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On the Contributions of Knowledge-Intensive Business-Services Multinationals to Laggard Innovation Systems

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Abstract

Foreign direct investment (FDI) is assumed to be a source of knowledge flows across National Innovation Systems, with particular relevance for developing countries. Nonetheless, empirical assessments are usually manufacturing-oriented, providing only a partial view of the phenomena under scrutiny. This article aims at contributing to this body of literature by investigating the impacts of inward FDI on aggregate outcomes of developing countries' National Innovation Systems, taking into account potential contributions from Knowledge-Intensive Business-Services (KIBS) multinationals and their respective comparison with manufacturing investments. Using a panel dataset comprising 38 developing countries (2001-2010), fixed-effects regressions are applied according to a traditional endogenous growth model. Empirical findings underscore the relevance of KIBS MNCs' contributions to host innovation systems in developing countries. These impacts broadly surmount those of manufacturing FDI and they are particularly significant for: (a) value added in services; (b) value added in manufacturing; (c) aggregate export capacity; and (d) international (United States Patent and Trademark Office [USPTO]) patenting activity.

Key words: KIBS; national innovation systems; foreign direct investment; multinational corporations.

Introduction

The usual assumption supporting the role played by multinational corporations (MNCs) in accelerating the pace of innovation and technological change is that host nations can benefit from foreign direct investments (FDI) through the generation and diffusion of technological and knowledge spillovers (Alfaro, Chanda, Kalemli-Ozcan, & Sayek, 2004). This perspective puts multinational companies as significant agents in the evolutionary dynamics of National Innovation Systems (NISs), not only because of their position of **endogenous growth agents** (De Mello, 1997; Girma, 2005; Mayer-Foulkes & Nunnenkamp, 2009), but also because of their capacity of becoming embedded in different contexts, performing a bridging function across economic environments (Bruhn & Calegario, 2014; Ghoshal & Bartlett, 1990).

However, most analytical frameworks are grounded on suppositions and data oriented towards manufacturing sectors (Ramasamy & Yeung, 2010), meaning that conclusions on the importance of multinationals to host markets are strongly related to statistical models and case studies focused on manufacturing agents. Although important, such analyses often ignore data and phenomena involving service industries, especially for countries that lie outside the group of developed nations (Massini & Miozzo, 2012). Hence, traditional models are bound to have diminishing relevance, as service activities respond for most of economic activity worldwide and also for an increasing share of FDI (Riedl, 2010).

Nonetheless, services' subsectors are extremely heterogeneous in their own nature (Miles, 2004; Miozzo, Lehrer, DeFillippi, Grimshaw, & Ordanini, 2010). In order to overcome this issue, narrowing down the operational definition of services to subsets of activities that share common characteristics becomes necessary. In the realm of innovation studies, a group that has rendered robust and interesting insights is that of Knowledge-Intensive Business Services (KIBS). KIBS represent a core feature of knowledge-based economies, since they leverage systemic capabilities by promoting the generation of innovative networks between agents, as well as contributing to produce, diffuse, supply and absorb knowledge across industries (He & Wong, 2009; Miles, 2004; Simmie & Strambach, 2006). These idiosyncrasies lead us to question what are the effective impacts of KIBS' FDI on the output dynamics of developing countries' innovation systems? And how do they compare with potential contributions related to manufacturing FDI?

The goal of this research is to investigate the impacts of inward FDI on aggregate outcomes of NISs, taking into account potential contributions from KIBS' multinationals and their respective comparison with manufacturing investments. Focus is given to the case of developing countries (classified as middle-income nations - see section Analytical Framework for a thorough conceptualization), since there is a widespread claim that positive externalities arising from FDI are particularly relevant for these nations, given their situation of innovative laggards (Hansen & Rand, 2006; Waldkirch, 2011). Also, these economies are playing an increasingly relevant role in FDI attraction flows (Álvarez & Marín, 2010), particularly for KIBS (Yang & Yan, 2010). Lastly, and perhaps more importantly, globalization issues related to developing countries' NISs are meagerly addressed in scientific literature (Teixeira, 2013), resulting in a lack of theoretical and empirical knowledge for the specificities of this group of nations. This is particularly relevant in a context in which the analysis of FDI impacts upon developing countries differs from that of industrialized economies as a function of distinct distances to the technological frontier (Wooster & Diebel, 2010).

To accomplish this objective, an unbalanced panel dataset comprising information for 38 developing countries throughout the period 2001-2010 was created. Relationships between KIBS' FDI were established with a set of eight economic output indicators that represent core dimensions of innovation systems. The simultaneous use of a heterodox set of output indicators stands for a broader comprehension of the complex dynamics involving National Innovation Systems. This approach also adds to existing literature that addresses FDI impacts based on a limited perspective of economic output (Wooster & Diebel, 2010).

Estimations were undertaken via fixed-effects methods, using regression models that follow the traditional endogenous growth rationale via an augmented production function. The use of a sound theoretical framework is an important feature of this analysis, as it provides robustness to this empirical exercise (a concern that is often overlooked in FDI-related studies, see Wooster & Diebel, 2010). Moreover, the novelty of this assessment lies in dealing with relationships between KIBS' multinationals and innovation environments from a quantitative viewpoint in the context of developing countries, a field that has received scant scientific treatment (Doloreux & Shearmur, 2013; Miozzo, Yamin, & Ghauri, 2012).

After this introductory outlook, second section presents contributions from FDI-related literature regarding its connections with National Innovation Systems. Third section depicts the characteristics of KIBS, their impacts on aggregate innovative capabilities and aspects concerning impacts arising from FDI. Fourth section is dedicated to outlining the analytical framework that guides the empirical exercise carried out in this research. Information on the sample and estimation procedures is offered in fifth section. Sixth section explores results of the statistical exercise and seventh section concludes with final remarks, avenues for future research and limitations of this assessment.

Foreign Direct Investments in the Context of National Innovation Systems

A first step in this literature review consists in delimiting what **National Innovation Systems** refers to. While there is significant flexibility on the applications and operational characteristics of this analytical toolbox, for the purposes of this research the National Innovation System concept is in accordance with the **Aalborg version** (see Lundvall, Johnson, Andersen, & Dalum, 2002, and Teixeira, 2013, for thorough reviews on the subject). Thus, the idea of NIS is assessed as a complex structure of elements and relationships contributing to innovation and competence building. Amongst agents involved in this framework are not only institutional settings, but also universities and, most importantly, firms and their respective sets of interorganizational linkages. In other words, reference to the concept of NIS functions as a neo-Schumpeterian interpretation of productive systems, encompassing issues related to business dynamics.

In its turn, Foreign Direct Investments constitute a particular sort of international capital flows that is strictly related to productive activities, usually impersonated by multinational corporations. Moreover, FDI has a close relationship with National Innovation Systems, representing a core vector of transnational integration (Guimón, 2009). This contribution is believed to be fundamentally related to knowledge spillovers (Alfaro *et al.*, 2004). Potential causes for this knowledge **leak** are expected to be related to forward and backward linkages with other firms (learning processes with clients and suppliers), generation of networks, and inter-firm mobility of human resources.

Hence, in the context of National Innovation Systems, knowledge spillovers are the feature of main interest regarding FDI flows, since they are likely to generate long-run structural benefits for host countries' economic dynamics through the promotion of enduring systemic shifts on the productive structure (Hansen & Rand, 2006; Waldkirch, 2011). As a consequence of these theoretical postulations, FDI attraction initiatives currently represent a policy trend in developing nations (Waldkirch, 2011).

Contributions of literature regarding FDI and its relationships with developing countries' innovation systems suggest that positive externalities from MNCs presence in relatively laggard nations can function as a vector of knowledge diffusion. Nonetheless, it should be noticed that individual firms represent a rather restricted unit within macroeconomic environments. For this reason, FDI should be understood as a potential source for marginal impacts upon overall capabilities within national boundaries (as proposed by De Mello, 1997). In a similar vein, it is argued that the marginality of FDI contribution to developing countries' innovation systems can also be a function of companies' location strategies in these markets, mostly oriented towards an **asset-exploiting** rationale that involves low levels of resource commitment from investors (Miozzo *et al.*, 2012; Narula & Dunning, 2010), and also

caused by weakness in terms of absorptive capacities in indigenous agents (Wooster & Diebel, 2010), which may lead to insignificant contributions to host environments. However, much of the background addressed in this section makes reference to a **manufacturing-oriented** analytical framework. The next section explores some key aspects of knowledge-intensive business services in order to further understand the process of FDI interaction with NISs.

Knowledge-Intensive Business Services

Hertog (2000) defines knowledge-intensive business services (KIBS) as firms that "rely heavily on professional knowledge, *i.e.*, knowledge or expertise related to a specific (technical) discipline or (technical) functional-domain to supply intermediate products and services that are knowledge based" (p. 505). Similarly, Miles *et al.* (1995) characterize KIBS as "services that involve economic activities which are intended to result in the creation, accumulation, or dissemination of knowledge" (p. 18). These concepts place KIBS in an influential position within the broad environment of National Innovation Systems, where they represent a core feature of the knowledge-based economy by promoting stronger ties and generating innovative networks between agents (He & Wong, 2009; Simmie & Strambach, 2006).

Nonetheless, services have long been neglected as relevant agents of innovation, given that scientific approaches have historically been biased towards technological, R&D-oriented forms of innovation (Miozzo *et al.*, 2010). Increasing concerns with the validity of linear ways of thinking about the innovative process represent a call to go beyond this traditional, shallow view of economic evolution. Dedicated research must also tackle softer forms of innovation generation and facilitation, as well as the development of forward and backward linkages among organizations (Markusen, Rutherford, & Tarr, 2005).

The role of KIBS within National Innovation Systems

The growing interconnection between firms in general and KIBS (concerning the generation of innovative products and processes) puts such services in a critical role for innovation systems (Miles, 2008). Operationally, the role of KIBS is one of bridging knowledge generation and diffusion throughout Innovation Systems, functioning as agents of the knowledge infrastructure, thus complementing the role played by public institutions in brokering innovation (Hertog, 2000; Koch & Stahlecker, 2006; Mas-Verdú, Wensley, Alba, & Álvarez-Coque, 2011; Simmie & Strambach, 2006; Yang & Yan, 2010). From this perspective, KIBS' interaction with innovation systems can take place in three conceptual forms (Hertog, 2000):

1. **Innovation Carriers**: this involves knowledge transfer across firms and/or geographic boundaries, enabling agents to enhance their innovative potential;

2. **Knowledge Facilitators**: introduction of new or improved processes, or sub-contracting of specific knowledge-intensive tasks (R&D, IT management, marketing), as well as continuous support for clients;

3. **Innovation Sources**: *de facto* co-production of innovation, representing a closer connection between KIBS and client firms than observed in the conceptual forms presented above.

Although these three conceptual forms stand for possibilities of interaction between KIBS' and innovation systems, the role of these firms as **Innovation Sources** entails a higher potential of impacts upon aggregate outcomes in innovation systems. This is because of the closer coordination between agents, generating joint innovation (instead of merely diffusing it) and promoting evolution of absorptive capacities in clients and suppliers. This seems a reasonable argument supporting the idea that such a conceptual form of KIBS' activities lies at the core of their embeddedness within NISs.

Nonetheless, in the case of developing economies, the importance of knowledge diffusion (not its creation *per se*) can also represent a source of significant aggregate advances in the economic and managerial realms and should not be underestimated. Hence, whenever potential contributions from KIBS to outcomes of developing countries' innovation systems are addressed, no practical distinction is made as to what mode of innovation takes place (I believe this issue lies beyond the scope of this research and it deserves attention from future studies in the field).

Foreign direct investment in the context of KIBS

The theoretical context of KIBS poses distinct dynamics for its contributions to socioeconomic environments; more than is usually assumed in business theory oriented towards manufacturing agents. KIBS are active participants in other agents' strategies and operations, shifting the customary definition of firms' limits to more open and collaborative configurations (Miozzo & Grimshaw, 2005). In this case, access to knowledge through cooperation and networking becomes a determinant aspect regarding the innovative activity in KIBS (Yang & Yan, 2010). As a result, co-creation or co-production of knowledge between KIBS and its clients emerge as fundamental concepts in the analysis of their respective innovative behavior (Hertog, 2000; Miozzo *et al.*, 2010).

Thus, the very nature of KIBS' FDI is inherently different from that of manufacturing industries. Contrary to the usual rationale of technological spillovers (based on upstream, or backward, interactions with suppliers and the like), KIBS' impacts upon innovation systems rely heavily on their forward connections with clients (Miozzo *et al.*, 2010). KIBS are then likely to promote productivity gains that are not restricted to any particular sector of the economy, contributing to the overall competitiveness of organizations (Golub, 2009).

Nonetheless, the majority of KIBS' interactions with other firms depend on a significant level of tacitness regarding knowledge flows, thus hampering codification and transmission of these assets over long distances. Accordingly, such processes put spatial proximity as a fundamental attribute for successful interactions between KIBS and their clients (Koch & Stahlecker, 2006). These characteristics of KIBS make them highly inclined to internationalize their activities via their physical presence abroad (Miozzo & Soete, 2001; Yang & Yan, 2010).

As is true for multinational companies in general (see section Foreign Direct Investments in the Context of National Innovation Systems), the spatial allocation of these particular service providers can have positive impacts on the dynamics of knowledge flows across economic systems. In the case of developing nations, the attraction of KIBS' FDI can play a beneficial role to the aggregate capabilities of host innovation systems, generating a powerful lever for future development (Miozzo & Soete, 2001). Further discussions regarding these matters and their potential implications are offered in the following section.

Analytical Framework

This section offers an integrative perspective between expected relationships amongst National Innovation Systems in developing countries and FDI flows with particular interest on contributions arising from KIBS. Taking into account the core features of knowledge-intensive business services, the conceptual rationale that applies to the interactions involving these firms and the local innovative environment seem somewhat different from the one concerning manufacturing-oriented frameworks.

As suggested by literature presented in section Foreign Direct Investments in the Context of National Innovation Systems, impacts from manufacturing FDI upon NISs are strongly associated with economic externalities (technology and knowledge spillovers). Nonetheless, the role played by KIBS' firms as innovation brokers, and co-producers, suggests a more active function within the dynamics of NISs (see section Knowledge-Intensive Business Services). Hence, the foundation of this analytical

framework relies on the proposition that **KIBS' FDI have positive impacts on aggregate outcomes of developing countries' innovation systems that surmount contributions from manufacturing FDI**.

This approach is in line with a **softer** comprehension of existing interactions amongst agents embedded in developing countries' NISs. This is in line with the idea that research in the field of innovation systems must go beyond a narrow focus based solely on science-based activities and tangible outputs, incorporating broader aspects of competence building in socioeconomic environments (Lundvall *et al.*, 2002).

With the intention of converting the proposition that impacts from KIBS' FDI are of a larger magnitude than those originated from manufacturing FDI (see sections The Role of KIBS within National Innovation Systems and Foreign Direct Investment in the Context of KIBS) into an operational research design, I have used the theoretical structure of an augmented production function structured in an endogenous growth fashion. This procedure is not particularly novel and it follows the basic composition outlined in Equation 1 (see De Mello, 1997):

$$Y = A\,(K, L, FDI, \Omega) \qquad \text{Equation 1}$$

Where Y is an indicator of economic output, A represents the residual, also referred to as Total Factor Productivity (TFP), K stands for physical capital, L is labor, FDI brings information for foreign direct investment as an element of growth in Y, and Ω is a representation of ancillary variables.

Research variables

In order to translate this rationale into an operational assessment of developing countries' innovation systems, the concept of **aggregate outcomes** deserves some further exploration. The production function outlined in Equation 1 is traditionally estimated via indicators of aggregate economic production as a proxy for Y (such as GDP or GNI). Nonetheless, economic growth *per se* is not a direct output indicator of innovation systems, but rather a dimension that is affected by overall innovative performance. Additionally, the relationship between economic spillovers and overall output happens via shocks in mediating activities, suggesting that traditional estimations found in literature may contain a significant amount of noise in statistical relationships.

Aiming at developing a comprehensive view of the impacts of KIBS' inward FDI on developing countries' NISs, the approach used in this research builds upon a more flexible perspective of economic output (see Table 1). This allows an investigation of FDI effects on: **(a) Intellectual property generation**: trademark applications at the national level; patents filed at the United States Patent and Trademark Office (USPTO); **(b) Intellectual property revenues**: international flows of royalty receipts (or charges for the use of intellectual property); **(c) Productivity**: value added in manufacturing and service industries; labor productivity; and **(d) Trade capabilities**: overall export flows; export flows in high-technology (R&D intensive) industries.

Table 1

Operational Indicators of the Analytical Framework - Dependent Variables

Code	Definition and Purpose	Source
TRM	Applications to register trademarks with national Intellectual Property Offices. Data in number of applications. This variable is related to NISs' capabilities of generating intellectual property. It functions as a proxy of competence building in indigenous environments. KIBS MNCs are expected to positively influence this dimension through any of its conceptual forms.	World Bank (2014)
ROY	Receipts from charges (royalties) regarding the use of nationally generated intellectual property (patents, trademarks, copyrights, industrial processes, designs, trade secrets and franchises). Data in current USD. This variable represents an indicator of intellectual property revenues and is related to the generation of innovative capabilities and competence building in National Innovation Systems. KIBS MNCs are expected to positively influence this dimension through any of its conceptual forms.	World Bank (2014)
SRVADD	Value added in services (International Standard Industrial Classification [ISIC] divisions 50-99) at the national level. Data in current USD. This variable is a proxy for value generation within service industries embedded in developing countries' innovation systems. KIBS MNCs are expected to have both a direct and indirect impact upon this indicator via their own activities and their interactions with clients.	World Bank (2014)
MANADD	Value added in manufacturing industries (ISIC divisions 15-37) at the national level. Data in current USD. This variable is a proxy for value generation within service industries embedded in developing countries' innovation systems. KIBS MNCs are expected to have an indirect impact upon this indicator via their organizational relationships with clients.	World Bank (2014)
PROD	Labor productivity per person employed in 2011 US$ (converted to 2011 price level with updated 2005 EKS PPPs). This variable is a proxy for impacts of innovative capabilities upon productive efficiency. Expectations are that KIBS MNCs might increase local agents' productivity via knowledge generation and diffusion.	The Conference Board (2014)
EXP	Exports of goods and services. Data in current USD. This variable stands for a rough proxy of international competitiveness of local firms. While I recognize its limitations in terms of signaling systemic innovative capabilities, it offers a robustness check for the case of high-technology exports (which are underrepresented in total exports from developing countries). Expectations are that KIBS MNCs can enhance exporting capacity via knowledge creation and diffusion.	World Bank (2014)
EXPHT	Exports of R&D-intensive goods (aerospace, computers, pharmaceuticals, scientific instruments and electrical machinery). Data in current USD. Similarly to EXP, this variable offers a proxy for international competitiveness with emphasis in R&D-intensive goods. Expectations are that KIBS MNCs may catalyze the export potential of local firms via knowledge creation and diffusion.	World Bank (2014)
PATS	Number of patent applications filed with the United States Patent and Trademark Office. This variable is related to NISs' capabilities of generating intellectual property. Although its use is commonly referred to as an imperfect indicator of innovative capabilities in service industries, for the case of KIBS it might be related to activities of knowledge co-production with clients. It functions as a proxy of innovative potential at the international level.	USPTO (2014)

This set of indicators represents an adaptation of indicators used by the European Commission in the Innovation Union Scoreboard (see European Commission, 2014), a document of reference in the field of innovation output assessment. Further aspects were gathered from Archibugi, Denni and Filipetti (2009), thus providing a comprehensive view on indicators of interest.

Many choices were made to define this particular group of indicators of aggregate outcomes in National Innovation Systems, leaving further dimensions of potential interest aside. Adaptations of indicators mainly involved not limiting value-added indicators (in Services and in Manufacturing industries) to high-tech sectors because of the economic composition of developing countries, where medium-tech (and even low-tech) activities may provide a better grasp on the dynamics of NISs. Also, from an operational perspective, these data are not consistently available for country-level analyses when such decomposition is intended. The same logic guided the inclusion of aggregate exports, though in this case a comparison with the specific behavior of high-tech goods was available.

In turn, the specification of predictors follows the rationale of the augmented production depicted in Equation 1; *i.e.*, making FDI an endogenous parameter in the dynamics of output evolution in National Innovation Systems (see Table 2). POP stands for a proxy regarding labor force within countries, and CAPFORM is an indicator of capital formation (public and private). ΔGDP (GDPGRT) is introduced as an ancillary variable in statistical estimations as a proxy for macroeconomic stability over time. GERD (Gross Expenditure in R&D) is also included as an ancillary term to provide a control for indigenous innovative efforts.

Table 2

Operational Predictors of the Analytical Framework (Equation 1)

Code	Definition and Purpose	Source
FDIKIBS	Inward flow of FDI in KIBS. Data in millions of USD. This variable stands for a proxy of the dynamics of KIBS MNCs presence in developing countries. Higher levels of FDIKIBS are expected to be related to positive impacts upon operational indicators (Table 1) as a function of: (a) positive externalities; (b) knowledge creation (or co-creation); and (c) knowledge diffusion.	International Trade Centre (2014)
FDIMAN	Inward flow of FDI in manufacturing activities. Data in millions of USD. This variable represents a proxy for the dynamics of manufacturing MNCs presence in developing countries. Higher levels of FDIMAN are expected to be related with positive impacts upon operational indicators (Table 1), although to a lesser extent than impacts observed for FDIKIBS.	International Trade Centre (2014)
CAPFORM	Investments in fixed assets plus net changes in the level of inventories (capital formation). Data in current USD. This variable represents a typical element in the assessment of production functions (regardless of their exogenous or endogenous growth orientation). Expectations are that it is positively related to growth in the generation of outputs.	World Bank (2014)
POP	Total population. This dimension stands for a proxy of labor pool (as more adequate measures are not consistently available for countries throughout time). It also controls for economic size of nations. Expectations are that larger systems are related to higher absolute levels of output.	World Bank (2014)
GERD	Gross Expenditures in Research and Development. Data is represented by total investments as a percentage of GDP. This variable functions as a control for formal aggregate innovative efforts. It is expected that, all else equal, it will exert a positive influence upon NISs' outputs.	World Bank (2014)

Continues

Table 2 (continued)

Code	Definition and Purpose	Source
GDPGRT	Rate of GDP growth. Data in percentage points of variation between period **t** and **t**+1. This variable stands for a proxy for macroeconomic stability. There are no expectations regarding its direction, as growth patterns may be related to both a substantial expansionary situation of aggregate output indicators (high growth) and to a situation of proximity to the steady state (low growth). Both cases may represent positive conditions of economic development. Nonetheless, its use is important to control for heterogeneous growth dynamics in the sample (a common feature amongst developing economies).	World Bank (2014)

Bearing in mind the objective of verifying differential contributions between inward FDI in KIBS (a list of KIBS' subsectors can be found in Appendix A) and in manufacturing, I have decomposed FDI into two vectors: FDIKIBS and FDIMAN. This procedure allows comparing investments' contributions to host economies according to their sectoral characteristics, an aspect that has received scarce attention in literature (Narula & Dunning, 2010). This data is provided by the International Trade Centre (ITC) and comprises information from The United Nations Conference on Trade and Development (UNCTAD), The United Nations International Trade Statistics Database (COMTRADE), among other primary sources. Industrial definitions are based on ISIC (Revision 3) nomenclature. A core limitation of this source is related to the combination of data gathered from several sources and grouped in the above mentioned industrial classification, which can generate cases of inaccurate categorization. Consequently, although the dataset available in ITC provides a detailed and comprehensive amount of information on FDI flows at the industrial level, overall results should be regarded as approximations of the real picture (a common hindrance faced by analyses that deal with aggregate data).

Methodological Remarks: Sample and Estimation Procedures

The empirical analysis carried out in this research comprises information for 38 developing countries (see Appendix B for the list of countries) for the period 2001-2010. Due to missing data, the resulting dataset represents an unbalanced panel. The definition of countries as **developing** follows the classification provided by the World Bank in 2012 based on levels of income (World Bank, 2015). To avoid further heterogeneity in the sample, only countries classified in the middle-income group were included (hence, low-income countries were not assessed). Although this classification can suffer modifications over time, these shifts are not representative of major structural changes in the short-run, indicating solely slight increases/decreases in per capita income.

Furthermore, for operational reasons, those countries that did not have available information on FDI flows and on the set of dependent variables throughout the period under scrutiny were suppressed from the sample. The lack of data for the analytical variables does not come as a surprise, as the research structure involves detailed information which is often scarce for developing nations (sectoral-level FDI for instance). Even though it can be claimed that some regions are over-represented in comparison to others, I do not believe that this can cause significant shortcomings in the analysis. First, because the intention is to develop an aggregate assessment of developing countries, recognizing that this is a heterogeneous group of nations (Álvarez & Marín, 2010). Second, the statistical method used is bound to deal with this heterogeneity adequately (see remarks of fixed-effects regressions below).

For empirical estimations, FDI variables (FDIKIBS and FDIMAN) are approached with a 1-year lag (t-1), since investment impacts are not expected to yield structural effects upon economic systems in a simultaneous manner. Nonetheless, as FDI effects on host countries' economic growth are likely to take place within the year of initial investment (Aleksynska, Gaisford, & Kerr, 2003), a 1-year lag is justifiable for empirical tests. To sum up these operational aspects of the method, the functional form of

the production function applied in this research takes the following form (all variables are assessed via their natural logarithms for statistical efficiency purposes, except for GERD and GDPGRT which represent percentage variations):

$$lnY_{i,t} = \alpha + \beta_1 lnFDIKIBS_{i,t-1} + \beta_2 lnFDIMAN_{i,t-1} + \beta_3 lnCAPFORM_{i,t} + \beta_4 lnPOP_{i,t} + \beta_5 GERD_{i,t} + \beta_6 GDPGRT_{i,t} + \alpha_i + \varepsilon_{it} \quad \text{Equation 2}$$

Where Y represents each of the eight dependent dimensions of this research, α is the constant of the model, β_k stands for each parameter of the k^{th} independent variable, t is an identifier of each time-period, α_i represents the time-invariant error term, and ε_{it} is the observation-specific error term (it must be noticed that the error term is decomposed into two components, thus accounting for country-specific heterogeneity). The estimation method is that of fixed-effects for panel data. The use of this particular strategy represents a fundamental tool in the verification of FDI effects upon innovation systems' dynamics, since it allows consistent estimates of time-constant omitted variables upon dependent constructs (Wooldridge, 2000). This strategy satisfactorily deals with any potential problems caused by the diversity of country profiles included in this sample.

Empirical Evidence

Results from fixed-effects estimations for the eight selected dimensions of developing countries' innovation systems are reported in Table 3. Overall adequacy of models is supported by estimations' R^2 statistics (see Table 3). Positive effects of KIBS' FDI regarding the sample under scrutiny seem to spread across four dimensions of developing countries' innovation systems. Besides expected contributions concentrated in SRVADD (Value added in services), KIBS' investment flows seem to positively affect MANADD (Value added in manufacturing industries), EXP (Total exports in goods and services), and PATS (Patents filed at the USPTO).

Table 3

Estimations of Fixed-Effects Regressions

Independent Variable	Model (dep. variable)							
	lnTRM	**lnROY**	**lnSRVADD**	**lnMANADD**	**lnPROD**	**lnEXP**	**lnEXPHT**	**lnPATS**
Constant	-48.204***	-81.929	-24.873**	-18.101*	-2.288	-30.798**	23.391	137.049**
	[13.636]	[63.864]	[10.353]	[10.799]	[4.097]	[14.069]	[29.102]	[60.409]
lnFDIKIBS (t-1)	.008	.001	.038***	.033**	.001	.051***	.059	.213**
	[.018]	[.087]	[.014]	[.014]	[.005]	[.019]	[.039]	[.081]
lnFDIMAN (t-1)	-.008	.056	-.001	.015	-.002	.009	.037	.119
	[.023]	[.104]	[.017]	[.018]	[.007]	[.023]	[.048]	[.111]
LnCAPFORM	.115	1.398***	1.135***	.890***	.348***	1.045***	1.139***	.184
	[.082]	[.434]	[.063]	[.066]	[.024]	[.086]	[.178]	[.379]
lnPOP	3.259***	3.699	1.319**	1.176*	.226	1.757**	-1.828	-8.166**
	[.821]	[3.761]	[.626]	[.653]	[.242]	[.851]	[1.761]	[3.636]

Continues

Table 3 (continued)

Independent Variable	Model (dep. variable)							
	lnTRM	**lnROY**	**lnSRVADD**	**lnMANADD**	**lnPROD**	**lnEXP**	**lnEXPHT**	**lnPATS**
GERD	-40.363**	205.977	20.457	38.506**	18.127***	37.779*	67.809*	-174.699**
	[18.514]	[72.992]	[14.271]	[14.886]	[5.289]	[19.394]	[40.114]	[82.045]
GDPGRT	1.100***	-2.143	-3.151***	-1.467***	-.648***	-1.640***	-2.236***	-1.143
	[.389]	[1.958]	[.297]	[.310]	[.114]	[.404]	[.837]	[1.757]
Adjusted. R^2	.978	.936	.993	.993	.992	.984	.981	.780
Valid N	160	124	166	166	152	166	166	156

Note. Std. errors in brackets.
***sig. at 1% **sig. at 5% *sig. at 10%.

Another relevant point is related to the comparison between the contributions from KIBS and manufacturing multinationals: KIBS' effects widely surmount those from their manufacturing counterparts. The absence of relevance in FDIMAN is not a particularly novel finding in assessments of manufacturing MNCs' contributions to host economic systems (see Aitken & Harrison, 1999; Bruhn & Calegario, 2014; Wooster & Diebel, 2010), but this direct comparison with KIBS represents new information for specialized research. Hence, it is possible to confirm the theoretical proposition that guides this approach, adding novel and valuable evidence to the contributions of KIBS' FDI towards National Innovation Systems' performance. This exploratory finding also functions as a call for future empirical and theoretical research. The development of more detailed comparative assessments concerning differential levels of embeddedness/impacts arising from the presence of KIBS and manufacturing MNCs in host innovation systems represents a promising field of investigation.

Furthermore, it is interesting to verify that KIBS contributions to value added in manufacturing industries is positive and significant, while these effects do not hold for FDIMAN. This finding gives a strong hint as to the importance of KIBS forward linkages with clients as a source of beneficial shocks upon aggregate economic outcomes. Similar explanations are consistent with KIBS' FDI effects on export and patenting activities, suggesting the importance of further investigations on the nature of KIBS embeddedness within NISs.

I remind the reader about this differential characteristic of business services, while manufacturing firms rely heavily on the flow of unintended spillovers (externalities) to positively affect their surrounding environment. In a context of low or intermediate absorptive capacities (as is often the case for developing countries with **weak** innovation systems), such externalities have a hard time finding their way into indigenous players.

Notwithstanding these arguments, the usual indicators for absorptive capacity can be regarded as partially adequate (at best) or even irrelevant (at worst) for the specific case of services. Because of their very nature, KIBS function as knowledge facilitators, carriers and sources, thus also creating absorptive capabilities in their forward linkages (clients). For this reason, these firms are likely to find lower levels of friction in their processes of transferring innovative capabilities, in direct contrast with their manufacturing counterparts. Additionally, the level of rivalry among agents tends to be negligible in this dynamic context of knowledge exchange, reducing potential transaction costs and other barriers that may hamper host markets' appropriation of MNCs intangible assets.

Nonetheless, effects of this particular subset of service providers on aggregate outcomes are somewhat limited. In this sense, no significant relationship arises between the inflow of KIBS' FDI and improvements in aggregate labor productivity (PROD). The same situation holds for high-tech exporting capacity (EXPHT), trademark applications (TRM), and royalty charges (ROY). These aspects put emphasis on the marginality of MNCs' contributions to the overall picture of productive structures in developing countries. A meta-analytical research conducted by Wooster and Diebel (2010) on FDI

impacts upon developing countries also reaches similar conclusions for investments in general. In this case, more research is needed and fundamental effects from foreign-owned KIBS and manufacturing enterprises should not be taken for granted.

Alternatively, there may be a timing issue in the estimated models. The 1-year lag suggested by Aleksynska, Gaisford and Kerr (2003) is a possible source of instability in results, since structural shifts in large and complex innovation systems can take longer periods to become noticeable. Nonetheless, there is not an optimal form of establishing the timing of externalities; *i.e.*, how long they take to occur (assuming they take place at all) and when these impacts can be translated into aggregate gains for the economic system.

This **timing** issue is a potential source of bias in econometric models with aggregate data, especially taking into account that MNCs tend to follow progressive processes in terms of knowledge creation in host markets (Guimón, 2009). This situation poses methodological problems to establish optimal lags for the evaluation of FDI impacts upon recipient innovation systems, since they ought to be firm-specific. Future empirical assessments comprehending microeconomic data are essential for providing in-depth knowledge in this realm. A distinct explanation can be related to a low intensity in knowledge creation in the case of developed nations' MNCs that have subsidiaries in developing countries, hampering effective generation and dissemination of knowledge within host economies.

As per control variables, some comments are noteworthy. First of all, it is interesting to identify that for SRVADD as dependent dimension, GERD is not statistically significant, providing support to the perspective that innovation in services *per se* may not be efficiently measured by this traditional, tangible, indicator. In a similar vein, it is surprising that for the LnPATS model, GERD turns out to have significantly negative effects on outcomes. It can be argued that this result suggests the vulnerability of innovation policies that tackle systemic challenges via linear ways of thinking. Nonetheless, when looking at the remaining models, the traditional logic holds (except for the case of LnTRM). Hence, it cannot be ruled out that effects on patenting activity may be highly sensible to small variations, as developing countries' patents filed at the USPTO represent small numbers (maximum=919; minimum=0; mean=68,16; std. dv.=129,53).

Impacts from capital investments (CAPFORM) are consistently positive for six of the analytical dimensions, suggesting its importance in the economic evolution of developing countries' innovation systems. On the other hand, the predominantly negative role played by GDPGRT can be explained by the volatility of this indicator in relatively short-term evaluations, as consistent rates of growth in a given decade may not be strictly related to enduring capabilities in National Innovation Systems. In orthodox economic jargon, this is referred to as **proximity to the steady state**, where countries in more advanced conditions often achieve slower GDP growth.

Concluding Remarks

This investigation has addressed a fundamental cornerstone of laggard National Innovation Systems: their capacity of absorbing knowledge flows from foreign sources and catalyzing them into aggregate outcomes generated by local agents. Particular emphasis was given to the role of knowledge-intensive business services. It should be emphasized that while most literature draws conclusions from manufacturing companies, more attention should be given to the service sector, given its increasing relevance in the composition and dynamics of economies worldwide (and its growing connection with innovative activities).

Empirical results of this assessment have been tested according to the proposition that contributions of KIBS' FDI surmount those arising from the presence of manufacturing MNCs in developing countries. Main findings underscore the relevance of KIBS MNCs' contributions to host innovation systems in developing countries in four particular dimensions, namely: (a) value added in

services; (b) value added in manufacturing activities; (c) aggregate export capacity; and (d) international (USPTO) patenting activity. Such findings are in accordance with lines of thought that stress the systemic character of KIBS, whereas its impacts seem to be related to different scopes of NISs in developing countries.

More interestingly, these effects broadly surmount those of manufacturing FDI, casting severe criticisms on the widespread use of this latter construct as a robust indicator of multinational corporations' integration within National Innovation Systems. These outcomes stress the differential framework in which FDI contributions arise in KIBS and in manufacturing industries. While the latter is strongly associated with the generation of unintentional externalities, the former is likely to play a bridging role for knowledge generation and diffusion in a fundamentally systemic manner – mainly through forward linkages. Hence, hindrances caused by lower levels of absorptive capacity in local firms are likely to be diminished in the dynamics of innovation related to KIBS' multinationals.

Regarding the contributions for innovation management research and practice, it should be noticed that the aggregate pool of indigenous companies in developing countries is bound to have deficiencies in terms of **Ownership Advantages** (Narula & Dunning, 2010), a feature that compromises the innovative capabilities and competitiveness of entire industries. There are several ways out of this trap, and one of them has been traditionally related to the activity of multinational corporations. Results of this research provide an exploratory perspective that suggests that this is likely to be the case in the presence of KIBS. A theoretical implication of this finding for developing countries concerns the importance of knowledge diffusion, a central feature of KIBS, in laggard innovation systems. In this regard, the role of these services as **innovation carriers and knowledge facilitators** can help closing the gap with advanced economies (where the role of KIBS may be more strongly related to knowledge production *per se*). This represents a call to address in future research how these impacts take place. Perhaps a constructive path can be developed by studying the dynamics of relationships that KIBS establish with local firms in developing markets.

It must be remembered, however, that although this investigation represents a significant step forward in terms of theoretical and empirical aspects of the inherent interconnections between KIBS' FDI and innovation systems in developing countries, it does not go without limitations. First, results cannot be regarded as conclusive, since KIBS' contribution to innovation systems are hard to quantify by using traditional linear measures, as their impacts are of a systemic and complex nature.

Moreover, analytical models represent only a partial perspective of the complex structures involved in National Innovation Systems. Further research that includes different sets of explanatory variables (particularly those that can deal with institutional environments) is required in order to validate findings. This same criticism is applicable to dependent dimensions: overall analysis of NISs have been defined using a limited structure, and it is an interesting path of research to develop alternative empirical frameworks in this regard. Lastly, when dealing with economic systems, a 10-year time frame can restrict the evaluation of evolutionary trends. This aspect has to be taken into account in the appropriation of the results.

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APPENDIX A

KIBS Sectors Used in the Analysis

. Real estate activities with own or leased property . Real estate activities on a fee or contract basis . Unspecified real estate . Renting of transport equipment . Renting of other machinery and equipment . Renting of personal and household goods . Unspecified rental . Hardware consultancy . Software consultancy and supply . Data processing . Data base activities	. Other computer related activities . Unspecified computer related activities . Research and experimental development on natural sciences and engineering . Unspecified research and development . Legal, accounting, market research, business and management activities . Architectural, engineering and other technical activities . Advertising . Business activities . Unspecified other business activities

APPENDIX B

List of Developing Countries Included in the Panel Dataset

Argentina, Armenia, Brazil, Bulgaria, Chile, Costa Rica, Croatia, Dominican Republic, Ecuador, Egypt, Ghana, Honduras, Hungary, India, Jamaica, Kazakhstan, Kyrgyz Republic, Latvia, Lithuania, Malaysia, Mauritius, Mexico, Morocco, Oman, Pakistan, Panama, Peru, Philippines, Poland, Qatar, Romania, Russia, Saudi Arabia, Thailand, Turkey, Uruguay, Vietnam.