The FDI-Growth Nexus in Latin America: The Role of Source Countries and Local Conditions
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Abstract

Foreign Direct Investment (FDI) has surged in Latin America (LA) since the mid 1990s. Today European FDI outranks North American FDI in South America. We investigate the impact of European versus North American FDI on productivity growth analyzing more than 60 control variables. Country specific effects and parameter heterogeneity are incorporated in our estimation. We use Bayesian Model Averaging (BMA) to address model uncertainty and to select the best models and most robust parameters. We find that a positive FDI-growth nexus in LA requires political stability, a functioning legal framework, and macroeconomic stability. Given these conditions, investments from both North America and Europe contribute to productivity growth.

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1 Introduction

Because previous inward-looking development policies were ineffective, Latin American (LA) countries adopted outward-looking development policies in the 1990s. Since then, they have considered the attraction of foreign direct investment (FDI) as a key strategy to promote growth and development. At the end of the 1990s, FDI accounted for more than 80 per cent of the net private capital flows into the region (Levy Yegati et al. 2007). Western European economies (EUR)[1] have become the largest direct investors, ahead of North America (NA), in some of the LA countries, especially in South America (UNCTAD 2004, Vodusek 2004). Consequently, several questions arise: To what extent can FDI flows into LA actually contribute to growth? Which conditions must be met for FDI to be beneficial for growth? Are growth effects different if source countries differ; in particular, does it make a difference if FDI comes from EUR compared to NA?

The theoretical literature proposes a number of arguments for FDI having a positive impact on growth.[2] First, FDI is considered to act as the main channel for international technology transfers. It increases the productivity of the host country through direct and indirect effects: through productivity effects in the recipient firm and productivity spillovers to upstream and downstream industries. Second, foreign firms are supposed to increase competition, thus, inducing local firms to become more productive. Third, foreign firms are assumed to invest in training of the work force, thereby, improving qualifications in the country.

Compared to the extensive empirical literature on the FDI-growth nexus in many different country samples, there are relatively few studies for LA countries. Among them, several give a macro level assessment of FDI such as De Gregorio (1992) who investigates growth determinants in LA for the period 1950-85. He finds that FDI inflows are a significant factor explaining GDP per capita growth, having a 3-6 times higher impact than regular investment. Bengoa and Sanchez-Robles (2003) investigate the relationship between economic freedom, FDI, and per capita growth in a panel for the period 1970-99. They also find a significant positive impact. Performing Granger causality tests between FDI and output growth for the period 1975-97 for the three main FDI recipients, Cuadros et al. (2004) confirm a positive FDI-growth nexus in Mexico but not in Argentina and Brazil.

There are also a few studies for LA investigating the direct productivity effects and

[1] Henceforth, the abbreviation EUR will be used to address our European countries sample. In section 3, a detailed description of the countries in the sample is given.

[2] Blomström and Kokko 1997, Borensztein et al. 1998, Markusen and Venables 1999, Rodriguez Clare 1996, Görg and Greenaway 2004.

the spillover effects of FDI with firm level data. Blomström and Wolff (1994) find that foreign owned firms in Mexico in 1965-1985 were on average 3 times as productive as local firms. Sectors with a high share of FDI showed a higher productivity convergence with the US. Aitken and Harrisson (1999) investigate plant level data in Venezuela and find a direct productivity effect in the presence of foreign capital in the respective industry. However, this is detrimental for productivity of local firms in the same industry. Kugler (2006) investigates Colombian firm level data in order to identify intra-industry and inter-industry productivity spillovers from FDI and finds spillovers to upstream industries.

Two major drawbacks are related to these empirical studies. First, it is not possible to derive clear conclusions and robust policy implications due to varying methods, model specifications, country samples, and time spans used. Second, these studies consider neither source countries in general nor EUR- versus NA-FDI in particular. However, evidence suggests that the pattern and motivation of EUR-FDI and, therefore, also its impact on the host country differ from those of NA. While EUR companies have not only invested in manufacturing but recently also in public utilities and the service sector through acquisitions, NA investment has focused on greenfield investment in the manufacturing sector (UNCTAD 2004, Vodusek 2004).

This paper analyzes the FDI-growth nexus in LA in a comprehensive analysis for 16 LA countries to reconcile the scattered evidence. We consider the recent period of rapidly increasing FDI inflows following the LA debt crises of the 1980s. We test the impact of FDI in a complex model of endogenous growth, gaining insights in robust model specifications by applying Bayesian Model Averaging. We account for the necessity of conditional factors for a positive FDI-growth nexus and look at more than 60 different detailed indicators, capturing infrastructure and human capital conditions as well as the institutional, structural, and macroeconomic environment for FDI in LA. We first analyze total FDI inflows but then distinguish between NA- and EUR-FDI. In addition we allow for parameter heterogeneity between different groups of LA countries.

This paper is the first that uses Bayesian Model Averaging (BMA) in the FDI-growth context. BMA was first proposed for cross-country growth regressions by Fernández, Ley, and Steel (henceforth FLS) (2001a) and later augmented to a panel framework by Leon-Gonzalez and Montolio (2004). Since then its applications to growth empirics but also to international and monetary economics have surged.[3] The power of BMA is to incorporate model and parameter uncertainty in empirical (growth) research in a statistically rigorous way. BMA draws inference based on a weighted average of all available models, and

[3]Brock and Durlauf 2001, Brock et al. 2003, Milani 2003, Masanjala and Papageorgiou 2004, Sala-i-Martin et al. 2004, Eicher et al. (2007a).

endogenously determines a ranking in terms of explanatory power of all variables and models.[4] Both types of uncertainties originate from lacking theoretical guidance due to the 'openendedness' of growth theory that does not give one specific model that could rule out all others (Brock and Durlauf 2001). This model uncertainty is aggravated by the abundance of potential growth determinants: over 140 proxies have been used in empirical research (Durlauf et al. 2005).

Based on this robust ranking, we find that a positive FDI-growth nexus in LA depends on a country's political stability, the functioning of the legal framework, and on macroeconomic stability. Under these conditions neither the source country of FDI nor its nature and type seem to be important as investments from both NA and EUR are positively correlated with productivity growth.

The paper is organized as follows: Section 2 presents the hypotheses on the FDI-growth nexus and specifies our models. Section 3 describes the data. Section 4 describes the methodology and discusses econometric issues. Section 5 presents the results. Section 6 concludes.

2 Hypotheses and Model Specification

2.1 FDI in Latin America

While growth was high in LA in the 1960s and 1970s, it faded after the debt crises of the early 1980s. Growth has gained momentum since the first half of the 1990s after the adoption of economic reforms to reduce government interventions, induce liberalization, and macroeconomic stabilization in line with the Washington consensus.

Economic liberalization also entailed an opening towards FDI. LA countries and their representative international institutions like the UN Commission for LA and the Caribbean (ECLAC) and the Inter-American Development Bank (IDB) increasingly considered the attraction of FDI as key strategy to promote growth and development. Consequently, the total stock of FDI in LA rose steeply at a rate of around 30 per cent per year since the mid 1990s (Levy Yegati et al. 2007). In 2003, the stock of FDI as per cent of GDP reached 84 per cent in Bolivia, 74 per cent in Chile, and 63 per cent in Panama.[5] As Figure 1 in the Appendix shows, the increase in FDI affected all LA countries. NA- and

[4] See Hoeting et al. (1999) for a general overview of the methodology. For a recent survey of the econometric problems of standard cross-country growth regressions see Durlauf et al. (2005).

[5] We excluded Panama from our sample because it is a serious outlier receiving huge amounts of NA-FDI. Panama attracts primarily NA offshore-companies due to favorable tax arrangements for NA firms. Therefore, the circumstances for the FDI-growth nexus are completely different in Panama than in the rest of LA which is why an inclusion of Panama would distort our estimation results substantially.

EUR-FDI accounted with 70-80 per cent for the major share of FDI stocks in the large LA countries. FDI from the rest of the world accounted for 20-30 per cent. In some of the smaller LA countries the share of non-EUR- and NA-investors is higher, mainly due to intra LA-FDI. While NA-investment previously played an important role in LA, EUR-FDI surpassed NA-FDI stocks in South America in the 1990s. EUR-FDI dominates in Argentina, Bolivia, Chile, Colombia, Ecuador, Peru, Paraguay and slightly in Brazil in 2003, whereas NA-FDI it still most important in Central America, Mexico and Venezuela (see Figures 2-4 in the Appendix). Concerning EUR-FDI, we observe that all major EUR countries have been investing in LA to a similar extent. Only recently, Spain increased its share substantially in some countries, such as Argentina, Chile and Peru.[6]

One can distinguish clear differences between EUR- and to NA-FDI in LA. We will address the potentially different growth effects in the next subsection while discussing recent literature on varying motives, types, and sectors of FDI and the arising implications for productivity growth.

2.2 The Role of FDI in the Host Economy

The aggregate productivity effects of FDI on the macro level are the sum of several effects: (i) a direct productivity effect within the firm, since foreign investors commonly operate with superior technology and managerial practices, (ii) horizontal externalities on domestic firms operating in the same industry, either in the form of a rise in productivity in response to increased competition, or as knowledge spillovers when workers are trained in the foreign firm and change employment, and (iii) vertical productivity spillovers in upstream and downstream industries when the foreign firms establish linkages and requests improved technological standards.[7] The extent of these productivity effects depends (i) on the way in which foreign investment is provided (greenfield FDI versus mergers and acquisitions), (ii) the type of FDI (market-seeking/horizontal FDI versus efficiency-seeking/vertical FDI), which is often related to the distance of the source country and the applicability of free trade regimes, and (iii) the main sector of investment and the sectoral diversity of FDI.

First, it makes a difference whether FDI takes place as greenfield investment or through mergers and acquisitions. While greenfield investment usually introduces more advanced

[6] In countries with large FDI shares, the primary sector is a heavy recipient. In 2003, FDI to Bolivia was almost totally concentrated in the petroleum and natural gas extraction, the country's most important economic sector. In Ecuador the major share of FDI is in mining. In Chile the main share of FDI used to be in mining, however, since the mid 1990s the major share went into the category "electricity, gas and water". In Venezuela FDI is concentrated in the petroleum industry and finance.

[7] Rodriguez Clare 1996, Aitken et al. 1997, Blomström and Kokko 1997, Borensztein et al. 1998, Markusen and Venables 1999, Görg and Greenaway 2004.

technologies in the new production site and, thus, provides a substantial direct productivity effect, it is less likely to source locally and, thus, produces less spillover effects to backward industries. These spillovers are more important in the case of mergers and acquisitions where the supplier relations of the acquired firm are kept (Javorcik 2004, Javorcik and Spatareanu 2006). The FDI share of mergers and acquisitions substantially increased in LA from 20 per cent in the early 1990s to 50 per cent in 2000 (De Gregorio 2003). This is because EUR investors used the process of privatization in LA in the 1990s to acquire public utilities, firms in the energy and telecommunication sector and banks. Spain was particularly active in this field (UNCTAD 2004, Vodusek 2004). In contrast, NA companies were largely making greenfield investments in the manufacturing sector in Mexico (vertical FDI in the automotive and electronic industry) and Central America (Vodusek 2004).

Second, vertical FDI typically does not generate many spillover effects on the local industry because only one stage in the production is transferred to the host country to benefit from cost advantages, and the supplies are commonly imported from the source country. The benefits of this FDI remain limited to a direct productivity effect and the provision of additional production capacity offering employment and upgrading of skills (Peters 2000). With horizontal FDI, however, the entire production process of a product is placed in the host country. This provides not only a direct productivity effect through advanced technologies and the upgrading of a multitude of skills but also large productivity spillovers since a large number of intermediary products need to be purchased, mostly locally. Geographically close partner countries, labor cost differentials, and free trade regimes promote vertical FDI. Javorcik et al. (2004) show for Eastern Europe that distance to the source country and the applicability of free trade arrangements result in different types of investment and, hence, a different level of spillovers.

In the period under consideration, EUR-FDI in LA consisted of a larger share of market-seeking, horizontal FDI because home markets were too distant and the extent of free trade between EUR and LA countries was very limited. EUR firms tended to locate entire productions in LA and establish linkages with local suppliers. For example EUR-FDI in the automotive industries in Brazil, Mexico, and Argentina, as well as in the machinery industry in Chile, constituted market-seeking investments in sophisticated products whose motive is to conquer new markets rather than to benefit from low production costs (Vodusek 2004). In contrast, for NA investors, LA countries are close and free trade arrangements are well established, e.g. with Mexico and Central America under the umbrella of NAFTA and CAFTA-DR. Consequently, a large share of NA-FDI in Central America takes place as vertical FDI to benefit from cheap labor costs. All intermediary goods are easily imported under the free trade regime and final products are then again

exported into NA. This type of maquila industry is widespread with NA-FDI in Mexico and Central America in the machinery and electronics industry (Gomez Vega 2004; Lindegaard and Leiner 2003).

Third, investment in the manufacturing sector is likely to generate more spillover effects to the local economy through linkages than investment in the primary sector such as mining that uses imported capital goods and operates rather independently (Alfaro and Rodriguez Clare 2003). In contrast, FDI in the newly privatized service sector improves the efficiency of local infrastructure such as telecommunication and financial services and consequently enables productivity gains from FDI in manufacturing (Arnold et al. 2006). Examining UNCTAD data of the largest affiliates of EUR- and NA-investors, in almost all countries the share of EUR-FDI invested in the service sector is larger than the share of NA-FDI invested there. EUR firms show an important presence in telecommunication, the supply of gas, water, electricity, and in banking. Consequently, the important participation of European investors in service market liberalizations in LA should have a high potential to generate productivity effects.

The UNCTAD data can be used to identify further characteristics. In South America, EUR firms are more numerous, smaller, and more dispersed over all types of industries than NA firms. In Central America, in contrast, the number of NA-affiliates is larger than that of EU-firms. Here EUR-FDI tends to be more concentrated. The large number of EUR firms and their sectoral diversity is likely to to establish more local linkages and productivity spillovers in South American than NA ones. In summary, there is good reason to suppose EUR- and NA-FDI would yield different productivity effects in LA.

Finally, productivity effects from FDI seem to depend on the conditions provided in the country, especially a sufficient basis of human capital (Borensztein et al. 1998), the level of income (Blomström et al. 1994), the openness of the economy (Balasubramanyam et al. 1999), and financial development (Alfaro et al. 2004).

2.3 Model Specification and Control Variables

Assuming that FDI acts as a channel for technology transfer, it is straightforward to use an endogenous growth model. As argued by de Mello (1996), if FDI were a regular type of capital, it would just increase the long term per capita income in the context of a neo-classical Solow model. However, since FDI, (i) incorporates new technologies in the production function and (ii) leads to knowledge transfers (through labor force qualification, managerial practices and spillovers to local industries) we should consider it in the context of an endogenous growth model. Unlike physical capital, FDI has a constant marginal product. Therefore, FDI should have a permanent effect on the growth rate (De Mello

1999). Borensztein et al. (1998) derive the impact of FDI in an endogenous growth model analytically. They consider an economy that operates with a variety of capital goods as inputs. A part of those capital goods comes from foreign producers (FDI). To introduce a new type of capital good requires technological knowledge from outside. The higher the fraction of foreign capital goods, the lower are the costs to introduce new varieties. Borensztein et al. (1998) show that the growth rate in the technologically lagging economy depends on the level of FDI because this increases the rate of technology diffusion from developed countries.

We follow this approach and consider FDI in an endogenous growth model with physical and human capital and numerous other growth determinants. Our econometric strategy allows us to incorporate the widely varying findings of the FDI and growth literature. Consequently, we specify the following growth regression:[8]

$$y = \alpha + \beta_1 INV + \beta_2 HC + \beta_3 FDI + \beta_4 TRADE + \beta_5 MACRO + \beta_6 INFRA + \\ + \beta_7 INST + \beta_8 STRUC + \beta_9 FDI * HC + \beta_{10} FDI * TRADE + \beta_{11} FDI * MACRO + \\ + \beta_{12} FDI * INFRA + \beta_{13} FDI * INST + \varepsilon. \quad (1)$$

In this panel data model, productivity growth y is explained by gross fixed capital formation INV, three different human capital variables contained in matrix HC, our regressor of major interest, FDI, 2 trade statistics in matrix $TRADE$, 3 macroeconomic variables in matrix $MACRO$, 6 infrastructure variables in matrix $INFRA$, 8 different institutional variables in matrix $INST$, 3 structural variables in matrix $STRUC$ and country specific fixed effects, α, to account for unobserved heterogeneity among the countries. Additionally, we include 21 interaction terms of FDI with human capital, trade, macroeconomic factors, infrastructure, and institutional variables.[9][10] This is in line with the literature, which assumes threshold effects for the positive growth effects of FDI.[11] To

[8] We suppress subscripts i and t for simplicity.

[9] For EUR- and NA-FDI, this number doubles of course.

[10] For EUR- and NA-FDI, inherited and present cultural ties could also be conditioning factors to benefit from FDI. However, particularly investment from EUR originates from quite different countries and some of them have historical links with LA. Furthermore, recent socio-economic relationships between LA and EUR as well as LA and NA are very diverse as there exist vivid business and especially migrant networks among nearly all countries. Therefore, we think that cultural ties are too complex to be summarized by one indicator.

[11] Using interaction terms jointly with the main variables may result in multicollinearity. Therefore, some authors use quadratic interaction terms (for example Calderón et al. 2004). Since BMA is capable of handling highly collinear regressors, we use simple products as interaction terms. The algorithm described in section 4.2 appropriately weights the information added to a regression from two collinear variables: the Markov Chain will not incorporate models containing regressors that are collinear to those already

account for potential parameter heterogeneity in our estimations we include slope dummy variables for different country groups.[12] The subgroups are the large economies "D1", the rich economies "D2", and the South American economies "D3". We apply these dummies to all variables in the matrices HC, FDI, TRADE, and STRUC.

What are our hypotheses concerning the direction of influence for these variables? As endogenous growth theory suggests, we should assume that the availability of human capital in LA plays an important positive role for growth. Therefore, we test for the impact of primary, secondary, and tertiary level education. Our data shows that the share of population who completed each level of education increased in LA over the period considered. In primary and secondary education, the increase was only modest but in tertiary education it was very pronounced. As argued in the human capital literature,[13] we use the change in educational attainment instead of enrolment rates. The latter only proxies for human capital and is too volatile to yield reliable estimation results. Some caution applies, however. Since our data is derived from the Barro and Lee (2000) data set reporting 5-year intervals, our series do not represent the exact actual development path. The growth impact of education may differ for our country subgroups (D1 and D2). For rich economies an increase in tertiary education will be more important, while the poor may benefit more from an increase in primary and secondary education. Similarly, tertiary education may be more important in bigger economies because the availability of employment opportunities for university graduates is generally larger in big countries. Besides being a growth factor, human capital may also be an important precondition for productivity gains from FDI (Borensztein et al. 1998). Therefore we consider human capital also in interaction with FDI.

According to our data trade openness generally increased in LA countries during the period. Although, some countries (Venezuela, Paraguay, Colombia) also faced a prolonged decline of exports. Grossman and Helpman (1991) argue using trade theory that exporters would be forced to improve their productivity to compete on world markets and imports constitute a channel of technology transfer. So we test the impact of the share of exports and the share of exports and imports in GDP on growth. For worldwide samples such a positive relation was verified for example by Calderón et al. (2005), however, there is no empirical consensus on the effects. We account for the possibility that richer and larger

included as there is no additional information provided in such a model. In fact, the algorithm avoids such models and assigns high posterior model probabilities only to models not characterized by this problem (Masanjala and Papageorgiou 2004, Milani 2003).

[12] Due to the limited degrees of freedom given in both BMAs compared to the high number of variables and interaction terms, we had to refrain from permitting full parameter heterogeneity as is suggested, for example, by Hsiao and Pesaran (2004).

[13] For a survey, see Temple (2001).

countries may benefit more from trade openness because they have a higher potential to benefit from the challenges of openness. Therefore, we use the slope dummies D1 and D2 together with our trade variables. Furthermore, as in Balasubramanyam et al. (1999), we consider trade openness may act as a conditional factor for FDI growth effects since highly open economies know already how to adapt to external competition and how to benefit from technology transfers. We contemplate that both FDI and trade openness may reinforce each other.

The importance of macroeconomic stability for economic growth in developing countries was verified in previous growth studies (for example, Dollar and Burnside 1999). In LA, macroeconomic stability became a particular concern after the debt crises of the 1980s. The countries faced high inflation (sometimes hyperinflation), high external debts, and government deficits. This was accompanied by high interest rates and substantial currency devaluations (Corbo et al. 2005). Important reforms provoked advances in macroeconomic stability, above all in inflation and exchange rate volatility, and to some extent in budget discipline. We test whether the improved macroeconomic stability was beneficial for growth in LA using inflation volatility, the debt to export ratio and exchange rate volatility as macroeconomic indicators. Due to inconsistent definitions over time and the short time series, we cannot consider budget deficits and interest differentials. High values in our indicators are supposed to increase economic uncertainty, worsen the business climate, and, consequently, reduce growth. Since the generated uncertainty might also reduce the productivity effect of FDI, we use these macroeconomic variables in interaction with FDI.

The effect of public investment in infrastructure on growth and development has received much attention since the work of Aschauer (1989). A number of papers analyzes the important role of public infrastructure for development. For example, Calderón and Servén (2004b) investigated the growth impact of infrastructure in a sample of 121 countries in the period 1960-2000 and found that the quantity and quality of infrastructure in general, and of particular infrastructure items such as roads, telecommunication, and electric power have a positive impact on growth. Calderón and Servén (2004a) show that infrastructure endowments of LA lag behind other middle-income countries and that their development suffered from the retrenchment of public budgets since the mid 1980s. Looking at various infrastructure components, we find that the road network and electricity generating capacity in LA has in general grown modestly but stagnated in several countries. Telecommunication services, such as telephone mainlines, internet PC-use, steeply increased in the 1990s. In addition to contributing independently to growth, infrastructure is likely to be a conditional factor for FDI to produce growth effects. A good infrastruc-

ture can be considered as a complement for FDI. If FDI meets a poor telecommunication infrastructure, poor transport, and unreliable electricity provision, it may not produce a high productivity impact.

Recent empirical growth research, for example Acemoglu et al. (2001), Hall and Jones (1999), Rodrik et al. (2002), found that the quality of institutions is an important prerequisite for growth. In their growth regressions for LA, Bengoa and Sanchez-Robles (2003) use the index of economic freedom of the Fraser Institute[14] as institutional variable and find a significantly positive impact on growth. This composite index comprises judgements by experts, for example on government size, security of property rights, and on liberalization and is often used in growth regressions. In our opinion it is important to distinguish between single aspects of institutional quality rather then to look at a composite index. Therefore, we use detailed institutional data available for LA from the International Country Risk Guide. We consider government stability, democratic accountability, bureaucratic quality, corruption, law and order, military in politics and political risk in general as factors potentially affecting growth.[15] Government stability, political risk and internal conflicts (violence, civil disorder) - all of which may lead to severe economic uncertainty - generally improved in LA during the 1990s but deteriorated in the second half of the 1990s or after 2000. Democracy, which may improve the growth prospects, generally improved (with the exceptions of Venezuela and Colombia), and the involvement of military in politics generally, although not necessarily, decreased in parallel. Interestingly, in Brazil and Mexico the political role of the military increased.[16] The role of democracy and military involvement for growth is ambiguous. More military may also provide a more secure environment for economic decisions. Among the other institutional factors deemed important for efficient business, bureaucratic quality improved in most LA countries, but improvements in corruption and rule of law were often reversed soon.

We not only consider institutional variables per se in our regressions but also test their importance as a complementary factor for FDI. Therefore, we build interaction terms of all institutional variables with FDI. Why should institutional factors be critical for the effect of FDI? If foreign investors can rely on an efficient public administration (bureaucratic quality), low corruption, and an enforceable legal system, they can implement projects faster and will save time and resources. Therefore, investment meeting good institutional

[14] http://www.freetheworld.com/.

[15] An exploratory correlation analysis showed that there is no high correlation between these different institutional subcategories in LA.

[16] Note that military involvement in politics does not mean necessarily any direct involvement, for example, in the form of a military government. It comprises very subtle influences of the military in general executive decisions.

factors will contribute more to productivity growth than investment meeting poor institutions. Moreover, FDI meeting high political risk and political instability will more often produce failed projects due to an uncertain environment and will, therefore, have lower productivity effects. Whether democractic or military governments are important for the growth impact of FDI is questionable. Democracy as well as military governments may improve the reliability of government decisions and would, thus, produce a safer business environment which can boost the growth impact of FDI. However, military governments may also produce less predictable business environments.

Finally, we consider the sector structure and the degree of urbanization in matrix STRUC. LA countries have been experiencing a steady decline of the agricultural sector, and an increase in the industrial and service sector. However, there is a considerable difference between countries. We expect that richer LA economies will enjoy more growth if they possess a substantial industrial sector, while an increase in agriculture would be negative for growth at that stage of development. A higher degree of urbanization should lead to agglomeration advantages and enforce productivity growth.

3 Variables and Data

We include 16 LA countries in our analysis: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Peru, Paraguay, Uruguay and Venezuela. The time period considered is 1990-2003. We measure productivity growth in an economy by using the growth rate of GDP per labor force. Table A.1.1 in the appendix contains the list of included variables, their definitions and a detailed description of sources and compilations.

For total FDI we take aggregate LA inward stocks from UNCTAD. The FDI stock originating from NA and EUR is calculated using the inwards stocks of LA countries sourcing from NA and EUR as reported by UNCTAD.[17] Since these series show some missing values we complement them from inward FDI stocks from LA central banks and statistical offices and outward FDI stocks to LA countries from NA and EUR countries reported by their Central banks and the OECD. Consequently we can use a very complete and carefully compiled FDI data set.[18]

[17]The FDI stock originating from EUR contains inward stock from the following countries: Austria, Belgium, Denmark, France, Germany, Italy, Liechtenstein, Luxembourg, Netherlands, Portugal, Spain, Sweden, Switzerland, and United Kingdom. NA-FDI is the sum of FDI from the US and Canada. Note that the respective EUR countries may vary from one LA country to another since not all European countries are present in all LA countries (e.g. Portugal invests practically only in Brazil). EUR investment is slightly underestimated since official series do not report data for small investors below a certain threshold.

[18]A few limits of the data remain still. UNCTAD collects the series from national central banks which

In the case of LA one has to deal with the fact that several growth factors like educational attainment rates, infrastructure variables, and institutional factors are steadily increasing over time. Therefore, the presence of unit roots has be taken into account. We apply the Levin/Lin/Chu panel unit root test and the Im/Pesaran/Shin unit root test to our data. According to these tests unit roots were identified in the following data: educational attainment shares, FDI stocks, trade openness, consumer price volatility, all infrastructure variables, all institutional variables, urban population growth, and share of agriculture. To avoid spurious regressions we take the change of these variables to obtain stationary series.

4 Estimation

4.1 The Need for Model Averaging

Since the seminal work of Barro (1991) empirical research on the determinants of economic growth has identified numerous variables correlated with the growth rate.[19] Taking into account the limited number of observations on a national level, which limits the number of growth determinants to be included in one regression, empirical studies are exposed to severe criticism based on the inherent model and parameter uncertainty. To avoid misleading results due to spurious relations because of omitted variables or imprecise estimates due to the inclusion of irrelevant variables, growth regressions should address these uncertainties. In addition, standard results are often not robust to (minor) changes in model specification yielding uncertainty in valid interpretations of the results.

The lacking theoretical guidance has led to the increasing use of Bayesian methods to deal with parameter and model uncertainty within a formal framework.[20] They are of

often keep additional more recent or more detailed series. Commonly the UNCTAD data for our LA countries is given at historical costs, so that we can assume a standard definition across LA countries in this respect. However, some countries do not report all of the FDI components equity capital, reinvested earnings and intra-firm loans and hence the series are to some extent not strictly comparable across countries. When completing the UNCTAD data, we observed differences in data levels with other sources in several cases. Then we only used the FDI growth rates from the additional sources to interpolate missing values of the Unctad series.

[19] Durlauf et al. (2005) provide an impressive overview on potential right hand side variables and their effects in their appendix. The regressors can be clustered into 44 broader areas such as education, finance, government or trade.

[20] Another slightly different approach than BMA is the Bayesian Averaging of Classical Estimates (BACE) framework proposed by Sala-i-Martin, Doppelhofer and Miller (2004). Due to the fact that this method combines Bayesian with classical estimation techniques, it abandons the 'truly Bayesian' framework of proper, informative priors. As we are highly aware of the caveats related to this abandonment (see discussion in section 4.2), we prefer using BMA.

particular benefit for model averaging since models are treated as random variables and, thus, the concept of averaging over models can be given a rigorous statistical foundation. Although this is not the case in frequentist econometrics there are, however, various *ad hoc* classical methods of model averaging. Prominent examples are Levine and Renelt (1992), using a variant of Leamer's (1983, 1985) extreme-bounds analysis (EBA), or Sala-i-Martin (1997), who attenuated the extreme EBA-criteria for variables as being robust or non-robust regressors. Both approaches are preferable to using only one model for a growth regression. Nevertheless, they do not address the uncertainty about the true model entirely as each of those methods keeps certain variables constant in every model and changes only some of the regressors.[21]

In contrast, BMA does not require selecting any subset of the regressors a priori or fixing any variables as 'base-line' regressors. First, given a set of potential explanatory variables, BMA separately identifies models that are expedient to explain growth by allowing for *any* subset of the explanatory variables to combine in a regression and to estimate the posterior probability of any such combination of regressors. Second, conditional on the posterior model probabilities (PMPs), the issue of model uncertainty concerning the most efficient means of stimulating economic growth can be resolved by estimating the posterior probabilities of all possible explanatory variables commonly used.

4.2 BMA

Alternative models M^j, with $j = 1, ..., J$, will be defined through the set of K regressors they include. All linear regression models that differ in their explanatory variables and contain country-specific intercepts, α_i. It is assumed that the individual effects enter in all models and so the number of possible models is 2^K. We have data for N countries and T periods. The dependent variables for all countries and all models are grouped in vector y of length NT, the explanatory variables and the N dummy variables for each country, ι_T,[22] are stacked in design matrix X of dimension NT x $K+N$. β is defined as the full $K+N$-dimensional vector of regression coefficients and individual effects. Any model M^j with T observations for country i is represented by:

$$y_i = \alpha_i \iota_T + X_i^j \beta^j + \varepsilon_i \tag{2}$$

[21] For a detailed discussion of these model averaging techniques and their drawbacks applied to growth regressions, see Durlauf et al. 2005 and the references therein.

[22] The introduction of additional dummy variables for each country in ι_T could be confusing. By adding this to matrix X, the analysis of this Bayesian model with a non-hierarchical prior is equivalent to a frequentist model with fixed effects, though.

where X_i^j is the T x k^j submatrix of regressors of model M^j and β^j is the k vector of slope coefficients, $\beta^j \epsilon \Re^{k^j} (0 \leq k^j \leq K)$. ι_T is a column vector of T ones and ε_i is the T x 1 error vector that is normal, with covariance matrix $\sigma^2 I_T$, not autocorrelated and independent of X_i^j, α_i and β^j. Thus X_i^j is strictly exogenous with respect to ε_i given α_i. Although normality is not necessary for consistency, it guarantees good finite sample properties (FLS 2001b). The effect of variables not contained in X^j is assumed to be zero.

By averaging over all models the marginal posterior probability of including a certain variable is simply the sum of the posterior probabilities of all models containing this variable. Formally, the posterior distribution of any quantity of interest, say $\theta^j (= \beta^j, \sigma, \alpha_i)$, is an average of the posterior distributions of that quantity under each of the models with weights given by the PMPs:

$$p(\theta^j \mid y_i) = \sum_{j=1}^{2^K} p(\theta^j \mid y_i, M^j)\ p(M^j \mid y_i). \tag{3}$$

This procedure is typically referred to as BMA and it follows from direct application of Bayes' theorem (Leamer 1978). $P(\theta^j \mid y_i, M^j)$, the posterior distribution of θ^j under model M^j, is typically of standard form. However, we have to compute the PMPs due to model uncertainty. Using the standard method and allocating equal prior model probabilities, this yields

$$p(M^j \mid y_i) = \frac{p(y_i \mid M^j)}{\sum_{i=1}^{2^K} p(y_i \mid M^i)} \tag{4}$$

where $p(y_i \mid M^j)$ is the marginal likelihood of Model M^j. This is given by

$$p(y_i \mid M^j) = \int p(y_i \mid \alpha_i, \beta^j, \sigma, M^j)\ p(\alpha_i)\ p(\sigma)\ p(\beta^j \mid \alpha_i, \sigma, M^j) d\alpha_i\ d\beta^j\ d\sigma \tag{5}$$

with $p(y_i \mid \alpha_i, \beta^j, \sigma, M^j)$ the sampling model corresponding to equation (1) and $p(\alpha)_i$, $p(\sigma)$ and $p(\beta^j \mid \alpha_i, \sigma, M^j)$ the priors defined below in equations (6) and (7). Since marginal likelihoods can be derived analytically[23], the same holds for the PMP given in (4) and the distribution given in (3).

In practice, however, computing the relevant posterior distributions is still subject to challenges as the number of models to be estimated increases with the number of regressors at the rate 2^K. Furthermore, the derivation of the integrals implicit in (5) may be difficult because the integrals may not exist in closed form if the number of regressors is too large which is the case for our minimum number of 62 regressors.

[23] For the cross-section case with demeaned regressors, FLS (2001a) derive it in their equation (8), on p. 566.

Given these difficulties, we will approximate the posterior distribution on the model space $\mathcal{M}$ by simulating a sample from it. We apply the Markov Chain Monte Carlo Model Composition (MC^3) methodology by Madigan and York (1995). It is based on a Random Walk Chain Metropolis-Hastings algorithm which draws candidate models from regions of the model space in the neighborhood of the current draw and then accepts them with a certain probability. Posterior results based on the sequence of models generated from the MC^3 algorithm can be calculated by averaging over the draws. To verify the convergence of the algorithm, FLS (2001b) suggest a simple method: based on a reduced set of models, for example every model visited by the MC^3 algorithm, they calculate the analytical and the numerical PMP. This correlation should lie above 0.99.

The Bayesian framework needs to be completed with prior distributions for the parameters in each model M^j which are α_i, β^j and the scale parameter σ. While the inclusion of prior information is a particular feature of Bayesian inference, the choice of these distributions can have substantial impact on the PMPs.[24] Furthermore, in a context where there are many potential explanatory variables but one cannot be sure about which ones to include, this prior information is rare. Accordingly, non-informative priors would be preferable. However, PMPs cannot be meaningfully calculated with improper non-informative priors for parameters that are not common for all models. Thus, FLS (2001b), among others, have developed proper priors that do not require subjective input or fine tuning for each individual model. Given their conclusions, we use the following *benchmark priors* for our analyses. We take the $\{\alpha_i\}$ to be independently uniformly distributed on the real line and also adopt a uniform prior for the scale parameter common to all models which gives us

$$p(\alpha, \sigma) \propto \sigma^{-1}. \tag{6}$$

This prior implies that all values of α and of σ for $\ln(\sigma)$ are given equal prior weight. Furthermore, this distribution is invariant under scale transformations such as a change in the measurement units.

For β^j we choose an informative g-prior structure

$$p(\beta^j \mid \alpha, \sigma, M^j) \sim N(0, \sigma^2[g_j X'^j X^j]^{-1}). \tag{7}$$

It is common practice to center priors over the hypothesis that explanatory variables have no effect on the dependent variable, especially when there are many regressors but it is suspected that many of them may be irrelevant. Therefore, we set the mean of $\beta^j = 0$.

[24] Two recent studies have analyzed the effects of prior choices in growth regressions regarding different aspects such as robustness of parameter choices or posterior probabilities or the predictive performance in more detail (Ley and Steel 2007, Eicher et al. 2007).

Hence, one only has to elicit the scalar hyperparameter g_j and, following FLS (2001), we choose

$$g_j = \min\left\{\frac{1}{NT}, \frac{1}{(K+N)^2}\right\}. \tag{8}$$

As we have to deal not only with parameter but also with model uncertainty, we need to choose a prior distribution over the space $\mathcal{M}$ of all 2^K possible models. Following the standard practice for BMA in linear regression models, especially in the context of economic growth (Hoeting et al. 1999, FLS 2001a or Masanjala and Papageorgiou 2004), we allocate equal prior model probability to each model and set

$$p(M_j) = 2^{-K}. \tag{9}$$

This yields a uniform distribution on the model space which implies that the prior probability of including a regressor is $\frac{1}{2}$, which is independent of the combination of regressors included in the model.[25]

4.3 Endogeneity in Growth Regressions

Endogeneity of regressors constitutes a serious problem in growth regressions. Several of our regressors are considered to be endogenous: investment, FDI, trade, and institutions. Whenever possible, we chose our variables to avoid endogeneity problems: infrastructure variables refer to 3 year moving averages, and we take consumer price volatility over the last five years instead of the annual inflation rate. Also our educational variables are not endogenous because attainment rates rise only after the degree has been gained and when the person becomes part of the adult population.

Endogeneity leads to biased estimates in OLS regressions. The most common response to the endogeneity problem has been the use of instrumental variables (IV) in growth regressions. The application of instruments, however, is prone to severe problems on economic and econometric grounds. Statistically speaking, one has to assure the validity

[25] Some authors recommend different choices for $p(M_j)$. For instance, many researchers prefer parsimony and feel that simpler models should be preferred to more complex ones, all else being equal. In contrast, Durlauf et al. (2005) argue against priors promoting parsimonious models that the underlying "presumption is unappealing as our own prior beliefs suggest that the true growth model is likely to contain many distinct factors" (p. 83). Moreover, regular posterior odds ratios already include a reward for parsimony and the Bayes factor obtained in (4) has a built-in mechanism to avoid overfitting. Brock and Durlauf (2001) and Brock et al. (2003) raise objections against uniform priors on the model space because of the assumption that the probability that one regressor should appear in a growth model is independent of the inclusion of others. Some regressors are correlated with others and/or could be proxies for the same growth theory. Therefore, they suggest a hierarchical structure for the model prior. This, however, requires agreement on which regressors are proxies for the same theories. As stated in Eicher et al. (2007), such an agreement is often not existent and, therefore, independent model priors should be preferred.

of instruments, that is, that they are uncorrelated with the error term, and avoid weak instruments which would not be strongly correlated with the endogenous variable(s). Otherwise, IV estimation would lead to inefficient and inconsistent estimates. It is especially difficult to find valid instruments in the growth context because the openendedness of the theory and the complexity of the matter make it especially hard to find instruments that are not growth determinants themselves or that are definitively uncorrelated with omitted growth determinants.[26]

A panel data framework makes it even harder to find suitable instruments as many of the standard suggestions, as, for example, geographical characteristics, are not time-varying. The generally proposed solution to work with lagged values of the regressors in the IV estimation is also problematic in our case.[27] We considered lagged values as instruments for all likely endogenous variables. Moreover, we experimented with trade measures and tariffs as instruments for FDI or, alternatively, with tariffs as instruments for trade. All these potential instruments are not highly correlated with the respective endogenous regressors in our data set, which would seriously effect the efficiency of any IV estimation. We assume that the very low correlation of lags and original variables stems from the fact that LA data are subject to sudden changes and rapid developments.

Economically speaking, endogeneity of regressors means that one can establish a certain association between the dependent variable and an endogenous regressor but cannot identify a causal effect. According to Mankiw (1995) and Warzciag (2002) growth regressions, nevertheless, can be used to benefit from. Durlauf et al. (2005) summarize their position on page 117: "[...] one should accept that reliable causal statements are almost impossible to make, but use partial correlations of the growth literature to rule out some possible hypotheses about the world." in addition, Warzciag (2002) argues that the use of IV estimation may run into a statistical exercise where the structural economic relationship is no longer investigated. In our opinion, this is especially crucial in our BMA context where we are not primarily interested in coefficient estimates but in the identification of robust regressors. The use of an instrument instead of an (endogenous) variable, originally selected to be in our model for theoretical economic reasons, could lead to wrong conclusions about robustness or could conflate the robustness of IV and original variable. Therefore, we refrain from including instruments in our BMAs. We have to keep in mind that this will not permit us to determine robust growth determinants for the FDI-growth nexus in LA. Rather, we are able to identify robust growth correlates which can be used to

[26] Durlauf et a. (2005) discuss extensively the difficulties to find valid instruments for growth regressions and mention the general caveat that applies to IV estimation.

[27] See Durlauf et al. (2005) for an in-depth overview on instruments generally suggested for Solow and non-Solow growth determinants.

establish a deeper notion on the relationship among economic growth and other prominent variables.

5 Estimation Results

5.1 Posterior probabilities

Our results for the first BMA with total FDI are based on taking 2 million draws and discarding the first 500,000 as burn-in replications.[28] The second BMA with decomposed FDI from EUR and NA contains many more regressors. Therefore, we repeated the sampling mechanism 2.8 million times and discarded the first 800,000. The correlation coefficient between visit frequencies and posterior probabilities lies, thus, above the recommended threshold of 0.99 for both BMAs.

Dealing firstly with the inherent model uncertainty and with the significance of respective combinations of regressors, which represent our different model specifications, we report the PMPs for the ten best models of the two BMAs and list their respective regressors in Tables A.1.2 and A.1.4 in the appendix. The ten best models' posterior probabilities are quite spread between and within our two samples. Also the cumulative PMP, which is the numerical probability of the top 10 models out of the total number of models, varies a lot between our two samples. In the first sample, with total FDI, it accounts for 7 per cent of the total posterior mass, whereas it is as high as 11 per cent for our second BMA with decomposed EUR- and NA-FDI. This can be seen as an indicator of the fact that decomposed FDI reveals more information in our growth regression than does total FDI. Another indicator for that is the high PMP of the most important model in the second BMA, which is 27 per cent. For the estimation with total FDI, the PMP of the most important model is only 15 per cent. All our PMPs are high compared to other BMA studies of economic growth in which the PMP of the most important model sometimes is only between 1 and 5 per cent, thus, resembling the PMP of only our tenth best model or being even lower than that.[29]

Looking secondly at the importance of single regressors in affecting growth, the second columns of Tables A.1.3 and A.1.5 in the appendix report the posterior probabilities for each of the explanatory variables in our two BMAs. It can be interpreted as the probability

[28] As with other Markov Chain Monte Carlo algorithms, a starting value, $M^{(0)}$, must be chosen. Therefore, it is necessary to discard a sufficient number of replications from the simulation to ensure that this choice does not influence the results.

[29] See, for example, FLS 2001a; Masanjala and Papageorgiou 2004. This could be due to the fact that we use a quite homogenous country sample and do a panel analysis including individual effects while the other studies do cross-country analyses on a large number of quite heterogenous countries.

that the respective regressor should be included in the evaluation as it exerts some influence on the dependent variable regardless of which other explanatory variables are included as well. We ranked the variables according to their probability of inclusion and will discuss their respective effects in the next section. We base our discussion not only on the regressors that have a high posterior probability but also on regressors that are contained in one of the ten best models. These variables do not exert a high effect themselves but are relevant in certain combinations with other regressors.[30]

5.2 Discussion and policy implications

When assessing the growth nexus of total FDI in 16 LA countries in the period 1990-2003 (see tables A.1.2 and A.1.3 in the appendix), our BMA indicates that investment and FDI - but only under specific conditions - are the most robust growth correlates. The ten best models also contain primary and tertiary education, road and phone infrastructure, political risk, and military involvement as growth factors. While increasing primary education in the population is good for growth, the increase in tertiary education in LA only has a positive effect in the bigger economies. Improvements in road and phone infrastructure are important for growth. Higher political risk is adverse to growth. Less military involvement is negative. The positive contribution of FDI depends on institutional and macroeconomic factors in the country. Thus, productivity growth is only associated with FDI in LA if the rule of law in a country is sufficiently developed, the country faces low political risk, and the country has a low share of external debt. The stage of democracy development seems to have no effect on the FDI-growth nexus. As more military involvement in politics is also not detrimental for growth, we may conclude that this could be related the specific circumstances of military involvement in politics or the definition of democratic stability.

The second BMA, which refers to the same sample and same regressors but distinguishes between the FDI sources EUR and NA (see tables A.1.4 and A.1.5 in the appendix), also identifies investment and FDI - under certain conditions - as the most robust growth correlates, while road and phone infrastructure follow as in the first BMA. Since there are more candidate variables when accounting for different FDI sources and their corresponding interactions, some important variables from the first BMA loose their rank to FDI interaction variables. We find that both, EUR- and NA-FDI, are associated with productivity growth but only if certain conditions are given in the country. Only FDI recipients with a sound legal framework experience productivity growth, regardless of the

[30] According to FLS (2001a) there exists no theoretical justification for any threshold of posterior probabilities over which to call a regressor 'very important'. Kass and Raftery (1995), however, suggest to start with the threshold of 50 per cent saying that the evidence for a regressor having an effect is at least weak.

source country. For the growth effects of EUR-FDI low political risk is important, while for NA FDI stable currencies are vital. We identify also a negative growth nexus from NA-FDI in the big LA countries.

There are some important findings, but also some puzzles in these results. First, from the analyses of both samples, we find a positive FDI-growth nexus under a well developed legal framework, low political risk, and stable macroeconomic conditions (both magnitudes for exchange rate volatility and external debts appearing in the two BMAs are economically related to each other). Given their dominance, bureaucratic quality and corruption become subordinate, as our results show. FDI as such is not a robust growth factor. Investment and infrastructure improvement appear to be important for growth. A higher level of education is only important for the big countries.

Second, we have to note that trade openness does not appear as an important growth factor, nor do modern telecommunication infrastructure; certain institutional variables like bureaucratic quality, corruption, and internal conflict; and sectoral structures. With respect to the country conditions interacting in the FDI-growth nexus, we cannot find evidence that education, infrastructure or trade openness are essential conditions in LA, however, stable macroeconomic and political conditions are.

Third, despite the different types of FDI provided by NA-FDI and EUR-FDI, we cannot find evidence that one of the two investors plays a more important role for growth. Therefore, we cannot say that the dominance of EUR-FDI in horizontal FDI or that of NA-FDI in vertical FDI plays a role. Moreover, our results do not indicate that the greenfield investment oriented NA-FDI is superior or inferior for growth than the acquisition oriented EUR-FDI. With respect to the increasing orientation of EUR-FDI towards service sectors against the manufacturing orientation of NA-FDI, we cannot state that this makes a difference for growth either. A simple interpretation of the equal contribution of EUR- and NA-FDI may be that NA-FDI manages to bring new vintage capital at large scale into key branches to LA while EUR-FDI makes an important contribution in modernizing existing firms that were privatized and enables technological spillovers though diverse network of EUR-affiliates. Deeper insights into the relation between different FDI types and productivity growth, however, can only be established via sectoral FDI studies in LA, which we intent to pursue in future research.

The insight gained from the use of conditioning factors is important and specific to the situation in LA. While in other country contexts, an educational threshold (Borensztein et al. 1998), trade openness (Balasubramanyam et al. 1999) or an income threshold (Blomström et al. 1994) seem to be important for FDI effects, a stable political and macroeconomic environment seems to be most important for the FDI-growth nexus in

LA. We cannot find evidence that the growth effect of FDI generally differs between rich and poor LA countries, between bigger and smaller ones, or between South America and Central America either. Only NA-FDI has a negative record in large countries.

One may find it puzzling that the increase in tertiary education over the 1990s appears to be negatively related to growth in LA, at least in the small economies. Why should only big economies benefit from university education? One reason may be that big economies offer more positions where tertiary education is required and that economies of scale or spillovers among university educated arise only at a sufficient size of the economy.

Another, at first sight, surprising result is that none of our trade variables - solitary or in interaction with FDI - appears to be a robust growth factor. However, there is also conflicting evidence on the relation between trade and growth in other studies on LA. De Gregorio (1992) cannot find a statistically significant relationship between trade and growth in LA. The country study of Cuadros et al. (2004) finds a causal relationship in Mexico and Argentina, but not in Brazil. The study of Paus et al. (2003), which finds a positive relationship in 7 LA countries, refers to the manufacturing sector only. There are two main reasons why trade may not enhance growth. First, if exports do not lead to specializations in the comparative advantage of an economy or if trade does not take place in products of increasing returns, the growth effect may not appear. Second, there is some evidence that countries that export resource intensive goods often do not benefit in terms of growth (Sachs and Warner 1999). The exploitation of natural resources cannot open possibilities for productivity growth in the economy as would be the case with manufactured goods. Several LA countries are heavy exporters of primary goods, for example Venezuela, Bolivia, and Chile. This argument is also supported by the fact that we cannot observe an increase in investment in LA when exports increase. Therefore, we conclude that the type of goods exported by LA do not produce productivity growth as in the common Helpman and Grossman (1991) argument. Consequently, we are also not surprised to find that the interaction of FDI and trade is not a robust regressor for our LA sample. If LA countries do not mainly trade in manufactured goods, where productivity improvements are stimulated, but in primary goods, those countries with high trade shares will not have a better capacity to reap technology spillovers from FDI either. In this respect our findings are different to the recent conclusions in Makki and Somwaru (2004) who found in a similar model specification that trade intensity of a large set of developing countries, including also the East-Asian heavy exporters of manufactures, is a prerequisite for them to benefit from FDI.

It is also striking that among the infrastructure variables, only the fairly standard ones, such as road networks and basic telecommunications, are important growth factors

but not advanced telecommunications. Evidently, since some countries do not even have acceptable standards in basic infrastructures, this becomes most import for growth.

6 Conclusion

This paper investigates the FDI-growth nexus in 16 LA countries conditional on macroeconomic, institutional, structural, and infrastructure factors and on trade and education. Examining the period 1990-2003, we first analyze the effects of aggregated FDI inflows and then distinguish between EUR- and NA-FDI. In doing so, we account for the major shifts in the regional composition of these inflows since the 1990s and for the varying types and motives of FDI coming from EUR as opposed to coming from NA. We allow for country specific effects in our panel data model and look at group specific coefficients addressing potential parameter heterogeneity within the LA countries.

The method we propose in this context is BMA as it is a suitable way to account for model uncertainty in growth regressions and to ascertain the most robust regressors. Out of more than 60 potential growth determinants, we identify not only the regressor combinations of the best models – which can be seen as the most relevant 'policy packages' for stimulating FDI-led growth in LA – but also a ranking of all included regressors according to their respective importance for growth.

Consequently, our findings entail new insights in the conflicting results on the FDI-growth nexus in LA in two respects: We are in the position to suggest an empirical growth model that is more robust and, therefore, more reliable as it was selected 'conditional on model uncertainty'. On that account, our paper provides an 'external robustness check' for related studies showing contrasting results. Our own policy implications are more robust because we use consistent samples in a unified, statistically rigorous method.

Our BMAs provide the following insights: First, FDI in general as well as EUR- and NA-FDI are robustly correlated with productivity growth in LA subject to certain local conditions. Necessary prerequisites are low political risk, a sufficiently developed rule of law, and macroeconomic stability. Second, domestic and infrastructure investments are the most robust growth correlates in LA. Finally, we cannot find evidence that one of the two sources is more important for the FDI-growth nexus in LA. Therefore, we cannot conclude that the dominance of EUR-FDI in horizontal FDI or that of NA-FDI in vertical FDI plays a role, nor that the greenfield investment oriented NA-FDI is superior or inferior for growth than the acquisition oriented EUR-FDI. Similarly, the increasing orientation of EUR-FDI towards service sectors compared to the manufacturing orientation of NA-FDI does not make a difference for the FDI-growth nexus in LA.

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A Appendix

A.1 Variables and Data Sources

Variable	Definition	Source	Remarks
$GROWTH_{LF}$	Share of real GDP growth per labor force	WDI 2005	Constant US-Dollars in 2000
INV	Share of gross fixed capital formation in GDP	WDI 2005	
LIT	Change of literacy rate	WDI 2005	
PRIM	Change share of adult population with completed primary education	Barro/Lee	Missing years interpolated
SEC	Change share of adult population with completed secondary education	Barro/Lee	Missing years interpolated
TERT	Change share of adult population with completed tertiary education	Barro/Lee	Missing years interpolated
FDI_T	Change share total FDI stock in GDP	UNCTAD	Generated from inward stocks of LA data by country of origin
FDI_{EUR}	Change share FDI stock from Europe in GDP	UNCTAD	Data completed with data from OECD International Investment Directory for EUR countries, data from EUR, NA, and LA central banks, and statistical offices
FDI_{NA}	Change share FDI stock from North America in GDP	UNCTAD	See FDI_{EUR}
X-M	Change share exports and imports to GDP	WDI 2005	
X	Change share exports to GDP	WDI 2005	
CPI_{VOL}	Change consumer price volatility	IFS	Standard deviation relative to country mean, quarterly data of past 5 years
EXCH	Exchange rate volatility	IFS	Calculated from official exchange rate national currency per US-Dollar, quarterly data of past 5 years
DEBT	Share external debt to exports, in logs	WDI 2005	
ELEC1	Growth electricity generating capacity per 1000 persons	WDI 2005	3 year moving averages
ELEC2	Electric power transmission and distribution loss, share of output	WDI 2005	
ROAD	Change paved road, km per square kilometer	International Road Fed.	3 year moving averages
PHONE	Growth telephone mainlines per 1000s	WDI 2005	
PC	Change growth rate of PCs per 1000s	WDI 2005	
WWW	Change growth rate internet users per 1000s	WDI 2005	

Variable	Definition	Source	Remarks
BURO	Change bureaucratic quality index (in logs)	ICRG	Improvement indicates better bureaucracy, index runs from 0 to 1.4
CORR	Change corruption index (in logs)	ICRG	Improvement indicates less corruption, index runs from 0 to 1.8
DEMO	Change index democratic accountability (in logs)	ICRG	Improvement indicates more democracy, index runs from 0 to 1.8
GOV	Change index government stability (in logs)	ICRG	Improvement indicates more stability, index runs from 0 to 2.5
CONFL	Change index internal conflict (in logs)	ICRG	Improvement indicates less conflict, index runs from 0 to 2.5
LAW	Change index law and order (in logs)	ICRG	Improvement indicates better law, index runs from 0 to 1.8
MILI	Change index military in politics (in logs)	ICRG	Improvement indicates less military, index runs from 0 to 1.8
POLRI	Change index political risk (in logs)	ICRG	Improvement of index indicates less risk, index runs from 0 to 4.6
URBAN	Change urban population growth	WDI 2005	
AGRI	Change GDP share agriculture	WDI 2005	
IND	GDP share industry	WDI 2005	
$FDI_T * SEC$	Interaction term		
$FDI_T * TERT$	Interaction term		
$FDI_T * X - M$	Interaction term		
$FDI_T * X$	Interaction term		
$FDI_T * CPI_{VOL}$	Interaction term		
$FDI_T * EXCH$	Interaction term		
$FDI_T * DEBT$	Interaction term		
$FDI_T * ELEC1$	Interaction term		
$FDI_T * ELEC2$	Interaction term		
$FDI_T * ROAD$	Interaction term		
$FDI_T * PHONE$	Interaction term		
$FDI_T * PC$	Interaction term		
$FDI_T * WWW$	Interaction term		
$FDI_T * BURO$	Interaction term		
$FDI_T * DEMO$	Interaction term		
$FDI_T * CORR$	Interaction term		
$FDI_T * LAW$	Interaction term		
$FDI_T * GOV$	Interaction term		
$FDI_T * CONFL$	Interaction term		
$FDI_T * MILI$	Interaction term		
$FDI_T * POLRI$	Interaction term		
D1	Dummy for big economies obtained from ranking GDP in 2000 USD in 1980 and 1990		ARG, BRA, CHL , COL, MEX, PER, URU, VEN (no change of group members between years)
D2	Dummy for rich economies obtained from ranking GDP p.c. in 2000 USD in 1980 and 1990		ARG, BRA, CHL, CRI, MEX, URU, VEN (no change of group members between years)
D3	Dummy for South America		

A.1.1 BMA 1: Total FDI-growth nexus in 16 LA countries 1990-2003: Regressors and PMP of ten best models

Model	Regressors	PMP (in per cent)
1	INV, FDI_T*DEBT, FDI_T*LAW	15.20
2	INV, MILI, POLRI, FDI_T*DEMO, FDI_T*LAW	12.31
3	INV, FDI_T*LAW	12.21
4	INV, FDI_T*DEBT, FDI_T*DEMO, FDI_T*LAW	11.57
5	INV, PRIM, TERT, D1*TERT, MILI, FDI_T*DEBT, FDI_T*LAW	10.82
6	INV, FDI_T*DEMO, FDI_T*LAW	10.44
7	INV, PRIM, TERT, D1*TERT, MILI, FDI_T*LAW	6.25
8	INV, PHONE, FDI_T*LAW	6.98
9	INV, PRIM, TERT, D1*TERT, FDI_T*DEBT, FDI_T*DEMO, FDI_T*LAW	5.89
10	INV, ROAD, FDI_T*LAW	5.67

A.1.2 BMA 1: Total FDI-growth nexus in 16 LA countries 1990-2003: Regressors' posterior probabilities and posterior means

Importance	**Regressor**	**Posterior probability**	**Posterior Mean**
1	INV	0.9467	0.3772
2	FDI_T *LAW	0.8032	1.7843
3	FDI_T *DEMO	0.4801	-1.7227
4	D1*TERT	0.4494	28.8387
5	TERT	0.4448	-25.3021
6	PRIM	0.3378	0.8445
7	FDI_T*DEBT	0.3266	-0.0739
8	ROAD	0.2178	0.9134
9	FDI_T*POLRI	0.2067	1.0602
10	POLRI	0.1540	0.0322
11	MILI	0.1429	-0.0077
12	PHONE	0.1313	0.0109
13	DEBT	0.1149	-0.0023
14	X	0.0905	-0.0160
15	FDI_T*ELEC2	0.0833	-0.1097
16	D2*IND	0.0719	0.0158
17	PC	0.0683	0.0004
18	EXCH	0.0671	0.0008
19	D1*X-M	0.0563	0.0177
20	FDI_T*GOV	0.0547	0.0467
21	SEC	0.0511	0.0287
22	FDI_T	0.0486	-0.0073
23	D1*X	0.0408	0.0050
24	D2*FDI_T	0.0405	-0.0073
25	FDI_T*TERT	0.0383	-2.0772
26	FDI_T*ELEC1	0.0374	-0.0786
27	FDI_T*EXCH	0.0357	0.0109
28	FDI_T*ROAD	0.0348	2.2150
29	FDI_T*X	0.0328	-0.0941
30	D2*PRIM	0.0294	0.0307

Importance	Regressor	Posterior probability	Posterior Mean
31	D1*PRIM	0.0269	0.0474
32	D1*FDI_T	0.0268	-0.0040
33	D2*X-M	0.0265	0.0015
34	DEMO	0.0264	-0.0005
35	D2*X	0.0261	0.0015
36	ELEC2	0.0260	-0.0031
37	CPI_{VOL}	0.0258	-0.0001
38	FDI_T*WWW	0.0257	-0.0033
39	IND	0.0249	0.0017
40	D2*TERT	0.0218	-0.1598
41	X-M	0.0209	0.0003
42	WWW	0.0207	-0.0001
43	ELEC1	0.0199	0.0011
44	FDI_T*BURO	0.0194	-0.0105
45	URBAN	0.01866	-0.0214
46	D2*AGRI	0.0185	-0.0050
47	FDI_T*MILI	0.0178	0.0021
48	AGRI	0.0175	0.0016
49	FDI_T*SEC	0.0174	-0.0300
50	CORR	0.0171	-0.0002
51	CONFL	0.0170	0.0001
52	FDI_T*CPI_{VOL}	0.0166	-0.007
53	FDI_T*PHONE	0.0164	0.0046
54	LAW	0.0157	-0.0001
55	FDI_T*X-M	0.0156	0.0036
56	GOV	0.0155	-0.0001
57	FDI_T*PC	0.0153	0.0007
58	FDI_T*CONFL	0.0150	-0.0013
59	D1*SEC	0.0149	0.0022
60	D2*SEC	0.0148	0.0038
61	FDI_T*CORR	0.0147	0.0015
62	BURO	0.0137	0.0001

A.1.3 BMA 2: EUR-/NA-FDI-growth nexus in 16 LA countries 1990-2003: Regressors and PMP of ten best models

Model	Regressors	PMP (in per cent)
1	INV, FDI_{NA}*EXCH, FDI_{NA}*LAW	26.83
2	INV, ROAD, FDI_{NA}*EXCH, FDI_{NA}*LAW	19.71
3	INV, PHONE, FDI_{NA}*EXCH, FDI_{NA}*LAW	12.68
4	INV, FDI_{EUR}*LAW, FDI_{NA}*EXCH	10.64
5	INV, ROAD, PHONE, FDI_{NA}*EXCH, FDI_{NA}*LAW	9.91
6	INV, PC, FDI_{NA}*EXCH, FDI_{NA}*LAW	5.17
7	INV, ROAD, FDI_{EUR}*LAW, FDI_{NA}*EXCH	4.69
8	INV, FDI_{EUR}*POLRI, FDI_{NA}*EXCH, FDI_{NA}*LAW	4.11
9	INV, D1*FDI_{NA}, FDI_{NA}*LAW	3.34
10	INV, PHONE, FDI_{EUR}*LAW, FDI_{NA}*EXCH	2.91

A.1.4 BMA 2: EUR-/NA-FDI-growth nexus in 16 LA countries 1990-2003: Regressors' posterior probabilities and posterior means

Importance	**Regressor**	**Posterior probability**	**Posterior Mean**
1	INV	0.9910	0.4348
2	FDI_{NA}*EXCH	0.8297	-1.0930
3	FDI_{NA}*LAW	0.5867	2.8968
4	ROAD	0.3276	1.4788
5	PHONE	0.2238	0.0200
6	FDI_{EUR}*POLRI	0.1915	2.3877
7	FDI_{EUR}*LAW	0.1734	1.0176
8	D1*FDI_{NA}	0.1517	-0.1523
9	D1*TERT	0.1234	6.3799
10	TERT	0.1196	-5.7135
11	PC	0.1026	0.0006
12	FDI_{NA}*TERT	0.0937	-26.3739
13	FDI_{EUR}*DEBT	0.0800	-0.0470
14	FDI_{EUR}*EXCH	0.0704	0.1263
15	DEBT	0.0690	-0.0012
16	PRIM	0.0688	0.1405
17	SEC	0.0588	0.0378
18	FDI_{EUR}*SEC	0.0480	-2.6069
19	FDI_{EUR}*CONFL	0.0471	0.1536
20	POLRI	0.0469	0.0063
21	X	0.0467	-0.0069
22	FDI_{NA}*POLRI	0.0430	0.3088
23	FDI_{NA}*DEBT	0.0429	-0.0109
24	FDI_{EUR}*ELEC2	0.0424	-0.1645
25	D2*FDI_{EUR}	0.0404	-0.0240
26	URBAN	0.0360	-0.0718
27	MILI	0.0358	-0.0012
28	FDI_{EUR}	0.0355	-0.0147
29	FDI_{NA}*ELEC2	0.0334	-0.0559
30	D2*IND	0.0328	0.0056

Importance	Regressor	Posterior probability	Posterior Mean
31	FDI_{EUR}*PHONE	0.0322	0.1056
32	D1*FDI_{EUR}	0.0315	-0.0161
33	FDI_{NA}*ELEC1	0.0290	-0.1649
34	D1*PRIM	0.0288	0.0489
35	D2*FDI_{NA}	0.0285	-0.0121
36	D1*X	0.0273	0.0058
37	D2*PRIM	0.0265	0.0389
38	FDI_{EUR}*CPI_{VOL}	0.0264	-0.0057
39	FDI_{EUR}*ELEC1	0.0261	-0.1887
40	FDI_{NA}	0.0253	-0.0056
41	FDI_{NA}*CONFL	0.0224	0.0411
42	D1*X	0.0223	0.0065
43	D2*TERT	0.0216	-0.1972
44	DEMO	0.0209	-0.0008
45	FDI_{EUR}*X	0.0203	-0.1098
46	FDI_{NA}*WWW	0.0197	-0.0067
47	CPI_{VOL}	0.0195	-0.0001
48	EXCH	0.0182	0.0001
49	FDI_{EUR}*DEMO	0.0179	-0.0861
50	FDI_{NA}*X-M	0.0178	0.0389
51	WWW	0.0169	-0.0001
52	FDI_{EUR}*GOV	0.0168	0.0110
53	FDI_{EUR}*TERT	0.0166	-0.2854
54	X-M	0.0155	-0.0004
55	D2*X	0.0153	0.0006
56	FDI_{NA}*CPI_{VOL}	0.0148	-0.0010
57	D2*X-M	0.0144	0.0005
58	AGRI	0.0143	0.0019
59	D2*SEC	0.0139	0.0065
60	FDI_{NA}*ROAD	0.0138	0.4304
61	D1*SEC	0.0132	0.0063
62	FDI_{NA}*GOV	0.0131	0.001
63	FDI_{EUR}*WWW	0.0130	-0.0031
64	FDI_{NA}*X	0.0127	0.0103
65	LAW	0.0125	0.0002
66	FDI_{EUR}*X-M	0.0124	0.0109
67	FDI_{NA}*PHONE	0.0123	0.0036
68	ELEC2	0.0122	-0.0008
69	FDI_{EUR}*CORR	0.0121	0.0017
70	FDI_{NA}*DEMO	0.0120	-0.0124
71	GOV	0.0119	0.0001
72	FDI_{NA}*BURO	0.0118	0.0157
73	FDI_{EUR}*PC	0.0117	0.0006
74	ELEC1	0.0116	0.0003
75	FDI_{NA}*SEC	0.0114	0.0770
76	FDI_{NA}*PC	0.0113	0.0007
77	D2*AGRI	0.0113	-0.0025
78	IND	0.0112	0.0002
79	FDI_{NA}*CORR	0.0112	-0.0063

Importance	**Regressor**	**Posterior probability**	**Posterior Mean**
80	FDI_{EUR}*MILI	0.0111	0.0035
81	CORR	0.0109	-0.0001
82	FDI_{NA}*MILI	0.0106	0.0009
83	FDI_{EUR}*ROAD	0.0105	0.3995
84	FDI_{EUR}*BURO	0.0104	-0.0099
85	CONFL	0.0103	0.0001
86	BURO	0.0095	0.0001

Figure 1: Development of total FDI stock in LA (share of GDP)

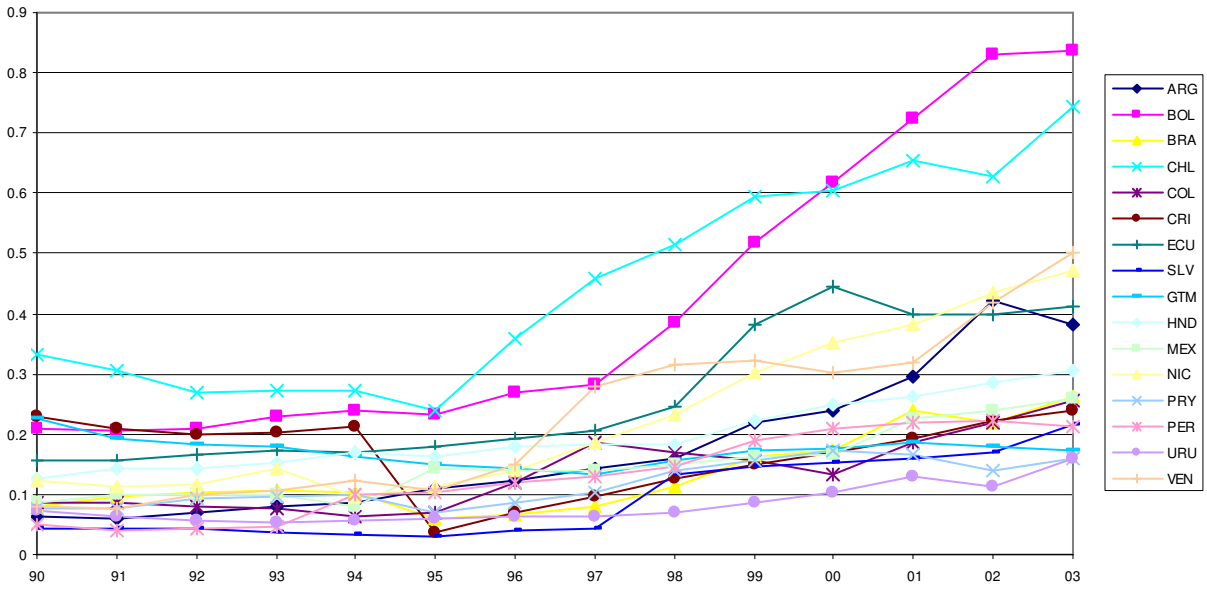

Figure 2: Development of EUR-FDI stock in LA (share of GDP)

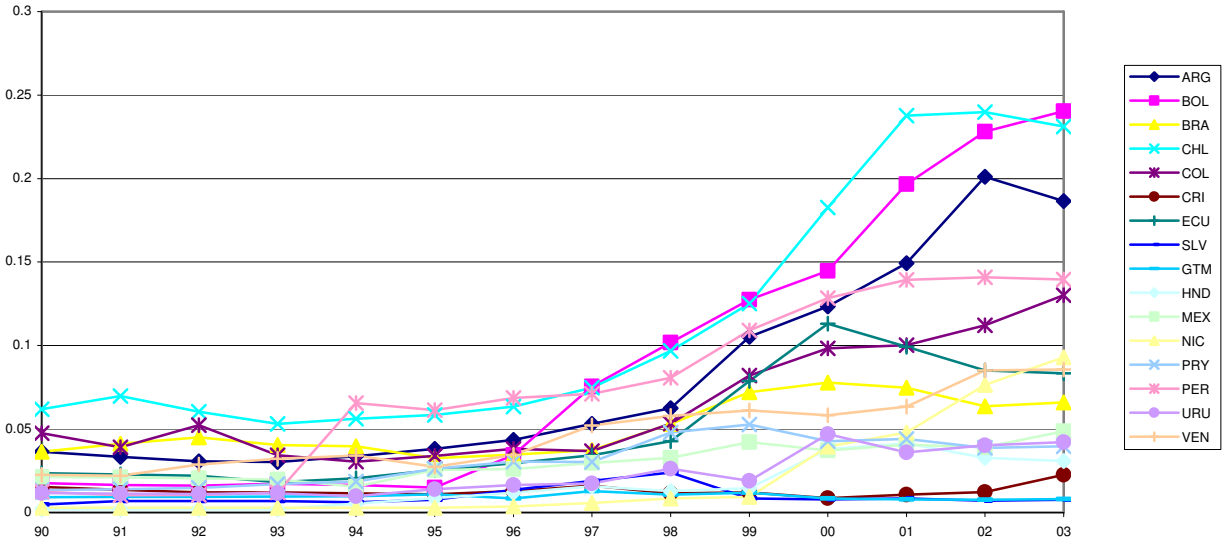

Figure 3: Development of NA-FDI stock in LA (share of GDP)

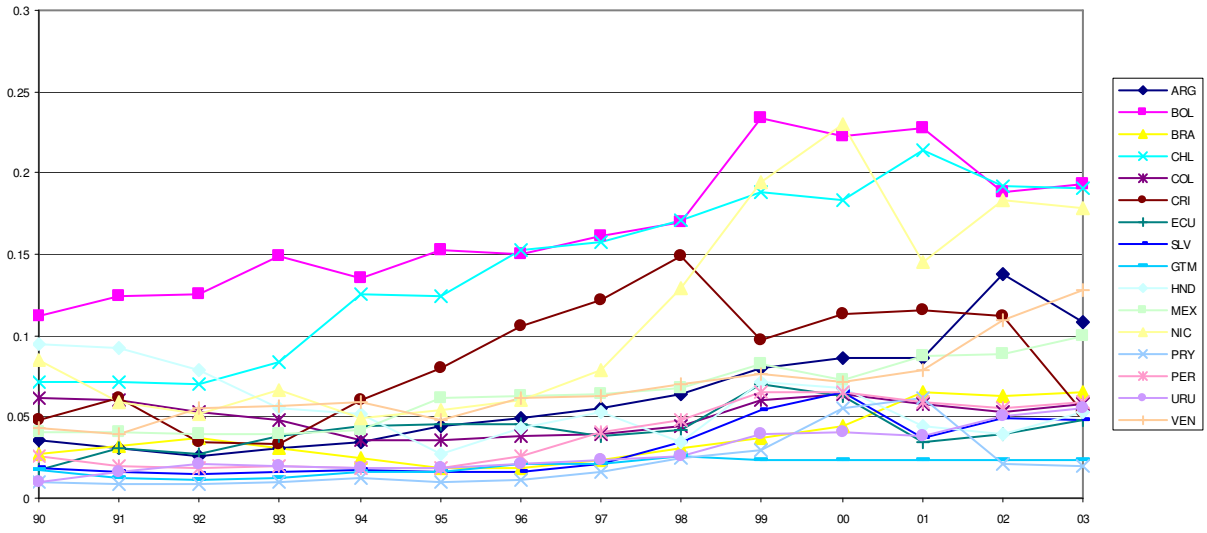

Figure 4: EU- vs. NA-FDI stock in LA countries in 2003 (share of GDP)