host GDP*GAFTA* is greater than one, suggesting that the GAFTA South-South trade agreement has increased the sensitivity of the incidence of FDI to the traditional determinant of market-seeking horizontal investment, i.e. the size of the host economy. This means that South-South regional trade integration has increased the incidence of horizontal investment between the developing countries of the MENA region.

We now have to test whether vertical and horizontal investments are impacted differently by source instability. As noted by Busse et al. (2010), the difference between the average per-capita income in the source country and that in the host country is typically used to capture the relevance of vertical FDI undertaken by relatively rich source countries in poorer host countries. According to the knowledge-capital model of MNCs, skill differences between the labour force in the source and the host countries would be a preferred indicator (Carr et al. 2001).

[24] Surveys show that it varies considerably among developing countries' MNCs depending on their country or region of origin and on their industry (CNUCED, 2006, 158-9).

[25] In Asian countries, like Taiwan, vertical investment to China has become the response of new MNCs to the erosion of their export competitiveness (Aykut and Ratha, 2003; Liu and Nunnenkamp, 2011).

[26] See Nicet-Chenaf and Rougier (2014) for an additional empirical test of this assumption on the same dataset.

Table 3: Poisson Pseudo Maximum Likelihood model with country and time fixed effects: instabilities and types of FDI

Dependant variable FDI levels	3.1 IRR	3.2 IRR	3.3 IRR	3.4 IRR	3.5 IRR
Source GDP	.836 (3.21)***	1.344 (6.51)***	.831 (3.23)***	1.328 (6.15)***	1.636 (13.21)***
Host GDP	.950 (3.66)***	1.186 (3.27)***	.949 (3.79)***	1.1913 (3.34)***	1.218 (4.47)***
Distance	.722 (-1.37)	.720 (-1.50)	.723 (-1.37)	.724 (-1.47)	.645 (-1.93)**
Adjacency	727 (-1.32)	735 (-1.37)	.727 (-1.32)	.822 (-0.87)	.730 (-1.17)
Past colonial links	1.152 (0.26)	.813 (0.92)	1.153 (0.26)	1.378 (0.63)	.911 (-0.17)
Common language	.969 (0.11)	1.152 (0.54)	.968 (0.12)	1.164 (0.57)	1.803 (2.15)**
Source instability	1.035 (2.67)***	1.048 (3.62)***	1.165 (0.27)	1.122 (3.03)***	1.091 (-0.55)
Host instability	.551 (-3.03)**	.567 (-2.88)***	.705 (-1.74)	.555 (-2.99)*	.470 (-4.62)***
Host investment profile	1.084 (9.04)***	1.079 (8.63)***	1.084 (-9.04)***	1.079 (8.61)***	1.090 (10.17)***
MED	1.042 (1.28)	1.019 (0.60)	1.043 (1.28)	1.018 (0.50)	-
AMU	2.104 (1.48)	1.947 (1.43)	2.106 (1.48)	1.953 (1.43)	-
GAFTA	1.216 (2.69)***	1.228 (2.83)***	1.216 (2.69)***	1.228 (2.83)***	-
BITs	1.151 (3.63)***	1.153 (3.70)***	1.150 (3.69)**	1.153 (3.68)***	-
Market size	2.213 (4.01)***	-	2.230 (3.98)***	-	-
GDP per capita difference	-	1.159 (5.16)***	-	1.180 (5.40)***	-
Marketsize*Source instability	-	-	.994 (-0.21)	-	-
GDPpcDiff.*Source	-	-	-	.979 (-1.87)*	-
instability	-	-	-	-	.997 (-0.29)
GDPhost*Source instability	.0004 (-4.3)***	.003(-3.17)***	.0003 (-4.03)***	.0033 (-3.13)***	.0001 (-4.49)***
Constant					
Log-Likelihood	-5260.51	-5254.06	-5262.27	-5252.43	-5960.41
Log-Likelihood ratio test	χ^2=2467.52 ***	χ^2 = 2507.47 ***	χ^2 = 2451.75 ***	χ^2 = 2469.95 ***	χ^2 =4687.25 ***
Wald test	χ2= 1095.59***	χ2=1102.55***	χ2= 1093.62***	χ2=1103.29***	χ^2=1311.85***
Country FE *vs* pooled	Yes***	Yes***	Yes***	Yes***	Yes***
Time effects *vs* pooled	Yes**	Yes**	Yes***	Yes**	Yes
Hausman test	χ2 (14) =25.48 Prob>chi2=0.0000	χ2 (14) =33.38 Prob>chi2=0.0025	χ2 (15)= 30.48 Prob>chi2 =0.010	χ2 (15) =32.75 Prob>chi2 =0.005	χ2 (10)= 70.32 Prob>chi2=0.0000

Notes: *, **, *** significant at 10%, 5% and 1% risk. IRRs of less than one reveal a negative impact of the corresponding determinant on bilateral FDI flows, whereas ratios greater than one reveal a positive impact.

However, the relevant data are missing for many host countries. The *Difference in GDP per capita* (in log form) between the two countries is therefore used as a proxy for the differences in factor endowments or in the level of economic and technological development in each country. The coefficient takes a positive sign if FDI is attracted by low labour costs, and a negative sign if the FDI-related labour requirements are more skill-intensive. As in Kleinert and Toubal (2010), an additional variable, the sum of source and host countries' GDP per capita, is generally added to assess the size of the demand for the goods provided by the vertical investment. It is expected that vertical investment will increase with the skill difference as well as with the size of the demand by the two countries (Kleinert and Toubal, 2010)[27].

[27] Busse et al (2010) also test the vertical or efficiency-seeking FDI model by incorporating the difference in per-capita GDP between the source and the host country (diffgpdpc). In addition, they take into account the fact that the host country's openness to trade (hosttrade)

The results reported in column 3.2 mean that, for the countries in our sample, the greater the technological distance, the greater the incidence of FDI between the country pair, therefore suggesting that FDI to MENA countries may be equally vertical and horizontal. Such a positive impact is however reduced by the event of a higher inequality in the source country. This suggests, as attested by the value of the estimated IRR of less than one for the interaction between *GDP per capita difference* and *Host instability* (Column 3.4), that the sensitivity of FDI to the cost differential between the source and host countries tends to be lowered when instability is higher in the source economy[28]. As for the second factor of vertical investment, i.e. *Market size*, columns 3.1 and 3.3 show that although a higher market size of the pair of countries may increase the incidence of FDI between them, uncertainty in the home market has no significant influence on this relationship. To conclude, there is weak evidence that the choice of investing to produce abroad is less sensitive to cost concerns when MNCs are exposed to higher uncertainty at home. For the same level of cost differential, the incidence of vertical FDI thus tends to be higher when uncertainty is high than when uncertainty is low. Finally, column 3.5 shows that, for the whole sample, the effect of the main determinant of horizontal FDI, i.e. size of the host country's economy, is not significantly affected by source instability.

5. Robustness checks

In this section, we address additional issues relating to the robustness of the results discussed in section 4.

5.1. Robustness 1: Source instability measurement

It could be objected that insofar as the value of a distribution's standard deviation is proportional to the value of its arithmetic mean, the positive coefficient estimated for source country volatility could therefore reflect revenue rather than a substitution effect. The more volatile domestic markets (as measured by the standard deviation) may also be the most dynamic ones (as measured by average GDP growth). The MNCs operating in these markets may therefore invest more abroad because their revenues are higher, and not because of a substitution effect. In order to test the robustness of this substitution effect, once the possibility of such a size effect is ruled out, a coefficient of variation has been used in Column 4.1 of Table 4 as a replacement for the standard deviation without modifying the core results. Since the coefficient of *Source instability* remains greater than one even after controlling for the size effect, we can rule out the argument that the positive impact of the standard deviation of GDP growth

may induce vertical FDI, arguing that closed economies are hardly attractive to vertical FDI which involves fragmented production patterns and international trade in intermediates. This variable is never significant and may be correlated to RTAs and it is not included in our specification which is more akin to that of Kleinert and Toubal (2010).

[28] The statistical significance of this effect is however weak.

is not driven by the fact that the most volatile countries are also those where the growth rates of aggregate income and corporate revenues are the highest. By simultaneously rejecting the revenue effect at the level of the source country's MNCs, this test reinforces the conclusion that our sample of countries shows a substitution effect caused when the source country's macroeconomic instability increases.

5.2. Robustness 2: Alternative sources of uncertainty in the host country

Since there is a risk that source country macroeconomic instability may be correlated to a global, or at least regional, trend, we have to check whether the effects estimated for our overall sample hold when the perimeter of external instability is extended to the source country's region or to the world economy.

Various measurements of global and regional macroeconomic trends have been successively introduced as additional controls in the baseline model (Column 2.3) estimation: (1) the lagged three-year averaged world GDP growth, (2) the lagged three-year averaged European Union GDP growth, (3) the lagged three-year averaged standard deviation of world GDP growth, (4) the lagged three-year averaged standard deviation of European Union GDP growth. As expected, the estimated coefficient of the first two variables takes a positive and significant value, whereas that of the last two variables is negative and significant. It means that the incidence of FDI flows tends to increase with world and European GDP growth, and to decrease when growth becomes more unstable. On the other hand, the inclusion of these four variables in the baseline model 1.3 does not change the estimated values of the Source and Host instability IRRs (Table 4). This suggests that the positive FDI effect found in the baseline estimation is not driven by the possible correlation between GDP instability in the source country and a global, or at least regional, trend of macroeconomic instability.

Table 4: Poisson Pseudo Maximum Likelihood model with country and time fixed effects: instabilities, RTAs and BITs and global instability

Dependant variable FDI levels	4.1 IRR Global FDI waves	4.2 IRR European FDI waves	4.3 IRR 3-year world GDP growth	4.3 IRR 3-year world GDP standard deviation
Source GDP	1.333 (6.26)***	1.339 (6.38)***	1.337 (6.38)***	1.386 (7.05)***
Host GDP	1.140 (2.13)**	1.169 (2.76)***	1.225 (3.78)***	1.204 (3.59)***
Distance	.733 (-1.41)	.725 (-1.47)	.709 (-1.59)	.708 (-1.60)
Adjacency	.812 (-0.93)	.813 (-0.98)	.813 (-0.91)	.819 (-0.89)
Past colonial links	1.371 (0.66)	1.366 (0.61)	1.381 (0.64)	1.283 (0.49)
Common language	1.111 (0.40)	1.136 (0.48)	1.157 (0.55)	1.264 (0.88)
Source instability	1.047 (3.55)***	1.048 (3.58)***	1.047 (3.55)***	1.051 (3.80)***
Host instability	1.879 (3.05)***	.583 (-2.68)***	.522 (-3.27)***	.662 (-2.00)***
Host investment profile	1.073 (7.78)***	1.076 (7.48)***	1.075 (8.20)***	1.074 (8.00)***
MED	1.007 (1.22)	1.013 (0.39)	1.006 (1.20)	1.037 (1.10)
AMU	1.940 (1.43)	1.942 (1.43)	1.912 (1.39)	1.998 (1.50)
GAFTA	1.212 (2.62)***	1.220 (2.71)***	1.213 (2.66)***	1.230 (2.85)***
BITs	1.155 (3.72)***	1.154 (3.71)***	1.148 (3.55)***	1.154 (3.70)***
Market size	2.248 (4.49)***	2.471 (4.67)***	2.272 (4.02)***	2.625 (4.76)***
GDPpercapitadifference	1.1560 (5.01)***	1.157 (5.10)***	1.150 (4.86)***	1.170 (5.44)***
World FDI waves	1.035(1.19)	-	-	-
Europe FDI waves	-	1.015 (0.62)	-	-
3-year world GDP growth	-	-	1.020(2.91)***	-
3-year world GDP SD	-	-	-	.999 (-2.49)***
Constant	.0026 (-3.26)***	.002 (-3.21)***	.0022 (-3.34)***	.001 (-3.58)***
Log-Likelihood	-5253.3654	-5253.8557	-5249.7904	-5250.9783
Log-Likelihood ratio test	χ^2 = 2503.74 ***	χ^2 = 2502.15 ***	χ^2 = 2510.05***	χ^2 =2488.99 ***
Wald test	χ^2 =1104.54***	χ^2 = 1103.54***	χ^2 = 1107.69***	χ^2 = 1106.67***
Country FE vs pooled	Yes***	Yes***	Yes***	Yes***
Time effects vs pooled	Yes**	Yes**	Yes**	Yes**
Hausman Test	χ2 (16) =29.86	χ2 (16)= 28.09	χ2 (16) =26.00	χ2 (16)= 17.17
	Prob>chi2=0.0142	Prob>chi2=0.0138	Prob>chi2 =0.025	Prob>chi2 =0.24

Notes: *, **, *** significant at 10%, 5% and 1% risk. IRRs of less than one reveal a negative impact of the corresponding determinant on bilateral FDI flows, whereas ratios greater than one reveal a positive impact.

In order to test whether the positive effect on FDI of source countries' GDP instability is not an *artefact* produced by the correlation between our sample countries outward FDI and a more global trend of increased FDI, an indicator of global waves of FDI[29] and an indicator of European waves of FDI have also been successively introduced into the estimation of model 1.3. These two controls have a non-significant impact on FDI flows and their addition to the estimated model leaves the coefficient for source country instability unchanged.

The possible influence of world price variations on FDI decisions has also been tested using the yearly average levels of commodity industrial inputs (including agricultural raw materials and metals) price index and of the crude oil

[29] Similarly to Méon and Sekkat (2012), the World FDI wave indicator consists of the annual value of world FDI outflows; similarly, the European FDI wave is computed as the annual value of European FDI outflows.

price[30]. The tested assumptions were that (1) decisions to invest in certain MENA countries could be motivated by changes in the prices of commodities extensively exported by some countries of the region such as Egypt, Morocco or Tunisia, and (2) that, if source country volatility was provoked by such commodity prices, the positive effect on FDI of source country instability would reflect the fact that FDI to commodity-exporting countries increases when world commodity prices become higher, and that there was not a substitution effect. Our estimations show that both the commodity and oil price indexes have an adverse effect on the incidence of FDI on the whole sample. The fact that the incidence of FDI to MENA countries decreases when commodity and oil prices increase suggests that it is not motivated by access to extractive resources, but is, instead, more akin to vertical investment whose costs increase with commodity prices. Finally, the inclusion of these price controls does not change the magnitude and sign of the source instability variable (Columns 5.4 and 5.5).

[30]Both were taken from the IMF World Economic Outlook online database.

Table 5: Poisson Pseudo Maximum Likelihood model with country and time fixed effects: instabilities, RTAs and BITs and other sources of macroeconomic instabilities

Dependant variable FDI levels	5.1 IRR Coeff. variation	5.2 IRR Crude oil petrol	5.3 IRR Commodity price index	5.4 IRR Inflation	5.5 IRR Exchange Rate
Source GDP	1.740 (2.72)***	1.749 (2.88)***	1.347 (6.10)***	1.788 (3.51)***	1.742 (2.92)***
Host GDP	1.944 (2.22)**	1.041 (2.51)***	1.347 (2.11)***	1.938 (2.82)***	1.944 (2.57)***
Distance	.776 (-1.08)	.725 (-1.31)*	.661 (-1.89)*	.783 (-1.07)	.773 (-1.05)
Adjacency	.819 (-0.82)	.834 (-0.73)	.815 (-0.89)	.817 (-0.84)	.813 (-0.87)
Past colonial links	1.287 (0.46)	1.169 (0.29)	1.252 (0.44)	1.244 (0.40)	1.279 (0.44)
Common language	1.052 (1.18)	1.294 (0.88)	1.406 (1.24)	1.050 (0.18)	1.047 (0.16)
Source instability (SE)	-	1.046 (3.40)***	1.054 (4.06)***	1.040 (2.98)***	1.042 (3.11)***
Source instability (CV)	1.879 (3.05)***	-	-	-	-
Host instability	.542 (-3.11)***	.628 (-2.33)***	.655 (-2.12)***	.530 (-3.22)***	.498 (-3.51)***
Host investment profile	1.083 (9.00)***	1.078 (8.31)***	1.073 (7.93)***	1.075 (7.66)***	1.080 (8.58)***
MED	2.218 (1.54)	1.067 (1.94)**	1.055 (1.59)	1.029 (0.97)	1.034 (1.02)
AMU	1.927 (1.22)	2.291 (1.59)	1.996 (1.49)	2.225 (1.57)	2.208 (1.52)
GAFTA	1.240 (2.96)***	1.256 (3.12)***	1.246 (3.02)***	1.238 (2.93)***	1.246 (3.02)***
BITs	1.152 (3.66)***	1.135 (3.25)***	1.138 (3.34)***	1.141 (3.40)***	1.150 (3.60)***
Market size	2.288 (4.09)***	2.481 (4.47)***	2.372 (4.27)***	2.151 (3.76)***	2.289 (4.08)***
GDPpercapitadifference	1.161 (5.21)***	1.168 (5.41)***	1.168 (5.39)***	1.163 (5.29)***	1.151 (4.91)***
Crude Oil price	-	.995 (-4.78)***	-	-	-
Commodity Price index	-	-	.996(-4.36)***	-	-
Host inflation	-	-	-	.964 (-2.34)***	-
Host exchange rate instability		-	-	-	.938 (-2.89)***
Constant	.0008 (-3.48)***	.00004 (-4.75)***	.0002 (-4.39)***	.001 (-3.46)***	.0009 (-3.46)***
Log-Likelihood	-5245.3218	-5234.0992	-5244.4365	-5242.739	-5241.2839
Log-Likelihood ratio	χ^2 =2425.12 ***	χ^2 = 2409.43 ***	χ^2= 2485.05 ***	χ^2 = 2429.58 ***	χ^2 = 2430.57 ***
test	χ^2 = 1116.19***	χ^2 = 1120.11***	χ^2 = 1106.82***	χ^2 = 1119.59***	χ^2 = 1119.28***
Wald test	Yes***	Yes***	Yes***	Yes***	Yes***
Country FE *vs* pooled	Yes**	Yes**	Yes**	Yes**	Yes**
Time effects *vs* pooled	χ2 (16) = 29.48	χ2 (16) = 49.49	χ2 (16) = 41.63	χ2 (16) = 52.99	χ2 (16) = 27.39
Hausman Test	Prob>chi2=0.0142	Prob>chi2=0.0000	Prob>chi2 =0.0000	Prob>chi2 =0.0000	Prob>chi2 =0.0374

Notes: *, **, *** significant at 10%, 5% and 1% risk. IRRs of less than one reveal a negative impact of the corresponding determinant on bilateral FDI flows, whereas ratios greater than one reveal a positive impact.

Nominal instability in host country may also affect the level of FDI inflows. Since inflation increases uncertainty about the future value of liabilities and assets acquired by the MNC, it should adversely influence FDI inflows since incoming investments which could have long-term higher returns are generally not implemented (Krueger, 1992). Although mixed, the empirical evidence for this adverse effect is nevertheless mixed: whereas more inflation does not appear to be a significant determinant of FDI inflows for Frenkel, Funke and Stadtmann (2004), it does significantly reduce incoming investment for Garibaldi et al. (2001) and Tapsoba (2012). As for exchange rate instability, its FDI impact is more ambiguous, both theoretically and empirically. It is generally considered, however, that horizontal FDI might be triggered by exchange rate volatility whereas vertical investment may conversely be depressed (Aizenman and Marion, 2004). In line with Kaminsky, Lizondo and Reinhart (1998) and

Ahluwalia (2000), we implement for each host country an ex-post identification of the periods during which they were affected by such a crisis. To this end, an index, combining variations of the nominal exchange rates and variations in the foreign exchange reserves, has been computed (See Appendix 1 for details). Although they reduce the incidence of FDI flows, nominal sources of host country instability (inflation and exchange rate instability) modify neither the magnitude of IRR nor the significance of host country instability.

6. Conclusion

Using a gravity model, the present paper tests the assumption that foreign direct investment is reactive to macroeconomic instability in both source and host countries in a sample of European and MENA countries for the period 1985-2009. In order to diversify their risks, firms facing increased demand uncertainty in their domestic market may choose to increase their investment abroad by transferring production to the more stable host economies. In that case, they may choose to invest in destinations where uncertainty and trade costs are the lowest. From this theoretical model, we draw the assumption that aggregate FDI outflows may be higher from more volatile home countries and FDI inflows may be higher for host economies where uncertainty is the lowest. Using a reduced form model, we show that the incidence of FDI between two countries increases with source GDP instability and with host GDP stability. We also find that this reactivity is conditioned by (1) trade and investment agreements and by (2) the type of FDI (vertical or horizontal).

The impact of output volatility on FDI location in Middle Eastern and North African countries is analysed within the framework of a gravity model. As such a model allows the risks and costs associated with distance (geographical, linguistic and legal) to be controlled for, this enables the impact of macroeconomic sources of risks and costs on FDI to be differentiated from other sources of risks and costs. Additionally, since the gravity model allows the effect on FDI of various determinants concerning source countries to be assessed, our paper has been able to pay special attention to the impact of source country output volatility on FDI. We could therefore consider output volatility in both source and host countries, and find evidence of opposing impacts on FDI flows for these two variables, when controlling for bilateral and host country characteristics such as economic and political risk, trade openness and distance.

Our results raise several policy issues. Trade integration does not necessarily improve developing countries' capacity to attract vertical foreign investment. On the one hand, the reduction of microeconomic transaction costs and the increase in the market size tend to increase levels of FDI to developing economies. On the other hand, our findings relating to MENA economies show that RTAs tend to raise the macroeconomic costs associated with partner countries' volatility. This is especially true of South-South FDI (here, FDI received by MENA countries from other MENA countries) which appears to be pro-cyclical, with source country macroeconomic instability depressing FDI to other countries of the region and of the RTA. The opposite seems to be true for FDI coming from

more traditional (Western European) sources. Thus, deepening integration with central European economies, via association agreements, would be more beneficial to MENA economies than increasing purely regional integration since it could reduce the risks related to pro-cyclical FDI behaviour.

However, our results are drawn from the estimation of a reduced form model and they would certainly be strengthened if supported by the estimation of a structural model breaking down and articulating the decision to invest abroad and the choice of the location. Equally, our results are based on a limited dataset, in particular as regards host countries on which we have not focussed. However, the results would certainly be strengthened if confirmed for a larger sample including more source and host countries.

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Appendix

Appendix 1: The exchange rate crisis indicator

Equation 2 shows that the indicator consists in a weighted average of the variations of the nominal exchange rate and in the exchange reserves. These two variables, computed as quarterly variations on the basis of monthly average levels, are respectively named ΔTCN and ΔRES. The weights respectively measure the shares of the variance of the exchange rate and of the foreign exchange reserves in the sum of these variances.

$$IND = \left(\frac{\frac{1}{\sigma^2_{TCN}}}{\left(\frac{1}{\sigma^2_{TCN}} + \frac{1}{\sigma^2_{RES}} \right)} \right) * \Delta TCN + \left(\frac{\frac{1}{\sigma^2_{RES}}}{\left(\frac{1}{\sigma^2_{TCN}} + \frac{1}{\sigma^2_{RES}} \right)} \right) * (-1) * \Delta RES \qquad (3)$$

This index, designed to reflect the intensity of the pressures that a national currency undergoes during an episode of balance of payments crisis, enables the severity of those periods of external instability to be assessed. It should be noted that a negative sign for the average monthly variation of the foreign exchange reserves enables to get the highest level of the index when the crisis is imminent (Ahluwalia, 2000). The instability threshold above which whether a country *j* is affected by a crisis at date *t* is defined on a country-by-country basis and not for the whole sample. It is obtained by considering both the average level ($Mean_{IND}$) and the standard deviation (σ_{IND}) of IND. A crisis is detected when IND is superior or equal to $Mean_{IND} + \sigma_{IND}$. That threshold definition corresponds to the minimal bound found in the literature. A higher threshold ($1{,}5*\beta_{IND} + \sigma_{IND}$) would have resulted in an insufficient variation of the variable. Subsequently, a binary variable *Exchange rate instability* has been created, with this variable taking the value 1 if IND = $Mean_{IND} + \sigma_{IND}$ and 0 otherwise. In order to transpose these quarterly crises data into annual impacts, it is commonly admitted that any episode of crisis duration exceeding a period of three months will have effects on the current year, which means that the crisis could be regarded as annual. In order to avoid reverse causality with FDI inflows, a crisis in year *t* has been imputed in estimation as a determinant of FDI inflows in *t+1*.

Table A1: Data sources and definitions

Variables	*Description*	*Data Source*
FDI	The value in thousands of US dollars of flows of foreign direct investment (FDI) from one country (source country) towards another country (host country)	OECD, UNCTAD; Balance of payments of Morocco, Central Bank of Tunisia
Host GDP	GDP in thousands of US dollars	CEPII, CHELEM database
Source GDP	GDP in thousands of US dollars	CEPII, CHELEM database
GDP per capita difference	Difference in GDP per capita (thousands of US dollars) between source and host country	CEPII and IMF International Financial statistics for population data
Distance	Distance in kilometres between source and host countries' capitals	CEPII, Geo dataset
Adjacency	Common Border between source and host countries (takes the value 1 if the two countries share a common border, and 0 otherwise)	CEPII, Geo dataset
Common language	Common official language for source and host countries (takes the value 1 if the two countries share a common language, and 0 otherwise)	CEPII, Geo dataset
Common colonial power	Common colonizer for source and host countries (takes the value 1 if the two countries had a common colonizer, and 0 otherwise)	CEPII, Geo dataset
Past colonial links	Dummy variable taking the value 1 if host country was colonized by source country, and 0 otherwise	CEPII, Geo dataset
Investment profile	Host country's score for institutional risk to FDI including ratings of contract viability, risks of expropriation, profit repatriation and payment delays. Highest score equates to very low risk.	ICRG database
Source instability Host instability	3-year standard deviations of GDP growth for host and source countries	Authors' calculations CEPII, CHELEM database
MED, GAFTA, AMU	Dummy variables taking the value 1 for the countries-years covered by these bilateral or multilateral trade agreements, and 0 otherwise	Authors' calculations based on UNCTAD
BITs	Dummy variable taking the value 1 for the countries-years covered by a bilateral international investment agreement, and 0 otherwise	Authors' calculations based on UNCTAD
Market size	Sum of source and host GDPs	Authors' calculations CEPII, CHELEM database
GDP per capita difference	Source GDP per capita minus host GDP per capita	Authors' calculations CEPII, CHELEM database
World FDI wave	World levels of FDI flows in value	UNCTAD
Europe FDI wave	European Union (UE25) levels of FDI flows in US Dollars	UNCTAD
3-year world GDP growth	Three-year moving average of world GDP growth	Authors' calculations on the basis of IMF data
3-year world GDP SD	Three-year moving standard deviation of world GDP growth	Authors' calculations on the basis of IMF data
Commodity price index	Commodity industrial inputs (including agricultural raw materials and metals) price index	IMF WEO
Crude oil price	Crude oil price	IMF WEO
Inflation host	Annual rate of inflation in the host country	Authors' calculations on the basis of IMF data
Exchange rate instability	Index taking the value 1 if the country has experienced a large variation in the value of the real exchange rate or of the foreign currencies reserves, and 0 otherwise	Authors' calculations on the basis of IMF data

Table A2
List of countries in the sample

Algeria	Germany	Mauritania	Sweden
Austria	Greece	**Morocco**	Switzerland
Belgium-Luxembourg	Hungary	Netherlands	Syria
Czech Republic	Ireland	Norway	**Tunisia**
Denmark	Italy	Poland	**Turkey**
Egypt	Jordan	Portugal	United Kingdom
Finland	Libya	Romania	
France	Malta	Spain	

Note: the four MENA host countries are shown in bold

Table A3: FDI levels: Eichengreen correction and Tobit RE estimations

Estimator	Eichengreen's correction RE estimator		Tobit RE estimator	
	A3.1	A3.2	A3.3	A3.4
GDP source	1.608 (16.29)***	1.532 (14.34)***	1.608 (16.45)***	1.522 (13.78)***
GDP host	1.081 (11.09)***	1.072 (9.70)***	1.079 (11.13)***	1.081 (9.58)***
Distance	- 1.016 (-2.85)***	-.996 (-2.70)***	-1.016 (-2.89)***	-.994 (-2.59)***
Adjacency	-.570 (-1.20)	-.679 (-1.39)	-.569 (-1.22)	-.676 (-1.34)
Past colonial links	.130 (0.13)	.649 (0.62)	.130 (0.13)	.676 (0.62)
Common language	1.862 (3.93)***	1.720 (3.50)***	1.862 (3.99)***	1.711 (3.34)***
Instability source	-	.237 (2.68)***	-	.237 (2.69)***
Instability host	-	-.634 (-1.04)	-	-.617 (-1.09)
Constant	-37.651 (-11.94)***	-36.047 (-10.57)***	-37.630 (-12.07)***	-36.041 (-10.24)***
R^2 within	0.20	0.15		
R^2 Between	0.53	0.53		
R^2 Total	0.39	0.39		
Tests	Fisher Test : MCO vs individual FE F(134, 3238) = 21.32 Pr>F=0.000	Fisher Test : MCO vs individual FE F(134, 2696) = 21.34 Pr>F=0.000	Log likhd = -8472.271	Log likhd=-7087.8369
	Fisher Test : MCO vs time : FE F(24, 3244) = 3.61 Pr>F=0.000	Fisher Test : MCO vs time : FE F(20, 2806) = 2.27 Pr>F=0.000	Wald χ^2=992.20*** Prob > chi2 = 0.0000	Wald χ2= 642.25*** Prob > chi2 =0.0000
	Hausman test χ^2 = 3.61 Pr>χ^2 = 0.1604 Wald χ^2= 990.96***	Hausman test χ^2 = 22.52 Pr>χ^2 =0.040 Wald χ^2=651.60***		
Breush Pagan $\chi^2_{(1)}$ test	χ^2 = 6654.43 Pr>χ^2 =0.000	χ^2 = 5727.60 Pr>χ^2 =0.000		

Notes: *, **, *** significant at 10%, 5% and 1% risk. Number of observations: 3375; Number of years : 23; Number of country-pairs: 27*5=135)

Table A4: Poisson Pseudo Maximum Likelihood model with country and time fixed effects: instabilities, RTAs and BITs and types of FDI

Dependant variable FDI levels:	A4.1 IRR	A4.2 IRR	A4.3 IRR	A4.4 IRR	A4.5 IRR
Source GDP	.836 (3.80)***	1.299 (5.62)***	.901 (3.68)***	1.287 (5.34)***	1.417 (8.31)***
Host GDP	1.050 (3.63)***	1.206 (3.56)**	1.017 (3.23)***	1.216 (3.68)***	1.198 (3.47)***
Distance	.727 (-1.33)	.731 (-1.43)**	.742 (-1.15)	.725 (-1.43)	.661 (-1.86)*
Adjacency	.724 (-1.34)	.826 (-0.85)	.747 (-1.22)	.824 (-0.85)	.717 (-1.46)
Past colonial links	1.343 (0.54)	1.404 (0.66)	1.262 (0.43)	1.437 (0.70)	1.377 (0.61)
Common language	.968 (-0.11)	1.168 (0.59)	1.022 (0.08)	1.153 (0.53)	.977 (-0.08)
Source instability	1.025 (1.93)**	1.047 (3.54)***	1.030 (2.24)***	1.047 (3.53)***	1.045(3.40)***
Host instability	.687 (-1.88)*	.601 (-2.58)***	.617 (-2.44)***	.589 (-2.69)***	.542 (-3.10)***
Host investment profile	1.070 (7.55)***	1.075 (8.24)***	1.081 (8.75)***	1.078 (8.51)***	1.079 (8.62)***
MED	1.018 (8.20)***	1.482 (4.15)***	1.080 (2.33)**	1.045 (0.34)	1.056 (1.67)
AMU	2.624 (1.91)*	2.235 (1.73)	2.291 (1.64)	2.089 (1.54)	1.867 (1.33)
GAFTA	1.087 (1.14)	1.163 (2.03)**	1.039 (0.52)	1.081 (1.03)	.001 (-3.99)***
BITs	1.149 (3.58)***	1.143 (3.47)***	3.673 (6.48)**	1.619 (6.47)***	1.141 (3.43)***
Market size	2.056 (3.58)***	-	2.101 (3.69)***	-	-
GDP per capita difference	-	1.239 (6.57)***	-	1.268 (7.15)***	-
Market size*Med	.799 (-9.15)***	-	-	-	-
GDP per capita diff*Med	-	.884 (-4.21)***	-	-	-
Marketsize*BITs	-	-	.840 (-6.25)***	-	-
GDP per capita diff*BITs	-	-	-	.873 (-5.36)***	-
Host GDP*GAFTA	-	-	-	-	1.459(4.11)***
Constant	.00008 (-4.69)***	.0033 (-3.13)***	.00005 (-4.89)***	.0033 (-3.13)***	.002 (-3.17)***
Log-Likelihood	-5217.31	-5244.96	. -5240.87	-5239.36	-5260.3756
Log-Likelihood ratio test	χ^2 = 2409.70 ***	χ^2 = 2280.49 ***	χ^2 =2476.61***	χ^2 =2522.02***	χ^2=2565.36***
Wald test	χ2= 1138.79***	χ2=1101.46***	χ2=1112.46***	χ2= 1109.76***	χ^2=1102.22
Country FE *vs* pooled	Yes***	Yes***	Yes***	Yes***	Yes***
Time effects *vs* pooled	Yes**	Yes**	Yes***	Yes**	Yes**
Hausman test	χ2 (15) =37.61 Prob>chi2 =0.00	χ2 (15)= 21.88 Prob>chi2 =0.11	χ2 (15)= 30.48 Prob>chi2 =0.010	χ2 (15) = 19.08 Prob>chi2 =0.21	χ2 (14) =41.35 Prob>chi2=0.0002

Notes: *, **, *** significant at 10%, 5% and 1% risk. IRRs of less than one reveal a negative impact of the corresponding determinant on bilateral FDI flows, whereas ratios greater than one reveal a positive impact.