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DOES CAPITAL DRAIN REDUCE TOTAL FACTOR PRODUCTIVITY GROWTH IN DEVELOPING COUNTRIES?

This study investigates the effects of foreign direct investment (FDI) and royalties and licence fees (RLF) on total factor productivity (TFP) growth of about 90 countries for the period 2003-2011 for both inward and outward variables. The estimates for the full sample indicate that while inward FDI stocks have no significant impact, outward FDI stocks reduce TFP growth. While none of the RLF measures have any significant effects, imports and exports have significantly positive effects on TFP growth for the full sample. Outward FDI stocks and RLF payments are estimated to have negative effects on TFP growth for developing nations. Moreover, both RLF receipts and payments are found to have a positive effect on TFP growth in developed nations. To stimulate TFP growth further, developing nations should improve their domestic business environments and find ways to keep investments at home.

Keywords: capital drain, FDI, RLF, TFP growth
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1. INTRODUCTION

This paper examines the nexus between technology transfer and total factor productivity (TFP) growth. The authors think that it is a worthwhile effort to consider both inward and outward economic parameters associated with foreign direct investment (FDI) stock and royalties and licence fees (RLFs) together as important channels of technology and knowledge transfer. RLFs reflect the international bilateral exchange (trade) of the main outcomes of R&D activities and FDIs reflect the practical exploitation of available technological capacity in other regions by Multinational Enterprises (MNEs). These variables enable undertaking a more detailed analysis to estimate the impact of some other embodied R&D spillovers not directly measured by R&D capital stocks.

Moreover, TFP growth and international technology transfer cannot be separated from each other. The process of dissemination of commercial

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technology across economies is vitally important for TFP growth (Sharma and Ambrammal, 2015) since foreign sources of technology constitute approximately 90% or more of domestic productivity growth (Keller, 2009). Despite a large number of empirical studies associated with FDI in terms of technology transfer, these spillover effects have been examined associated mostly with inward variables. Empirical studies associated with RLF measures are also very limited. Although the studies mostly focus on various types of productivity spillover channels, they mostly ignore RLF trade in their empirical analyses for productivity spillovers as a direct way of technology transfer. The study thus employs both RLF payments and RLF receipts to fill this gap. In today's world, not only developed countries but also developing countries continuously seek ways to gain more from the global economy by increasing their outward investments. However, capital drain has important implications for home countries, too. Given the increasing recognition of productivity growth as the key to long-term growth, measuring and evaluating the determinants of total factor productivity in such a way are imperative both for economists and policy makers.

This study empirically analyses the effects of the inward and outward measures of FDI and RLF on TFP growth for developed and developing countries separately by using the common framework. The authors found the significantly negative effects of outward FDI stocks on TFP growth for developing countries. This is an important contribution to the empirical literature because many studies report the results contrary to the theoretical expectation of the literature. The study also concludes that the main technology transfer channels for developing countries have been exports and imports given the results that RLF measures have no positive effects on TFP in these countries.

The next section discusses the relevant literature. The data and empirical methodology are discussed in Section 3. The results are presented in Section 4, followed by the concluding Section 5.

2. LITERATURE REVIEW

Coe and Helpman (1995) in one of the earliest studies on the relationships between R&D spillovers and productivity calculated both domestic and foreign R&D capital stocks of 22 countries (21 OECD countries and Israel) for the period 1971-1990. They found that international R&D spillovers have a positive impact on productivity and depend on the level of trade openness. Engelbrecht (1997) extended the study by Coe and Helpman (1995) adding a human capital variable. Since there exists innovation outside the R&D sector

and formal R&D does not capture some aspects of human capital, he concluded that human capital has a distinct role within the growth of OECD countries by its impact on TFP. Coe et al. (2009) first revisited the study of Coe and Helpman (1995) by using panel cointegration estimation techniques, and then extended the dataset from 22 to 24 countries and the period from 1971-1990 to 1971-2004. Their main findings were: (1) after controlling for the impact of human capital, domestic and foreign R&D capital stocks have measurable impacts and (2) institutional differences such as ease of doing business, the quality of tertiary educations systems, patent protection and legal systems based on different origins (French, Scandinavian, English and German law) are important determinants of TFP and affect the degree of R&D spillovers. If the quality of the tertiary education system is relatively high, such countries tend to benefit more from their own R&D efforts, from international R&D spillovers and from human capital formation. Countries whose legal origins are based on English and German law benefit relatively more from their own and foreign R&D capital. In a recent study, Bournakis et al. (2017) showed that institutional factors such as stronger protection of intellectual property rights and great ease of doing business determine the impact of FDI-related spillovers on productivity.

There are many studies investigating the role of FDI on TFP. However, they mostly focus on inward FDI and associated variables. Although a number of studies (Liu and Wang, 2003; Arisoy, 2012; Haskel et al., 2007; Baltabaev, 2014; and Newman et al., 2015) provide evidence for the positive effect of inward FDI on TFP, contradictory results (Fan and Hu, 2007; Murakami, 2007; Irsova and Havranek, 2013; Elmawazini, 2014; and Bitzer and Görg, 2005) were also observed. In a recent study, Herzer and Donaubauer (2017), considering the mixed results, revisited this issue for developing countries for the period 1981-2011. They used panel cointegration and causality techniques to examine the long-term effects of the level of inward FDI on the level of TFP for 49 developing countries. They found that FDI has a negative long-term effect on TFP in developing countries and its impact is determined by human capital, financial development and trade openness.

Regarding outward FDI, by questioning whether firms investing abroad simultaneously reduce their domestic activities, Desai et al. (2009) investigated the relationship between the domestic and foreign operations of US manufacturing firms between 1982 and 2004. Their results indicate that expansion abroad actually increases a firm's domestic activity. Herzer (2011) found a positive long-run effect of outward FDI on domestic TFP over the period of 1980-2005 for 33 developing countries. Imbriani et al. (2010) concluded that there is a positive effect of outward FDI on productivity and

employment in manufacturing and a negative effect of outward FDI on productivity and employment in services for the period 2002-2007. Hsu et al. (2011) reported the insignificant effect of outward FDI on productivity for 15 Taiwanese manufacturing industries over the period 1991 and 2007. However, they found that outward FDI of Taiwan increases its own productivity if outward FDI goes to other destination countries but not to China. Hyun and Jang (2015) reported that outward FDI increases productivity in industries through the intra-sectoral reallocation of firms using industry-level data from 1992 to 2008.

Amann and Virmani (2014) examined the effect of R&D spillovers resulting from outward FDI flows from 18 emerging economies into 34 OECD countries over the 1990-2010 period, comparing the impact with those of spillovers resulting from inward FDI flows. Their results show that outward FDI from emerging economies into OECD countries has a positive and significant impact on the TFP growth of emerging economies. The effect here is mitigated through the transfer of foreign R&D capital, but the magnitude of the impact is smaller than that of R&D spillovers resulting from inward FDI flows in the opposite direction. Similarly, Xianfeng and Yan (2013) evaluated the reverse technology spillovers[1] based on the panel data of Chinese outward FDI to 26 ASEAN countries from 2003 to 2010 by using time series methods. Their findings suggest that the role of reverse technology spillovers on promoting China's economic growth has been proved, but the size of the effect is less than that of inward FDI flows. Considering outward FDI and inward FDI stocks separately in the estimates[2], Zhu and Jeon (2007) concluded that both inward and outward FDI yield substantial technology transfers. Khan and Luintel (2006), by identifying ten important determinants of productivity from different theoretical models, examined their relationship with productivity for a sample of 16 OECD countries. Among these variables, they employ the stocks of outward FDI and inward FDI separately.

Kim et al. (2015) examined the spillover effects focusing on FDI flows by classifying the OECD countries as Northern countries and non-OECD countries as Southern countries. Their findings support the North-South effects indicating the positive effects of FDI inflows from developed countries on TFP of developing countries, but they did not find any evidence for the South-South effect. As to the impact of outward FDI from developed countries on

[1] Reverse technology spillovers are defined as the getting of technology spillover from host country to home country by FDI after MNEs get closer to R&D resources in the host country (Xianfeng and Yan, 2013).

[2] They test the foreign R&D stocks, weighted by inward FDI stock and outward FDI stock, separately in regressions.

their own productivity, Tang and Altshuler (2015) observed significant productivity spillovers from outward FDI of the United States by using data from 1999 to 2009. Bitzer and Görg (2005) found that outward FDI stock of a country has a negative effect on productivity for 17 OECD countries. In a study of ten manufacturing sectors in 17 OECD countries, Bitzer and Kerekes (2008) failed to find any positive spillovers from outward FDI although they found positive externalities of FDI inflows.

There are fewer studies on spillovers considering royalties and licenses fees. Pessoa (2008) is one of the rare studies examining the effects of RLF indicators. He examined the effects of RLF and FDI on host countries' TFP for 16 OECD countries for the period 1985-2002 and found that the impact of inward FDI on TFP in a host country is positive and the inward FDI and RLF payments are substitutes in positively influencing TFP of a host country. He explained his results by the scant technological content of production and exports with the scarce use of RLF such as patents, brand names, copyrights, etc. Alvarez and Marin (2013) examined technology spillovers by focusing on high-tech export performance and reported that while royalty payments have significantly positive spillover effects, royalty receipts have significantly negative spillover effects for developing countries. They also found that royalty receipts are correlated with high-tech export performance, R&D efforts and royalty payments do not have any significant effects for developed countries.

3. MODEL AND DATA

Given the Cobb-Douglas production function in equation (1):

$$Y_{i,t} = A_{i,t} K_{i,t}^{\alpha} L_{i,t}^{\beta} \tag{1}$$

where Y is the output level for country i at time t; A is the level of total factor productivity; K is the capital stock level; and L is the amount of labour available. Let us now take logs of the production function and differentiate with respect to time to obtain the TFP growth function as in equation (2):

$$\dot{A}_{i,t} = \dot{Y}_{i,t} - \alpha \dot{K}_{i,t} - \beta \dot{L}_{i,t} \tag{2}$$

where a dot above a symbol means that a derivative is taken with respect to time. For example, "A dot" shows the annual rate of change of TFP.

In fact, capital productivity may vary for different types of capital. Thus, inward or outward capital movements can have different impacts on domestic capital productivity. One can then discuss the impact of capital drain, as a proxy for outward FDI flows, on TFP through this channel.

Simply by focusing on capital (this is also valid for labour but the authors just focus here on capital for reasons of simplicity), assume that K_{total} is the amount of capital in period 0. This is the sum of the amount of capital available inside in the country (K_{inside}) and the amount of capital probably goes outside the country ($K_{outside}$):

$$K_{total} = K_{inside} + K_{outside} . \tag{3}$$

In period 0 total capital is just K_{total} because of no capital drain:

$$\dot{TFP}_0 = \dot{Y}_0 - \alpha \dot{K}_0 - \beta \dot{L}_0 \tag{4}$$

If there is capital drain in period 1, then $K_1 = K_{inside}$. Thus, the Cobb-Douglas production function will be:

$$\dot{TFP}_1 = \dot{Y}_1 - \alpha \dot{K}_1 - \beta \dot{L}_1 \tag{5}$$

Assume that the amount of labour remains constant, one can then compare $TFP_{0,}$ with TFP_1 :

$$\dot{TFP}_1 - \dot{TFP}_0 = \left(\dot{Y}_1 - \alpha \dot{K}_{inside}\right) - \left(\dot{Y}_0 - \alpha \dot{K}_{total}\right) \tag{6}$$

There can be three different cases:

If $K_{outside}$ is as productive as K_{total} , then $\dot{TFP}_0 \quad \dot{TFP}_1$.

If $K_{outside}$ is more productive than K_{total} , then $\dot{TFP}_0 > \dot{TFP}_1$.

If $K_{outside}$ is less productive than K_{total} , then $\dot{TFP}_0 < \dot{TFP}_1$.

Thus, if drained capital is more productive than the remaining capital, then capital outflows are expected to decrease TFP growth. However, if drained capital is less productive than the remaining capital, then they are expected to increase TFP growth.

Regarding the model outlined above, the authors consider the following autoregressive panel data model for TFP growth. In general, this model can be shown as follows:

$$y_{it} = \alpha y_{i,t-1} + \theta X_{it} + \varepsilon_{it}, \tag{7}$$

$$\varepsilon_{it} = \mu_i + \nu_{it}, \tag{8}$$

$$E\left[\mu_i\right] = E\left[\nu_{it}\right] = E\left[\mu_i \nu_{it}\right] = 0, \tag{9}$$

where: y_{it} is the dependent variable which reflects TFP growth in the study; $y_{i,t-1}$ is the lag of the dependent variable, and X_{it} is a vector of characteristics

measured during, or at the start of, the period. Here the disturbance term has two orthogonal components: the fixed effects, μ_i, and the idiosyncratic shocks, v_{it} (Bond et al., 2001; Roodman, 2006). However, the dynamic panel bias is available because of the endogeneity of $y_{i,t-1}$ to the fixed effects in the error term. To deal with this endogeneity, transforming data by taking first difference and instrumenting $y_{i,t-1}$ and any other similarly endogenous variables with variables thought uncorrelated with the fixed effects are potential solutions and system GMM uses the latter (Roodman, 2006). Thus, the authors employ the following model similar to Baltabaev (2014) in the empirical part of the study:

$$\begin{aligned} tfpg_{i,t} = \; & \alpha_0 + \alpha_1 \mathrm{Ltfpg}_{i,t} + \alpha_2 \ln\left(\mathrm{cappc}\right)_{i,t} + \alpha_3 \ln\left(\mathrm{hc}\right)_{i,t} + \ldots \\ & + \alpha_4 \mathrm{rlaw}_{i,t} + \alpha_5 \ln\left(\mathrm{FDI}\right)_{i,t} + \alpha_6 \ln\left(\mathrm{RLF}\right)_{i,t} + \ldots \\ & + \alpha_7 \ln\left(\mathrm{R\ \&\ }D\right)_{i,t} + \alpha_8 \ln\left(\mathrm{DTF}\right)_{i,t} + \ldots \\ & \alpha_9 \ln\left(\mathrm{Export\ /\ GDP\ or\ Import\ /\ GDP}\right)_{i,t} + \varepsilon_{i,t}, \end{aligned} \tag{10}$$

where *tfpg* is TFP growth for country *i* at period *t*; *Ltfpg* is one-period lagged tfpg; *cappc* is capital stock per capita; *hc* is human capital index; *rlaw* reflects perceptions of agents in the economy in terms of confidence and abiding by the rules of society; (*FDI*) is the ratio of inward or outward *FDI* stocks to *GDP*; (*RLF*) is the ratio of *RLF* payments (imports) or *RLF* receipts (exports) to *GDP*; *R&D* is the ratio of *R&D* expenditures to *GDP*; *DTF* reflects the distance to technology leader country in terms of labour productivity; (*export/GDP*) and (*import/GDP*) are the ratio of imports or exports to *GDP*, respectively. For detailed explanations of the variables and their sources, see Appendix Table A1. Table 1 provides a summary of the statistics.

It is important to note that this study employs FDI stock values instead of flows because stock values are more likely to enable coping with the issue of reverse causation. FDI flows are more likely to be affected by economic conditions in host countries causing endogeneity (see Cipollina et al., 2011). Moreover, FDI stock values enable to capture medium to long-term effects through accumulating FDI flows (Bitzer and Görg, 2005). Another important point is the assumption that FDI has a role in the contribution to the stock of general-purpose technology available in the economy (Figini and Görg, 2006).

Table 1

Summary statistics

		All countries	Developing countries	Developed countries	All countries		
Variables	Obs.	Mean values			Q1	Median	Q3
tfpg	990	0.842	1.283	-0.189	-0.93	0.84	2.51
cappc	990	48865	21982	111593	10861	30143	79249.86
hc	990	2.632	2.482	2.983	2.33	2.75	2.97
rlaw	990	0.200	-0.317	1.407	-0.63	0.08	1.02
FDIISGDP	986	47.69	31.92	84.61	17.62	30.44	47.36
FDIOSGDP	929	24.514	4.815	66.85	1.11	4.78	22.81
RLFrGDP	735	0.290	0.098	0.645	0.01	0.05	0.2
RLFpGDP	856	0.580	0.246	1.310	0.08	0.2	0.39
R&D	666	1.063	0.577	1.79	0.34	0.73	1.62
DTF	990	7.888	10.71	1.293	1.57	3.26	7.67
XGDP	987	45.668	39.48	60.04	26.34	39.3	54.42
MGDP	987	47.614	45.23	53.14	28.93	40.66	57.57

Notes: tfpgis calculated as the yearly TFP growth; cappc=capital stock per capita is calculated as capital stock (rkna) divided by population (pop) (cappc= rkna/pop) from PWT 8.1; hc= index of human capital per person, based on years of schooling (Barro/Lee, 2012) and returns to education (Psacharopoulos, 1994); rlaw=Rule of Law reflects perceptions of the extent to which agents have confidence in and abide by the rules of society" from the 2015 update of The Worldwide Governance Indicators; FDIISGDP=the ratio of FDI instock to GDP; FDIOSGDP=the ratio of FDI outstock to GDP; RLFrGDP=the ratio of Royalties and Licenses Fee (RLF) receipts (exports) to GDP; RLFpGDP=the ratio of Royalties and Licence Fees (RLF) payments (imports) to GDP; R&D=R&D intensity (the ratio of R&D Expenditure to GDP); DTF=Distance to the Technological Frontier calculated as labour productivity of the US (Amax) divided by the labour productivity of the country (Ai) under consideration (Baltabaev, 2014); MGDP=the ratio of imports to GDP; XGDP=the ratio of exports to GDP.

Source: author's calculations.

4. EMPIRICAL RESULTS

4.1. The GMM results: full data set

The model described in equation (10) was estimated for all countries using both FDI and RLF measures. The specifications include the following determinants of TFP growth: the natural logarithm of the capital stock per capita for the physical capital stock; the natural logarithm of value of human capital index for the human capital; the rule of law index for institutional

quality; the value of imports (or exports) as a percentage of GDP for trade openness; the ratio of R&D expenditures to GDP; distance to the technological frontier; and various measures of FDI stocks and RLF figures.

This study first reports the system GMM estimation results for the full sample. Table 2 reports the GMM estimates for inward and outward variables.

Table 2

The system GMM estimations: full data set

	INWARD					OUTWARD			
	(1)	(2)	(3)	(4)		(5)	(6)	**(7)**	**(8)**
Ltfpg	0.375*** (0.000)	0.323*** (0.008)	0.348*** (0.001)	0.381*** (0.000)	Ltfpg	0.298*** (0.006)	0.182* (0.057)	0.219*** (0.003)	0.276** (0.019)
lncappc	0.028 (0.674)	0.063 (0.203)	0.065 (0.208)	0.071 (0.287)	lncappc	0.041 (0.576)	0.100 (0.116)	0.037 (0.147)	0.130** (0.018)
lnhc	0.166 (0.113)	0.155* (0.089)	0.126 (0.201)	-0.064 (0.605)	lnhc	0.187 (0.148)	0.101 (0.300)	0.101* (0.072)	0.018 (0.837)
rlaw	-0.097*** (0.003)	-0.077*** (0.008)	-0.078** (0.010)	-0.037 (0.258)	rlaw	-0.099** (0.011)	-0.067** (0.011)	-0.003 (0.905)	0.011 (0.612)
lnR&D	0.012 (0.459)	-0.004 (0.814)	-0.015 (0.503)	-0.014 (0.564)	lnR&D	0.016 (0.415)	0.016 (0.221)	-0.001 (0.865)	-0.004 (0.771)
lnDTF	0.013 (0.817)	0.055 (0.207)	0.048 (0.347)	0.006 (0.908)	lnDTF	-0.020 (0.810)	0.103** (0.034)	0.042* (0.086)	0.170*** (0.008)
lnFDIISGDP	0.007 (0.730)	-	0.025* (0.088)	-0.027 (0.258)	lnFDIOSGDP	-0.023** (0.046)	-	-0.011** (0.022)	-0.016** (0.032)
lnRLFpGDP	-	0.010 (0.191)	0.005 (0.429)	-0.005 (0.535)	lnRLFrGDP	-	0.000 (0.794)	0.000 (0.791)	0.003 (0.322)
lnMGDP	-	-	-	0.155** (0.012)	lnXGDP	-	-	-	0.058** (0.025)
Constant	-0.343 (0.668)	-0.786 (0.203)	-0.821 (0.203)	-0.660 (0.397)	Cons	-0.525 (0.530)	-1.121* (0.077)	-0.569* (0.061)	-1.543 (0.015)
AR1	**0.001**	**0.005**	**0.002**	**0.001**	**AR1**	**0.001**	**0.001**	**0.000**	**0.001**
AR2	**0.277**	**0.197**	**0.307**	**0.875**	**AR2**	**0.668**	**0.541**	**0.765**	**0.836**
Hansen	**0.164**	**0.366**	**0.180**	**0.227**	**Hansen**	**0.326**	**0.266**	**0.175**	**0.393**
Instruments	**72**	**72**	**81**	**82**	**Instruments**	**72**	**72**	**65**	**74**
Groups	**92**	**87**	**87**	**87**	**Groups**	**92**	**83**	**79**	**79**
Observations	**664**	**606**	**604**	**604**	**Observations**	**639**	**550**	**534**	**534**

Notes: See Table 1for notes for variable definitions. The Hansen test checks the validity of instruments where the null hypothesis is instruments are not correlated with the residuals. The Arellano-Bond AR test measures the first (AR(1)) and second order (AR(2)) autocorrelation. Time (year) dummies included in the estimates. All variables except time dummies are considered as endogenous or predetermined variables in the estimates. T test p values (based on robust standard errors) are in parenthesis. *, **, *** indicate significance at 10%, 5% and 1% levels, respectively.

Source: author's calculations.

The model is estimated for a sample of about 90 countries for a sample period of 2003-2011. The AR(1) and AR(2) tests are the Arellano-Bond tests for autocorrelation in these estimations, where the AR(1) tests are significant and the AR(2) tests are insignificant. This means there is autocorrelation in AR(1); however, the authors observed no autocorrelation in first difference levels of AR (2). While considering autocorrelation in GMM, the Hansen tests provide test statistics for the validity of instruments. In order to be confident about the appropriateness of the instrument set, the number of countries in the estimates should be more than or equal to the number of instruments. High (insignificant) *p* values for these Hansen tests in these estimations indicate that this group of instruments is exogenous and the instruments are strong enough.

The statistically significant and positive estimated coefficients on the lagged dependent variable in all specifications in Table 2 indicate that there is a considerable persistency in TFP growth. While physical capital stock and human capital are mostly insignificant with the correct signs, rule of law is negatively significant in most specifications. Other control variables include R&D expenditures and distance to technology frontier. The former variable has insignificant coefficients both for inward and outward measures, but the latter variable has significantly positive coefficients only for outward measures. The significantly positive coefficients on the distance to technology frontier indicate that the closer the country is to the technology frontier, the higher TFP growth it has.

The estimates reported in the first four columns of Table 2 are for the impact of inward FDI stock and RLF payments (imports) on TFP growth. If they are included separately in the estimates, none are statistically significant. When included together, inward FDI stocks have a weak positive and significant effect on TFP growth for the baseline estimations. In the fourth column of Table 2, there are added imports as a percentage of GDP to the estimations since the import channel is another important channel for technology transfer for most countries. Although the authors obtained insignificant coefficients for inward FDI stock and RLF measures, the significantly positive estimated coefficients on imports clearly imply that imports increase TFP growth through this channel.

Columns 5 to 8 of Table 2 report the system GMM estimations for outward FDI stocks and RLF receipts. Estimated coefficients for the control variables for the outward analysis are very similar to those for inward measures except for DTF. However, estimation results for outward FDI stocks are substantially different from those for inward FDI stocks. The statistically significant and negative estimated coefficients on outward FDI stocks clearly indicate that

outward FDI stocks reduce TFP growth for all countries. As discussed below, this conclusion is primarily driven by the estimates for developing countries. Similarly, to RLF payments, RLF receipts also have no significant effects on TFP growth the full sample, and as with imports, exports have also a significant and positive effect on TFP growth.

4.2. The GMM results: by income levels

It is possible that the coefficients for FDI and RLF vary between income levels. For developed countries, assuming that they have higher productivity levels if inward FDI flows to these countries from developing countries due to relatively low values of A_K and A_L in the latter countries, it is less likely for them to experience positive technology spillover effects. If inward FDI flows occur to developing countries from developed countries, it is then much more likely for developing countries to have positive spillovers. For the differential effect of FDI outflows on TFP growth is that if developing home countries are more likely to send more productive capital abroad for competing in global markets compared to developed home countries, this type of FDI outflows may then reduce TFP growth in developing home countries. For example, by analysing the investment behaviour of Slovenian firms over the period from 1994 to 2002, Damijan et al. (2007) empirically find that more productive, capital-intensive and larger firms are more likely to invest abroad. Similarly, Simpson (2012) reports that relatively more productive UK firms are able to overcome high fixed costs of investing in a number of different countries.

To investigate the potential parameter heterogeneity, the authors thus divided the sample into two groups: developing and developed countries[3]. The system GMM estimations for inward FDI stocks and RLF payments by income levels are reported in Table 3, and there are similar results for control variables for both developing and developed countries except for their distance to technology frontier, which is mostly significant and positive only for developing countries.

While the study estimation results for inward FDI stocks do not differ for income levels, the results for RLF payments do significantly differ with income levels. Significantly negative estimated coefficients on RLF payments indicate that while they reduce TFP growth in developing countries, RLF payments increase TFP growth in developed countries. These results also show that imports do not affect TFP growth differently based on income levels.

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[3] The list of countries is available upon the request. Countries are divided into two groups based on the World Bank country classification.

Table 3

The system GMM estimations for inward measures: by income levels

	(1)-0	(1)-1	(2)-0	(2)-1	(3)-0	(3)-1	(4)-0	(4)-1
Ltfpg	0.259*** (0.002)	0.403*** (0.000)	0.302*** (0.003)	0.352*** (0.000)	0.263* (0.063)	0.331*** (0.000)	0.174** (0.028)	0.328*** (0.000)
lncappc	0.061 (0.245)	-0.008 (0.583)	0.084 (0.107)	-0.007 (0.496)	0.128* (0.063)	-0.001 (0.908)	0.010 (0.321)	-0.001 (0.913)
lnhc	0.085 (0.204)	-0.008 (0.723)	0.089 (0.229)	-0.004 (0.850)	0.075 (0.334)	-0.022 (0.400)	0.000 (0.985)	-0.023 (0.461)
rlaw	0.012 (0.467)	-0.014 (0.293)	0.017 (0.152)	0.000 (0.969)	0.034 (0.154)	0.002 (0.864)	-0.017 (0.107)	0.002 (0.860)
lnR&D	-0.006 (0.562)	0.003 (0.687)	-0.004 (0.586)	-0.005 (0.454)	-0.004 (0.724)	-0.006 (0.366)	0.001 (0.820)	-0.007 (0.365)
lnDTF	0.112* (0.072)	-0.016 (0.259)	0.111** (0.046)	-0.010 (0.355)	0.175* (0.052)	-0.010 (0.399)	0.005 (0.421)	-0.010 (0.393)
lnFDIISGDP	0.009 (0.599)	0.011 (0.184)	-	-	-0.009 (0.755)	-0.004 (0.292)	-0.002 (0.873)	-0.004 (0.333)
lnRLFpGDP	-	-	-0.017** (0.020)	0.002 (0.367)	-0.018** (0.031)	0.005* (0.099)	0.002 (0.687)	0.006* (0.050)
lnMGDP	-	-	-	-	-	-	0.020 (0.380)	-0.001 (0.838)
Constant	-0.859 (0.189)	0.155 (0.296)	-1.200* (0.065)	0.084 (0.569)	-1.746* (0.053)	0.040 (0.817)	-0.053 (0.678)	0.040 (0.824)
AR1	**0.001**	**0.057**	**0.002**	**0.065**	**0.004**	**0.076**	**0.001**	**0.079**
AR2	**0.244**	**0.445**	**0.652**	**0.211**	**0.687**	**0.210**	**0.362**	**0.212**
Hansen	**0.180**	**0.393**	**0.434**	**0.768**	**0.342**	**0.914**	**0.216**	**0.912**
Instruments	**56**	**32**	**56**	**32**	**49**	**33**	**50**	**34**
Groups	**62**	**32**	**57**	**30**	**57**	**30**	**57**	**30**
Observations	**401**	**263**	**354**	**252**	**354**	**250**	**354**	**250**

Notes: See Table 2. For each cell, the first number in parenthesis refers to the regression number of inward parameters in Table 2 and the second one refers to the income level of countries: 0 for developing countries and 1 for developed countries.

Source: author's calculations.

The findings of the positive effects of RLF payments on TFP growth of developed countries are consistent with the findings of Pessoa (2008). The negative impact of RLF payments on TFP growth of developing countries may, however, indicate the opportunity cost of technology transfer by licence to technology generating and production for developing countries. Since the share of developed countries (especially for the USA) in RLF payments is

very high[4], the authors included a dummy variable for the US in the estimates. With the US dummy, the results for developed countries turn out to be insignificant. Thus, significant results for developed countries in terms of RLF payments cannot be generalized.

Similarly**,** Table 4 presents the estimation results for outward FDI stocks and RLF receipts by income levels. Statistically significant and negative coefficients suggest that outward FDI stocks lower TFP growth for developing countries although they fail to have any significant effects on TFP growth for developed countries. These results clearly imply that capital drain reduces TFP growth in developing countries. Assuming that relatively more productive capital (and probably effective entrepreneurs) is more likely to exit from these countries, it is then not surprising to see this inverse effect on TFP growth. It is important to note that although these results contradict the findings of some empirical studies, they are solely consistent with the theoretical expectations of the literature, as discussed above.

Similar to the estimation results for RLF payments, RLF receipts have also differential TFP growth effects on developing and developed countries. The results imply that RLF receipts have positive impacts only on TFP growth for developed countries[5]. The positive impact of RLF receipts on TFP growth for developed countries is consistent with the findings of Alvarez and Marin (2013). The results for outward FDI stocks and RLF receipts are robust to the inclusion of a number of control variables such as physical capital stock, human capital, institutional quality, R&D expenditures, and relative backwardness measures.

By employing a large number of control variables, the estimation results provide substantial evidence for the significant and negative impact of outward FDI stocks on TFP growth for the full sample and for developing countries. For further robustness checks, the authors also tested the models by the fixed effects estimations. The overall conclusions did not change in any significant way. The authors report the fixed effects estimations in the appendix. These interesting results can be explained by at least two arguments. One possible explanation for the inverse effects is the distribution of outward FDI stocks among developing and developed countries. For the differential spillover effects based on the destination countries whether developed (North) or

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[4] Developed countries account for more than 75% of total RLF payments. The share of USA and EU5 together in total RLF payments was approximately 33% in 2003 and 29% in 2012.

[5] Since the US has been responsible for almost half of the RLF receipts for the period considered in the study, we also include a dummy variable for the US. An inclusion of US dummy does not change our conclusions from the estimation results for RLF receipts.

Table 4

The system GMM estimations for outward measures: by income levels

	(5)-0	(5)-1	(6)-0	(6)-1	(7)-0	(7)-1	(8)-0	(8)-1
Ltfpg	0.072 (0.476)	0.384*** (0.000)	0.365*** (0.004)	0.172** (0.037)	0.222** (0.025)	0.198** (0.010)	0.228*** (0.005)	0.188** (0.014)
lncappc	0.126 (0.141)	-0.007 (0.423)	0.073 (0.378)	-0.003 (0.601)	0.079 (0.114)	-0.004 (0.598)	0.007 (0.340)	-0.004 (0.646)
lnhc	0.123 (0.265)	-0.025 (0.627)	0.062 (0.706)	-0.001 (0.932)	0.053 (0.377)	0.001 (0.946)	0.093** (0.046)	-0.003 (0.818)
rlaw	0.041* (0.092)	0.004 (0.811)	0.011 (0.621)	-0.004 (0.316)	0.016 (0.406)	-0.006 (0.180)	0.003 (0.656)	-0.005 (0.244)
lnR&D	-0.016 (0.344)	-0.001 (0.776)	-0.013 (0.409)	0.004 (0.283)	-0.011 (0.334)	0.002 (0.387)	-0.002 (0.644)	0.003 (0.234)
lnDTF	0.179* (0.076)	-0.010 (0.509)	0.102 (0.192)	0.004 (0.710)	0.096 (0.162)	-0.000 (0.933)	0.012 (0.145)	-0.000 (0.954)
lnFDIOSGDP	-0.020** (0.016)	-0.004 (0.811)	-	-	-0.018* (0.053)	0.001 (0.701)	-0.007* (0.063)	0.000 (0.966)
lnRLFrGDP	-	-	0.000 (0.931)	0.002* (0.053)	0.003 (0.284)	0.002* (0.052)	-0.000 (0.994)	0.002* (0.053)
lnXGDP	-	-	-	-	-	-	-0.028 (0.231)	0.000 (0.789)
Constant	-1.793* (0.083)	0.103 (0.464)	-0.990 (0.255)	0.078 (0.328)	-1.063* (0.093)	0.089 (0.375)	-0.232* (0.064)	0.088 (0.382)
AR1	**0.008**	**0.056**	**0.003**	**0.002**	**0.005**	**0.001**	**0.002**	**0.001**
AR2	**0.361**	**0.558**	**0.519**	**0.276**	**0.620**	**0.290**	**0.656**	**0.288**
Hansen	**0.454**	**0.656**	**0.515**	**0.385**	**0.711**	**0.458**	**0.373**	**0.513**
Instruments	**56**	**32**	**56**	**32**	**49**	**33**	**50**	**34**
Groups	**60**	**32**	**54**	**29**	**50**	**29**	**50**	**29**
Observations	**376**	**263**	**309**	**241**	**295**	**239**	**295**	**239**

Notes: see Tables 2 and 3.

Source: author's calculations.

developing (South) countries, Amann and Virmani (2014) in studying outward FDI from South to North and Liu et al. (2015) in studying FDI into high-wage countries (horizontal FDI) reported that if the destination is North (developed countries), a positive productivity spillover can be expected and vice versa. Moreover, Liu et al. (2015) suggested that if the destination is a Southern country (vertical FDI), the possible effects are going to be negative. Given

that South-South outward FDI stock has increased from $1.7 trillion in 2009 to $2.9 trillion in 2013 (World Investment Report, 2015), the increasing trend for South-South outward FDI may be one of the causes for such a significant negative impact; note also that between 1990 and 2004, outward FDI from developing and transition countries to developing and transition countries was much higher than to developed countries. For some years, more than 90% of outward FDI (excluding offshore financial centres) went to developing and transition economies (World Investment Report, 2006).

Moreover, the negative impact of outward FDI on TFP growth for developing countries can also be explained by the increasing share of service industry in the world outward FDI stocks. These results are consistent with the findings of Imbriani et al. (2010) on the negative impact of outward FDI of services on domestic employment and productivity, since world FDI stocks in services have been steadily increasing[6]. The share of services in outward FDI stock of developing countries increased from 45% to 81% and the share of manufacturing in outward FDI stock of developing countries decreased from 53% to 14% between 1990 and 2004. For developed countries, the share of services increased from 47% to 67% and the share of manufacturing decreased from 44% to 28% for the same period (World Investment Report, 2006).

CONCLUSION

This paper empirically examined the effects of FDI and RLF on TFP growth of about 90 countries for the period 2003-2011. For the full sample, the system GMM results indicated that while outward FDI stocks have significantly negative effects, inward FDI stocks have no significant effects on TFP growth. Moreover, neither RLF payments nor RLF receipts have any significant effects on TFP growth for the full sample. The results also imply the significantly positive effects of imports and exports on TFP growth for all countries.

The authors then obtained several interesting results from the estimations for income levels. The estimations clearly show that the negative effect of outward FDI stocks on TFP growth is mainly driven by the results for developing countries. Both the ever increasing role of South-South FDI flows

[6] The share of world FDI stocks in services increased from 49% to 63% and the share of manufacturing FDI stocks decreased from 41% to 26% between 2001 and 2012 (World Investment Report, 2015).

and the increasing share of services in their outward FDI taken together can provide possible explanations for the negative impacts of outward FDI on TFP of South (developing) countries. This finding is crucial because many studies theoretically emphasize the negative effect of outward FDI on TFP growth for home countries even though empirical studies to date have failed to find evidence to support their theoretical expectations. Regarding inward FDI stocks, the results failed to provide satisfactory evidence to indicate the positive effect of inward FDI on TFP growth. At the same time, considering the sub-samples of countries, while RLF payments reduce TFP growth in developing countries, RLF receipts increase TFP growth in developed countries. The negative effect for developing countries may indicate the opportunity cost of technology transfer by licence to technology generating and production for developing countries.

The negative effects of outward FDI and RLF payments on TFP growth in developing countries have important policy implications for these countries. To stimulate nationwide TFP growth further, developing nations should improve their domestic business environments and find ways to keep productive investments at home, especially for some industries. Given that capital flows are among the main channels of integrating to the global economy for developing nations, they should reconsider their FDI and RLF policies to benefit more from these flows. To investigate the TFP growth effects of FDI and RLF flows thoroughly, the trends of both North and South bilateral FDI/RLF statistics and their distributions by industry (services or manufacturing) should not be overlooked. The understanding of the nature of interactivity between countries within and across borders has great significance for policy development and decision-making in today's world. The authors believe that this study fills an important gap in terms of these dimensions.

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APPENDIX

Table A1

Data definitions and sources

PARAMETERS	EXPLANATIONS	DATA SOURCES
Tfpg	TFP growth (tfpg) which we calculated by TFP statistics (rtfpna) from Penn World Table (version 8.1). In PWT 8.1, there is data between 1950 and 2011. The last available year for data is 2011 and that is why the limit of the study is 2011.	Penn World Table 8.1 (See Feenstra et al. (2015)); http://www.rug.nl/research/ggdc/data/pwt/pwt-8.1
Cappc	Capital stock per capita, cappc which is calculated by dividing capital stock (rkna) by population (pop) (cappc=rkna/pop) from PWT 8.1.	Penn World Table 8.1 (See Feenstra et al. (2015)); http://www.rug.nl/research/ggdc/data/pwt/pwt-8.1
Hc	Index of human capital per person, hc which is index of human capital per person, based on years of schooling from PWT 8.1 (Barro/Lee, 2012) and returns to education (Psacharopoulos, 1994).	Penn World Table 8.1 (See Feenstra et al. (2015)); http://www.rug.nl/research/ggdc/data/pwt/pwt-8.1
rlaw	*"Rule of Law reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. We used this data from the 2015 update of The Worldwide Governance Indicators which is available for the dates between 1996 and 2014."* (From definitions of WGI).	World Governance Indicators, World Bank; http://info.worldbank.org/governance/wgi/index.aspx#home
(FDI) FDIISGDP, FDIOSGDP	FDI Stocks/GDP. FDI Stocks statistics are available at the statistics database of UNCTAD (1980-2014) and GDP statistics are available among World Development Indicators of the World Bank.	UNCTAD and the World Bank; http://unctadstat.unctad.org http://data.worldbank.org/indicator
(RLF) RLFpGDP, RLFrGDP	RLF receipts or payments/GDP. We primarily use the RLF data which is available in the statistics database of UNCTAD as Royalties and Licenses Exports or Imports (2003-2012). For missed variables we benefit from the database of WDI as Charges for the use of intellectual property, payments or receipts (when we conducted our analysis, the latest available data was for 2005-2014 and being updated in 22.12.2015) Thus 2003 became another limit for the analysis.	UNCTAD and the World Bank; http://unctadstat.unctad.org http://data.worldbank.org/indicator
R&D	R&D expenditures over GDP calculated from WDI R&D expenditures as % GDP multiplying by 100.	http://data.worldbank.org/indicator
DTF	By referencing Baltabaev (2014), "Distance to the technological frontier calculated as labour productivity of the US (Amax) divided by the labour productivity of the country (Ai) under consideration."	UNCTAD and the World Bank; http://www.rug.nl/research/ggdc/data/pwt/pwt-8.1
(Export/GDP) or Import/GDP) MGDP XGDP	Imports/GDP or exports/GDP.	World Bank, World Development Indicators; http://data.worldbank.org/indicator

Source: own elaboration.

Table A2

The fixed effects estimations: full data set

	INWARD					OUTWARD			
	(1)	(2)	(3)	(4)		(5)	(6)	(7)	(8)
lncappc	-0.104*** (0.007)	-0.084** (0.024)	-0.085** (0.023)	-0.088** (0.011)	lncappc	-0.117*** (0.005)	-0.053** (0.047)	-0.058 (0.173)	-0.073* (0.073)
Lnhc	0.323** (0.029)	0.216* (0.078)	0.221* (0.074)	0.248* (0.064)	lnhc	0.230* (0.057)	0.141 (0.186)	0.115 (0.284)	0.146 (0.221)
Rlaw	0.020 (0.307)	0.022 (0.334)	0.022 (0.335)	0.025 (0.222)	rlaw	0.024 (0.239)	-0.001 (0.940)	-0.003 (0.833)	0.004 (0.778)
lnR&D	-0.001 (0.934)	-0.006 (0.552)	-0.006 (0.552)	-0.009 (0.400)	lnR&D	-0.002 (0.873)	-0.004 (0.671)	-0.003 (0.729)	-0.005 (0.611)
lnDTF	-0.077* (0.052)	-0.082* (0.095)	-0.082* (0.091)	-0.093* (0.053)	lnDTF	-0.110** (0.021)	-0.039 (0.176)	-0.052 (0.247)	-0.067 (0.102)
lnFDIISGDP	-0.003 (0.625)	-	-0.003 (0.697)	-0.005 (0.558)	lnFDIOSGDP	-0.011*** (0.004)	-	-0.006** (0.035)	-0.007** (0.019)
lnRLFpGDP	-	0.004 (0.315)	0.004 (0.328)	0.004 (0.312)	lnRLFrGDP	-	0.003** (0.016)	0.003** (0.024)	0.002 (0.131)
lnMGDP	-	-	-	0.050*** (0.000)	lnXGDP	-	-	-	0.043*** (0.004)
Cons	0.855 (0.027)	0.749 (0.071)	0.756 (0.068)	0.802 (0.034)	Cons	1.078** (0.018)	0.484 (0.146)	0.560 (0.299)	0.720 (0.151)
Observations	664	606	604	604	**Observations**	639	550	534	534
F test (p-value)	0.0000	0.0000	0.0000	0.0000	**F test (p-value)**	0.0000	0.0000	0.0000	0.0000
Adjusted R^2	0.438	0.444	0.445	0.463	**Adjusted R^2**	0.473	0.515	0.528	0.545

Notes: See Table 1 and Table A1 for variable sources and definitions. The F test finds the joint significance of estimated coefficients. p-values (based on robust standard errors) are in parentheses. *, **, *** indicate significance at 10%, 5% and 1% levels, respectively.

Source: author's calculations.

Table A3

The fixed effects estimations for inward measures: by income levels

	(1)-(0)	(1)-(1)	(2)-(0)	(2)-(1)	(3)-(0)	(3)-(1)	(4)-(0)	(4)-(1)
lncappc	-0.075* (0.064)	-0.131** (0.023)	-0.046 (0.116)	-0.083 (0.125)	-0.044 (0.140)	-0.087 (0.133)	-0.056** (0.049)	-0.104* (0.097)
lnhc	0.445*** (0.005)	0.083 (0.761)	0.299** (0.010)	-0.122 (0.539)	0.288** (0.012)	-0.113 (0.574)	0.300** (0.012)	-0.150 (0.456)
rlaw	-0.002 (0.889)	0.065* (0.095)	-0.008 (0.538)	0.079* (0.068)	-0.008 (0.562)	0.080* (0.070)	0.004 (0.701)	0.083* (0.069)
lnR&D	0.004 (0.526)	-0.006 (0.868)	0.002 (0.807)	-0.025 (0.407)	0.001 (0.889)	-0.024 (0.418)	-0.002 (0.727)	-0.020 (0.483)
lnDTF	-0.096*** (0.002)	-0.254*** (0.002)	-0.082** (0.024)	-0.262*** (0.000)	-0.077** (0.038)	-0.263*** (0.000)	-0.094*** (0.009)	-0.262*** (0.000)
lnFDIISGDP	-0.007 (0.373)	-0.000 (0.936)	-	-	-0.010 (0.379)	-0.002 (0.695)	-0.015 (0.156)	-0.002 (0.649)
lnRLFpGDP	-	-	-0.002 (0.577)	0.006** (0.031)	-0.002 (0.622)	0.007* (0.095)	-0.002 (0.444)	0.008* (0.079)
lnMGDP	-	-	-	-	-	-	0.062*** (0.000)	-0.035 (0.231)
Cons	0.519 (0.163)	1.356** (0.027)	0.329 (0.351)	0.960* (0.052)	0.296 (0.404)	1.003* (0.060)	0.466 (0.166)	1.217** (0.038)
Observations	401	263	354	252	354	250	354	250
F test (p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Adjusted R^2	0.491	0.545	0.496	0.614	0.499	0.614	0.532	0.618

Notes: See Table A2. For each cell, the first number in parentheses refers to the regression number of inward parameters in Table A2 and the second one refers to the income level of countries: 0 for developing countries and 1 for developed countries.

Source: author's calculations.

Table A4

The fixed effects estimations for outward measures: by income levels

	(5)-(0)	(5)-(1)	(6)-(0)	(6)-(1)	(7)-(0)	(7)-(1)	(8)-(0)	(8)-(1)
lncappc	-0.093*	-0.121**	-0.044	-0.018	-0.043	-0.018	-0.095*	-0.025
	(0.078)	(0.013)	(0.134)	(0.721)	(0.431)	(0.722)	(0.073)	(0.612)
lnhc	0.369**	0.082	0.294**	-0.224	0.247**	-0.224	0.347**	-0.225
	(0.010)	(0.746)	(0.017)	(0.233)	(0.040)	(0.236)	(0.014)	(0.228)
rlaw	0.001	0.068*	-0.009	0.017	-0.011	0.017		
	(0.921)	(0.093)	(0.541)	(0.374)	(0.480)	(0.376)	0.002 (0.906)	0.015 (0.457)
lnR&D	0.004	-0.003	-0.006	0.006	-0.006	0.005	-0.009	
	(0.576)	(0.938)	(0.592)	(0.727)	(0.607)	(0.738)	(0.446)	0.006 (0.709)
lnDTF	-0.119**	-0.242***	-0.079**	-0.150**	-0.078	-0.150**	-0.137**	-0.162**
	(0.012)	(0.001)	(0.027)	(0.035)	(0.183)	(0.037)	(0.026)	(0.030)
lnFDIOSGDP	-0.008***	-0.010	-	-	-0.007***	0.001	-0.008***	-0.000
	(0.001)	(0.392)			(0.006)	(0.802)	(0.000)	(0.983)
lnRLFrGDP	-	-	0.002	0.004***	0.002	0.004***		0.005***
			(0.289)	(0.000)	(0.350)	(0.000)	0.002 (0.237)	(0.000)
lnXGDP	-	-	-	-	-	-	0.075***	-0.019
							(0.000)	(0.360)
Cons	0.781	1.232**	0.297	0.507	0.292	0.507		
	(0.171)	(0.015)	(0.392)	(0.328)	(0.663)	(0.331)	0.863 (0.179)	0.588 (0.255)
Observations	376	263	309	241	295	239	295	239
F test (p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Adjusted R^2	0.512	0.558	0.550	0.634	0.565	0.633	0.609	0.635

Notes: See Table A2. For each cell, the first number in parentheses refers to the regression number of inward parameters in Table A2 and the second one refers to the income level of countries: 0 for developing countries and 1 for developed countries.

Source: author's calculations.