

AN EVALUATION OF THE RELATIONSHIP BETWEEN TRADE, FINANCIAL DEVELOPMENT AND INNOVATION IN TURKEY

EVALUACIJA POVEZANOSTI TRGOVINE, FINANSIJSKOG RAZVOJA I INOVACIJA U TURSKOJ

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ABSTRACT

This study aims to analyze the dynamic relationship between trade, financial development and innovation in Turkey by employing the Toda and Yamamoto approach. The annual time-series data have been collected in the period of 1973-2016. The empirical evidence highlights bidirectional link between the variables of interest. Accordingly, trade openness tends to Granger cause financial development but can also be just accompanying result of the improvement in financial development. Moreover, technological innovation is found to Granger cause both, trade openness and financial development. Technological innovation is found to be caused by the other variables of interest. Similar conclusion is drawn for the case of financial development. Thus, government needs to make significant effort to promote technological innovation by increasing the number of patents and enhancing financial development, to decrease the information asymmetry and to ease the flow of information.

KEYWORDS: financial development, technological innovation, Toda and Yamamoto approach, trade openness, Turkey

KLJUČNE RIJEČI: finansijski razvoj, tehnološka inovacija, Toda i Yamamoto pristup, otvorenost trgovine, Turska

SAŽETAK

Ovaj rad ima za cilj analizirati dinamičku povezanost trgovine, finansijskog razvoja i inovacija u Turskoj primjenjujući Toda i Yamamoto pristup. Podaci vremenskih serija su prikupljeni na godišnjem nivou u periodu između 1973. i 2016. godine. Rezultati empirijskog istraživanja ukazuju na dvosmjernu kauzalnu vezu između posmatranih varijabli. U skladu s tim, otvorenost trgovine kauzalno utiče na finansijsku razvijenost ali može biti i rezultat napretka u razvoju finansijskog sektora. Nadalje, tehnološke inovacije kauzalno utiču na otvorenost trgovine i finansijsku razvijenost. Finansijski razvoj i otvorenost trgovine također kauzalno utiču na tehnološke inovacije. Sličan zaključak se donosi kada je u pitanju proxy varijabla finansijskog razvoja. U skladu s tim vlada treba donijeti adekvatne politike koje će stimulisati tehnološke inovacije tako što će povećati broj patenata i unaprijediti razvoj finansijskog sektora, smanjiti informacionu asimetriju i olakšati protok informacija.

INTRODUCTION

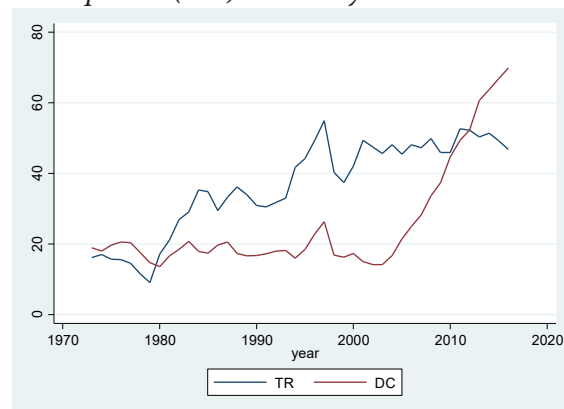
Due to the dynamics in the value of local currency, case study of Turkey has received much attention while analyzing the link between various macroeconomic variables what was the motivation to collect the data and conduct the empirical analysis in the case of Turkey. To give a brief introduction, it is of key importance to emphasize a remarkable growth in economic performance in Turkey

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in the last decade (Akat and Yazgan, 2012). The extraordinary economic performance is even more visible in the years after the financial crisis. The economic growth rates placed Turkey in the group of most rapidly growing countries. Thus, various macroeconomic measures have recorded significant improvements especially GDP; consumption and employment. The recovery from crisis was accompanied by the explosion of loans given by the banks. Hence, the transformation of Turkish economy has been characterized as sensational in the period of interest. However, the biggest issue assigned with that is the strong dependence on the external finance (Akat and Yazgan, 2012). For years, more than half of capitalization of Turkish stock markets is composed of foreign investors. Such big foreign capitalization might have some important implications for the capital market and should be analyzed (Sevil et al., 2012).

With regards to the role of financial development in the growth process, it is important to mention many papers that analyze this link and in general agree on the positive relationship (Valderrama, 2003; Hassan et al., 2011; Satrovic and Muslija, 2018). This is since financial institutions tend to find potentially high beneficial projects much easier compared to the individuals. The financial institutions are well organized and have the good monitoring mechanism which helps to find potentially good projects. Moreover, financial institutions play a great role in the accumulation of capital since these are of the key importance in savings and the mobilization of funds. Moreover, financial institutions enable the capital to be directed to the projects that promise the good returns (Bayar et al., 2017).

Figure 1. Trade openness (TR) and financial development (DC) in Turkey



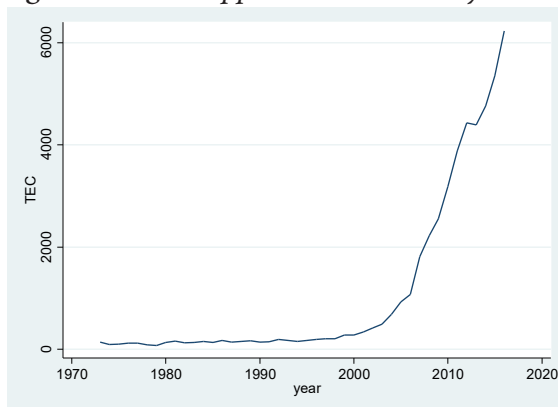
Source: Author

Free trade affects both what is produced and how it is produced (Shah et al., 2020). In addition, trade openness has a great potential to influence the development of financial system. This impact is even stronger if it is supported by the financial openness. Financial openness tends to contribute to the financial development by improving the accumulation and allocation of the capital as well as by improving the efficiency (Levine, 2001). With regards to the impact of trade openness on financial development, the role is evident in the sense that trade openness increases the need for insurance and the diversification of the risk in international trade. Financial institutions provide these services and also tend to reduce the volatility of income as well as to mitigate the negative external shocks (Svaleryd and Vlachos, 2002). The essential role of trade openness in the development of financial sector is also recognized by Rajan and Zingales (2003). With regards to Turkey, it is important to emphasize the significant increase in both, trade openness and financial development in the period of interest. Figure 1 maps these two time-series. Trade openness records the dynamic increase and takes higher percentage of GDP compared to financial development until the financial crisis. However, after the financial crisis, domestic credit to private sector is recorded to take higher percentage of GDP compared to trade. This can advocate the remarkable recovery from the financial

crisis since Turkey tended to support the domestic manufacturing sector in order to mitigate the effects of financial crisis.

Trade openness tends to improve the utilization of resources and to achieve the economics of scale. There are in general many positive externalities assigned with the increase in the exports. One of those is the technological innovation and the financial development in order to be more competitive in the global market and in order to reduce the risks by providing the insurance services (Pan et al., 2019). The role of globalization has been greatly acknowledged all over the world in terms of enhancing trade at global level (Mehmood and Tariq, 2020). Figure 1 advocates the better performance in the fields of financial development. The key attention is paid to the technological innovation, so there is a need to provide the statistics on this time-series (Figure 2).

Figure 2. Patent applications in Turkey



Source: Author

Figure 2 displays the steady increase in the number of patent applications until the year 2000. However, the period after 2000 records an exponential increase in the patent applications. Both, financial development and trade openness play a significant role to the improvements in technological innovations especially in manufacturing sector. Thus, the monitoring process should be careful while providing the loans and the manufacturing sector should be stimulated for innovations since those are essential for achieving competitive advantages (Anser et

al., 2020).

The rest of this paper will provide a literature review on the link between financial development, trade openness and technological innovation in Turkey as well as in the rest of the world. Moreover, methodology section will present the methods employed in this research. Results section provides the most important findings together with the interpretations. The paper ends by providing the concluding remarks together with the policy implications and the recommendations for future research.

1. LITERATURE REVIEW

This section gives the summary of the empirical findings on the link between all three variables of interest at the global level as well as in the case of Turkey. For instance, Kim et al. (2010) analyze the link between trade openness and the development of financial sector by employing the PMG estimator. The sample consists of 88 countries in the period between 1960 and 2005. The significant positive link between these two variables is recorded in the long-run whereas short-run impact is found to be negative. However, this impact holds true only in the case of low-income countries. The positive link between these two variables of interest is also supported by King and Levine (1993a, b).

Ashraf (2018) has analyzed the link of interest in the case of emerging economies. The author suggests that higher inclusion in international trade and finance tends to enhance the development of financial sector. Thus, the data on 37 countries and 287 banks are collected in the time span between 2000 and 2012. The empirical evidence suggests the positive impact of trade openness on the development of banking sector since it tends to increase the provided loans and to decrease the risk. This is due to the fact that higher demand for financial services stimulates the financial reform that is caused by the better inclusion in trade openness. However, the author suggests the need to

consider the accompanying issues connected with the increase in risk-taking. These findings are supported by Baltagi et al. (2009) and Hauner et al. (2013).

In terms of emerging economies it is also important to emphasize the evidence given by Hajilee and Niroomand (2018). The link between variables of interest is examined while assuming the existence of shadow economy. The authors recognize the trade openness as a key determinant of economic growth in emerging economies. Moreover, financial development is displayed to be strongly connected with the development of financial markets. The 18 countries are observed in the period ranging between 1983 and 2014. Trade openness is found to play a great role in financial development in the short-run. Niroomand et al. (2014) and Gnanon (2017) provide supportive evidence to these findings.

Apart from the emerging economies, Menyah et al. (2014) analyze the link of interest in the case of African countries. This paper also introduces the financial development index based on the four proxies of financial development. The data are collected for the sample of 21 economies. Granger causality test is used in methodological part. The findings are bit surprising suggesting that trade openness and financial liberalization have no impact on economic growth. Even though this evidence is in sharp contrast with the other countries in the world, the evidence from Africa is still supportive (Murinde, 2012; Ghirmay, 2004).

With regards to the time-series studies, it is important to emphasize Chandrashekar et al. (2018) who analyze the link of interest in the case of India. The authors have employed the time-series econometrics. The evidence suggests a long-run link between trade openness, financial development and economic growth. This is since the productivity is expected to be fostered by the accumulation of capital. The inclusion in international trade is expected to increase the productivity. This evidence is also supported by Law and Demetriades (2006). The authors

suggest that the competition increases together with the inclusion in international trade. The financial development plays very important role in this process since it eases the inclusion in international trade by providing insurance services. In this regards, special attention should be paid on the role of tourism industry (Satrovic and Muslija, 2019; Nathaniel and Adedoyin, 2020; Galic et al., 2020; Khan and Hou, 2021).

Pan et al. (2019) analyze the link of interest in the case of Bangladesh. They have also included the energy intensity. The findings of this paper suggest that technological innovation has an important role in energy intensity and it is strongly influenced by the financial development and the openness of the trade. It is also indicated that technological innovation enlarges the varieties of the goods and services produced and thus tends to have a positive impact on both, trade openness and financial development. Moreover, in the case when financial systems offer lower cost loans, this can be a great motivation for manufacturing sector to invest significant amounts of money in the research and development to be able to be more competitive in the global market and to use the advantage of lower cost loans. However, trade liberalization policies are inefficient in curbing the relative consumption of non-renewable energy resources (Murshed, 2018). These findings are in line with Muslija et al. (2020). Bese and Kalayci (2021) reveal no causal relationship between foreign direct investments and trade openness. Using the panel of 70 countries, Satrovic (2018) displays positive relationship between high-technology export and economic performance. Similarly, Satrovic et al. (2020) suggest that economic growth is found to Granger cause innovation and entrepreneurship activity in the sample of developing countries.

At last, this literature review section summarizes some papers that analyze the case of Turkey. Kar et al. (2014) have collected the data on monthly level in the period from 1989 to 2007. The most important findings

of this paper suggest the unidirectional link running from financial development to trade liberalization. Moreover, the findings suggest that economic growth is strongly driven by the external finance and trade liberalization. The trade openness is recognized as an important determinant of financial development by Do and Levchenko (2006) and Demetriades (2008). Cetin et al. (2018) and Mujtaba et al. (2020) have analyzed the impact of trade openness on CO2 emissions. The findings support the EKC hypothesis while observing the short- as well as the long-run. Thus, it is suggested that the real sector should be supported by financial system to invest in technologies that are cleaner and that will protect the environment.

2. DATA AND METHODOLOGY

2.1. Data

Interdependency between trade openness, financial development and technological innovation has been explored in the case of Turkey in the period between 1973 and 2016. The criterion to select the time-span is the availability of the data. All of the variables of interest are collected using The World Bank dataset. There are several estimation issues assigned with the both, trade openness and financial development. Therefore, the proxy variables have been selected very carefully following Pan et al. (2019). Thus, TR (the sum of export and import as a percentage of GDP) is the proxy for trade openness (Satrovic, 2017). Furthermore, DC (domestic credit to private sector as a percentage of GDP) is used as a proxy for financial development. Lastly, technological innovation is approximated using patent applications (TEC).

2.2. Methodology

The Toda and Yamamoto approach has been employed in this paper to explore the potential causal link between the three variables of interest. This procedure can operate in the case when variables are not

cointegrated or are integrated of the different order. Thus, we have checked the presence of unit root by employing the Augmented Dickey-Fuller-ADF and Phillips-Perron-PP tests.

Under the null hypothesis, ADF and PP assume the presence of unit root, i.e. nonstationary properties of the time-series. To formalize the ADF test we have used the regression proposed by Said and Dickey (1984) as following (Eq. 1):

$$y_t = \beta' D_t + \phi y_{t-1} + \sum_{j=1}^p \omega_j \Delta y_{t-j} + \varepsilon_t \quad (1).$$

The meaning of the abbreviations can be summarized as: D_t is the vector of deterministic terms, errors (ε_t) are not assumed to be correlated. Moreover, the regression that is the basis for PP test can be expressed as (Eq. 2) based on Phillips and Perron (1988):

$$\Delta y_t = \beta' D_t + \pi y_{t-1} + u_t \quad (2)$$

where u_t are assumed to be integrated I(0) and are allowed to be heteroskedastic. In the next step, it will be tested whether or not a causal link between the variables of interest exists. The Granger causality test can be outlined as (Toda and Yamamoto, 1995):

$$y_t = \mu + \sum_{i=1}^{p+m} \alpha_i y_{t-i} + \sum_{i=1}^{p+m} \beta_i x_{t-i} + u_{1t} \quad (3)$$

$$x_t = \mu + \sum_{i=1}^{p+m} \gamma_i x_{t-i} + \sum_{i=1}^{p+m} \delta_i y_{t-i} + u_{2t} \quad (4).$$

The number or lags that are selected to be appropriate is expressed by p; m denotes the order of integration (max). Error terms are assumed to be normally distributed with no serial correlation. It is also of key importance to determine the order of integration. $m'=1$ in the case when variables are I(1). With regards to the determination of p, it

is expressed using Akaike's information criterion (AIC) and the Hannan and Quinn information criterion (HQIC). Hence, the VAR model will be outlined as (Eq. 5 and Eq. 6):

$$y_t = \mu + \sum_{i=1}^{p'+m'} \alpha_i y_{t-i} + \sum_{i=1}^{p'+m} \beta_i x_{t-i} + u_{1t} \quad (5)$$

$$x_t = \mu + \sum_{i=1}^{p'+m'} \gamma_i x_{t-i} + \sum_{i=1}^{p'+m} \delta_i y_{t-i} + u_{2t} \quad (6).$$

Based on the previous estimations, the final decision on the causal link between the variables of interest will be made. It is important to emphasize that null hypothesis suggests no causality while alternative suggests the potential causal link between the variables of interest.

3. EMPIRICAL RESULTS

The findings section first presents the most important measures of descriptive statistics. Table 1 displays these results. With regards to the trade as a percentage of GDP, it is found to be at maximum in the year 1997 while the minimum level is recorded in the year 1979. On average, the share of trade in GDP accounts for 36.56% in the case of Turkey.

Table 1. The description of the data

stats	TR	DC	TEC
mean	36.56	25.58	1069.41
sd	13.20	15.50	1687.63
max	54.97	69.85	6230.00
min	9.10	13.59	73.00
skewness	-0.57	1.76	1.74
kurtosis	2.10	4.76	4.67

Source: Author

Table 2. Augmented Dickey-Fuller (ADF) test

Variable		Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value
lnTR	Z(t)	-2.291	-4.224	-3.532	-3.199
	MacKinnon approximate p-value Z(t) = 0.4390				
D.lnTR	Z(t)	-5.531	-4.224	-3.532	-3.199
	MacKinnon approximate p-value Z(t) = 0.0000				
lnDC	Z(t)	-0.818	-4.233	-3.536	-3.202
	MacKinnon approximate p-value Z(t) = 0.9641				
D.lnDC	Z(t)	-5.131	-4.224	-3.532	-3.199
	MacKinnon approximate p-value Z(t) = 0.0001				
lnTEC	Z(t)	-1.352	-4.260	-3.548	-3.209
	MacKinnon approximate p-value Z(t) = 0.8745				
D.lnTEC	Z(t)	-0.982	-4.224	-3.532	-3.199
	MacKinnon approximate p-value Z(t) = 0.9465				

Source: Author

As of domestic credit to private sector to GDP, the maximum value of 69.85% is displayed in the last observed year while the year 1980 records minimum value of 13.59%. At last, technological innovation approximated by the patent applications is found to be at maximum in the last observed year while the minimum value pertains to the year 1979. The Table 1 that summarizes

the most important measures of descriptive statistics suggesting significant differences in the period of interest for all three variables. Moreover, skewness and kurtosis measures suggest the deviation from the normal distribution. To proceed with the Toda and Yamamoto approach, it is first necessary to examine the presence of unit root. Since the variables of interest are expressed in different

measurement units, we have calculated the natural logarithm form to ease the comparison and interpretation. Thus, the natural logarithm of the variables is applied in the research to follow. The two unit root tests are used in research article. Augmented Dickey-Fuller-ADF suggests unit root under the null. The results are displayed in the Table 2.

The findings (Table 2) outline that the null on unit root cannot be rejected in log levels for all variables of interest. For this reason we have generated the first difference and have tested for the stationarity properties. The findings suggest the stationary properties of the trade openness and financial development proxy, however technological innovation is not found to be stationary. Phillips-Perron-PP

Table 3. Phillips-Perron test

Variable		Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value
lnTR	Z(t)	-1.587	-3.628	-2.950	-2.608
	MacKinnon approximate p-value Z(t) = 0.4903				
D.lnTR	Z(t)	-5.529	-3.634	-2.952	-2.610
	MacKinnon approximate p-value Z(t) = 0.0000				
lnDC	Z(t)	0.458	-3.628	-2.950	-2.608
	MacKinnon approximate p-value Z(t) = 0.9835				
D.lnDC	Z(t)	-4.872	-3.634	-2.952	-2.610
	MacKinnon approximate p-value Z(t) = 0.0000				
lnTEC	Z(t)	-1.761	-3.628	-2.950	-2.608
	MacKinnon approximate p-value Z(t) = 0.9983				
D.lnTEC	Z(t)	-6.513	-3.634	-2.952	-2.610
	MacKinnon approximate p-value Z(t) = 0.0000				

Source: Author

Table 4. The number of lags needed VAR

lag	LL	LR	Df	p	FPE	AIC	HQIC	SBIC
0	-38.7444				.002181	2.3854	2.43142	2.51871
1	84.0512	245.59	9	0.000	3.3e-06*	-4.11721	-3.93313	-3.58395*
2	90.2546	12.407	9	0.191	3.9e-06	-3.95741	-3.63526	-3.0242
3	98.1973	15.885	9	0.069	4.3e-06	-3.89699	-3.43679	-2.56384
4	103.926	11.457	9	0.246	5.5e-06	-3.71006	-3.11179	-1.97696
5	121.813	35.774	9	0.000	3.7e-06	-4.21788	-3.48155	-2.08483
6	131.405	19.185	9	0.024	4.2e-06	-4.25173	-3.37734	-1.71873
7	142.478	22.146	9	0.008	4.9e-06	-4.37018	-3.35773	-1.43724
8	164.571	44.186	9	0.000	3.6e-06	-5.11834	-3.96783	-1.78546
9	185.87	42.598*	9	0.000	3.6e-06	-5.82115*	-4.53258*	-2.08832

Source: Author

test is employed to validate the results of ADF. Table 3 displays the findings of this test. The second unit root test suggests non stationary properties in the log levels for all three variables. However, first difference

variables are all found to be stationary for a 1% level of significance. Since these tests show that variables may be integrated of the different order, Toda and Yamamoto approach is found to be appropriate.

To proceed to this approach, there is a need to determine the number of lags needed. Table 4 suggests mixed results. However, Akaike's information criterion (AIC) and the Hannan and Quinn information criterion (HQIC) suggest the optimal number of lags to be 9. Hence, the research to follow uses 9 lags.

The last step before testing for the Granger causality following Toda and Yamamoto procedure is the evaluation of the VAR model specification. For this purpose, the presence of autocorrelation is tested in the Table 5. The null suggests no serial correlation. The p values > 0.05 imply no autocorrelation. These findings are confirmed at the first and second lag (for a 5% significance level).

Table 5. Testing for the serial correlation

lag	chi2	df	Prob>chi2
1	7.7688	9	0.5576
2	2.4255	9	0.9828

Source: Author

The most important part of this research is the estimation of the findings on Granger causality. Table 6 outlines these findings. Under the null, there is no causal link between the variables of interest.

Table 6. Granger causality tests

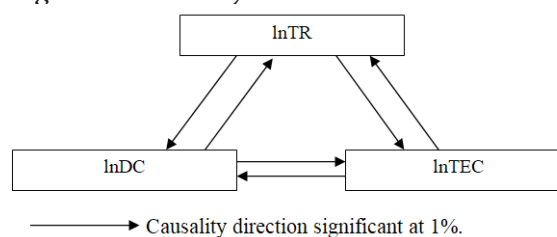
Equation	Excluded	Prob>chi2
lnDC	← lnTR	0.000
lnTEC	← lnTR	0.000
lnTR	← lnDC	0.002
lnTEC	← lnDC	0.000
lnTR	← lnTEC	0.000
lnDC	← lnTEC	0.000

Source: Author

The findings of Granger causality test are first presented in the tabular form. Trade openness is found to Granger cause both, financial development and technological innovation for a 1% level of significance. Null hypothesis on no Granger causality is also rejected in

the case of the link running from financial development to the trade openness as well as to the technological innovation for a 1% level of significance. The same conclusion can be drawn for the causal link running from the technological innovation to the trade openness and financial development. Figure 3 provides more informative evidence on the links between the three variables of interest in the case of Turkey.

Figure 3. Causality direction



Source: Author

Empirical evidence presented in Table 6 and Figure 3 suggest bidirectional causal link between trade openness and financial development for a 1% level of significance. Besides that, the bidirectional causal link is also reported between the technological innovation and financial development as well as between the trade openness and technological innovation in Turkey in the time period ranging between 1973 and 2016. All of the links of interest are found to be significant for a 1% level of significance.

CONCLUSION

This paper has explored the trivariate link between trade openness, financial development and technological innovation in the case of Turkey. The motivation behind selecting Turkey lies in the fact that the dynamics in currency recorded recently tended to have a significant impact on the both, financial development and trade openness. To analyze the causal link between the three observed variables, we have employed the Toda and Yamamoto approach in the time span 1973-2016.

The results of this paper suggest that trade openness is found to Granger cause both, financial development and technological innovation for a 1% level of significance. Null hypothesis on no Granger causality is also rejected in the case of the link running from financial development to the trade openness as well as to the technological innovation for a 1% level of significance. The same conclusion can be drawn for the causal link running from the technological innovation to the trade openness and financial development. Thus, the empirical evidence suggests bidirectional link between the variables of interest. Based on these findings, we propose some policy implications as follows.

First, the Granger causal link running from trade openness to financial development suggests that decision makers should carefully formulate trade policies in order to stimulate the technological innovations in the manufacturing sector. The policy makers should prevent bad loans that will stay locked in the corporations that do not pay attention to the technological innovation and that do not plan to repay debt within the contracted period. Thus, policy makers should watch over the financial institutions to ease the availability of loans for those corporations that are planning to invest in the innovation and that are planning to repay the loan on time.

Second, with regards to the bidirectional link between trade openness and financial development it is important to emphasize that trade liberalization stimulates decision makers to reform the institutions. Due to the competition, governments should conduct the reforms to improve the institutional quality that boosts the link between trade openness and financial development. This is of key importance since weaker institutions increase the vulnerability of the country to the shocks connected with the trade liberalization. On the other hand, the inclusion in trade openness can decrease the income inequality, can improve the standard of living and potentially reduce the poverty. Lastly, the policy makers need to find

a mechanism to beat the threats to the financial development. For this purpose, the financial development strategy needs to be created very carefully in order to provide modern financial products that will improve the role of Turkey in the global trade and the integration in the global economy. In addition, it is of key importance to reduce the obstacles to the inclusion in financial market by promoting the development of financial markets and by increasing the availability of financial products.

For future research, it will be of great importance to explore the role of energy consumption (Ahmad et al., 2021; Incekara, 2019; Su et al., 2021) since the energy market plays very important role in today's economy and is closely related to the trade openness, financial development and technological innovations. Besides these, income can also be the variable of interest. In addition, the financial crisis 2007-2008 has brought in significant shocks, thus it will be of great importance to control for the possible structural breaks.

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