Cherkas, N. & Chekh M. (2018). Economic Effects of Production Fragmentation and Technological Transfer: the Evidence from CEE Countries. In M. Papież and S. Śmiech (Eds.), The 12th...

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Conference is held under the auspices of
Department of Statistics, Cracow University of Economics, Poland
Committee of Statistics and Econometrics, Polish Academy of Sciences
Polish Statistical Association

Honorary Patronage of the Conference
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Socio-Economic Modelling and Forecasting

No.1 (2018)

The 12th Professor Aleksander Zelias International Conference on Modelling and Forecasting of Socio-Economic Phenomena. Conference Proceedings

Edited by

Monika Papież and Sławomir Śmiech

MAY 8-11, 2018

ZAKOPANE, POLAND

Editors: Monika Papież, Sławomir Śmiech

All published papers have been reviewed by two anonymous referees before publishing

The proceedings have not been amended or proofread and editors are not responsible for the language used in papers

Publishing of the proceedings is founded by Polish Academy of Sciences and Cracow University of Economics

Suggested citation:

AUTHOR, A. (2018). Title of the paper. In M. Papież and S. Śmiech (Eds.), *The 12th Professor Aleksander Zelias International Conference on Modelling and Forecasting of Socio-Economic Phenomena. Conference Proceedings*. Cracow: Foundation of the Cracow University of Economics, pp. xx-xx. ISBN: 978-83-65907-20-2 (HTML).

e-ISSN
ISBN: (HTML) 978-83-65907-20-2
DOI: 10.14659/SEMF.2018.01

Year of publishing: 2018
Number of pages: 611

Publishing House:
Foundation of the Cracow University of Economics
Rakowicka 27, 31-510 Cracow, Poland

CONTENTS

Economic effects of production fragmentation and technological transfer: the evidence from CEE countries

Nataliia Cherkas[1], Myroslava Chekh[2]

Abstract

Foreign direct investment (FDI) inflow is traditionally considered as an important factor of structural changes and productivity growth in Central and Eastern European countries (CEECs) due to transfer of technologies and active participation in global value chains (GVC). The aim of the study is to estimate the influence of technological transfer on structural changes in CEECs. An empirical analysis of the impact of FDI and other indicators of technological transfer on the export structure was performed. We consider three export groups of technology-intensive manufactures: high-, medium- and low skill and one export group of labor and resource-intensive manufactures.The analysis includes a panel framework covering seven CEECs (Croatia, Czech Republic, Hungary, Poland, Romania, Slovakia and Slovenia) over the period of 2001–2016. OLS with pooled data, panel data with fixed effects and dynamic panel-data model were used as principal methods. Our results mostly reflect the prediction of the Flying Geese Model (FGM) and GVC theory in terms of: (i) stimulating effect of FDI on high-skill and technology-intensive manufactures; (ii) significance of impact of technology transfer through technological import growth for all export sectors; (iii) important contribution of EU integration to technological development of CEECs.

Keywords: *technological transfer, export structure, production fragmentation, FDI, imports*

JEL Classification: F14, F63

DOI: 10.14659/SEMF.2018.01.05

1 Introduction

The most of theoretical approaches suggest that foreign direct investment (FDI) positively affect development and structural changes in host countries due to technology transfer through multinational corporations. However, the benefits for host countries considerably depend on their absorption capacity (Damijan, Kostevc and Rojec, 2013; Salamaga, 2013).According to the theory of endogenous growth FDI inflow is an important channel for technology transfer to host countries (Danakol et al., 2017). International business theory implies that technology is a core type of ownership advantages of foreign investorstransmitted tothe country that accepts investments (Dunning and Lundan, 2008). “Flying geese model” (FG), suggested by Akamatsu (1962) and developed by Ozawa (2007) considers the formation

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of a new dynamic paradigm of multinational development through technology transfer to recipient country by multinational corporations.

The main features of Akamatsu's FG concept are shown on figure 1. His approach suggests four fundamental stages of the FG pattern that was developed in the historical context of the Euro-American leadership and Asia as a follower (Kojima, 2000; Li, 2017).At the first stage manufactured consumer goods are imported from advanced to less-advanced countries (started from t_1 in Panel a). Such import can lead to negative consequences for the industry of less developed country because of the substitution effect. Second stage describes increasing import from time t_1 to $t_2$and possibility of domestic production to start from t_2. Simultaneously, the host country should import capital goods (Panel b). The competition between imported and domestic consumer goods can be observed at this stage. At the third stage, the internal consumer goods industry develops into the export industry (started from t_3 in Panel a).This stage reflects a successful implementation of the catching-up process of the industry concerned along the consistent way import-production-export (M-P-E) which is the basic pattern of the FG model (Kojima, 2000). At fourth stage it is shown the decline of consumer goods exports (started from t_4 in Panel a), whereas capital goods started exporting (started from t_4 in Panel b). The export reduction ensue as a result of consumer goods production transfer to other less-developed countries (offshore production at panel a), besides it is also possible a reverse import existence (Panel a) (Widodo 2007).But, in terms of the FGM, it is difficult to clarify the catching-up process at more advanced stages of host-country development. The influence of FDI along the lines of the FGM appears mostly in industries at the lower end of the technology scale and less when it comes to industries at the upper end (Damijan and Rojec, 2004).

The recent theoretical approach of global value chains (GVC) economics (Baldwin 2012, 2016) is seen as an adjustment of the FGM to the trends of the 21st century, because globalization's 2nd unbundling means off shoring of production stages, but not industries (as in case of FGM). Damijan, Kostevc and Rojec (2013) prove the importance of GVC concept for export sophistication and growth of labor productivity in Central and Eastern Europe (CEE). Using data for industry-level and accounting for technology intensity, they demonstrated significance but heterogeneity of FDI to export restructuring in the CEECs.While Visegrad group countries managed to increase exports in high-tech industries, non-Visegrad countries couldn't change their export specialization. This points out that direction of FDI flows is crucial. In addition, the results show that export sophistication and economic specialization caused by FDI during the last two decades in CEECs are very important for their potential and productivity growth in the long run.

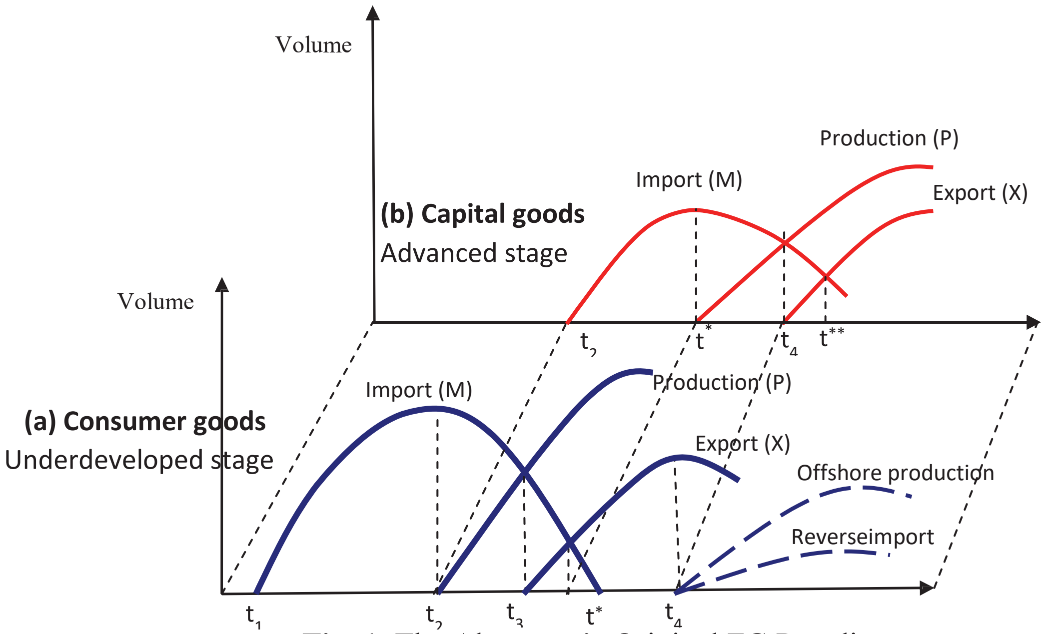

Fig. 1. The Akamatsu's Original FG Paradigm

Source: Widodo (2007).

Nevertheless, in his theoretical approach of GVC Baldwin (2016) claims that, within the "vertical specialization", which is typical for offshore stages of labor-intensive industries, transmitted from headquarter economies to "factory economies", instead of technology transfer we observe the technology lending. Nowadays, manufactured goods export is no longer a sign of economies' competitiveness, but it can simply reflect the position of the nation in global value chains. Such trend could mean the limited impact of FDI on host countries.

Therefore, the aim of the study is to estimate the effects of technological transfer on export structure with the main focus on the impact of high-tech imports, intra-industry trade and FDI on the export groups. Section 2 presents the data. Statistical methodology is provided in Section 3. The estimation of the implied panel methods are interpreted in Section 4 that is followed by the conclusions.

2 Data

The annual data for the period of 2001-2016 is used to study the impact of technological transfer on export structure in CEECs. The analysis includes a sample covering seven CEECs, namely Croatia (HR), Czech Republic (CZ), Hungary (HU), Poland (PL), Romania (RO), Slovakia (SK) and Slovenia (SI). The data is transformed into logs in order to avoid the influence of outliers. The dependent variables are the following (in US dollars): x_ht_t– exports of high-skill and technology-intensive manufactures; x_ms_t – exports of medium-skill and technology-intensive manufactures; x_ls_t –exports of low-skill and technology-intensive manufactures;x_l_t– exports of labour-intensive and resource-intensive manufactures.

The list of explanatory variables includes: fdi_t – foreign direct investment, inflows (% of GDP);$patents_t$– patent applications of residents;m_ht_t – imports of high-skill and technology-intensive manufactures (US dollars);iit_ht_t – Intra-industry trade, sector of high-skill and technology-intensive manufactures, index; $manuf\_va_t$ – manufacturing, value added (% of GDP); $service\_va_t$ – services, value added (% of GDP); E_t – price level ratio of PPP (purchasing power parity) conversion factor (GDP) to market exchange rate; EU_t – dummy variable of EU membership (1 – EU member, otherwise – 0); $Crisis_t$ – dummy variable (1 – crisis period from 2009 till 2015, otherwise – 0). Foreign trade data and inward foreign direct investments are obtained from UnctadStat. The data on manufacturing and services, value added, Price level ratio of PPP and patent applications are collected from the World Development Indicators (WDI, 2017). All data are transformed into logarithmic form, except the dummy variables.

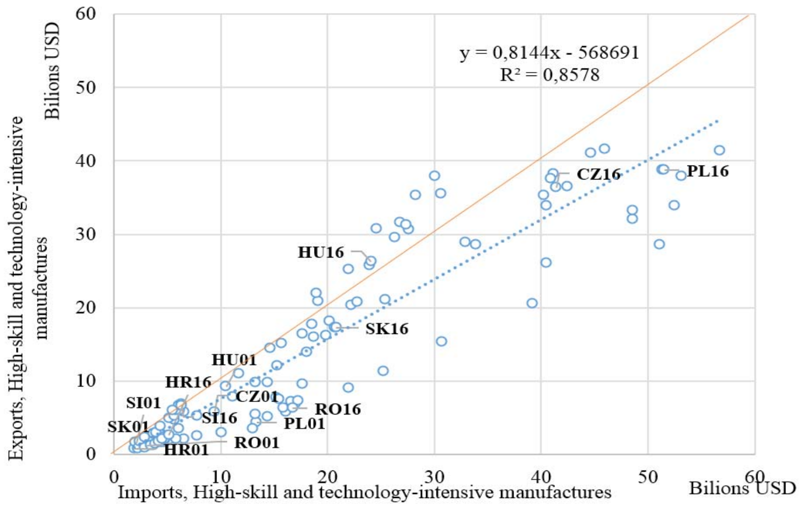

Fig. 2. High-skill and technology-intensive manufactures: exports versus imports (billions, USD), 7 CEE countries (HR, CZ, HU, PL, RO, SK, SI), 2001-2016.

Notes: Red line denotes the 45° line. The countries are marked for the first and last year.

Figure 2 presents the countries' specific positions considering high-skill and technology-intensive manufactures exports versus imports for the sample of CEE countries. These figures give some preliminary evidence about the differences in cross-country data. V-4 economies (especially Poland and Czech Republic) demonstrate increasing over time technology-intensive manufactures exports via imports, while for other CEECs the impact is less evident.

3 Methodology

The empirical analysis is conducted on panel data, which includes 112 observations (seven countries for 16 years). We apply the following techniques: pooled ordinary least squares (OLS), model with fixed effects (FE) and dynamic panel-data model. The selection of FE model in this analysis is confirmed with the Hausman test for all specifications (Hausman, 1978).

The following base model is used to study the relationships following the methodology for panel data estimation (Wooldridge, 2010):

$$\boldsymbol{x_{it}} = a_0 + a_1 fdi_{it} + a_2 patents_{it} + a_3 m\_ht_{it} + a_4 iitiit\_ht_{it} + a_5 manuf\_va_{it} + a_6 service\_va_{it} + a_7 e_{it} + a_8 EU_{it} + a_9 Crisis_{it} + \varepsilon_{it}, \quad (1)$$

where $\boldsymbol{x_{it}}$ represent the four groups of manufactured exports: x_ht_t:, x_ht_t;, x_ls_t, andx_l_t..ε_{it} is the error term. The explanatory variables are described in detail in Section 2. Table 1 reflects the correlations results for variables, which are used in logarithms (except dummies).

Table 1. Correlation matrix for the explanatory variables.

	fdi_t	$patents_t$	m_ht_t	iit_ht_t	$manuf\_va_t$	$service\_va_t$	e_t	EU_t	$CRISIS_t$
fdi_t	1.000	–	–	–	–	–	–	–	–
$patents_t$	0.029	1.000	–	–	–	–	–	–	–
m_ht_t	0.091	0.610	1.000	–	–	–	–	–	–
iit_ht_t	0.046	0.215	0.387	1.000	–	–	–	–	–
$manuf\_va_t$	0.088	-0.044	0.228	0.500	1.000	–	–	–	–
$service\_va_t$	0.025	0.281	-0.070	0.199	-0.534	1.000	–	–	–
e_t	0.091	-0.039	0.013	0.428	-0.088	0.435	1.000	–	–
EU_t	-0.014	0.163	0.595	0.552	0.212	0.046	0.328	1.000	–
$Crisis_t$	-0.154	0.017	0.144	0.125	-0.211	0.059	0.254	0.214	1.000

4 Results and discussion

As mentioned above, the verification of the main functional dependencies is performed by the following panel methods: OLS (model 1), FE (model 2) and Dynamic panel-data (model 3). Table 2a presents the results for high-and medium-skill technology-intensive manufactures, while table 2b – low-skill technology-intensive, labor- and resource-intensive manufactures.

Our results indicate that inward FDI generally did not support the growth of exports in CEEC during the period of evaluation, which is consistent with the results of Damijan and Rojec (2004), Damijan, Kostevc and Rojec (2013). We observe the positive effect of FDI only on the exports of technology-intensive manufactures in case of OLS. The study of Kalotay (2010) revealed that FDI in CEES had the deepest impact on structural change due to the effective sectoral composition of FDI.

The impact of high-tech imports is highly significant and positive for all sectors and methods used. The results of the impact of intra-industry trade on export performance show different results within four export groups. The impact is positive for industries with higher level of technology that emphasizes the importance of foreign trade exchange. These findings go in line with the results of Jude (2016), where is indicated that the position of a sector in the supply chain is essential for capturing the technology spillovers. An increase of manufacturing value added acts as a stimulating factor for the exports of high-, medium- and low-skill and labor-intensive sectors.

The growth of value added in services contributes positively only to high- and medium-skill technology intensive manufactures. These results can be explained by the fact that services create value added mostly for high-tech industries. According to the estimation results, the strong exchange rate show a positive impact on exports for low-skill and technology intensive manufactures (models 1-3) and for high-skill manufactures (model 3), while the OLS and FE results (models 1-2) for high-technology sector indicate the opposite results. The impact of exchange rate on different export groups of Ukraine was studied in Cherkas (2013) and it was shown that the exports of high value-added goods are strongly dependent on imports but less on exchange rate.

Our data indicate that the impact of EU integration is positive for technology intensive manufactures (high- and medium-skill) and labor-intensive manufactures, but insignificant and even negative (dynamic panel data estimation) for low-skill industries. The influence of another dummy variable, characterizing the impact of global financial crisis is stimulating for high-skill and technology intensive sectors. However, positive effect disappears at the lower level of technology and even turns opposite.

Table 2a. Determinants of x_ht_t and x_ms_t.

Explanatory variables	High-skill and technology-intensive manufactures (x_ht_t) (1)	(2)	(3)	Medium-skill and technology-intensive manufactures (x_ms_t) (1)	(2)	(3)
Constant	-5.978***	-0.762	-1.482**	-10.368**	-16.194***	-7.566***
	(1.21)	(0.94)	(0.47)	(3.32)	(2.59)	(1.30)
Lagged dependent	–	–	0.117***	–	–	0.358***
variable	–	–	(0.02)	–	–	(0.04)
fdi_t	0.419**	0.019	-0.029	-0.797*	-0.224	-0.025
	(0.13)	(0.08)	(0.05)	(0.36)	(0.23)	(0.13)
$patents_t$	-0.022	0.056*	0.022	-0.018	-0.265***	-0.043
	(0.01)	(0.02)	(0.01)	(0.04)	(0.07)	(0.03)
m_ht_t	1.017***	1.078***	0.875***	1.052***	1.054***	0.730***
	(0.02)	(0.03)	(0.02)	(0.05)	(0.07)	(0.06)
iit_ht_t	1.491***	1.036***	1.249***	0.439*	0.653**	0.410***
	(0.07)	(0.08)	(0.05)	(0.19)	(0.22)	(0.09)
$manuf\_va_t$	0.368***	-0.048	0.165**	1.901***	1.184***	1.337***
	(0.10)	(0.11)	(0.05)	(0.27)	(0.30)	(0.15)
$service\_va_t$	1.114***	-0.229	0.242**	0.993	3.322***	0.640*
	(0.22)	(0.20)	(0.09)	(0.60)	(0.55)	(0.25)
e_t	-0.101*	-0.095*	0.084***	0.105	0.055	0.021
	(0.05)	(0.05)	(0.02)	(0.13)	(0.13)	(0.06)
EU_t	0.031	0.073***	0.021*	0.220**	0.040	-0.031
	(0.03)	(0.02)	(0.01)	(0.07)	(0.05)	(0.03)
$Crisis_t$	0.071**	0.036*	0.018*	-0.004	-0.031	-0.013
	(0.02)	(0.02)	(0.01)	(0.07)	(0.04)	(0.02)
R^2	0.942	0.923	–	0.903	0.901	–
F-test	210.27	183.14	–	298.97	220.94	–
Hausman χ^2 *(Prob>* χ^2*)*		74.88 (0.000)		–	72.71 (0.000)	

Notes: ***, ** and * represent the levels of significance of 1%, 5% and 10% respectively. The values of the standard errors are in parenthesis.

Table 2b. Determinants of x_ls_t and x_l_t.

Explanatory variables	Low-skill and technology-intensive manufactures (x_ls_t)			Labour-intensive and resource-intensive manufactures (x_l_t)		
	(1)	(2)	(3)	(1)	(2)	(3)
Constant	16.671***	1.871	2.292	19.618***	6.729***	7.418***
	(3.74)	(2.45)	(1.59)	(2.87)	(1.84)	(1.60)
Lagged dependent	–	–	0.110**	–	–	0.440***
variable	–	–	(0.04)	–	–	(0.06)
fdi_t	-1.602***	-0.142	-0.095	-1.003**	-0.131	0.014
	(0.41)	(0.22)	(0.16)	(0.31)	(0.17)	(0.14)
$patents_t$	0.210***	0.087	0.010	0.289***	-0.119*	0.058
	(0.04)	(0.06)	(0.04)	(0.03)	(0.05)	(0.05)
m_ht_t	0.770***	0.842***	0.782***	0.532***	0.527***	0.454***
	(0.05)	(0.07)	(0.05)	(0.04)	(0.05)	(0.06)
iit_ht_t	-0.592**	-0.391	0.196	-0.629***	0.520**	-0.473***
	(0.21)	(0.21)	(0.16)	(0.16)	(0.16)	(0.14)
$manuf\_va_t$	0.128	0.856**	0.921***	0.158	0.873***	0.132
	(0.30)	(0.29)	(0.15)	(0.23)	(0.22)	(0.18)
$service\_va_t$	-3.688***	-0.802	-0.931**	-3.675***	-0.337	-1.700***
	(0.68)	(0.52)	(0.34)	(0.52)	(0.39)	(0.31)
e_t	1.026***	0.509***	0.612***	0.051	0.078	-0.199**
	(0.15)	(0.12)	(0.07)	(0.12)	(0.09)	(0.07)
EU_t	0.140	0.041	-0.121***	0.247***	-0.044	-0.011
	(0.08)	(0.05)	(0.04)	(0.06)	(0.04)	(0.03)
$Crisis_t$	-0.154*	-0.011	-0.029	-0.096	-0.040	-0.048*
	(0.08)	(0.04)	(0.02)	(0.06)	(0.03)	(0.02)
R^2	0.908	0.871	–	0.926	0.568	–
F-test	123.02	131.35	–	155.28	88.09	–
Hausman χ^2 *(Prob>* χ^2*)*		79.51 (0.000)		–	80.44 (0.000)	

Notes: ***, ** and * represent the levels of significance of 1%, 5% and 10% respectively. The values of the standard errors are in parenthesis.

Conclusions

The results of our study are consistent with the prediction of the FG Model (considers a new dynamic paradigm of development through technology transfer) and GVC theory (according to which the CEEC are integrated into EU's supply chains)and can be summarized as follows. First, we point out the importance of technology sophistication of 'implanted' industries for FDI benefits brought to the host country. Second, technological transfer for CEEC takes place rather through the import of technologies. Third, integration into EU is positively correlated with technological development of CEECs. Further research directions include the study of the factors of economic divergence of transitional countries based on the FDI into high-skill and technology intensive sectors.

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