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Internationalization–Industrial output nexus: Evidence from 15 late-industrialized economies

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The paper empirically examines the internationalization-output nexus in 15 late-industrialized countries from 1976 to 2018 using fixed and random effects techniques. The findings reveal that trade openness negatively impacts the industrial output, while the labor force shows a positive and statistically significant impact. Domestic investment and education show negligible and insignificant positive and negative impacts on output, respectively. Investment is supposedly incurring zero marginal productivity of capital as it is high in excess of labor. In a nutshell, it is capital bias. Furthermore, bias in terms of complex skill requirements in production prevents the entry of less-skilled labor force. Given these outcomes, we conclude that the incremental capital-output ratio (ICOR) needs to be tested to find out additional intricate issues involved in investment. Besides, the comparative advantage in less skilled labor is underutilized. To overcome this, the policymakers should ensure absorption of such semi-skilled human capital. This requires removing skill bias and capital bias to a reasonable extent without damaging output generation. Hence, the study suggested that the late-industrialized nations may use the potential labor force and capital to speed-up long-term industrial development by enhancing human capital through training, technical know-how, etc., to attain sustainable industrial development.

KEYWORDS
industrial output, late-industrialized countries, panel data modeling, trade openness

1 | INTRODUCTION

Throughout the development process, the transformation from agricultural to manufacturing and service sectors has been the mainstream of economic development (Chenery, 1979; Chenery et al., 1986; Fuchs, 1980 & Kuznets, 1957). Industrialization is viewed as synonymous to economic development and social change. The existing literature is well defined in the association between industrial development and the paramount development of the economy. According to Kaldor (1967), the industrial sector, particularly manufacturing sector of any economy is the engine of growth. Further studies confirm Kaldor's hypothesis that "manufacturing is an engine of growth" in different nations for different periods (Chakarvarty & Mitra, 2008; Fagerberg & Verspagen, 1999; Felipe et al., 2014; Mc Causland & Theodossiou, 2012; Necmi, 1999 & Su & Yao, 2017). In another comprehensive research, Marconi et al. (2016) using panel data for the sample of 63 nations, which comprise 32 low and lower middle income and 31 upper-middle and high-income countries established the validity of Kaldor's first and second laws for both of these groups for periods 1990–2011. The significance of the manufacturing sector in an economy can be understood from two major channels: the backward and forward linkages. According to Hirchman (1958), the backward linkages generate demand for suppliers who provide input to industrial units (mining or construction) as endorsed by Veugelers (2013), while the forward linkage is the connection between the manufacturing sector, wholesale, retail trade and business services sectors. The positive effect of the interconnection of the manufacturing sector with the rest of the sectors is

documented by the European Commission (2013) and Westkämper (2014). Another important benefit of the development of the industrial sector is the "structural change bonus" (Chenery et al., 1986; Fagerberg & Verspagen, 1999; Fei & Ranis, 1964; Rodrik, 2009; Temple & Woessmann, 2006; Timmer & Szirmai, 2000 & Van Ark & Timmer, 2003), which is the augmentation of labor productivity by transfer of labor resource from agriculture to the industrial sector.

Scholars around the world have examined the role of the manufacturing sector in different areas of an economy, notably in employment generation, increase in per capita income, technological up-gradation and poverty alleviation. From available studies, UNIDO (2013) highlighted that "manufacturing jobs tend to be more productive than others, and so tend to be better paid and to offer better labour conditions." The manufacturing economy engenders higher productivity level (Cornwall, 1977; Kaldor, 1967), which in turn increases the level of technology; capital accumulation and economics of scale (Tahir et al., 2014). The existing endogenous growth theory advanced by Romer (1986, 1990) and Lucas (1988) centered on describing the Solow residual. Change in technological growth is endogenous to the model and is due to the allocative choices of the person executing the economic activity (Aghion & Howitt, 1998 and Veloso & Soto, 2001). To maximize the profit level, private firms are earmarking huge amount of money on research and development leading to technological progress, and to increase productivity, entrepreneurs are increasing the level of technology in manufacturing industries (Cornwall, 1977; Maddison, 2001). In the seminal work of Szirmai (2012a, 2012b), the study affirmed that technological development is higher in the industrial sector than the agricultural sector.

Manufacturing as the potential sector offers a considerable porting of employment opportunity and observes surplus labor existing in other corners of an economy. In an early work, Diaz-Alejandro (1975) mentioned that due to the lack of governments' effort to develop the industrial sector, some nations are facing the problem of urban unemployment. Athukorala and Sen (2015) rightly pointed out that industrialization is the most significant way to generate decent employment opportunities with appropriate salary, particularly in developing countries. From the study in United States, Moretti (2010) highlighted that one new job in the manufacturing sector creates nearly two additional jobs in the non-tradable sector. Furthermore, Lavopa and Szirmai (2012) concluded that industrialization is crucial for employment generation. This conclusion was accepted in the very recent work conducted by Wang and Chanda (2018). Moreover, the recent experience of the world revealed that a few countries in East Asia and South-East Asian regions such as Japan, Korea, Singapore, Taiwan, China and Vietnam attained substantial growth in their economy such that in the course of economic development, the manufacturing sector generated employment for a considerable amount of labor (Haggard, 1996; Krueger, 1997; Perkins, 2013). Industrialization is an effective instrument for the eradication of poverty both in the short and long runs. Development of the industrial sector eradicates the level of poverty both in rural and urban centers by generating employment opportunities and remunerating labors' service. In a disaggregated level research, Bhagwati (2005) and Mohsin et al. (2001) opined that the pull-up effect of the manufacturing sector eradicates the poverty level. In addition to this, Athukorala and Sen (2015) highlighted that the wage gains of industrial development can pull a considerable proportion of the people from the vicious circle of poverty. In the same vein, Lavopa and Szirmai (2012) and UNIDO (2013) evaluated the indirect effects of industrialization as a poverty-reduction mechanism through economic development in general and employment generation in particular.

Since the second half of the 20th century, there has been a radical change in trade policy, technology and total volume of the world trade. The total volume of world export (merchandize) achieved around 6% growth while the Gross Domestic Product of the world improved 3% during the above-mentioned period (UNCTAD, 2008). According to the recent statistical evidence, the world merchandize volume has increased to 3.6% in 2017. The appreciable performance of the world trade in 2017 was ascribed to the resurrection of Asian trade flows and perceptible improvement in the demand level of North America (WTO, 2017). With regards to trade policy, following the development models of advanced nations, even underdeveloped and developing nations are enacting different varieties of support systems to attain sustainable growth and improve social welfare. Right from the early 1970s, advanced nations and very recently developing and late industrialized nations are changing their trade policies drastically to reduce trade barriers and increase the volume of total trade (Wong, 2009).

Given these, the study contributes to the literature by examining the impact of trade openness (a proxy for internationalization) on the manufacturing output of 15 late-industrialized countries for the past four decades from 1976 to 2018. The main variables of interest are manufacturing value-added (a proxy for industrialization) and trade openness while the control variables used are investment, secondary school enrolment ratio, labor input and inflation. This study thus differs from the erstwhile literature and tries to portray the relative performance of conventional factors of production in the manufacturing sector in comparison to the less skilled labor force in explaining the industrial output amidst the suspicion of the possible prevalence of skill bias and capital bias among the registered industrial sector in these 15 late industrialized nations. The rest of the paper is structured as follows: Section 2 discusses the extant literature, Section 3 highlights the data and empirical technique, Section 4 discusses the results and Section 5 concludes with policy implications.

2 | BRIEF LITERATURE REVIEW

A substantial body of empirical research has paid attention to the effects of trade openness and economic growth and found that it affects the economy via various channels, but majorly through technology, income and saving, productivity, poverty, and overall development of a nation. The effect of trade openness on technology was widely scrutinized by researchers like Lucas (1988) and Krueger and Berg (2003). According to them, trade liberalization helps in the

diffusion of technology and innovative knowledge, an assertion supported by Grossman and Helpman (1991), Rivera-Batiz and Romer (1991b), Romer (1990), and Krugman (1990). The footprint of these research works exposed the impact of trade on technology through technology spillover, economies of scale in research and development, and higher profits to innovators. In a comprehensive research work covering 126 nations, Freund and Bolaky (2008) found that the trade openness offers higher income levels, which support the previous work of Frankel and Romer (1999) using cross-country data for 36 nations.

Trade openness has become the main area of research among economists and policymakers in picturing the growth episode (Dawson, 2006; Dutta & Ahmed, 2004; Edwards, 1992; Dutta & Ahmed, 2001; Salehezadeh & Henneberry, 2002; Weinhold & Rauch, 1999). The existing theory portrayed that international trade enhances the allocation of productive resource, imports of modern technology, improves productivity and lowers consumers' prices. International level organizations advocated trade liberalization for stimulating growth and welfare (Montalbano, 2011). The recently emerged endogenous growth theories advanced by Rivera-Batiz and Romer (1991a) and Grossman and Helpman (1991) demonstrated that trade openness offers four discrete opportunities such as communication, duplication, integration and allocation effects to attain long-run economic growth. Trade openness is an essential sub-segment to attain paramount economic growth and increase in trade openness is positively associated with social welfare (Sadorsky, 2012).

Furthermore, some studies examined the connection between liberalized trade and its impact on productivity. For instance, the experiment of Tybout and Westbrook (1995), Pavcnik (2002), and Tybout (2000) for different regions revealed that trade openness offers productivity gain through re-allocation of productive resources. In another work, Tybout (1996) concluded that the net increase in exit increased the overall productivity of Chile during the study period of 1975–1985. Using industry-level data in two different studies conducted by Haddad (1993) and Paus et al. (2003) highlighted that the trade measures and productivity measures are significantly correlated. Empirical research works of Edwards (1993), Sachs and Warner (1995), Frankel and Romer (1999), Dollar and Kraay (2002, 2004), and Cline (2004) concluded that trade openness trim downs the poverty level at different periods.

A substantial portion of the empirical literature confirms the positive impact of trade openness on economic growth. It has long been widely found by researchers that trade liberalization positively impacts the overall economic condition of nations through different means (Balassa, 1971; Barro & Sala-i-Martin, 1995; Chang et al., 2009; Coe & Helpman, 1994; Dollar & Kraay, 2004; Grossman & Helpman, 1991; Jonsson & Subramanian, 2001; Kajiwara, 1994, 1995; Krueger & Bhagwati, 1978 & Romer, 1998). While comparing the economic performance of liberalized and non-liberalized nations, World Bank (2020) and Thirwall (1994) concluded that countries with more trade openness have fast economic development pace than those of less opened nations. Lloyd and MacLaren (2000) studied the role of trade openness in the economic development of East Asian countries and found that these nations have achieved a rapid growth supported by trade openness. Furthermore, the regression result of cross-country study executed by Barro (1991), Dollar (1992), Sachs and Warner (1995), Edwards (1993), Frankel and Romer (1999), and Dollar and Kraay (2001, 2002) corroborated the result that there is a positive and significant relationship between trade openness and economic growth.

Investigating the effect of trade openness on the industrial sector has its significance. According to the view of Bhagwati (1978), Zattler (1996), and very recently Tahir et al. (2014), scrutinizing the impact of trade openness on industrial output is very pertinent and legitimate in an economy. Few studies have attempted to examine the effect of trade openness on industrial output, among them Adenikinju and Olofin (2000) found that trade openness is one of the determinants of industrial development in Africa. Similarly, Dijkstra (2000) on Latin America by assessing the growth performance of the manufacturing sector, and Choudhri and Dalia (2000) in their comprehensive work covering a group of developing countries, found the positive relationship between trade openness and industrial development.

Likewise, in the past one and half decade, Barua and Chakraborty (2010) while exploring the effect of trade openness in inequality with special reference to the manufacturing sector in India, Dutta and Ahmad (2004) using endogenous growth model in Pakistan, Rae et al. (2010) in their sectoral approach to finding the effect of trade liberalization and Cho and Yoon (2014) when computing the effect of Australia–India free trade agreement, offered firm support in favour of positive effect of trade openness on the industrial sector. Even though a considerable number of studies have been pursued on the effect of trade, there is no comprehensive research in the existing body of literature to represent late industrialized countries. Hence, the primary objective of this attempt is to address this lacuna and capture the relative impact of trade openness, conventional factors of production and less skilled human capital on the manufacturing output for the past four decades.

3 | DATA AND MODEL

This study selects 15 late-industrialized countries to evaluate the impact of trade openness on industrial output. The reason for choosing these countries is because their economic performance internationally is commendable (for example, China and India) particularly in the past few years, and also these nations are relaxing restrictions for international economic co-integration. According to the World Bank, the following nations are categorized as late-industrialized economies: Bangladesh, Bolivia, Cameroon, China, Egypt, Honduras, India, Indonesia, Jordan, Kenya, Morocco, Pakistan, Peru, Philippines, Sri Lanka, Thailand, Tunisia and Vietnam. Among these nations, 15 countries (Bangladesh, Bolivia, Cameroon, China, Egypt, Honduras, India, Kenya, Morocco, Pakistan, Peru, Philippines, Sri Lanka, Thailand and Tunisia) are considered based on the availability of time-series data. The major source of data is World Development Indicators (WDI) from

the World Bank (2020). Furthermore, the International Finance Statistics (IFS, 2020), World Trade Organization (WTO, 2020) Handbook of Statistics on Indian Economy, and Economic Survey are the additional sources of data and information. The data used in the present exercise are panel data consisting of 15 countries for 41 years from 1976 to 2018 and the period of study is also selected based on the availability of continual data. The development of the industrial sector in general and manufacturing output, in particular, is dependent on several explanatory variables. In line with the existing literature (Dijkstra, 2000; Tahir et al., 2014), the control variables are trade openness, secondary education (used for technological progress/knowledge), inflation (a measure of macroeconomic stability), investment and labor force. All variables are converted to their natural logarithms to smoothen the data and to establish elasticity relationships. Estimations are carried out using the fixed and random effects techniques and the empirical model is specified as follows:

$$\ln inou_{it} = b_0 + b_1 \ln top_{it} + b_2 \ln inve_{it} + b_3 \ln lab_{it} + b_4 \ln \inf_{it} + b_5 \ln edu_{it} + V_{it} \quad (1)$$

where ln stands for natural logarithms; the subscripts *t* is time series; *i* is the cross-sectional dimension of the data; V_{it} is disturbance term; ln*inou* denotes the natural logarithm of industrial output, which measures manufacturing value-added by the industrial sector; ln*top* represents trade openness; ln*inve* is the domestic capital formation (proxy for investment); ln*lab* is the labor force; ln*infl* represents inflation and the gross enrolment ratio is ln*edu*.

4 | RESULTS AND DISCUSSIONS

Before analysing the data, it is important to understand the specifics by examining its descriptive features. To do so, the present study applies panel summary statistics and the results are shown in Table 1. The average industrial output is 2.88 with a standard deviation of 0.286 with minimum and maximum values ranging from 2.09 to 3.691. Even though the summary statistics vary widely across the variables and groups, there is a higher variation of trade openness from the mean value of 3.699. The correlation analysis (see Table A1) shows the model does not suffer from multi-collinearity issues as there are no high correlations between the independent variables. Also, the correlation between dependent and independent variables is mandatory to proceed with regression.

The results from the econometric analysis are shown in Table 2 using the fixed effects approach, which is premised on the outcome of the Hausman test (Hausman, 1978) (see Table B1). Findings reveal that trade openness has a negative impact on industrial output, which implies that a 1% increase in trade openness causes 0.59% decrease in industrial output, on average, ceteris paribus. This outcome supports the argument that trade openness augments imports from advanced nations, which in turn causes a reduction in the domestic production of the industrial sector. Furthermore, it may be attributed that using advanced machines, managerial skills and other resources, advanced nations might have produced a huge volume of consumable items, dumped them in late-industrialized nations and used this ground as a potential market and as a result, the industrial output of these economies are trimmed down. Apart from that, a strong export

TABLE 1 Panel summary statistics

Variable		Mean	*SD*	Min	Max	Observation
Industrial output	Overall	2.882	0.286	2.090	3.691	*N* = 615
	Between		0.262	2.469	3.508	*n* = 15
	Within		0.133	2.273	3.224	*T* = 41
Trade openness	Overall	3.699	0.512	2.130	4.810	*N* = 615
	Between		0.418	2.931	4.374	*n* = 15
	Within		0.312	2.348	4.593	*T* = 41
Investment	Overall	3.163	0.286	2.290	3.860	*N* = 615
	Between		0.219	2.811	3.669	*n* = 15
	Within		0.192	2.463	3.640	*T* = 41
Labor force	Overall	17.084	1.606	14.290	20.720	*N* = 615
	Between		1.632	14.937	20.480	*n* = 15
	Within		0.301	16.341	17.770	*T* = 41
	Overall	0.026	0.094	−0.710	0.510	*N* = 615
Inflation rate	Between		0.009	0.011	0.035	*n* = 15
	Within		0.094	−0.695	0.505	*T* = 41
Education	Overall	4.588	0.175	3.890	4.870	*N* = 615
	Between		0.135	4.229	4.740	*n* = 15
	Within		0.117	4.205	4.919	*T* = 41

Note: Statistics performed using the log transformation of the variables.
Source: Authors' computations.

TABLE 2 Fixed and random effects model results

Dependent variable: Industrial output		
Variable	**Fixed effects**	**Random effects**
Constant	1.189 (0.00)	1.450 (0.29)
Trade openness	−0.059 (0.00)	−0.040 (0.02)
Investment	0.049 (0.13)	0.042 (0.03)
Labor force	0.127 (0.00)	0.095 (0.01)
Inflation rate	−0.035 (0.54)	−0.040 (0.06)
Education	−0.089 (0.11)	−0.040 (0.05)
Wald test		33.150 (0.00)
F-statistic	79.43 (0.00)	

Note: p values are in parenthesis.
Source: Authors' computations.

production mechanism that could offset this effect is understood to be absent. Moreover, it may be articulated from the result that the domestic investment of these late industrialized nations revealed a positive sign, which means that an increase in investment increases the industrial output. This result is a resemblance to the traditional capital accumulation theories (Kaldor, 1961; Solow, 1956). But there is no statistical significance for the coefficient of the variable investment. Also, the coefficient is less than 1% for a 100% change in the independent variable. Investment plays a very negligible role. This might be because as Solow model indicated, the level of capital accumulation reached that level any further change in the capital (ΔK = investment) in the form of investment will not bring any further increase in output. This is because of the diminishing returns to factor property associated with the production function. Any effect if at all is random.

At the same time, the labor force is performing as a driving force of the industrial economy of these nations as it has a positive and statistically significant influence on industrial output. It is universally accepted that the existence of labor force is one of the important sources in underdeveloped and developing nations. It is quite noteworthy that as we go back to history, the newly industrialized nations built human capital, which is highly skilled and by using the human capital, they learned sophisticated technology and techniques related to production, which helped them successfully transforming into industrialized nations. The size effect of labor and quality effect of labor are both reflected in the coefficient. Hence, investment in human capital such as education, training and technical know-how will reinforce the industrial output in future. Hence, policymakers of these nations should frame the suitable policy in which ensuring favourable investment climate and suggest the government to earmark more investment for the development of both human and physical capital to increase the industrial output.

Surprisingly, we find that though not statistically significant, secondary education harms industrial output. Nevertheless, the conjecture is that poor human capital development may hamper the production process. That is, the poorly educated workforce is not able to operate recently imported machines and equipment from foreign countries. Hence, these nations may design a separate model to use trade openness as an effective instrument to enhance the industry-related education introduced by advanced nations. Less skilled human capital is heavily getting replaced by the production process. The production process is highly sophisticated/highly mechanized and requires a complex set of skills. In one way, we can argue that the skill bias and capital bias are barriers for less sophisticated people to find jobs in the industrial sector. Quite unexpectedly, the result of the experiment revealed that there is a negative insignificant relationship between inflation and industrial output in the studied 15 later industrialized nations. Inflation is not seemed to be a major determining factor explaining manufacturing output. So the classical dichotomy between real and nominal variables holds here.

Furthermore, the panel data model demonstrated that the model is well-fitted as the adjusted R^2 value is 0.87 which indicates that 87% variation in explanatory variables has been caused by explained variables. At the same time, the value of the *F*-test is also statistically significant at 1% level, which exhibits that this model is efficient and satisfactory (for the sake of convenience, we did not present the table but available upon request). Overall, the findings show that trade openness negatively influences industrial output, implying that the trade openness in the late industrialized nations obliterates the industrial sector. But some caution, we state that, in the dynamic world, a nation being a closed economy cannot independently flourish and sustain. Hence, these nations should carefully open their doors to trading with the rest of the world not only by protecting the domestic industries but also to attain the overall growth and social welfare.

5 | CONCLUSION AND POLICY IMPLICATIONS

The present empirical research is an attempt to capture the impact of the internationalization of trade on the industrial output of 15 late industrialized nations over 41 years from 1976 to 2018. These nations are selected by considering the availability of time series data. To capture the effect of trade internationalization on the industrial output, the study considered trade openness, secondary education, inflation, investment and labor force as explanatory variables and all the variables are transformed into a natural log form. Based on the panel model, both fixed and random effect models are executed, but the Hausman test favours the fixed effect model. The overall result of the study found that trade openness has negatively affected the industrial output in these late-industrialized nations. This finding gives alert to these nations that in the long run, they should not rely upon the trade openness for their sustainable industrial development. However, this suggestion contradicts the argument at the end of the empirical analysis that no nation can sustain being a closed economy.

Furthermore, delving into history reveals classic examples of newly industrialized countries that have developed through human capital and imported technology (Jones, 2015). These countries are still largely dependent on the developed countries for technology (except China) and a larger import burden is unavoidable. Furthermore, these countries

require a lot of oil import. Apart from that, these countries, in general, are not able to penetrate the export market and also face strong competition from developed countries, which have a much-sophisticated production mechanism. The "J" curve effect is still not actualized for them. The indigenous technology expansion is not happening and R&D sectors are in infant stages or otherwise, these late industrialized nations should carefully enact the trade openness in future to avoid the detrimental impact of trade openness. The trade policies and export competitiveness among industries should be critically examined by policymakers to come-up with suitable policy alterations if needed.

The investment shows no statistically significant influence on output and the effect is negligible. It might be because rather than the replacement of machines and equipment, it might be the embodied or disembodied technology along with investment that caters to production. The investment itself has less role to play in determining the output. It might be the embodied technology in investment that is contributing to output. Hence, policymakers should strive to frame a suitable policy, reflecting on the level of incremental capital–output ratio and why the negative relationship exists. It is probably an imbalance between capital and labor ratio, which results in negative marginal return. Labor has a positive and significant impact but this should be read with a negative insignificant effect that education variable has. The insignificant education variable represents less skilled labor forces that are excluded from the production system. This indicates strong skill bias and capital bias in the mechanism. These regions are not seemingly exploiting the comparative advantage in less-skilled labor. The capital bias and skill bias nature possibly pinpoint a skewed production system and technique. Hence, policymakers can look into and find whether is it possible to bring modifications to include less skilled labor and less skilled labor-intensive techniques to be the component of production to a significant degree. Hence, on the policy front, effective investment on entrepreneurial spirit, training, technical know-how, etc., will reinforce the economy of these nations in general and industrial output in particular. For future studies and given data availability, the impact of information and communication technology (ICT) on the industrial output of the late-industrialized nations can be taken up.

CONFLICT OF INTEREST

The authors declare they have no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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APPENDIX A.

TABLE A1 Correlation matrix

	lnINOU	lnTOP	lnINVE	lnLAB	lnEDU	lnINF
lnINOU	1.00					
lnTOP	0.16	1.00				
lnINVE	0.55	−0.19	1.00			
lnLAB	0.41	−0.47	0.88	1.00		
lnEDU	0.16	0.34	0.17	0.04	1.00	
lnINF	−0.15	−0.12	−0.21	−0.13	−0.15	1.00

Abbreviations: EDU, secondary education; INF, inflation rate; INOU, industrial output; INVE, investment; LAB, labor; ln, natural logarithm; TOP, trade openness.
Source: Authors' computations.

APPENDIX B

TABLE B1 Hausman test

	Fixed	Random	Difference	Standard error
lnTOP	−0.059	−0.037	−0.022	0.009
LnINV	0.049	0.042	0.007	0.008
LnLAB	0.127	0.095	0.032	0.018
lnINF	−0.035	−0.036	0.002	0.000
LnEDU	−0.089	−0.040	−0.049	0.022

Abbreviations: EDU, secondary education; INF, inflation rate; INVE, investment; LAB, labor; ln, natural logarithm; TOP, trade openness.
Source: Authors' computations.