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The Relationship between Export and Growth: Panel Data Evidence from Turkish Sectors

Alper Aslan  and Ebru Topcu * 

Department of Economics, Nevsehir Haci Bektas Veli University, Nevsehir 50300, Turkey; alperaslan@nevsehir.edu.tr

* Correspondence: ebruerdogan@nevsehir.edu.tr; Tel.: +90-384-228-1000

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Abstract: The aim of this study is to examine the impact of sectoral exports on economic growth in Turkey over the period 2000–2015. To this end, empirical models are estimated using panel data techniques in which quarterly data are gathered for eight sectors. Findings in the case of the pooled panel indicate the validity of the export-led growth hypothesis. Disaggregated evidences, on the other hand, reveal the validity of export-led growth hypothesis in the case of (i) agriculture and forestry; (ii) fishing; (iii) mining and quarrying; (iv) manufacturing; (v) electricity, gas and water supply; and (vi) wholesale and retail trade while it is found to be invalid in the case of (i) real estate, renting and business activities; and (ii) other community, social and personal service activities. The sectors that have the highest growth contributions are listed as follows: (i) agriculture and forestry; (ii) mining and quarrying; and (iii) manufacturing. Causality results also provide a strong support in favor of an export-led growth hypothesis for four sectors in addition to the feedback hypothesis which is valid for three sectors.

Keywords: export; economic growth; export-led growth hypothesis; Turkey; panel data analysis

JEL Classification: F11; O4

1. Introduction

Although the basis of the relationship between international trade and economic growth dates back to the Mercantilist period, the theoretical setting of this relationship has been proposed by Adam Smith and David Ricardo in line with international trade theories. The empirical studies have been the center of interest since the 1970s (Kravis 1970; Michaely 1977; Balassa 1978, 1981, 1982, 1985; Heller and Porter 1978; Krueger 1978; Williamson 1978; Fajana 1979; Tyler 1981; Feder 1982; Salvatore 1983; Kavoussi 1984; Jung and Marshall 1985; Ram 1985; Darrat 1986; Chow 1987; Hsiao 1987; Ram 1987; Bhagwati 1988).

From 1923 when the Republic was declared up to date, different foreign trade policies such as liberal or protectionist have been applied in Turkey according to the necessities of the period. Implementation of export-oriented growth policy with the 24 January 1980 Decisions was a milestone in Turkey. Export promotion policies in this period have largely been aimed at increasing exports of the manufacturing sector. While the sector which had the largest share in total exports in 1980 was the agricultural sector, the share of the manufacturing sector has started to increase since 1981. Over the analysis period (2000–2015), manufacturing, mining and quarrying, agriculture and forestry, wholesale and retail trade sectors have the highest export values as a share of total exports. On the other hand, sectors of real estate, renting and business activities and other community, social and personal service activities have the lowest shares. Sustainable economic growth is seen as a growth based on net export within the current global and local conditions in Turkey. Accordingly, “rebalancing in the economy”

policies have been implemented in the Turkish economy since 2012 in order to ensure growth based on net export ([Turkish Exporters Assembly TEA](#), p. 30). In this context, a number of empirical studies addressing the sample of Turkey have been conducted in order to assess whether the export-based growth strategy has achieved its goal since 1980. When these studies are examined, it is seen that a large part of the work is at the macro level while the number of studies dealing with the relationship at the micro (sectoral) level is rather limited. Macro-scale studies commonly measure the aggregated impact; the differentiated impact of each sector with different export volumes cannot be measured. Therefore, the problem of aggregation bias may arise, in which the findings might be inconsistent.

Given the aforementioned motivation¹, the aim of this study is to examine the impact of sectoral exports on economic growth in Turkey over the period 2000:Q1–2015:Q4 within the panel data framework. For this purpose, two hypotheses have been proposed accordingly. The first one is that “exports will affect growth in the micro-base as well as in the macro-base”. As these effects may change with respect to the export and production potential of the concerned sector, the second hypothesis is that “sectors that increase export volume more will contribute to economic growth more”. To test these hypotheses, the impact of eight different sectors’ export volumes on economic growth is analyzed using quarterly data covering the period 2000–2015 by employing panel time series estimator.

The rest of the study is structured as follows: Section 2 reviews relevant literature, Section 3 describes model and data, Section 4 presents methods and results, and Section 5 concludes.

2. Literature Survey

As stated in the introduction section, most of the studies focus on the nexus between export and economic growth at the aggregate level. In addition to the regression approach, on the other hand, causality approaches are used in most of the macro level studies as well. Table 1 summarizes these studies.

Table 1. Aggregate Level.

Author (s)	Country/Countries	Period	Method	Findings
Sharma et al. (1991)	Germany, Italy, Japan, USA and England	1960–1987	VAR	Germany and Japan; Export $\kappa \rightarrow$ Growth
Thornton (1996)	Mexico	1895–1992	Cointegration and Granger Causality	Export \rightarrow Growth (long run)
Shan and Sun (1998)	China	1987–1996	Causality	Export \leftrightarrow Growth
Dhawan and Biswal (1999)	India	1961–1993	VAR	Export \rightarrow Growth (short run)
Shan and Sun (1999)	USA	-	Toda and Yamamoto Causality	Export \leftrightarrow Growth
Hatemi-J and Manuchehr (2000)	Turkey, Greece Mexico, Ireland and Portugal	-	VAR	Mexico and Ireland; Export \rightarrow Growth Portugal: Growth \rightarrow Export Greece and Turkey; Export θ Growth
Hatemi-J (2002)	Japan	1960–1999	Bootstrap Approach	Export \leftrightarrow Growth
Kónya (2004)	25 OECD Countries	1960–1997 (except Hungary, Korea and Mexico)	Granger Causality	Iceland, Ireland, Australia and Austria; Export \rightarrow Growth The Netherlands, Luxemburg, Denmark, France, Greece, Hungary, Norway; Export θ Growth Canada, Japan, Korea, Finland, USA and Portugal; Growth \rightarrow Export

¹ The novelty of the study is also presented thoroughly at the end of the literature section.

Table 1. Cont.

Author (s)	Country/Countries	Period	Method	Findings
Awokuse (2005)	Japan	-	VAR and DAG	Export ↔ Growth
Awokuse and Christopoulos (2009)	Canada, Italy, Japan, England and USA	-	STAR Model	Canada, Italy, England and USA; Export → Growth Italy and Japan; Growth → Export
Tang et al. (2015)	Asian's Four Little Dragons (Hong Kong, Singapore, South Korea and Taiwan)	-	Johansen Cointegration and MWALD Causality Tests	Bivariate Model: Hong Kong and Singapore; Export → Growth South Korea and Taiwan; Growth ↔ Export Trivariate model: Export ↔ Growth (for all countries)
Ee (2016)	Sub-Saharan Africa Countries (Botswana, Equatorial Guinea, Mauritius)	1885–2014	Panel Cointegration	Export → Growth

Note: → indicates unidirectional relationship, ↔ indicates bidirectional relationship, θ indicates no relationship.

Unlike the studies at the aggregated level, studies at the disaggregate level are relatively limited. Table 2 reviews sectoral level studies based on the causality approach.

Table 2. Disaggregate Level.

Author	Country/Countries	Period	Method	Findings
Ghatak et al. (1997)	Malaysia	1955–1990	Granger Causality	Manufacturing Export → Growth
Biswal and Dhawan (1998)	Taiwan	1960–1990	Engle Granger Cointegration and Error Correction Model	Growth → Manufacturing Export
Alam (2003)	Mexico and Brazil	1959–1990 (Mexico) 1955–1990 (Brazil)	ARDL-FMOLS	Manufacturing Export θ Growth
Herzer et al. (2006)	Chile	1960–2001	Granger Causality	Manufacturing Export → Growth
Parida and Sahoo (2007)	South Asia	1980–2002	Panel Cointegration	Manufacturing Export → Growth
Hennebery and Khan (2000)	Pakistan	-	2SLS and OLS estimation	Agricultural Export → Growth
Duc and Tram (2011)	Vietnam	1997–2008	Vector Error Correction	Fishery Sector Export → Growth
Shakouri and Yazdi (2012)	Iran	1959–2008	Cointegration and Granger Causality	Mining Export → Growth
Cipamba (2012)	South Africa	1990–2011	Cointegration and Granger Causality	Manufacturing Export → Growth (long run) Manufacturing and Mining Export → Growth (short run)
Sahoo et al. (2014)	India	1981–2010	VECM Granger Causality	Growth → Mining Export
Uddin (2015)	Bangladesh	1980–2013	Cointegration and Granger Causality	Agricultural Export → Growth
Shafiullah et al. (2017)	Australia	1990:Q3–2013:Q2	Granger Causality	Long Run; Mining and Fuels export → Growth Agriculture Export → Growth Manufacturing Export → Growth Other Sector Export → Growth
Sjarif et al. (2011)	Indonesia	1969–2005	Cointegration and Error-Correction Model	Fishery Sector Export ↔ Growth
Toyin (2016)	South Africa	1975–2012	Granger Causality	Agricultural Export θ Growth

Note: → indicates unidirectional relationship, ↔ indicates bidirectional relationship, θ indicates no relationship.

In the case of Turkey there are a limited number of studies using disaggregated data. In addition, the scope of the sectors discussed by the aforementioned literature is very scarce. Sectoral relationships on the export-led growth hypothesis in the case of Turkey are mostly investigated through causality approaches. Table 3 reviews sectoral level studies in the case of Turkey.

Table 3. Disaggregate Level for Turkey.

Author	Country	Period	Method	Findings
Abu-Quarn and Abu-Bader (2004)	Turkey	-	Granger Causality	Manufacturing Export → Growth
Ciftcioglu and Nekhili (2005)	Turkey	1987:Q1–2004:Q1	Cointegration and Granger Causality	Mining Export → Growth
Kurt and Terzi (2007)	Turkey	1989:Q1–2003:Q4	VAR Model	Manufacturing Export → Growth
Yaprakli (2007)	Turkey	1970–2005	Cointegration and Granger Causality	Agricultural and Mining Export ↔ Growth, Manufacturing Export → Growth
Sandalcilar (2012)	Turkey	1987–2007	Panel Cointegration and Causality	Agricultural export θ Growth
Akbulut and Terzi (2013)	Turkey	1980–2010	Granger Causality	Growth → Agricultural export Manufacturing Export ↔ Growth
Onder and Hatirli (2014)	Turkey	1994–2009	Three Stage Least Squares Method	Manufacturing Export ↔ Growth

Note: → indicates unidirectional relationship, ↔ indicates bidirectional relationship, θ indicates no relationship.

While studies are investigated in export-growth literature employing sectoral export data, two deficiencies are remarked: (i) the sectors covered by the sectoral studies are rather narrow in terms of sectors (ii) most of the sectoral studies use causality approaches². This situation is still valid in studies conducted for Turkey. In this context, the main motivation of this study is to test the validity of the export led growth hypothesis using sectoral data for Turkey using panel regression approaches. To the best of our knowledge, this is the first study which investigates export-growth nexus with comprehensive sectoral data for Turkey employing this method.

3. Model and Data

In line with the theory which extended Neoclassical production function with foreign trade and empirical literature (see, for example: Feder 1982; Baldwin 1992; Ben-David and Loewy 2003; Gundlach 2007; Parida and Sahoo 2007; Awokuse 2008; Kristjanpoller and Olson 2014), economic growth (y) is defined as a function of physical capital (k), labour (l) and exports (x):

$$y = f(k, l, x) \quad (1)$$

In Equation (1), the growth, the capital and the labor are taken in aggregate forms³. The export consists of eight different sectors namely (i) agriculture and forestry; (ii) fishing; (iii) mining and quarrying; (iv) manufacturing industry; (v) electricity, gas and water supply; (vi) wholesale and retail trade; (vii) real estate, renting and business activities and (viii) other social and personal services. Function in Equation (1) can be written in panel data format as the following:

$$y_{i,t} = \beta_1 k_{it} + \beta_2 l_{it} + \beta_3 x_{it} + v_i + \varepsilon_{it} \quad (2)$$

² See, Hennebery and Khan (2000); Sentsho (2000); Alam (2003); Hossain and Karunaratne (2004); Duc and Tram (2011) among others for the micro level studies using regression approach.

³ Since there is no sectoral data related to these variables, total values are used.

where i and t represents sectors ($i = 1, \dots, 8$) and time period ($t = 2000:Q_1, \dots, 2015:Q_4$), respectively. In addition, v and ε represents sector-specific variable and random error term, respectively.

To examine the effect of sectoral export on economic growth, we focus on the 2000:Q1–2015:Q4 period. Growth variable is represented using GDP by expenditure approach at 1998 fixed prices. Gross fixed capital formation is used as fixed capital at 1998 fixed prices according to the expenditure method. The labor variable is measured as the number of workers over the age of 15. Export variable comprises of sectoral export data according to ISIC. 3. All data in the model were obtained from the Turkish Statistical Agency database (<http://www.tuik.gov.tr/UstMenu.do?metod=temelist>). In addition, all variables are modeled as natural logarithms. This transformation ensures that the coefficients obtained after parameter estimation can be interpreted as elasticities.

4. Methods and Findings

4.1. Unit Root Analysis

In econometric applications, it is necessary to investigate whether the series contain unit root before testing any relation between the variables in the model. Granger and Paul (1974) point out that the results obtained using nonstationary variables might be biased and inconsistent. For this reason, determining the degree of integration of the variables in the model is an extremely important step.

Widely used unit root tests in panel data econometrics are LLC (Levin et al. 2002) and IPS (Im et al. 2003) tests. The alternative “ H_A : serial unit does not contain root (serial is stable)” is tested against the null hypothesis “ H_0 : serial unit contains root (series is not stable)”. The mathematical notation of the LLC test with a test statistic with standard normal distribution is as follows:

$$\Delta y_{i,t} = \rho^* y_{i,t-1} + \sum_{L=1}^{\rho} \delta_{iL} \Delta y_{i,t-L} + z_{i,t} \gamma + \varepsilon_{i,t} \quad (3)$$

The IPS test also considers the same hypothesis with the LLC test. The mathematical notation of the IPS test is as follows:

$$\Delta y_{i,t} = \rho^* y_{i,t-1} + \sum_{L=1}^{\rho_i} \delta_{iL} \Delta y_{i,t-L} + z_{i,t} \gamma + \varepsilon_{i,t} \quad (4)$$

Table 4 shows the results of LLC and IPS panel unit root tests for variables in the system. The null hypothesis indicating unit root cannot be rejected at the level of 10% significance. Once we look at the first differences, the null hypothesis is rejected at the level of 1% significance. For capital variable, LLC and IPS tests yield different results. The LLC test indicates that the null hypothesis at the level of the capital variable may be rejected at the level of 5% significance, whereas the IPS test shows that the null hypothesis can only be rejected if the first variance of the capital variable is taken. It can be seen that the null hypothesis for the export variable can be rejected at 1% significance level in both the LLC and IPS test results. The export variable is also stationary at 1% significance level.

Table 4. Results of Panel Unit Root Test.

Variable	LLC	IPS
y	2.038	4.249
k	−2.216 **	5.531
l	6.190	6.750
x	−5.012 ***	−3.833 ***
Δy	−90.646 ***	−81.646 ***
Δk	−10.036 ***	−14.412 ***
Δl	−16.187 ***	−28.798 ***

Note: Δ represents difference operator. Estimates include a constant. LLC Maximum lag length is set to 4 with respect to SIC. *** and ** represent levels of significance at 1% and 5%, respectively.

4.2. Regression Analysis: Panel Data Approach

To tackle the aggregation bias problem in panel data econometrics, parameter estimation should be done using heterogeneous panel time series estimators. One of the biggest advantages of heterogeneous panel time series estimators is that it is not important whether the variables in the model be integrated at I (0) or I (1), and therefore it is not necessary to investigate whether the variables are cointegrated (see, for example: Chudik Alexander and Tosetti 2011; Kapetanios et al. 2011; Pesaran and Tosetti 2011; Sadorisky 2014). In the panel data econometrics, mean group estimators are used in the recently developed heterogeneous coefficient time series approach. These estimators are: Mean Group (MG) estimator developed by Pesaran and Smith (1995), Estimator of Common Correlated Effects Mean Group (CCEMG) developed by Pesaran (2006) and Augmented Mean Group (AMG) estimators developed by (Eberhardt and Bond 2009; Eberhardt and Teal 2010; Bond and Eberhardt 2013). Eberhardt (2012), however, suggests that CCEMG and AMG predictors are more suitable for macro panels. Since our study is a micro panel, we estimate the parameters in Equation (2) with the MG estimator developed by Pesaran and Smith (1995). The relation presented in Equation (2) is a static panel data model. In this study, Equation (5), which is the dynamic version of Equation (2), will be estimated. The reason that dynamic models are more useful than static models is that the coefficients obtained from dynamic models are used to calculate short and long run elasticities and these elasticities provide useful information in policy implication.

$$y_{i,t} = \beta_{1i}y_{it-1} + \beta_{2i}k_{it} + \beta_{3i}l_{it} + \beta_{4i}x_{it} + v_i + e_{it} \quad (5)$$

Table 5 shows the MG estimator results for both the pooled panel and the sectors. In the pooled panel, the lagged growth coefficient was estimated at 0.270 and is significant at 1% level. In the pooled panel, coefficients for capital, labor and export variables are found respectively 0.409, 0.607 and 0.041. Also, they are significant at 1% level. In the agriculture and forestry sector, all of the lagged growth, capital, labor and export coefficient are significant at 1% significance level and their coefficient have respectively 0.450, 0.385, 0.430 and 0.084 values. For the fishery sector, lagged growth, capital, labor and export variables are estimated respectively as 0.263; 0.427; 0.689 and 0.022. Also, all the coefficients are significant at the 1% level. Similarly, all variables in the manufacturing industry are significant at the 1% significance level. In this sector the lagged growth rate, capital, labor and export coefficients are respectively calculated as 0.291, 0.366, 0.516 and 0.072. The coefficients for lagged growth, capital, labor and export variables which are significant at 1% level in electricity, gas and water sector are estimated as 0.217, 0.433, 0.799 and 0.018, respectively. The lagged growth, capital and labor coefficients, which are significant at the 1% significance level for the wholesale and retail trade sectors, are calculated as 0.237, 0.420 and 0.648, respectively. The export coefficient in this sector is estimated at 0.035, which are significant at the level of 10%. The lagged growth, capital and labor coefficients for real estate, renting and business activities sector are estimated at 0.220, 0.462 and 0.738, respectively which are significant at the 1% significance level. Export coefficient is estimated at 0.004 and insignificant even at the 10% level. In other community, social and personal service activities sector, the lagged growth, capital, labor coefficients are estimated 0.200, 0.471 and 0.691, respectively which are significant at the level of 1%. The coefficient for the export variable is 0.008, which is insignificant at the 10% level.

Short and long-term elasticities can be calculated using the findings obtained from the MG estimator. Accordingly, the coefficients obtained from the MG estimator in Table 5 can be interpreted as direct short-term elasticities. Long run elasticities can also be calculated from the data in the table. Table 6 reflects the short and long-term growth elasticities. Capital elasticity in the short term varies between 0.308 and 0.471. In the pooled panel, the short run capital elasticity is 0.409. This finding reveals that as long as the capital ratio increases, growth will also increase consistent with the Neoclassical production function, Learning by Doing Model by Arrow (1962), Human Capital Model by Lucas (1988) and R & D Growth Model by Rivera-Batiz and Romer (1991). Moreover, while the sector with the greatest capital elasticity in the short term is the other community, social and personal

service activities sector, the mining and the quarrying sector has the lowest. Long-run capital elasticity varies between 0.427 and 0.700. In the pooled panel, the long-run capital elasticity is calculated as 0.560. This finding, in line with the theoretical and empirical literature, implies that increases in capital inputs will increase growth in the long run. In addition, while the sector with the greatest capital elasticity in the long run is the agriculture and forestry sector, the sector with the lowest elasticity is mining and quarrying. According to these results, mining and quarrying is the sector with the lowest capital elasticity in both the short and long term. The main reason for this situation is that the production in this sector is largely dependent to naturel resources rather than inputs such as labor and capital. An increase in capital in the personal and social services sector, which is highly sensitive to capital, increases the growth in the short term more than in other sectors. In the long run, an increase in capital in the agriculture and forestry sector contributes to the growth more.

Table 5. Results of Mean Group (MG) Estimator.

Cross Section	$y(-1)$	k	l	x
Pooled Panel	0.270 ***	0.409 ***	0.607 ***	0.041 ***
Agriculture and Forestry	0.450 ***	0.385 ***	0.430 ***	0.084 ***
Fishery	0.263 ***	0.427 ***	0.689 ***	0.022 ***
Mining and Quarrying	0.279 ***	0.308 ***	0.348 ***	0.084 ***
Manufacturing	0.291 ***	0.366 ***	0.516 ***	0.072 ***
Electricity, Gas and Water Supply	0.217 ***	0.433 ***	0.799 ***	0.018 ***
Wholesale and Retail Trade	0.237 ***	0.420 ***	0.648 ***	0.035 *
Real Estate, Renting and Business Activities	0.220 ***	0.462 ***	0.738 ***	0.004
Other Community, Social and Personal Service Activities	0.200 ***	0.471 ***	0.691 ***	0.008

Note: Estimates consist constant term. *** and * represent levels of significance at 1% and 10%, respectively.

Table 6. Growth Elasticities.

Cross Section	Short Term			Long Term		
	k	l	x	k	l	x
Pooled Panel	0.409	0.607	0.041	0.560	0.831	0.056
Agriculture and Forestry	0.385	0.430	0.084	0.700	0.781	0.152
Fishery	0.427	0.689	0.022	0.579	0.934	0.029
Mining and Quarrying	0.308	0.348	0.084	0.427	0.482	0.116
Manufacturing	0.366	0.516	0.072	0.516	0.727	0.101
Electricity, Gas and Water Supply	0.433	0.799	0.018	0.553	1.020	0.022
Wholesale and Retail Trade	0.420	0.648	0.035	0.550	0.849	0.045
Real Estate, Renting and Business Activities	0.462	0.738	0.004	0.592	0.946	0.005
Other Community, Social and Personal Service Activities	0.471	0.691	0.008	0.588	0.863	0.010

According to Table 6, the short-run elasticity of labor varies between 0.348 and 0.799. In the pooled panel the short-term capital elasticity is 0.607. This finding is consistent with Neoclassical production function. This finding reveals that as long as the labor ratio increases, growth will also increase. This finding is consistent with Learning by Doing Model by Arrow (1962), Human Capital Model by Lucas (1988), R & D Growth Model by Rivera-Batiz and Romer (1991), Neoclassical production function. Moreover, while the sector with the greatest labor elasticity in the short-term growth is the electricity, gas and water sector, the mining and the quarrying sector has been the least. Long-run labor elasticity varies between 0.482 and 1.020. In pooled panel, long run labor elasticity is calculated as 0.831. This finding, in line with the theory and the empirical literature, indicates that in the long run the increases in labor input will increase growth. Moreover, the sector with the greatest amount of labor elasticity in the long run is the electricity, gas and water supply sector; the mining and quarrying sector has been the least. The increase in the labor force in the electricity, gas and water supply sector is the biggest contributor to growth. In the case of capital, the sector with the least capital elasticity in both the short and long term has been mining and quarrying.

The empirical evidence that exports positively affect economic growth in Turkey is provided by the MG estimator for the pooled panel. This finding suggests that export led growth hypothesis is valid in the Turkish economy at the macro level. Accordingly, the export elasticity of growth in Turkey in the short term was calculated as 0.041, which indicates that the 1% increase in exports will increase the growth by 0.041%. The sectoral export elasticity of growth in the short-term is calculated as 0.084 in the agriculture and forestry sector, 0.022 in the fishery sector, 0.084 in mining and quarrying, 0.072 in the manufacturing industry, 0.018 in electricity gas and water supply, and 0.035 in wholesale and retail trade. Even though export elasticity of growth in the real estate, rental and business sectors as well as other community, social and personal service activity sectors is positive, the estimated coefficients of the export variable are not statistically significant at 10% significance level in these sectors. Therefore, it can be interpreted that the growth in these two sectors is not sensitive to exports in the short term.

4.3. Cointegration

In panel data econometrics Pedroni (1999) cointegration test is the commonly used one. The procedure consists of seven statistics for the test of the null of no cointegration against the alternative of cointegration. Four out of seven statistics (panel v, panel rho, panel PP and panel ADF) pertain to the within dimension test; the remainder of the statistics (group rho, group PP and group ADF) pertain to the between dimension test.

Table 7 presents the results of the cointegration test. Both the results of within group and between group cointegration tests reveal the rejection of the null hypothesis indicating no cointegration. Therefore, we can conclude that the variables are cointegrated.

Table 7. Pedroni's Cointegration Results.

Dimension	Test	Result
Within group cointegration tests	Panel-v	2.498 [0.00] ***
	Panel-rho	−14.741 [0.00] ***
	Panel-pp	−14.540 [0.00] ***
	Panel-ADF	−2.402 [0.00] ***
Between group cointegration tests	Grup-rho	−15.017 [0.00] ***
	Grup-pp	−17.335 [0.00] ***
	Grup-ADF	−2.089 [0.01] **

The tests are carried out with 4 lags. Figures in the brackets are p -values. *** and ** represent levels of significance at 1% and 5%, respectively.

4.4. Causality

Standard causality tests do not provide cross sectional results in heterogeneous panel data models. Thus, Dumitrescu and Hurlin (2012) propose a simple non-causality test for testing Granger (1969) causality in heterogeneous panel data models, which is shown as follows:

$$y_{it} = \alpha_i + \sum_{k=1}^K \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^K \beta_i^{(k)} x_{i,t-k} + \varepsilon_{i,t} \quad (6)$$

where y and x represent growth and exports, respectively. The approach uses an average Wald and tests the null of homogeneous non-causality from exports to growth against the alternative of causality from exports to growth for at least one cross-section. Compared to traditional causality tests, this test has a great number of advantages, including, for example: (i) the test fits well even with smaller size in terms of time and cross-section dimension; (ii) the test depends on cross section average of Wald statistics without estimating any particular panel regression; (iii) the test fits well for unbalanced panels as well as for the panels with different lag order for each cross section.

Table 8 demonstrates the causality results of the Dumitrescu and Hurlin test⁴. Test results indicate unidirectional causality from export to economic growth for (i) agriculture and forestry; (ii) fishery; (iii) electricity, gas and water supply sectors and (iv) other community, social and personal service activities whereas unidirectional causality from growth to export is found in the case of mining and quarrying. In addition, causality findings show bidirectional in (i) manufacturing; (ii) wholesale and retail trade; and (iii) real estate, renting and business activities sectors.

Table 8. Causality Results.

Sectors	$x \rightarrow y$	$y \rightarrow x$
Agriculture and Forestry	63.276 [0.00] ***	0.825 [0.36]
Fishery	20.908 [0.00] ***	1.760 [0.18]
Mining and Quarrying	1.474 [0.22]	12.454 [0.00] ***
Manufacturing	4.285 [0.03] **	20.142 [0.00] ***
Electricity, Gas and Water Supply	3.970 [0.04] **	0.343 [0.55]
Wholesale and Retail Trade	12.467 [0.00] ***	3.560 [0.05] *
Real Estate, Renting and Business Activities	8.901 [0.00] ***	3.031 [0.08] *
Other Community, Social and Personal Service Activities	5.903 [0.01] **	0.845 [0.35]

Figures are reported using Wald statistics. Figures in the brackets are p -values. ***, ** and * represent levels of significance at 1%, 5% and 10%, respectively.

5. Concluding Remarks

In this study, export-led growth hypothesis is analyzed at the micro-scale in Turkey. Two hypotheses have been proposed in this framework. The first is “exports will affect growth in the micro-base as well as in the macro-base”. As these effects may change with respect to the export and production potential of the relevant sector, the second hypothesis is “sectors that increase export volume more will contribute to economic growth more”. To test these hypotheses, the impact of eight different sectors’ export volumes on economic growth is analyzed using quarterly data covering the period 2000–2015 by employing the MG estimator.

Findings provide some useful information in terms of policy implications. Export incentive policies will contribute positively to economic growth. Although the largest share in the sectoral composition of exports belongs to the manufacturing industry, increases in export level in the agriculture and forestry, and mining and quarrying sectors enhance economic growth more than the manufacturing industry. Therefore, export promotion policies in the agriculture and mining sectors will have a larger effect on the growth than the effect created by the manufacturing industry. This finding is consistent with [Khalafalla and Webb \(2001\)](#), which has resulted in the primary export of goods having a greater impact on growth than manufacturing industry exports in Malaysia, which is a developing country like Turkey. This can be explained by the fact that the agriculture and mining sectors are the two main sectors that provide raw materials to the manufacturing industry. Therefore, the increase in production in these two sectors will contribute to the manufacturing industry, whose production is largely based on imported raw materials, due to the inadequacy of domestic resources. Import of energy is in the first place among imported raw materials. In particular, the incentives to evaluate the current potential of the mining and quarrying sector will increase mining production, especially energy production. Therefore, imports of intermediate goods in manufacturing industry will decrease.

Except for exports, the coefficients of the estimated control variables also provide some important data. For all sectors, the estimated coefficient on the labor variable is greater than that of capital

⁴ Table 8 reports the causality results only for the first lag. Testing the robustness of the results to different lag lengths, however, is very crucial especially with the quarterly data. Even though they are not reported herein, causality results with respect to four lags can be found in the Appendix.

variable. This finding reveals that the increases in labor input increase economic growth more than the increases in capital input. This finding is also confirmed for all sectors. This result is quite consistent with [Alam \(2003\)](#) and [Cueraşma and Wörz \(2005\)](#), in which the validity of Neo-classical origin-export led growth hypothesis is analyzed in Mexico and 45 developed and developing countries, respectively. Although the impact of labor on growth in Turkey is greater than the effect of capital on growth, technology (capital) intensive policies should be implemented rather than labor intensive policies. In this context, technology-intensive production with a higher added value will lead to a higher growth rate. In addition, findings from the MG estimator show that growth elasticity of labor is elastic in the electricity, gas and water supply sector. Further increases in the input of labor lead to an additional increase in the production level of this sector. This finding can be explained by the need for a large infrastructure in terms of distribution and storage activities of the electricity, gas and water sector. Infrastructure necessity of the sector is directly related to the construction sector which is labor intensive.

The findings indicate that growth contribution of the exports in real estate, renting and business activities sector and other community, social and personal service activities sector is very low. In fact, the impact of exports on growth in these sectors is generally statistically insignificant. The relative insignificance of both sectors in the sectoral export composition is likely to explain the finding.

Micro findings are consistent with [Abu-Quarn and Abu-Bader \(2004\)](#), [Kurt and Terzi \(2007\)](#), and [Yapraklı \(2007\)](#) who conclude that the export-led growth hypothesis is found to be valid in the manufacturing sector of Turkey. Moreover, in the manufacturing industry findings are consistent with [Parida and Sahoo \(2007\)](#), [Ghatak et al. \(1997\)](#), [Herzer et al. \(2006\)](#), [Cueraşma and Wörz \(2005\)](#), [Cipamba \(2012\)](#), [Shakouri and Yazdi \(2012\)](#), and [Shafiullah et al. \(2017\)](#) in the case of countries other than Turkey. In the case of the fishery sector, findings of this study have results consistent with those by [Duc and Tram \(2011\)](#) in Vietnam. In the case of the agriculture sector, findings are consistent with [Hennebery and Khan \(2000\)](#), who report validity of export led growth hypothesis in Pakistan, [Uddin \(2015\)](#), who confirm the export led growth hypothesis in Bangladesh, and [Shafiullah et al. \(2017\)](#), who examine Australia. In the case of the mining sector, results match [Ciftcioglu and Nekhili \(2005\)](#) who support validity export led growth hypothesis in Turkey, [Cipamba \(2012\)](#). who investigates South Africa, [Shakouri and Yazdi \(2012\)](#), who confirms validity of export led growth hypothesis in Iran, and [Shafiullah et al. \(2017\)](#), who validate validity of export led growth hypothesis in Australia.

Finally, empirical findings can be evaluated in terms of the aforementioned hypotheses. The findings verify the hypothesis that “exports will affect growth in micro-base as well as macro-base”. The hypothesis that “sectors that increase export volume more will contribute to economic growth more” is also confirmed to be in line with the empirical results.

In this study, Dumitrescu and Hurlin’s causality test is also employed. Test results indicate the validity of the export-led growth hypothesis for (i) agriculture and forestry; (ii) fishery; (iii) electricity, gas and water supply sectors and (iv) other community, social and personal service activities whereas growth-led export hypothesis is valid in the case of mining and quarrying. In addition, causality findings support the feedback hypothesis in (i) manufacturing; (ii) wholesale and retail trade; and (iii) real estate, renting and business activities sectors. The results based on different lag lengths show that causal hypotheses are sensitive to the lag specifications. Given these findings, this study underlines the importance of lag specification in determining the causality between exports and growth.

In the case of Turkey, the findings of the causality test are consistent with [Akbulut and Terzi \(2013\)](#) and [Onder and Hatirli \(2014\)](#) who confirm a bidirectional relationship between export and growth in the manufacturing industry.

Although the main motivation of the study depends on the estimation of the slope coefficients through the panel regression approach, we also employ causality for robustness purpose. Once the results obtained from two procedures are compared, the majority of the sectors produce consistent results. In the case of some sectors, however, this study reveals that findings might be volatile across the empirical approach.

It is possible to make some suggestions for the researchers who will work on similar issues in the future. First, this study analyzes the effects of sectoral exports on growth using a Neoclassical production function. Upcoming studies could analyze the effect of exports on growth by using internal growth models. Second, the analysis period can be divided into two sub-periods in order to see the impact of the 2008 financial crisis.

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Appendix A

Lag Length	Sectors	$x \rightarrow y$	$y \rightarrow x$
$k = 1$	Agriculture and Forestry	63.276 [0.00] ***	0.825 [0.36]
	Fishery	20.908 [0.00] ***	1.760 [0.18]
	Mining and Quarrying	1.474 [0.22]	12.454 [0.00] ***
	Manufacturing	4.285 [0.03] **	20.142 [0.00] ***
	Electricity, Gas and Water Supply	3.970 [0.04] **	0.343 [0.55]
	Wholesale and Retail Trade	12.467 [0.00] ***	3.560 [0.05] *
	Real Estate, Renting and Business Activities	8.901 [0.00] ***	3.031 [0.08] *
Other Community, Social and Personal Service Activities	5.903 [0.01] **	0.845 [0.35]	
$k = 2$	Agriculture and Forestry	59.793 [0.00] ***	61.795 [0.00] ***
	Fishery	23.561 [0.00] ***	30.171 [0.00] ***
	Mining and Quarrying	0.743 [0.68]	16.398 [0.00] ***
	Manufacturing	3.534 [0.17]	36.582 [0.00] ***
	Electricity, Gas and Water Supply	3.654 [0.16]	2.527 [0.28]
	Wholesale and Retail Trade	14.240 [0.00] ***	7.422 [0.02] **
	Real Estate, Renting and Business Activities	9.896 [0.00] ***	3.033 [0.21]
Other Community, Social and Personal Service Activities	6.637 [0.03] **	0.844 [0.65]	
$k = 3$	Agriculture and Forestry	37.357 [0.00] ***	13.350 [0.00] ***
	Fishery	14.788 [0.00] ***	5.708 [0.12]
	Mining and Quarrying	10.855 [0.01] **	2.908 [0.40]
	Manufacturing	4.352 [0.22]	1.732 [0.62]
	Electricity, Gas and Water Supply	8.807 [0.03] **	1.188 [0.75]
	Wholesale and Retail Trade	12.398 [0.00] ***	0.749 [0.86]
	Real Estate, Renting and Business Activities	11.971 [0.00] ***	0.329 [0.95]
Other Community, Social and Personal Service Activities	8.450 [0.03] **	1.161 [0.76]	
$k = 4$	Agriculture and Forestry	1.071 [0.89]	10.886 [0.02] **
	Fishery	12.733 [0.01] **	4.795 [0.30]
	Mining and Quarrying	8.350 [0.07] *	1.598 [0.80]
	Manufacturing	6.641 [0.15]	1.535 [0.82]
	Electricity, Gas and Water Supply	5.212 [0.26]	1.522 [0.82]
	Wholesale and Retail Trade	11.653 [0.02] **	0.617 [0.96]
	Real Estate, Renting and Business Activities	12.502 [0.01] **	0.275 [0.99]
Other Community, Social and Personal Service Activities	7.749 [0.10]	1.312 [0.85]	

Figures are reported using Wald statistics. Figures in the brackets are p -values. ***, ** and * represents levels of significance at %1, %5 and %10, respectively.

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