Volume **28** • **2021** • Number **1**

TRANSNATIONAL CORPORATIONS

INVESTMENT AND DEVELOPMENT

UNITED NATIONS

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UNITED NATIONS
Geneva, 2021

United Nations publication issued by the United Nations Conference on Trade and Development.

UNCTAD/DIAE/IA/2021/1

UNITED NATIONS PUBLICATION
Sales no.: ETN281 ISBN: 978-92-1-1130140 eISBN: 978-92-1-4030195
ISSN: 1014-9562 eISSN: 2076-099X

EDITORIAL BOARD

EDITORIAL STATEMENT

Transnational Corporations[1] is a longstanding policy-oriented refereed research journal on issues related to investment, multinational enterprises and development. It is an official journal of the United Nations, managed by the United Nations Conference on Trade and Development (UNCTAD). As such it has a global reach, a strong development policy imprint, and high potential for impact beyond the scholarly community.

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The journal aims to advance academically rigorous research to inform policy dialogue among and across the business, civil society and policymaking communities. Its central research question – feeding into policymaking at subnational, national and international levels – is how to make international investment and multinational enterprises contribute to sustainable development. It invites contributions that provide state-of-the-art knowledge and understanding of the activities conducted by, and the impact of multinational enterprises and other international investors, considering economic, legal, institutional, social, environmental or cultural aspects. Only contributions that draw clear policy conclusions from the research findings will be considered.

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The scale and complexities of the "grand challenges" faced by the international community, such as climate change, poverty, inequality, food security, health crises, and migration – as embodied in the United Nations' Sustainable Development Goals (SDGs) – are enormous. These challenges, combined with the impact of disruptive technologies on business, rapidly evolving trends in international production and global value chains, new emerging-market players and new types of investors and investment, make it imperative that policymakers tap a wide range of research fields. Therefore, the journal welcomes submissions from a variety of disciplines, including international business, innovation, development studies, international law, economics, political science, international finance, political economy and economic geography. However, submissions should be accessible across disciplines (as a non-specialized journal idiosyncratic research should be avoided); interdisciplinary work is especially welcomed. The journal embraces both quantitative and qualitative research methods, and multiple levels of analyses at macro, industry, firm or individual/group level.

Inclusive: multiple contributors, types of contributions and angles

Transnational Corporations aims to provide a bridge between academia and the policymaking community. It publishes academically rigorous, research-underpinned

[1] Previously: The CTC Reporter. In the past, the Programme on Transnational Corporations was carried out by the United Nations Centre on Transnational Corporations (1975–1992) and by the Transnational Corporations and Management Division of the United Nations Department of Economic and Social Development (1992–1993).

and impactful contributions for evidence-based policymaking, including lessons learned from experiences in different societies and economies, both in developed and developing-country contexts. It welcomes contributions from the academic community, policymakers, research institutes, international organizations, and others. Contributions to the advancement and revision of theories, frameworks and methods are welcomed as long as they are relevant for shedding new light on the investigation of investment for development, such as advancing UNCTAD's *Investment Policy Framework for Sustainable Development*.

The journal publishes original research articles, perspective papers, state-of-the art review articles, point-counterpoint essays, research notes and book reviews. All papers are double blind reviewed and, in line with the aims and mission of the journal, each paper is reviewed by academic experts and experts from the policymaking community to ensure high-quality impactful publications that are both academically rigorous and policy relevant. In addition, the journal features synopses of major UN reports on investment, and periodic reviews of upcoming investment-related issues of interest to the policy and research community.

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ARTICLES

UNCTAD INSIGHTS

When near is far and far is near: physical and constructed dimensions of geography and their implications for inward FDI performance*

Lilac Nachum,[a] Grigorios Livanis[b] and Hyokyoung Grace Hong[c]

Abstract

Building on a sociology theory of space, we conceptualize physical geography as separated from its constructed connotations and suggest that the impact of geographic location on countries' attraction for foreign direct investment (FDI) is contingent upon their constructed qualities – that is, their unilateral characteristics and connectivity to other countries. Quantile regression analyses confirm these predictions and show notable variations across the distribution of FDI. The findings show that geography is not destiny and should rather be treated as an endogenous country characteristic whose consequences for FDI are subject to actions of policymakers and firms. Subsequent analyses show that the level of economic development affects the relationships between the physical and constructed consequences of geography on FDI, introducing significant differences between developed and developing countries. We outline the role for policy in shaping the contingencies that affect the relationships between geographic location and FDI.

Keywords: countries' geographic location, actual and constructed geographic space, sociology theory of space, quantile regression, connectivity, FDI policy

JEL classification numbers: F21, C32

* Received: 20 September 2020 – Revised: 10 February 2021 – Accepted: 22 February 2021.

This article is the recipient of the AIB Best Paper Award, Research Method Division, 2017, Dubai.

The authors wish to thank the excellent comments of two anonymous reviewers and outstanding guidance of the Editorial Team of Transnational Corporations in revising the paper.

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Does countries' location in relation to other countries affect their performance as hosts for foreign direct investment (FDI)? Although this is a fundamental question for the understanding of FDI patterns and has been the subject of substantial research over decades, both theory and empirical research offer inconclusive answers to this question.

The theoretical ambiguity resides in the conflicting arguments advanced by different theoretical perspectives in relation to the anticipated impact of geographic location on FDI. Theories that regard FDI as an economic activity that is based on the transfer of weightless, intangible, mobile assets at no cost across borders entail that FDI is not affected by geographic location. Moreover, by internalizing economic transactions FDI offers a means to avoid many frictions related to geography and remoteness (Beugelsdijk, Ambos and Nell, 2018; Buckley and Casson, 1976; Singh and Marx, 2013). In contrast, other theoretical perspectives emphasize cultural barriers and costs of managing international operations, and posit that remoteness reduces FDI (Head and Mayer, 2013; Hymer, 1960). In agreement with the theoretical ambiguity, the findings of studies that empirically tested the relationships are mixed and inconclusive (Keller and Yeaple, 2013; Nachum, Zaheer and Gross, 2008). The persisting impact of geography at a time when transportation costs have sharply declined further complicates the puzzle about the impact of geographic location on FDI (Dosdier and Head, 2008).

The limited understanding of these relationships is inappropriate for an economic activity that takes place over distance. The impact of geographic location, or lack thereof, on FDI has underlaid some of the most fundamental questions raised by FDI research and is of critical importance for policymakers and firms. An incomplete understanding of these relationships undermines theoretical developments and constrains the ability to provide adequate guidance for practice.

In this paper, we seek to address this deficiency. Building on sociology theory that distinguishes the physical from the constructed dimensions of space (Bligh and Riggio, 2013; Kim, 2006), we submit that the impact of physical location on FDI is moderated by constructed dimensions that are not directly related to geography (Marotta, 2012). Thus, countries' unilateral economic and institutional characteristics (Berry, Guillén and Zhou, 2010), and their connectivity to other countries (Alcacer and Ingram, 2013; Shulgin, Zinkina and Andreev, 2019) shape the impact of countries' location on their FDI performance.

We test these predictions based on quantile regression, a statistical technique that offers a means to estimate variations of relationships across the distribution of a phenomenon of interest (Hong, 2013; Hong, Christiani and Li, 2019; Koenker, 2005). In the context of our paper, this implies that the impact of geographic location, country characteristics and country's connectivity to other countries

would vary across different scales of the distribution of FDI (Paniagua, Figueiredo and Sapena, 2015; Dimelis and Louri, 2002). The empirical testing is based on FDI flows and stocks to all the countries that received FDI during 1980–2017. In employing inward FDI flows and stocks as measures of countries' performance as host for FDI, we follow a long tradition in FDI research regarding the operation of this construct (Keller and Yeaple, 2013).

The findings provide general support for the hypothesized relationships and show substantial variations across different quantiles of the FDI distribution. We draw the implications of these findings for policy and suggest that they assign active roles for policymakers, in their ability to shape the consequences of geography by affecting the contingencies that determine its consequences. They also have implications for firms whose location strategies affect many of these contingencies. We call for caution in interpreting these findings due to manipulations of financial flows that undermine the employment of FDI data as indicators of actual economic activity (for an elaboration, see the methodology section).

The findings make several important contributions to theory and practice. For one, the separation of geographic location from its constructed meanings, which we theorize and confirm empirically, challenges the deterministic view of geographic location as an exogenous country characteristic, the "design of nature", which has often underlaid (implicitly at least) discussions in this area. Rather, it calls for the treatment of geography as a country attribute whose consequences for FDI are constructed by actions, the "design of humanity" (Addison and Rahman, 2005).

Sociology theory provides the theoretical underpinning for the distinction we introduce between the physical and the constructed nature of geographic location, and enables us to offer a novel conceptualization of what constitutes near and far. Our findings show the merits of this approach in explicating the separate and combined effect of the physical and the constructed on FDI and settling some of the conflicting findings of extant research. This contributes to the emergence of new ways of theorizing about space (Hall, 2012; Enos, 2017; Cook et al., 2018) and demonstrates the merits of a sociology perspective for extant theorizations that have been underpinned predominantly by economic and economic geography perspectives (Head and Mayer, 2013; Beugelsdijk and Mudambi, 2013). It also contributes to the growing interest in connectivity among countries, notably between home and host countries, and its impact on FDI patterns and offers insights into the theoretical boundaries of this impact (e.g., Cano-Kollmann et al., 2016). This bears relevance also to recent debate regarding the theoretical meanings of distance measures and suggestions that impact assumed to be due to geography in fact reflects other influences, including connectivity-related measures (Frankel and Rose, 2000; Berry et al., 2010).

Furthermore, studying countries' unilateral characteristics and their connectivity to other countries in a unified framework, and measuring them in a comparable manner so that their respective impacts can be fully evaluated, enables us to deepen understanding of the interactions and interdependencies between these distinct, yet related, determinants of the relationships between geography and FDI. These contingencies represent forces of integration, expressed by connectivity among countries, and fragmentation, accentuated by differences among them (Zhou, 2010), and as such carry different consequences for countries' ability to attract FDI. They also require different policy interventions, reinforcing the need to understand the complex and nuanced interdependencies and cross influences between them as a guide for adequate policy response.

Last, the employment of quantile regression contributes to the development of a theory that accommodates variations in the impact of location across different scales of the FDI distribution. The large variations we find across quantiles call for nuanced responses to geography in theory and practice, informed by explicit recognition of varying dynamics in different volumes of FDI. This contribution is particularly important as the number of countries participating in FDI and their diversity have increased considerably in recent decades.

1. Theory and hypotheses

The notion that geographic location affects FDI is inconsistent with the conceptualization of the assets driving FDI as being weightless and fully mobile over distance at no cost (Beugelsdijk et al., 2018). Indeed, historically, discussions of FDI paid little attention to the impact of geography on FDI. Rather, the use of firm-specific intangible assets was conceptualized as the underlying rationale for FDI (Buckley and Casson, 1976; Hymer, 1960). This has changed with the growing influence of Dunning's ownership-location-internalization paradigm and its emphasis on the role of location and geography in shaping the patterns of FDI (Dunning, 2008). Substantial attention has subsequently been given to geography-related issues such as networks (Calatayud, Mangan and Palacin, 2017), agglomeration (Fujita and Thisse, 2013) and country-specific institutional, cultural and social factors (Berry et al., 2010). Recent interest in global supply chains has given additional impetus to geography and the interaction among value-creating activities spread across geographies (Buckley, 2009). The growing interest in location and geography has also triggered interest in economic geography and the incorporation of place, space and scale in FDI theorization (Hall, 2012; Beugelsdijk and Mudambi, 2013; Cook et al., 2018).

This research has demonstrated the strong impact of geography on FDI but yielded mixed and inconclusive findings about the direction and nature of the impact.

Some studies show that countries' remoteness from other countries weakens their attractiveness as host for FDI, presumably a result of the cost of management over distance and the difficulties of transferring MNE assets that rise with distance (Keller and Yeaple, 2013). Other studies accentuate the positive impact of remoteness, suggesting that it fosters the development of distinctive skills and affords access to resources and knowledge that are not available in central locations (Redding and Schott, 2003). Yet other studies suggest that the significant impact of geography is a result of model mis-specification and omitted variables, and show that it is lessened and may disappear when these variables are added to the model (Markusen and Maskus, 2002).

In this paper, we offer some reconciliation for these ambiguous theoretical arguments and inconclusive empirical findings. Building on sociology theory of space and applying it to FDI, we distinguish the physical from the constructed dimension of geography and employ this distinction to offer a different conceptualization of what constitutes near and far in relation to FDI.

The sociology theory of space originates in Simmel's metaphor of the Stranger (Simmel, 1908), a newcomer to a society whose newness implies that he is physically near but socially remote. This combination of near and far defines the actual meaning of the Stranger's location as a member of a system in the spatial sense but not in the social sense (Best, 2019). Simmel attributes this separation between the physical and constructed to the Stranger's own characteristics and his interaction with others and suggests that these define the consequences of the physical (Simmel, 1908; Jackson, Harris and Valentine, 2017). Accordingly, whereas the physical dimension of geography is fixed, its constructed connotations are intertwined with the characteristics of the participants and vary across them in a manner that reflects their characteristics (Kim, 2006; Marotta, 2012).

Applying this duality of the physical and the constructed to FDI, we suggest that the consequences of countries' physical location for their performance as host for FDI is determined by constructed characteristics and interaction with other countries. Thus, countries' unilateral characteristics modify the impact of geographic location on their FDI performance, such that the same geographic location differentially affects countries with different characteristics. Similarly to the notion that the properties of the Stranger determine the consequences of his strangeness (Simmel, 1908), we suggest that the characteristics of countries determine the consequences of their geographic location. As Strangers with different properties would experience strangeness differentially under identical conditions (Löw and Weidenhaus, 2017), the impact of geographic location on FDI would vary across countries with different characteristics.

For instance, the abundance and quality of local resources render geographic location less impactful because they lessen dependency on other countries for

complementary resources and make countries more self-sufficient. Such local resources could also command rent that is high enough to make up for the costs of remoteness. In a similar fashion, large economic size offers scale economies that may make up for additional costs that arise as a result of remoteness, as do also markets with high purchasing power, thus diminishing the negative impact of remoteness. Social structure and the dynamics of social relationships also vary across countries, reflecting their geographic location in relation to other countries (Löw and Weidenhaus, 2017). Diamond (1997) describes how geographic remoteness has isolated societies from social patterns established in central locations and created distinctive social relationships and modes of social interactions. Blainey (1966) portrays distance and isolation as the they have shaped Australia's society throughout its history.

Furthermore, the benefits of spillover effects and externalities that take place among countries located in proximity to each other matter less for larger and resource-rich countries, because their own endowments offer many of these benefits (Redding and Scott, 2003). In contrast, smaller and less endowed countries benefit more from geographic proximity to neighbouring countries because it may enable them to make up for their size by drawing on resources of those countries, or else take part in global and regional networks of production and consumption (Shulgin et al., 2019). Research shows that FDI to small island countries is affected by regional location (and openness) to a greater extent than is FDI to other countries (Reed, 2004).

In a similar fashion, political institutions matter differently in different geographic locations (Enos, 2017). Well-functioning institutions signal for investors that their rights are protected and guarded and thus reduce risk, a guarantee that matters more in remote locations because it lessens the greater risk that arises because of remoteness (Poot, 2004).[1]

Unilateral country characteristics thus indicate that countries experience differentially the consequences of remoteness from other countries, changing the impact on their FDI performance of being far or near (Bligh and Riggio, 2013). The impact of remoteness is therefore weaker for more endowed countries, and vice versa. Formally:

> *H1: Countries' unilateral characteristics negatively moderate the impact of geographic location on the amounts of FDI they receive.*

[1] Competitive pressure and barriers to entry are also likely to be affected by location and remoteness, and are likely to manifest in the markets for both consumers and resources. Remoteness may increase competitive pressure because isolation from foreign competition had enabled incumbents to develop strong competitive positions and dominate markets. These effects are likely to be accentuated by scale.

In Simmel's theory and its subsequent developments, interaction is a means of constructing metaphorical proximity, which creates channels of communication that lessen the perception of strangeness (Bligh and Riggio, 2013; Marotta, 2012; Simmel, 1908). The physical thus takes on different meanings that are shaped by the nature and dynamics of the communication.

Applying this idea to FDI, we suggest that countries' interaction with other countries increases familiarity and legitimacy, creates trust and reduces negative perceptions of foreignness (Shulgin et al., 2019; Zaheer, 1995). Such interactions override the impact of geographic distance, and according to some studies eliminate it altogether (Calatayud et al., 2017). Frankel and Rose (2000) found that the impact of common language increases the likelihood of trade between two countries by 200 per cent, whereas a 1 per cent increase in geographic distance reduces it by 0.2 per cent.

The interactions that create connectivity can take place through multiple channels. We focus here on human, political and technological connectivity, three major channels of interaction that have been shown to affect economic relationships among countries (Gould and Panterov, 2017).

Human connectivity, in the form of flow of people across countries or human interaction through e.g. phone calls and mail, establishes communication routes that reduce the impact of geography. It transfers knowledge of market opportunities and preferential access between countries (Freeman, 2006). Geographic distance affects the costs of human connectivity (by i.e. increasing travel costs, and often also cultural and linguistic distance) (McKercher, 2018), but research shows that much of human interaction takes place with little regard to geography. Analyses of air traffic find intense activity among remote countries and show that travel routes between Asia and North America and between Asia and Europe are the world's busiest (Smith and Timberlake, 2001; World Economic Forum, 2013).

Political relationship is another venue of connectivity that facilitates the establishment of economic relationships among countries by creating venues for coordination and institutional ties that facilitate convergence, and reduce transaction costs and frictions caused by remoteness. Frankel and Rose (2000) show that the impacts of a common regional trading bloc, colony-colonizer relationships and a common polity increase the likelihood of trade between countries by 330 per cent, 900 per cent and 300 per cent respectively. Spilker, Bernauer and Umaña (2016) find that countries' choice of partners for preferential trade agreements is driven by cultural similarity, political system, and environmental and labour standards, and that geographic distance has a weak effect on the choice.

Technological connectivity, through internet, telephone and transportation infrastructure, is another means of interaction that reduces the impact of geographic distance on economic transactions between countries (Calatayud et al., 2017). In the presence of digital technology, geographic distance was found to have no impact on the flow of knowledge and information (Forman and van Zeebroeck, 2019). Studies show that country differences in terms of culture, language and shared history affect the intensity of communication through technological means between them more than geographic distance does (Blum and Goldfarb, 2006).

Connectivity, through human, political and technological interaction, draws remote countries closer to other countries and diminishes the impact of physical location, such that geography matters less for more connected countries. Formally:

> *H2: Countries' connectivity to other countries negatively moderates the impact of geographic location on the amounts of FDI they receive.*

2. The model and measures

Underpinned by the logic driving our theory, the empirical testing is based on a model that links countries' FDI performance as the response with geographic location in relation to other countries as the covariate. Countries' unilateral characteristics and their connectivity to other countries are added as two moderators whose impact determine the outcome:

$$y_{it+1} = \beta_0 + \beta_1 x_{1it} + \beta_2 x_{2it} + \beta_3 x_{3it} + \beta_4 x_{1it} x_{2it} + \beta_5 x_{1it} x_{3it} + \varepsilon_{it+1} \quad (1)$$

where y_{it+1} is the amounts of FDI that country i receives in year $t+1$, x_{1it} is a location measure, and x_{2it} and x_{3it} represent respectively vectors of country characteristics and their connectivity to other countries. Furthermore, ε_{it+1} is a country-specific standard error term that accounts for unobservable and idiosyncratic country attributes.

We operationalize the response variable by the annual amounts of FDI stocks and flows that countries receive. The data on FDI stocks measure cumulative activity over time and as such are free of the volatility of flows, whereas flow measures correct for distortions of stocks whose cumulative nature means that they may not accurately reflect the changing industrial composition of FDI over time in terms of sensitivity to location. Stock data could also be biased by incomparable methods of accounting for historical stocks across countries.[2] Following Pence (2006),

[2] Systematic collection of FDI stock data started in 1980, decades and in some cases centuries after FDI activity had started. At that time, only a few countries collected historical data based on FDI market values. The majority of countries calculated the stock figures by aggregating FDI flows, an inaccurate way to measure stocks.

we use an inverse hyperbolic sine transformation of the FDI stock and flows data. This transformation approximates the natural log and is defined for zero and negative values, thus enabling us to include observations with such values.

Geographic location, the main explanatory variable, is measured as the sum of the distance in kilometres (km) of a focal country from all other countries that receive FDI in a given year, using capital cities as the points of measurement.[3] The measure is time varying, reflecting changes in the country set during the study period caused by the formation of new countries, the opening up for FDI of other countries and the achievement of a level of economic development that makes FDI feasible. This measure, which presents geographic location as a unilateral attribute of countries, is free of distortions of dyadic relationships; for instance, when intense FDI activity between neighbouring countries shows a positive effect of location (Smarzynska, 2001). This approach has particular appeal in light of the growing prevalence of vertical investment, whereby the position of countries in relation to other countries is often a more informative indicator of their ability to participate in global networks than their bilateral distance from specific partners (Buckley, 2009). It is also more in tune with MNE location choices, which are made within an overall location portfolio (Nachum and Song, 2011).

The moderating effects – countries' unilateral attributes and their connectivity to other countries – are measured by two corresponding indices. The country index is the standardized value of the sum of the major economic and institutional country attributes that – according to theory – affect the attraction of countries for FDI (Blonigen and Piger, 2014). The connectivity index is calculated as an aggregation of human, political and information connectivity measures created by the KOF Swiss Economic Institute (Axel, Gaston and Martens, 2008). For comparability, we standardized both measures to have a mean of zero and a standard deviation of one. We include year fixed effects to allow the FDI distribution to shift over time and country fixed effects to account for observable and unobservable country characteristics that are likely to affect FDI, such as agglomeration effects, trade and inflation.

Table 1 presents the variables included in the model, their operation measures and the data sources. Table 2 provides descriptive statistics and the correlation coefficients of these variables. Most correlations among the explanatory variables are at accepted levels. We perform unit root tests for each variable in the model (Im, Pesaran and Shin, 2003), and confirm that the variables are stationary. The variance inflation factor is below 4.82 in all the models, well below the generally accepted threshold of 10, lessening concerns regarding multicollinearity.

[3] The location measures are available from the authors upon request.

Table 1. Variables in the model, measures and sources

Constructs	Operation measures	Sources of data
A country's performance as host for FDI	Total annual FDI stocks and flows (US$ million, current prices)	United Nations UNCTAD FDI database (http://stats.unctad.org/fdi)
Geographic location	Cumulative km distance of a country from all other countries that receive FDI at time t (the choice set)	Authors' calculations based on GeoDist Database (http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=)
Unilateral measures (H1) – dimensions of the index:		
Size and agglomeration	GDP (US$ million)	World Bank Economic Development Indicators database
Economic development	Per capita GDP (US$)	
Natural resources	Natural resource rents (per cent of GDP)	
Political institutions	POLCON 2017 index (Henisz, 2000)	http://www-management.wharton.upenn.edu/henisz/
Connectivity measures (H2) - dimensions of the index:		
Political connectivity	1. Number of embassies in a country 2. Membership in international organizations 3. Participation in UN Security Council Missions 4. International treaties	KOF (http://globalization.kof.ethz.ch) (Axel, Gaston and Martens, 2008) The indices are constructed on a scale of zero to 100. Higher values represent greater connectivity.
Information connectivity	1. Internet users per 1,000 people 2. Number of television sets per 1,000 people 3. Trade in newspapers (per cent of GDP)	
Human connectivity	1. Telephone traffic 2. Transfers (per cent of GDP) 3. International tourism (arrivals and departures, per cent of population) 4. Foreign population (per cent of population) 5. International letters (per capita)	
Control variables		
Country and year fixed effects	Dummy variables for each country and year in our sample	

Table 2. Descriptive statistics and correlations

	Mean	St. Dev.	1	2	3	4	5	6	7	8	9	10	11
1. FDI flows (US$ million) (log)	5.82	3.90	1										
2. FDI stocks (US$ million) (log)	8.72	2.95	0.63	1									
3. Geographic location (thousand km) (log)	13.90	0.24	0.14	0.15	1								
4. Political connectivity	61.28	21.77	0.51	0.72	0.05	1							
5. Information connectivity	52.50	22.94	0.46	0.63	0.08	0.55	1						
6. Human connectivity	46.76	22.25	0.20	0.32	-0.19	0.24	0.67	1					
7. Connectivity index	0.07	1.00	0.40	0.58	-0.11	0.64	0.83	0.85	1				
8. GDP (US$ million)	277,000	1,130,000	0.26	0.37	0.11	0.28	0.22	0.11	0.23	1			
9. Per capita GDP (US$)	8,376	13,529	0.29	0.53	-0.06	0.45	0.62	0.66	0.69	0.36	1		
10. Natural resource rents (per cent of GDP)	8.10	11.28	-0.17	-0.14	-0.11	-0.27	-0.22	-0.18	-0.31	-0.12	-0.11	1	
11. POLCON	0.39	0.33	0.36	0.47	0.13	0.55	0.52	0.37	0.57	0.23	0.42	-0.35	1
12. Unilateral index	0.01	1.00	0.27	0.47	-0.05	0.40	0.42	0.46	0.56	0.60	0.66	0.14	0.59

[a] Coefficients with absolute values above 0.05 are statistically significant at the 0.01 level.

Endogeneity concerns in our model could originate in the relationships among FDI, country characteristics and the connectivity measures that might be jointly determined. We believe, however, that our study design and model lessen concerns on this ground. The study is based on annual data over four decades, with a time lag between the response variables and the covariates and moderators, which diminishes the possibility of reverse causality. Selection bias is minimized because we study the entire population of countries at each point in time. The consistent results of the moderating effects in the partial and full models reduce concerns that these variables are jointly determined. The year and country fixed effects address, at least in part, endogeneity on the ground of omitted variables. Nonetheless, to further reduce endogeneity concerns we conduct two-stage analyses, which offers formal reassurance that endogeneity is not driving the results.

We estimate the model with quantile regression, a statistical technique that allows for varying impacts of a set of regressors on different quantiles of the outcome distribution and reports the relationships separately for each quantile (Hong, 2013; Hong et al., 2019; Koenker, 2005). Quantile regression enables the impact of geographic location on FDI performance to vary for countries that receive large or small volumes of FDI, a quality that is of particular value for a heterogeneous phenomenon as FDI (Dimelis and Louri, 2002; Yasar and Paul, 2007). All the covariates in our model are potentially sensitive to the amount of FDI that countries receive. For instance, the impact of remoteness on FDI matters less for countries that receive large amounts of FDI because internal externalities are likely to lessen the need for external interactions. Larger volumes of FDI are also likely to diminish the impact of transportation costs because local purchases from other foreign investors could replace the need to import inputs from elsewhere. Modelling such relationships with OLS regression models that are based on the conditional mean would yield erroneous results because they assume away such variations and do not account for the highly skewed distribution of FDI.

Furthermore, a quantile regression estimation on the median is more suitable than estimation at the mean through ordinary least squares (OLS) for dealing with skewed distribution and violations of the normality assumption. Outliers and skewed data affect the median less and in general quantile regression estimates at any quantile are more robust against outliers in the response variable. In our dataset, the flow data have a median of $0.33 billion, and a mean of $5.02 billion, and the stock data have a median of $3.43 billion and a mean of $62.53 billion. With such skewed distribution, extreme observations have significant impacts on the estimates, painting a distorted picture of actual relationships. Moreover, the quantile regression technique treats individual observations in relative terms to others. This makes it appealing for the study of FDI because

countries' FDI performance is evaluated in relation to that of other countries. These features make the quantile regression particularly suitable for the study of FDI, which is notorious for outliers and has skewed, heavy-tailed distributions, with large variations of response variables in relation to varying ranges of covariates (Yasar and Paul, 2007).

We report our findings in quantiles. The adequate level of aggregation in quantile regression analyses – whether quantiles or quartiles – is related to the nature of the phenomenon studied. Given the highly skewed nature of the FDI data and the large number of stark outliers, we opted for a disaggregated level of analysis that enables us observe detailed nuanced in the results.[4] Following Firpo, Fortin and Lemieux (2009), we use the two-step unconditional quantile regression approach, which offers direct indications of how marginal change in the level of one variable affects the distribution of FDI while keeping the other characteristics constant.

The time window for the study begins in 1980, when systematic collection of stock data at the international level started and the flow data reached sufficient magnitude.[5] The analysis ends in 2017, the latest year for which data were available at the time of collection. This long timespan reduces concerns regarding left-censoring bias and diminishes the effect of cyclical shifts that could distort the nature of the relationships. We define the country choice set to include all sovereign states that received FDI during the study period. We take the first year in which a country receives FDI as the indication that it entered investors' choice set. This removes sample selection bias because we study the entire population at each point in time. We exclude tax-haven countries because investment in these countries is driven by tax minimization motives rather than the theoretical relationships we assume (Hines, Gumpert and Schnitzer, 2016).[6] The complete data sets include 148 countries and 4,932 country/year observations.

[4] Note that the estimate of the model for different quantiles of the distribution does not imply splitting up the observation. The quantile regression technique uses the full data sets (not subgroups) to estimate the effect of independent variables on quantiles of the outcome.

[5] FDI flow data have been collected since 1970, but prior to 1980 there are many missing observations that do not appear to be randomly distributed.

[6] There is no established consensus on a specific definition for a tax haven (Hines, Gumpert and Schnitzer, 2016). We adopt the classification of the Organization for Economic Cooperation and Development (OECD), a widely accepted definition first introduced with the publication of the OECD report (OECD, 2000). This long history is particularly important for a study, like ours, that spans almost four decades. The OECD list of tax haven countries includes 35 states, mostly small islands in the Pacific and Atlantic Oceans.

3. Statistical analysis and results

A few words of caution are in order before we discuss the findings. When constructing the country location measure, we followed a common procedure in research in this area and used capital cities as the point of measurement. This approach captures countries' location by a single point, which may not necessarily correspond to the actual location of economic activity, a concern that is particularly troubling in relation to large countries (Gleditsch and Ward, 2001). In addition, the operation of the measure is based on the direct, shortest line between capital cities. This may not correspond to the actual distance that affects economic activities.

Possible distortions in the FDI data should also be noted. FDI data represent internal transfers and reinvested earnings of multinational enterprises (MNEs) and are silent about capital raised locally, a feature that could lead to a systematic underreporting of economic activity, particularly in countries with large and developed financial systems that offer attractive fundraising options (Beugelsdijk et al., 2018). Furthermore, the complex distribution of value-creating activities across countries and intense intrafirm trade have enabled MNEs to distort the connection between actual location of economic activity and financial flows, and undermined the value of FDI data as an approximation of value-creating activities. Alternative indicators that are immobile and cannot be manipulated by internal accounting, such as employment and tangible assets or actual control, are not available at the international level and do not match the requirements of our study design (Zucman, 2015). We stress the need to address this limitation of the FDI data as an important task for future research. With these caveats in mind, we move on to discuss the findings.

Table 3 presents the results of the unconditional quantile regression analyses. The first pre-regression step involves estimating the re-centered influence function (RIF) of y_{it} for each quantile as:

$$RIF(y_{it+1}, q_\tau) = c_{1,\tau} 1(y_{it+1} > q_\tau) + c_{2,\tau} \quad (2)$$

where q_τ is the value of the FDI at quantile τ, $c_{1,\tau} = 1 / f_y(q_\tau)$, $f_y(q_\tau)$ is the density of the FDI at q_τ, $c_{2,\tau} = q_\tau - (1 - \tau)c_{1,\tau}$, and the indicator function $1(y_{it+1} > q_\tau)$ identifies whether the value of a country FDI is above q_τ. In the second step, we estimate the following linear probability response model at each quantile of interest by incorporating country and time fixed effects:

$$\mathrm{E}[RIF(y_{it+1}, q_\tau)|x] = \alpha_r + \gamma_{t+1} + x_{it}\beta_\tau + e_{it+1} \quad (3)$$

where x_{it} denotes the covariates and moderators for countries' geographic location, unilateral characteristics and connectivity to other countries. Since the link function

$\mathrm{E}[RIF(y_{it+1}, q_\tau)|x]$ is equal to $c_{1,\tau} \Pr[\mathbf{1}(y_{it+1} > q_\tau)|x] + c_{2,\tau}$, it is linear in probability and therefore the average marginal effects of covariates β_τ can be consistently estimated using a simple OLS (Firpo et al., 2009). The RIF-OLS regression results are estimates of unconditional quantile marginal effects.

The results show that the impact of countries' geographic location on FDI performance is contingent upon their unilateral characteristics and connectivity to other countries, in support of H1 and H2. Both effects are significant for most of the quantiles, in agreement with the idea that underlies our theory, namely that the constructed dimensions of geography change the consequences of physical location, such that countries with different such dimensions are differentially affected by geographic location.

The results show interesting differences between the two contingency effects. Countries unilateral attributes are negative in all the estimates up to the 90th quantile when they turn positive and their impact diminishes slightly across the distribution. The connectivity measure changes direction at the 70th quantile and becomes positive as the volume of FDI increases. As representation of forces that separate countries and those that draw them together (Zhou, 2010), these differences speak for the differential effects of these conflicting forces.

The results offer also suggestive evidence of interdependencies between the two contingencies. The inclusion of the connectivity measures in the model changes the results of the two top quantiles of the unilateral measures (the differences between models 2 and 4), such that the switch from negative to positive sign of unilateral characteristics is pushed from the 70th quantile to the 90th. Similarly, the inclusion of unilateral characteristics in the model changes the results of the connectivity measures (differences between models 3 and 4), pushing the switch from negative to positive sign down the FDI distribution. These relationships perhaps suggest some substitution between countries' unilateral attributes and their connectivity to other countries.

Taken together, these differences could be understood as indicative of differences in kind between the two measures. The connectivity measures are human-made in the sense that they are the outcome of government policies, and several of them can be changed quite easily should policymakers decide to do so (e.g., establishment of political relationships with other countries). The unilateral measures, in contrast, combine those that are human-made but evolve slowly and gradually (e.g., GDP, institutions) with others that are given by nature, such as natural resources and size. As such, these variables relate to geography and remoteness in different ways, consistent with our findings. The results of the stock and flow analyses are largely consistent with each other, and thus reassuring of the robustness of our theory and empirical analyses.

Table 3. Country unilateral characteristics, connectivity and FDI, unconditional quantile regression

a. FDI Flows

Variables/ Quantiles	Model 1: Baseline					Model 2: Unilateral Measures					Model 3: Connectivity Measures					Model 4: Full Model					OLS
	0.10	0.30	0.50	0.70	0.90	0.10	0.30	0.50	0.70	0.90	0.10	0.30	0.50	0.70	0.90	0.10	0.30	0.50	0.70	0.90	
Unilateral$_{t-1}$						87.39 (0.00)	65.98 (0.00)	35.90 (0.00)	0.73 (0.86)	-62.0 (0.00)						25.80 (0.21)	47.78 (0.00)	32.82 (0.00)	10.51 (0.01)	-38.3 (0.00)	9.73 (0.23)
Location*Unilateral$_{t-1}$						-6.26 (0.00)	-4.72 (0.00)	-2.57 (0.00)	-0.03 (0.92)	4.52 (0.00)						-1.85 (0.21)	-3.42 (0.00)	-2.36 (0.00)	-0.73 (0.02)	2.82 (0.00)	-0.68 (0.24)
Connect$_{t-1}$											244.7 (0.00)	90.80 (0.00)	24.04 (0.00)	-35.80 (0.00)	-102.9 (0.00)	231.5 (0.00)	66.13 (0.00)	7.46 (0.28)	-42.3 (0.00)	-87.6 (0.00)	24.63 (0.16)
Location$_{-1}$*Connect$_{t-1}$											-17.80 (0.00)	-6.55 (0.00)	-1.68 (0.00)	2.68 (0.00)	7.46 (0.00)	-16.9 (0.00)	-4.79 (0.00)	-0.49 (0.32)	3.15 (0.00)	6.35 (0.00)	-1.77 (0.16)
Location$_{-1}$	1.01 (0.92)	16.36 (0.00)	-2.14 (0.37)	-14.8 (0.00)	-22.1 (0.00)	-4.50 (0.59)	12.24 (0.00)	-4.41 (0.03)	-14.70 (0.00)	-17.6 (0.00)	-12.74 (0.21)	12.32 (0.00)	-2.08 (0.36)	-11.18 (0.00)	-16.79 (0.00)	-13.9 (0.17)	10.14 (0.00)	-3.64 (0.08)	-11.5 (0.00)	-14.4 (0.00)	-3.03 (0.43)
Constant	-18.7 (0.89)	-224 (0.00)	28.52 (0.38)	205.9 (0.00)	307.8 (0.00)	57.48 (0.62)	-167.4 (0.00)	59.90 (0.03)	204.4 (0.00)	246.9 (0.00)	165.9 (0.23)	-169.10 (0.00)	29.32 (0.34)	158.6 (0.00)	236.36 (0.00)	182.1 (0.19)	-139 (0.00)	50.50 (0.07)	163.3 (0.00)	204.7 (0.00)	45.73 (0.39)
R-squared	0.23	0.50	0.58	0.60	0.52	0.23	0.51	0.58	0.60	0.54	0.24	0.51	0.58	0.61	0.55	0.25	0.52	0.58	0.61	0.56	0.18[a]

.../...

Table 3. Country unilateral characteristics, connectivity and FDI, unconditional quantile regression (Concluded)

b. FDI Stocks

Variables/ Quantiles	Model 1: Baseline					Model 2: Unilateral Measures					Model 3: Connectivity Measures					Model 4: Full Model					OLS
	0.10	0.30	0.50	0.70	0.90	0.10	0.30	0.50	0.70	0.90	0.10	0.30	0.50	0.70	0.90	0.10	0.30	0.50	0.70	0.90	
$Unilateral_{t-1}$						43.32 (0.00)	40.86 (0.00)	27.82 (0.00)	-13.86 (0.00)	-75.7 (0.00)						14.97 (0.18)	26.16 (0.00)	27.61 (0.00)	-0.10 (0.98)	-45.3 (0.00)	2.36 (0.67)
$Location*Unilateral_{t-1}$						-3.06 (0.00)	-2.94 (0.00)	-2.00 (0.00)	1.00 (0.00)	5.48 (0.00)						-1.03 (0.19)	-1.88 (0.00)	-1.99 (0.00)	0.01 (0.98)	3.31 (0.00)	-0.15 (0.70)
$Connect_{t-1}$											117.4 (0.00)	64.55 (0.00)	9.70 (0.09)	-60.66 (0.00)	-131.3 (0.00)	107.3 (0.00)	51.74 (0.00)	-3.81 (0.51)	-60.8 (0.00)	-112 (0.00)	1.45 (0.86)
$Location_{-1}*Connect_{t-1}$											-8.54 (0.00)	-4.64 (0.00)	-0.63 (0.13)	4.53 (0.00)	9.51 (0.00)	-7.82 (0.00)	-3.72 (0.00)	0.33 (0.43)	4.53 (0.00)	8.12 (0.00)	-0.06 (0.91)
$Location_{-1}$	-10.6 (0.01)	9.12 (0.00)	0.01 (1.00)	-18.0 (0.00)	-27.6 (0.00)	-12.9 (0.00)	6.47 (0.00)	-1.81 (0.35)	-17.03 (0.00)	-22.3 (0.00)	-17.21 (0.00)	6.58 (0.00)	0.92 (0.63)	-12.20 (0.00)	-20.90 (0.00)	-17.5 (0.00)	5.29 (0.00)	-0.44 (0.81)	-12.2 (0.00)	-18.3 (0.00)	-7.76 (0.01)
Constant	144.9 (0.01)	-122 (0.00)	1.77 (0.95)	250.6 (0.00)	384.5 (0.00)	178.7 (0.00)	-85.64 (0.00)	26.74 (0.32)	237.8 (0.00)	312.6 (0.00)	233.7 (0.00)	-86.80 (0.00)	-8.96 (0.73)	175.8 (0.00)	294.49 (0.00)	238.9 (0.00)	-69.3 (0.01)	9.60 (0.71)	175.4 (0.00)	259.2 (0.00)	113.44 (0.00)
R-squared	0.53	0.65	0.69	0.67	0.55	0.53	0.66	0.69	0.67	0.58	0.54	0.67	0.69	0.70	0.59	0.55	0.67	0.69	0.70	0.60	0.66[a]

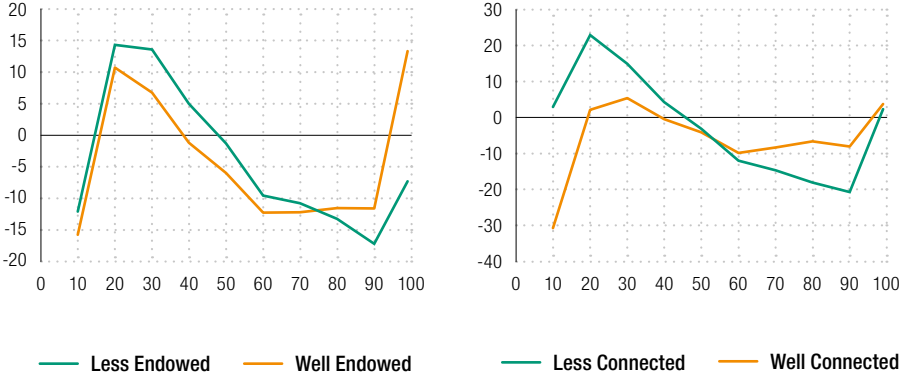
Note: Values in parentheses denote robust p-values obtained from bootstrapped standard errors of the coefficients based on 200 replications. N = 4,932. Country and year fixed effects are added to all the models.

[a] Derived from a least squares dummy variable approach.

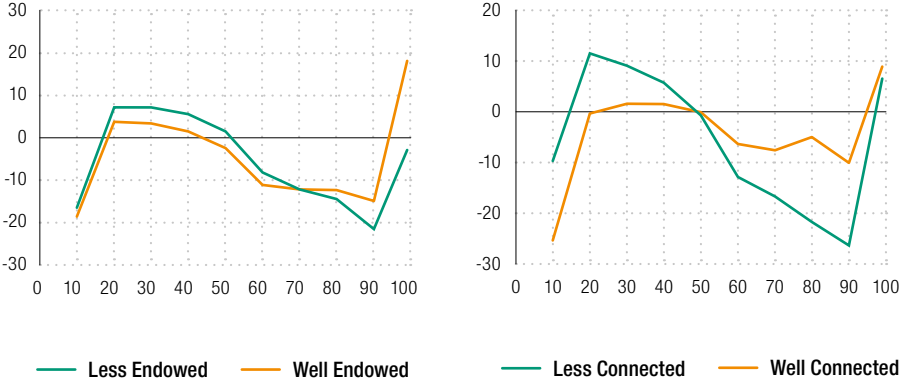
There are notable differences between the contingency effects across the FDI distribution. At the lower scale of the distribution (countries that receive small amounts of FDI), both contingencies are negative, in agreement with our predictions regarding the diminishing effect of geography in the presence of the constructed dimensions. As the volume of FDI increases, the contingency effects become less influential. Figure 1 presents these variations graphically.

Figure 1. Average marginal effect of geographic location on FDI at one standard deviation of unilateral characteristics (left) and connectivity (right)

a. Flow



b. Stock



We reason that these changes are driven by the logic of agglomeration economies that give rise to cumulative processes and path dependencies (Fujita and Thisse, 2013). The location of economic activity is typically triggered initially by location characteristics but over time generates self-perpetuating processes that create vicarious cycles in which the economic activity itself attracts additional activity in a manner that may not be related to locational characteristics. This dissociation of agglomeration from the location attributes that gave them rise is likely to diminish the contingency effect of countries' unilateral characteristics, consistent with our findings. In contrast, the impact of the contingency effect of connectivity is positive, in agreement with research that shows that flows of people and political ties facilitate interaction and advance economic relationships between countries (Foley and Kerr, 2013; Alcacer and Ingram, 2013). The positive signs we find at the higher scale of the FDI distribution suggest that connectivity enables remote countries to override the constraints of geography on their FDI performance.

These findings offer some reconciliation for the inconclusive findings of extant research (Dosdier and Head, 2008; Keller and Yeaple, 2013; Nachum et al., 2008) that motivated our paper. The employment of quantile regression shows that the relationships between geography and FDI change across different scales of the FDI distribution, variations that could not be detected by extant research that applied a single model to the entire distribution. The limitations of this approach are vividly apparent in the vast differences between the quantile regression and the OLS results in tables 3a+b. Given the variations we found across different scales of the FDI distribution in the quantile regression analyses, the interpretation of findings based on the application of a single model to the mean of the entire population becomes dubious. The OLS results could be the outcome of conflicting processes at different levels of the FDI distribution that cancel each other out, which is consistent with the conflicting findings of extant research. The second way by which our study offers reconciliation with extant research is by including unilateral and connectivity measures in a single model. As our findings show, these dimensions influence each other in a variety of ways. Studying them on their own, as has been common in most extant research, is likely to yield unstable results.

4. Additional tests

We conducted multiple additional analyses to test the sensitivity of the findings to different specifications, sub-models and statistical techniques. The complete results of these analyses are available upon request. We estimated the models with the variables comprising the indices on their own, to examine their independent impact, and address concern that conflicting forces cancel each other out or that a single component is driving the results (Gould and Panterov, 2017).

We also conducted additional two-stage analysis based on the control variable approach (Imbens and Newey, 2009; Rothe, 2010), using the values of the connectivity and country indices along with their interaction with distance as excluded instruments. The estimates with the endogeneity correction are stronger than those in the main analyses (table 3), offering additional grounds for believing that endogeneity does not affect our results in a significant way. Additional analyses include the introduction of varying time lags, use of size-adjusted (by GDP) measures of FDI, inclusion of regional fixed effects and application of the conditional quantile regression technique. These made small changes in coefficients' magnitude, but overall the results are consistent with those of the main analyses.

In yet another test we examined the possible impact of outliers within quantiles. Quantile regression corrects for outliers in the entire data set but does not exclude the possibility of outliers within individual quantiles. Intuitively, such outliers may have an important effect, particularly in the bottom and top quantiles. To address this concern, we employed the BACON algorithm of Billor, Hadi and Velleman (2000) to identify outliers and estimate the model without them (32 and 12 in the flow and stock data, respectively). The results are comparable with those in the full analyses.

Additional notable tests included estimates of the model on sub-samples split by level of economic development. All the variables in our model are likely to be sensitive to level of economic development. Substantial research shows that countries at varying levels of economic development are affected differentially by location and remoteness (Brun et al., 2005; Boulhol and de Serres, 2010; Guerin, 2006). There are also suggestions that connectivity and integration differentially affect the FDI performance of countries at different levels of economic development (Ghosh and Holf, 2000). The results of the split analysis are consistent with these theoretical predictions (table 4). They show substantial differences in the magnitude of the effects and, particularly for countries with low FDI performance, also in their direction (negative/positive).

The industrial structure typical of developing countries, with heavy reliance on raw material and bulky manufacturing, makes them more amenable to the negative impact of transportation cost and remoteness. Developing countries' participation in global supply chains as production platforms for export further increases sensitivity to the cost of remoteness. Vertically integrated production shows negative relationships with distance, whereas horizontal investment, which is in part a means of overcoming distance, tends to increase with distance (Markusen and Maskus, 2002). Moreover, a low level of economic development is often associated with a small local resource pool, making investors dependent on imports and thus further increasing the negative implications of remoteness. The results of the unilateral interaction term, notably for the countries with high FDI performance,

Table 4. Level of economic development

a. Developed countries

Variables/ quantiles	FDI flows					OLS	FDI flows					OLS
	0.10	0.30	0.50	0.70	0.90		0.10	0.30	0.50	0.70	0.90	
$Unilateral_{t-1}$	58.74 (0.03)	44.81 (0.00)	6.53 (0.33)	-17.43 (0.04)	-46.06 (0.00)	-11.90 (0.35)	82.71 (0.00)	34.40 (0.00)	9.97 (0.05)	-22.00 (0.00)	-63.15 (0.00)	21.00 (0.30)
$Location*Unilateral_{t-1}$	-4.26 (0.02)	-3.19 (0.00)	-0.49 (0.30)	1.24 (0.04)	3.33 (0.00)	0.80 (0.37)	-5.91 (0.00)	-2.44 (0.00)	-0.75 (0.04)	1.57 (0.00)	4.51 (0.00)	-1.46 (0.30)
$Connect_{t-1}$	331.06 (0.00)	2.97 (0.94)	-25.69 (0.30)	-6.46 (0.74)	9.61 (0.59)	103.51 (0.02)	75.49 (0.06)	-89.21 (0.00)	-81.03 (0.00)	-31.28 (0.11)	-26.58 (0.11)	28.71 (0.49)
$Location_{-1}*Connect_{t-1}$	-24.25 (0.00)	-0.26 (0.93)	1.86 (0.31)	0.48 (0.73)	-0.71 (0.58)	-7.63 (0.02)	-5.71 (0.05)	6.57 (0.00)	5.94 (0.00)	2.30 (0.11)	1.96 (0.10)	-2.08 (0.49)
$Location_{-1}$	36.06 (0.02)	-7.06 (0.38)	-19.09 (0.00)	-7.27 (0.15)	-0.96 (0.79)	-1.14 (0.89)	24.40 (0.02)	-12.68 (0.02)	-18.61 (0.00)	-8.97 (0.07)	-6.93 (0.07)	4.94 (0.51)
Constant	-480.53 (0.03)	110.26 (0.33)	280.69 (0.00)	112.14 (0.12)	23.40 (0.64)	34.33 (0.76)	-330.18 (0.03)	184.78 (0.01)	272.00 (0.00)	136.93 (0.05)	107.06 (0.05)	-58.59 (0.58)
Observations	885	885	885	885	885	885	885	885	885	885	885	885
R-squared	0.23	0.50	0.57	0.57	0.44	0.29	0.52	0.65	0.68	0.63	0.53	0.80

b. Developing countries

Variables/ quantiles	FDI flows					OLS	FDI flows					OLS
	0.10	0.30	0.50	0.70	0.90		0.10	0.30	0.50	0.70	0.90	
$Unilateral_{t-1}$	28.48 (0.23)	31.83 (0.00)	21.61 (0.00)	-5.44 (0.34)	-56.18 (0.00)	3.77 (0.75)	17.69 (0.13)	15.10 (0.02)	11.42 (0.01)	1.82 (0.74)	-57.69 (0.00)	-4.74 (0.49)
$Location*Unilateral_{t-1}$	-2.01 (0.24)	-2.26 (0.00)	-1.55 (0.00)	0.39 (0.33)	4.08 (0.00)	-0.24 (0.77)	-1.21 (0.15)	-1.08 (0.02)	-0.83 (0.00)	-0.15 (0.72)	4.18 (0.00)	0.36 (0.47)
$Connect_{t-1}$	87.32 (0.02)	54.70 (0.00)	-5.41 (0.43)	-25.37 (0.00)	-100.61 (0.00)	-1.85 (0.93)	91.17 (0.00)	41.51 (0.00)	1.97 (0.75)	-60.81 (0.00)	-117.18 (0.00)	-0.90 (0.93)
$Location_{-1}*Connect_{t-1}$	-6.43 (0.02)	-3.98 (0.00)	0.43 (0.38)	1.91 (0.00)	7.36 (0.00)	0.14 (0.92)	-6.66 (0.00)	-2.97 (0.00)	-0.09 (0.83)	4.50 (0.00)	8.59 (0.00)	0.11 (0.88)
$Location_{-1}$	-38.27 (0.00)	2.22 (0.53)	-3.78 (0.11)	-7.61 (0.00)	-2.99 (0.31)	-6.28 (0.24)	-27.49 (0.00)	2.69 (0.27)	-0.53 (0.79)	-11.41 (0.00)	-3.25 (0.26)	-9.13 (0.01)
Constant	514.29 (0.00)	-28.17 (0.56)	52.54 (0.10)	108.80 (0.00)	48.88 (0.22)	88.03 (0.22)	373.95 (0.00)	-31.95 (0.33)	10.70 (0.69)	162.81 (0.00)	55.06 (0.16)	129.62 (0.01)
Observations	4,047	4,047	4,047	4,047	4,047	4,047	4,047	4,047	4,047	4,047	4,047	4,047
R-squared	0.23	0.51	0.58	0.59	0.52	0.52	0.54	0.65	0.68	0.67	0.56	0.88

Note: Values in parentheses denote robust p-values obtained from bootstrapped standard errors of the coefficients based on 200 replications. R-squared from a least squares dummy variable approach for the OLS is reported. Country and year fixed effects are included in all models.

reflect these characteristics. The moderating effect of connectivity appears to be more impactful for developing countries, particularly the countries with high FDI performance (0.70 and 0.90 quantiles), consistent with observations about the close relationships between global integration and economic development (Bong and Premaratne, 2018). Of note are the considerable differences in the OLS results in the split analyses, which offers additional support for the contribution of the quantile regression technique to our understanding of FDI patterns.

5. Conclusion and policy implications

In this study we sought to identify the contingencies that determine the relationships between countries' location in relation to other countries and their performance as hosts for FDI. Drawing on Simmel's metaphor of the Stranger as being simultaneously proximate and remote (Simmel, 1908), we presented physical geographic location as distinct from its constructed representations and suggested that the factors that separate the two are related to unilateral characteristics of countries and their connectivity to other countries. Our findings imply that the impact of geographic location on FDI performance cannot be properly understood without accounting for the constructed dimensions of geography, and call for a reconceptualization of what constitutes near and far in relation to FDI. This duality of the physical and the constructed may serve to explain the inconclusive state of research regarding the impact of countries' geographic location on their FDI performance that motivated our study.

Separating the impact of geographic location from the factors that determine its consequences is important not only because these relationships have different theoretical meanings but also for practice. The significant moderating effects we find challenge the deterministic view of geographic location as an exogenous country characteristic, the "design of nature", and indicate that the consequences of location should not be treated as fixed and unchangeable. With the right policies and actions, these consequences could become the "design of humanity" (Addison and Rahman, 2005). This assigns an active and critical role for policymakers who are often either in direct control of the moderating effects that determine the consequences of geographic location or else exercise strong influence on them.

Furthermore, the large variations we find across different quantiles of the FDI distribution challenge generic policy recommendations that do not recognize this variation and call for nuanced responses by policymakers in different countries. As our findings show, an identical model yields significantly different results for countries at different quantiles of the FDI distribution in terms of level of significance, magnitude and direction of effects. The same country attribute may have opposite effects for countries at different scales of the FDI distribution.

Policy responses ought to reflect this variation and be tailored specifically to individual countries. Such political response needs to be adjusted regularly, as the amounts of FDI that a country receives change over time.

Moreover, the combined effect of countries' unilateral attributes and their connectivity to other countries calls for policy responses that address both and at the same time are responsive to their distinctive nature and varying demands. Improvement of countries' unilateral attributes is subject to country discretion, often based on local resources. Most research attention has traditionally been given to policy measures that would enable countries to improve unilateral attributes, driven by the assumption that countries' locational attributes relative to other countries is the major determinant of their performance as hosts for FDI (Dunning and Lundan, 2008). Policies based on this approach have sought to alleviate the costs of geographic location, for instance by developing infrastructure and simplifying cross-border procedures (Limao and Venables, 2001).

Policy responses to connectivity-related issues are fundamentally different and can be achieved only through collaboration with other countries. They require the embrace of political agendas that draw countries into global networks of relationships and interactions with other countries, and facilitate economic relationships with other countries through open borders and the free flow of people and capital (Alcacer and Ingram, 2013; Calatayud et al., 2017). Establishing these connections and driving their benefits for FDI is subject to government policy to a greater extent than are unilateral attributes, many of which are not subject to policy measures or else respond to them slowly and gradually over time.

Our findings suggest that different connectivity measures might require different policy responses. Separate analyses that we conducted for the different measures show considerable variations in terms of the magnitude and direction of the impact. Of the three dimensions of the connectivity index (table 1), political connectivity is by far the most important moderating effect between geographic location and FDI. For countries with high FDI performance, political connectivity appears to significantly mitigate the impact of geographic location on FDI performance, accentuating the impact of governments policy on the outcome.

The differences we find between developed and developing countries (table 4) also call for policy responses, notably in relation to the connectivity measures. Our findings show that remoteness and distance from centres of economic activity are more detrimental for developing countries than for developed ones. This assigns greater importance to intervention, particularly in relation to the connectivity measures that are more responsive to policy intervention and are highly impactful on developing countries' ability to attract FDI. Governments of developing countries should recognize the critical impact of connectivity on their FDI performance and incorporate this recognition in their FDI policy agenda.

They should actively seek political, technical and human connections with other countries in order to facilitate economic relationships and encourage FDI. Alas, connecting to others requires the willingness of others to connect, assigning a critical role to policymakers outside a country. Such interactions should be seen as generating mutual benefits to the parties involved because developed countries have much to gain from such collaborations too. Differences in level of economic development and industrial structure imply that developed countries do not compete for FDI, at least directly, with developing countries, reducing concerns about conflicting interests. There is also a role for international organizations in promoting these relationships and supporting the creation of the conditions that encourage their formation.

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An evaluation of the effects of the European Commission's proposals for the Common Consolidated Corporate Tax Base*

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Abstract

This paper evaluates the Common Consolidated Corporate Tax Base (CCCTB) recently proposed by the European Commission. We find that if the CCCTB is introduced as it is currently proposed (including loss consolidation), then it is likely to impose large tax revenue costs of about one fifth of the corporate tax base. Second, we show that an application of the CCCTB proposals at only the European Union (EU) level would overlook the extent of profit shifting out of the EU and could lock in further unnecessary revenue losses. Third, major EU profit-shifting countries such as Luxembourg, Ireland and the Netherlands may experience significant revenue losses. Based on our analysis, the main policy recommendation is to consider extending the approach to a worldwide system, which would simultaneously deal with profit shifting within and out of the EU, and appears to offer the best prospect for revenue-positive, welfare-enhancing reform. For this to be viable, an immediate priority is to collate cross-country-comparable data and provide precise assessments of the range of policy scenarios.

Keywords: Common Consolidated Corporate Tax Base, CCCTB, corporate taxation, profit shifting, European Union, multinational enterprises

JEL classification numbers: F23, H25, H32

* Received: 23 October 2020 – Revised: 21 January 2021 – Accepted: 15 February 2021.

The authors acknowledge funding from the GUE/NGL European Parliamentary Group, Leverhulme Trust (Grant RPG-2017-419), and useful comments from two anonymous reviewers, as well as Veronica Grondona and Sol Picciotto.

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1. Introduction

At present, European Union (EU) countries have self-determination with respect to the setting of corporate taxation. Over the last 20 years, this self-determination has led to a so-called "race to the bottom" in terms of corporate tax rates. Instead of cooperating with one another, EU countries have been competing over tax rates and tax bases, leading to a reduction in the size of the corporate tax base. In order to foster greater collaboration in international corporate taxation, a unitary approach (e.g. within the United States) may go a long way to mitigate the profit-shifting activities of multinational enterprises (MNEs) located within the EU. Thus, in 2016, the EU renewed its interest in the adoption of a common consolidated corporate tax base (CCCTB).

This paper evaluates the European Commission's proposals and assesses the impact on the corporate tax base, should the EU decide to go ahead with the CCCTB proposal or an alternative proposal *without* full consolidation (the common corporate tax base, or CCTB). The CCCTB proposal includes a single set of rules for calculating companies' taxable profits in the EU, allowing the filing of a single tax return. The consolidated taxable profits would be shared between the EU member states in which the MNE group is active, using an apportionment formula. If the formula reflects companies' economic activity, such as assets, sales and employment, this will guarantee that profits are aligned with economic activity, which has been the single most important goal of the Base Erosion and Profit Shifting (BEPS) Project of the G20 and the Organization for Economic Cooperation and Development (OECD).

Most recently in the BEPS process, the OECD/G20 Inclusive Framework has been working on designing a two-pillar approach. The first pillar is intended to overhaul the existing nexus and profit allocation rules to align taxing rights with the real economic activity of MNEs, making profit shifting more difficult to achieve, while the second pillar is intended to set a global minimum tax rate, making profit shifting less attractive even where feasible. At present, however, further progress is highly uncertain because at the same time, many countries have prepared digital sales taxes, which sidestep the need to allocate profits but also fail to address the underlying issues. The proposal for a CCCTB has the potential to deliver within the EU what it was hoped the OECD's first pillar would do.

This paper contributes to the literature in several ways. First, it is important to note that any analysis that tries to estimate the effects of a policy change like this, on a grand scale, is likely to encounter a number of challenges – especially in terms of data quality and the time period under investigation. Hence, an important goal of this paper is to comment on the quality of data available to scholars to make these types of assessments and to state how data could be improved in the future through open and transparent country-by-country reporting.

Second, this paper uses data extracted from the Orbis database so as to undertake a simulation approach common in the literature (the alternative would be to use a computable general equilibrium model, e.g. the one used by the European Commission (2016). Our analysis differs from previous studies, such as Mintz and Smart (2004), Cobham and Loretz (2014) and Clausing (2016), in that it focuses on the CCCTB. In contrast with CCCTB-focused studies such as those of Devereux and Loretz (2008) and Nerudová, Solilová and Dobranschi (2016), in this paper we use a more recent data set with longer time series data.

The use of the imperfect, but best available Orbis data enables us to evaluate the extent to which taxable profits would be redistributed, if they were to be aligned with the level of real economic activity, as the CCCTB indicates. We use this framework to assess a set of specific issues and scenarios. We focus on various apportionment formulas and estimate the effects of varying the longstanding proposal for formulary apportionment under the CCCTB, which combines weighted indicators of sales, tangible assets and employment, with two other possible apportionment formulas. Furthermore, we investigate the impact of loss offsetting between member states as a natural first step. We conclude with an exploratory analysis of the intra- and extra-EU application of unitary taxation.

Third, we contribute to the literature by uncovering new results in our analysis. Overall, we find that the introduction of the CCCTB would have substantial effects on the EU. Three main new findings emerge from our analysis, which adds to the literature with respect to furthering our understanding of MNE taxation across borders. First, the proposed loss consolidation is likely to impose large revenue costs of about one fifth of the corporate tax base, with no offsetting benefits of comparable scale. Second, an application of the CCCTB proposals at only the EU level would overlook the extent of profit shifting out of the EU and could lock in unnecessary revenue losses. Third, major EU profit-shifting countries such as Luxembourg, Ireland and the Netherlands may experience significant revenue losses (which would, of course, depend on the design specifics and the way the proposal is implemented).

The rest of this paper is set out as follows. In section 2 we outline in detail how our research contributes to the literature, specifically in the context of four important areas. First, we discuss the BEPS agenda introduced by the OECD. Second, we describe the extent of profit shifting by MNEs, on the basis of the literature. Third, we discuss the EU's proposal for the CCCTB and contrast it with a milder version that does not consolidate the tax base. Fourth, we discuss the various approaches used by scholars to estimate the impact of adopting a unitary approach. Section 3 outlines the methodology, and section 4 provides a detailed discussion of the firm-level data used in our analysis. Section 5 presents our central results and results for alternative scenarios. The final section concludes with specific policy recommendations that can lead to greater transparency in terms of the adoption of country-by-country reporting.

2. Contextual background and previous literature

2.1 The BEPS initiative

Following the global financial crisis that emerged in 2008 and the subsequent fiscal pressures faced by many developed countries, significant public and political scrutiny has come to bear on the extent of tax avoidance by the world's leading MNEs. In 2012, the G20 began to develop a response, which eventually led to the OECD's BEPS action plan. The BEPS Project had widespread support from many developing and emerging countries where MNE profit shifting had long been recognized as a major revenue threat. The BEPS action plan, which began in 2013 and concluded in 2015, can be viewed as a renewed narrative, loosely following the harmful tax competition debate in the EU in the late 1990s (Radaelli, 1999).

There is growing evidence that the BEPS Project has not lived up to expectations. The initial ambition was weakened in a number of areas by an absence of full cooperation between OECD member states, so that the resulting measures lacked the necessary technical power. Politically, the perception of failure has led lower-income countries to coalesce around the G77 proposals for greater tax policy responsibility to be vested in the United Nations (UN) rather than the OECD. Not so long ago, United States policymakers were considering quite radical and untested proposals for corporate tax, such as the destination-based cash-flow tax, that were entirely at odds with agreed BEPS actions, and EU policymakers are seeking to go beyond BEPS in a range of areas, including the adoption of the CCCTB within the Union.

Common to each of these political responses is the desire to challenge the "arm's-length principle" that lies at the heart of the OECD-set rules for international tax and to challenge the decision taken at the League of Nations in the interwar years that set the world on a path to corporate taxation on the basis of separate accounting rules rather than unitary taxation (Picciotto, 2013). A unitary approach treats the MNE itself as the profit-maximizing unit and the group profits as the tax base to then be allocated between jurisdictions on the basis of a formula. Separate accounting, in contrast, rests on treatment of individual entities across the MNE as if they were individually profit-maximizing; hence, the requirement to account separately for each subsidiary and to report profits as they would be distributed if the subsidiaries were truly operating at arm's length from each other and pricing intra-MNE transactions accordingly.

The central strength of the BEPS action plan lay in the initial agreement to collaborate with the specific aim of reforming international corporate tax rules so that they "better align rights to tax with economic activity" (OECD, 2013: 11).

Although there is a broad consensus that the BEPS Project has fallen far short of the changes needed, an important element of progress has been the creation of a standard for country-by-country reporting by MNEs, based on an original proposal from the Tax Justice Network (Murphy, 2003; Cobham, Janský and Meinzer, 2018). As things stand, these country-by-country data are only provided privately to some tax authorities – but there are growing moves, including a strongly supported European Parliament position, to make the data publicly available as originally intended.

2.2 Evidence of profit shifting

The evidence clearly confirms not only the existence of serious profit misalignment but also its sharp growth over recent decades. For example, Cobham and Janský (2019) use data on United States MNEs to show the increasing extent of profit misalignment as a share of gross profits for a number of years and indicators of economic activity. Their estimates suggest that 5–10 per cent of United States MNEs' global profits were misaligned in the 1990s and that by the early 2010s, this misalignment had grown to as much as 25–30 per cent of their global profits. Hence, the landscape has changed from being a relatively marginal problem to a first-order economic issue. If other countries' MNEs are equivalently aggressive in their tax strategies, profit shifting may amount, in total, to a material distortion of global economic activity (Cobham and Janský, 2019). Similar studies, such as those by UNCTAD (2015) (Bolwijn et al., 2018), the OECD (2015) using different data sources and estimation strategies. While measuring the scope of BEPS is challenging given its complexity and existing data limitations, a number of recent studies suggest that BEPS is responsible for significant global corporate income tax (CIT, the IMF (Crivelli et al., 2016), Clausing (2016), Cobham and Janský (2018), Janský and Palanský (2019) and Tørsløv et al. (2020), report comparable estimates of profit shifting.

The impact is also far from uniformly distributed. Cobham and Janský (2019) find that for United States MNEs, only a handful of jurisdictions (including Ireland, Luxembourg and the Netherlands) consistently lay claim to substantially higher shares of global profits than their shares of "economic activity" – and that each of these jurisdictions levies an effective tax rate below at least 5 per cent but often as low as below 2 per cent. The losses have a significant impact on other countries, at all levels of per capita income. In absolute terms, the losses are greatest in the biggest high-income economies, but in relation to GDP and to existing tax revenues, the losses are greatest in lower-income countries. Huizinga and Laeven (2008) estimate tax revenue losses related to profit shifting for 21 European countries, with losses largely concentrated in Germany.

2.3 Proposals for a common consolidated corporate tax base

The leading policy proposal in response to profit misalignment is a unitary approach to MNEs. Such an approach treats company profits as arising at the unit of the group, rather than the individual subsidiary, and so replaces the requirement to construct arm's-length prices for intragroup transactions with the requirement for a basis to allocate profits across countries in which the group has operations. A number of countries already use such an approach at a subnational level. The United States uses a range of formulas to calculate its share of companies' United States economic activity and therefore of the corporate tax base; while Canada uses a single agreed formula to allocate taxable profit between provinces.

The European Commission's earlier proposal for a unitary taxation system envisaged a single formula for EU member states to apportion the tax base among themselves. The European Commission (2011) proposed a formula for the CCCTB, which weighted tangible assets one-third, sales one-third and split one-third equally between compensation costs and (number of) employees. In the current proposal (European Commission, 2016), this formula remains but a number of other changes appear. There are now two proposals for Council Directives: one for a CCCTB, and one for a milder version, the CCTB, which differs from the CCCTB in that it does not consolidate the tax base but is seen as first step towards CCCTB.

2.4 Estimating the impact of the CCCTB on the EU corporate tax base

Estimating the impact from such a change to tax policy is inherently difficult. Two main approaches can be identified. The first approach takes advantage of computable general equilibrium (CGE) models, such as the CORTAX model produced by CPB Netherlands (the Bureau for Economic Policy Analysis) and used by the European Commission (2016), which is designed to evaluate the effects of tax reform and assumes that individual agents within the economy use optimizing behaviour. CGE models rely on a number of structural parameters that capture economic agents' behavioural responses to tax changes and thus are only reliable insofar as the parameters are correctly specified and estimated. Criticisms of CGE models tend to focus on the extent to which their outputs depend upon the assumptions made when constructing the underlying model – and in particular the combination of their high sensitivity to, and the often low visibility of, these assumptions, when sweeping policy claims are made.

The European Commission (2016) provides estimates of the impact of introducing the CCCTB. In its baseline scenario it suggests that the CCCTB has very clear advantages compared with the no-action scenario. Profit shifting would essentially be eliminated. Accordingly, the CCCTB boosts wages and employment,

and reduces the cost of capital to boost investment. Aggregate GDP would increase, and hence economic welfare would improve. This is the case for two scenarios, the first including only MNEs and the second including all firms. In terms of total tax revenue, the European Commission estimates that there will be a small decrease (0.08 per cent of GDP for the EU-28 as a whole). This is due to a fall in corporate tax revenues, largely offset by an increase in revenues from other taxes.

The alternative approach, as used in this paper, puts more emphasis on static comparisons, using comprehensive firm-level data to estimate the impact on tax bases for each country had it used the CCCTB in a previous period. These estimates are then compared with the actual tax bases observed during the period under study. A number of studies have used this methodology in order to assess the impact of formulary apportionment, and it important to mention that their different results depend on the factors used and weights chosen. For example, Mintz and Smart (2004) find that apportionment between Canadian provinces results in less profit shifting. Clausing (2016) investigates formulary apportionment in the United States and suggests that it is unlikely to generate significant changes in economic activity. Cobham and Loretz (2014) use the Orbis database of company balance sheets and find that apportioning profits according to measures of actual economic activity would result in a major redistribution of the tax base at the expense of a particular group of jurisdictions, and that international loss consolidation as proposed under the CCCTB could reduce the overall tax base by about 12 per cent.

For Europe, examples of studies with findings of revenue effects for various apportionment formulas include Fuest, Hemmelgarn and Ramb (2007), Devereux and Loretz (2008), Nerudová, Solilová and Dobranschi (2016) and Nerudová and Solilová (2019). Furthermore, Nerudová and Solilová (2019) take into account the behaviour of the firms that can join the CCCTB voluntarily. They estimate that for the group of large firms above the set threshold of €750 million of consolidated turnover, which would require entry into the CCCTB system, the implementation of CCCTB would result in a relatively high decrease in the total corporate income tax base in the EU of 4.2 per cent in comparison with the current situation (mainly identified due to the cross-border loss offsetting during the consolidation regime, which many EU member states do not currently allow, as discussed by Nerudová and Solilová, (2019: 165)). The corresponding decreases for a group of large firms not meeting the threshold is 16.4 to 26.8 per cent and for small and medium enterprises is 46.0 to 58.6 per cent. In contrast to all of these studies, we use a more recent data set with a longer time series. Whereas Devereux and Loretz (2008) naturally evaluated the earlier CCCTB proposal with the best data available then and the latest study of Nerudová and Solilová (2019) uses 2014 data, in this paper we use the Orbis data for years between 2007 and 2015.

The analyses cited are subject to criticism that they do not sufficiently take into account the behavioural dynamics that would follow from the announcement of a major change in tax policy, and therefore lack evidence at the starting point for policy changes that may affect the ultimate equilibrium. Relative certainty of these findings may however be preferable to the highly uncertain equilibrium analysis promised by CGE modelling. A major additional problem with any results based on firm-level data is the quality and coverage of those data, which we discuss below.

3. Methodology

To simulate the effects of the CCCTB, we use a modified version of the approach taken by Devereux and Loretz (2008) and Cobham and Loretz (2014), who have simulated the effects of formula apportionment on corporate tax revenues in the EU and worldwide, respectively. Our approach is also similar to that of Nerudová and Solilová (2019) and other similar studies, but, in contrast, does not aim to model changes in the behaviour of the economic subjects such as those in a reaction to the CCCTB implementation. We use firm-level data from the Orbis database as follows. First, for each country we estimate a sum of positive profits under separate accounting (i.e. specification 1). Second, for each country we estimate a sum of profits and losses after the profit and loss consolidation (i.e. specification 2). Third, for each country we estimate a sum of profits and losses under unitary taxation (after the profit and loss consolidation at the MNE level and their apportionment according to formula on the basis of economic activity) (i.e. specification 3).

In the results section we present three sets of results: specification 2 relative to specification 1 (baseline results for the loss consolidation – percentage change relative to sum of positive profits); specification 3 relative to specification 2 (baseline results for the so-called CCCTB apportionment formula – percentage change under unitary taxation relative to the sum of firm-level, loss-consolidated, positive profits); and specification 3 relative to specification 1 (baseline results for the so-called CCCTB apportionment formula – percentage change under unitary taxation relative to the sum of positive profits). The first two sets of results shed light on the intermediate steps of consolidation and apportionment, but we consider the final, third set of results of the overall effects of the CCCTB to be the most important ones.

We now describe in detail some of the important aspects of the simulation. In describing our methodological approach to simulating the effects of the CCCTB, we first focus on the profit and loss consolidation within the corporate groups and only then investigate a number of ways of how the consolidated tax base can be apportioned among countries according to economic activity and compare the simulation results of various scenarios. After each unit of an MNE group residing

within the EU computes its profits and losses according to the harmonized common tax rules, the profits and losses of all these units are added together and consolidated at the level of the group's parent. Perhaps the most complicated aspect of the envisaged consolidation is that it includes not only profits but also any losses. We deal with the consolidation of losses within the MNE groups in a similar way to Cobham and Loretz (2014), and we draw on their description below. Under the current system of separate accounting (SA), the taxable income and tax liabilities of an individual firm j in country i need to be adjusted to reflect the loss carry forward and the asymmetric treatment of profit (π) and losses. With t denoting the taxable year and $\lambda_{ij,t-1}$ the losses brought forward into the period, one can rewrite the taxable income and the loss carry forward of the current period as

$$\pi_{ij,t}^{SA} = \max\left(0, \left(\pi_{i,j,t} + \lambda_{ij,t-1}^{SA}\right)\right) \text{ and } \lambda_{ij,t}^{SA} = \min\left(0, \left(\pi_{i.j.t} + \lambda_{ij,t-1}^{SA}\right)\right) \quad (1)$$

which can then be aggregated to the total taxable profit (for all units of an MNE across all countries N) under separate accounting as:

$$\Pi_{j,t}^{SA} = \sum_{i=1}^{Njt} \pi_{ij,t}^{SA}$$

Under a unitary taxation (UT) approach, losses in individual countries will be immediately offset against profits elsewhere, and losses will be carried forward or carried back only at the corporate group level. Hence the profit (Π) and the loss carry forward (Λ) will be

$$\Pi_{j,t}^{UT} = \max\left(0, \left(\Pi_{j,t}^{UT} + \Lambda_{j,t-1}^{UT}\right)\right) \text{ and } \Lambda_{j,t}^{UT} = \min\left(0, \left(\Pi_{j,t-1} + \Lambda_{j,t-1}^{UT}\right)\right) \quad (2)$$

To simulate the tax base effect of a move to unitary taxation with formula apportionment, we need information about the tax base under separate accounting ($\Pi_{j,t}^{SA}$), the tax base under unitary taxation ($\Pi_{j,t}^{UT}$) and the apportionment factors (θ_{ijX}) that are chosen by the policymaker. The simplest way to measure the tax base is to use profit and loss before tax as reported in company accounts. In order to account for the possibility of domestic loss consolidation and loss carry forwards, we aggregate profit and loss before tax at the country-firm level and carry the losses forward to be set off against future profits, as in equation (1). Similarly, we aggregate profit and loss before tax at the firm level and carry remaining losses forward, as in equation (2).

In section 5 we present baseline results in what we call the CCCTB scenario with the European Commission-proposed formula, which combines weighted indicators of sales, tangible assets and employment (which consists of wage costs and number of employees) (θ_{ijX}). For the estimated simulations, we present the results of the loss consolidation as the percentage change relative to the sum of positive profits (a sum of positive profits seems a more suitable comparator for

this purpose than a sum of profits and losses). We present the results of the CCCTB apportionment formula as a percentage change relative to a sum of firm-level, loss-consolidated, positive profits and, separately, relative to a sum of positive profits. These two comparators make it possible to disentangle the effects of consolidation and formula apportionment. As a next step we focus on various apportionment formulas, a choice of which has been found to be of vital importance by Devereux and Loretz (2008). Specifically, we explore the effects of varying the longstanding proposal for formulary apportionment under the CCCTB by considering the Canadian formula (weighted indicators of turnover and payroll, according to the formulary apportionment applied in Canada); and turnover (or sales) only.

In this manner, we are able to address some important aspects of the CCCTB proposals, but not all of them. We do address loss offsetting between member states, which turns out to have important revenue consequences, and a variety of apportionment formulas. We study the effects of varying the longstanding proposal for formulary apportionment under the CCCTB, which combines weighted indicators of sales, tangible assets and employment – for example, by considering the Canadian formula (a combination of wages and sales). We also discuss some of the caveats regarding the quality and coverage of the data that do not enable us to provide a full assessment of three specific aspects of the policy proposal. First, we are not able to study in detail the firm group structure and membership. For example, the analysis does not explore the effects of varying the current proposal that an entity be considered part of a group if the group holds more than 50 per cent of voting rights and 75 per cent capital ownership of profit distribution – for example, to 10 per cent thresholds in each case. Second, the analysis does not explore the effects of varying the current proposal that an entity be included in CCCTB if it has annual global turnover of €750 million or more (thus implicitly assuming that the proposal is either mandatory for all MNEs or that all MNEs voluntarily opt in), whereas, for example, Nerudová and Solilová (2019) deal with this aspect in more detail and explicitly model the behaviour of MNEs that can enter the CCCTB voluntarily. Relatedly, a recent research paper by the European Commission's researchers (Barrios et al., 2020) exploit recently released unique survey data designed to provide comparable information on corporate tax compliance costs in order to assess the impact of the CCCTB. Their results suggest that the reduction in tax compliance costs would be associated with greater economic efficiency. Third, we only partially estimate the effects of intra- versus extra-EU application, i.e. the effects of considering apportionment purely within the EU, or globally. In the baseline results, we simulate the CCCTB only within the EU, given the current proposal and the characteristics of our EU-focused data, but we explore the effects of considering apportionment globally using other data sources. Future research should explore these aspects of the CCCTB proposals question, subject to data limitations.

4. Data

We use the largest commercially available database of company balance sheets, Orbis, provided by Bureau van Dijk. This is the same data source as that used by Cobham and Loretz (2014) but with different country coverage and periods. Whereas Cobham and Loretz (2014) use information on all firms worldwide from 2003 to 2011, in this paper we use only data for firms with an EU presence – headquartered both within and outside the EU (Clausing, 2018) – for years between 2007 and 2015. This means the sample includes companies from the 28 members of the EU (as of 2018, i.e. including the United Kingdom). This matches the coverage adopted by Devereux and Loretz (2008), whom we follow by using only individual unconsolidated accounts and aggregating them to obtain the country-by-country information. We focus only on multinational groups, defined as corporate groups that own at least one subsidiary in a different country.[1] Our data set includes all EU-located, majority-owned subsidiaries of a global owner (i.e. with ownership shares above 50 per cent). For each company, we have information on the company's country location and the location of its global owner. We exclude companies for which this information is not available.

In total, the sample of firms includes up to 34,266 individual corporate entities, which consolidate in up to 19,223 groups. Table A1 in the Appendix shows the distribution of these firms and their ownership across countries and regions. The companies reside in the 28 EU member countries, and the global ultimate owners are based in 147 countries and territories, which we list according to regional groupings (with the exception of the EU), instead of a country-by-country table because of the large size.[2] We use a time window of nine years, from 2007 to 2015. The data are pooled, and the estimations thus reflect all nine years. For some companies, not all the necessary information is available for each year. To maximize the coverage, we calculate the resulting tax base allocation for each apportionment formula separately, which results in different sample sizes for each of the formulas.

Table 1 reports the basic statistics for the profit measure (all values, both positive and negative), the apportionment factors and the other indicators of economic activity (only including observations with non-negative values). This is in line with Cobham and Loretz (2014), who drop all observations with negative values for the apportionment factors (i.e. with the exception of profits).

[1] We also retain only MNEs for which we have information for at least two companies, which implies dropping about 14 per cent of the observations for companies for which we have identified a foreign global owner but insufficient additional data.

[2] We use the World Bank classifications (as of July 2015) to divide both companies' and their global owners' countries into regions and income groups.

For each apportionment formula, only observations with available data are used in the estimation and shown in the results tables in the next section. Hence, we apply this logic for table 1, where we show information for all observations with available data. For most factors, we have the necessary information for between 10,000 and 20,000 distinct companies and between 5,000 and 10,000 groups. For payroll and EBIT (earnings before interest and taxes), the number of companies with available data is relatively low. For eight economic indicators, table A2 reports the mean values by the firm's country as well as number of firms in a given country. From the latter we see that in some countries, such as Cyprus and Lithuania, not many firms are available. Furthermore, for some countries, the availability of firm data is very low for some of the relevant variables, and we are therefore not able to show some of the results for some additional countries, such as Greece. The core of our analysis is based on the Orbis data for firms located in the EU.

Table 1. Descriptive statistics, observations for 2007–2015

Variable	Obs.	Mean	S.D.	Min	Max	Distinct companies	Distinct groups
P&L before taxes	174,619	10,078	228,680	-19,269,866	21,947,531	17,582	9,027
Turnover	146,177	132,872	1,017,437	0	73,854,761	14,781	7,655
Tangible assets	215,509	15,156	229,662	0	37,729,781	21,684	11,655
Total assets	224,754	443,502	7,568,782	0	729,167,703	22,613	12,153
Payroll	104,275	15,960	67,408	0	2,875,082	10,592	5,268
No. of employees	126,950	244	1,769	1	182,865	12,923	6,515
Taxation	115,033	2,209	17,370	0	1,615,343	11,556	6,256
EBIT	88,939	14,082	157,251	0	15,616,509	8,974	4,575

Source: Authors' calculations based on the Orbis data.

Note: All values except number of employees and the number of companies and groups are in thousand US dollars. All observations are included for profit/loss before taxes; for other variables, only observations with non-negative values are included.

This is the best available global data set, although it does suffer from some shortcomings, such as the selection bias described by, for example, by Cobham and Loretz (2014), Kalemli-Ozcan et al. (2015), Jones et al. (2018), Bajgar et al. (2018) and Garcia-Bernardo et al. (2021). Even some European countries often considered to be tax havens, such as Luxembourg (Zucman, 2014) or Malta, seem to be relatively poorly represented in the sample, and there are hardly any firms for Cyprus. For some countries, only a limited number of firms are available in the data: Croatia, Hungary, Latvia, Luxembourg and the Netherlands, for example (countries with less than 50 firms, highlighted with an asterisk in table 2).

This poor coverage of some tax havens in particular can have implications for our analysis, such as not showing the full scale of a likely redistribution of the tax base or pointing the other way for some countries, but we are not able to quantify these effects owing to the very limitations of the data.

The issue of Orbis's poor country coverage is of course of even higher concern beyond Europe. When we or others use the Orbis data to investigate the impact of extending the approach worldwide, for example through controlled foreign corporation (CFC) rules, one needs to be much more cautious, as a recent comparison of Orbis with other data sets and across regions shows (Garcia-Bernardo et al., 2021). This also provides the case for country-by-country reporting data as a promising alternative to Orbis in the future. In addition, Tørsløv et al. (2020) show that some MNEs' profits are not included in the Orbis data and that the coverage is severely limited among developing countries.

5. Results

We show the main results in table 2. The results of simulating the loss consolidation using our data for the firms located in the EU are presented in the second (consolidation) column of table 2. Overall, the simulation results suggest that as a consequence of the loss consolidation the sum of positive profits would decrease by 21 per cent (according to our sample for the EU as a whole from a total of almost €1,000 billion to less than €800 billion). This is higher than some recent results. For example, Cobham and Loretz (2014) find that international loss consolidation, facilitated by a global switch to unitary taxation, would reduce the overall corporate income tax base by about 12 per cent. As is clear from table 2, there is substantial heterogeneity among the countries, which is in line with Cobham and Loretz (2014). The simulation results enable a simple comparison of allowing and disallowing loss offsetting between the EU member states. For some countries, including Austria, the Netherlands and Luxembourg, the estimations suggest that the decrease in the corporate tax base due to the loss consolidation would be in the region of 50 per cent. In contrast, for some smaller countries – such as Malta, Estonia and Slovenia – the estimations suggest that tax bases would be increased by loss consolidation. Overall, on the basis of the presented estimates, we conclude that loss consolidation would likely result in significant reductions in corporate tax bases for the EU. If this policy step were introduced on its own, it seems highly unlikely that it would generate substantial benefits for governments, businesses or other stakeholders (such as companies having lower compliance costs and lower risks of double taxation, or other potential benefits that we do not explicitly consider here) as compared with these estimated costs in terms of tax revenue.

Table 2. Baseline results (Percentage change)

Country	CCCTB relative to status quo (A relative to C)	Consolidation only relative to status quo (B relative to A)	CCCTB formula relative to consolidated (C relative to B)	Canada formula relative to consolidated (C relative to B)	Turnover formula relative to consolidated (C relative to B)
Austria	-59	-59	-1	-25	-33
Belgium	-36	-30	-8	22	33
Bulgaria	71	45	17	1	45
Croatia*	53	65	-7	-39	-86
Czechia	-7	32	-29	-25	20
Denmark	-14	31	-34	0	14
Estonia	-4	144	-61	-32	-55
Finland	8	-8	17	28	0
France	-25	-24	-2	22	2
Germany	-32	-37	9	17	42
Hungary*	-49	-24	-33	13	-63
Ireland	-38	-38	1	-12	8
Italy	27	4	22	25	23
Latvia*	-43	-43	0	0	-56
Luxembourg*	-55	-45	-19	-50	-8
Malta*	-90	475	-98	29	-27
Netherlands*	-51	-58	17	-16	-53
Poland	-23	-7	-17	-11	-7
Portugal	2	39	-27	-53	-55
Romania	0	30	-23	-49	-44
Slovakia	-23	22	-37	-59	-37
Slovenia	-14	126	-62	-65	12
Spain	-21	-30	12	6	8
Sweden	-9	20	-24	-15	14
United Kingdom	-24	-34	15	6	18
Total	-21	-21	0	0	0

Note: Only a limited number of firms are available in the data. Owing to the very limitations of the data, we are not able to quantify the implications of these limitations, other than that this poor coverage of some tax havens in particular can have implications for our results, such as not showing the full scale of a likely redistribution of tax base or pointing the other way for some countries. The extreme case of Malta is one example of an estimate based on a limited number of firms (see also figures 3, 4 and 5). The at times contradictory results presented in this paper are somewhat consistent with other research that suggests that Malta is both a secrecy jurisdiction (Cobham, Janský and Meinzer, 2015) and a country vulnerable to international corporate tax avoidance (Cobham and Janský, 2018).

* Countries with fewer than 50 firms.

A = sum of positive profits.

B = sum of firm-level loss-consolidated positive profits.

C = CCCTB apportionment formula – under unitary taxation.

For consolidated losses, following an appropriately modified version of Cobham and Loretz (2014) as the baseline model, we provide estimations for a number of specific policy scenarios. In the main estimation results we compare the country-level results against the baseline results and the simulated tax bases following the loss consolidation. We start by investigating what we call the CCCTB scenario, in which the apportionment formula follows the current European Commission proposal. The results of simulating this using our data for the firms located in the EU are presented in the third (CCCTB formula) column of table 2. The table shows the percentage change under unitary taxation relative to the sum of firm-level, loss-consolidated, positive profits. According to the estimates presented, a diverse group of smaller countries (including Czechia, Portugal and Sweden) might expect their corporate tax bases to shrink by about one third, and others (Malta, Slovenia and Estonia) by more than half in terms of their loss-consolidated tax base due to formulary apportionment in the CCCTB scenario. With the exception of France, for which we estimate the CCCTB formulary apportionment to have a negligible effect, all the other big Western European countries seem to gain with the loss-consolidated tax base. If the tax bases were apportioned according to the three-part CCCTB formula, the tax bases of Germany, Spain, the United Kingdom and Italy would all increase by about 10–20 per cent. Although these percentage gains are not that high, the fact that they occur in these big economies means that in terms of number of countries, most EU member states might expect their tax bases to decline following this apportionment. These findings fit well with the hypothesis by Wasserfallen (2014) that low-tax countries are more likely than high-tax countries to oppose the pooling of tax authority.

The first (CCCTB) column of table 2 shows the percentage change under unitary taxation relative to the sum of positive profits (i.e. the status quo and before any loss consolidation, in order to see the pure realignment effect, independent of the impact of loss consolidation). These results highlight that aligning profits (and hence the tax base) with the location of real economic activity, as the CCCTB envisages, would result in a very substantial redistribution of tax base among member states, at the expense of those members positioned aggressively as profit-shifting hubs and to the benefit of others.

We now compare three scenarios that differ by apportionment formula only: CCCTB (one-third tangible assets, one-third turnover, one-sixth payroll, one-sixth number of employees), Canada (one-half turnover, one-half payroll) and turnover. The first, fourth and fifth columns of table 2 show results for these three formulas, with country-level estimates of percentage change under unitary taxation relative to the sum of firm-level, loss-consolidated, positive profits. For some countries, the estimates from the three formulas point in the same direction of either shrinking or expanding the corporate tax bases and often the estimates are of quite

similar magnitude, as in Italy or Estonia. For other countries, the apportionment formulas produce notable differences. Germany's corporate tax base would increase by 9 per cent, 17 per cent or 42 per cent, depending on whether profits were apportioned according to the CCCTB, Canada or Turnover formula, respectively. According to the estimates, Slovenia, Czechia and Sweden should expect their corporate tax base to decrease under the CCCTB and Canada apportionment but to increase if the profits were apportioned on the basis of turnover. Of course, these kind of distributional differences, discussed in studies such as Devereux and Loretz (2008), might make the choice of the apportionment formula a political question.

6. Conclusions and policy recommendations

The European Commission's proposed CCCTB has been much discussed and analysed for more than a decade. The explicit unitary treatment of MNEs had been considered somewhat controversial, despite the economic logic of the approach and its successful use for corporate tax within a range of countries from Switzerland to the United States. Now, however, there is a growing interest in introducing one form or another of unitary taxation, as partly done by the OECD/G20 Inclusive Framework's first pillar proposal for countries at all levels of per capita incomes (OECD 2020). European policymakers are actively considering the introduction of the CCCTB, or an alternative without full consolidation (the CCTB).

This paper presents a new analysis of the likely impact on EU member states' MNE corporate tax bases, for a range of scenarios. Overall, we find that aligning profits (and hence tax base) with the location of real economic activity, as the CCCTB envisages, would result in a very substantial redistribution of tax base among member states – at the expense of those members that are positioned aggressively as profit-shifting hubs. Adopting a formula for profit apportionment based on sales and employment seems preferable for various reasons (although any formula is bound to create new opportunities for tax avoidance). However, allowing the cross-border transfer of losses could lead to a potentially dramatic reduction in tax base across the EU as a whole – especially if this is done separately from the introduction of a unitary approach, or if consolidation is not envisaged at the global level but rather at the EU level (since the latter would leave profit shifting out of the EU untouched). As a consequence, the EU should consider recasting the CCCTB as a worldwide approach by incorporating full-inclusion CFC rules (and ensuring that adoption of the Anti-Tax Avoidance Directive does not conflict with doing so).

In our paper, we show that an application of the CCCTB proposals at only the EU level would overlook the extent of profit shifting out of the EU and could lock in further unnecessary revenue losses. In addition, it is obvious that this would not directly help developing countries despite the fact that, in comparison with

developed countries such as the EU member states, developing countries lose more tax revenue due to profit shifting by MNEs relative to GDP (Crivelli et al., 2016). This makes relevant any unitary tax proposals that include developing countries, such as those unitary taxation aspects of the OECD/G20 Inclusive Framework's first pillar proposal for countries at all levels of per capita incomes (OECD, 2020).

On the basis of our analysis, we offer the following policy recommendations. First, extending the approach to a worldwide system, for example through full inclusion of CFC rules, would simultaneously deal with profit shifting within and outside the EU. This appears to offer the best prospect for revenue-positive, welfare-enhancing reform. On the basis of the estimates presented, we argue that loss consolidation would result in significant declines in corporate tax bases across the EU – likely with no correspondingly large benefit, if countries did not switch to unitary taxation and formula apportionment. The revenue impact of loss consolidation, if introduced as a separate step, would be dramatic and immediate; any possible gains would be gradual and quite likely small in comparison.

Second, we further argue that locking in current EU member losses to the rest of the world – or expecting to continue the current exploitation of the rest of the world by some other member states, such as the three misalignment jurisdictions of Ireland, Luxembourg and the Netherlands – does not make good sense. In addition, there is a need to agree a timetable at the outset for a fully global application of the unitary approach (e.g. through full-inclusion CFC rules).

Last, but not least, our findings also add further weight to previous conclusions, that none of the public data sets provide a suitable basis to assess the proposal – and that the Orbis data set in particular is systematically likely to understate both the extent of MNEs' profit shifting, and of the redistributive potential of unitary approaches. We conclude that, to eliminate all uncertainty about the data quality underlying static findings, before committing to global application of unitary taxation, the European Commission should prepare a study on the basis of country-by-country data (possibly those collected under the OECD framework, although they are limited by the reporting threshold of €750 million in turnover). As OECD country-by-country reporting is currently available privately to EU tax authorities, an immediate priority should be to collate these data and provide precise assessments of the range of policy scenarios. Committing to such a major policy reform without using this available data resource is unnecessary and would be gravely irresponsible.

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Appendix

Table 1A. Number of firms in MNE groups by location of firms and owner country groups

Group headquarters country	Subsidiary location								
	EU	East Asia Pacific	Other Europe and Central Asia	Latin America and Caribbean	Middle East and North Africa	North America	South Asia	Sub-Saharan Africa	Total
Austria	738	31	185	30	17	103	2	2	1,108
Belgium	1,033	47	33	28	8	143	7	4	1,303
Bulgaria	301	9	60	68	11	43	0	16	508
Croatia	58	0	9	2	1	4	0	0	74
Cyprus	23	0	9	9	3	1	2	3	50
Czechia	733	32	134	39	11	74	0	26	1,049
Denmark	936	80	181	29	25	157	4	7	1,419
Estonia	229	4	38	21	2	19	0	1	314
Finland	336	12	27	1	0	32	1	1	410
France	1,632	116	185	52	66	450	11	6	2,518
Germany	2,436	302	681	116	62	659	36	11	4,303
Greece	95	3	9	3	2	18	0	1	131
Hungary	35	0	5	0	0	1	0	1	42
Ireland	459	38	18	51	3	275	3	5	852
Italy	1,360	92	345	67	29	259	13	10	2,175
Latvia	228	7	114	17	5	16	2	3	392
Lithuania	46	0	7	0	0	4	0	0	57
Luxembourg	625	25	59	85	13	152	3	4	966
Malta	352	12	29	25	8	31	1	2	460
Netherlands	1,798	199	157	253	61	818	31	12	3,329
Poland	989	32	67	21	14	132	1	12	1,268
Portugal	558	18	39	47	11	104	1	29	807
Romania	1,036	14	118	35	84	59	2	13	1,361
Slovakia	340	5	24	4	1	21	0	1	396
Sloveniwa	60	3	7	2	3	6	0	0	81
Spain	1,195	74	96	80	21	251	13	6	1,736
Sweden	1,033	44	274	23	8	165	5	5	1,557
United Kingdom	2,123	540	334	380	95	1996	64	68	5,600
Total	20,787	1,739	3,244	1,488	564	5,993	202	249	34,266

Source: Authors' calculations based on Orbis data.

Table 2A. Mean values by firm's country, observations for 2007–2015

	Number of firms	P&L before taxes (US$ thousand)	Turnover (US$ thousand)	Tangible assets (US$ thousand)	Total assets (US$ thousand)	Payroll (US$ thousand)	Number of employees	Taxation (US$ thousand)	EBIT (US$ thousand)
Austria	9,972	21,641	127,287	6,322	428,608	18,635	201	1,995	3,668
Belgium	11,727	12,811	274,637	15,400	406,170	21,071	237	1,288	5,607
Bulgaria	4,572	2,544	36,398	13,527	113,521	2,178	161	179	1,348
Croatia	666	3,049	63,552	30,872	143,068	7,040	325	414	3,420
Cyprus	450	53,296	158,636	11,304	1,446,013		152	1,381	64,340
Czechia	9,441	4,793	61,044	14,910	89,257	6,365	318	621	3,109
Denmark	12,771	3,827	109,636	7,451	229,114	11,570	133	101	669
Estonia	2,826	1,189	16,874	4,479	19,869	1,379	117	136	765
Finland	3,690	4,232	113,430	18,243	233,352	17,160	325	2,420	4,122
France	22,662	7,312	126,111	10,711	458,731	15,951	215	-324	2,240
Germany	38,727	17,140	263,987	10,783	434,825	29,048	310	3,934	5,252
Greece	1,179	744	114,966	34,882	231,098		350	1,879	4,563
Hungary	369	9,280	78,023	27,710	156,578	9,682	460	746	1,294
Ireland	7,668	11,696	126,162	32,187	608,185	16,112	153	1,310	12,872
Italy	19,575	-2,863	171,104	23,409	886,819	22,111	468	1,781	2,916
Latvia	3,528	540	9,876	2,775	21,309	1,003	66	24	496
Lithuania	513	1,974	40,420	7,918	52,313		123	398	2,069
Luxembourg	8,694	37,294	66,582	3,366	1,274,457	5,894	165	863	14,903
Malta	4,140	9,284	88,478	5,934	160,274	4,313	133	2,101	7,633
Netherlands	29,961	90,756	160,371	23,732	908,682	10,190	35	27	4,532
Poland	11,412	5,498	112,569	27,733	102,888	7,391	449	1,149	5,904
Portugal	7,263	3,966	54,171	9,049	77,989	7,188	250	1,071	4,207
Romania	12,249	1,802	27,738	17,192	37,000	3,083	143	440	2,313
Slovak Rep.	3,564	5,428	84,910	24,771	88,838	8,259	372	801	3,823
Slovenia	729	4,023	68,453	16,596	70,141	10,293	290	798	3,880
Spain	15,624	6,585	181,825	27,508	845,533	18,840	361	541	5,824
Sweden	14,013	8,351	80,526	9,358	194,066	9,248	106	1,571	3,529
United Kingdom	50,400	8,727	144,407	10,068	321,848	22,209	229	759	3,011
Total	308,385	10,078	132,050	15,153	443,389	15,946	244	1,032	4,026

Source: Authors' calculations based on Orbis data.
Note: All observations are included for profit/loss before taxes; for other variables, only observations with non-negative values are included.

Rapid FDI of emerging-market firms: foreign participation and leapfrogging in the establishment chain*

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Abstract

This research explores the enablers of emerging-market firms (EMFs) leapfrogging in the internationalization process. Although many studies on rapid internationalization focus on exporting activities, we expand the concept to a higher-commitment entry mode: foreign direct investment (FDI). In addition, we investigate the role of an understudied force, foreign multinational enterprises (MNEs) in emerging markets, in enabling rapid internationalization of EMFs. Our hypotheses are tested using 1,612 first-time outward FDI projects from China between 2000 and 2014. The largely supported results suggest that minority foreign ownership and co-location with foreign MNEs allow EMFs to leapfrog certain stages in the establishment chain. Our findings offer alternative explanations, besides the government steward logic, to EMFs' international expansion and contribute to the understanding, from a policy standpoint, that encouraging foreign-local partnerships is conducive to host-country industrial upgrading.

Keywords: Emerging-market multinational enterprises (EMNEs); Rapid FDI; Foreign ownership; Foreign spillovers

JEL classification numbers: F2, F6, O1

* Received: 25 July 2020 – Revised: 16 March 2021 – Accepted: 31 March 2021.

The authors appreciate the financial support from the Rutgers Graduate School – Newark Dissertation Fellowship and the Rutgers Business School Dean's Fund for Summer Research.

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1. Introduction

The antecedents of rapid internationalization remain interesting to international business scholars because a significant portion of rapid internationalization is executed by resource-deficit and experience-scarce firms such as international new ventures, born global firms and, more recently, emerging-market multinational enterprises (EMNEs). In the new millennium, we see more and more emerging-market firms (EMFs), without prior internationalization experiences, penetrate international markets quickly (Chang and Rhee, 2011) and use large-commitment entry modes (Kumar et al., 2020). Nevertheless, the enablers of these rapid movements of EMNEs remain unknown (Hernandez and Guillén, 2018; Ramamurti and Hillemann, 2018).

International entrepreneurship literature argues that rapid internationalization is largely attributed to organizational knowledge intensity (Autio, Sapienza and Almeida, 2000), including technology competencies (McDougall, Shane and Oviatt, 1994), marketing know-how and unique product design (Knight and Cavusgil, 2004). Yet, the antecedents identified in the international entrepreneurship literature cannot fully explain the rapid internationalization of EMNEs. First, the samples dominating the international entrepreneurship studies are developed-country firms instead of EMFs which lack ground-breaking innovation capabilities and managerial expertise (Luo and Tung, 2007, 2018). Second, international entrepreneurship research focuses on exporting activities (Cavusgil and Knight, 2015), and relatively little is known about how firms rapidly become MNEs (Monaghan and Tippmann, 2018).

In this research, we explore the enablers of EMFs' rapid foreign direct investment (FDI). In particular, how and where do EMFs gain knowledge to facilitate their subsequent rapid international expansion? The literature regarding EMNEs argues that EMFs are quick learners and leverage external resources to achieve important goals (Mathews, 2006). In an emerging-market context, foreign multinational enterprises (MNEs) are important sources of resources and knowledge to local firms (Wei and Liu, 2006; Liu et al., 2016). EMFs acquire knowledge from foreign MNEs through international joint venture experiences or involvement in downstream or upstream industry relationships with foreign MNEs. By conducting this research, we learn that EMFs' connections with foreign MNEs at home allow EMFs to leapfrog certain stages in the establishment chain.

The present study makes three contributions to the international business literature. First, we identify an under-explored factor, inward FDI, in explaining EMFs' rapid international expansion. The influence of inward FDI on outward FDI (OFDI) from emerging markets is understudied (Deng, 2012). EMNE literature oftentimes attributes the aggressive expansion of EMNEs to government affiliation (e.g., State ownership) (Wang et al., 2012) or the home country's "go-global" policy (Deng, 2009). By studying the influence of inward FDI, we seek an alternative

explanation to the phenomenon and argue that the internationalization capabilities of EMFs are not just about the home country's institutional support.

Second, this research connects the concept of rapid internationalization to the mainstream international business literature which has a focus on FDI activities. Exporting activities do not require as much resource commitment as FDI does, such that firms can withdraw without losing too much asset specificity. We argue that rapid internationalization of EMNEs is an FDI phenomenon that requires EMFs to have a deeper understanding of the host country to mitigate their liability of foreignness.

Third, we contribute to the understanding of the internationalization process of EMFs. The general conceptualization of rapid internationalization implies a limited temporal perspective with only the time between inception and start of internationalization considered (Chetty, Johanson and Martín, 2014). The current definition of rapid internationalization – (1) within six years after a firm's inception (e.g., McDougall, Shane and Oviatt, 1994; Coviello, 2015; Deng, Jean and Sinkovics, 2017), (2) undertaking FDI projects at an accelerated speed (Chang and Rhee, 2011) and (3) fast transition of the firm towards becoming an MNE (Monaghan and Tippmann, 2018) – discards the central aspects of the internationalization process of firms. In this paper, we focus on the market commitment dimension of the internationalization process to show subsidiary activities in the host country according to the seminal categorization of Johanson and Vahlne (1977). Market commitment is defined as the amount of resources an internationalizing firm devotes to its host country in a particular globalization project (Johanson and Wiedersheim-Paul, 1975). We therefore define rapid internationalization as when, in the early stage of its internationalization, the firm already has high-profile activities such as foreign production and manufacturing in the host country, meaning the firm has leapfrogged low commitment activities such as exporting or the "sales subsidiaries" stage in the establishment chain.

Besides contributing to the international business literature, we also intend to contribute to understanding several international investment policy initiatives, including UNCTAD's Investment Policy Framework for Sustainable Development. In particular, we point out two channels of foreign participation that governments should encourage in investment policies in order to enlarge the host country's development benefits from inward FDI.

The remainder of this paper is structured as follows. Building on the relational perspective of internationalization and the literature on international knowledge diffusion, we propose our hypotheses related to foreign participation in an emerging-market context and EMFs' rapid internationalization. We introduce our data and sample, measurements and regression models in the methodology section, tackling specific issues related to our research design. We then present our statistical results and conclude with our findings. After discussing the theoretical and practical implications, we point out some possible directions for future research.

2. Theory and hypotheses development

External knowledge acquisition has played an important role in the internationalization speed of experience-scarce firms (Oviatt and McDougall, 2005; Casillas and Acedo, 2013). Contemporary literature argues that knowledge acquisition from external sources or vicarious learning (Bingham and Davis, 2012; De Clercq et al., 2012) allows firms to reduce perceived risks and uncertainty in unfamiliar tasks, making firms more likely to pursue international opportunities (Bruneel, Yli-Renko and Clarysse, 2010; Freeman, Edwards and Schroder, 2006; Johanson and Vahlne, 2009; Love, Roper and Zhou, 2010).

Dunning (1998) recognized that the ownership advantage of MNEs could be acquired through both internal and external sources. In the era of alliance capitalism, external transfer, such as through ongoing global-local connection, plays a role in knowledge generation for local firms. External knowledge transfer can be a partial substitute for in-house technological development. This is because both technology and products are becoming more complex, and one firm cannot master all types of relevant technology (Cantwell and Piscitello, 1999). When external knowledge overlaps with the complementary paths of technological development, a firm can take advantage of the knowledge from an external provider and realize rapid development (Prashantham, Zhou and Dhanaraj, 2020; Wiklund and Shepherd, 2003). In addition, when a certain type of technology is standardized and reaches its mature phase, firms are more likely to adopt this readily available technology and free more resources for other innovative activities from an economic standpoint. Furthermore, interfirm agreements for technology transfer generally result in a more focused profile of technological specialization, thus gradually improving firm innovation and financial performance (Wan and Hoskisson, 2003).

These prior studies have highlighted the importance of sourcing knowledge from external sources but seldom specify the sources with which firms should be connecting (Prashantham and Dhanaraj, 2015; Prashantham, Kumar and Bhattacharyya, 2019).

2.1 The nature of EMNEs

EMNEs are documented as an appropriate example of firms acquiring knowledge from external sources. Usually, EMFs are categorized as weak firms in internationalization because of the lack of the proprietary resources and capabilities possessed by large MNEs from advanced economies (Contractor, 2013; Luo and Zhang, 2016). Based on the linkage-leverage-learning model identified by Mathews (2006) and the composition-based view (Luo and Child, 2015; Luo and Bu, 2018), EMFs often leverage knowledge from external sources for internal development. Similarly, Bierly III et al. (2009) argue that technologically

weaker firms or temporal laggards are more likely to take advantage of readily accessible knowledge developed by pioneers. Therefore, an outstanding feature of EMNEs is their asset-seeking behaviour during internationalization (Luo and Tung, 2007). Instead of exploiting existing asset-based and transaction-based advantages, EMFs tend to explore resources and capabilities in the host country (Cui, Meyer and Hu, 2014).

Nevertheless, EMFs' asset-augmenting activities are not limited to the post-internationalization era. Owing to intense competition at home, EMFs are motivated learners before they internationalize. One of the important sources of external knowledge at home is inward FDI (Jin, García and Salomon, 2019). In an emerging-market context, most inward FDI comes from developed countries (UNCTAD, 2015). With the entry of foreign MNEs, a significant amount of knowledge flow is from foreign MNEs to indigenous firms, as these foreign MNEs are at an advantage in terms of technology and managerial know-how and internationalization experiences. Occasionally, EMFs even sacrifice short-term profits and market share to form partnerships with foreign MNEs to ensure knowledge diffusion (Contractor, 2013).

International knowledge diffusion is generally defined as the acquisition of knowledge by indigenous firms because of foreign presence (Keller, 2004). It contains two possible channels: purposeful knowledge transfer and unintentional knowledge spillovers from the knowledge supply side (Acharya and Keller, 2009). Table 1 reviews the two possible channels. Foreign MNEs' influences are categorized into (1) foreign ownership in EMFs and (2) foreign MNEs co-locate with EMFs. Through foreign ownership, EMFs obtain purposeful knowledge transfer from foreign MNEs, whereas, when foreign MNEs co-locate with EMFs, unintentional knowledge spillovers take place.

Table 1. Foreign knowledge diffusion in an emerging-market context

	Foreign ownership in EMFs	Knowledge-intensive foreign MNEs co-locate with EMFs
Channels	• In-house knowledge transfer within the partnership entity (Teece, 1977; Steensma et al., 2005) • External knowledge exchange with foreign partner's parent group (Li and Cantwell, 2012)	• Demonstration (Caves, 1974) • Competition (Xia et al., 2014) • Upstream/downstream industry Linkages (Hertenstein, Sutherland and Anderson, 2017) • Employee mobility (Blomström and Kokko, 1998)
Outcomes	Knowledge transfer to EMFs	Knowledge spillovers to EMFs

Source: Based on the literature on international economics and international business.

2.2 Foreign ownership and rapid FDI of EMFs

To overcome their liability of foreignness in the host country, foreign entrants tend to have more knowledge about international markets as well as cutting-edge technologies. Such knowledge is easier to transfer in the corporate hierarchy than in the arm's-length market owing to the embeddedness of knowledge in organizational routines (Teece, 1977). The traditional international business literature (e.g., Dunning, 1958; Hymer, 1976; Vernon, 1966; Buckley and Casson, 1976) refers to this mechanism as the competence-exploiting motives of MNEs or the international knowledge transfer function of FDI in the host country. MNEs are equipped with technological competencies and are capable of transferring such competencies to their subsidiaries around the globe. Hymer (1976) stated that foreign firms are usually stronger than local firms in technology and managerial skills, so they will be able to use these advantages to offset the liability of foreignness in the host country. Vernon (1966) agreed that MNEs are usually the technology leader in a product line. The argument that foreign firms are competitive is applicable in an emerging-market context where local players are known to lack proprietary knowledge about cutting-edge technologies and international markets (e.g., Mathews, 2006; Madhok and Keyhani, 2012; Peng, 2012; Wang et al., 2014; Yiu, Lau and Bruton, 2007).

Foreign partners share international experiences, as well as managerial and technical knowledge, with indigenous firms (Fernhaber, McDougall and Oviatt, 2007), a bundle of information that is readily available to EMFs before their actual internationalization. Due to the level of detail and frequency in updates, EMFs can borrow such information without engaging in multiple attempts abroad to gain international experience or spend extensive effort developing or adapting technologies to satisfy the foreign market. Learning from foreign partners allows EMFs to leapfrog the initial stage of internationalization and reach a relatively more advanced stage in the internationalization process.

We use a case to illustrate how a prior partnership with foreign MNEs at home increases the likelihood of an EMF's subsequent rapid internationalization. Shanghai Automotive Industry Corporation (SAIC), formed in 1955, is one of the "Big Four" automotive manufacturing companies in China and a Fortune Global 100 company. Compared with other big Chinese automakers (Changan Automobile, FAW Group and Dongfeng Motor Corporation), SAIC has only recently emerged as a prominent player in the Chinese vehicle industry – in the early 2000s. Its recent success, such as owning the largest production volume of any Chinese automaker in 2014, making more than 4.5 million vehicles, is largely attributed to partnering with foreign automakers and creating joint ventures with overseas component suppliers (Ma, Wu and Zhang, 2015). In the 1970s, SAIC was a small automobile assembly factory. However, a cooperative agreement

with Volkswagen and the formal establishment of Shanghai Volkswagen Automotive Co. Ltd. in 1985 made possible the production of competitive cars in the domestic market and increased its capacity tenfold, to 300,000 units a year, using foreign technology. In addition, SAIC's second major international joint venture in 1998, Shanghai General Motors Co. Ltd., allowed a doubling in SAIC's vehicle production between 2000 and 2004 because of a boost in foreign sales.

The Shanghai General Motors Co. Ltd. started to learn about foreign operations in 2002, four years after the inception of the international joint venture (in which General Motors has a 40 per cent equity share). The joint venture participated in General Motors' purchase of Korean automaker Daewoo in 2002. In 2004, Shanghai General Motors Co. Ltd. confirmed a cross-border merger and acquisition deal with SsangYong Motor, an ailing automaker from the Republic of Korea, paying US$500 million for 48.9 per cent ownership and later on 51 per cent. This was the first multinational company formed within SAIC group (China Daily, 2004[1]). This earliest attempt at OFDI is within six years of Shanghai General Motors Co. Ltd.'s inception, complying with the definition of rapid internationalization in Shrader, Oviatt and McDougall (2000). More importantly, Shanghai General Motors Co. Ltd. did not use export or sales subsidiaries before establishing its first international production site. Using established sales channels within Ssang Yong Motor, SAIC's sales revenue in the host country was generated immediately.

Therefore, we hypothesize:

> *H1 EMFs with foreign ownership, compared with purely domestically owned firms, are more likely to engage in rapid FDI.*

2.3 Co-locate with knowledge-intensive foreign MNEs and rapid FDI of EMFs

Although knowledge transfer in international joint ventures is mostly a purposeful behaviour between agreed-upon organizational partners, knowledge spillovers from co-location usually benefit the knowledge recipient, regardless of whether the knowledge provider takes the initiative in such knowledge diffusion. As an actor in a local innovation system, which sometimes depends on geographical proximity to industry clusters, a firm tends to benefit from knowledge spillovers through four mechanisms: demonstration, competition, linkages and employee mobility

[1] China Daily (2004). "SAIC takes on Ssangyong Motors." Archived from the original on 11 October 2012. Retrieved 14 April 2011.

(Blomström and Kokko, 1998; Liu and Buck, 2007; Perri and Peruffo, 2016; Wei and Liu, 2006). Knowledge spillovers occur through formal and informal linkages with other firms in the region and beyond, as well as with local universities and public research agencies, consultants, industry associations, regulatory bodies and training facilities (Amann and Cantwell, 2012). Technology spillovers could lead to an increase in productivity of local firms (Buckley, Clegg and Wang, 2002; Wei and Liu, 2006; Buckley et al., 2010), triggering a cumulative process of knowledge accumulation, especially in high-tech industries (Patibandla and Petersen, 2002).

Knowledge-intensive inward FDI brings more spillovers because of the investing firm's technological leadership position in the industry and knowledge field. Its local embeddedness creates a co-evolution of the knowledge base of local and foreign firms. Cantwell and Smeets (2013) argued that, because of the desirable nature of knowledge development (Kogut and Zander, 1993), the technology leaders who are capable of identifying, assimilating and exploiting knowledge (Cohen and Levinthal, 1989) also tend to seek it. Berry (2006), in contrast, explains that technology-laggard firms are less likely to successfully incorporate acquired knowledge back into the MNE system. Therefore, technology laggard firms are less likely to engage in a competence-creating mandate, which is more costly than a competence-exploiting mandate (Cantwell and Mudambi, 2005) in the host country. Hence, knowledge-seeking FDI is mainly conducted by technology leaders, who have more potential to generate knowledge spillovers into the environment. Tong and Hu (2003) found that foreign firms originating from technologically advanced countries such as Germany and the United States are associated with more productivity spillovers in the host country than those from regions with comparatively low technological competence, such as Hong Kong (China), Macao (China) and Taiwan Province of China.

More importantly, the knowledge-intensive inward FDI requires foreign firms to be locally embedded when seeking knowledge in the host location (Cantwell and Smeets, 2013). To benefit from learning feedback, foreign MNE subsidiaries need to tap into the local knowledge base. This subsequently benefits local firms by giving them exposure to foreign knowledge (Cantwell, 1989). Geographical proximity stimulates face-to-face interactions and expedites knowledge transmission (Jaffe, Trajtenberg and Henderson, 1993), whereas learning and demonstration effects are more effective among agglomerated firms (Driffield and Love, 2007; Thompson, 2002). More local embeddedness generates more spillovers (Beugelsdijk, Smeets and Zwinkels, 2008), an outcome of strategic games between the involved parties, including foreign-invested firms, indigenous firms and host-country governments. Knowledge-intensive FDI and its embeddedness also require MNEs to adapt their technologies to the local environment. This adaptation creates a continuous learning process for both foreign MNEs and local firms.

Accompanied by the gradual localization process, more "learnable" knowledge is available to indigenous firms. Moreover, increasing embeddedness into the host-country environment may broaden the scope and strengthen the intensity of interactions with indigenous firms.

An example of EMFs co-locating with foreign MNEs at home is Fuyao Glass Industry Group Co. Ltd., an automobile component manufacturer founded in 1987. Headquartered in Fuqing City, Fujian Province, Fuyao has purposefully established branches in Changchun (Jilin Province, the traditional Chinese automobile capital) and subsequently in Chongqing, Shanghai and Guangzhou to supply to Volkswagen's international joint ventures in China. These locations are either the traditional Chinese automobile capital or developed into automobile industry clusters after the Open and Reform policy, which attracted a considerable amount of inward FDI in the 1990s. Fuyao has benefited from locating in the automobile clusters not only because of its supply-buyer relationships with the Volkswagen Group and later on with General Motors (GM), but also owing to its collaborations with Volkswagen and GM's international suppliers, such as Compagnie de Saint-Gobain and Pittsburgh Plate Glass, which have followed the global flagship MNEs to China. One of Fuyao's key technologies, the float-glass manufacturing technique, was developed during the company's partnership with Saint-Gobain. The float-glass technique offsets the drawbacks of traditional flat-glass manufacturing by offering perfectly parallel surfaces, a quality standard that most global flagship auto assemblers require. Fuyao also collaborated with Pittsburgh Plate Glass in Shanghai to further advance its float glass manufacturing, transforming Fuyao from a low-cost substitute in China to a high-quality supplier to the global automobile industry.

Close interaction with global flagship companies and their international suppliers in local clusters familiarized Fuyao with the international market preferences and production standards (Hertenstein, Sutherland and Anderson, 2017). Starting in 2007, Fuyao was invited to supply Volkswagen's European plants, involving brands such as Audi and Bentley (Ling, 2008). To serve Volkswagen in a speedy manner, Fuyao acquired FüMoTec in Heidelberg, Germany, which was Fuyao's first OFDI project. Working with global companies located in domestic automobile clusters allows Fuyao to effectively build a knowledge system that fits international standards of the modern automotive component supply chain. Fuyao has successfully evolved into a global player and experienced ongoing international growth without following the incremental internationalization path.

We then hypothesize:

> *H2 EMFs in a region with more knowledge-intensive inward FDI, compared with EMFs from regions with less knowledge-intensive inward FDI, are more likely to engage in rapid FDI.*

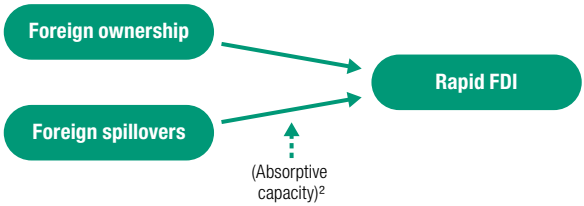
2.4 The moderating role of the absorptive capacity

Cohen and Levinthal (1989) defined absorptive capacity as the fraction of knowledge in the public domain that the firm can assimilate and exploit. It measures the ability to absorb available external knowledge while also determining a firm's ability to incrementally increase its technological knowledge stock through the adaptation and application of outside knowledge.

In the international business scenario, an influx of FDI does not guarantee technological spillovers. The firm-level model of Cohen and Levinthal (1989) show that absorptive capacity matters for organizational learning. Whether FDI facilitates local firms' acquisition of knowledge from foreign firms depends on the ability of local firms to understand the new knowledge introduced by foreign firms and incorporate such knowledge into their organizational routine. In other words, absorptive capacity affects local firms' ability to use MNE subsidiary knowledge and thus increase realized spillovers (Meyer and Sinani, 2009). Klevorick, Nelson and Winter (1995) and Borensztein, Gregorio and Lee (1998) suggested a basic threshold in absorptive capacity, before which FDI does not contribute too much to the innovative capability building of the local industry. Excessively low absorptive capacity thus prevents firms from benefiting from spillovers because of insufficient competencies to internalize foreign knowledge. At the other extreme, the literature on organizational learning and on innovation also suggests that when absorptive capacity is too high, local firms are also prevented from acquiring knowledge from spillovers because they have little to learn from subsidiaries (Girma, 2005; Huang, Liu and Xu, 2012). In general, the relationship between absorptive capacity and learning outcomes is not linear. Figure 1 illustrates our conceptual model.

> *H3 The medium-level absorptive capacity positively moderates the relationship in H2, such that the relationship between foreign spillovers and rapid FDI of EMFs is the most salient when the absorptive capacity of EMFs is neither too high nor too low.*

Figure 1. Conceptual Model



Source: Authors' own interpretative framework.

3. Methodology

3.1 Data and sample

China, an emerging economy, has a dynamic pro-learning environment domestically and has a significant amount of inward FDI since the 1990s. Therefore, foreign knowledge transfer and knowledge spillovers are specifically relevant to our research setting. The research evidence is collected from two data sources: the OFDI directory from the Ministry of Commerce of China and the Annual Report of Industrial Enterprise Statistics (ARIES) from the Chinese Bureau of Statistics.

The OFDI directory documents project-level OFDI activities outside the financial sector (financial sectors include banks, insurance companies and brokerage agencies) from China since 1983. The version available to us ends in 2014. To acquire a clean and comparable sample, we extract the first OFDI project for each Chinese parent firm. This is because more than half the recorded Chinese parent firms do not conduct subsequent OFDI projects after their first attempt. Hence, we use the "first OFDI project" sample to study the degree of host-market commitment for each Chinese parent firm's first OFDI project. The OFDI directory offers the following relevant information: OFDI year, host-country and subsidiary activities. However, the OFDI directory does not provide parent firm-level information such as inception year, ownership structure, company size or performance indicators.

ARIES is a firm-level data set compiled by the Bureau of Statistics of China on the basis of annual surveys of selected manufacturing firms located in China between 1998 and 2013, which supplements parent firm-level information. For the purpose of this research, we allow all the parent firm-level variables from ARIES to have a one-year lag when merging with the OFDI directory, making sure parent firm-level information such as ownership structure and performance indicators are the potential antecedents of OFDI activities. After merging the ARIES and the OFDI directory with a fuzzy match algorithm, which captures firm name match in different versions and typographical errors, we generate 3,437 matched parent firms between the two sources. We then eliminate tax haven cases such as Hong Kong (China), Macao (China), Taiwan Province of China, Bermuda, the British Virgin Islands, Luxembourg and others, which is a common practice for FDI studies (e.g., Sutherland and Anderson, 2015; Shi et al., 2017) because investment in a tax haven is largely foreign portfolio investment and does not involve an actual business operation. The sample size then shrinks to 2,382. In addition, we include only parent firms that are not majority foreign-owned because we are studying EMFs, in which emerging-market players should have majority ownership and control.

Suppose an OFDI project is conducted by a foreign subsidiary whose ultimate owner is the foreign parent. In that case, even if the subsidiary is located in an emerging market, this OFDI project cannot be attributed to the emerging market but to the foreign parent's home country (Cantwell, 1992). The final sample contains 1,612 OFDI projects by 1,612 Chinese parent firms from 2000 to 2014.

We also use data from the Chinese provincial statistic yearbook for inward FDI in relevant industries and years from 1999 and 2013. Each of the 30 provinces maintains a separate yearbook every year. Several province-level control variables also use information from the Chinese provincial statistic yearbook.

3.2 Variables

3.2.1 Dependent variables

Our dependent variable, rapid internationalization, is measured by market commitment (*Production subsidiary = 1; Sales subsidiary = 0*). The degree of host-market commitment emphasizes the state of internationalization. On the basis of documented subsidiary activities in the OFDI directory, we code each OFDI project using the establishment chain categorization of Johanson and Vahlne (1977), namely sales subsidiaries or production subsidiaries. *Sales subsidiaries* exist to supply goods or services to a particular host country or region (Cuervo-Cazurra, Narula and Un, 2015; Dunning, 1993). They can either maintain current market share or explore a new market share. Typical sales subsidiary activities involve facilitating export activities, selling, marketing, conducting market research, maintaining customer and public relations and providing after-sales services. *Production subsidiaries* exist to rationalize the structure of established resource-based or market-seeking investment so that the investment firm can gain from the common governance of geographically dispersed activities (e.g., achieving economies of scale and scope) (Cuervo-Cazurra, Narula and Un, 2015; Dunning, 1993). Production subsidiaries embrace activities such as finishing, assembling, processing, packaging, or establishing full manufacturing and production sites in the host country.

We identify 907 out of the 1,612 subsidiaries that have at least one type of foreign production activity and 644 that are sales subsidiaries, engaging in only sales activities. The other 61 subsidiaries are neither production nor sales subsidiaries, with 30 being natural resource seeking and 31 being strategic asset seeking, which is not the topic of this research and is thus eliminated in this empirical study.

3.2.2 Independent variables

Two variables measure foreign participation in a local market: foreign ownership and foreign spillovers. *Foreign ownership* is a continuous measure between 0 and 0.5. Foreign ownership is a measure of foreign partnership and the possibility of foreign knowledge transfer (Chetty, Johanson and Martín, 2014). The foreign ownership percentage is calculated by the realized foreign capital input to realized total capital input in a given year.

Foreign spillovers are measured as the percentage of inward FDI in knowledge-intensive industries such as pharmaceuticals, automobiles and machinery, and scientific and computer services within a given province of China. Local firms can enjoy the benefits of knowledge spillovers through supplier-buyer relationships, employee mobility and other learning opportunities such as regional trade fairs (Freeman, Edwards and Schroder, 2006).

3.2.3 Moderator

We use a firm's new product revenue ratio to total revenue to measure the firm's innovation capability and thus absorptive capacity. The new product revenue ratio indicates a firm's ability to yield positive outcomes by identifying, assimilating, transforming and applying exogenous knowledge (Xie and Li, 2018; Zhou, Gao and Zhao, 2017).

3.2.4 Control variables

We control for firm-level, industry-level, province-level and host-country-level features. In terms of firm level, we control for factors that are identified in the literature as organizational capability enablers of rapid internationalization, including *export intensity* (Ciravegna, Majano and Zhan, 2014), *profit ratio* (Mohr and Batsakis, 2018), *firm size* (Teixeira and Coimbra, 2014) and *state ownership* (Meyer et al., 2014).

Industry features may affect the speed of internationalization (Autio, Sapienza and Almeida, 2000; Chang and Rhee, 2011). For example, the high-tech industry operates in time-compressed economies; therefore, firms in the industry tend to expand faster than those in other industries to obtain first-mover advantages and keep up with technology trends. The industry-level controls include industry categories: *energy, food, textile, furniture, equipment* and *chemistry*. We have five dummy variables for these six industry categories. The categorization is based on the one-digit general category of the Chinese Industrial Classification for National Economic Activities (CICNEA).

We also include other contextual variables identified in Teixeira and Coimbra (2014) at the province level: *province ID*, which will be used as a group identifier in the

hierarchical linear modelling (HLM). *Province GDP* proxies the general business development level of a given province. Host-country features also have been recognized as enablers of rapid internationalization, including *host-country GDP per capita*, which in general measures production cost and market size of the host economy (Chen and Yeh, 2012) while *host-country political stability* measures the institutional risk in the host country for FDI (Shrader, Oviatt and McDougall, 2000).

3.3 Analytic strategy

Since one of our key independent variables, *foreign spillovers*, is at the province level while other variables are at the firm level, our sample is nested in nature. Therefore, we apply HLM to test our hypotheses. When analyzing province-level variance in firm-level outcomes, HLM gives precise estimates because it accounts for within-group and between-group variance simultaneously (Raudenbush and Bryk, 2002). We use mixed-effects logit regression since our dependent variable *(production subsidiary)* is binary. We follow the sequential steps in multilevel testing. First, we run null models with no predictors for our dependent variable, which tests for significant between-province variance in the dependent variables. Second, we introduce firm-level control variables. We add firm-level independent variables last. To reduce potential multicollinearity problems in HLM, we choose grand mean centering from the HLM centering options.

4. Results

Table 2 presents descriptive statistics and a correlation matrix describing the key variables and their interrelationships. From the correlation matrix, we did not find a high correlation with independent variables; yet, some control variables show high variance inflation factor scores. We adjust the model accordingly after eliminating those variables. Across different models, the highest variance inflation factor is 7.94, below the rule of thumb threshold of 10.

Table 3 reports results on the mixed-effects logit regression. We use *production subsidiary* as the dependent variable and find support for *foreign ownership* and *foreign spillovers* (H1 and H2 are supported). The control variables *province GDP* and *firm size* are eliminated from the models as they introduce a multicollinearity issue. The coefficient of foreign ownership is 1.4, with the significance level at 0.05, across different models. The coefficient of foreign spillovers is 6.6, also with the significance level at 0.05. The results are based on 1,293 observations across 30 provinces.

We did not find support for the moderating effect (H3 is not supported), suggesting that the level of absorptive capacity does not alter the relationship in H2. Neither the term nor the square term of absorptive capacity is significant in model 3 or model 4.

Table 2. Correlation matrix

	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Production Subsidiary	0,56	0,50	0	1	1															
2 Foreign ownership	0,02	0,09	0	0,50	0,0272	1														
3 Foreign spillovers	0,05	0,06	0,00	0,26	0.1021*	0,0035	1													
4 Absorptive capacity	0,11	0,24	0	1	-0,0193	0,0277	-0,0353	1												
5 Export intensity	0,23	0,34	0	1	-0.1473*	0.0873*	-0.2414*	0.0717*	1											
6 Profit ratio	0,05	0,13	-2,12	0,76	-0,0040	0,0019	0,0035	0,0292	-0.0583*	1										
7 log (firm size)	5,73	1,49	0	11,97	-0,0440	0.0570*	-0.0791*	0.1891*	0,0556	0.0856*	1									
8 State ownership	0,10	0,30	0	1	0.0803*	-0,0223	0,0316	0.1027*	-0.1154*	0,0467	0.2910*	1								
9 Energy	0,02	0,13	0	1	-0,0264	-0,0223	0,0310	-0,0268	-0.0714*	0,0335	0.1776*	0.2436*	1							
10 Food	0,05	0,21	0	1	0,0056	-0,0164	0,0460	-0.0537*	0.0586*	-0,0273	-0.0680*	-0.0718*	-0,0290	1						
11 Textile	0,33	0,47	0	1	-0.0848*	0.0893*	-0.0595*	-0.0922*	0.1746*	-0,0474	-0,0016	-0.1119*	-0.0934*	-0.1531*	1					
12 Furniture	0,04	0,20	0	1	0,0458	0,0097	-0,0224	-0.0661*	-0,0432	-0,0207	-0.0587*	-0,0164	-0,0277	-0,0454	-0.1464*	1				
13 Equipment	0,39	0,49	0	1	0.0548*	-0,0371	0,0207	0.1462*	-0,0103	0,0401	0,0364	0,0160	-0.1058*	-0.1733*	-0.5593*	-0.1657*	1			
14 log (Province gdp)	9,42	0,68	5,93	10,58	-0,0193	0.0577*	0.3744*	-0.0945*	-0.1379*	0.1050*	-0.0565*	-0.1959*	-0.0859*	-0,0061	0,0422	-0,0447	0.0582*	1		
15 log (Host GDP percapita)	9,45	1,60	5,27	11,48	-0.1466*	0.0548*	0.1641*	0,0297	0,0260	0.0847*	-0,0048	-0,0328	-0,0391	0.0615*	-0,0053	-0,0106	-0,0054	0.2568*	1	
16 log (Host political stability)	0,13	0,85	-2,81	1,50	-0.1238*	0,0325	0.1161*	0,0164	0,0231	0.0714*	-0,0233	-0,0143	-0,0289	0.0590*	-0,0049	-0.0625*	-0,0211	0.1631*	0.6899*	1

Source: Authors' calculation based on data from the Ministry of Commerce of the People's Republic of China and the Chinese Bureau of Statistics.
Notes: SD = standard deviation. These correlations do not account for the nested nature of the data and should be interpreted with caution. * $p < 0.05$.

Table 3. Mixed-effects logit regression

DV: Production Subsidiary	Baseline Model		Model 0 (only controls)		Model 1		Model 2		Model 3 (with moderator)		Model 4 (with moderator)	
	Coefficient	(s.d.)	Coefficient	(s.d.)	Coefficient	(s.d.)	Coefficient	(s.d.)	Coefficient	(s.d.)	Coefficient	(s.d.)
Intercept	0,252 ***	0,050	1,849 ***	0,548	1,884 ***	0,551	1,934 ***	0,569	1,916 ***	0,571	1,916 ***	0,573
Level 1												
Foreign ownership					1,568 **	0,704	1,418 **	0,717	1,411 **	0,716	1,441 **	0,712
Absorptive capacity			-0,167	0,251	-0,183	0,252	-0,108	0,258	0,146	0,398	1,361 *	0,801
(Absorptive capacity)^2											-1,188	1,023
Export intensity			-0,704 ***	0,179	-0,732 ***	0,181	-0,358 *	0,210	-0,356 *	0,211	-0,321	0,211
Profit ratio			-0,169	0,473	-0,174	0,475	-0,215	0,487	-0,208	0,487	-0,266	0,491
State ownership			0,259	0,224	0,247	0,224	0,246	0,229	0,234	0,229	0,209	0,231
Energy			-0,602	0,471	-0,603	0,471	-0,599	0,481	-0,584	0,482	-0,523	0,485
Food			0,317	0,319	0,308	0,319	0,213	0,326	0,200	0,326	0,199	0,327
Textile			0,149	0,183	0,117	0,184	0,116	0,187	0,116	0,187	0,125	0,187
Furniture			0,557	0,365	0,533	0,365	0,503	0,371	0,499	0,371	0,529	0,372
Equipment			0,331 *	0,174	0,323 *	0,174	0,333 *	0,176	0,328 *	0,177	0,329 *	0,177
log (Host GDP percapita)			-0,133 **	0,056	-0,137 **	0,057	-0,173 ***	0,058	-0,174 ***	0,058	-0,176 ***	0,059
log (Host political stability)			-0,101	0,104	-0,101	0,104	-0,074	0,106	-0,072	0,106	-0,063	0,106
Level 2												
Foreign spillovers							6,629 **	3,268	7,198 **	3,351	7,169 **	3,472
Absorptive capacity x Foreign spillovers									-6,12	7,251		
(Absorptive capacity)^2 x Foreign spillovers											-15,592	10,897
LR χ^2(Wald test of random effect)			43,7 ***		48,32 ***		44,29 ***		44,93 ***		48,89 ***	

Source: Authors' calculation based on data from the Ministry of Commerce of the People's Republic of China and the Chinese Bureau of Statistics.
Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; n = 30 for province-level variables, n = 1,293 for firm-level variables. Province GDP and firm size variables were eliminated due to multicollinearity issue.

5. Robustness test

We conduct an endogeneity test for our key variable, foreign ownership, as a supplementary analysis and robustness check. We are aware that foreign ownership's causality in relation to rapid FDI can be influenced by firm characteristics such as firm size and profit ratio, such that larger firms and better-performing firms are more likely to engage in rapid FDI regardless of the foreign ownership. We identify five confounding variables, shown in table 4. Based on these confounding variables, we conduct propensity-score matching based on a binary *foreign* variable (*foreign* = 1; *non-foreign* = 0). The propensity score is calculated as the predicted probability of firms being foreign-owned entities, using a probit model with these five firm-level characteristics. With the propensity score calculated from the probit model, we match 251 foreign-owned firms with the remaining non-foreign firms. We impose two conditions: (1) the difference in propensity score is less than 0.05; and (2) firms operate in the same two-digit code industry and same province, and the firm-level statistics are documented in the same year. These two criteria give us a comparable control group with 205 pairs.

To assess the similarity between the treatment and control groups, we perform a balancing test based on individual t-tests. The results (table 4) show that the mean difference is no longer significant after the propensity score matching at the five per cent level. This suggests that the 205 pairs in the newly matched sample are similar in observable characteristics and indeed comparable. Therefore, any differences between the treatment group and the control group can be attributed to foreign ownership. We then compare the mean of rapid FDI between foreign and non-foreign ownership. As the results in table 5 show, the likelihood of rapid FDI in the foreign group is higher than in the non-foreign group.

Table 4. Balancing test for the whole sample

		Mean		t-test	
Variable		Foreign	Non-foreign	t-stat	p-value
Log (firm size)	U	11,868	11,541	1,94	0,053
	M	11,857	11,917	-0,32	0,75
Profit ratio	U	0,08082	0,0625	1,94	0,052
	M	0,07806	0,08657	-0,65	0,514
New product ratio	U	0,19027	0,21269	-0,45	0,653
	M	0,1912	0,22015	-0,48	0,63
Export intensity	U	0,36796	0,2905	1,82	0,069
	M	0,35529	0,35782	-0,05	0,957
Intangible asset ratio	U	0,071	0,14792	-0,34	0,731
	M	0,00713	0,01085	-1,2	0,231

Source: Based on data from the Chinese Bureau of Statistics.

Table 5. Production subsidiary tendencies for foreign vs. non-foreign firms

Foreign vs. Non-foreign	Mean	s.d.	N
0 (non-foreign)	0,551	0,248	205
1 (foreign)	0,614	0,238	205

Source: Based on data from the Ministry of Commerce of the People's Republic of China.

6. Summary of findings

The empirical results inform us that knowledge diffusion from foreign MNEs, either through equity ownership or through contracts and other interactions in the region, reduces the perceived risk of foreign expansion. Chinese firms connected to foreign MNEs at home are more likely to skip the initial testing stage in the internationalization process and to directly set up production and manufacturing sites. In the current, increasingly globalized world, external forces such as business partners (who you connect with) and operation location (where you are) have a significant role to play in shaping a firm's international business strategy.

Overall, we did not find support for our moderating effects. Similarly, Jin et al. (2019) also have the surprising findings that technological capabilities do not positively moderate the relationship between inward FDI and subsequent upgrading in local firms' capabilities. This unexpected result can be explained by the fact that local technological leaders suffer a stronger foreign competition effect than laggards (and thus have fewer resources left to support rapid international expansion) or that local technological leaders, after benefiting from foreign knowledge spillovers, are even stronger in domestic market competition and feel less compelled to explore international opportunities early.

7. Implications

7.1 Theoretical implications

Our research contributes to explaining EMNEs' departure from the internationalization process model. Conventional internationalization theories suggest that firms tend to learn from their own prior internationalization experience and commit resources to internationalization incrementally to minimize the hazard of failure (e.g., Andersen, 1993; Johanson and Vahlne, 1977, 2009). But our research shows that EMNEs initiate their internationalization-related learning process domestically.

The accumulation of internationalization experience can happen before the actual go-global activities. In other words, firms can accumulate international experience while operating at home by connecting with foreign MNEs.

We argue that foreign participation tends to provide indigenous firms with resources and skills directly related to international market access, such as referrals and contacts in the host country, and the ability to identify local customer needs, avoid potentially costly missteps in terms of host-country business regulations and develop location-specific technological competences. These resources and skills influenced by foreign MNEs at home familiarize local firms with the nature of international markets, reduce the perceived risks and enable the local firms to leapfrog the initial stage of internationalization. Using export and sales subsidiaries to test the international markets can be replaced by working with foreign MNEs at home.

We also contribute to the understanding of EMNEs' firm-specific advantages (FSAs). As Ramamurti and Singh (2009) and Verbeke and Kano (2015) point out, the FSAs possessed by EMNEs may not have seen before in developed-country multinational enterprises (DMNEs), but they are valuable in an emerging-market context. In particular, we argue that whereas conventional DMNEs develop capabilities in-house (Guillén and García-Canal, 2009), EMNEs do so partially by leveraging partnerships and networks with foreign MNEs that are more advanced in internationalization and technological development.

7.2 Policy implications

We relate our findings to UNCTAD's Investment Policy Framework for Sustainable Development. Our study confirms the possibility of embedding investment policy for the host country's development strategy. Investment can be a key driver of economic growth, a prerequisite for building up production capacity and enabling industrial upgrading (UNCTAD, 2015). Inward FDI, in particular, creates cross-border industrial clusters, which further upgrades host-location infrastructure and absorptive capacity for emerging technologies and business practices (UNCTAD, 2013, 2018). The Action Plan for Private Investment in the Sustainable Development Goals also indicates that through sharing good practices, FDI can promote local firms' absorptive capacity in adopting sustainable development models (UNCTAD, 2014). The Ministry of Commerce of China issues the Catalogue for the Guidance of Foreign Investment Industries and updates it frequently to ensure inward FDI activities do not impede domestic economic development and societal stability. In the 2007 amendment, the Catalogue further associates industrial restructuring with investment, encouraging FDI in high-tech industries while restricting FDI in high-energy-consuming industries and prohibiting FDI that exacerbates environmental concerns.

Furthermore, our findings point out two possible channels through which the host country's development goals can be realized. These channels, equity ownership and co-location, require host-country institutions, such as intellectual property (IP) protection, to promote partnerships between foreign MNEs and local firms. In both the 2000 and 2011 versions, the Guidelines for Multinational Enterprises promoted by the Organization for Economic Cooperation and Development (OECD) encourage "MNEs [to] conduct knowledge transfer in the host country to facilitate the development of the host-country local and national innovation capabilities and to contribute to the long-term development prospects of the host country" (OECD, 2011: 55). Nevertheless, weak intellectual property protection in developing countries has prevented this endeavour. UNCTAD's work on intellectual property, particularly international partnership on intellectual property and the Sustainable Development Goals, has provided guidance to developing countries on issuing rules on investment and intellectual property protection that are favourable to foreign investors (Zhan and Spennemann, 2020).

Our research also contributes to the measurement of the impact of investment promotion policies. Whereas, in the international economics literature, findings on the effectiveness of FDI spillovers are inconclusive (e.g., Aitken and Harrison, 1999; De Backer and Sleuwaegen, 2003; Buckley, Clegg and Tan, 2004; Zhao, 2006), our findings show that the outcome of inward FDI is not just about local productivity. Foreign MNEs in an emerging-market context might not increase the international competitiveness of EMFs right away. But through association with foreign MNEs, EMFs discover or have easier access to further development opportunities such as internationalization. As the upward spiral model (Luo and Tung, 2018) suggests, the upgrading of EMF capabilities is a long-term process and involves multiple rounds of evolution.

Moreover, our findings highlight the need for policymakers in emerging countries to pursue coordinated inward and outward investment policy approaches conducive to accelerating the internationalization of local firms and their participation and integration in the international economy. Last, our research has implications for the recent upward trend of deglobalization, nationalism and protectionism. Restricting inward FDI potentially deprived indigenous firms of connecting to international markets and emerging technologies. Inward FDI is an integral part of globalization and potentially facilitates local firms' go-global activities.

8. Future research directions

Owing to data availability, we cannot test firm performance subsequent to OFDI. But it would be interesting to learn how foreign participation affects the internationalization performance of local firms. In addition, the stage of internationalization is subjective

(from managers' self-reported business activities in the host country) in our sample. Future studies can use objective performance indicators to measure international market growth.

Another interesting area to explore would be the location choice of EMNEs. Are local firms more likely to invest in foreign partners' home countries? How does foreign participation affect the distance travelled of EMNEs? Addressing these questions will allow us to better understand the geographical linkages created by bilateral and multilateral FDIs.

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Cultural spillovers from multinational to domestic firms: evidence on female employment in Costa Rica*

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Abstract

We study cultural spillovers from multinational corporations (MNCs) to domestic companies in the information technology (IT) sector of Costa Rica. Using firm-level panel data for 2001–2011, we explore to what extent domestic firms' female labour share increases as a result of business operations of MNCs. We find evidence of two channels for cultural spillovers from foreign direct investment (FDI) to domestic IT firms influencing higher shares of female employment: *learning* (imitation) effects through labour mobility, which allows former MNC employees working in domestic firms to apply skills and gender practices from their previous work experience, and *demonstration* effects with the presence of MNCs (through competition in the labour market), which include imitation of social norms and values of MNCs by local firms. No evidence was found for a relationship between backward linkages (purchases) of MNCs from domestic suppliers and female labour share. To promote greater participation by women in labour markets through FDI attraction, strengthening cultural spillovers would require implementing FDI promotion policies to (i) enhance the absorptive capacity of domestic IT firms, (ii) attract IT MNCs with greater potential to generate spillovers, and (iii) foster a favourable national investment climate for enhancing business interactions between IT MNCs and domestic IT firms.

Keywords: Costa Rica, cultural spillovers, foreign direct investment, labour mobility, multinational firms, gender equality

JEL Codes: F21, F23, J16, C23

* Received: 27 July 2020 – Revised: 18 February 2021 – Accepted: 24 March 2021.

This research was conducted with support from the United Nations Conference on Trade and Development (UNCTAD), as a case study for the *Multinational Enterprises and the International Transmission of Gender Policies and Practices* report (UNCTAD, 2021).

The authors are grateful for valuable comments and suggestions from the Editors and anonymous referees, and from Jennifer Poole, Amelia U. Santos-Paulino, and Claudia Trentini. The usual disclaimer applies.

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1. Introduction

Multinational corporations (MNCs), particularly those in high-technology industries, are leaders in advanced business practices and global transmitters of capital, new ideas and technologies. Thus, FDI is seen as an engine of growth and development for host countries because of its potential to increase productivity, create employment, help diversify exports and drive productive structural transformation (Harrison and Rodríguez-Clare, 2010; Alfaro, 2016). FDI can also contribute to sociocultural change and gender equality, improving labour conditions for women (Word Bank and WTO, 2020). Through increased demand for labour, technological spillovers and corporate social responsibility practices, FDI can potentially influence women's welfare (UNCTAD, 2014; Oueadraogo and Marlet, 2018).

Developed countries that are sources of the most outward FDI tend to be more gender equal than developing countries. MNCs can be international vehicles of their country of origin's gender norms in terms of female employment, the wage gap and gender equality (Kodama et al., 2018; Choi and Greaney, 2020). Moreover, MNCs can create cultural spillovers (a process of local firms updating their biased perceptions of the costs of female workers) to domestic firms when their female labour share grows with the operation of multinationals in the same industry (Tang and Zhang, 2017).

This study explores cultural spillovers from MNCs to domestic companies and their impact on female employment in the IT sector in Costa Rica. The country is an illustrative case to study the impact of FDI on gender-specific local firm practices. On one hand, Costa Rica's strategy for the attraction of FDI has targeted MNCs that operate in high value-added sectors (explicitly including foreign IT companies), whose presence has the potential to increase demand for products and services from domestic firms and create productive linkages with the national economy (Monge-González and Rivera, 2020). On the other hand, gender imbalances in the labour market of Costa Rica are persistent. According to INEC (2019), women account for 37 per cent of the national workforce. This share varies across sectors: 13 per cent in agriculture, livestock, and fishing; 18 per cent in manufacturing; and 48 per cent in services. In the IT sector, women represent 38 per cent of the labour force.

A key policy question is whether closing the gender employment gap in Costa Rica could be achieved through cultural spillovers from FDI. We aim to disentangle different channels from three forms of MNC interaction with domestic firms in the same industry: (i) *backward linkages* between MNCs and their local suppliers; (ii) *labour mobility*, which allows former employees of MNCs working in domestic firms to apply skills from their previous work experience and training; and (iii) *demonstration effects*, which include imitation of social norms and values practices of MNCs by local businesses (Saggi, 2002).

In the first case (backward linkages), we use MNCs' transactions per worker (frequency of purchases) from domestic IT firms as co-variables. In the second case (labour mobility), we use as a co-variable the number of former MNC workers working in domestic IT firms. And in the third case (demonstration effects), we use as an explanatory variable the presence and competition of MNCs in the labour market though their employment share in the IT sector. Thus, we explore to what extend domestic firms' female labour share increases with the operation of MNCs in the same industry. More specifically, we address these research questions: Do backward linkages between MNCs and local suppliers facilitate the imitation of MNCs' cultural gender practices by domestic firms? Does labour mobility from multinational companies to local companies facilitate the imitation of MNCs' cultural gender practices by local firms? Do MNCs' affiliates induce domestic firms to employ more women through higher competition in the labour market?

Our findings suggest two channels for cultural spillovers in female employment from MNCs to IT domestic firms: learning (imitation) effects through labour mobility, which allow former employees of MNCs working in domestic firms to transfer skills and gender practices from their previous work experience and training; and demonstration effects through the presence of MNCs, through competition in the labour market. No evidence was found for a relationship between backward linkages (purchases) of MNCs from domestic suppliers and the female labour share.

In the next section, we present the conceptual background. Then, we describe data and some stylized facts, followed by the empirical strategy. Afterwards, we discuss the results of the model estimations. In the final section we present the conclusions and policy implications.

2. Conceptual background

For the analysis of cultural spillovers, Tang and Zhang (2017) and Acemoglu and Autor (2011) use multi-sector task-based models with firm heterogeneity in productivity and biased perceptions about female labour costs. Their models focus on firms' labour demand and assumes an inelastic labour supply of both female and male workers. Cultural spillovers occur when domestic firms revise their (biased) beliefs about the cost of female workers towards the objective benchmark. Specifically, a domestic firm changes its prior belief about the cost of female workers if that belief differs from the average belief among MNCs it interacts with. These models also predict stronger cultural transfers in female-labour-intensive industries (i.e., when women have a comparative advantage in production).

Various studies have found both knowledge spillovers and cultural spillovers from MNCs to domestic firms in countries that receive FDI (Saggi, 2002; Smeets, 2008; Tang and Zhang, 2017; Monge-González and Rivera, 2021). Social scientists have analysed how MNCs influence host countries' social norms and values, contributing to cultural convergence across countries toward gender equality (Neumayer and De Soysa, 2011; Fernández, 2013; Wang, 2018).[5]

Domestic firms often react to higher FDI presence in the same sector for two reasons: competition and learning (imitation). Regarding competition, the entry of MNCs into a market may increase input costs but lower final good prices. Both effects lower profits for all firms, possibly inducing some of them to employ more women. This is particularly true for the least productive firms, which struggle for their survival (Juhn et al., 2014). In the case of learning, domestic firms will adjust their beliefs about female workers towards the "average" level in the market because of their interaction with MNCs (Tang and Zhang, 2017). This adjustment increases to the extent that MNCs come from countries with less biased perceptions of female employment. We argue that the business relationships between MNCs and local firms facilitate the process of local firms acquiring MNCs' advanced cultural practices regarding female workers. Equality-targeted gender practices at IT MNCs in Costa Rica illustrate this point (box 1).

Box 1. Gender practices at IT MNCs in Costa Rica

Advancing gender equality is not just an opportunity for countries; companies also stand to gain. Research on diversity shows that companies with higher levels of both gender and ethnic diversity perform better in economic terms, and that the relationship between diversity on executive teams and the likelihood of financial outperformance has strengthened over time. In short, these analyses find a statistically significant relationship between a more diverse leadership team and better financial performance (Hunt et al., 2018; Dixon-Fyle et al., 2020).

In the IT sector in Costa Rica, MNCs state that, because of the important results of gender diversity on their performance, they develop programs within companies and in association with educational agencies to promote equal opportunities for women for capacity-building and work engagement.

At Intel Costa Rica, through a program called WIN STEM, the company works with organizations and individuals from all industry areas to promote gender inclusion in careers in science, technology, engineering and mathematics (STEM).

.../...

[5] A special 2020 issue of *Transnational Corporations* (volume 27, number 3) presents novel and high-quality empirical evidence on the role of MNCs in promoting women's empowerment and gender equality.

Box 1. Gender practices at IT MNCs in Costa Rica (Concluded)

In addition, Intel Costa Rica works with the educational authorities of Costa Rica to motivate more women to pursue STEM careers. Company managers found that women reacted to safe environments and showed constant positive improvements. Therefore, the firm adopted as part of its organizational climate the emblem of zero tolerance for discrimination. Intel Costa Rica has the goal that by 2025, 40 per cent of its employees in technical areas will be women.

At Procter & Gamble (P&G) Costa Rica, managers point out that many efforts are made to ensure that all people can develop their capabilities and grow within the company. Thus, the company provides support and encouragement so that women can manage different stages of life without sacrificing their professional career. One of its key professional development programs for women is Inspire IT, in which female university students in Costa Rica are invited to do internships in P&G so that they can experience the gender-equal working environment of the company and thus be likely to consider P&G Costa Rica as a place to work in the future. The Reentry Task Force is a program aimed to support professional women over the age of 35 who work in STEM areas and who have been absent from work for various reasons. The Women Initiative is another program that aims to facilitate the promotion of women within the company. Finally, in partnership with other educational organizations, the Scholars program provides the opportunity for female students at technical colleges to perform professional practice at P&G Costa Rica, with the aim that they can then apply for a permanent position within the company. P&G Costa Rica also works with educational authorities of the country and non-governmental organizations to motivate more women to participate in STEM careers and MNC employment.

Both companies (Intel and P&G) stated that their gender practices are key performance drivers not only in their own companies but in the industry as well, particularly when their workers move to national companies (looking for higher positions) or new businesses (spin-offs or start-ups of former employees). These moves are regarded as a positive channel of transmitting advanced gender practices to local businesses.

Source: Based on information from interviews with company managers at Intel Costa Rica and P&G Costa Rica and sector stakeholders at the AZOFRAS (the Association of Free Zone Companies) and CINDE (the investment promotion agency).

2.1 The relevance of mediating factors for knowledge and cultural spillovers

When exploring possible cultural spillovers from FDI, factors that mediate the extent of MNC impacts in local firms become relevant, specifically *foreign firm characteristics*, *domestic firm characteristics*, and *host country factors and institutional framework* (Paus and Gallagher, 2008; Farole and Winkler, 2014). These mediating factors affect the interaction between MNCs and domestic firms and therefore influence the potential for cultural spillovers.

In this regard, Monge-González et al. (2015) construct three indices based on surveys of IT MNCs and domestic IT firms (table 1). The first measures absorptive capacity, to measure the degree to which domestic IT firms are likely to be able to absorb knowledge and technology from their interactions with IT MNCs.The average value for Costa Rican domestic IT firms is relatively low (2.51), owing to their relatively low levels of productivity, proportions of skilled labour in the workforce, levels of innovation, exports and scale. These factors prevent domestic IT firms from taking full advantage of opportunities offered by interactions with IT MNCs that operate in Costa Rica. The second index measures the degree to which the national environment favours the emergence of positive impacts from the interactions between IT MNCs and domestic IT firms. To improve its very low value (1.82) would require improvement in the business environment (access to finance, telecommunication infrastructure, promotion of innovation, human resource development, and trade, investment and industry policies), for domestic IT firms to be able to take advantage of the operations of IT MNCs. The third index measures the potential of IT MNCs to generate spillovers for local IT firms. The low value (2.01) indicates a need to target the generation of spillovers as an FDI attraction policy priority (Monge-González et al., 2015).

These indices indicate that the absorptive capacity of domestic IT firms, the potential of IT MNCs to generate spillovers and the national environment of Costa Rica are not very favourable for promoting strong interactions between IT MNCs and domestic IT firms. This evidence should be considered when evaluating cultural spillovers and their effective potential in the country.

Table 1. Costa Rica: Domestic IT's absorptive capacity, national environment and MNC spillover potential indexes

Mean	N	Median	Mean	Std. Dev.	Min.	Max.
Absorptive capacity	72	2.45	2.51	0.70	0.91	3.91
National environment	83	1.83	1.82	0.71	0.23	3.57
MNCs' spillovers potential	33	2.09	2.01	0.57	0.6	3.39

Source: Monge-González et al. (2015).
Note: Index scores range from 1 (lowest) to 5 (highest).

3. Data

This study uses a novel micro-level panel data set of both domestic firms and MNCs in the IT sector with annual observations from 2001 to 2011. Data sources include the Costa Rican Social Security System (CCSS), the Ministry of Foreign Trade (COMEX) and the Ministry of Finance (MH). Since these agencies do not register all firms in the IT sector, additional sources were used to complete the data set, namely the Chamber of Information and Communication Technologies, the Export Promotion Agency (PROCOMER), the investment promotion agency (CINDE) and the Costa Rican-American Chamber of Commerce (AmCham Costa Rica). The exports of these firms were estimated on the basis of information provided by PROCOMER.[6] In addition, the MH provided information on commercial links between MNCs and IT domestic firms.

This firm-level data set allowed us to classify businesses as mainly domestic or MNC affiliates and among different IT categories. The final panel data set includes 873 companies: 587 are domestic IT firms and 286 IT MNCs. We included in the group of domestic IT firms only those that we could confidently assign to one of four standard IT subsector categories. These categories, which are particularly closely associated with the creation and implementation of IT, are the following four:[7]

- Telecommunication: companies that own, operate and/or use voice and data networks to provide communications services between people and devices
- Hardware: businesses that carry out activities related to the design, manufacture and/or assembly of electronic devices such as computers and their peripherals, telephones, network devices (e.g., routers, switches) and various types of integrated circuits
- Software: businesses that are primarily dedicated to the creation and sales of relatively standardized applications and software tools (e.g., BIOS firmware, operating systems, application software) for horizontal or vertical market niches, or for individuals
- Solutions providers: businesses that offer consulting, assistance, training, custom software development, systems integration or any other of many services that are closely related to the creation, implementation and maintenance of information or telecommunication systems.

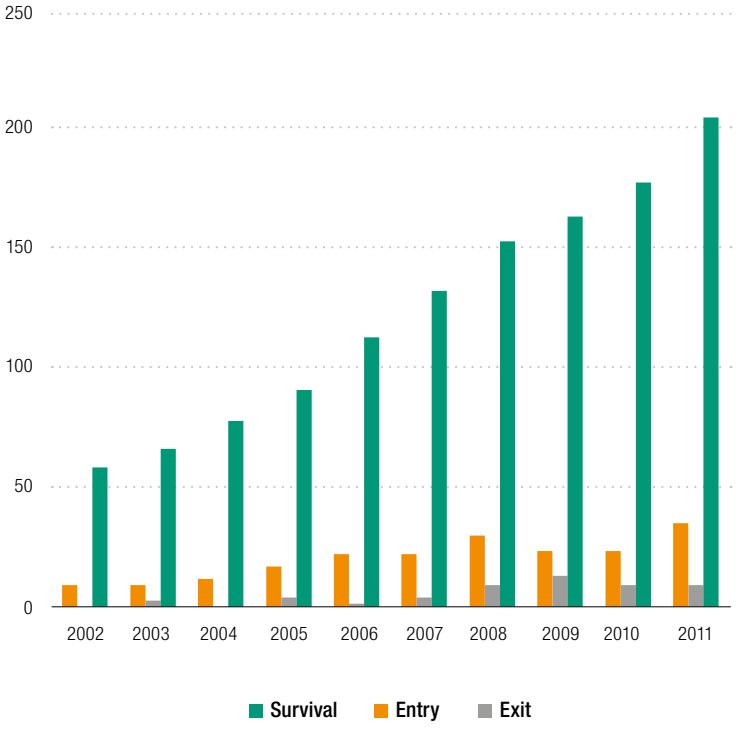
[6] An exporter is a company selling products abroad worth more than US$10,000 per year.

[7] Almost no domestic firms were involved in the design and/or manufacture of hardware. This is to be expected as such manufacturing typically requires substantial investments in infrastructure (which very few local firms are capable of). The analysis therefore does not include domestic hardware companies, but only IT MNCs.

3.1 The dynamics of MNCs and domestic firms in the IT Sector

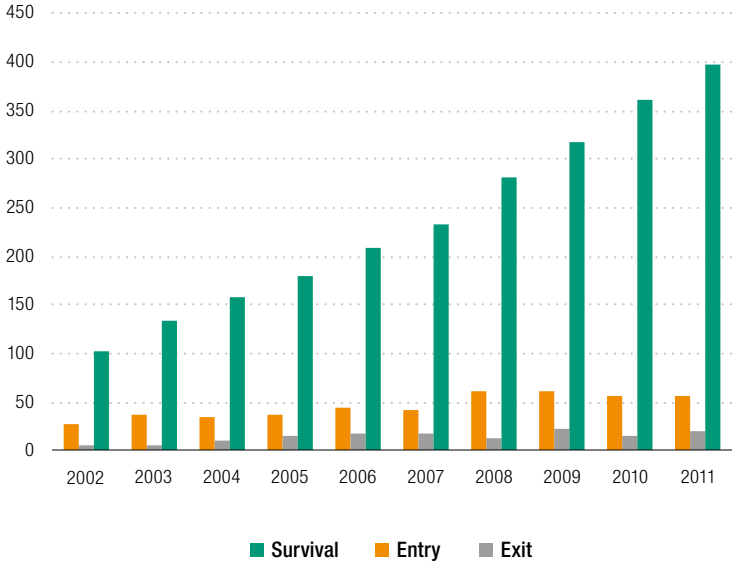
Figure 1 depicts the pattern of entry and exit of IT MNCs in Costa Rica between 2002 and 2011. It seems that the efforts of Costa Rica to attract FDI in IT industries have been successful, as the number of MNCs exiting is much lower than that of MNCs entering the country, resulting in a sustained increased in the number of MNCs operating in the country over time. Figure 2 shows the pattern of entry, exit and survival of domestic IT firms in Costa Rica from 2002 to 2011. As in the case for IT MNCs, the number of domestic firms has increased over time, because of more domestic firms entering the market than leaving it during the period analysed. These results can be interpreted as a preliminary indication that the presence of IT MNCs did not hinder the survival of domestic IT firms but contributed the creation of a national cluster with local and foreign firms.

Figure 1. Costa Rica: Entry, exit and survival of IT MNCs, 2002–2011 (Number of firms)



Source: Authors' calculations based on data from CCSS.

Figure 2. Costa Rica: Entry, exit and survival of domestic IT firms, 2002–2011 (Number of firms)



Source: Based on data from CCSS.

3.2 Female employment in MNCs and domestic IT firms

When analysing female employment in both MNCs and domestic firms in the IT sector, differences between the types of firms are not evident. Indeed, in both, women represent more than 30 per cent of the total payroll during the whole period under analysis (table 2).

This result changes when we compare the proportion of women in the total workforce in MNCs and in domestic companies that have hired former employees of MNCs, as shown in table 3. Indeed, whereas in MNCs the share of women moved from 30 per cent in 2001 to 36 per cent in 2011, in domestic firms that hired former MNC employees the share moved from 25 per cent in 2001 to 36 per cent in 2011. Thus, it is possible that such an increase in the share of women may occur because of cultural spillovers from MNC firms.

In this regard, figure 3 plots the kernel density of female labour shares for domestic firms and MNCs, showing a larger density of MNCs in terms of the ratio of female to total labour. Notwithstanding, results by subindustry show that the share of female workers does not differ significantly between MNCs and domestic firms.

Table 2. Costa Rica: Employment in MNCs and domestic firms from the IT sector, by gender

	Multinational firms			Domestic firms		
	Annual average (number)		Share of women (%)	Annual average (number)		Share of women (%)
Year	Women	Total		Women	Total	
2001	1,834	6,154	30	530	1,518	35
2002	2,191	6,967	31	624	1,796	35
2003	2,732	8,470	32	746	2,047	36
2004	3,628	11,181	32	747	2,128	35
2005	4,464	13,376	33	834	2,346	36
2006	6,178	17,948	34	954	2,612	37
2007	7,631	21,997	35	1,105	3,137	35
2008	9,155	25,866	35	1,376	3,919	35
2009	9,739	27,280	36	1,549	4,475	35
2010	10,676	29,901	36	1,808	5,294	34
2011	12,551	35,244	36	1,961	5,828	34

Source: Based on data from CCSS.

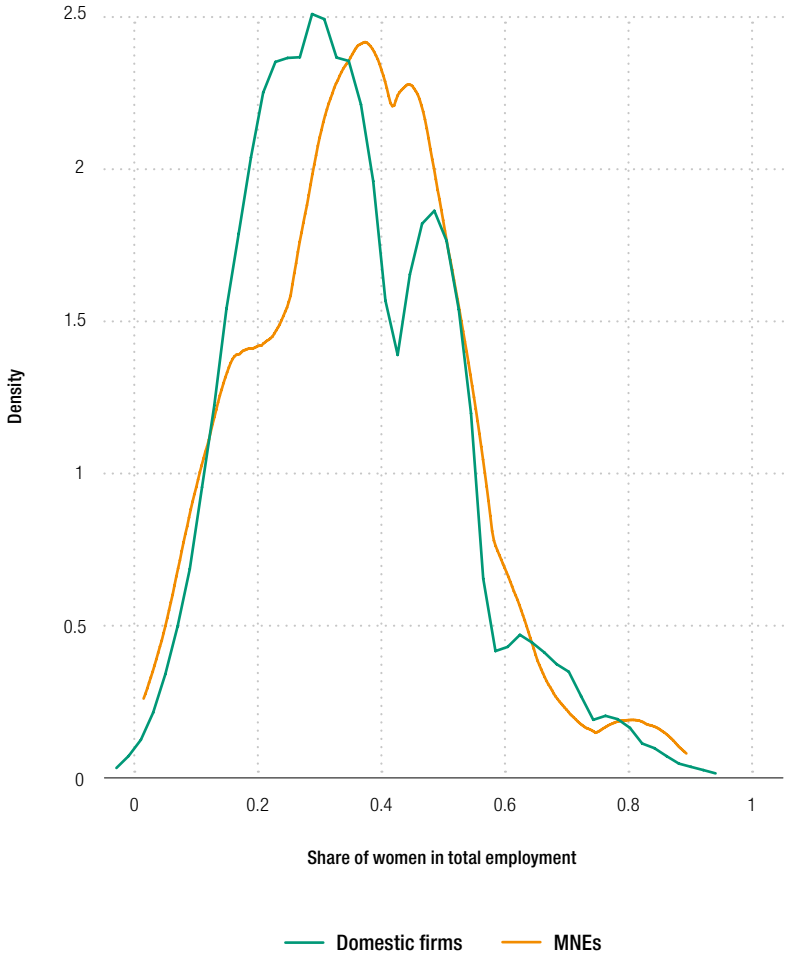
Table 3. Costa Rica: Employment in MNCs and domestic firms that hired former MNC employees from the IT sector, by gender

	Multinational firms			Domestic firms with former MNC em-ployees		
	Annual average (number)		Share of women (%)	Annual average (number)		Share of women (%)
Year	Women	Total		Women	Total	
2001	1,834	6,154	30	49	194	25
2002	2,191	6,967	31	79	305	26
2003	2,732	8,470	32	164	499	33
2004	3,628	11,181	32	165	480	34
2005	4,464	13,376	33	158	463	34
2006	6,178	17,948	34	186	560	33
2007	7,631	21,997	35	241	656	37
2008	9,155	25,866	35	368	1,016	36
2009	9,739	27,280	36	366	1,010	36
2010	10,676	29,901	36	509	1,429	36
2011	12,551	35,244	36	599	1,678	36

Source: Based on data from CCSS.

Accordingly, the panel data used for this study shows variability in terms of the share of female employment by subindustry and by firm type (domestic or MNCs). National averages described before are like sample results, while shares by domestic firms are slightly larger than MNCs (table 4). This variability should be recalled when analysing the model results described later.

Figure 3. Costa Rica: Distribution of firms' female labour share in IT sector, 2001–2012



Source: Based on data from CCSS.
Note: Kernel = Epanechnikov, bandwidth = 0.0318.

Table 4. Costa Rica: Share of women in total Employment in the IT sector, by sub-industry and firm type, 2001–2012 (Average percentage)

Subindustry		MNCs	Domestic Firms	Total
Hardware	Mean	0.4124	..	0.4124
	Standard deviation	0.1962	..	0.1962
	Frequency	221	..	221
Software	Mean	0.3136	0.3247	0.3231
	Standard deviation	0.147	0.141	0.1419
	Frequency	91	537	628
Solutions providers	Mean	0.2692	0.368	0.355
	Standard deviation	0.1657	0.1657	0.169
	Frequency	180	1,183	1,363
Telecom	Mean	0.3026	0.3146	0.3111
	Standard deviation	0.1774	0.1706	0.1724
	Frequency	125	311	436
Total	Mean	0.3654	0.3484	0.355
	Standard deviation	0.1674	0.1619	0.1643
	Frequency	1,282	2,031	3,313

Source: Based on panel data.
(..) = not available.

4. Empirical strategy

Using a balanced panel data for the 2001–11 period, we estimate the impact of MNCs on female employment in domestic firms according to the following fixed effects model:[8]

$$\left(\frac{f}{f+m}\right)_{it} = X'_{k,it}\beta_k + v_i + \gamma_t + \epsilon_{it} \quad (1)$$

[8] The challenge of equation (1) lies in estimating the coefficients associated with the impact of the presence and activities of IT MNCs, while controlling for any factor that may affect the gender practices of firm i in year t. We therefore estimate equation (1) by ordinary least squares using both fixed-effects and cluster-robust standard errors. With the fixed-effects estimation, we explore the relationship between the independent and outcome variables within firms by removing the effect of the time-invariant unobserved characteristics. The error-robust option is used to consider heteroskedasticity and within-panel serial correlation in the idiosyncratic error term (Greene, 2008; Das, 2019). We also computed a generalized least squares model using random effects. Results are available upon request.

Where $\left(\frac{f}{f+m}\right)_{it}$ is the female labour share of IT domestic firm i at time t; X' is a $k \times 1$ vector of firm-specific independent variables at time t that may affect gender practices at the firm level; and β_k is the $k \times 1$ vector of regression coefficients to be estimated. We include firm-specific (v_i) and year-specific (γ_t) intercepts (fixed effects), and ϵ_{it} is the "usual" residual.

The X' vector includes two sets of variables. The first set of explanatory variables refers to the presence and activities of IT MNCs in Costa Rica and their interaction with domestic firms through three channels of cultural spillovers: linkages (measured as the total number of MNCs' purchases per worker (frequency of purchases) from domestic IT firms (local suppliers) in year t); labour mobility (measured as the total number of former MNCs' employees working in domestic IT firms in year t), and presence of MNCs in labour markets (quotient of the total number of employees working in IT MNCs from subsector j by the total number of employees across the subsector [IT multinationals plus domestic IT firms] in year t, accumulated for each year of the sample). The coefficients of this first set of explanatory variables estimate the impact of MNCs on gender employment practices by domestic firms in the IT sector.

The second set of control variables relates to characteristics of domestic IT firms and the IT sector. First, a dummy variable for firm size following Haltiwanger, Jarmin and Miranda, 2010): we estimate firm size by the average number of employees in year t-1 and year t (1 for micro: fewer than 9 employees, 2 for small: 10–49 employees, 3 for medium: 50–249 employees and 4 for large: 250+ employees).[9] Second, a Herfindahl index (the sum at the level of subsector j of the squares of the quotients of the division of the number of employees of firm i by the number of employees in subsector j, for the period under study). Finally, Years exporting (number of years domestic IT companies exported during the period under study for, to account for export experience).[10]

In table 5 we present the descriptive statistics of the variables used in the estimation of equation (1). There is a large variability in the female labour share, with a mean of 0.35. We have a sample of IT domestic firms of different sizes, from microenterprises to large firms. The concentration of firms is relatively low, with a maximum value for the Herfindahl index of 0.33. The minimum scale is a firm with fewer than two workers. For the case of independent variables to measure cultural spillovers, we see that the number of linkages per worker averages 0.27, with a maximum of 3.

[9] We tested a continuous variable (number of employees) as well and found no statistical significance. Results are available upon request.

[10] In an alternative model we included a dummy variable to control for exporter status, which was not statistically significant. Results are available upon request.

In addition, the number of linkages looks small. Regarding the presence of MNCs in the market, we found that this variable is important as 35 per cent of all workers are employed by MNCs. Finally, regarding labour mobility, as an average during the period under analysis, 65 per cent of domestic firms' workers come from MNCs.

Table 5. Descriptive statistics of the model variables

Variable	Observations	Mean	Std. Dev.	Min.	Max.
Female labour share	3,313	0.354968	0.164259	0.002933	0.909091
Linkages	498	0.196678	0.276171	0.000389	3
Labour mobility	10,452	0.644661	4.467279	0	176
Presence of MNCs	10,452	0.350728	0.319748	0.051881	1
Herfindahl index	10,452	0.101523	0.078896	0.023599	0.327416
Firm size	4,472	1.679562	0.914826	1	4
Years exporting	10,452	0.214217	1.131882	0	12

Source: Based on panel data.

5. Results

Table 6 shows the results for equation (1) with the female labour share as dependent variable. We included the explanatory variables one by one (Columns 1 to 3) and added the control variables afterwards (Columns 4 to 6). Column 6 depicts the results of the full model. Female labour share relates positively with labour mobility and the presence of MNCs (competition in the labour market), with statistical significance. In the first case, the mobility of former MNC employees to domestic firms has a positive relationship with the share of female employees in domestic firms. This result is consistent with the evidence of gender practices in the MNCs operating in the country and the number of former MNC employees working in domestic IT firms. In the second case, the presence of MNCs in the labour market is positively related to the share of women in total employment in domestic firms.[11]

[11] According to interviews with companies in the IT sector, the existence of an inelastic supply of qualified labor implies that domestic companies compete more strongly for the labor factor. As a response, one of their strategies is to improve employment conditions for women and imitate the gender practices of MNCs.

Yet, the linkage effect is not statistically significant, which could be attributed to a low record of transactions between domestic firms and MNCs. This outcome could be related to a low, economy-wide absorptive capacity of local IT companies that limits potential spillovers from FDI.

These results are robust for the inclusion of the three control variables. As a general conclusion, the estimations give support for cultural spillovers in terms of higher female employment in domestic firms, through two channels: labour mobility and the presence of MNCs in the labour market.

Table 6. Cultural spillovers from IT MNCs to domestic firms reflected in female labour share

	Dependent variable: Female labour share					
	1	2	3	4	5	6
Linkages	0.0398 (0.072)	0.0514 (0.073)	0.053 (0.074)	0.0311 (0.073)	0.0392 (0.074)	0.0471 (0.077)
Labour mobility		0.0006** 0.000	0.0006*** 0.000		0.0005* 0.000	0.0007** 0.000
Presence of MNC			0.0252 (0.148)			0.2529* (0.145)
Herfindahl index				0.4292* (0.246)	0.4793* (0.247)	0.6867*** (0.248)
Size_2 (small)				0.0084 (0.023)	0.0106 (0.023)	0.0084 (0.022)
Size_3 (medium)				-0.0213 (0.029)	-0.0182 (0.029)	-0.0244 (0.028)
Size_4 (large)				0.0318 (0.055)	-0.005 (0.054)	-0.0277 (0.048)
Years exporting				0.0142** (0.005)	0.0151*** (0.006)	0.0153*** (0.005)
Constant	0.3005*** (0.065)	0.3145*** (0.058)	0.3117*** (0.063)	0.2457*** (0.058)	0.2379*** (0.060)	0.1754** (0.067)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	255	255	255	255	255	255
r2 (within)	0.0517	0.0607	0.0609	0.0958	0.1008	0.1119
F	1.5266	23.069	21.8763	3.672	31.97	36.191
p value	0.1436	0.0000	0.0000	0.0000	0.0000	0.0000

Source: Based on panel data.
Note: Standard errors in parentheses. Robust z-statistics: * = $p < 0.10$, ** = $p < 0.05$, *** = $p < 0.01$.

6. Conclusion and policy implications

We find evidence of two channels for cultural spillovers from FDI to domestic IT firms influencing higher shares of female employment: learning (imitation) effects through labour mobility, which allows former employees of MNCs working in domestic firms to transfer skills and gender practices from their previous work experience and training, and demonstration effects through the presence of MNCs (through competition in the labour market), which include imitation of social norms and values practices of MNCs by local suppliers. No evidence for a relationship between backward linkages (purchases) of MNCs from domestic suppliers and female labour share was found.

These results coexist with observed similar shares of women in total employment by subindustry in the panel data analysed. They also indicate a business environment with low potential for interaction (linkages) between MNCs and domestic firms caused by country conditions. Therefore, to promote greater participation by women in labour markets through FDI attraction, strengthening of cultural spillovers would require FDI spillover growth policies to (i) enhance the absorptive capacity of domestic IT firms, (ii) attract IT MNCs with higher potential to generate stronger spillovers, and (iii) foster a favourable national investment climate for enhancing business interactions between IT MNCs and domestic IT firms.

This is a first effort to understand cultural spillovers from FDI in Costa Rica. One limitation is the number of transactions recorded between MNCs and domestic firms during the study period. Thus, the potential impact of business linkages for cultural spillovers is not fully addressed. The dynamics of labour mobility (long-term effects) and cultural spillovers is not incorporated in the analysis. These limitations open new avenues for future research, incorporating longer and recent periods of time and distinctive employee and firm characteristics. Another issue to explore is the role of mediating factors in the investment climate for FDI attraction and gender equality. In-depth case studies of MNCs and local suppliers could contribute to a better understanding of business practices and women's empowerment at the firm level. The study of MNCs and cultural spillovers in leading FDI-driven sectors of Costa Rica that are growing (e.g., medical devices) should be considered for future research as well.

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Forecasting global FDI: a panel data approach*

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Abstract

The future patterns of foreign direct investment (FDI) are important inputs for policymakers, even more so during severe economic downturns, such as the one caused by the COVID-19 pandemic. Yet, there is neither empirical consensus nor significant ongoing empirical research on the most appropriate tool for forecasting FDI inflows. This paper aims to fill this gap by proposing an approach to forecasting global FDI inflows based on panel econometric techniques – namely the generalized method of moments – accounting for the heterogeneous nature of FDI across countries and for FDI dependence across time. The empirical comparison with alternative time-series methods confirms the greater predictive power of the proposed approach.

Keywords: FDI, forecast, panel econometrics, time-series econometrics, underlying FDI trend, generalized method of moments

JEL Codes: C23, F23, F47

* Received: 20 December 2020 – Revised: 26 January 2021 – Accepted: 13 February 2021.

The views expressed in this article are solely those of the authors and do not necessary represent the views of the United Nations.

The authors are grateful to Andrija Đurović for programming support. The paper benefits from many comments and suggestions from participants to UNCTAD's Research Seminar Series.

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1. Introduction

Foreign direct investment (FDI) is an important contributor to economic growth. The FDI-growth linkage operates through direct and indirect channels. Directly, multinational enterprises (MNEs) expand host countries' production capacities and employ local workers (Dunning and Lundan, 2008), resulting in higher employment and increased income. Indirectly, MNE activity can produce positive spillovers to domestic economies, improving the productivity of local firms through the transfer of advanced production technologies, managerial knowledge and working practices (Segerstrom, 1991; Grossman and Helpman, 1994). Foreign direct investments have been instrumental in the expansion of global value chains (GVCs), with MNEs coordinating GVCs through their networks of foreign affiliates and non-equity mode partners (*UNCTAD,2013*; Farole and Winkler, 2014).

Future FDI trends are pivotal information for policymakers, in particular in developing economies, where development prospects are often tied to inflows of foreign productive capital. Sustainable and sustained external financing, including FDI, is key to achieving the United Nations Sustainable Development Goals (SDGs; *UNCTAD, 2014*). In the midst of an unprecedented health and economic crisis, with potentially dramatic consequences for cross-border capital flows (*UNCTAD, 2020*), and with less than a decade left to the deadline for the SDGs, it is all the more important to have reliable tools for predicting future trends in FDI.

Yet, although the forecasting of macroeconomic variables such as gross domestic product (GDP) and inflation has a long history, the forecasting of FDI remains empirically relatively unexplored. Some studies perform FDI forecasting for a single country or for a limited set of countries through the application of country-specific univariate time-series, disregarding countries' heterogeneity and interdependence (Al-Rawashdeh, Nsour and Salameh, 2011; Shi et al., 2012; Perera, 2015; Nyoni, 2018; George and Rupashree, 2019; Sharma and Philli, 2020). To our knowledge, Speller, Thwaites and Wright (2011) is the only effort to simulate future international capital flows at the aggregate level – i.e. including not only FDI. The paper proposes a simulation approach based on simple ordinary least square (OLS), which is potentially prone to problems of endogeneity and reverse causality between the covariates and the dependent variable. UNCTAD has included forward projections of FDI at the global and regional level in its annual World Investment Report for many years, integrating econometric forecasting employing the estimated generalized least square approach (EGLS) with survey data and perspectives based on project announcements. This study formally presents an improvement to UNCTAD long-standing forecasting approach, employing the generalized method of moments (GMM) instead of EGLS to address some key issues related to FDI forecasting.

Two issues make FDI forecasting particularly challenging, explaining to some extent the very limited methodological advances in this area: (i) the highly volatile nature of FDI data and (ii) the complexity of properly capturing the many determinants that affect FDI and their interactions.

(i) Although FDI is the most stable source of external financing (*World Investment Report*, various editions), in the last 20 years its dynamics have exhibited significant variations (figure 1). These are typically generated by one-off transactions such as large cross-border mergers and acquisitions (M&As) and by financial flows, mainly involving developed economies. A useful step for forecasting is to mitigate the strong volatility in the data while retaining the most structural and productive component of FDI.

(ii) Longitudinal and cross-sectional factors interact in complex ways to determine the level of FDI in a country, as investment depends both on the behaviour of past investors (longitudinal dimension) and on the macroeconomic and institutional conditions prevailing across countries (cross-sectional dimension).

The purpose of this paper is to suggest an econometric approach to forecasting FDI that properly addresses these two issues. For the first problem (volatility of FDI) we introduce an *underlying FDI trend*, smoothing the FDI time series by taking into account the differing nature of the key FDI components, such as greenfield investment, cross-border M&As, financial flows and intracompany loans (ICLs) (section 2).[1] For the second problem (heterogeneity across countries and time dependence), we suggest a dynamic panel econometric approach (section 3). The resulting model is a GMM model such as that proposed by Arellano and Bover (1995), accounting for cross-country heterogeneity and time dependence (section 4). The GMM model is then used to forecast FDI (section 5) and the results are compared with alternative time-series methods, confirming the higher predictive power of the proposed approach (section 6). This paper is a step in investigating methods for forecasting global FDI flows within a panel data econometric framework; possible alternative directions for future research, including beyond panel data econometrics, are briefly discussed in the final section (section 7).

[1] The UNCTAD underlying trend used in this paper is a composite construct combining different sets of data. For ease of interpretation, we use the term "FDI components" – which in the balance-of-payments construct of FDI denotes equity, reinvested earnings and ICLs (i.e. sources of finance) – in a different sense here to distinguish greenfield projects (i.e. new investments) and M&As (i.e. ownership changes).

2. Addressing the first issue (volatility of FDI): the underlying FDI trend

FDI inflows exhibit a strong volatility, particularly from the 2000s onwards. The highly volatile pattern results mostly from inflows to developed economies, while FDI to developing economies displays far more stable dynamics (figure 1).

Large fluctuations and cyclical movements in total FDI flows are mostly caused by (i) investment flows to (or rather through) large financial centres and conduit countries (offshore financial centres, or OFCs); (ii) global trends in M&As, which correlate closely with financial markets; and (iii) large swings in the volume of ICLs.

Letting global FDI_t denote global FDI inflows at time t and OFC_t, the subset including inflows to OFCs, we define:

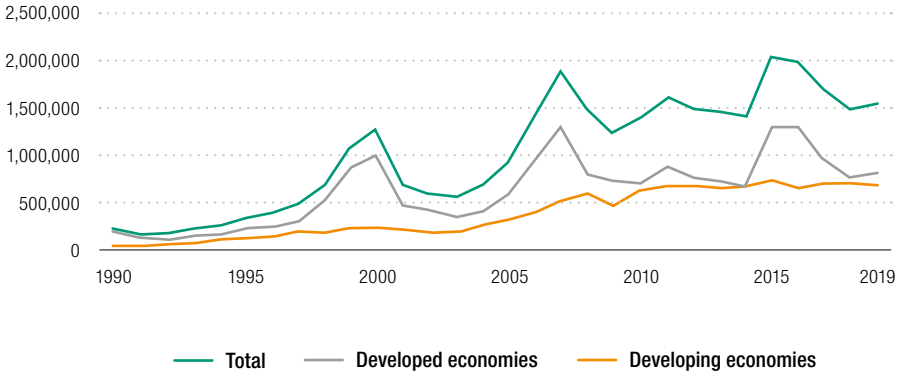
$$FDI_t^* = FDI_t - OFC_t \quad (1)$$

Decomposing FDI_t^* into its ICL component (ICL), its M&A component ($M\&A$), and its greenfield component (GI) then yields:

$$FDI_t^* = ICL_t^* + M\&A_t^{**} + GI_t^{**} \quad (2)$$

where ICL_t^* are ICLs excluding OFCs and $M\&A_t^{**}$ are cross-border M&As, after excluding flows to OFCs and ICLs, with the residual component GI_t^{**} interpreted as the greenfield, non-financial component of FDI.

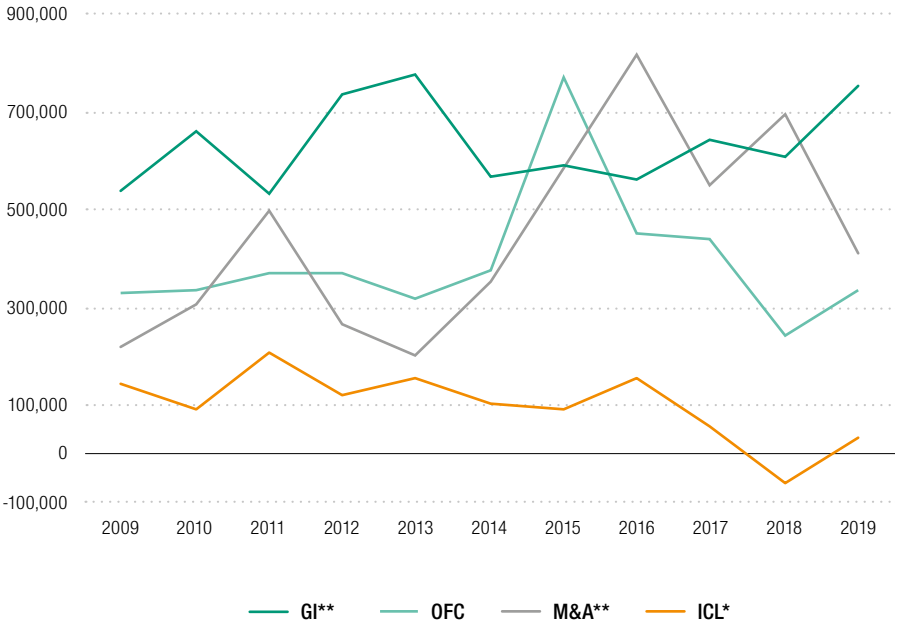
Figure 1. FDI inflows, 1990–2019 (Millions of dollars)



Source: UNCTAD FDI database.

Decomposition (2) can be concretely obtained in two steps. First, FDI inflows to the set of OFCs are subtracted from total FDI inflows to derive FDI_t^*; second, ICLs (ICL_t^*) and cross-border M&As ($M\&A_t^{**}$), sourced from national accounts data and commercial project databases (such as Refinitiv) respectively, are subtracted from FDI* to compute an approximation of the greenfield component GI_t^{**}.[2] Figure 2 shows the historical pattern of the components in decomposition (2).

Figure 2. FDI components, 2009–2019 (Millions of dollars)



Source: Based on UNCTAD FDI data.

Note: OFC: FDI inflows to offshore financial centres; M&A**: cross-border mergers and acquisitions in all countries, excluding OFCs; ICL*: intracompany loans to all countries, excluding OFCs; GI**: residual component.

[2] Notice that although exclusion of OFCs from ICLs and cross-border M&As is straightforward, there is no clear way to break down ICLs by mode of entry, making exclusion of ICLs from cross-border M&As not feasible from the perspective of data availability. As a consequence, for computational purposes in decomposition (2) we assign to $M\&A_t^{**}$ (i.e. cross-border M&As excluding OFCs and ICLs) the value of $M\&A_t^{*}$ (i.e. cross-border M&As excluding only OFCs), assuming that the ICL component of M&As is sufficiently small not to alter the dynamics and interpretation of the components in decomposition (2). This assumption appears safe, because cross-border M&As tend to translate into the equity component of FDI.

The main driver of the large fluctuations in global FDI inflows is the value of cross-border M&As, which in some years of frothy financial markets can account for more than half of global FDI values. For example, the peaks in 2000, 2007 and 2015 (figure 1) were driven to a large extent by M&A booms (compare with figure 2 for 2015). In some years, global FDI statistics are skewed by a very few extremely large transactions, such as the SAB Miller deal in 2016 (6 per cent of global flows in that year), or the Verizon deal in 2014 (10 per cent of total flows). Although the volatility of ICLs is greater, their impact on global FDI flows is significantly less due to their limited absolute size. Nonetheless, they can cause very significant upward or downward swings in individual countries.

All components of FDI are relevant indicators of global investment trends, from the perspectives of both macroeconomics (e.g. the health of a country's balance of payments) and international production (which expands as much through M&As as through greenfield investments). Yet, it can be hard for policymakers to draw sound conclusions – say, on progress in building a conducive investment climate – on the basis of trends that show wild fluctuations, often driven by exogenous cyclical dynamics in financial markets or by anomalous outliers (such as one-off M&A transactions). It is therefore helpful to study the underlying directional trend, net of the oscillations caused by the most volatile elements in FDI flows. Not only is the construction of an underlying trend a useful descriptive monitoring and analytical tool in itself (*UNCTAD, 2019* and *2020*), it is also instrumental in addressing the issue of volatility in the forecasting exercise.

The main challenge is to define the underlying trend in such a way as to remove the most disturbing part of the volatility while retaining the fundamental long-term dynamics of FDI. To do so, we rely on decomposition (2), leveraging our prior knowledge of the economic interpretation and statistical behaviour of the elements involved:

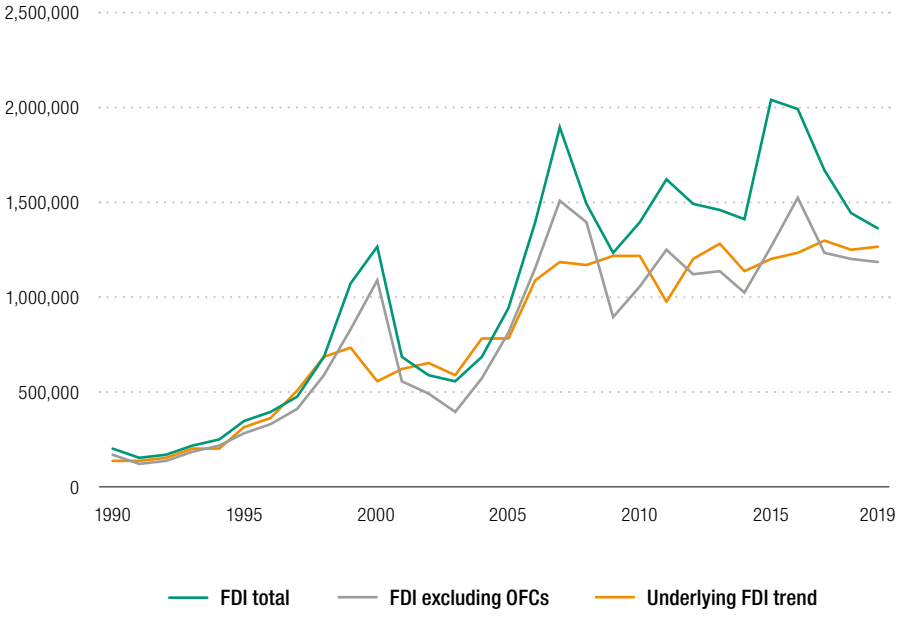
- FDI to OFCs is excluded from the calculation of the trend, as it is largely conduit flows and driven by financial and tax motives.
- The moving average technique is applied to smooth the dynamics of M&A** and ICL*, to mitigate large swings generated by one-off transactions.
- The remaining component, GI**, is retained as is to recognize the more productive nature of greenfield investment, which is empirically supported by the evidence of a more stable historical pattern relative to the other components (figure 2).

The underlying FDI trend $FDI\_trend_t^*$ is then calculated as:

$$FDI\_trend_t^* = GI_t^{**} + MA_5(M\&A_t^{**} + ICL_t^*) \quad (3)$$

where GI_t^{**}, $M\&A_t^{**}$ and ICL_t^* are defined as in (2) and $MA_5(..)$ is the five-year moving average function. Consistent with the notation introduced, the asterisk superimposed on the variable FDI_trend indicates the exclusion of flows to OFCs. Figure 3 shows the dynamics of the underlying FDI trend, $FDI\_trend_t^*$, relative to total FDI and to total FDI without OFCs ($\mathrm{FDI_t}$ and FDI_t^*, respectively).

Figure 3. FDI inflow, with and without OFCs, and underlying FDI trend, 1990–2019 (Millions of dollars)

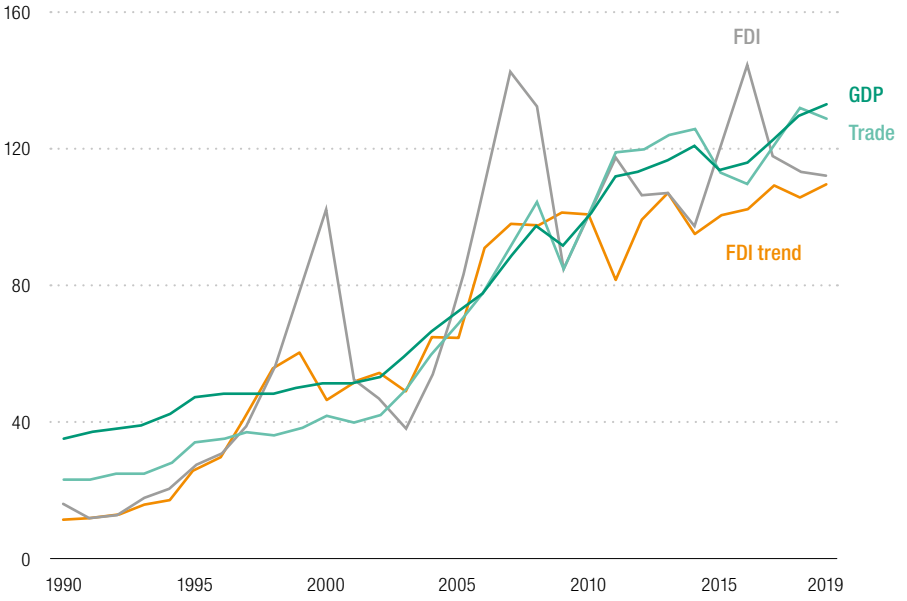


Source: Based on UNCTAD FDI data.

The underlying investment trend line does not show the drops in FDI after the dotcom boom and during the global financial crisis. This suggests that FDI is, at its core, quite stable: investment projects have long gestation periods and investment decisions are not easily reversed on the basis of developments in financial markets. Also, a large part of FDI flows is generated by existing FDI stocks, particularly the non-M&A component – including, for example, reinvested earnings. This time-dependent feature makes the underlying FDI trend less prone to external shocks and inherently more stable.

The underlying trend line follows global macroeconomic indicators, such as GDP and trade, more closely than total FDI (figure 4).

Figure 4. FDI and other macroeconomic indicators, 1990–2019 (Indexed, 100 = 2010)

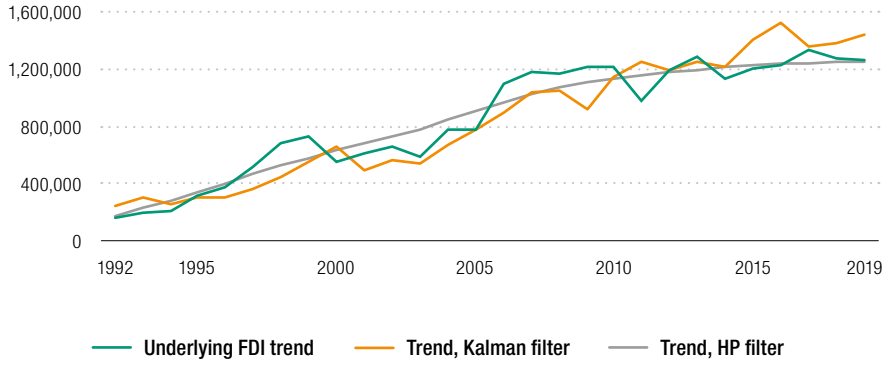


Source: Based on UNCTAD FDI data.

UNCTAD's underlying trend can be seen as an *informed* approach to smoothening the FDI time series. It has the big advantage of offering a very natural economic interpretation of the trend in terms of the underlying components of FDI, as opposed to smoothing techniques, such as filtering techniques, that rely on algorithmic solutions. Figure 5 compares UNCTAD's underlying trend with two alternative well-established filtering techniques applied to FDI time series, that of Hodrick and Prescott (1997) and the state-space model of the Kalman (1960) filter.

The graph suggests that the underlying FDI trend has a pattern similar to the trends calculated with alternative techniques, as also confirmed by high correlation among the three series (see the correlation matrix in table 1A in the appendix). This suggests the robustness of the methodological approach in (3) for the extraction of the FDI trend and provides reassurance about its application for forecasting purposes.

Figure 5. Comparison between the underlying FDI trends and the trends generated by Kalman filtering and HP filtering, 1992–2019 (Millions of dollars)



Source: Estimation based on UNCTAD FDI data.

3. Addressing the second issue (time dependence and cross-country heterogeneity): dynamic panel model

Besides the volatile nature of FDI, intrinsic features of the investment process such as its time dependence and cross-country heterogeneity make FDI forecasting particularly challenging and prone to issues such as endogeneity and reverse causality.

FDI is a dynamic process in which past investment experience serves as a predictor of future investment paths. Investors take time to become familiar with the culture, institutional framework and preferences prevailing in a market. As they learn, they adapt their cross-border investment decisions. Time dependence of investments is also generated "automatically" by the reinvestment of foreign earnings, a component of FDI in national accounts. This inherent time structure requires explicit inclusion of the past (lagged) value into any econometric and forecasting model attempting to explain or predict the behaviour of FDI.

In addition to time dependence, a rich empirical literature has identified various country-level macroeconomic and institutional factors influencing FDI inflows, such as market size, openness, taxes, labour costs, trade costs and exchange rate, among others (for a complete review of FDI determinants and relevant literature, see the *UNCTAD 1998*, and Vujanović (2018)). These factors cause cross-sectional (or spatial) heterogeneity of FDI across countries, which needs to be addressed by the forecasting model directly.

Combining a time-dependent (autoregressive) component and a cross-sectional component in the standard linear model leads to the following formulation of the econometric problem, for the general case with T periods, N observations for each period and M covariates:

$$Y_t = a_1 Y_{t-1} + a_2' X_t + u_t;\ \mathrm{t} = 1, 2, \ldots., \mathrm{T} \quad (4)$$

$$u_t = \eta + \varepsilon_t \quad (5)$$

where Y_t is a $(N \mathrm{x}\ 1)$ vector of dependent variables, X is the $(N \mathrm{x}\ M)$ matrix of the explanatory variables and u_t is the $(N \mathrm{x}\ 1)$ vector of the composite error term consisting of two components (5). The first component η is fixed over time and represents unobserved time-invariant fixed effects, such as the culture or the institutional framework. The second dynamic component, ε_t, is the idiosyncratic error term, independent from the explanatory variables.

Two endogeneity issues – conditions in which an explanatory variable is correlated with the error term – prevent us from estimating eq. (4) with simple OLS regression:

(i) The first issue (simultaneity bias) arises from the fact that the unobservable time-invariant component of the error term (η in 5) is correlated with the (lagged) dependent variable Y_{t-1} $(E[Y_{t-1}, u_t] \neq 0)$ appearing in the right-hand side of the econometric equation (4).

(ii) The second issue (reverse causality) arises as explanatory variables in the covariate matrix X_t are potentially influenced by the dependent variable. Specifically, multinational firms can contribute to host countries' income through production, labour creation and technology transfers (Findlay, 1978), causing reverse causality between GDP and FDI and (upward) bias estimate of GDP coefficient.

Simple cross-sectional methods, such as OLS, are not equipped to deal with endogeneity issues. *Static panel econometric techniques* offer some partial solutions. For example, fixed-effect models attenuate simultaneity bias by de-meaning each variable but do not deal with reverse causality.

Dynamic panel models, such as the *generalized method of moments* (GMM), instead allow for the appropriate consideration of the FDI dynamics while also addressing reverse causality and other potential endogeneities. Broadly, GMM models apply an instrumental variable approach that offers a wide set of internal instruments (available within the data set) to deal with endogenous variables. Their main advantage is to allow for the inclusion of the dynamic component, while solving resulting endogeneity issues with internal – easy to construct – instruments whose validity can be tested. Testing can be performed with the first- and second-order autocorrelation tests as well as the Sargan and Hansen tests of overidentifying restriction.

Finally, adding to their empirical appeal, GMM models do not require distributional assumptions such as the condition of normality and allow for heteroscedasticity (for details on GMM and instrumental variables, see for example Pesaran and Smith (1995) and Greene (2008)).

In the alternative between *differenced GMM* (Arellano and Bond, 1991) and *system GMM* (Arellano and Bover, 1995; Blundell and Bond, 1998), the preference here is given to the latter, which offers a wider choice of instruments (exploiting simultaneously levels and differences) and is more suitable when the panel data show some persistence (this is particularly the case for the underlying FDI trend) (Blundell and Bond, 1998; Roodman, 2009).

4. Model selection and results

We therefore apply system GMM to equation (4) in the following form, including time and regional fixed effects:

$$FDI_{it} = a_1 FDI_{it-1} + a_2' X_{it} + a_3' Z_{it} + \partial_t + \rho_k + u_{it} \quad (6)$$

$$u_{it} = \eta + \varepsilon_t \text{ (i = 1, 2, …., N; t = 1, 2, …., T)}$$

The dependent variable FDI_{it} is FDI inflows to country i at time t, $\mathbf{X_{it}}$ is a vector of M explanatory variables, Z_{it} is a vector of H control variables, and $\boldsymbol{\partial_t}$ and ρ_k are the variables representing time and regional fixed effects, respectively. The error term is the sum of country-specific unobservable fixed effect η and the idiosyncratic error term ε_t. Logarithmic transformation is applied to FDI_{it} as well as to other continuous variables in the vectors X_{it} and Z_{it} (see table 2A in the appendix).[3] The time horizon is 2003–2019 (T = 17). The number of countries N changes according to the year (making an unbalanced panel) because some observations of covariates in the vector Z_{it} are missing for some countries in some years.

A second specification is introduced using the underlying FDI trend as the dependent variable to capture the more structural dynamics of FDI and to mitigate volatility, in line with the discussion in section 2:

$$FDI\_trend_{it} = b_1 FDI\_trend_{it-1} + b_2' X_{it} + b_3' Z_{it} + \partial_t + \rho_k + v_{it} \quad (7)$$

where FDI_trend_{it} is defined by decomposition (3) for each country i, individually, after suppressing the superscript* for notational convenience.

[3] Logarithmic transformation makes the variable's distribution closer to the "normal" bell-shaped one, while allowing the interpretation of the effects in terms of percentage changes.

For FDI forecasting purposes, it is critical to select a set of predictors X_{it} (i) that is significant in explaining the behaviour of FDI and (ii) for which there exist solid forecasts to feed into the forward-looking estimation. The natural choice falls then on the two variables, GDP and trade openness, which are not only the most (theoretically and empirically) established determinants of FDI,[4] but are also supported by long-standing forecasting practice by international institutions. The model is then complemented by a vector of controls Z_{it} that includes other relevant variables such as taxation, income group, tariffs and exchange rate – all theoretically important drivers of FDI (Overesch and Wamser, 2010; Bevan and Estrin, 2004; Carstensen and Toubal, 2004; Martínez-San Román, Bengoa and Sánchez-Robles, 2016; Dixit and Pindyck, 1994; Aliber, 1970). Lacking established sources of their future values, the controls do not enter the forecasting exercise, but they are important to test the robustness of the predictors (the autoregressive term and the explanatory variables). Details on the definition, construction and sources of the dependent and independent variables are provided in the appendix (table 2A).

The results of model (6) and (7) are presented in table 1. The diagnostics tests confirm the model's validity. First- and second-order autocorrelation tests indicate that the instruments are correlated with the endogenous variables but not with the error term. Sargan and Hansen tests also confirm that the instruments, as a group, appear exogenous.

In both models (columns I and II), the lagged dependent variable, GDP and trade openness are significant with the expected positive sign, after controlling for other relevant factors Z_{it}, and for time and regional fixed effects. The coefficient of the lagged dependent variable indicates that the past is a good predictor of the future behaviour of both FDI inflows (column I) and the FDI trend (column II). The positive effect of GDP confirms the importance of market size for FDI inflows. Likewise, trade openness has the expected positive impact on FDI, although much smaller than the impact of GDP. Control variables Z_{it} – taxes, tariffs, exchange rate and the income group – are not statistically significant in either of the models, which is reassuring in regard to the choice – imposed by data constraints – to limit the set of predictors to only GDP and trade.

Comparing the estimates between the two GMM models (column I and column II) provides further insights. The lagged dependent variable affects FDI inflows more strongly than FDI trend. Market size and trade openness, by contrast, have a greater effect on FDI trend, confirming the conceptual intuition (and empirical observation – see figure 4) that the underlying FDI trend can track economic fundamentals more closely.

[4] The theoretical and empirical literature on market size (GDP) and trade openness (trade) as FDI determinants is vast. On the theoretical side, see for example Rodrik (1999) and Keller and Yeaple (2013) for GDP; and Caves (2007) for trade. On the empirical side, useful references for GDP include Resmini (2000); Hilber and Voicu (2010); Estrin and Uvalic (2014); and Blonigen and Piger (2014); and for trade include Janicki and Wunnava (2004); Clausing and Dorobantu (2005); and Du et al. (2014).

Table 1. System GMM estimation results, equation (6) and (7)

	Ln (FDI inflows)	Ln (FDI trend)
$Ln(FDI_{it-1})$ / $Ln(FDI\_trend_{it-1})$	0.665***	0.168*
	(0.132)	(0.160)
$Ln(GDP_{it})$	0.369***	0.825***
	(0.147)	(0.223)
$Openness_{it}$	0.0042**	0.00894**
	(0.00147)	(0.00397)
$Tariffs_{it}$	0.0523	0.0700
	(0.0276)	(0.0492)
Ln (exchange $rate_{it}$)	-0.0419	0.0385
	(0.0686)	(0.0847)
Corporate $taxes_{it}$	0.00243	-0.0158
	(0.00633)	(0.0125)
Income group		
Low income	-0.0181	-0.577
	(0.294)	(0.463)
Lower middle income	-0.117	-0.246
	(0.198)	(0.382)
Upper middle income	0.0327	-0.105
	(0.156)	(0.284)
Regional dummies		
Asia and Oceania	-0.292	-0.477
	(0.168)	(0.323)
Europe	-0.00268	-0.163
	(0.188)	(0.352)
Latin America and the Caribbean	0.102	0.105
	(0.145)	(0.299)
North America	-0.192	-1.045
	(0.309)	(0.544)
Other developed countries	0.240	0.0196
	(0.168)	(0.238)
South-East Europe and the new CIS	0.183	0.0898
	(0.175)	(0.355)
Cons	-1.977*	-3.821*
	(0.874)	(1.859)
Number of observations	866	686
Number of countries	70	61
Period	2003–2019	2003–2019
Model diagnostics (p-values)		
1st order autocorrelation	0.000	0.000
2nd order autocorrelation	0.690	0.601
Sargan test	0.117	0.100
Hansen test	0.377	0.973

Source: Estimation based on multiple sources (see table 2a in the appendix).

Note: Year dummies are excluded from the model results. Africa is a base region (to which other regions are compared) and is omitted from the table results. High-income countries are also the base income group. Standard errors are in parentheses. *** 1% significance level, ** 5% significance level, * 10% significance level.

5. Forecasting FDI with GMM

Panel data econometrics are gaining interest as forecasting tools (Baltagi and Griffin, 1997; Stock and Watson, 2004; Longhi and Nijkamp, 2007; Arkadievich et al., 2008; Girardin and Kholodilin 2011; Wenzel 2013). Yet, their application is still limited relative to time-series econometrics. Their main value added is the ability to control for heterogeneity of FDI across countries (Baltagi, 2013), in addition to the usual dynamic structure. Micro (country) unit contains important information for the dynamics of the aggregate series, and hence, pooling the country data into a panel, can add to the forecasting precision, under the assumption of homogeneity across slope parameters (Fok, Van Dijk and Franses, 2005; Baltagi, 2008; Hsiao, 2014; Dees and Güntner, 2014). The individual countries' forecast errors can also partially cancel out upon aggregation (Theil, 1957; Baltagi, 2013).

The final GMM specifications used in forecasting are derived from (6) and (7) after excluding the control variables Z_{it}:

$$FDI_{it} = a_1 FDI_{it-1} + a_2' X_{it} + \partial_t + \rho_k + u_{it} \quad (8)$$

$$FDI\_trend_{it} = b_1 FDI\_trend_{it-1} + b_2' X_{it} + \partial_t + \rho_k + v_{it} \quad (9)$$

The GMM regressions results for decompositions (8) and (9) (table 3A in the appendix) are fully consistent with the estimates from equations (6) and (7) reported in table 1.

This model has been used to provide the latest 2020-2021 forecasting of FDI inflows and the FDI trend, reported by UNCTAD 2020 (as of June 2020). UNCTAD forecasting has been relying on the past values of FDI up to 2019 (autoregressive term) and the projections of GDP and trade for 2020 and 2021. GDP and trade projections for 2020 and 2021 are sourced from the International Monetary Fund (IMF) World Economic Outlook of April 2020 and from the World Trade Organization (April 2020),[5] respectively.

Table 2 reports the forecasted growth rates of global FDI inflows and the FDI trend for 2020 and 2021, on the basis of the GMM estimation of model (8) and (9) (see table 3A in the appendix) and the IMF and WTO projections for GDP and trade.

The projection indicates a sharp decline of global FDI in 2020, to about a third lower than its value in 2019 (-35 per cent) because of the impact of COVID-19 and pre-existing challenging conditions. COVID-19 is exerting a dramatic impact on FDI

[5] World Trade Organization (2020). Trade set to plunge as COVID-19 pandemic upends global economy, press release, https://www.wto.org/english/news_e/pres20_e/pr855_e.htm.

Table 2. FDI inflows and underlying FDI trend 2020–2021 forecasts, annual growth rate (Per cent)

	2020	2021
FDI inflows	-35	-9
Underlying FDI trend	-12	4

Source: Forecast based on multiple sources: UNCTAD FDI database for FDI data; IMF World Economic Outlook (April 2020) for GDP and WTO (April 2020) for trade. Forecast obtained with Stata statistical software, aggregating country-level forecasts.

Note: UNCTAD projections for FDI inflows in *UNCTAD, 2020* are presented as ranges. For 2020, the reported expected decline of global FDI inflows is between 30 per cent and 40 per cent, including the GMM forecast in the table (-35 per cent) as the middle point (see *WIR 2020*, table I.3, page 8).

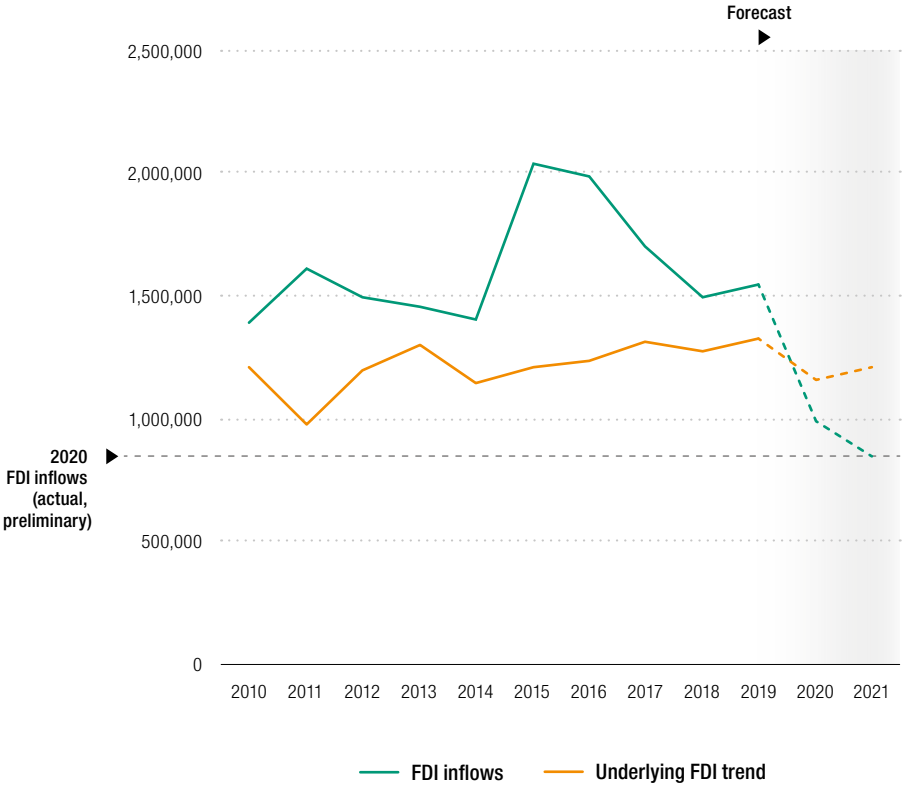
through different channels of transmission: the lockdown measures (supply-side), the automatic effect of reinvested earnings, the recessionary spiral (demand-side) and the policy context (see *UNCTAD, 2020*).

This projection is subject to significant uncertainty. The COVID-19 exogeneous shock adds to the high volatility of the FDI trend over the last two decades. Accounting for this uncertainty, the decline in FDI in 2020 was reported in UNCTAD, 2020 as ranging between -30 per cent and -40 per cent. In 2021 the value of FDI was forecasted to further deteriorate, with an expected decrease of 9 per cent relative to 2020.

As expected, the forecast for the underlying trend – designed to capture the long-term dynamics of FDI, netting out fluctuations driven by one-off factors such as megadeals and volatile financial flows – indicate milder, but still substantial, decline in 2020 (-12 per cent in 2020 relative to the value of the underlying trend in 2019) and the first rebound in 2021 (+4 per cent relative to 2020). The prospects for the underlying trend can be seen as the more systematic effect of the economic crisis, after removing the effect of the temporary shock (mainly related to the lockdown measures). However, by limiting the impact of the highly variable components in FDI, the underlying trend is particularly suitable for the analysis of "normal" times, when the trend and the economic fundamentals drive the dynamics of FDI and the variation is residual. When there are big discontinuities and very large swings, the indication of the underlying trend should be taken carefully (and loosely interpreted as the long-run level to which FDI will eventually revert when the shock is over).

The most recent figures from UNCTAD's *Global Investment Trend Monitor* (January 2021), although preliminary, confirm our most pessimistic forecasts, with a 42 per cent decline in global FDI inflows to a level of $850 billion (figure 6).

Figure 6. FDI inflows and underlying FDI trend, 2010–2019 and 2020–2021 forecasts (Millions of dollars)



Source: Forecast based on multiple sources: UNCTAD FDI database for FDI data; IMF World Economic Outlook (April 2020) for GDP and WTO (April 2020) for trade. Forecast obtained with Stata statistical software, aggregating country-level forecasts. Preliminary figures for FDI inflows 2020 from UNCTAD's *Global Investment Trend Monitor* (January 2021).

Beyond a good forecasting performance in the current year – particularly in capturing the massive discontinuity due to COVID-19 – FDI inflows and the underlying FDI trend are relatively well forecast also for the previous years (table 3). In general, the forecasts for the FDI inflows perform well in capturing the direction of the change – in table 3, the expected sign is in line with the actual sign in 10 out of 12 years – but it allows for potentially very large gaps. The forecast of the FDI trend instead helps mitigate the differences, producing a forecast that is generally closer to the actual values than the FDI inflows, and for some years very close. Yet, large discrepancies persist in some specific years (for example, 2014 and 2015 for FDI inflows, and 2016 and 2009 for the FDI underlying trend).

Table 3. FDI inflows and underlying FDI trend: realized and forecast 2008–2019, annual growth rates (Per cent)

Year	FDI inflows	FDI inflows forecast	FDI trend	FDI trend forecast
2019	3	-2	4	1
2018	-12	-2	-3	-3
2017	-14	-21	7	-4
2016	-3	-12	2	-11
2015	45	2	6	-8
2014	-4	13	-12	-9
2013	-3	-1	8	2
2012	-8	-8	22	6
2011	16	15	-19	-16
2010	13	27	-1	0
2009	-17	-25	4	-11
2008	-21	-9	0	1

Source: UNCTAD FDI data for realised values. Forecasts with Stata statistical software.

6. GMM vs time series: an empirical comparison

Panel data econometric techniques have proved to be quite reliable FDI forecasting tools even in the very challenging context of the current pandemic. Yet, their applications to forecasting, within and beyond FDI, are growing but still quite limited. A lack of general forecasting practice suggests some additional caution, relative to more established forecasting techniques such as in the time-series domain. To this purpose, in this section, we run a complete comparison between GMM forecasting and two time-series forecasting methods: the univariate autoregressive integrated moving average (ARIMA) model, popularly known as the Box-Jenkins (1970) methodology, and the multivariate autoregressive integrated moving average with explanatory variable (ARIMAX) model. The ARIMA model explains the outcome variable –FDI inflow (trend) – as the linear function of its past values and the unknown stochastic error process. The ARIMAX model allows for the inclusion of explanatory covariates, such as GDP. To preserve important country-level information, we apply the time-series forecasting to each of 195 UN-recognized countries individually, and then aggregate them at the global level.

The country-by-country ARIMA models have the following specification:

$$FDI_t = \alpha_o + \sum_{i=1}^{p} \alpha_i FDI_{it-i} + \sum_{i=0}^{q} \beta_i \varepsilon_{t-i} \quad (10)$$

$$FDI\_trend_t = \gamma_o + \sum_{i=1}^{s} \gamma_i FDI\_trend_{it-i} + \sum_{i=0}^{m} \zeta_i \varepsilon_{t-i} \quad (11)$$

where FDI_t (FDI_trend_t) is a function of the autoregressive terms of the order p (s) and the noise is presented as a moving average process of the order q (m), and α_o and γ_o are the two constants of equations (10) and (11), respectively. To allow for the inclusion of GDP as an explanatory variable, we also include an ARIMAX model in the comparison:

$$FDI_t = \alpha_o + \sum_{i=1}^{p} \alpha_i FDI_{it-i} + \lambda_0 GDP_t + \sum_{i=0}^{q} \beta_i \varepsilon_{t-i} \quad (12)$$

$$FDI\_trend_t = \gamma_o + \sum_{i=1}^{s} \gamma_i FDI_{it-i} + \varpi_0 GDP_t + \sum_{i=0}^{m} \zeta_i \varepsilon_{t-i} \quad (13)$$

The appropriate number of p and q (s and m) autoregressive terms are assesed with the use of the autocorrelation function and partial autocorrelation function and their corresponding corellograms. The best model choice is decided with the Durbin and Watson test (for serial correlation) as well as the Akaike and Bayesian information criteria of the model fit (Lütkepohl, 1984; Enders, 2008). The appropriate model choice (10-13), parameters estimation and forecasts are automatized with an automatic forecasting algorithm produced in R software (Hyndman and Khandakar, 2007). Once country-level forecasts of FDI inflows and trend are obtained, they are aggregated at the global level.

To summarize the results of the comparison over the 2008–2019 period, two measures of forecast errors are calculated: mean absolute deviation (MAD) and mean square error (MSE) (table 4). MAD is the absolute difference between the actual value and the forecasted values divided by the number of observations forecasted. MSE is the sum of the squared errors divided by the number of observations forecasted.

The GMM forecasting performance is superior to the two time-series techniques based on both MAD and MSE. Time-series techniques, even when applied to each country, produce less precise forecasts than panel econometric techniques, supporting the relevant theory and empirical evidence (Baltagi et al., 2000; Baltagi, Bresson and Pirotte, 2002; Brücker and Siliverstovs, 2006; see discussion in section 3). Applying the FDI trend improves the precision of forecasting for both the GMM and ARIMA techniques, confirming its validity as a tool to mitigate large variations and smooth the forecasting exercise. The poor forecasting performance of ARIMAX may be caused by the inclusion of endogenous GDP (see discussion in section 3), generating biased estimates at the country level and inflating the forecasts. Although the ARIMA model has better forecasting

performance than the ARIMAX model, it performs less well than the GMM model. The reason could be that ARIMA is a simple univariate technique that only account for the time dynamics of FDI, disregarding external macroeconomic factors that affect investors' preferences.

Table 4. FDI inflows and underlying FDI trend: forecast errors by GMM, ARIMA and ARIMAX

Model	Forecast error	FDI inflow (6)	FDI trend (7)
GMM	MAD	11	7
	MSE	236	87
		FDI inflow (8)	**FDI trend (9)**
ARIMA	MAD	14	9
	MSE	354	147
		FDI inflow (10)	**FDI trend (11)**
ARIMAX	MAD	18	38
	MSE	360	1541

Source: Authors' calculation based on GMM, ARIMA and ARIMAX forecasts over the 2008-2019 period, obtained in Stata (GMM) and R (ARIMA and ARIMAX).

7. Conclusions

One look at the pattern of global FDI inflows in the last 20 years (figure 1) suffices to appreciate why forecasting global FDI has become a very challenging task. Yet, FDI remains one of the most relevant economic targets for countries, especially developing ones, and a key indicator of global economic trends. This paper is a step forward in the development of reliable forecasting tools to predict global FDI.

The methodology presented in this paper was the basis of the UNCTAD forecast of global FDI 2020–2021 reported by *UNCTAD 2020*, produced in the midst of the outbreak of the COVID-19 pandemic. The model has proved to be effective in capturing the observed collapse of global FDI in 2020.

The proposed methodology is based on dynamic panel econometric techniques, particularly the system generalized method of moments (system GMM) of Arellano and Bover (1995) (Blundell and Bond, 1998). Dynamic panel econometric techniques directly address the heterogeneous nature of FDI

across countries and FDI dynamics across time. System GMM is suited to deal with endogeneity issues caused by the inclusion of lagged FDI and GDP among the regressors.

The forecast is applied not only to the FDI inflows but also to the underlying FDI trend. The underlying FDI trend is an alternative representation of FDI inflows, more in line with the economic fundamentals as it reduces noise in the data caused by one-off transactions and financial flows. The forecast of the underlying trend complements the standard FDI forecast by providing an indication of the long-term future dynamics of FDI.

Compared with two alternative time-series techniques (ARIMA and ARIMAX), the GMM models show better predictive performance, supporting the case for the use of panel data techniques (rather than time-series), pooling countries' individual information for forecasting FDI at the aggregate level.

Although highly encouraging, the results presented in this paper should not lead to any general claim about the superiority of this approach. This study aims at providing a step forward stimulating more systematic analysis of different methods in forecasting FDI.

Beyond GMM, other econometric tools deserve investigation. The panel vector autoregression (PVAR) accounts well for the static and dynamic interdependence between variables and between countries, as well as the contemporaneous and lagged effects of exogenous variables (Canova and Ciccarelli, 2004). This could be an important aspect in modeling FDI dynamics, where investors usually take time to react to changed macroeconomic circumstances. Spatial econometric techniques is another interesting option (Baltagi, 2013; Baltagi, Fingleton and Pirotte, 2014). In addition to the heterogonous nature of FDI across counties (and possibly across time) spatial econometric tools account for the spatial (geographical) dependence of FDI and its determinants.

* * *

Improving methods to forecast international investment flows, while seemingly an impossible task due to their lumpy and volatile nature, is important for the policy community. At the national level, it is helpful for policymakers to understand the expected direction of investment trends in processes ranging from designing industrial policies to setting performance targets for investment promotion agencies and special economic zones. At the international level, ongoing efforts to boost investment facilitation and to negotiate investment chapters in regional economic cooperation agreements benefit from greater awareness of the tides against which they are rowing and the currents they can exploit.

A huge push for new investment in infrastructure, renewable energy and Industry 4.0 is expected from the recovery stimulus packages that are being adopted in the more affluent regions of the world. It will be interesting to see how this big push affects investment trends going forward and to what extent the model presented in this paper will be able to capture those effects.

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Appendix

Table 1A. Pearson correlation coefficient matrix, underlying FDI trend, trend - Kalman filter, trend - HP filter

	Trend Kalman filter	Trend HP filter	Underlying FDI trend
Trend Kalman filter	1.0000		
Trend HP filter	0.9702	1.0000	
Underlying FDI trend	0.9496	0.9746	1.0000

Source: Authors' elaboration.

Table 2A. Variables definition, data sources and supporting literature

Variable	Definition	Sources	Literature review
Dependent variable			
FDI	Log (FDI inflows, millions of dollars, current prices)	UNCTAD (national statistical sources and central banks)	
FDI trend	Log (FDI underlying trend (equation1))	UNCTAD	
Main explanatory variables (X_{it})			
Market size	Log (GDP, million of dollars, current prices)	UNCTAD; IMF World Economic Outlook	Resmini, 2000 Bevan and Estrin, 2004 Janicki and Wunnava, 2004 Carstensen and Toubal, 2004 Clausing and Dorobantu, 2005 Hilber and Voicu, 2010 Estrin and Uvalic, 2014
Openness	(Export + Import) / GDP *100	UNCTAD; IMF World Economic Outlook; WTO	Garibaldi et al., 2001 Janicki and Wunnava, 2004 Clausing and Dorobantu, 2005 Du, Harrison and Jefferson, 2014
Controls (Z_{it})			
Tax levels	Log (Corporate tax)	Tax Foundation	Carstensen and Toubal, 2004 Clausing and Dorobantu, 2005 Overesch and Wamser, 2010
Labour cost/ Income	Dummy variable for different income groups	World Bank	Holland and Pain, 1998 Resmini, 2000 Janicki and Wunnava, 2004 Bevan and Estrin, 2004 Carstensen and Toubal, 2004
Tariffs	Log (Import tariffs on manufacturing goods, ores and metal)	UNCTAD	Cardamone and Scoppola, 2012 Carstensen and Toubal, 2004 Du, Harrison and Jefferson, 2014 Hijzen, Görg and Manchin, 2008
Exchange rate	Log (Exchange rate – compared to dollar)	International Financial Statistics, central banks	Blonigen, 1997 Abbott, Cushman and De Vita, 2012 Cavallari and d'Addona, 2013 Jeanneret, 2016

Source: Authors' elaboration.

Table 3A. System GMM estimation results, specification (8) and (9)

	FDI inflows Model (8)	FDI trend Model (9)
Autoregressive term		
Log (FDI_{t-1})	0.485*** (0.0977)	
Log (FDI $trend_{t-1}$)		0.328*** (0.0736)
Macroeconomic factors		
Log (GDP)	0.340** (0.153)	0.643*** (0.109)
Trade openness	0.00356** (0.00175)	0.00538*** (0.00111)
Regional dummies		
Asia and Oceania	0.210 (0.251)	-0.135 (0.166)
Europe	0.447 (0.328)	0.125 (0.281)
Latin America and the Caribbean	0.363* (0.195)	0.143 (0.166)
North America	1.042 (0.655)	-0.0263 (0.489)
Other developed countires	0.735** (0.293)	0.336 (0.216)
South East and the new CIS	0.308** (0.130)	0.245* 0.130)
Time dummies		
2004	0 (.)	0.197** (0.0861)
2005	0 (.)	0.0437 (0.111)
2006	0.328*** (0.0979)	0.378*** (0.0947)
2007	0.341*** (0.0927)	0.248* (0.137)
2008	0.315*** (0.107)	0.287*** (0.109)
2009	-0.0287 (0.111)	0.222* (0.131)
2010	0.150 (0.115)	0.241** (0.108)
2011	0.261** (0.113)	0.0890 (0.138)
2012	0.198* (0.103)	0.161 (0.133)

.../...

Table 3A. System GMM estimation results, specification (8) and (9) (Concluded)

	FDI inflows Model (8)	FDI trend Model (9)
Time dummies		
2013	0.0870 (0.107)	0.0870 (0.126)
2014	0.130 (0.115)	0.166 (0.126)
2015	0.0252 (0.117)	0.0690 (0.141)
2016	0.181 (0.115)	0.194 (0.125)
2017	0.141 (0.119)	0.123 (0.127)
2018	0.159 (0.109)	0.00881 (0.127)
2019	0.0497 (0.108)	0.0787 (0.133)
_cons	-0.554 (1.107)	-2.645*** (0.721)
Number of observations	1662	1829
Number of countries	111	111
Diagnostics (p-value)		
Autocorrelation tests		
1st order	0.000	0.000
2nd order	0.106	0.108
Hansen test	0.099	0.732

Source: Estimation based on multiple sources (see table 2a).

Note: Africa is a base region (that other regions are compared to) and is omitted. Standard errors in parentheses. *** 1% significance level, ** 5% significance level, * 10% significance level.

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Printed at United Nations, Geneva
GE

UNCTAD/DIAE/IA/2021/1
United Nations publication
Sales ETN281
ISSN 1014-9562

ISBN 978-92-1-1130140