EQUILIBRIUM
Quarterly Journal of Economics and Economic Policy
Volume 13 Issue 1 March 2018
p-ISSN 1689-765X, e-ISSN 2353-3293
www.economic-policy.pl

ORIGINAL PAPER

Citation: Pietrucha, J., Żelazny, R., Kozłowska, M., & Sojka, O. (2018). Import and FDI as channels of international TFP spillovers. *Equilibrium. Quarterly Journal of Economics and Economic Policy, 13*(1), 55–72. doi: 10.24136/eq.2018.003

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Received: 27 May 2017; Revised: 13 December 2017; Accepted: 2 February 2018

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Import and FDI as channels of international TFP spillovers

JEL Classification: *O11; O33; O50; C23*

Keywords: *technology transfer; growth; trade; foreign investment; TFP*

Abstract
Research background: In existing studies two main channels of international technology spillovers are extensively discussed — trade and FDI. Nevertheless empirical studies give mixed results regards the nature and extent of trade and FDI spillovers.
Purpose of the article: The aim of the article is to study import and foreign direct investments (FDI) as channels of international TFP spillovers.
Methods: We employ dynamic spatial autoregression (SAR) methods. Our panel comprises data for 41 developed and upper mid-developed countries over the period 1995–2014.
Findings & Value added: Our preliminary results show that (1) the trade and investment channels are both important for technology transfer, (2) the degree of their significance depends on the absorptive capacity such as good quality of the institutions.

Introduction

Total factor productivity (TFP) provides a synthetic assessment tool to measure the evolving efficacy of inputs deriving from progress in technology. Easterly and Levine (2001) suggest that "economists should devote more effort toward modeling and quantifying TFP". One of the well-known TFP determinants are spillover effects of technology (or more general productivity). Spillover effects are particularly interesting as an international phenomenon. The influential work by Coe and Helpman (1995) has generated a numerous follow up studies aimed at deepening the understanding of technology spillover.

Spillover effects may be transmitted by a few channels. Some part of capital endowment is purchased overseas and has a positive effect on the quality of domestic gross fixed and human capital stock. Foreign direct investment facilitates the direct and indirect transfer of technology. Knowledge transfer is promoted through foreign trade, and in particular through goods and service imports from countries with more advanced technology. Knowledge transfer may also be promoted by the formal and informal exchange of human capital stock across different countries due to trade- and FDI unrelated relationships. Individual countries may also benefit from global science and technology resources and patent solutions. There is a growing body of literature that addresses different channels of international spillovers. Nevertheless, whether international technology spillovers are FDI and trade-related is still a debated issue.

Considering the above, further in-depth research is required to verify the hypothesis on the relevant role of selected transmission channels of international TFP spillover effects. The aim of the paper is to elucidate on import and FDI as the channels of international TFP spillovers using dynamic spatial autoregression (SAR) methods. We also test trade (i.e. import) and FDI unrelated spillovers using a geographical distance matrix. Our paper is structured as follows: in the next section, we review the related literature on international spillover effects, in section 2 we discuss the data and the empirical model. Section 3 presents the empirical results.

Literature review

Grossman and Helpman (1991) analyzed the impact that technology spillovers through trade have on a small country. They suggest that knowledge is related to the "number of contacts" that an agent has with its trading partners abroad. They argue that local knowledge capital is likely to vary positively with the extent of contact between domestic agents and their counterparts in the international research and business communities and that the number of such contacts increases with the level of commercial exchange. Coe and Helpman (1995), using a sample of 22 advanced countries over the period 1971–1990, investigated the trade-related channel of international knowledge transmission. They found statistically significant and relatively large values for the trade-related channel.

Initially, trade has been considered as a main channel of technology diffusion; however, further studies increased the number of channels, adding foreign direct investment, R&D and international patenting (for literature review to the year 2007 see: Isaksson, 2007). A short review of selected studies after 2007 is provided in Table 1. Two main channels of international technology spillovers are discussed — trade and FDI. Empirical studies give mixed results, but mostly show that technology diffusion via FDI and trade is the main factor for TFP growth. Furthermore, some authors indicate the importance of additional factors that enhance absorption of knowledge. The details are shown in Table 1.

The state of the art of current research on potential channels of international TFP spillovers selected in Table 1 can be summarized as follows:

- they identify many paths and different ranges of technology spillover across borders (i.e.: import, export, inward FDI, outward FDI, patents stock),
- import and FDI are channels which are more often examined than others (this can be an incentive for further research)
- most of them use the static and dynamic panel data analysis,
- most of them confirmed statistically significant linkages between TFP and selected channels of spillovers.

We would like to expand the existing literature with a study of import and FDI channels using dynamic spatial autoregression (SAR) methods.

Research methodology & data

Different types of spatial interaction effects may be considered (Elhorst, 2017): (1) endogenous interaction effect, which measures whether the dependent variable of unit “i” depends on the dependent variables of other units, (2) exogenous interaction effects in that the dependent variable of unit i depends on the explanatory variables of other units, (3) an interaction effect among the error terms. Consequently, different spatial econometric models are proposed (Anselin *et al*., 2008, Elhorst, 2017) — among others: (i) the spatial autoregressive (SAR) model containing the endogenous interaction, (ii) the spatial error model (SEM) containing the interaction effect among the error terms. As we are looking for interaction between TFP of "i" country and TFP of the other countries, we employ the SAR model. SAR models have some limitation (Elhorst, 2017). (1) They show only one type of spatial interaction effect. (2) Spillover effects are global by construction. (3) The ratio between the spillover effect and direct effect is the same for every explanatory variable. Nevertheless, our approach gives acceptable results regarding our main goal of the research.

The following dynamic spatial autoregression (SAR) model is estimated:

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$$TFP_{it} = \phi_i + \rho TFP_{it-1} + \rho_s \sum_{j=1}^{N} w_j TFP_{jt} + \sum_{j=1}^{k} \gamma_j X_{jit} + \widetilde{\varepsilon}_{it} \tag{1}$$

where TFP is total factor productivity, X is the set of control variables.

Dynamic SAR specification allows for the additional spatial autoregressive term:

$$\rho_s \sum_{j=1}^{N} w_j TFP_{jt} \tag{2}$$

where w_j denotes spatial weights.

We use three different sets of spatial weights:

- inverse of physical distance between capitals,
- investment links computed as the ratio of FDI stock from country "j" to total FDI stock in country "i",
- trade links computed as the ratio of import value from country "j" to total import value of country "i".

The first set of spatial weights allows to capture a larger picture of spatial links that are trade- and FDI unrelated and produced by the "diffusion of ideas" (Eaton & Kortum, 1996; Fracasso & Vittucci Marzetti, 2013), with no underlying international market transactions. The second set of spatial weights allows for the capture of spillover via the foreign investment channel, and the third via the import channel.

The model is estimated with the bias-corrected quasi maximum likelihood approach proposed by Yu *et al*. (2008) using the Stata function xsmle developed by Belotti *et al*. (2016). The heteroscedasticity robust standard errors, which allow for different variances of the error term in each country, are reported.

Elhorst (2010) shows that the bias corrected quasi maximum likelihood approach proposed by Yu *et al*. (2008) outperform others like: ML estimator based on Hsiao *et al.* (2002) and the GMM estimator based on Arrelano and Bond (1991). Recently, some new proposals have been developed, but bias corrected quasi maximum likelihood approach produces acceptable results compared to other different estimators of the fixed effects dynamic panel data models.

Our panel comprises data from 41 developed and upper mid-developed countries over the period 1995–2014. We take into account 35 members of the OECD and the EU states that are not in the OECD, i.e.: Bulgaria, Croatia, Cyprus, Lithuania, Malta and Romania. The full list of the countries are presented in Table 2.

TFP data was taken from the Penn World Table (Feenstra *et al*., 2015). We examine: TFP level at current PPPs and TFP at constant national prices. A growing body of literature shows several determinants of TFP in micro, meso and macro levels (Isaksson, 2007; Islam, 2008; McMorrow *et al*., 2010; Danquah *et al*., 2014). In this article, the macro approach will be applied. Based on theoretical and empirical studies, the following sources of TFP change could be mentioned:

- gross fixed capital stock formation and learning by doing among the investors (Kaldor, 1957; Arrow, 1962; Danquah *et al*., 2014);
- human capital stock formation (Schultz, 1961; Uzawa, 1965; Lucas, 1988; Mankiw *et al*., 1992; Vandenbussche *et al*., 2006);
- the accumulation of science and technology expertise, R&D expenditures and patents (Shell, 1966; Schmookler, 1966; Romer, 1990; Aghion & Howitt, 1992, 1997; Jones, 1995; Guellec and van Pottelsberghe de la Potterie, 2001; Griffith *et al*., 2004; Abdih & Joutz, 2005);
- the rate of innovation and the distance from the technology frontier (Aghion & Howitt, 2006);
- trade openness (Grossman & Helpman, 1991; Islam, 2008; Danquah *et al*., 2014),
- FDI (Isaksson, 2007);
- the institutional environment (King & Rebelo, 1990; Rebelo, 1991; Acemoglu *et al*., 2001; Freire-Seren, 2001; Nicoletti & Scarpetta, 2003; Rodrick *et al*., 2004; Ulubasoglu & Doucouliagos, 2004; Acemoglu, 2013; Balcerzak & Pietrzak, 2016);
- geography (Rodrick *et al*., 2004; Isaksson, 2007; Islam, 2008; Danquah *et al*., 2014);
- spillover effects (Becker *et al*., 1990; Romer, 1986; Romer, 1990; Coe *et al*., 1997; Lucas, 1988; Furková & Chocholatá, 2017).

Consequently, our set of macroeconomic control variables is comprised of relevant variables in line with previous studies. They include, among others: human capital indicators, research and development expenditures, quality of institution indicators and capital stock. The data sources are presented in Table 3.

Results & discussion

First, we have focused on TFP level at current PPPs. All international spillover transmission channels turned out to be statistically significant. Both geographic distance as well as FDI and import play a role in promoting and sustaining international TFP spillover effects. The details are shown in Table 4.

It is also necessary to draw attention to certain results concerning control variables. The institutional environment turned out to be statistically significant. Due to the collinearity of variables, such as political stability and absence of violence/terrorism (PSAVT), government effectiveness, regulatory quality, rule of law, and control of corruption, PSAVT represents the institutional environment as a whole. The results for human capital index and PSAVT allow an interpretation whereby the positive role of international spillover effects must imply certain absorption capacity, such as high quality of institutional environment.

The applied measure of human capital, i.e., human capital index, is based on the average years of schooling and an assumed rate of returns to education. A negative sign of the coefficient is strongly surprising, but not rare in past studies (Balta & Mohl, 2013). Acemoglu *et al.* (2006) have pointed out that investments in research-type education (which usually needs more years of education) should pay off most in areas that are close to the world technological frontier because such areas specialize in innovation. Investments in vocational and lower types of education (which is usually shorter) should pay off most in areas below the technological frontier. It is likely that the relationship between years of schooling and TFP is more complex than simply linear — which is beyond the aim and scope of our paper and requires separate research.

Domestic patents have a significant effect on TFP insofar as import-related spatial effects are taken into account. They remain insignificant for other cases, which may suggest that domestic TFP is largely based on technology stimulated by the inflow of FDI.

Variables such as FDI inflow and trade openness (export and import as % of GDP) are no significant. In other words, FDI inflow and foreign trade volumes in our research do not matter. What matters is where investment comes from and the direction of trade. Interestingly, R&D expenditure also turned out to be irrelevant. The research seems to suggest that domestic R&D expenditure may be of lesser significance if TFP relies on international spillover effects. This is reflected in the opinions revealing the actual significance of R&D for pushing the technology frontier in only several of the most developed countries. It seems reasonable to pursue in-depth research in the area and replace the R&D independent variable in the face of the fact that international databases fail to provide satisfactory data on the subject. It would be recommended to redefine knowledge creation as a resource rather than a stream variable.

Our models were also recalculated to test the sensitivity of the outcomes to changing research methods — all variables were recalculated into 5-year means. Spatial weights for only 4 of the closest trade partners were also tested (and 4 closest countries for geographic distance). In principle, all results are similar to the baseline research, both spillover channels being statistically significant.

The second stage of the research was focused on TFP dynamic. Both spillover channels, i.e., FDI and import, proved to be statistically significant. Additionally, two control variables, i.e., FDI and a share of foreign trade in GDP, proved to be significant, which is an important change when compared to the research on TFP levels. Both variables have a positive effect on TFP change, which may suggest that they contribute to promoting the short-term effect of international technological shocks. Moreover, GFCS has a significant positive effect on TFP change only insofar as FDI-related spatial effects are taken into account. This is caused by the necessity to secure a certain quality of gross fixed capital stock and resource productivity in countries receiving capital such as FDI in relation to countries sending the capital. The details are shown in Table 5.

All our results show that foreign knowledge spillovers are negatively affected by distance, are trade-related and FDI-related, as well as closely associated with existing international trade and investment relationships. It can be concluded that trade and investment channels are important for technology transfer, but the degree of their significance depends on the absorptive capacity such as good quality of the institutions.

A number of limitations of our research that may influence the interpretation should be clearly showed:

– We employ SAR approach that uses only one type of spatial interaction effect.
– Sets of spatial weights are assumed to remain constant over time.

– Our study deals with the group of OECD and EU countries, i.e. relatively well-developed countries. As a result, spillover channels typical for countries with a lower level of development may be underestimated in the study.
– The requirements of including a broad group of OECD and EU countries cause that the time period of the study is greatly restricted.

Conclusions

We have studied import and foreign direct investments (FDI) as channels of international TFP spillovers using dynamic spatial autoregression (SAR). The research carried out on the sample of 41 OECD and EU countries from 1995–2014 corroborates the statistical significance of international TFP spillover effects for the following transmission channels: geographic distance, FDI, and import. The above channels turned out to be significant both for TFP levels and TFP change. Apart from the effect of foreign TFP through identified transmission channels, we show other significant determinants for TFP levels and TFP change:
- TFP values delayed by one year, which represent the continuity of technological advance processes
- the quality of the institutional environment, which creates conditions that either promote or curtail the opportunities to harness the potential of international TFP spillovers.

In the subsequent stage of the research, the research cohort will be expanded with a view to more diversity of the countries in terms of technological progress. The list of control variables will also be modified and expanded.

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Annex

Table 1. Selected empirical studies on international spillover of technologies

Authors	Description
Madsen (2007)	Madsen, using a dataset on imports of technology and total factor productivity for OECD countries over 135 years, examines whether knowledge has been internationally transferred through the channel of trade. The study shows that TFP growth is strongly influenced by imports of knowledge, with no occurrence of additional channels of knowledge transmission (e.g. trade openness, knowledge generated by multinational companies). These results indicate that the relationship between variables (transfer of knowledge through trade and TFP) is based on genuine connection. Empirical estimates present that 93% of the increase in TFP has been caused by imports of knowledge. It is also shown that TFP convergence is mainly contributed to by knowledge spillovers.
Madsen (2008)	The paper considers the effect of international patent stocks on TFP for 16 OECD countries over the past 120 years. Three potential channels have been considered: international patenting, knowledge spillovers through the channel of imports and transmission of world knowledge through channels that are not related to import or international patenting. TFP growth is highly determined by patents and knowledge spillovers through the channel of trade. However, the TFP effect is unequally distributed over the OECD countries. The final results indicate that international knowledge is one of the most essential factors behind economic growth, but should be supported by a highly educated labor force.
Krammer (2010)	The paper studies a panel on 27 emerging economies and 20 developed countries for the period 1990–2006. Import continues to exist as a main channel of diffusion for both groups of countries, while FDI remains a less significant factor for recipients. Due to transitional disinvestment and relative obsolescence, domestic R&D capital stock has a lower impact in Eastern Europe than in Western Europe. Additionally, the influence of human capital has been pondered. In accordance with the results, at the same time, it has a direct and indirect effect. Directly, these are effects on TFP as a factor of production, while the indirect effect is submitted by boosting the country's absorptive capacity.
Blomström & Kokko, (2011)	The paper discusses the connection between FDI and the diffusion of technology. The positive effect of FDI is not automatic, but is strongly influenced by a country's attributes. Additionally, the host country must undertake policies that contribute to affirmative results. Term policies indicate basic activities focused on fiscal incentives and technology transfer requirements to attract multinational foreign firms; however, they are not depicted as sufficient to create valid knowledge spillovers. Two additional suggestions are provided by the research. The first pays attention to policies that promote local technological capability and labor skills, which result in better absorption of foreign technology, but also cause a decrease in the transfer cost of intra-firm technology. The second suggestion indicates the importance of a competitive environment. The increased effect of spillovers to local industry is determined by national and international competition provided to MNCs.
Fawaz & Moghadam (2013)	This paper investigates the dependence of Total Factor Productivity among trading partners to account for technological spillover effects. This is done according to dynamic panel data for the 1960–2010 period for 22 OECD countries. The previous values of TFP in country "i" positively explain its current values. Most importantly, the TFP of a country is positively related to the lagged values of the TFP of its top three trading partners.

Table 1. Continued

Authors	Description
Fracasso & Vittucci Marzetti (2013)	The paper tests the hypothesis that international R&D spillovers are global and trade-unrelated for a sample of OECD countries over the period 1971–2004. In particular, via a randomization exercise, the authors reject the null hypothesis of a "global pool of technology" and show that there are partitions of countries associated with relatively strong/weak knowledge spillovers. They then estimate a nonlinear specification that includes, simultaneously, geographical distance and international trade among the determinants of domestic TFP. The authors find robust evidence that both factors affect how foreign knowledge impacts the domestic productivity of each recipient country.
Amann & Virmani (2014)	The authors address the issue of the effect of FDI on Total Factor Productivity growth in emerging economies through international technology spillovers. The paper examines the effect of R&D spillovers resulting from outward FDI (transfer from 18 emerging markets to 34 OECD economies between 1990 and 2010) and compares the influence with inward FDI results. The study confirms the positive effect of FDI; however, it indicates an advantage of inward FDI. In the case of the limited technological capabilities of developing economies, technology transfer is noted as a factor responsible for the foundation of technological improvement. Additionally, the research indicates that this transfer reduces the technological gap and enhances the productivity of the whole economy. However, the transition should be supported by an appropriate environment in the receiving country (human capital, policies and effective institutions).
Jinji *et al.* (2015)	The paper examines how bilateral trade patterns have an influence on technology spillovers across countries. The analysis includes a sample of 55 countries and uses patent citation data, provided by USPTO. The authors note a positive relationship between horizontal intra-industry trade (HIIT), vertical intra-industry trade (VIIT) and technology spillovers. However, the effect provided by HIIT is much more significant. In the case of VIIT, the influence stays at the same level whether export of high- or low-quality products is examined. Additionally, the issue of the technology gap has been raised. In contrast to Madsen's findings, the authors indicate that technology spillovers can increase the technology gap between technologically advanced and less-advanced countries.
Bae (2016)	The author created a model that puts together the traditional strategic R&D game and the concept of absorptive capacity to analyze R&D spillovers. The effectiveness of a company's R&D is constructed based on the types of investments: diosyncratic R&D – willingness to create own innovations, and identical R&D – absorbing capacity. According to the studies, own investments can both enhance and decrease the competitor's output, while identical R&D always results in a decline. The research suggests that the increase in the rate of spillovers is connected with a fall in the number of R&D investments. As indicated, the effect is caused by the free-ride strategy, in which the company has a tendency to put greater attention on the absorptive capacity instead of diosyncratic R&D. The author indicates this effect as socially negative and mentions the necessity of government intervention. Within the findings, the importance of IPR protection is emphasized as an incentive for diosyncratic R&D.

Table 1. Continued

Authors	Description
Ali *et al.* (2016)	The paper expands upon the results of the Coe and Helpman model of R&D spillovers by adding foreign direct investments to channels for knowledge spillovers. The authors consider the relationship between knowledge spillovers from imports and inward FDI. Additionally, human capital is examined as a one of the main factors for knowledge spillovers, with particular attention on quality-content (based on journal publications and patent applications). Research was performed using data collected from 20 European countries between 1995 and 2010 and by applying the cointegration estimation method. The authors have confirmed that domestic productivity is affected by FDI and import related spillovers. Furthermore, it has been indicated that countries with better adjusted human capital can gain an advantage not only from productivity effects, but they can also benefit from absorption and transmission of international knowledge spillovers. The final results emphasize that technological distance is not a significant factor in the case of absorption of knowledge.
Tientao *et al.* (2016)	The TFP growth model is estimated from a sample of 107 countries for the period 2000–2011. The main focus is on the role played by technological spillovers. They impact productivity growth substantially, as do traditional factors such as R&D and human capital stock. Technological spillovers are captured by the spatial autocorrelation coefficient and the indirect impact of R&D.

Table 2. List of countries in alphabetical order

No.	Country	No.	Country	No.	Country	No.	Country
1	Australia	12	Finland	22	Korea Rep.	32	Portugal
2	Austria	13	France	23	Latvia	33	Romania
3	Belgium	14	Germany	24	Lithuania	34	Slovakia
4	Bulgaria	15	Greece	25	Luxembourg	35	Slovenia
5	Canada	16	Hungary	26	Malta	36	Spain
6	Chile	17	Iceland	27	Mexico	37	Sweden
7	Croatia	18	Ireland	28	Netherlands	38	Switzerland
8	Cyprus	19	Israel	29	New Zealand	39	Turkey
9	Czech Republic	20	Italy	30	Norway	40	United Kingdom
10	Denmark	21	Japan	31	Poland	41	United States
11	Estonia						

Table 3. Variables and data sources

Abbreviation	Variable	Data source
TFP1	TFP level at current PPPs (USA=1)	Feenstra *et al.*, 2015; available at: www.ggdc.net/pwt
TFP2	TFP at constant national prices (2011=1)	Feenstra *et al.*, 2015; available at: www.ggdc.net/pwt
GFCF	Gross fixed capital formation (% of GDP)	Feenstra *et al.*, 2015; available at www.ggdc.net/pwt
CS	Capital stock at constant 2011 national prices (in millions of USD)	Feenstra *at al.*, 2015; available at: www.ggdc.net/pwt

Table 3. Continued

Abbreviation	Variable	Data source
HCI	Human capital index, based on years of schooling and returns to education	Feenstra *at al*., 2015; available at www.ggdc.net/pwt
LEB	Life expectancy at birth (years)	Human Development Report 2015, United Nations Development Programme; available at: http://hdr.undp.org/en/data
R&D	Research and development expenditure (% of GDP)	World Development Indicators, World Bank; available at: http://databank.worldbank.org/data
PA	Patent applications	World Development Indicators, World Bank; available at: http://databank.worldbank.org/data
TO	Trade openness, i.e. the sum of exports and imports of goods and services measured as % of GDP	World Development Indicators, World Bank; available at: http://databank.worldbank.org/data
FDI	Foreign direct investment, net inflow (% of GDP)	World Development Indicators, World Bank; available at: http://databank.worldbank.org/data
PSAVT	Political stability and absence of violence/terrorism	Worldwide Governance Indicators, 2016 Update; available at: www.govindicators.org
GE	Government effectiveness	Worldwide Governance Indicators, 2016 Update; available at: www.govindicators.org
RQ	Regulatory quality	Worldwide Governance Indicators, 2016 Update; available at: www.govindicators.org
RL	Rule of law	Worldwide Governance Indicators, 2016 Update; available at: www.govindicators.org
CC	Control of corruption	Worldwide Governance Indicators, 2016 Update; available at: www.govindicators.org
GD	Geographic distance, i.e. inverse of physical distance between capitals of countries	Own calculations based on worldatlas.com
IL	Investment links, i.e. FDI stock in the host economy, by geographical origin	Bilateral FDI Statistics 2014, UNCTAD; available at: http://unctad.org/en/Pages/DIAE/FDI%20Statistics/FDI-Statistics-Bilateral.aspx
TL	Trade links, i.e. external trade by counterpart, import	Direction of Trade Statistics (DOTS); available at: http://www.imf.org/en/data

Table 4. Results for TFP level

	IL		TL		GD	
	coef.	P-value	coef.	P-value	coef.	P-value
$TFP1_{t-1}$	0.85***	0.000	0.82***	0.000	0.82***	0.000
GFCF	-0.00	0.177	-0.00*	0.059	-0.00*	0.062
CS	0.00	0.708	0.00	0.868	0.00	0.571
HCI	-0.08***	0.000	-0.08***	0.000	-0.08***	0.000
LEB	0.00	0.761	0.00	0.201	0.00	0.247
PSAVT	0.03***	0.000	0.03***	0.000	0.03***	0.000
PA	0.00	0.155	0.00**	0.032	0.00	0.157
R&D	-0.00	0.541	-0.01	0.402	-0.01	0.373
TO	0.00	0.206	0.00	0.281	0.00	0.300
FDI	0.00	0.432	0.00	0.278	0.00	0.506
rho_spatial	0.31***	0.000	0.21***	0.000	0.19***	0.000
R^2 within	0.80		0.81		0.81	
R^2 between	0.95		0.96		0.96	
R^2 overall	0.93		0.94		0.94	

Significant coefficients are denoted with stars (* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$)

Table 5. Results for TFP change

	IL		TL		GD	
	coef.	P-value	coef.	P-value	coef.	P-value
$TFP2_{t-1}$	0.91***	0.000	0.86***	0.000	0.88***	0.000
GFCF	0.00*	0.057	0.00	0.706	0.00	0.301
CS	0.00	0.553	0.00	0.525	0.00	0.308
HCI	-0.05**	0.026	-0.07***	0.005	-0.06***	0.008
LEB	-0.00	0.118	-0.00	0.199	-0.00	0.293
PSAVT	0.02***	0.002	0.02***	0.001	0.02***	0.001
PA	0.00	0.807	0.00	0.143	0.00	0.462
R&D	0.00	0.958	-0.00	0.717	-0.00	0.707
TO	0.00***	0.008	0.00***	0.004	0.00**	0.011
FDI	0.00**	0.049	0.00**	0.023	0.00**	0.012

Table 5. Results for TFP change

	IL		TL		GD	
	coef.	P-value	coef.	P-value	coef.	P-value
FDI	0.00**	0.049	0.00**	0.023	0.00**	0.012
rho_spatial	0.09***	0.000	0.33***	0.000	0.16***	0.000
R^2 within	0.91		0.91		0.91	
R^2 between	0.84		0.82		0.85	
R^2 overall	0.87		0.86		0.87	

Significant coefficients are denoted with stars (* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$)