Latin America's FDI patterns: A panel data gravity model to asses the role of regional integration agreements.

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Abstract

Processes of integration and Regional Integration Agreements (RIAs) have proliferated during the last two decades. To this date it is not clear whether these agreements increase or diminish the Foreign Direct Investment (FDI) flows within the members of the bloc. This paper focuses on this issue for a sample of eleven Latin American countries over the years 1996-2012. We design and estimate an augmented gravity model in order to analyze FDI patterns among countries, taking into account, in particular, the impact of regional trade agreements and the role of specific location advantages and country characteristics. Results show that the main forces behind intra bloc FDI are endowment differences, cost differentials and distance among economic centers. Other aspects, such as macroeconomic stability and political climate, are also relevant. The findings suggest that FDI flows, in the countries of our sample, respond to a vertical model, in which firms seek efficiency gains when deciding to operate abroad.

Keywords: Foreign direct investment, Regional Integration Agreements, Augmented gravity model.

JEL Code: F21, F40, O11, O54.

1. INTRODUCCIÓN

During the past fifty years, the international economic framework in which countries, firms and consumers operate has experienced large transformations. World trade has increased dramatically, barriers to trade have diminished and substantive progress has been reached in main transport and communication systems. Meanwhile, the consensus over the beneficial impact of international trade on development and growth has spread from academia to policymakers in governments and international organizations. This

process has unveiled the existence of economies of scale in production and transportation, which in turn have changed trade patterns and fostered the apparition and consolidation of Regional Integration Agreements (RIAs) throughout the world. Presently the number of regional trade agreements worldwide exceeds 200 (WTO 2010a).

Latin American countries have also been part of this phenomenon, especially since the 1990s. Average tariffs in the region have been reduced from 40% in the 1980s to 10% in 2007 (WB 2010b). The need to reduce barriers to trade, increase international activity, and become more competitive urged these nations to build or become involved in different economic agreements, such as Asociación Latino Americana de Integración (ALADI), MER- COSUR, Caribbean Community and Common Market (CARICOM), and North American Free Trade Agreement (NAFTA), which not only affected trade but also helped introduce structural reforms in the economy. Although the process of regional integration in the area is not complete, advances have been made. According to data from the WTO, the number of trade agreements that have been signed and ratified since 1990 is 57, of which 31 are south-south and 26 north-south (WTO 2009).

Integration and its associated effects of larger markets and potentially more efficient reallocation of resources is expected to expand not only intra-regional trade but also foreign investment inflows (Motta and Norman, 1996). The formation of blocs generates positive externalities by fostering macroeconomic stabilization, establishing clear rules and law enforcement, and inducing political transformations that reduce political risk.

There are studies which focus on the links between RIAs and trade that suggest a beneficial effect of regional agreements on the volume of trade. Martinez (2003) evaluates the preferential agreements between several economic areas and shows that regional blocs have important implications for trade among country members of RIAs. Baier and Bergstrand (2007) conclude that economic international agreements double trade of members after ten years. Baier *et al* (2008) have shown that European Union state members' trade increased by 127-146% after at least ten years.

Work on the impact of RIAs on FDI flows, however, is sparser. There are several questions that lack clear, specific answers: does a substantial degree of regional integration affect FDI flows among the countries involved in the process? What are the different determinants that influence the FDI distribution among the members of the bloc? Are these factors different from the ones affecting the international FDI flows?

This paper focuses on the links between regional integration and FDI flows in a sample of Latin American countries. Traditionally, the empirical literature has mainly studied the effects of regional agreements on FDI flows originated from third countries. Our approach is different; it concen-

trates on the determinants of investment flows among countries which belong to the same bloc.

In this study we have employed a computable general equilibrium model, commonly known as an augmented gravity model, for FDI flows. This set up provides an appropriate framework to analyze the influence of preferential agreements among bloc members, together with the role of localization advantages and the potential relevance of geographical proximity.

The structure of the paper is as follows: Section 2 discusses the connection between FDI and RIAs. Section 3 summarizes some empirical evidence regarding this issue. Section 4 and Section 5 describe the data and the empirical methodology employed, respectively. Results are presented in Section 6. Section 7 concludes.

2. EFFECTS OF REGIONAL INTEGRATION AGREEMENTS ON FDI FLOWS

The determinants of FDI became a relevant issue for discussion in the late 60s. Later on, in the 90s, increasing regional and international linkages among countries have seemed to encourage the foreign investment process. In parallel, alternative explanations for the development of multinational firms have been prompted. The traditional motivations inducing a firm to enter new markets have been extended from many different perspectives. Dunning (1994) summarizes the reasons whereby firms are motivated to invest in foreign countries. Firms, when making their investment decisions, are looking for four different types of outcomes: (a) efficiency-seeking; (b) strategic asset-seeking (increasing competitive capacities in regional or global markets), (c) market-seeking, and (d) natural resource-seeking. Ultimately, two main groups of considerations shape the firms' decisions and thus FDI flows may be driven by the search of either a more efficient business model (that entails lower costs) or a larger market.

Other theories classify FDI into horizontal or vertical. In horizontal FDI models companies carry out the same production activity in different countries, with the aim to have easier access to those markets. In other words, firms choose to produce part of their output abroad, and sell it directly from abroad. In vertical FDI, instead, firms split up their production processes (usually consisting of more than a single stage) across national boundaries, producing intermediate goods in a country, and assembling and/or selling them in another. It follows that important determinants for vertical FDI are the differentials in resource endowments or in labor costs.

In vertical FDI the key question is where to locate production in order to minimize costs and to best serve the domestic market. In horizontal patterns,

instead, the crucial issue focuses on the host market. It turns out that the horizontal FDI framework is more suitable, on a priori grounds, to explain activity in a pair of developed countries, whereas the vertical FDI framework is appropriate to describe operations between a developed country and a host developing nation[1].

The literature also suggests the possibility of coexistence of vertical and horizontal motivations (Markusen, 1997). Markusen and Venables (2000) developed the Knowledge-Capital model which included horizontal and vertical FDI. The model was inspired by the phenomenon whereby reductions in trade costs, due to trade agreements, occurred at the same time as substantial growth in FDI. It was tested to find evidence in support of horizontal FDI *versus* vertical, but results regarding the prevalence of one type with respect to the other are unclear. This classification, though, makes it easier to relate FDI and RIAs since in this framework it is rather straightforward to think of FDI as substitute or complement for trade: if the investment process is driven by endowment differences (vertical), FDI can be considered as a complement for trade (Helpman, 1984; Zhang and Markusen, 1999). If foreign investment is horizontal, FDI and trade can be considered as substitutes (Markusen, 1984; Horstmann and Markusen, 1987, 1992; Markusen and Venables, 1998, 2000).

Trade blocs are usually formed among countries in the same region, which is the case in Latin America. Export-platform FDI allows the companies to settle part of the production in one of the bloc countries to guarantee access to the rest of the members or even third countries (Kumar, 1998; Ekholm *et al.* 2007 and Neary, 2009). Moreover, theoretical studies highlight the difficulty in measuring the size and impact of each separate effect (Motta and Norman, 1996; Dunning, 1997; Balasubramanyam, Sapsford and Griffiths, 2002; Neary, 2009).

Economic integration, thus, may have either positive or negative effects on FDI because of cost and market considerations. On the one hand, in the cases where horizontal FDI prevails, the elimination of tariffs that result from a RIA may favor foreign firms to export products from their own countries, hence reducing the intra bloc flows of FDI. When FDI is driven by vertical considerations, the reduction of trade barriers could increase FDI flows among the partners by enabling transnational corporations to operate more efficiently across borders. The formation of a new bloc, then, might provoke the division of the production chain throughout the regional economies in order to explore the location advantages of each partner, and in-

[1] This last claim should be made with caution, since nowadays there are multinationals which set some key processes, like production, in developed nations as well.

crease FDI directed to one member while reducing the flows to other members[2].

Furthermore, the larger degree of macroeconomic and political stability conceivably brought about by a RIA, may have a positive impact on FDI[3]. In effect, previous studies have pointed out that macroeconomic, political stability and lack of distortions are crucial for attracting FDI to developing economies (Blomström, Lipsey, and Zejan, 1992; De Haan and Sturm, 2000; Bengoa and Sánchez-Robles, 2003; Acemoglu *et al*, 2005.). Integrated economies tend to share common goals and normally rely on some degree of supranational coordination. The existence of some common legislations and business practices also have positive effects and affect investor's perception of a particular country. Daude, Stein and Yeyati (2003) conclude that RIA agreements had a positive expected impact[4]. Blomstrom and Kokko (1997) suggest that these effects are more important in agreements involving developing countries.

We can conclude that RIAs may affect member countries in different ways. The implicit reduction of trade barriers within the region has direct effects on intra-regional FDI flows. Individually, the effects can be ambiguous, as the regional production structure may change and the possibility of clustering in more favorable production locations may generate positive effects for some member economies in detriment of others. As far as FDI from outside the bloc, the effects on particular countries are also ambiguous. It is plausible, though, that the extended market size and the location advantages in the bloc might increase the net flows to the region as a whole. However, the integration can foster the formation of niches in specific countries or regions within the bloc.

[2] Low labor costs, abundance of a specific natural resource or infrastructure facilities are good examples of these advantages.

[3] It is generally accepted that improvements in technology, efficiency and productivity tend to foster economic growth. This is the channel that relates FDI inflows with economic growth according to the recent developments on growth theory. The arrival of new firms to the domestic market facilitates the transfer of new technologies from the home country, enhancing efficiency through knowledge diffusion. Hejazi and Safarian (1999), Aitken *et al* (1997) found some empirical evidence suggesting that FDI is a more important determinant of efficiency gains than international trade.

[4] The opposite is also true; considering Latin American countries, with a recent past of authoritarian governments, this issue represents a permanent concern. The upsurge of nationalists' left-wing governments in Venezuela (the new MERCOUSUR member) and Bolivia have discouraged potential foreign investors to these countries. In Bolivia, since president Evo Morales was elected in 2005, the nationalization of the oil and energy sector has affected directly some transnational corporations operating in the country. Henisz (2000) studies the role of institutional environment, political hazard and multinational investment relationship.

3. EMPIRICAL FINDINGS: REGIONAL INTEGRATION AND FDI

Previous empirical findings diverge and it seems that each study reports a different outcome, concluding that there is no consensus on the sign of the impact of RIAs on FDI. This is not surprising since we stated above that, on theoretical grounds, RIAs may impact foreign investment positively or negatively.

Motta and Norman (1996) found that an improved market access within a trade bloc led to export-platform FDI. As an additional benefit, FDI into the bloc became more attractive to outside firms, allowing them to reach the majority of markets within the block. Instead of considering only the market size of a potential host country, firms now consider the broader, regional market, which can be easy served from the country. Their analysis looked at the integration and FDI dynamics in the North American Free Trade Agreement (NAFTA), European Union (EU) and the Association of South East Asian Nations (ASEAN). Blonigen *et al.* (2004) studied the effects of USA FDI outflows to OECD countries and concluded that in Europe the pattern is consistent with an export-platform FDI. The FDI outflows to third countries close to the European recipients decreased with integration.

Blomström and Kokko (1997) described three cases of economic integration and their effect on FDI inflows. Their results suggest that the Canadian participation in the Canada-US Free Trade Agreement (CUSFTA) did not cause a significant change in the FDI that Canada received while the Mexican FDI inflows, after the integration into NAFTA, grew indeed significantly. The MERCOSUR establishment seemed to present a positive impact on FDI until 1994, with different effects among countries. The two biggest economies of the bloc are certainly the greater beneficiaries of the FDI inflows after integration[5].

Karp and Sanchez (1999) showed that the accession of Mexico to NAFTA in 1994 increased the Mexican FDI growth rate by 25 percent per year. Waldkirch (2003) concluded, similarly, that NAFTA raised the American and Canadian FDI flows to Mexico, while not changing the flows from the rest of the world. MacDermott (2007) also showed that NAFTA trade integration encouraged FDI flows towards the bloc, but contrarily to Waldkirch (2003) suggested that the increase in the flows did not seem to be stemmed by the regional partners. Castilho and Zignago (2000) used a gravity model to estimate the determinants of the FDI flows from OECD members to the MERCOSUR economies, taking into account the economic

[5] The authors found a positive effect of the MERCOSUR integration for Brazil and Argentina, although they stressed that the macroeconomic stabilization achieved by these economies in the beginning of the 90´s represented a more important determinant for FDI attraction.

integration process. They concluded that integration did not play an important role in FDI attraction; instead, macroeconomic stability, liberal economic reforms and privatization processes were the relevant explanatory variables for these economies. Daude, Stein and Yeyati (2003) pointed out that the formation of RIAs implied gains for the member countries in terms of FDI inflows, although the share of FDI among the economies was not expected to be evenly distributed. Bittencourt, Domingo and Reig (2006) argued that the development of the FTAA (Free Trade Area of Americas) or EU-MERCOSUR agreements could generate different results within MERCOSUR economies with respect to the attraction of FDI inflows. Frenkel *et al*. (2004) examined the determinants of FDI flows to emerging economies by analyzing recently compiled data set of bilateral FDI flows. They showed that home and host country factors played an important role in determining the level and destination of FDI flows.

Several papers focus on other economic areas, mainly Central and Eastern Europe. Bevan and Estrin (2004) found evidence in favor of labor cost and market size as determinants of FDI in Eastern Europe. Abilava (2006) examined the nature and determinants of FDI in nine economies from Eastern Europe, finding that countries with floating exchange rates attracted more FDI. Egger and Pfaffermayr (2004a) analyzed the effects of European economic integration on FDI during the 1990s using a gravity model. They found out that recent economic integration had substantial effects on FDI inflows, but these effects disappeared after the formal completion of the integration programs. Finally, Carstensen and Toubal (2004) studied the determinants of OECD´s FDI in seven Central Eastern Countries from 1993 to 1999. They concluded that both traditional determinants and transition-specific variables had significant and plausible effects on FDI[6].

Summing up, it seems from the existing literature that economic liberalization and stability are crucial in attracting foreign investment.

4. THE ECONOMETRIC BACKGROUND

Our empirical analysis is based on an extended gravity model, commonly used to test trade flows among regions or countries. Tinbergen (1962), Pöyhönen (1963) and Anderson (1979) were the pioneers in applying the gravity equation to study international flows[7]. According to the gravity model for international trade, the amount of trade between two countries is

[6] Daniels (2005) has published an excellent revision of the empirical studies of foreign direct investment.

[7] Anderson (1979) and Deardorff (1998) offer a theoretical background of the gravity model approach.

explained by their economic size (GDP), population, geographical distance and a set of variables that capture common institutional characteristics such as languages, culture, trade agreements and legal systems. Helpman and Krugman (1985) used a differentiated product framework with increasing returns to scale. Recent applications have improved the performance of the gravity equation. Piani and Kume (2000) studied bilateral trade flows between 44 countries and Anderson and Wincoop (2003) used a gravity model to solve the border puzzle. Bergstrand (1985) developed a gravity model by exploring the theoretical determination of bilateral trade associates in gravity equations using monopolistic competition models.

The gravity framework has also been used to model international patterns of foreign direct investment. A recent paper in this regard is Kleinert and Toubal (2010). The authors provide theoretical support for the FDI gravity model by estimating a gravity equation from three different models of multinational firms.

Empirically, several studies have contributed to the refinement of the gravity equation. Cheng and Wall (1999) assumed that the gravity equation for a country pair might have a unique intercept, and that it could be different for each direction. Mátyás (1997) proposed an alternative specification to the gravity model where each country has two fixed effects, one as a host country (receiving country) and one as a home country (parent country). In this specification, however, all country specific time-invariant effects drop out of the estimation.

Egger (2000) argued that panel data methods are the most appropriate for disentangling time-invariant and country specific effects. Egger and Pfaffermayr (2003) claimed that the omission of specific effects for country pairs could bias the estimated coefficients. This study faces a related difficulty: some variables, such as location-specific advantages, institutional aspects and inclusion in RIAs, have little variability over time. In this framework an ordinary least square estimation would lead to biased and inconsistent estimators.

While the pooled model is appropriate if the regressor and the error term are uncorrelated, and there is not perfect collinearity, it does not assume the existence of unobserved individual heterogeneity. An alternative solution is to use an estimator to control for bilateral specific effects as in a fixed effects model (FEM) or in a random effects model (REM). The fixed effects model treats individual effects as a variable which is partially correlated with the observed regressors x_i. The random effects model treats the unit effects as independently distributed of the regressors. There exists, though, a trade-off between bias and precision, if individual effects are uncorrelated with x_i, the random effects estimator will be more efficient. If individual effects are correlated with x_i, then the random effects estimator will be biased, but the

FEM model will provide consistent estimators. The Hausman (1978) test will allow us to choose the most appropriate method.

Hausman and Taylor (1981) (HT) considered a model which preserves the advantages of both estimators: It allows for correlation between individual effects and regressors (FEM) and it identifies the effects of time invariant regressors (REM).

The baseline specification is of the form:

$$(1) \qquad y_{it} = \alpha + \sum_{k=1}^{K} \beta_k x_{kit} + \sum_{j=1}^{J} \gamma_j Z_{mi} + u_i + \varepsilon_{it}$$

$$\sum_{k=1}^{K} \qquad\qquad J$$

$$it \qquad\qquad =1$$

Where x_{kit} is a set of K time varying variables, Z_{mi} represents the M time invariant variables, u_i is a set of N-1 unit specific effects and ε_{it} is a normally distributed error term. There are N cross section units observed for T periods.

To estimate time invariant or rarely changing variables in panel data models with unit effects, Hausman and Taylor (1981) proposed a method with several steps. First, use FE to obtain consistent estimators of betas, then, regress the γ_j using as instruments the group mean of the residuals. Finally, use the residual variances to obtain the FGLS weight and perform GLS transformation for all variables. The use of weighted instrumental variable estimators will allow to obtain the coefficients of interest by an instrumental variables regression[9].

This method does not distinguish between endogenous and exogenous variables. Hence, as Plumper and Troeger (2003) suggest, instruments may not be adequate. They developed an alternative to the estimation of time-invariant variables in the presence of unit effects name Fixed Effects Vector Decomposition model (FEVD). Equation (1) can be re-written as:

$$(2) \qquad y_{it} = \alpha + \beta X_{it} + \gamma Z_i + \mu_i + \varepsilon_{it}$$

The first stage of the proposed estimator runs a fixed-effects model to obtain the unit effects ($\hat{\mu}_i$):

$$(3) \qquad \hat{\mu}_i = \bar{y}_i - \sum_{k=1}^{K} \beta_k^{FE} \bar{x}_{kit} = \hat{\alpha} + \gamma_j \sum_{j=1}^{J} z_{ji} + \eta_i + \bar{\varepsilon}_i$$

[8] The method assumes that x_1 and z_1 are uncorrelated with u_i and employs them as instruments of x_2 and z_2, respectively.

[9] Serlenga and Shin (2007) provide a good revision of the HT estimation in heterogeneous panels with time specific factors applied to gravity trade models. The number of economies in the sample is low compared to the number of years, and restrictions on the number of lags as instruments are needed.

where β_k^{FE} is the pooled-OLS estimate of the model in equation (1), η_i is the unexplained part of the unit effects and $\bar{\hat{\varepsilon}}_i$ are the average unit means of the fixed effect estimation (with panel heteroskedasticity if $\bar{\varepsilon}_i \neq 0$).

The second stage breaks down the unit effects into a part explained by the time-invariant and/or rarely changing variables and an error term. Given equation (3), the unit effects are regressed on the *z* variables to obtain an estimator of γ.

$$\hat{\mu}_i = \omega + \gamma_j \sum_{j=1}^{J} z_{ji} + \eta_i \hat{\eta}_i = \hat{\mu}_i - \varpi - \gamma_j \sum_{j=1}^{J} z_{ji} \quad (4)$$

where ω is the intercept and η_i is the unexplained part of the unit effects in equation (3). It must be noted that the exclusion of variables correlated with the unit effects and the time invariant variables could lead to biased estimates.

The third stage re-estimates the first stage by pooled OLS (with or without autocorrelation corrections and with or without panel-corrected SEs) including the time-invariant variables plus the error term of stage 2, which then accounts for the unexplained part of the unit effects.

$$y_{it} = \alpha + \beta_k \sum_{k=1}^{K} x_{kit} + \gamma_j \sum_{j=1}^{J} Z_{ji} + \hat{\eta}_i + \varepsilon_{it} \quad (5)$$

Essentially FEVD produces unbiased estimates of the time-varying variables, regardless of whether they are correlated with the unit effects or not, and unbiased estimates of the time invariant variables that are not correlated (ηi is not correlated with zij).

The main advantages of FEVD come from its lack of bias in estimating the coefficients of time-variant variables correlated with the unit effects. This method has received some criticisms. Greene (2010) asserts that the FEVD estimator simply reproduces (identically) the linear fixed effects (dummy variable) estimator. The consistency result follows from the "estimator" relying upon turning the fixed effects model into a random effects model, in which case simple GLS estimation of all parameters would be efficient among all estimators. Breusch *et al.* (2010) suggest that the estimator is inconsistent when the time-invariant variables are endogenous. They recommend an alternative estimator that has superior risk properties to the decomposition estimator, unless the endogeneity problem is known to be small or no relevant instruments exist.

From the above discussion, it is apparent that the issue of the correct specification is still a matter of debate among econometricians. However, this debate also suggests that in small samples, as the one in our study, the FEVD

offers consistent and efficient estimators. Furthermore, endogeneity of variables is not significant in our sample. Consequently, we use this technique for the empirical analysis. For completeness, we also present the results using the FE model, the RE model, and the Hausman-Taylor formulation.

5. EMPIRICAL APPLICATION TO THE INTRA-FDI FLOWS IN LATIN AMERICA

We propose an augmented gravity model to analyze FDI patterns among several Latin American countries. Our main goal is to analyze the impact of regional trade agreements between partners and the role of specific location advantages and country characteristics. This approach allows us also to take into account the heterogeneous nature of FDI patterns, which may be related to the idiosyncrasy of the country or to country-specific traditional gravity variables. We follow the contributions of Markusen and Maskus (2002) and Blömstrom and Kokko (1997).

This approach is applied to a panel data of 11 Latin American economies, over the years 1996-2008. This is a lightly unbalanced panel, as data are not available for all the economies every year[10]. Consequently, the panel comprises 1147 observations; hence the sample is relatively small for the number of countries included in the econometric study. This is a compelling reason to consider the FEVD method as the one that offers more consistent and efficient estimators. The composition and sources of the database are detailed in Table 1 of the Appendix.

We design an FDI non-restricted model with different specifications: vertical, horizontal and a hybrid "Knowledge Capital". The model includes dummy variables for partners sharing a common border or having preferential trading agreements, and other variables, like distance, which are time-invariant. The basic equation is:

$$FDI_{ij,t} = \beta_0 Y_{i,t}^{\beta_1} Y_{j,t}^{\beta_2} N_{i,t}^{\beta_3} N_{j,t}^{\beta_4} D_{ij}^{\beta_5} A_{ij,t}^{\beta_6} \varepsilon_{ij,t} \quad (6)$$

where country pairs are denoted by *ij* = Argentina-Brazil, Argentina-Bolivia…, and time *t* =1996,1997….2008. $FDI_{ij,t}$ is the real bilateral FDI in the year *t*, from country *i* to country *j*. $Y_i(Y_j)$ indicates the GDPs of the home (source country) and host country (receiving the FDI flows), $N_i(N_j)$ are home-host country populations and D_{ij} measures the distance between the

[10] Economies included: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico, Paraguay, Peru and Uruguay. All the variables are expressed in log form, only positive investment has been included. Moreover, and following Chen *et al* (1999) to avoid ln(0), a value of 1 replaces disinvestments, in these cases ln(FDI+1)=0. The large number of zeros tends to reduce the variance of the sample. The estimations include time dummies.

two country capitals (or economic centres). A_{ij} accounts for other factors such as belonging to the same RIAs, resource endowments and proxies to capture the idiosyncrasy of the economies in terms of macroeconomic stability or political risk (budget differences between pairs of countries, debt differences, country risk). ε_{ij} is the error term.

In order to estimate equation (6), it can be transformed in a log-linear specification (an augmented gravity model), expressed as:

$$\begin{aligned} FDI_{ij,t} = {} & u_{ij} + \beta_1 Y_{i,t} + \beta_2 Y_{j,t} + \beta_3 POP_{i,t} + \beta_4 POP_{j,t} + \beta_5 \text{Distance}_{ij} \\ & + \beta_6 \text{Adjacency}_{ij} + \beta_7 \text{TradeFree}_{ij,t} + \beta_8 \text{MERCOSUR}_{ij} + \beta_9 \text{ALADI}_{ij} \\ & + \beta_{10} \text{FactEndow}_{ij,t} + \beta_{11} \text{LaborCost}_{ij,t} + \beta_{12} \text{DebtDif}_{ij,t} + \beta_{13} \text{PolitRisk}_{ij,t} \\ & + \nu_t + \varepsilon_{ij,t} \end{aligned} \tag{7a}$$

$$\begin{aligned} FDI_{ij,t} = {} & u_{ij} + \beta_1 (\Delta GDP_{ij,t}^{RIA}) + \beta_2 \text{Distance}_{ij} + \beta_4 \text{Adjacency}_{ij} + \beta_5 \text{TradeFree}_{ij,t} \\ & + \beta_6 \text{MERCOSUR}_{ij} + \beta_7 \text{ALADI}_{ij} + \beta_8 \text{FactEndow}_{ij,t} + \beta_9 \text{LaborCost}_{ij,t} \\ & + \beta_{10} \text{DebtDif}_{ij,t} + \beta_{11} \text{PolitRisk}_{ij,t} + \nu_t + \varepsilon_{ij,t} \end{aligned} \tag{7b}$$

where

$$FactEndow_{ij,t} = \left| \ln\left(\frac{K_{it}}{L_{it}}\right) - \ln\left(\frac{K_{jt}}{L_{jt}}\right) \right|$$

$$LaborCost_{ij,t} = \left| \ln\left(\frac{GDP_{i,t}}{L_{i,t}}\right) - \ln\left(\frac{GDP_{j,t}}{L_{j,t}}\right) \right|$$

$$Debtdif_{ij,t} = \left| \ln(debt/Y)_{it-} \ln(debt/Y)_{jt} \right|$$

where K, L are capital and labor and debt is external debt.

A high level of income in the host country indicates a larger potential market share, which may attract FDI for market-expansions reasons. The population variable is included in our specification, as in equation (6). Its sign is unclear on a priori grounds. It may be positive if it acts as a proxy for the number of consumers and market size considerations dominate; however, it may be negative if more populated countries may afford to keep higher tariffs, and import-substitution strategies drive FDI between the pair of countries.

The variables related to the effects of RIAs on FDI flows are:

1. $\left(\Delta GDP_{ij,t}^{RIA}\right)$ captures the extended market effect. This variable accounts for the joint GDP of all countries to which the host country has tariff-free access due to the common membership to a RIA.

2. Distance is measured by the bilateral distance between the main economic centres in the two countries. Data are obtained from the Centre d´Etudes Prospectives et d'Informations Internationals (CEPII). CEPII provides different measures of bilateral distances for most countries across the world. Basically, these data compute the distance between two countries based on bilateral distances between their biggest cities, those inter-city distances being weighted by the share of the city in the country's overall population. Studies suggest that distance is a good proxy for transportation costs; larger distance involves higher transportation costs. The distance coefficient might be positive in the case that FDI is driven by horizontal motivations and is a substitute for exports, and negative for vertical FDI models. Adjacency relates to sharing a common border.

3. Trade Freedom Index published by the Heritage Foundation. This refers to import and export bans and controls, restrictions on trade in services, tariff escalation, import and export taxes and fees, minimum and reference pricing, regulations and licensing provisions, and issues involving enforcement of intellectual property rights. More trade freedom implies fewer restrictions to trade, and its effect on FDI depends on whether foreign investment acts as a complement to trade (as in vertical models) or as a substitute (horizontal models). In the first case the expected sign is positive, whereas in the second scenario the sign is negative. Alternative indexes have been used in the study, as the Terms of Trade index published by the UNCTAD, available for the 12 economies and years.

4. The MERCOSUR and ALADI dummy variables try to capture the effect of the most important RIAs among the Latin American nations. They take the value 1 when the home and host country belong to MERCOSUR or ALADI. These are similar to those used by Frankel et al (2004) to analyze trade patterns, and to those used by Yeyati *et al.* (2003) to study FDI among developed countries.

The variables included in the model which specifically refer to country endowments and other characteristics are: *FactorEndow*, *laborCost* and *DebtDif* measures. Theory suggests that among developing economies, factor endowments differences may have a large influence in the process of investing abroad. Markusen and Maskus (2002) noted that the choice between vertical and horizontal production structures depends on country characteristics, such as relative size and relative endowment differences, as

well as trade and investment costs. The variable factor endowments measures the difference between the two countries in terms of gross fixed capital formation as a percentage of the labor force, following Janicki *et al*. (2005). Equality in factor endowments represents a value of 0; a value of 1 represents the maximum difference between the two countries. Along the same lines, the difference between labor costs (ratio of GDP in ppp over the number of workers) in the pair of countries may account for differences in productivity[11]. The ratio debt to GDP tries to capture the differences between the two countries regarding their governments' fiscal responsibility and the long term stability of their public finances. A reduction in the debt difference distance should lead to an increase in FDI.

The *Political Risk* variable accounts for the role of institutions, government stability and law enforcement. Stein and Daude (2001) applied a gravity model to study the effects of institutions on FDI among OECD countries. They found that the quality of institutions has positive effects on FDI and that the impact of institutional variables is statistically significant and economically relevant. More generally, countries which provide reliable legal systems and efficient public administration receive more investment and profit more from it than countries with poor governance. We have used different indexes to measure this aspect. The World Bank provides an aggregate governance indicator for 1996-2006 which includes six dimensions of governance: voice and accountability; political stability and absence of violence; government effectiveness; regulatory quality; rule of law and control of corruption. Other studies use the International Country Risk Index published by Princeton University, which offers data since 1987.

Finally, a time trend (*vt*) is included to control for a positive FDI trend in recent years that may affect all countries in a similar way. The disturbance is expressed by $\varepsilon_{ij,t}$.

6. EMPIRICAL RESULTS

In this section we discuss the results obtained when estimating the model equation (7) using the different techniques described above. There are a few particular issues we had to deal with in this regard. First, and as individual effects are part of the model, we had to decide whether they were treated as Random Effects (RE) or Fixed Effects (FE). Egger (2000) points that the FE

[11] Other measures of labor costs are not available for all the countries and years in the sample. We have adopted the methodology used by the International Labor Organization, i.e., measuring differences in productivity as a proxy for the labor cost and assuming that productivity is equal to real wages.

specification fits better if the selection of nations corresponds to an ex-ante predetermined sample[12]. For comparison, the results obtained when estimating both models are presented.

We may also face the problem of misspecification in the gravity model if we do not include variables such as distance, adjacency, or being part of a RIA. These variables will be treated as part of the individual effects. We consider this aspect important for the analysis, this being the reason why we decide to employ the Hausman-Taylor formulation and the FEVD model. The advantage of the former is that it allows for unobserved or misspecified factors that simultaneously explain the FDI activity between two countries, and leads to unbiased and efficient results in small samples.

Table 1 displays the results from the Pooled OLS model for the overall group of countries. The first part of the table refers to the basic model, the second to the augmented model with additional variables. The GDPs of both the parent country and the host country are positive. The significance of the GDP of the host country is more in accord with horizontal FDI models than with vertical modes. In vertical models the size of the market of the host country does not matter much since products are not necessarily intended for that market.

Coefficients of the population of the source and host countries are also positive and significant, this last fact implies that a large number of potential consumers may attract FDI. Distance is negative and significant; this result is reasonable since distance can be thought of as a proxy for transportation costs. Model 3 considers adjacency, which is also positive. Finally, dummy variables for MERCOSUR and ALADI are positive and significant, although only marginally in the case of the second. The overall fit of the estimation is sound, around 0.6-0.75%.

The second part of Table 1 summarizes the results of an augmented model, which includes other variables related to the nature of trade, the role of factor endowment and costs differences. The proxy for free trade is positive and significant, and differences in both factor endowments and labor costs are positive and significant. This result is relevant, since it suggests that FDI flows within the countries of the sample may be driven by vertical, rather than horizontal, considerations. Finally, coefficients of debt differentials and political risk have, as expected, a negative sign, showing that fiscal and political instabilities harm FDI. These results, though, should be taken with caution, since the OLS model ignores valuable information captured in the time dimension of the data and provides results that are neither consistent nor efficient. The magnitude of the coefficients is basically stable across models.

[12] We also report the results from the Hausman test, useful to discriminate among FE and RE models.

Table 1
Pooled OLS Results for the Basic and Augmented Gravity Equation

Dependent Variable: ln(FDI_{ij},t)						
Independent Variables	**Basic Model**			**Augmented Model**		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
Const	0.291 (0.004)	0.652 (0.002)	-1.653 (0.004)	-0.736 (0.001)	-1.541 (0.002)	-1.378 (0.001)
$\left(\Delta GDP_{ij,t}^{RIA}\right)$					0.127 (0.000)	0.157 (0.001)
GDP_i	0.649 (0.003)	0.663 (0.001)	0.531 (0.000)	0.319 (0.002)		
GDP_j	1.201 (0.001)	1.332 (0.000)	1.297 (0.000)	0.743 (0.002)		
POP_i	1.012 (0.026)	1.027 (0.087)	1.036 (0.086)	0.034 (0.072)		
POP_j	0.537 (0.042)	0.672 (0.000)	0.659 (0.000)	0.463 (0.014)		
Distance	-0.934 (0.000)	-1.037 (0.000)	-1.041 (0.000)	-0.894 (0.000)	-1.072 (0.000)	-1.091 (0.000)
Adjacency		0.586 (0.032)			0.328 (0.043)	0.264 (0.025)
TradeFree*j*				0.129 (0.004)	0.145 (0.000)	
Mercosur		0.2942 (0.013)	0.218 (0.022)	0.341 (0.021)	0.3756 (0.026)	0.4432 (0.016)
ALADI			0.187 (0.097)			0.108 (0.076)
Factor Endow dif					0.901 (0.000)	0.739 (0.000)
Labor Cost dif				0.32 (0.000)		
DebtDif						-0.0134 (0.032)
Political Risk				-0.100 (0.031)	-0.077 (0.044	
Adjusted *R*-squared	0.5732	0.608	0.753	0.851	0.850	0.852
F test ($n-1$, $nT-n-K$) (critical values 1.696 and 1.521 at the1% and 5% level respectively)	1.72	1.68	1.54	1.57	1.53	1.62
White test for heteroskedasticity	62.452	61.345	64.987	62.006	65.324	65.012

Note: Time dummies are included but not reported. All variables are expressed in ln. White´s heroskedasticity covariance matrix estimator applied. *P*-value > *t* in parenthesis. *F* ($n-1$, nT, $n-K$), where n represents the flow pairs (36), T represents the time (11 years) and K the number of regressors.

Table 2
Results for the FEM *versus* REM (GLS)

Dependent Variable: ln(FDI_{ij}, t)								
Independent Variables	**Fixed Effects Model**				**Random Effects Model**			
	Model 1a	**Model 1b**	**Model 2a**	**Model 2b**	**Model 1a**	**Model 1b**	**Model 2a**	**Model 2b**
Const					-1.672 (0.074)	-1.576 (0.063)	-1.326 (0.042)	-1.539 (0.0542)
$\left(\Delta GDP_{ij,t}^{RIA}\right)$			0.134 (0.239)	0.127 (0.248)			0.223 (0.259)	0.112 (0.301)
GDP_i	0.513 (0.012)	0.539 (0.036)			0.823 (0.001)	0.487 (0.006)		
GDP_j	0.893 (0.000)	1.106 (0.000)			0.767 (0.000)	1.006 (0.000)		
POP_i	1.040 (0.012)	0.911 (0.000)			1.017 (0.000)	0.928 (0.000)		
POP_j	-0.491 (0.000)	-0.405 (0.000)			-0.457 (0.003)	-0.437 (0.000)		
Distance					-0.884 (0.000)	-0.930 (0.000)	-1.002 (0.000)	-0.960 (0.000)
Adjacency							0.314 (0.031)	0.296 (0.028)
$TradeFree_j$			0.105 (0.000)	0.189 (0.002)			0.134 (0.000)	0.191 (0.000)
Mercosur	0.252 (0.141)	0.397 (0.135)	0.298 (0.198)	0.4048 (0.141)	0.415 (0.053)	0.387 (0.047)	0.424 (0.146)	0.371 (0.102)
ALADI	0.094 (0.096)	0.096 (0.097)			0.023 (0.153)	0.088 (0.074)		
Factor Endow dif			1.027 (0.000)	0.982 (0.000)			1.014 (0.000)	0.786 (0.000)
Labor Cost dif		0.365 (0.002)				0.372 (0.000)		
DebtDif		-0.0204 (0.039)	-0.0287 (0.001)	-0.0197 (0.000)			-0.0172 (0.012)	-0.250 (0.032)
Political Risk		-0.103 (0.008)		-0.107 (0.012)		-0.124 (0.013)		-0.077 (0.003)
Adjusted R-squared	0.8130	0.8186	0.8129	0.8128	0.8129	0.8182	0.8127	0.8112
Hausman Test (*P*-value)	0.00417	0.000	0.000	0.000				
Wald Chi2. Prob > chi2					0.000	0.000	0.000	0.000

Note: Time dummies are included but not reported. Estimations use White´s heteroskedasticity consistent covariance matrix. *P* value > *t* in parentheses. Hausman test null hypothesis: difference in coefficients not systematic (prob > chi2).

Table 2 summarizes the results of a classical panel estimation, in its two versions of fixed and random effects. Model 1a and 1b comprise variables already considered in the pooled OLS. The main difference with the pooled OLS is that now population of the host country appears negative and significant, maybe reflecting colinearity problems. The significance of the dummy variable for MERCOSUR has decreased in these estimations.

The other variables display the same sign as before: positive for adjacency, trade freedom, RIAs, factor endowment, and labor cost differentials, and negative for distance, debt differential and political risk. The overall fit of the estimation has increased to 0.8. It should be noticed that the results of the fixed and random model are similar.

The FE model does not allow for the estimation of time-invariant variables. A second drawback of the FE model is its inefficiency in estimating the effect of variables that have very little variance within. One standard approach to this problem, as stated above, is to use the instrumental variables technique developed by Hausman and Taylor.

Thus, the next step is to run the equation using the Hausman-Taylor estimator (Table 3) in which the endogenous variables are the GDPs of the source and host countries. In the basic model, results are similar to the fixed-random effects models, except for the population of the source country; its coefficient is larger than before, but the point estimate is no longer significant. In the case of the augmented model the extended market effect is again positive but not significant.

In order to increase the robustness of the specification and explore the role of RIAs and other time invariant variables more accurately, we apply the Fixed Vector Decomposition Method to different versions of the augmented gravity model. Results are shown in Table 4. They do not differ substantially of those provided by other techniques in terms of the sign of the point estimates. There are some differences, though, regarding the size of the coefficients of factor endowments and labor cost differences; they are now substantially larger, in the neighborhood of 2 or even 3. Neither the extended market effect nor the dummy variable for MERCOSUR are significant.

These results suggest that the model which fits better the pattern of intra regional investment flows among Latin American countries is the vertical FDI. MERCOSUR and ALADI regional agreement are only marginally significant in some specifications. These findings also fit well the FDI pattern of intra-regional investment flows, where the FDI concentrates in Argentina, Brazil and Chile, while Mexico FDI flows mainly come from other NAFTA partners.

Summing up, the results provided by all techniques suggest that bilateral FDI flows within the sample countries over the period 1996 to 2008 are mainly driven by vertical considerations. Variables such as distance, endowment differences and labor cost differences have a remarkable impact on the decision to invest in other countries. The horizontal approach does not appear as important in the sample considered: the GDP of the host country has the expected sign, but the size of the population in the host country seems to affect FDI inflows negatively. Finally, Latin American firms investing in the region do not seem to be affected by the fact of the source and host country belonging to RIAs.

Table 3
Regression Results for the Hausman-Taylor Estimation. Basic and Augmented Gravity Model for FDI in Latin America

Dependent Variable: ln(FDIij,t)								
Independent Variables	**Basic Model**			**Augmented Model**				
	Model 1	**Model 1a**	**Model 1b**	**Model 1a**	**Model 1b**	**Model 1c**	**Model 2a**	**Model 2b**
Const	-3.285 (0.000)	-3.536 (0.000)	-3.601 (0.000)	-3.724 (0.000)	-3.859 (0.000)	-3.762 (0.000)	-3.443 (0.000)	-2.378 (0.000)
$\left(\Delta GDP_{ij,t}^{RIA}\right)$							0.340 (0.278)	0.533 (0.300)
GDP_i	.6122 (0.000)	0.763 (0.001)	0.731 (0.000)	0.797 (0.000)	0.805 (0.000)	0.910 (0.000)		
GDP_j	1.431 (0.000)	1.451 (0.000)	1.502 (0.000)	1.537 (0.000)	1.627 (0.000)	1.668 (0.000)		
POP_i	2.322 (0.326)	2.171 (0.307)	2.006 (0.186)	1.929 (0.252)	2.024 (0.201)	1.961 (0.237)		
POP_j	-0.640 (0.000)	-0.759 (0.000)	-0.807 (0.000)	-1.002 (0.000)	-1.195 (0.000)	-1.203 (0.000)		
Distance	-1.291 (0.000)	-1.338 (0.000)	-1.491 (0.000)	-1.364 (0.000)	-1.369 (0.000)	-1.448 (0.000)	-1.482 (0.000)	-1.504 (0.000)
Adjacency			1.081 (0.000)			0.969 (0.000)	1.098 (0.000)	1.114 (0.000)
$TradeFree_j$				0.060 (0.000)			0.105 (0.000)	
Mercosur		0.079 (0.078)	0.113 (0.089)	0.145 (0.087)	0.120 (0.141)	0.133 (0.096)	0.1522 (0.106)	0.1472 (0.102)
ALADI			0.095 (0.2622)					0.081 (0.467)
Factor Endow dif						1.948 (0.000)	1.846 (0.000)	1.937 (0.000)
Labor Cost dif				1.006 (0.000)	1.096 (0.000)			
DebtDif							-0.630 (0.000)	-0.5137 (0.000)
Political Risk				-0.271 (0.001)	-0.183 (0.000)	-0.1006 (0.000)		
Wald chi2. Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sargan Overid. (*P*-Value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Endogenous Variables	GDPi, GDPj	GDPi, GDPj	GDPi, GDPj	GDPi, GDPj	GDPi, GDPj	GDPi, GDPj	GDPi, GDPj	GDPi, GDPj

Note: Time dummies are included but not reported. All variables are expressed in LN. White´s heteroskedasticity covariance matrix estimator applied. *P* value > *t.*

Table 4
Results for the Fixed Effects Vector Decomposition Model. Basic and Augmented Gravity Model for FDI in Latin America

Independent Variables	Dependent Variable: ln(FDIij,t)							
	Basic Model			Augmented Model				
	Model 1	Model 1a	Model 1b	Model 1a	Model 1b	Model 1c	Model 2a	Model 2b
Const	-7.328 (0.000)	-8.729 (0.000)	-8.001 (0.000)	-7.264 (0.000)	-7.814 (0.000)	-7.801 (0.000)	-8.336 (0.000)	-8.332 (0.000)
$\left(\Delta GDP_{ij,t}^{RIA}\right)$							0.420 (0.300)	0.538 (0.313)
GDP_i	.6011 (0.000)	0.608 (0.000)	0.654 (0.000)	0.702 (0.000)	0.712 (0.000)	0.724 (0.000)		
GDP_j	1.037 (0.000)	1.060 (0.000)	1.074 (0.000)	1.127 (0.000)	1.133 (0.000)	1.169 (0.000)		
POP_i	0.847 (0.465)	1.016 (0.462)	1.174 (0.405)	1.037 (0.694)	1.074 (0.672)	1.106 (0.592)		
POP_j	-0.532 (0.000)	-0.558 (0.000)	-0.637 (0.000)	-0.893 (0.000)	-0.923 (0.000)	-0.961 (0.000)		
Distance	-1.059 (0.000)	-1.106 (0.000)	-1.174 (0.000)	-1.196 (0.000)	-1.204 (0.000)	-1.225 (0.000)	-1.301 (0.000)	-1.368 (0.000)
Adjacency			0.796 (0.000)			0.851 (0.000)	0.900 (0.000)	0.918 (0.000)
$TradeFree_j$				0.153 (0.000)			0.172 (0.000)	
Mercosur		0.196 (0.187)	0.147 (0.165)	0.1286 (0.179)	0.135 (0.146)	0.1518 (0.151)	0.1964 (0.196)	0.238 (0.193)
Factor Endow dif.						2.7245 (0.000)	2.958 (0.000)	3.007 (0.000)
Labor Cost dif.				2.104 (0.000)	2.083 (0.000)			
DebtDif							-0.401 (0.000)	-0.412 (0.000)
Political Risk				-0.305 (0.001)	-0.295 (0.000)	-0.286 (0.000)		
Residuals	1 (0.000)	1 (0.000)	1 (0.000)	1 (0.000)	1 (0.000)	1 (0.000)	1 (0.000)	1 (0.000)
Adj. *R*-squared	0.9003	0.9017	0.9104	0.937	0.938	0.938	0.812	0.804

Note: Time dummies are included but not reported. All variables are expressed in logarithms. White´s heteroskedasticity covariance matrix estimator applied. *P* value > *t* in parentheses.

7. CONCLUSIONS

The proliferation of regional integration agreements is a prominent phenomenon in the world economy in general and in the Latin America area in particular. On a theoretical basis, RIAs are thought to affect FDI flows within a bloc, but there is not much evidence available on the issue. Hence, the objective of this study is to find the most important intra-regional investment

determinants for the Latin American economies, taking into account the last regional integration efforts and the members' idiosyncrasy.

Our main results, robust to alternative specifications and estimation methodologies, support the hypothesis of a FDI driven by endowments rather than by commercial agreements. This points out to a vertical model of FDI in the countries that make up the sample, in which firms are mainly concerned with cost reductions. In Latin America the trade barriers among the members of the bloc are low, however, there exists still a high level of external barriers with third countries.

Distance, endowment differences and labor cost differences have a remarkable impact in the decisions to invest in other countries. The horizontal approach, whereby firms choices are driven by market size considerations, does not appear as important in the sample, although the existence of a hybrid model cannot be dismissed. The fact that the variable which measures the extended market effects is positive and significant in some of the estimations suggests that companies establish part of the production process in other countries within the bloc (especially the ones with more stability, lower labor costs and big market shares) to use it as a platform to serve other members of the bloc, which increases trade flows among the economies.

The policy recommendations are straightforward: all measures intended to improve macroeconomic and political stability, on the macro side, and increase efficiency, on the micro side, are useful to attract FDI inflows. It seems that the attractiveness of a particular economy inside the bloc depends on market size, macro factors and endowment differences. These characteristics are recognized by the economic literature as the main determinants driving the international pattern of FDI inflows-outflows. It seems that in Latin America, companies choose the big and more stable economies among the members of the bloc to follow an export-oriented FDI strategy. This allows them to serve the rest of the RIAs members or third countries markets.

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APPENDIX. Variables and Sources

Table A.1
Variables and sources

Variable Code	Description	Source
FDI_{ij}	Bilateral Foreign Direct Investment.	United Nations. Foreign Direct Investment Statistics database.
Y_i	GDP home country (constant dollars 2000)	Balance of Payments, IMF
Y_j	GDP host country (constant dollars 2000)	Balance of Payments, IMF
POP_i	Population home country	World Development Indicators. World Bank
POP_i	Population host country	World Development Indicators. World Bank (WB)
D_{ij}	Bilateral Distance	CEPII
$\left(\Delta GDP_{ij,t}^{RIA}\right)$	Sum of GDP to which the host country has tariff-free access.	Own elaboration (GDP data in constant dollars from IMF or WB)
Adjacency	Dummy variable. It takes value 1 when both countries share border, zero otherwise.	Own elaboration
TradeFree	Trade Freedom Index and also Terms of Trade Index	Heritage Foundation and UNCTAD
MERCOSUR	Dummy variable. It takes value 1 when both countries belong to *MERCOSUR* and zero otherwise.	Own elaboration
ALADI	Dummy variable. It takes value 1 when both countries belong to *ALADI* and zero otherwise.	Own elaboration
FactEndow	Factor Endowments. Difference between the home and host country ratio of gross fixed capital formation as a percentage of labor force	World Development Indicators (WB) and labor force from International Labor Organization and United Nations database.
LaborCost	Difference in the Relative Cost of Labor among the home and host country	International Labor Organization
DebtDif	Difference in the ratio Debt over GDP among the two economies.	World Development Indicators (WB)
PolitRisk	Role of Institutions, law enforcement and government stability called Governance Indicator. Alternative measure used is the International Country Risk	World Bank and Princeton University