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The Effect of Logistics Development on Economic Growth: A Comperative Analysis

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Abstract

Due to rapid economic growth with the help of globalization, countries aiming to step forward competitively are in need of new dynamics. As a consequence of that, the logistics sector holds the opportunity to be distinguished as support for economic growth. Therefore, today's developing countries attach great importance to logistics developments and improvements.

Within the scope of this research, variables on BRICS countries and Turkey for the time period from 1999 to 2017 have been determined in consideration of a detailed literature review and analyzed with vector autoregressive (VAR) models. The main hypothesis of this research is that there is a bilateral positive relationship between logistics development and economic growth. In other words, this paper advocates that not only logistics developments support economic growth but also vice-versa.

Keywords: *Logistics Development, Economic Growth, VAR Analysis*

1. Introduction

Thanks to globalization, commerce and services have exceeded national borders. With international capital mobility, expansion of commerce limits, and migration of technology and human resources, economics has also had its share from globalization. So as to distinguish themselves from others, nations have required new dynamics and among these dynamics, logistics has become much more prominent. Therefore, with the rapid development of national economics, logistics has become an irreplaceable sector.

With the help of vector autoregressive (VAR) models, this research aims to analyze the relationship between economic growth and logistics development in BRICS countries and Turkey between 1999 and 2017. In order to determine the variables utilized on the model, a great deal of literature on both economic growth and logistics development has been examined and they are explained in the following sections.

2. Literature Review on Economic Growth

Economic growth, to give a broad definition, is the quantitative increase of a nation's production capacity in time (Arslan, 2013; Gömleksiz & Alagöz, 2012; Özel, 2012; Taban et al., 2013). The number of literature studying GDP and industrial production index as an economic growth indicator is really astonishing.

Aslan and Küçükaksoy (2006) researched the relationship between financial development and economic growth in Turkey between 1970 – 2014 with a Granger causality test. The research resulted in one-way causality from financial development to economic growth. Korkmaz (2010) had a study on the relationship between R&D investments and economic growth in Turkey between 1990 – 2008. The study resulted in bilateral Johansen co-integration. The relationship between production and economic growth in developed and developing countries in 1950 – 2005 is researched by Szirmai and Verspagen (2011) and resulted in an intermediate positive relationship between production and economic growth. Ersoy (2012) did a panel data analysis on the relationship between primary energy consumption and economic growth in OECD countries between 1987 – 2007 and concluded that the relationship is cointegrated. Easterlin (2013) analyzed the relationship between happiness and economic growth and stated that a high economic growth rate provides happiness for neither developed nor developing countries. Pala and Teker (2014) studied the factors affecting economic growth in EU-27 countries and Turkey between 2000 – 2011 and they stated that while consumer inflation rate and domestic credits provided by financial sector had a negative effect on economic growth, other studied variables had a positive effect. Ahlborn and Schweikert (2015) researched the relationship between public debt and economic growth in the light of various variables and found that there is a noticeable heterogeneity among the studied country groups. Artan et al. (2015) made a panel data analysis about the effect of economic growth and outward-oriented growth on environmental pollution. The analysis showed that economic growth initially causes environmental pollution however, later it prevents pollution. On the other hand, the relationship between CO2 emission and outward-oriented growth is quite the opposite. The researches concluded that growth in outward-direction would promote reducing CO2 emission. Uçak and Usupbeyli (2015) analyzed the relationship between petroleum consumption and economic growth in Turkey between 1971 – 2013. Granger causality and Johansen cointegration test had been applied. In conclusion, no causality has been found between petroleum consumption and economic growth in Turkey. Bhattacharya et al. (2016) researched the effect of renewable energy on economic growth in the top 38 countries in terms of using renewable energy sources between 1991 – 2012. With the help of heterogenous estimation method, renewable energy sources had a neutral effect on economic growth in 11 countries (Australia, Belgium, Brazil, Ireland, Japan, Mexico, Slovenia, South Africa, Sweden, Thailand, and Turkey). In the rest of the countries, renewable energy sources had a promoting effect on nations' economic growth. Öztürk and Acaravcı (2016) studied the relationship between economic growth and CO2 emission, energy consumption, foreign trade rate and employment rate in Cyrpus and Malta between 1980 - 2006. As a result of the applied analysis, only the data on Malta has shown a causality between the variables in the long term. CO2 emission, energy consumption, foreign trade rate, and employment rate had indeed an effect on economic growth however, this effect was unilateral. Sezer and Abasız (2016) researched the relationship between communication technologies and economic growth in 34 OECD countries with the data of 1970 – 2013 obtained from OECD and World Bank databanks. In the research, unbalanced panel data analysis was implemented and the results showed that infrastructure investments in communication technologies promote economic growth in OECD countries. Teixeira and Queiros (2016) analyzed the relationship between human capital and economic growth in the short term (1990 – 2011) and the long term (1960 – 2011). Dynamic panel data

analysis was utilized and in conclusion, it was stated that structural changes had a critical role in economic growth, and human capital and structural changes were related. Tunalı and Yılmaz (2016) studied the relationship between economic growth, human capital and economic development in OECD countries between 2005 – 2014. They found that economic growth does not necessarily cause economic development. In order to accomplish that, nations should focus on social policies. Acemoğlu and Restrepo (2017) studied the effect of the aging population on economic growth in 169 countries between 1990 – 2015 and did not find any effect of the aging population on economic growth. Bove and Elia (2017) analyzed the relationship between migration and economic growth and found that every variable used for the research had a positive impact on economic growth. Duarte et al. (2017) researched the relationship between foreign direct investment, economic growth and financial development in Cabo Verde between 1987 – 2014. The analysis showed that foreign direct investment had a positive effect on economic growth both in the short and long term. Serel and Özdemir (2017) had research on the relationship between female employment and economic growth in Turkey between 2000 – 2013 and found that the growth in female employment promoted national economic growth. Acs et al. (2018) studied the relationship between economic growth, production factors, firms and entrepreneurship in 46 countries between 2002 – 2011. In conclusion, it was found that entrepreneurship had a bigger effect on economic growth than firms. Çalışkan et al. (2018) researched the relationship between health, education and social expenditures and economic growth in Turkey between 1998 – 2016 with the help of unit root test. The research showed that expenditures in health and education promoted economic growth however, these expenditures were under the effect of real and structural changes. Ogundari and Awokuse (2018) studied the effect of human capital on economic growth in the south Saharan countries between 1980 – 2008 with the help of the generalized method of moments. Even though human capital promoted economic growth in terms of both health and education scales, investments in the health sector had a more positive effect on economic growth. Songur and Yüksel (2018) analyzed the relationship between tax structures and economic growth in Turkey between 1980 – 2015. Although no causality between direct tax and GDP in both short and long term was found, it was observed that indirect taxes had a great portion in Turkish taxing system and it was recommended to change the indirect tax system into the direct tax system in order to promote economic growth.

3. Literature Review on the Relationship between Logistics and Economics

Logistics is a broad concept which consists of transporting raw materials obtained from suppliers to a production facility, movement and storing of raw materials and end products within facilities, delivering raw materials and end products to distribution centers, retail shops or end-users (Höller vd., 2014: 96). Logistics management, on the other hand, is a part of supply chain management which plans, implements and controls production, services and relevant information in order to satisfy consumer needs (Vitasek, 2003: 98).

The number of firms outsourcing services has been rising since the 1980s so as to focus more on core competencies. Therefore, logistics as a service sector has grown rapidly and obtained a significant role in economic growth (Chu, 2012: 87). This rapid growth brought academic researches along. In the literature, research about the logistics sector is really comprehensive. However, these researches focus mainly on the effect of logistics on economics rather than vice-versa. (Lan et al., 2016: 67). For this reason, it would be more practical to separate the relevant literature into three sections: the effect of logistics on economics, the effect of economics on logistics and other studies advocating that there is no relationship between economic growth and logistics development.

3.1 The Effect of Logistics Development on Economic Growth

The number of studies showing a positive relationship between logistics development and economic growth is great (Lan et al.,2016). Chu (2012: 90) stated that the capital emerged from logistics development contribute to economic growth in four ways:

a) Direct investments in logistics promote the demand for products and services.

b) An effective logistics system shortens traveling time and therefore provides savings for passengers and employees.

c) The better logistics infrastructure systems get, the more direct foreign investments attract.

d) Lower transportation and trade costs fastens and enhances production, and intensifies economic activities.

Relevant literature will be reviewed by classifying according to Chu's (2012: 90) research.

3.1.1 Creating Demand for Products and Services

According to Talley (1996: 145), logistics infrastructure investments would surely contribute to economic growth in less developed regions. However, the effect of investments in developed regions might not be that much intense. Therefore, he created a model in order to reflect the relationship between regional economic growth and regional transportation infrastructure investments. Mody and Wang (1997) researched the contribution of 23 different sectors to economic growth in China between 1985 – 1989. The research stated that openness to foreign trade and policies about free trade zone made China an important investment center. Moreover, the effect of communication and freight transportation infrastructure was a significant factor for economic growth in China. Fernald (1999) studied the effect of 29 different sectors on economic growth in the USA between 1953 - 1989 and in conclusion of the research, the investments in freight transportation promoted the production of firms that used roadway delivery. Sturm et al. (1999) detected a strong relationship between GDP and transportation infrastructure investments in the Netherlands. Thanks to Granger causality test and VAR analysis, it is shown that investments promoted economic growth. Demurger (2001) made a panel data analysis on infrastructure and economic growth in China between 1985 – 1998. The researcher stated that a less developed infrastructure system created economic unbalance in Chinese regional economies. Therefore, improving and developing transportation, storage, delivery, and telecommunication systems promoted economic growth. Carruthers et al. (2004) researched the contributions of modern logistics to economic growth and analyzed Eastern Asian Countries. The research contributed that investments in logistics would affect supply competences of regional logistics directly and therefore the demand for services would grow and economic growth was promoted. Liu (2009) made a Gray Relational Analysis research the relationship between economic growth and logistics in China between 2001 – 2008. The researcher stated that all the benefited indexes had a positive impact on GDP but the highest positive impact belonged to logistics added value and freight turnover. The impact of total employment and new fixed asset investments were relatively low. Egert et al. (2009) studied the relationship between economic growth and infrastructure investments in 24 OECD countries between 1960 – 2005. In the long term, the contributions of infrastructure investments to economic growth were not homogenous by taking the countries into account. Ateş and Işık (2010) analyzed the growth and export of logistics in Turkey between 1990 – 2005. According to Granger causality test results, a one-way causality was detected from transportation revenue to industrial production index. Cheng et al. (2010) studied the effect of logistics on regional economics in the Henan region, China between 1978 – 2008. In accordance with the lifecycle theory, if logistics index exceeds the balance, it is considered that logistics may a

promoting effect on economic growth. Otherwise, it is stated that the whole sector may prohibit economics. Çekerol and Nalçakan (2011) studied the demand for railway transportation with seven variables in Turkey between 1990 – 2009 with the help of the least-squares method. The findings of the study showed that the most important variable was the total transported goods by railway and the least important variable was GDP per capita. Navickas et al. (2011) reviewed the literature about the functional competences of logistics systems and emphasized that investments in logistics were a necessity to promote economic growth. Hu et al. (2012) researched the effect of logistics infrastructure investments on regional economic growth in the central region of China between 1986 – 2007. In conclusion of the study, co-integration was found between all of the variables and it was stated that the growth in logistics added value contributed to logistics fixed asset investments. Saatçioğlu and Karaca (2013) researched how differences between regions affect transport infrastructure in Turkey between 2006 – 2008 in the light of Cobb-Douglas production function. According to findings, the research stated that improvements in transportation infrastructure could reduce the differences between regions. Sezer (2018) set two different models in order to research the effect of logistics and communication on economic growth. According to research, infrastructure investments contributed to economic growth.

3.1.2 Saving Time and Money

Rietveld (1989) advocated that on one hand, improved infrastructure promoted more production, on the other hand, neglected infrastructure caused to more damage. In other words, improved infrastructure would reduce transportation costs. Visser et al. (1999) compared the similarities and differences of development policies regarding freight transportation in the Netherlands, France, Germany, and Japan. In light of the comparison, the researchers stated that improvements in logistics infrastructure contributed to saving money and time. Shirley and Winston (2004) found that investments in improving highways in the USA promoted cost reduction, speed and trust in freight transportation and help reduce the inventory of firms in time.

3.1.3 Foreign Direct Investment

With globalization, multinational companies incorporate small businesses into their international production chain. These companies have an important role in producing and delivering technology to the world. When trading is globalized, logistics competences start attracting foreign direct investments (Held vd., 2000: 24).

Skjött-Larsen et al. (2003) considered the "Öresund" bridge, built by both Swedish and Danish governments, as a logistics development and indicated that thanks to this bridge, its region became a logistics center. Berechman et al. (2005) researched the relationship between transportation capital formation and economics activities in the USA. Results showed difference according to level of model implemention. Nalçakan (2008) stated in her research that logistics developments promoted employment structure, investments and production level in macroeconomics way and business activities in microeconomics way. Wang and Wang (2010) researched the relationship between economic growth and foreign direct investments in China between 1997 – 2007 and recommended to raise the quality of foreign investors, optimize logistics structures and promote updated technology.

431.4 Lower Cost, Faster Production

Debbage (1999) researched the link between air freight, competitive strategies of airport administration and regional economies in North and South Caroline, the USA between 1973 – 1995. It is observed that the rise in employment and quality of services contributed to regional economics. Gandlur (2002) created a simulation for a logistics network in the southern states of the USA. The network had 36 delivery centers and 59 routes connecting states together. The research advocated

that a systematic and efficient transportation network would optimize resource procurement. Yamaguchi (2007) implemented a Cobb-Douglas production function to 47 Japanese provinces between 1995-2000 in order to search the accessibility of transportation and infrastructure services. The research indicated that the more the accessibility develops, especially in crowded places such as Tokyo, the bigger the product income gets. Wiengarten et al. (2013) made a survey to companies with more than 50 employees in 19 countries in order to investigate the integration and efficiency of the supply chain. The survey findings were incorporated with the Logistics Performance Index of the World Bank. In conclusion, the research indicated that supply chains were getting more and more complicated day by day due to globalism; therefore logistics innovations would contribute operational success such as bilateral relations, innovative product, and process design. Arvin et al. (2015) made a panel VAR analysis on G-20 countries between 1961 – 2012. With the findings, they analyzed the causality between transportation volume, economic growth, CO2 emission, and urbanization and they found causality between variables in the short term. Hayaloğlu (2015), in accordance with data obtained from the World Bank Database, researched the effect of logistics development on economic growth in 32 OECD countries between 1995 – 2011. The study stated that logistics had an important role in economic growth in OECD countries and any promoted investment would be beneficial to economic growth. Moreover, investments would reduce costs and therefore, product and service activities would increase.

3.2 The Effect of Economic Growth on Logistics Development

Wenjie (2002) studied the relationship between regional economics and logistics and indicated that the development of regional logistics in China. The study indicated that developing modern logistics would change the structure of regional economies by promoting new industries and new regional trade centers. Lee and Yang (2003) examined South Korea Incheon International Airport so as to suggest new strategies for setting an Asian Logistics Center and stated that the airport contributed to the great potential economic growth of northeast Asia region. Zhu et al. (2007) analyzed economic growth and logistics in 31 cities of China between 1994 – 2004 and expressed that economic growth and logistics development were both mutually complementary. The degree of the development and growth in economics determined the degree of logistics development and on the other hand, developments in logistics contributed to economic growth. Beyzatlar et al. (2014) studied the relationship between transportation and GDP in EU-15 countries. The variables, dated between 1970 – 2008, were analyzed with Panel Data Analysis and almost all of them had mutual causality. Kuzu and Önder (2014) researched the relationship between economic growth and logistics in Turkey between 2005 – 2013. Emphasizing that the logistics sector of Turkey was relatively young, a one-way causality from GDP to transportation and turnover index was found, which meant that economic growth promoted logistics development. Lean et al. (2014) analyzed the relationship between logistics development and economic growth in China and found causality in short and long terms. According to the research, developments in logistics networks were beneficial to saving time and money, which meant promoting economic growth, and grown economics enabled logistics infrastructure developments. Lan et al. (2014) studied data from 2009 – 2013 about five metropolitan cities of China in order to examine the relationship between urban logistics and economic growth. All variables were analyzed with the Granger causality test. In conclusion, the study stated that not only logistics developments contributed to economic growth but also vice-versa. Şekelli and Bakan (2018) indicated that Industry 4.0 would contribute Logistics 4.0 by enabling employment, economic growth, stability, activity, job security, productivity, and sustainable competition.

4. Literature Review with No-Relationship between Economic Growth and Logistics Development

Even though it is rare, some studies state that there are insignificant or no relationship between economic growth and logistics development. It might be practical to bear in mind that the different variables, analyze methods and time periods may cause different results.

Banerjee et al. (2009) studied the accessibility to transportation infrastructure in China and found that the contribution of transportation infrastructure investments to economic growth was too small to consider. Kayode et al. (2013) researched the effect of public investments in transportation on economic growth in Nigeria. All variables were analyzed with the least-squares method and it is found that the effect of investments was too insignificant to take notice. Sezer (2019) analyzed the relationship between air freight transportation and GDP in BRICS countries and Turkey between 1993 – 2017 and found no causality between variables.

To sum up all the relevant literature, it is obvious that the relationship between logistics and economy gets closer day by day and therefore, studies about the subject are rapidly getting popular. However, the relevant literature has still some deficiency, explained as follows (Lan vd., 2016: 76).:

I. Current literature focuses on more the effect of economic growth on logistics development rather than vice-versa.
II. Most of the studies completed their research with a single variable to reflect logistics development or economic growth.
III. Implemented methods might be either subjective or objective and this leads to doubt about the scientificness of the studies.
IV. Most of the studies were generally on the macro level, rather than the micro-level.

Moreover, most of the literature is contributed to by Chinese academicians in China. It is recommended to diversify countries to enrich the relevant literature.

5. Scope, Limitations, and Methodology

Thanks to a comprehensive literature review, it is observed that every single comparative analysis had its own data set and methodology. In Turkey, with a growing economy and developing logistics, it is quite important to determine and analyze the investments in logistics and transportation in order to arrange. The direct relationship of logistics infrastructure, technology and transportation-oriented investments with economic growth in developed and developing countries can be reviewed in academic studies, especially contributed in the literature by Chinese academicians. This research aims to analyze the relationship between economic growth and logistics development in BRICS countries (Brazil, Russia, India, China, and South Africa) and Turkey. The reason lying behind selecting BRICS countries for the research is that they are estimated to have a greater economy than G7 countries by 2050 (Wilson et al.,2003: 1).

All the data derived for the research were from national statistical yearbooks, BRICS joint statistical yearbooks and online databanks of national statistical institutions, the World Bank and OECD. Data containing national currency unit were converted to US dollars according to year-end buying exchange rates of CBRT (Central Bank of the Republic of Turkey) in order to provide unity. To keep the research more updated and valid, the time period of data was limited from 1999 to 2017.

The detailed literature review had enabled us to decide on 14 different variables however, a consistent research model was accomplished with only 3 variables. Due to shortenings in data of South Africa, the country was cut from the research. As a research method, vector autoregressive (VAR) analysis,

Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were implemented. And all of the tests were completed with open-source software.

6. Data Set

When generating the data set of 14 variables, the studies of Ateş and Işık (2010), Banerjee et al. (2009), Artan et al. (2015), Hayaloğlu (2015) and Sezer (2019) provided inspiration. The following table shows all of the variables considered analyzing initially, but those written in bold are actually the ones included in analysis. Industrial Production Index (manufacturing) was selected as an economic growth indicator. For logistics development, transportation infrastructure investments and air freight (million tons/km) were the indicators.

Table 1. Data Set

Abbr.	Variable
GDP	Gross Domestic Product ($)
FPE	Final Public Expenditure (% GDP)
EMP	Employment (%)
TII	Total Inland Transportat Infrastructure Investments ($)
RWF	Railway Freight Transportation (Million tons/km)
RFT	Road Freight Transportation (Million tons/km)
ATF	Air Transport, Freight (Million tons/km)
FTL	Fixed Telephone Lines (per 100 people)
FIS	Fixed Internet Subscription (per 100 people)
INT	Use of the Internet (per 100 people)
IPI	Industrial Production Index (Manufacturing)
GINI	GINI Index (World Bank estimation)
EXP	Export of Goods and Services ($)
IMP	Import of Goods and Services ($)

7. Analysis

All of the variables were initially investigated with ADF stability test by means of three models; stable, stable and trend, and neither. Then, the PP test results were reviewed.

The results of Brasil's variables had unit root and therefore, all three models were reimplemented at the first difference level. When the results were stabilized, a VAR model was generated. In order to determine whether the model is steady or not, autocorrelation functions were used. The model was considered steady due to the fact that all the inverse roots were in the unit circle. In the generated model, errors were homoscedastic and no autocorrelation issue was detected. In accordance with the Granger causality test, there was no causality between BTII and BATF, mutual causality between BIPI and BATF and one-way causality from BTII to BIPI. The action-reaction function of the model showed no reaction for D_BIPI to D_BTII in the first period and showed a negative reaction in the second period, then stabilized. In the third period, the reactions became positive again. The action-reaction function for D_BIPI to D_BATF, on the other hand, showed an almost negative reaction in the first period, negative reaction in the second period, and positive reaction in the third period, then stabilized at zero levels. Finally, variance decomposition of the model explained BIPI at 90.95%, BTII at 7.22% and BATF at 1.81%.

The results of Russia's variables had unit root and therefore, all three models were implemented at the first difference level. When the results were stabilized, a VAR model was generated. In order to determine whether the model is steady or not, autocorrelation functions were used. The model was considered steady due to the fact that all the inverse roots were in the unit circle. In the generated

model, errors were homoscedastic and no autocorrelation issue was detected. According to the Granger causality test, only one causality was found and that was a one-way causality from RTII to RATF. The action-reaction function of the model showed positive reaction for D_RIPI to D_RTII in the first period and showed a negative reaction at the beginning of the third period, then stabilized after the middle of the fourth period at zero levels. For D_RIPI to D_RATF, the actipn-reaction function showed negative reaction in the first period, then showed positive reaction from the beginning of the third period. Variance decomposition of the model explained RIPI at 70.30%, RTII at 7.25% and RATF at 22.44%.

The results of India's variables had unit root and therefore, all three models were implemented at the first difference level. Unfortunately, the results were not stabilized therefore, all three models were implemented once again at the second difference level. When the results were stabilized, a VAR model was generated. In order to determine whether the model is steady or not, autocorrelation functions were used. The model was considered steady due to the fact that all the inverse roots were in the unit circle. In the generated model, errors were homoscedastic and no autocorrelation issue was detected. According to the Granger causality test, no causality was detected between any of the variables. The action-reaction function of the model showed a positive reaction for D_IIPI to D_ITII in the first period and stabilized in the middle of the third period at zero levels. The action-reaction function of the model showed a positive reactipn for D_IIPI to D_IATF in the first period, and stabilized at zero levels in the middle of the third period. Finally, variance decomposition of the model explained IIPI at 85.13%, ITII at 2.55% and IATF at 12.31%.

The results of China's variables had unit root and therefore, all three models were implemented at the first difference level. Unfortunately, the results were not stabilized therefore, all three models were implemented once again at the second difference level. When the results were stabilized, a VAR model was generated. In order to determine whether the model is steady or not, autocorrelation functions were used. Unfortunately, the model was considered unsteady due to the fact that all the inverse roots were not in the unit circle. Therefore, the model was terminated.

The results of Turkey's variables had unit root and therefore, all three models were implemented at the first difference level. When the results were stabilized, a VAR model was generated. In order to determine whether the model is steady or not, autocorrelation functions were used. The model was considered steady due to the fact that all the inverse roots were in the unit circle. In the generated model, errors were homoscedastic and no autocorrelation issue was detected. According to the Granger causality test, no causality was detected between any of the variables. The action-reaction function of the model showed no reaction for D_TIPI to D_TTII, and showed negative reaction for D_TIPI to D_TATF in the first period, a positive reaction in the middle of the second period and stabilized at zero levels in the fourth period. Finally, variance decomposition of the model explained TIPI at 96.72%, TTII at 0.43% and TATF at 2.83%.

8. Results and Recommendations

Thanks to the globalization of trade and services, logistics has become a sector with global competitive power. Sectorial developments promote economic growth by the sustainability of production flow regarding ro rising demands of the global economy and by providing employment, and therefore let economies open to more active and competitive markets. The studies on the development of logistics and economic growth are really comprehensive and those resulted in one-way causality from logistics development to economic growth domain the literature. On the other hand, there are also some studies resulted in mutual causality or no causality between economic growth and logistics development.

Within the scope of this research, selected variables were analyzed with VAR models. Due to the lack of data related to South Africa and instability in analysis results of China, the research could only be implemented in four countries. Even though the limitations, we can make an inference from relevant literature that there would be a positive relationship between logistics and economic growth in China if the analysis was remade with different variables and limitations, and in South Africa if the data set was more complete. As a result of this research, a mutual causality between air freight and industrial production index was found only in Brasil meaning that logistics developments and economic growth affect each other only in Brasil. The result, therefore, contributed to the limited literature advocating that economic growth have an effect on logistics development. However, there was no causality between these two variables in other countries which showed a general consistency with the research of Sezer (2019). Yet, the findings from this aspect were in contradiction with Ateş and Işık (2010). When evaluating the findings of the relationship between transportation infrastructure investments and industrial production index, a one-way causality from transportation infrastructure investments to industrial production in Brasil and therefore, it supported the remark of Chu's (2012) stating that investments in logistics would raise the demands for goods and services. Unfortunately, this finding was not valid for other countries because they did not show any causality between the previously mentioned variables. The only causality found between air freight and transportation infrastructure investments belonged to Russia. This could be evaluated in accordance with Talley's (1996) assessments referring that regional transportation infrastructure investments would rise domestic economic productions and services. It is advised to extend the research considering regional economic growth. When the action-reaction function of the model was considered, the reaction of countries could be correlated with the countries geopolitical position and natural resources (Yılmaz, 2018). Variance decomposition of the model showed that the best explanatory variable for industrial production index was itself. However, variance decomposition for air freight in Russia was at 22.44% which might be associated with the recent rise in passenger transportation of Russian airline companies.

To sum up, we could say that only in Brasil logistics development and economic growth showed a bilateral effect. However, this is not valid for other countries. Last but not least, we could add that air freight in Russia supported transportation infrastructure investments. As the comprehensive literature research shows, the number of variables for analyzing economic growth is really great. Academicians, who support causality between economic growth and logistics development, should not be discouraged by the results of this study. It is recommended to remake the research by changing the variables, countries or the year span.

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