The share of FDI in the value added of innovative and other industries in Poland

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Abstract

Purpose – This study aims to examine the share of foreign direct investment (FDI) in creating the value added (VA) of innovative and other industries in Poland in 2004–2020.

Design/methodology/approach – In terms of the empirical analysis of FDI stocks, their locations were divided into innovative and other industries. The differences in the creation of VA are presented by domestic and foreign enterprises. The impact of FDI stocks in individual industries on gross domestic product (GDP) changes was assessed using the vector error correction model (VECM).

Findings – FDI from innovative industries generated approx. 7% VA of the Polish economy in the years 2004–2020. In 2009–2018, the share of VA of foreign enterprises in innovative industries in Poland showed a faster growth (by 5 pp) than in other industries. The results of decomposition confirm that the level of explanation of GDP by FDI in innovative industries is higher than in other industries.

Research limitations/implications – Changes in the classification of activities reduce the time series period available.

Practical implications – This study explains the participation of foreign and domestic enterprises in creating VA. The results are useful to pursuing the national investment policy.

Social implications – The economic results of domestic and foreign enterprises in the host country affect the economic growth and development and ultimately the socio-economic conditions of life.

Originality/value – This work provides some additional explanations for the inconclusive results of international research into the impact of FDI on GDP or the spillovers effects. Its usefulness concerns the detailed impact of FDI by industrial structures on GDP.

Keywords FDI, Industries, Innovation, Technology, VA, GDP, Poland

Paper type Research paper

1. Introduction

The deregulation of markets, technological innovations and cheaper communication tools has allowed investors to diversify their participation in competitive markets internationally. In consequence, a significant increase in cross-border capital movements including direct investment has become a key factor in international economic integration, more generally referred to as globalization (OECD, 2008, p. 22). According to the OECD Benchmark definition, a direct investment is considered evident when a direct investor owns directly or indirectly at least 10% of the voting power of a direct investment enterprise. In other words, the 10% threshold is the criterion of determining whether (or not) an investor has influence over the management of an enterprise and, therefore, whether the basis for a direct investment relationship exists or not (OECD, 2008, p. 23).

Aneta M. Kosztowniak, Manager in the research project of the National Bank of Poland (2022) on the topic: The role of foreign direct investment in supporting innovation and technology transfer in Poland.

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As technological innovations accelerate the expansion of cross-border financial flows, including foreign direct investment (FDI) (OECD, 2008, p. 14), these investments are of interest to both economic theory and empirical research. Investor and host countries are interested in the relationship between FDI and technological innovation and, consequently, economic performance. This article focuses on the economic effects of FDI on innovative and other industries in a host country. Thus, the main segment of literature to which it relates is the international finance.

Most economic theories emphasize the beneficial influence of FDI on economic growth, while empirical research by both international financial institutions and economists shows inconclusive results. Many early theories and theoretical research recognized the role of FDI in supporting capital accumulation in host countries. According to Harrod (1939) and Domar (1947) growth models, savings are the key, driving capital accumulation and growth. When the neoclassical growth theory (Solow, 1956; Swan, 1956) replaced the Harrod–Domar concept, a new rationale for the flow of funds from rich countries to developing nations was found: as diminishing returns to capital and a lower capital stock in developing countries are assumed, returns on capital should be higher in developing countries, enticing international capital from rich to poor countries, helping the latter catch up. This narrative also provided theoretical support for developing countries to utilize foreign investment, including FDI. But empirical evidence has suggested otherwise: long-run growth is empirically due to technical progress, not capital or investment (Abramovitz, 1956; Solow, 1957).

According to the theory of the development paradigm (dynamic comparative advantages) by Ozawa (1992), economic development, i.e. a gradual transformation of an economy, requires maintaining a stable level of FDI inflow from resource-intensive to technologically intensive industries in the long term to increase the effectiveness of their the spillovers effects).

With technical progress outside neoclassical (exogenous growth) models, technology transfer from abroad via FDI remained a key recommendation by international organizations for countries to enhance growth (Blomström *et al.*, 1994; Balasubramanyam *et al.*, 1996; Blomström and Kokko, 1998; Blomstrom and Sjoholm, 1999). When the Solow–Swan exogenous growth theory was challenged by the endogenous growth theory (Lucas, 1988; Barro, 1990; Romer, 1990), emphasizing the role of technology, FDI remained justified to transfer technology, igniting domestic productivity (Johnson, 2006). However, evidence that technology gets transferred to receiver countries has remained sparse (e.g. Young and Lan, 1997; Ashraf *et al.*, 2016, found no positive effect of FDI on total factor productivity in 123 countries).

In many studies, authors analyze the impact of FDI on GDP for groups of countries, e.g. using panel methods. According to Makiela and Ouattara (2018, pp. 296–305), the results, based on a sample of developed and developing countries over the period 1970–2007, conclusively reveal that FDI affects growth via inputs accumulation but not the total factor productivity growth channel. In other words, the results suggest that factors other than FDI may have contributed to the increase in productivity witnessed in developing countries in recent decades. Carbonell and Werner (2018) did not confirm the positive impact of FDI on economic growth in Spain.

In a different approach, Alfaro *et al.* (2004) focused on the role of local financial markets and the link between FDI and growth. Their empirical evidence using cross-country data between 1975 and 1995 suggests that FDI plays an important role in contributing to economic growth. However, the level of development of local financial markets is crucial for these positive effects to be realized. The link between FDI and growth is causal, where FDI promotes growth through financial markets. Even the investment policies of host countries can be very effective in attracting foreign investment, although local conditions can limit the potential benefits FDI can provide to the host country by not generating benefits that go beyond the "capital" FDI brings and the wages it generates. Therefore, countries should weigh the cost of policies aimed at attracting FDI versus those that seek to improve local conditions.

Similarly, Osei and Kim (2020) investigated the extent to which an increase in financial development affects the positive effect of FDI on economic growth. According to the authors, although the financial sector is beneficial for economic growth, the effect of further financial development on growth is found to become insignificant. Using a dynamic panel threshold model on 62 middle- and high-income countries spanning the period 1987–2016, they re-examine the possible nonlinearity between finance, FDI and growth. Consistent with the "vanishing effect" of financial development, they find significant evidence that FDI fosters growth in general, but the growth effect of FDI becomes negligible when the ratio of private sector credit to gross domestic product (GDP) exceeds 95.6%. This finding is robust to different econometric methods, various subsamples and interaction analyses, and distinct financial development indicators.

Moreover, Tahir and Alam (2022) studied the relationship between banking sector performance and FDI inflows for five selected countries of the South Asian Association for Regional Cooperation (SAARC) for the period 1998–2017. Their results indicate a significant negative relationship between banking sector performance and FDI inflows while demonstrating a significant positive association of inflation and trade openness with FDI inflows. Moreover, the higher per capita income, which is one of the indicators of a growing economy, exerts a statistically significant positive impact on FDI inflows. Finally, institutional factors have not played a significant role in attracting FDI in the sampled countries.

In theoretical literature and empirical research, there are no studies focusing on the importance of the structure of an economy for economic growth, including the impact of FDI in individual industries on the increase in the value added (VA). There is a gap in the field of theoretical and empirical analyzes of the countries of systemic transformation, changing these structures in the 1990s (as part of the marketization of the economy) and since 2004, with the accession to the EU (Poland and other Central and Eastern Europe – CEE-10 countries). Therefore, the author has undertaken such research for a single country, i.e. Poland.

The research gap concerning the effects of FDI in the host country, considering the importance of the industry structure of FDI inflow and the structure of the economy absorbing this inflow in innovative industries (with the highest R&D expenditure) and other industries. Changes in VA in the sectors of economy were treated as the results of a complex impact of FDI and its spillover effects in the transfer of technology and innovation.

In theoretical terms, the study is an attempt to verify T. Ozawa's theory of the development paradigm, which draws attention to the role of FDI influx to resource-intensive and technology-intensive industries in increasing the spillover effects. In empirical terms, the study is an attempt at assessing the effects of FDI to date on the real economy of the former transition countries and at developing recommendations for economic policy.

The research results fill a gap in the diagnosis of the impact of FDI on the economic structure of Poland, i.e. one of the countries of the former systemic and economic transformation group, modifying this structure of the economy. Importantly, the analyzed period of 2004–2020 allows accumulating the effects of changes in the structure of the Polish economy because of both the system transformation and the presence in the EU.

Considering the similarities in the evolution of the economic structures of Poland and other transition countries, the results of the study may be useful for the CEE countries. The results for the Polish economy may be useful in formulating assumptions for the economic policy (achieving accelerated convergence to the most developed countries in Europe), including the investment policy of attracting FDI (to individual industries).

This study aims to examine the share of FDI in creating VA of innovative and other industries in Poland in the years 2004–2020.

The following research hypotheses were formulated:

H1. Entities with foreign capital achieve a higher growth of added value in innovative than in other industries.

H2. The share of FDI added value in innovative industries is higher in Poland's GDP than in the VA generated in other industries.

As part of the empirical analysis, the main industries considered innovative in Poland were identified. Changes in the accumulation of FDI, income and their structure were assessed, broken down into innovative industries and others in the years 2004–2020. The share of enterprises controlled by foreign capital in the creation of VA was compared. Using the vector error correction model (VECM), including the impulse response functions and the variance decomposition allowed to estimate the impact of FDI stocks from innovative and other industries on GDP.

2. The impact of FDI on productivity, technology transfer and innovation

Several factors influence the scale of the effects of innovation diffusion through FDI. The following can be mentioned: investors' motivation, the industry structure of these investments (including the level of technological advancement of individual industries), the way of entering a market (through exports, joint ventures or independent business operations), the propensity of investors to export, as well as the tendency of management to professional and territorial mobility in a country, or the impact of investments on market competition (Crespo and Fortuna, 2007).

On the host country's side, the absorption capacity of a sector and an entire economy is of key importance for the scale of diffusion of innovation through FDI. The absorptive capacity, which determines the possibilities of benefiting from access to knowledge, technology and new markets by FDI, is crucially influenced by the level of human and social capital in country and favorable institutional conditions (NBP, 2016).

FDI can be a channel for the transfer of innovation (OECD, 2008a, b) and technology to host countries. The effects of the transfer depend on the type of innovation and technology advancement (Carlino and Kerr, 2014) transferred within international value chains (Bair, 2005; Gereffi and Fernandez-Stark, 2011; Gorynia and Jankowska, 2008), as well as the type of transfers vertical and horizontal linkages (Krugman, 1991; Hagemejer and Kolasa, 2011), and the stages of investment development path (Dunning, 1981, Gorynia *et al.*, 2010; Kosztowniak, 2018, pp. 41–60).

For example, AlAzzawi (2012) examined the effect of FDI on innovation and productivity in some host and home countries. She investigated how the flows of knowledge transmitted through FDI affect the production of knowledge in both the source and recipient countries, as well as how these flows affect productivity. The researcher analyzed a set of 30 selected countries classified as technology leaders and technology followers. Using patent citations within FDI as the measure of the degree of "access" that one nation gains to the R&D knowledge of another and new patents as the measure of innovation, her results revealed that there are large differences in the way FDI affects innovation and productivity between countries that are technological leaders and technological followers.

Both inward and outward FDI is found to have a strong positive effect on domestic innovation and productivity in countries that are technological followers. For technological leaders, outward FDI is highly conducive to increased domestic innovation, while inward FDI seems to increase competition between domestic and foreign firms, making it more difficult to come up with new viable ideas.

As for domestic productivity, inward FDI is highly beneficial for technological leaders, while outward FDI does not have a significant effect. AlAzzawi concluded that technological followers (including, we can add, for Poland) have much to gain from FDI-induced RD spillovers, therefore, governments in these countries will find it worthwhile to attract foreign multinationals, while those in the more technologically advanced economies need to weigh the costs and benefits of FDI carefully.

Moreover, in the case of Poland, the research by Kolasa (2008) on the impact of FDI on the productivity of domestic companies shows that domestic companies benefit from the presence of foreign entities in the industry sectors and in the enterprises where these entities operate. The absorption of the capital of domestic companies is significantly dependent on the scale of vertical spillover effects in the case of companies intensifying R&D, while other companies achieve benefits with horizontal connections.

When analyzing the impact of FDI on the transfer of innovation and the convergence process, it is worth remembering that the disproportions in the level of investments in Poland compared to the EU countries are also determined by the sectoral structure of an economy. According to Growiec and Mućk (2018), if the share of individual sectors in creating VA in Poland was the same as the EU average, the investment rate would be systematically approx. 1.5 pp higher.

To sum up, the effects of implementing innovation in production processes and technical progress are revealed primarily in the growth of VA and labor productivity.

3. The identification of innovative industries

An attempt to empirically assess the impact of FDI on the innovation potential in Poland was based on the NBP data describing the status of FDI liabilities, i.e. the value of direct investment at the end of a given period. These data are compiled with an annual frequency on the basis of reports submitted by foreign direct investors (non-residents) investing in Poland and are expressed in Polish zlotys (PLN).

Innovative industries were identified based on the amount of expenditure on research and development (R&D). According to the definition of the Central Statistical Office (CSO), as many as 11 industries can be considered innovative (Table 1).

According to the CSO data, these sectors have a relatively highest percentage of expenditure on R&D [1]. The adopted selection criterion is in line with the approach used in the NBP Report (NBP, 2016) on Innovative Potential of the Economy: Conditions, Determinants, Perspectives and by the CSO in its Reports on Innovative Activity of Enterprises in Poland (CSO, 2021).

4. Empirical data

Changes in FDI accumulation in Poland in 2004–2020 were high both in innovative and in other industries. The aggregated level of foreign capital, measured under FDI, increased fourfold in both the industry types. This means that foreign investors have comparatively spread their interest between innovative and other lines of economic activity.

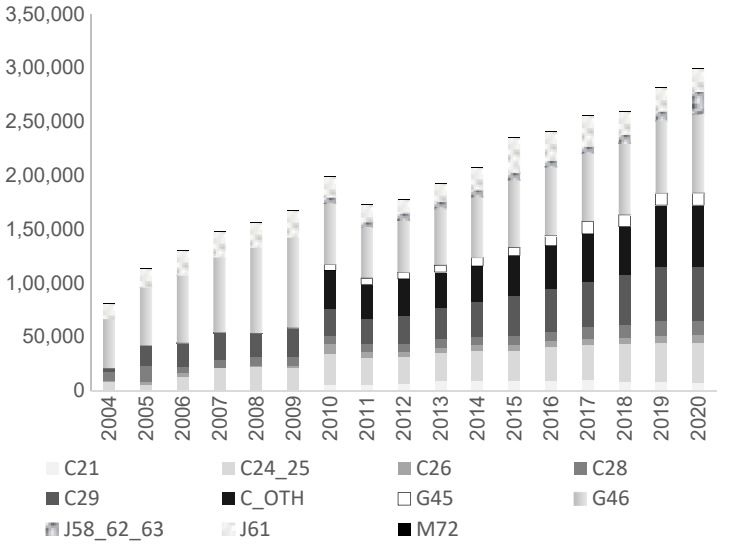
Among innovative industries, the FDI reached the highest value in 2020 in the following sectors: wholesale, excluding trade in motor vehicles and motorcycles (G46, PLN 72.6 billion), other sectors related to production in total (C_OTH, PLN 56.9 billion), and the production of motor vehicles, trailers and semi-trailers (C29, PLN 50.3 billion). The lowest value of FDI was noted in: research and development activities (M72, PLN 0.1 billion) and production of computers, electronic and optical products (C26, PLN 6.8 billion). These industries (M72 and C26) increased 6 times and 10 times in the period 2004–2020, respectively, and show a development potential. Their growth was higher than that of most other innovative industries (Figure 1).

In the industry structure, the majority share belonged to FDI in other industries. In 2004–2020, the average share of FDI in the remaining industries in total FDI was 68%, compared to the average 32% share of FDI in innovative industries. The highest level of foreign capital, i.e. 39%, was achieved in the second year of Poland's membership in the EU, 2005, dropping in the following years to 28% (2013–2014) and increasing again to 32% in 2020. In geographical terms, the largest interest was shown by foreign investors from the Netherlands, Germany, Luxembourg, France and Spain (Figure 2).

No.	DSD code/Sections and division of PKD 2007	Type of business activity
1	C21	Manufacture of pharmaceutical products
2	C24_25	Production of metals and finished metal products, except machines and devices
3	C26	Manufacture of computers, electronic and optical products
4	C28	Manufacture of machinery and equipment not elsewhere classified
5	C29	Manufacture of motor vehicles, trailers and semi-trailers
6	C_OTH	Other manufacturing sectors (total)
	C15	Manufacture of leather and leather products
	C23	Manufacture of products from other non-metallic mineral raw materials
	C27	Manufacture of electrical equipment
	C31	Furniture production
	C32	Other production
	C33	Repair, maintenance and installation of machinery and equipment
7	G45	Wholesale and retail of motor vehicles and motorcycles; repair of motor vehicles and motorcycles
8	G46	Wholesale trade, except of motor vehicles and motorcycles
9	J58_62_63	Other information and communication activities
10	J61	Telecommunication
11	M72	Research and development work

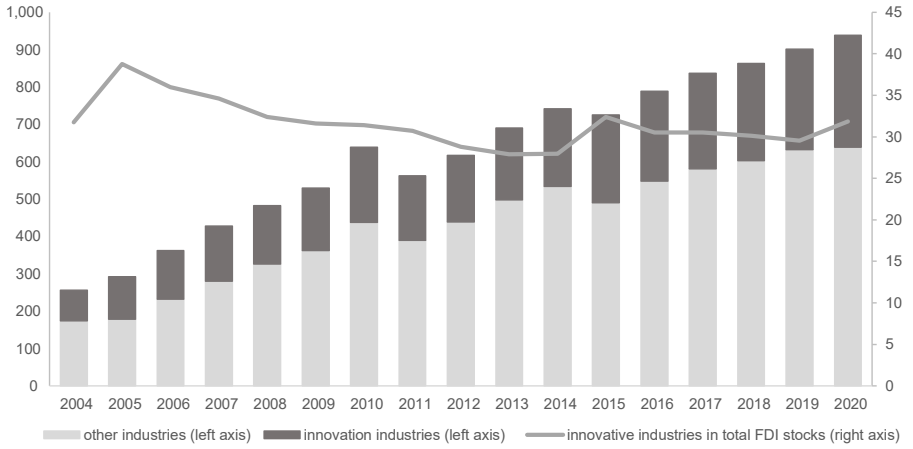
Note(s): Taking into account the conditions of the collected statistical data, the analyzes of specific types of activity were carried out for some sections; for others, aggregates were built, such as for the "Other activities, not elsewhere classified" C_OTH, which includes several types of activity in total
Source(s): The author's own calculations: NBP (2016), GUS (2021)

Table 1.
FDI stocks by innovative industries (sectors) in Poland (NACE rev. 2)



Source(s): The author's own calculations: NBP (2021)

Figure 1.
The balance of FDI liabilities in innovative industries in Poland in 2004–2020 (PLN million)



Source(s): The author's own calculations: NBP (2021)

Figure 2.
The balance of FDI liabilities in innovative and other industries in Poland in 2004–2020 (the left axis in PLN million, the right axis in %)

In the years 2004–2020, the total foreign capital amounted to approximately 38.3% of GDP, including approximately 12.0% of GDP in innovative industries and 26.3% of GDP in other industries (OECD, 2021). These data indicate the existing potential for further FDI growth in innovative industries, which has so far been 2 times lower than in other industries.

5. A look at the income and structure FDI

The interest of foreign direct investors in taking up activities in innovative industries was related to, *inter alia*, the latter's higher profitability than of other industries [2].

The average level of the FDI profitability index of innovative industries for the years 2005–2020 exceeded by 3 pp. the profitability of other industries (12.5% compared to 9.5%). The annual changes in the FDI profitability ratios fluctuated. Before the financial crisis of 2007–2009, these indicators in innovative and other industries showed an increase (to the level of over 14%); the profitability declined at the time of the economic slump, (to around 7%). However, this reduction was temporary and, already in 2020, the FDI profitability ratio strongly rebounded in innovative industries (to nearly 15%), maintaining a constant surplus over the profitability of other industries in the following years, with a common downward trend resulting from a decreasing marginal capital productivity (Figure 3).

FDI income includes income from capital engaged in these investments. This means that it comprises income from stocks and other forms of equity (dividends, reinvested earnings) and income from debt instruments (interest). FDI profitability is determined, in addition to the rate of return on inputs, by the method of their financing and a dividend policy pursued by a foreign direct investor. In the complex ownership structures of international corporations, the decisions of a parent company towards its controlled entities are decisive, including the transfer pricing system used or the aforementioned policy of dividends paid annually from profit to be distributed as well as super-dividends (from several years back) (Kosztowniak, 2021).

Reinvested earnings accounted for the highest share of FDI income. In the years 2004–2020, FDI in innovative industries showed on average a higher share of reinvested profits (49%) and a lower share of paid dividends (43%) than FDI in other industries (38 and 48%, respectively). These results are the basis for decisions made by foreign investors to maintain the existing investments and their further development in innovative industries.

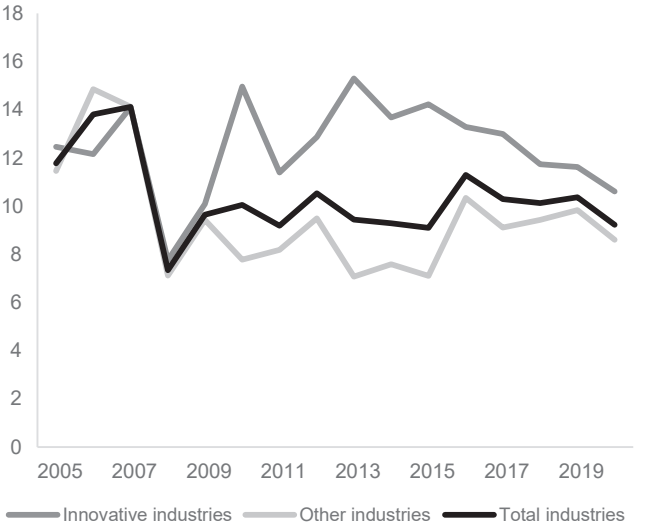


Figure 3.
FDI profitability ratio in Poland in 2005–2020 (%)

Note(s): The profitability ratio is calculated as the quotient of the current year's income (t) and the balance of FDI liabilities from the previous year (t-1) (NBP, 2016b)

Source(s): The author's own calculations: NBP (2021)

The retention of generated profits and their allocation to subsequent years in Poland in terms of innovative industries may indicate better prospects for these industries than for others (Figure 4).

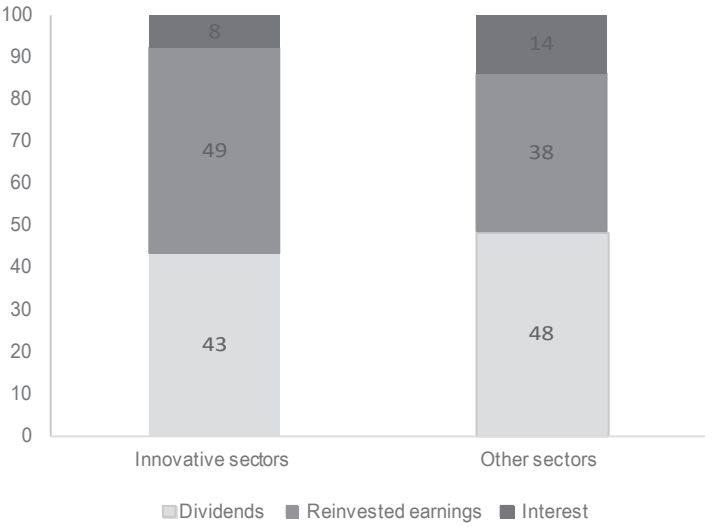


Figure 4.
The structure of FDI income in Poland in 2004–2020 (%)

Source(s): The author's own calculations: NBP (2021)

The period of the COVID-19 pandemic brought changes to the structure of income of innovative industries. Among innovative industries, in 2020 foreign direct investors achieved the highest income from other activities related to information and communication (J58_62_63), other sectors related to production jointly (C_OTH) and telecommunications (J61). The growing demand for IT services, both in the financial and non-financial sector of enterprises and households, and the continued demand for durable consumer goods effectively supported these industries in achieving the higher income. For example, in previous years, the highest incomes came from wholesale trade, excluding trade in motor vehicles and motorcycles (G46), followed by other manufacturing sectors combined (C_OTH) and the production of motor vehicles, trailers and semi-trailers (C29).

6. The role of FDI in the economy

In 2009–2018, the cumulative increases of VA in entities controlled by foreign capital were higher than in domestic entities. While in 2018 the level of the VA index for domestic enterprises in innovative industries reached 1.5 and in other industries 1.6, in the case of enterprises controlled by foreign capital, it amounted to 2.0 and 1.9, respectively. Thus, the VA gap widened over time between these two groups of enterprises (Figure 5).

The share of VA of entities controlled by foreign capital in innovative industries in Poland showed a faster growth than in other industries. In 2009–2018, the share of the VA of entities controlled by foreign capital in innovative industries in the total VA of entities in Poland from innovative industries showed an increase by 7 pp (from 26% to 33%). Weaker dynamics of growth in the share of VA were recorded by foreign entities from other industries, i.e. by 2 pp (from 11% to 13%). These results may indicate a higher efficiency of entities controlled by foreign capital in Poland in innovative industries than in other industries, despite comparable increases in the FDI status in both industries. On the other hand, the share of the VA of the innovative industry entities in the total VA of the Polish economy averaged 7% (from 6.6% in 2009 to 8.1% in 2018) (Figure 6).

In 2018, the share of the VA in the Polish economy was 15% in terms of the VA of entities with foreign capital, of which approx. 7% in innovative industries and approx. 8% in other industries. In the innovation industry itself in Poland, the total share of foreign entities was approx. 32%.

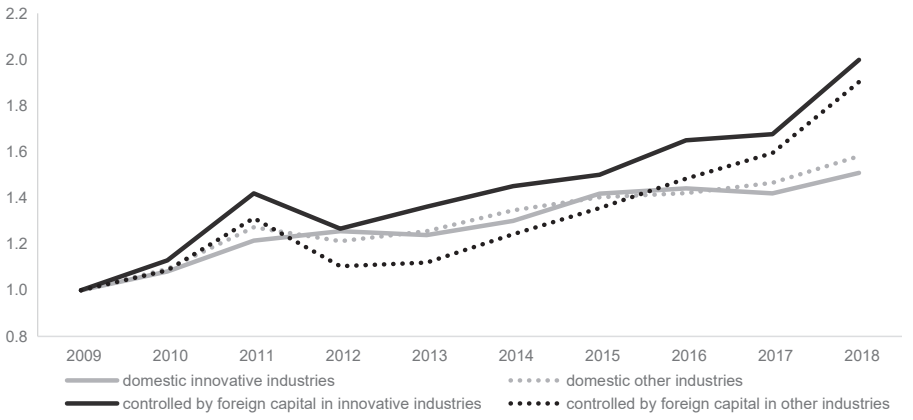


Figure 5.
VA in domestic enterprises and enterprises controlled by foreign capital in Poland in 2009–2018

Note(s): Constant prices from 2009 and index 2009 = 1
Source(s): The author's own calculations: Eurostat (2021)

Despite the relatively low level of foreign capital in Poland in relation to GDP in 2004–2020 (on average 38%), FDI can be expected to have played an important role in the transfer of technology, which supported the process of real convergence. In addition to the significantly faster growth in productivity of foreign enterprises (Figure 5), this may be evidenced by a low role of R&D expenditure, which in 2008–2019 remained approximately 2 times lower in relation to GDP than the average level in the EU28. In 2008, the level of expenditure on R&D in Poland amounted to 0.6% of GDP (comparable to Slovakia, Lithuania or Latvia), rising to 1.3% of GDP in 2018. Both domestic and foreign entities participate in these expenditures. Nevertheless, the postulated level of expenditure for which the Polish economy should aim by 2030 (3% of GDP) [3] still requires growth to support economic development.

7. The research procedure

In order to analyze the relationship between changes in GDP values and FDI stocks in the innovative and other sectors in the years 2004–2020, a final formula for the GDP function was developed:

$$d\_GDP_t = \propto_0 + \propto_1 d\_FDI\_IS_t + \propto_2 d\_FDI\_OS_t + \xi_i \quad (1)$$

The dependent variable: d_GDP_t – Gross domestic product (PLN million).

Independent variables:

$d\_FDI\_IS_t$ – FDI stocks in innovative sectors (PLN million),

$d\_FDI\_OS_t$ – FDI stocks in other sectors (PLN million)

ξ_t– random component

t– period

The GDP data came from the OECD database and those for FDI stocks from NBP sources. All variables expressed in terms of value are included in the form of the first differences variables. The empirical analysis used e-Views.

An initial data verification concerned the verification of stationarity with the use of several tests (Tables 2 and 3). To verify the stationarity of the analyzed time series, the Augmented Dickey-Fuller (ADF) test is used, estimated by means of the regression equation in the following form:

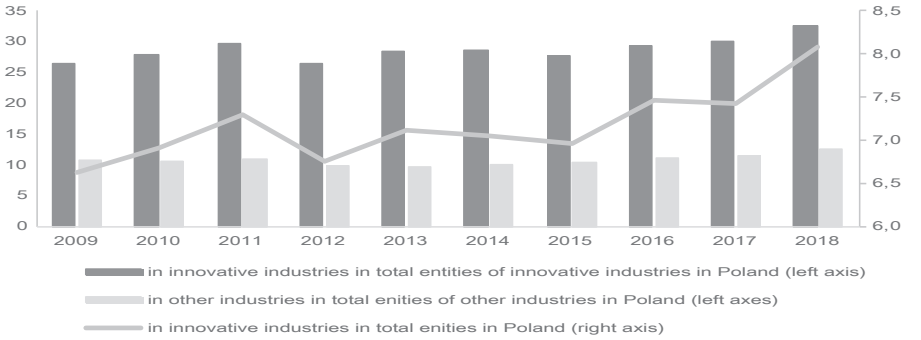


Figure 6.
The shares of the VA of entities controlled by foreign capital in Poland in 2009–2018 (%)

Source(s): The author's own calculations: Eurostat (2021)

$$\Delta_{yt} = \mu + \delta_{t-1} + \sum_{i=1}^{k} \delta_i y_{t-1} + \epsilon_t \quad (2)$$

The value of the test statistic: $ADF = \frac{\widetilde{\delta}}{S_{\widetilde{\delta}}}$

where δ means the parameter evaluation and s_δ is the parameter estimate error.

To verify the conclusions drawn on the basis of the ADF test, the Kwiatkowski–Philips–Schmidt–Shin (KPSS) stationarity test is carried out, where the null hypothesis assumes sequence stationarity, whereas the alternative hypothesis assumes the occurrence of the unit root. The initial test model can take the following form:

$$\gamma_t = \beta_t + r_t + \xi_t \quad (3)$$

where: $r_t = r_t\text{–}1 + u_t$, with ξ_t and u_t being a stationary and a white-noise random component, respectively.

On the other hand, the KPSS test statistic is calculated by means of the following formula:

$$KPSS = T^{-2} \sum_{t=1}^{T} \left(\sum\nolimits_{t=1}^{t} e_i \right) \Big/ \widehat{\delta}^2 \quad (4)$$

where e_i denotes residuals and $\widehat{\delta}^2$ is a long-term variance estimator.

A comparison between test τ statistics and the critical values of these statistics shows that, in the case of basic variables, the series are non-cointegrated and variables are non-stationary because the test probabilities are above 0.05. On the other hand, in the case of first differences, variables are mostly stationary and the series are co-integrated to the order of 1. An ultimate confirmation of stationarity requires an additional test, e.g. KPSS (Table 3).

The lag order for the VAR/VECM model was determined on the basis of an estimation of the following information criteria: the Akiake information criterion (AIC), Schwartz–Bayesian information criterion (BIC) and Hannan–Quinn information criterion (HQC). According to these criteria, the best, that is, minimal values of the respective information criteria are: AIC = 1, BIC = 1 and HQC = 1, with the maximum lag order of 2. Ultimately, the lag order 1 was accepted.

In order to analyze the stability of the VAR model, a unit root test was applied. The test indicates that, in the analyzed model, the equation roots in respect of the module are lower than one, which means that the model is stable and may be used for further analyses.

Table 2. Stationarity test results on the basis of the Augmented Dickey–Fuller (ADF) test

Variable	Null hypothesis The unit root appears	With constant Test statistic τ_ct (1)	With constant Asymptotic p-value	Constant and trend Test statistic τ_ct (1)	Constant and trend Asymptotic p-value
GDP_t	$a = 1$ process I (1)	−3.00205	0.03472	−2.4350	0.3612
FDI_IS_t		−4.65799	0.00278	−4.4208	0.0167
FDI_OS_t		−3.87557	0.00223	−2.6116	0.2750

Table 3. KPSS stationarity test results (lag transaction = 2)

Specification		GDP	FDI_IS	FDI_OS
Without a trend	Test statistic	0.117417	0.124192	0.196723
	Critical value of the test	0.360 (10%); 0.463 (5%); 0.682 (1%)		

Co-integration was verified using two tests: the Engle–Granger and Johansen tests (Johansen, 1991, 1995). Their results comprehensively confirmed co-integration for lag 1. This is proved by the values of the test statistic τ_e, lower than critical values $\tau_{critical}$, by the levels of asymptotic p-values and integrated processes $a = 1$ and I (1) (Table 4).

The results of the Johansen test show that at the significance level of 0.05, a co-integration to the order of one occurs. Due to the occurrence of unit element in all the time series and the existence of cointegration between the model variables, it was possible to extend and transform the model into VECM.

8. The empirical model and results

8.1 VECM model

Co-integration was verified by means of the Engle–Granger and Johansen tests, which confirmed the co-integration and thus justified the use of the VECM model for the lag order 1 and the co-integration of order 1. In accordance with the Granger representation theorem, if variables y_t and x_t are integrated to the order of I (1) and are co-integrated, the relationship between them can be represented as a VECM (Piłatowska, 2003).

The general form of the VECM can be written as:

$$\begin{aligned}\Delta Y_t &= \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \ldots + \Gamma_{k-1} \Delta Y_{t-k+1} + \pi Y_{t-k} + \varepsilon_t \\ &= \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + \pi Y_{t-k} + \varepsilon_t,\end{aligned} \tag{5}$$

where:

$$\Gamma_i = \sum_{j=1}^{i} A_j - I,\ i = 1, 2, \ldots, k-1,\ \Gamma_k = \pi = -\pi(1) = -\left(I - \sum_{i=1}^{k} A_i\right)$$

and I is a unit matrix.

The vector correction model component (EC1) representing the mechanism of short-term adjustments which serves the attainment of the long-term model balance. The evaluation of the EC1 indicates that the strongest correction of the deviation from long-term equilibrium occurs in the case of the FDI stocks from the other sectors. Here, around 3.9% of the imbalance from the long-term growth path is corrected by a short-term adjustment process. Weaker deviation adjustments occur for GDP from FDI stocks from innovative sectors (0.5%). The values of the coefficient of determination R^2 reveal an adjustment matching of the VECM model equations to empirical data, i.e. for GDP (17.5%), IS (10.7%) and OS (69.3%) (Table 5).

In order to verify the correctness of the VECM model results, the ARCH test was carried out verifying the autocorrelation for the lag order for test = 1. The ARCH test results indicate that, in the examined model of the residual-based process (three variables), the ARCH effect was not observed because LM test statistics are lower than the levels of χ^2. This means that

Table 4.
The results of the Engle–Granger co-integration test

Specification	d_GDP	d_FDI_IS	d_FDI_OS
Unit root appears		$a = 1$; process I (1)	
ADF test with test with constant, test statistic τ_c (1), τ_e (asymptotic p-value), lag order = 2	−3.00205 (0.03472)	−4.65799 (0.00278)	−3.87557 (0.00223)

	Beta (cointegrating vectors standard errors in parentheses)		Alpha (adjustment vectors)	
d_GDP	1.0000	(0.00000)	−0.0017288	
d_IS	−88.420	(166.32)	0.00055033	
d_OS	−341.40	(66.103)	0.0038695	
Equation (1): d_d_GDP	*Coefficient*	*Std. Error*	*t-ratio*	*p-value*
Const	−21670.0	17434.0	−1.243	0.2358
EC1	−0.00172882	0.00103975	−1.663	0.1203
R^2 0.175373	Adjusted R^2 0.111940		DW 1.635717	
Equation (2): d_d_IS	*Coefficient*	*Std. Error*	*t-ratio*	*p-value*
Const	5348.96	7390.76	0.7237	0.4820
EC1	0.000550327	0.000440778	1.249	0.2339
R^2 0.107072	Adjusted R^2 0.038385		DW 2.927567	
Equation (3): d_d_OS	*Coefficient*	*Std. Error*	*t-ratio*	*p-value*
Const	44722.9	11987.9	3.731	0.0025***
EC1	0.00386950	0.000714948	5.412	0.0001***
R^2 0.692619	Adjusted R^2 0.668975		DW 2.141991	

Note(s): Lag order 1, 2006–2020 (T = 15), cointegration rank = 1; *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

Table 5.
VECM system

there is no autoregressive changeability of the conditional variance and there is no need to estimate model parameters by means of the weighted least squares method. Thus, the results of this test confirm the credibility of the VECM model and allow for conclusions drawn on their basis (see also: Figure A1).

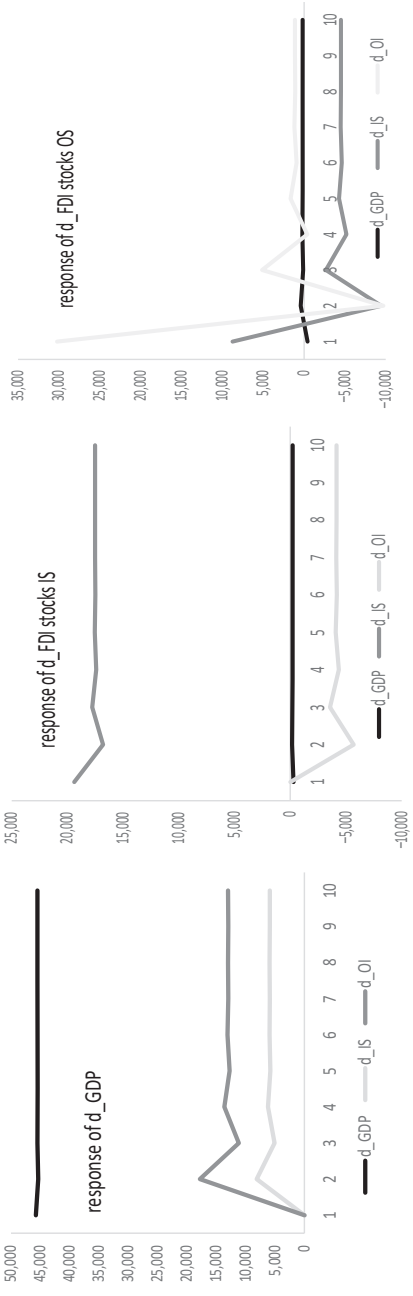
8.2 Impulse response functions

The analysis of GDP responses to shocks derived from FDI stocks from the innovative and other sectors reveals that GDP responses are the strongest to impulses from other sectors and weaker from innovative sectors. However, GDP responds positively to both shocks. The strongest GDP responses occur in the periods of 1–2 years. Period 3 is characterized by a falling tendency after which fluctuations in GDP responses stabilize slowly, usually starting from period 5 or 6. Moreover, the response of FDI stocks from the innovative sector come mainly from its own past shocks, stabilizing after period 3. The responses of FDI from other sectors are also the strongest to their own shocks, while the negative response is caused by changes in FDI from innovative industries. This may indicate a rivalry of FDI between these two sectors. A higher inflow of FDI to innovative sectors means a decreased accumulation in other sectors (and vice versa) (Figure 7) (see also: Figure A2).

8.3 The decomposition of variance

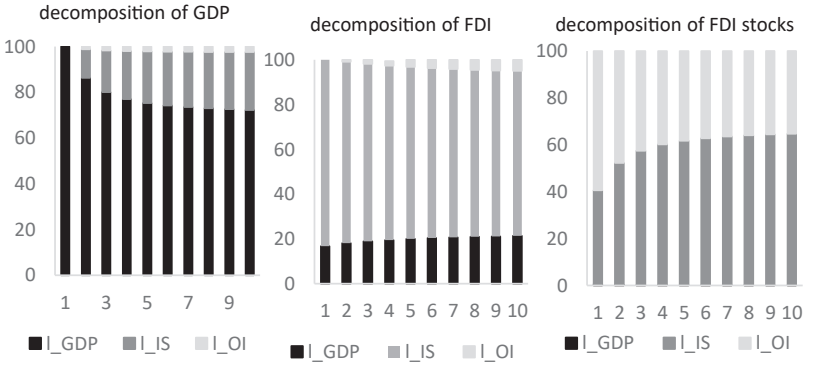
GDP and all FDI stocks were analyzed by means of variance decomposition in the forecast horizon of 10 quarters (Figure 8). The results of GDP decomposition indicate that, in period 1, these changes are fully accounted for with their own forecast errors. In period 2, their own changes lose (86.3%) and such FDI in innovative sectors (12.5%) and other sector (1.2%) grow in significance. In period 10, GDP's own changes decrease to 72.3% and increase the degree of its explanation by FDI in innovative (25.3%) and other sectors (2.4%). The degree of explanation of FDI in innovative sectors depended mainly on own shocks, although they show a certain reduction (83.2 and 73.7%). On the other hand, the degree of explanation of FDI in other sector depended mainly on the increase in FDI from innovative sectors (40.0 and 64.7%) (see also: Figure A3).

All in all, these results indicate an increasing level of FDI in innovative sectors for explanation GDP. This means that the accumulation of these investments should be



Source(s): The author's own calculations

Figure 7.
The response of GDP to a standard shock in FDI stocks in innovative and other sectors



Source(s): The author's own calculations

Figure 8.
The decomposition of variance for GDP, FDI stocks in innovative and other sectors

encouraged. Even though FDI resources in innovative sectors are twice lower in value than FDI in other sectors, their impact on GDP growth is stronger. These results correspond to the higher added value generated by foreign entities in innovative sectors (Figures 5 and 6), confirming an increase in productivity due to the positive effects of innovation and technology transfer to Poland.

9. Discussion

The effects of FDI, as indicated, depend on many conditions on the part of an investor and a host country, the types of connections among companies (financial, economic, organizational), the diffusion of financial, managerial and technical knowledge, the scale of differences in the levels of innovation and efficiency, and a range of conditions in the real economy (Crespo and Fortuna, 2007; Osei and Kim, 2020). All these conditions are important because they determine the differences in the inflow of FDI to Poland and other transition countries.

The theoretical implication of this article concerns the confirmation of T. Ozawa's development paradigm for Poland in the sense that the key is to move away from FDI inflow from raw material-intensive sectors to technologically intensive sectors to increase the effects of foreign investments measured with the VA growth.

The empirical implication of the presented results consist in supplementing the existing international research on FDI relations, innovation, technology transfer and growth effects. Referring, for example, to Alfaro *et al.* (2004) and the conditions of local financial markets in achieving growth by FDI, the results of this article confirmed the importance of the relevant sectoral structures in the economy. In the absence of an appropriate industry structure, the effects of FDI may be limited only to capital growth and wages (emphasized, among others, by Makieła and Ouattara, 2018).

The results for Poland confirm that the inflow of FDI to technology-intensive industries is strictly dependent on (conditioned by) the development of the economic structure of a host country (e.g. Growiec and Mućk, 2018), as well as the so-called stages of the inflow of foreign investments (according to Dunning, 1981, Gorynia *et al.*, 2010; Kosztowniak, 2018, pp. 41–60).

The structure of an economy as well as economic and social conditions determine the possibilities of FDI absorption by a receiving country. Consequently, the absorption capacity of an economy, including its individual sectors, determines the type of inflow of innovation and technological progress (Carlino and Kerr, 2014). Therefore, changes in the conditions of the

inflow and absorption of FDI are evolving and require supervision and a targeted investment policy in countries such as Poland and other countries of economic transformation.

Belonging to the group of technology leaders or technology imitators, one can achieve benefits from the research and development effects of FDI, as emphasized in studies by, for example, AlAzzawi (2012). In the case of Poland, considered one of the technology imitators, such effects occur in the fields of information and communication and telecommunications. These industries achieved an increase in VA.

The research results for Poland also confirm the importance of efficient supply chains for creating a high added value in the wholesale trade. This relationship is emphasized by many other authors (Bair, 2005; Gorynia and Jankowska, 2008; Gereffi and Fernandez-Stark, 2011).

The verified hypotheses (H1 and H2) for Poland prove the truth of the thesis that long-term economic growth is determined by technological progress (concentrated in innovative industries) to a greater extent than by increased capital accumulation (Abramovitz, 1956; Solow, 1957).

In summary, the presented review of theoretical and empirical literature confirms the complex conditions determining the impact of FDI on the creation of added value. In the context of the ongoing discussions, it is worth emphasizing the key conditions, such as:

(1) The structure of an economy (industries, sections, classes, etc.),

(2) The condition of technical, economic and institutional infrastructure and human capital resources,

(3) Economic policy, including the investment policies of host countries,

(4) Other conditions for the absorption capacity of FDI by a host country.

The current and expected state of the structure of an economy, infrastructure and economic policy, as well as the absorption capacity determine the current and future decisions of foreign investors (e.g. concerning the reinvestment of profits). Therefore, it is important to reconcile often diverging interests. On the one hand, the economic interests of a host country, on the other hand, the commercial interest (profit maximization) on the part of foreign investors.

The results presented in the article fill a research gap related to a wide group of determinants of the impact of FDI on GDP. These results indicate an important role of the structure of an economy, including innovative industries. The structure of a host country's economy determines the possibilities of FDI absorption and has an impact on the distribution of economic effects between the parties.

10. Conclusion

10.1 Theoretical and empirical results

The research results confirm the importance of industry structure of the economy for the growth of added value in Poland in the years 2004–2020. Innovative industries (with high expenditure on R&D) are of key importance, because they more effectively absorb the transfer of technology, innovation or learning outcomes, revealed in the increase in the productivity of these industries and the creation of final VA.

The theoretical contribution of this article concerns the confirmation of T. Ozawa's development paradigm for Poland in the sense that the key is to move away from FDI inflow from raw material-intensive sectors to technologically intensive sectors to increase the effects of foreign investments measured with the VA growth. The direction of these changes is correct now both in terms of social, environmental protection, postulated changes in the green transformation (by EU institutions) and in economic terms.

The identifying 11 innovative industries for Poland made it possible to confirm their better results in achieving VA than by other industries.

The results of empirical research for Poland in 2004–2020 confirmed that FDI supported innovation and technology transfer, as evidenced by its participation in innovative industries. The highest added value was generated by enterprises with foreign capital operating in the field of wholesale trade, excluding trade in motor vehicles and motorcycles (G46), and the highest growth in the field of information and communication (J58_62_63) and telecommunications (J61). Due to the production and trade cooperation as well as the participation in the value chains of foreign and Polish companies (including sub-suppliers), the internal and external transfer of innovation and technology were possible.

The possibilities of supporting innovation and technology transfer on the part of foreign direct investors in Poland are not exhausted; however, the structure of interest in industries (innovative and other) has remained quite similar in recent years. In 2004–2020, the average share of FDI in the other industries was 68%, compared to the average 32% share of FDI in innovative industries. If the share of investments in innovative industries in the structure of FDI accumulation was higher, the productivity effects would be better. In the years 2004–2020, the FDI status was approximately 38.3% of GDP, including approximately 12.0% of GDP in innovative industries and 26.3% of GDP in other industries.

The interest of foreign direct investors in taking up activities in innovative industries was related, for example, to the latter's higher profitability than of other industries. The average level of the FDI profitability index of innovative industries for the years 2005–2020 exceeded by 3 pp the profitability of other industries (12.5% compared to 9.5%). In 2004–2020, the share of reinvested profits (49%) in innovative industries exceeded this share in other industries (38%), confirming the plans of foreign investors to maintain and to further develop the existing investments.

The degree of support for growth by FDI from innovative industries is evidenced by its share in the added value of the Polish economy, which remained at a stable level of approx. 7% in the years 2004–2020. In turn, in 2009–2018, the share of the VA of entities controlled by foreign capital in innovative industries in Poland showed a faster growth (by 5 pp) than in other industries, despite comparable increases in the FDI status in both industries (a positive verification *the H1*).

Moreover, the results of the response function indicate a stronger short-term influence of FDI in other industries on GDP. However, the results of the decomposition confirm that the level of explanation of GDP by FDI in innovative industries is higher than in other industries and, importantly, their level of explanation grows over time (a positive verification of *the H2*). It would be postulated to change the structure of FDI accumulation by increasing FDI in innovative industries. This is evidenced by the better results of innovative industries in terms of generated VA or the decomposition of GDP variance.

10.2 Economic policy recommendations

In transition countries, such as Poland, with a problem of capital shortages (especially in 1950–2000), FDI is one of the main channels of replenishing this capital. Nevertheless, the period of 30 years of transformation and over 20 years of integration with the EU economy is a sufficient time to summarize the effects of the presence of foreign capital in order to skillfully shape the investment policy.

The contribution to economic practice, including recommendations for shaping investment policy in host countries, concerns a more intensive attracting of FDI to innovative industries, while limiting it in others, because the condition for economic development and achievement of international competitiveness is an increased share of innovative industries in the VA. It is worth noting, however, that sometimes the possibilities of attracting FDI to industries important for a host economy are limited, for example, by the strategic goals of multinational companies, which may be different.

Targeting the policy supporting the inflow of FDI to innovative or other branches important for a receiving country should be conditional in order to fairly distribute the economic effects (Blomström *et al.*, 1994; Balasubramanyam *et al.*, 1996; Blomström and Kokko, 1998; Blomstrom and Sjoholm, 1999). This conditionality is especially justified in the countries of economic transformation. A host country should offer various concessions, fiscal and trade facilities, opportunities to open enterprises in exchange for, e.g. technology transfer and innovation through new or the modernization of existing investments.

It would be advisable to maximize efforts to attract FDI in the form of new enterprises (the so-called greenfield investments), the branches/subsidiaries of foreign parent companies or enterprises with foreign capital in innovative industries.

The recommended economic policy should also focus on creating favorable conditions for cooperation between foreign and domestic entities. This support should cover the various stages of the business chain in order to achieve side effects (technological, know-how, organizational, etc.). If the scope of a host country's support is balanced by the VA created by foreign investors, then the gains on both sides are balanced. When the benefits are captured by foreign investors, negative effects emerge, for example, the crowding out effect of domestic investment by foreign investment in host economies.

The experiences of recent years (i.e. the COVID-19 pandemic and the war in Ukraine) show that it is important, in addition to supporting innovative industries, to maintain the domestic economic potential in the so-called strategic sectors (energy, transport, military, fossil fuel extraction, agriculture and healthcare, etc.). Problems with supply chain disruptions have highlighted the importance of keeping basic sectors of the economy functioning well. At the same time, an increase in demand for ICT services is conducive to the development of innovation and technological progress, to which the countries receiving FDI must be open.

10.3 Expected future research and limitations

The complex issue of the impact of FDI on economic growth, although discussed in the literature since the 1860s, still determines new research tasks, for example:

(1) The impact of FDI on innovative sectors, broken down into activities related to medium and advanced technologies.

(2) The impact of FDI on innovative and other industries broken down into vertical and horizontal links between foreign and domestic investors.

(3) The diagnosis of the distribution of the effects of the presence of FDI on innovative industries on the part of a host country and an investor, not only at the macro level but also at the micro level (of individual entities).

These areas of future research would be justified for Poland and other transition countries, as the identified differences in outcomes between countries would be important in developing optimal economic policy methods and tools.

Among the research limitations, it can be indicated, first of all, that changes in the classification of activities reduce the time series period available. Secondly, the published VA statistics may be understated through tax optimization activities undertaken by foreign investors. The development of tax havens and the activities of special purpose entities (SPE) distort the real effects of FDI in the world economy, including Poland.

Notes

1. Despite the fact that these industries showed the highest absorption of R&D expenditures, it should be remembered that many effects of FDI concern other industries that inherently show a lower absorption of these expenditures.

2. Apart from the above-average profitability, foreign investors invested their capital in foreign economies due to the prospects of staying in a large market, in this case Poland, which could be a channel for expansion into other CEE markets. The good economic situation, the lack of demand barriers, and the relatively stable level of prices and the zloty exchange rate could have been additional elements of the favorable investment climate of the Polish economy as a host country.
3. In line with the long-term national development strategy, the third wave of modernity, the expected level of increase in R&D expenditure for Poland is up to 3% of GDP by 2030. The earlier goals of the Europe 2020 Strategy assumed the level of 1.7% of GDP for investments in R&D for Poland, compared to 3% of GDP for the entire EU (Poland, 2030, 2013).

References

Abramovitz, M. (1956), "Resource and output trends in the United States since 1870", *American Economic Review*, Vol. 46 No. 2, pp. 5-23.

AlAzzawi, S. (2012), "Innovation, productivity, and foreign direct investment-induced R&D spillovers", *The Journal of International Trade and Economic Development*, Vol. 21 No. 5, pp. 615-653, doi: 10.1080/09638199.2010.513056.

Alfaro, L., Chanda, A., Kalemli-Ozcan, S. and Sayekd, S., "FDI and economic growth: the role of local financial markets", *Journal of International Economics*, Vol. 64 No. 1, pp. 89-112.

Ashraf, A., Herzer, D. and Nunnenkamp, P. (2016), "The effects of greenfield FDI and cross-border M&As on total factor productivity", *World Economy*, Vol. 39 No. 11, pp. 1728-1755, doi: 10.1111/twec.2016.39.issue-11.

Bair, J. (2005), "Global capitalism and commodity chains: looking back, going forward", *Competition and Change*, Vol. 9 No. 2, pp. 153-180.

Balasubramanyam, V.N., Salisu, M. and Sapsford, D. (1996), "Foreign direct investment and growth in EP and IS countries", *Economic Journal"*, Vol. 106 No. 434, pp. 92-105, doi: 10.2307/2234933.

Barro, R.J. (1990), "Government spending in a simple model of endogenous growth", *Journal of Political Economy*, Vol. 98 No. 5 Part 2, pp. 103-125, doi: 10.1086/261726.

Blomström, M. and Kokko, A. (1998), "Multinational corporations and spillovers", *Journal of Economic Surveys*, Vol. 12 No. 3, pp. 247-277, doi: 10.1111/1467-6419.00056.

Blomström, M., Lipsey, R.E. and Zejan, M. (1994), "What explains the growth of developing countries", Working Paper No. 4132. Cambridge, MA: National Bureau of Economic Research, Cambridge, MA, available at: http://www.nber.org/papers/w4132

Blomstrom, M. and Sjoholm, F. (1999), "Technology transfer and spillovers: does local participation with multinationals matter?", *European Economic Review*, Vol. 43 Nos 4-6, pp. 915-923.

Carbonell, J.B. and Werner, R.A. (2018), "Does foreign direct investment generate economic growth? A new empirical approach applied to Spain", *Economic Geography*, Vol. 94 No. 4, pp. 425-456, doi: 10.1080/00130095.2017.1393312.

Carlino, G. and Kerr, W.R. (2014), "Agglomeration and innovation", NBER Working Paper No. 20367.

Crespo, N. and Fortuna, M.P. (2007), "Determinant factors of FDI spillovers – what do we really know", *World Development*, Vol. 35 No. 3, pp. 410-425.

Domar, E.D. (1947), "Expansion and employment", *American Economic Review*, Vol. 31 No. 1, pp. 34-55.

Dunning, J.H. (1981), "Explaining the international direct investment position of countries: towards a dynamic or development approach", *Weltwirschaftliches Archiw*, Vol. 119, available at: https://rd.springer.com/chapter/10.1007/978-1-349-05989-8_4

Gereffi, G. and Fernandez-Stark, K. (2011), *Global Value Chain Analysis: A Primer, Center on Globalization, Governance and Competitiveness*, Duke University Durham, North Carolina, pp. 1-40.

Gorynia, M. and Jankowska, B. (2008), *Klastry a Międzynarodowa konkurencyjność i internacjonalizacja przedsiębiorstwa (Clusters versus international Competitiveness and internationalization of the Enterprise)*, Difin, Warsaw.

Gorynia, M., Nowak, J. and Wolniak, R. (2010), "Investment development paths of Central European countries: a comparative analysis", *Argumenta Oeconomica*.

Growiec, J. and Mućk, J. (2018), "Długookresowe spojrzenie na stopę inwestycji w Polsce (A long-term look at the investment rate in Poland)", *Obserwator Finansowy*, Vol. 18 August. available at: https://www.obserwatorfinansowy.pl/bez-kategorii/rotator/dlugookresowe-spojrzenie-na-stope-inwestycji-w-polsce/

GUS (2021), "Działalność innowacyjna przedsiębiorstw przemysłowych w latach 2017-2019, Analizy statystyczne (Innovative activity of industrial enterprises in 2017-2019, Statistical analyzes)", Warsaw, available at: https://stat.gov.pl/obszary-tematyczne/nauka-i-technika-spoleczenstwo-informacyjne/ nauka-i-technika/dzialalnosc-innowacyjna-przedsiebiorstw-w-latach-2017-2019,2,18.html#

Hagemejer, J. and Kolasa, M. (2011), "Internationalization and economic performance of enterprises: evidence form firm-level data", National Bank of Poland Working Paper No 51.

Harrod, R.F. (1939), "An essay in dynamic theory", *Economic Journal*, Vol. 49 No. 193, pp. 14-33, doi: 10.2307/2225181.

Johansen, S. (1991), "Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models", *Econometrica*, Vol. 59 No. 6, pp. 1551-1580.

Johansen, S. (1995), *Likelihood-Based Inference in Cointegrated Vector Autoregressive Models*, Oxford University Press, Oxford.

Johnson, A. (2006), "The effects of FDI on host country economic growth", working paper No. 58. Stockholm, Sweden: Royal Institute of Technology, Centre of Excellence for Studies in Science and Innovation.

Kolasa, M. (2008), "How does FDI inflow affect productivity of domestic firms? The role of horizontal and vertical spillovers, absorptive capacity and competition", *The Journal of International Trade and Economic Development, An International and Comparative Review*, Vol. 18, pp. 1-28.

Kosztowniak, A. (2018), "Changes of inward and outward FDI stocks in Poland and the stage of the investment development path", *Journal of Management and Financial Sciences (JMFS)*, Vol. XIII No. 35, pp. 41-60.

Kosztowniak, A. (2021), "What should the optimal financial structure of FDI inflows to Poland be for stimulating growth processes", *Journal of Management and Financial Sciences (JMFS)*, No. 42, pp. 25-38, ISSN 1899-8968.

Krugman, P.R. (1991), "Increasing returns and economic geography", *Journal of Political Economy*, Vol. 99 No. 31, pp. 483-499.

Lucas, R.E. Jr. (1988), "On the mechanics of economic development", *Journal of Monetary Economics*, Vol. 22 No. 1, pp. 3-42, doi: 10.1016/0304-3932(88)90168-7.

Makiela, K. and Ouattara, B. (2018), "Foreign direct investment and economic growth: exploring the transmission channels", *Economic Modelling*, Vol. 72, pp. 296-305.

NBP (2012), "Statystyka bilansu płatniczego, Zagraniczne inwestycje bezpośrednie w Polsce (Balance of payments Statistics, Foreign Direct Investment in Poland)", available at: https://www.nbp.pl/home.aspx?f=/publikacje/zib/zib.html

NBP (2016), "Potencjał innowacyjny gospodarki: uwarunkowania, determinanty, perspektywy (The innovative potential of the economy: conditions, determinants, perspectives)", Warsaw, pp. 17-21, available at: https://www.nbp.pl/home.aspx?f=/publikacje/innowacyjnosc/index.html

OECD (2008a), *OECD Benchmark Definition of Foreign Direct Investment*, 4th ed., Vol. 14, OECD Publishing, Paris, pp. 22-23.

OECD (2008b), "Zasady gromadzenia i interpretacji danych dotyczących innowacji, Komisja Europejska (Principles of collecting and interpreting data on innovation, European Commission)", OECD, III, Warsaw, Oslo, pp. 1-168.

OECD (2021), "OECD.Stat", available at: https://stats.oecd.org/

Osei, M.J. and Kim, J. (2020), "Foreign direct investment and economic growth: is more financial development better?", *Economic Modelling*, Vol. 93 C, pp. 154-161.

Ozawa, T. (1992), "Foreign direct investment and economic development", *Transactional Corporations*, Vol. 1 No. 1, pp. 27-54.

Piłatowska, M. (2003), "Modelowanie niestacjonarnych procesów ekonomicznych. Studium metodologiczne (Modelling of non-stationary economic processes. A methodological study)", Uniwersytet M. Kopernika, Toruń, pp. 1-388.

Polska 2030 (2013), "Trzecia fala nowoczesności. Długookresowa Strategia Rozwoju Kraju", Ministerstwo Administracji i Cyfryzacji (Poland 2030, the third wave of modernity), (Long-term National Development Strategy (2013), Ministry of Administration and Digitization), Warsaw, available at: http://kigeit.org.pl/FTP/PRCIP/Literatura/002_Strategia_DSRK_PL2030_RM.pdf (accessed 11 January).

Romer, P.M. (1990), "Endogenous technological change", *Journal of Political Economy*, Vol. 98 No. 5, pp. 71-102, doi: 10.1086/261725.

Solow, R.M. (1956), "A contribution to the theory of economic growth", *Quarterly Journal of Economics*, Vol. 70 No. 1, pp. 65-94, doi: 10.2307/1884513.

Solow, R.M. (1957), "Technical change and the aggregate production function", *Review of Economics and Statistics*, Vol. 39 No. 3, pp. 312-320, doi: 10.2307/1926047.

Swan, T.W. (1956), "Economic growth and capital accumulation", *Economic Record*, Vol. 32 No. 2, pp. 334-361, doi: 10.1111/ecor.1956.32.issue-2.

Tahir, M. and Alam, M.B. (2022), "Empirical evidence from the SAARC economies", *International Journal of Emerging Markets*, Vol. 17 No. 2, pp. 413-432, doi: 10.1108/IJOEM-04-2020-0441.

Young, S. and Lan, P. (1997), "Technology transfer to China through foreign direct investment", *Regional Studies*, Vol. 31 No. 7, pp. 669-679, doi: 10.1080/00343409750130759.

Appendix

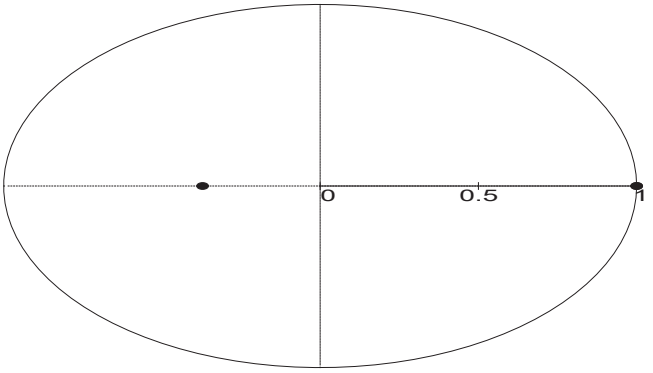


Figure A1.
The VAR inverse root

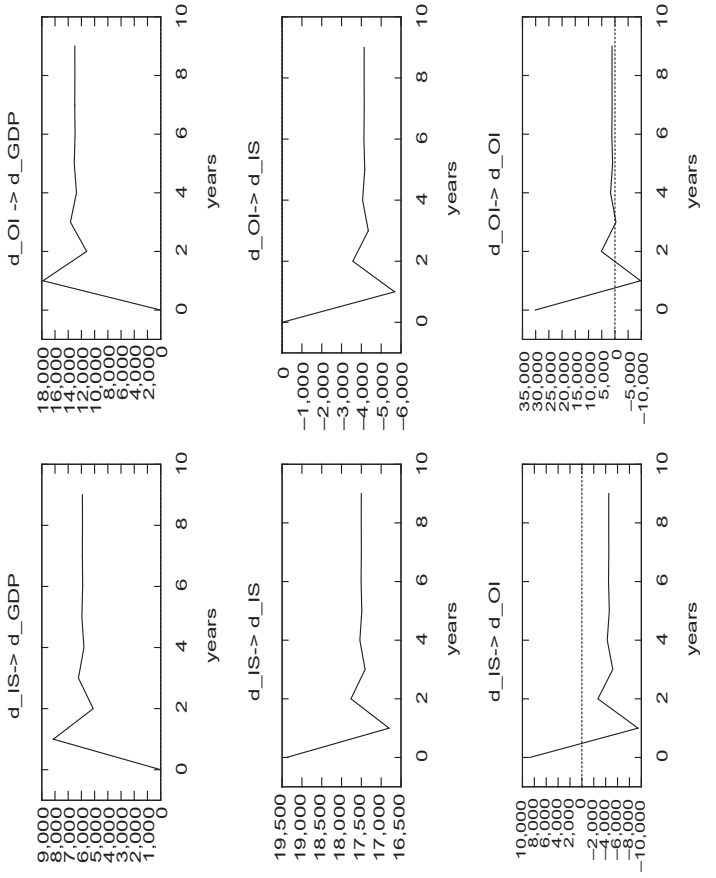


Figure A2.
The impulse response functions

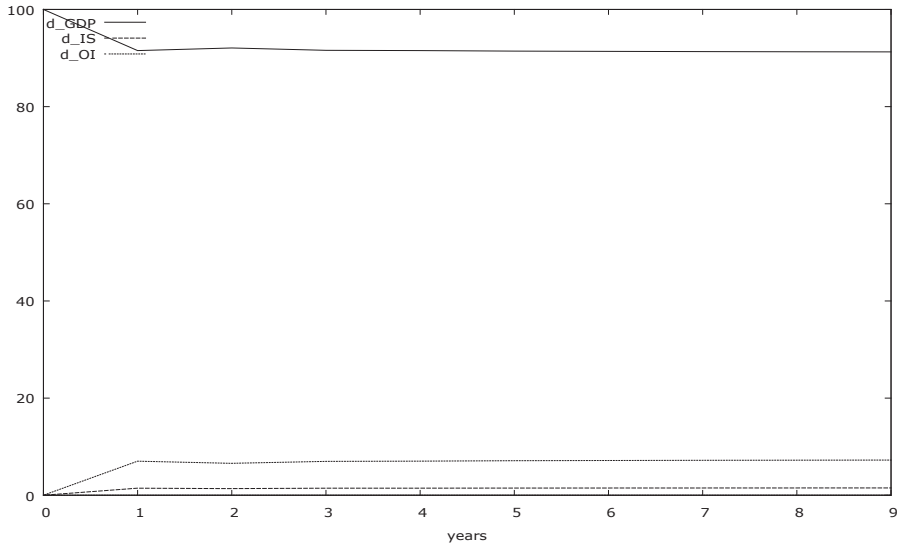


Figure A3.
The forecast variance decomposition for d_GDP

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