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The Relationship Between Middle Income Trap and Structural Transformation: The Case of Selected Countries

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Abstract

Many studies on middle income trap draw attention to the product trap that can be expressed as the fact that countries are stuck in the production and export of unsophisticated products. In this sense, it is stated that the role of a country in the production and export of sophisticated goods is one of the determinant factors to increase the level of income. In the literature, the concept of economic complexity, which is expressed as gaining competitiveness of complex products in terms of production and export, is noteworthy in recent years. In this framework, relationship between the per capita GDP and the economic complexity is examined with regression analysis in this study for selected countries with high-level of income. In the analysis, in which random coefficient panel regression model is applied, a significant relationship was found between the two variables for Austria, Finland, Hong Kong, Japan, Norway, Singapore and Sweden.

Keywords: middle-income trap, structural transformation, economic complexity index, per capita GDP, random coefficient panel regression model

JEL Classification: C23, E01, O11

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1 Introduction

The middle income trap concept has found broad audience recently in the economic literature. As it is reported first by Gill and Kharas (2007), the concept was indirectly described by Garrett (2004) (Pruchnik and Zowczak, 2017). By repeating former US president Clinton, Bush's discourse of "globalization is a phenomenon which supplies income for both developed and developing countries and free trade would finally introduce increase of wealth" is touched upon by Garrett (2004) and he reports that the countries confined in middle income trap would never experience enrichment promised. While majority has access to benefits of globalization, the middle income countries are trapped in certain limitations. Garrett (2004) states that countries are required to either have institutions and/or labor force capable of yielding substantial technological innovations to build information economy or have competitive advantage in maintaining ordinary businesses at lowest cost through available technology. Garrett (2004) claims that the countries that fall behind these requirements remain in the middle income range of the world.

Afterwards of Garrett's (2004) indirect description, Gill and Kharas (2007) emphasize the advantage of *economies of scale* in terms of escaping from middle income status and report that strategies based on factor accumulation result in adverse consequences because of marginal utility of capital and that Latin American and Middle Eastern economies have been the most common examples for decades by failing to avoid such trap.

Agenor and Canuto (2015) explain countries' situation to fall into the middle income trap as follows: countries reach high growth rate owing to low wage cost and imitation of foreign technology at the beginning of fast-paced development process. However, this situation diminishes as these countries reach lower-middle or upper-middle income level; and continual increment of per capita income requires new resources. In fact, low-income countries have competitive strength at the global market at first owing to their imported technology and current low-cost wage for labor-intense manufacturing. Such countries could benefit significantly from their labor force by their reassignment from less productive agricultural sector to high-yielding manufacturing sector at first. Nevertheless, when these countries reach middle income level, agriculture-based labor force decreases and average wages start to increase, which results in loss of global competitive power of the relevant country on its export goods. Hence, productive increase by sectoral reassignment of labor force comes to an end. That is, slowing growth rate is consequence of decreasing income obtained from imported technology and the decreasing productivity obtained from labor transfer from agriculture to industry.

Countries are required to determine structural factors causing the middle income trap timely so that they could escape from this and to discover new methods to develop productivity. In this regard, further study on this issue gains importance. From here, the present study aimed to investigate the impact of economic complexity level on per capita income for a group of high-income countries managed to escape from the middle income trap beside export and fixed capital investments. In this framework, relevance between middle income trap and economic complexity level was given in Section 2. Current relevant literature on the issue was reviewed in Section 3 while econometric methodology was explained in the Section 4 as well as the data set employed. Obtained findings were shared in Section 5 as the conclusion was drawn in Section 6.

2 Relationship between middle income trap and economic complexity

Theoretically, the essence of the middle income trap is based on neoclassical growth model known as *Solow model* which gives production function as Equation (1) below (Yeldan et al., 2012):

$$Y = AK^{\alpha}L^{1-\alpha} \tag{1}$$

where L, K and A refer to labor, capital and technology level, respectively. The fundamental basis of the model is comprised of neoclassical assumption of diminishing returns. Accordingly, this means that while technology and labor variables remain constant, the production level is to increase when capital factor is increased. Nevertheless, this increment will display a decreasing rate. Within such structure, as capital per labor increases, production per labor increases in a decreasing trend. Finally, at the end of this trend, investments made per labor become equal to the depreciation of capital. The point where this equality is found is described as *steady state* in the Solow model. The main point of this model is that capital investment tends to continue as long as the profit rate remains positive but it will have a decreasing trend subject to diminishing returns principle and finally gained profits will barely cover depreciation of capital. At this ultimate point, profit rate becomes zero. Beyond this point, it is not possible to increase growth by increasing capital amount. The sole condition to ensure growth is to take further steps to have technological development. If this steady state is considered as middle income trap, technological advancements make it possible to escape from there instead of larger capital investment.

The convergence hypothesis, one of the primary deductions of Solow model, suggests that poor countries with limited capital tend to accumulate capital and display higher growth rate with respect to wealthier countries and catch up on them at a common steady state. When the convergence hypothesis is considered in terms of middle income trap, it could be inferred that all countries could fell into middle income trap and converge each other unless they could not gain technological advancement (Yeldan et al., 2012).

The middle income trap, a subject frequently handled in the contemporary economic literature, has attracted close attention of international institutions. Additionally, there is no universally agreed description on the middle income trap yet. According to the calculation by Felipe et al. (2012) which is based on PPP of 1990, countries are classified in four groups in terms of per capita income: low-income, the ones with per capita income level under 2,000 USD; lower-middle income, the ones with per capita income between 2,000 USD and 7,250 USD; upper-middle income, the ones with per capita income between 7,250 USD and 11,750 USD; and high income, the ones with per capita income higher than 11,750 USD. According to estimations of Woo (2012), using the Madison data set and catch-up index, countries whose per capita income levels under 20% of the US's per capita income level are classified as low-income; the ones remain between 20% and 55% is middle income; the ones above 55% are classified as high-income countries. In regard to the World Bank estimations (World Bank, 2018); the countries with per capita income level under 995 USD in 2017 are classified as low-income; the ones between 996 USD and 3.895 USD are lower-middle income; the ones between 3.896 USD and 12.055 USD are upper-middle income; and finally the ones with 12.056 USD are classified as high-income countries. 47 countries in the lower-middle income group and 56 countries in the upper-middle income group, by the definition of World Bank, is presented in Table 1.

Table 1: Middle income countries

Lower-middle income countries ($996 - $3.895)	Angola, Bangladesh, Bhutan, Bolivia, Cape Verde, Cambodia, Cameroon, Congo, Cote d'Ivoire, Djibouti, Egypt, El Salvador, Georgia, Ghana, Honduras, India, Indonesia, Kenya, Kiribati, Kosovo, Kyrgyzstan, Laos, Lesotho, Mauritania, Micronesia, Moldova, Mongolia, Morocco, Myanmar, Nicaragua, Nigeria, Pakistan, Papua New Gine, Philipines, Sao Tome and Principe, Solomon Islands, Sri Lanka, Sudan, Swaziland, Timor Leste, Tunusia, Ukraine, Uzbekistan, Vanuatu, Vietnam, Palestine, Zambia
Upper-middle income countries ($3.896 - $12.055)	Albania, Algeria, American Samoa, Armenia, Azerbaijan, Belarus, Belize, Bosnia, Herzegovina, Botswana, Brazil, Bulgaria, China, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Equatorial Guinea, Ecuador, Fiji, Gabon, Grenada, Guatemala, Guyana, Iran, Iraq, Jamaika, Jordan, Kazakhstan, Lebanon, Libya, Macedonia, Malaysia, Maldives, Marshall Islands, Mauritius, Mexico, Montenegro, Namibia, Nauru, Paraguay, Peru, Romania, Russia, Samoa, Serbia, South Africa, Saint Lucia, Saint Vincent and Grenadines, Surinam, Thailand, Tonga, Turkey, Turkmenistan, Tuvalu, Venezuela

Source: World Bank (2018), `https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups`, (18.10.2018)

It is commonly known that structural transformation of economy has positive impact on development and growth. Hence, as it is reported by Fortunato and Razo (2014), countries which have succeeded in development accomplish this success by replacing production of low value added simple goods with the more sophisticated products with higher value added. Yet, initiating this innovation is not solely adequate for sustainable development. Besides, it is substantially important to establish economical skills and knowledge and transform them into productive information. Another issue to remark in terms of structural transformation is that industrial development of countries display gradual and path-dependent characteristic; and therefore it is not possible for countries to shift abruptly from production of goods made by current available production capability to the goods requiring much more advanced capacity (Fortunato ve Razo, 2014).

Hidalgo (2009) addresses that these capabilities including physical and non-physical inputs as well as social interaction networks are fundamental elements of production. While goods are requiring specific capabilities, countries are equipped with set of certain capabilities in any given period of time. As the sophistication degree of goods is determined by capabilities required, sophistication degree of an economy is determined by the set of capabilities displayed by the economy of the relevant country. According to Hausmann et al. (2011), these capabilities are the divisioned fragments of knowledge inherent to the relevant goods. While some of these capabilities in are defragmented at individual level, some are grouped at institutional level or even in an institutional-network. Hence, sophistication level of an economy is related with the diversity of useful knowledge embedded in this economy. Nevertheless, knowledge diversity is not sufficient on its own. Interaction among individuals and institutions that possess these knowledge and their skills to combine their knowledge gain importance at the same level (Hausmann et al., 2011).

Recent studies reveal the significance of sophistication level of exported goods manufactured by a country and structural transformation experienced by them in terms of acquisition of sustainable economic growth rate. Thus, *'what'* is manufactured by a country becomes more important issue with respect to *'how much'* is manufactured by them because all goods are not as equally as sophisticated with each other. On the long term, income level of country is determined by sophistication level of manufactured and exported goods instead of their volume (Hidalgo, 2009).

Hausmann analyzed the differences among the countries with respect to the sophistication levels of their export goods. The basic motive behind this was that export characteristic of a country reflects its current capability to develop and diversify the export goods already. That is, it is assumed that countries producing and exporting more complex goods have better design, higher innovation and production capabilities (Fortunato and Razo, 2014). In measurement of sophistication of goods manufactured by countries, the concept of economic complexity is utilized. In fact, economic complexity could be determined by answering the question of *"if a good is no longer manufactured by a country, which else would produce it?"* Accordingly, if the list of potential producer countries is rather long, it could be inferred that the respective country economy's complexity level is low. If there is short list in our hand, then economic complexity level of the concerned country is regarded as high (Hausmann et al., 2011).

The studies in an effort to quantitatively measure a country's complexity level have finally revealed the 'economic complexity index'. The higher the index score, the

higher the country economic complexity level. Countries could increase their economic complexity index scores by developing competitive strength of their industrial sophisticated goods. Accordingly, a country's economic complexity level depends on the complexity level of the goods that they export (Hausmann et al., 2011). In this scope, it is necessary to mention the concept of 'product trap' because of its close relevance with the subject since they stuck with middle income trap. Felipe (2012) concluded in his study that long term stay of countries within the middle income level could be result of product trap. That is, countries confined in the low middle income trap export more simple goods displaying poor connection with other goods.
Consequently, it can be stated that a country that is in middle-income trap, should increase its level of economic complexity by producing more sophisticated products in order to avoid the trap and also to sustain its development consistently.

3 Literature review

As previously stated by numbers of studies available in the current literature, export and fixed capital investments have positive impact on growth. When studies concentrated on the middle income trap are taken into consideration, it could be seen that increasing number of studies have focused on the impact of sophisticated export products on growth.
In the study of Jankowska et al. (2012), comparing the countries from Latin America and Asia, the role played by productive development policies in formation of structural transformation process is analyzed. In comparison of the policies adopted by South Korea, Brazil and Mexico, the authors analyze the role of economic specialization of the respective country on its further transition to progress of economic development. Fortunato and Razo (2014) reveal the impact of composition of export structure on economic growth. Their findings obtained from the regression analysis suggest that sophisticated characteristics of export have significant and positive impact on economic growth. Yılmaz (2014) compares Turkey with others either stuck in the middle income trap or not; and emphasizes importance of human capital for production of technologically sophisticated goods to escape from the middle income trap. The author also reports that countries successful at escaping this trap accomplished structural transformation through high productivity and knowledge-intense production activities. Furthermore, it is stated that Turkey, as a country stuck in middle income trap, has failed to steer labor surplus emerged as a result of reduction of economic share of agricultural sector to knowledge-intense manufacturing sector and wasted the chance of taking advantage of shrinking share of agriculture from the economy adequately. In the study of Cherif and Hasanov (2015), in which Malaysia compared with Taiwan and South Korea, countries succeeded to escape from middle income trap, certain policies are suggested to avoid the trap and addressed that Malaysia has broke through in sophistication of export goods especially in electronic sector through multi-national companies; however, the country

fell back in dispersion of technology across the country. The study also asserts that government-backed domestic technological initiatives have emerged in the cases of South Korea and Taiwan as well as high value-added manufacturing sectors and high-tech innovative sectors gained significance in development of local technology. In the comprehensive study of Kocenda and Poghosyan (2017) including 101 countries along the period of 2001-2015, the authors conclude significant and positive relation between GDP per capita and economic size on sophistication of export through dynamic panel data analysis method. Findings of this study also suggest that export sophistication has path-dependent characteristic. Another finding especially with the developing countries is that the weak institutional structure has negative impact on sophistication process of export goods. Demir (2017), based on his investigation of 34 countries classified in group of high-middle income for the period of 1995-2015 in terms of the effect of technological diversity of export goods on economic growth by using dynamic panel data analysis method, concludes high-tech level export display significant impact on growth, while medium-tech level export has more limited impact. Furthermore, low-tech export displays negative impact on growth on the long term.
Following studies above investigating the relationship between sophistication of export and economic growth and performance, it is necessary to consider the studies concentrated on the relationship between economic complexity, which resembles export sophistication, and economic growth and performance. It could be seen that a newly developing literature exists in this domain. In one of the studies investigating this relationship, Hartmann et al. (2017) addresses the relationship between countries' economic complexity levels and income inequality and revealed a negative correlation between high economic complexity and income inequality. Stojkoski and Kocarev (2017) exhibit the significant effect of economic complexity level on long term growth in their study analyzing economic complexity level and growth for Southeast Asian and Central European economies. Moreover, the authors imply that economic complexity has supportive characteristic for long term development strategies. Ferraz et al. (2018) reports that these two variables are positively correlated with each other as a result of their study in which they investigated the relationship between country-specific economic complexity and human development levels. As the study covers the period of 2010-2014 for Asia and Latin America countries, it is concluded as a result of comparative study that, except China and Philippines, all Asian countries have played effective role in transformation of economic complexity into human development. Japan, Singapore and South Korea have become more efficient countries over the time. Cuba displays the best performance among the Latin American countries. Finally, Jinn and Shuhalmen (2018), in their study analyzing Malaysia's economic complexity level in terms of temporal change and development, estimate the GDP growth rate based on the convergence capability of Malaysia to the income levels of countries with similar economic complexity level.

4 The data and econometric methodology

In the present study, the factors effective on per capita income were analyzed based on the estimations reported by Felipe et al. (2012) by considering countries shifted to high-income level in the pre-1990 period while they were upper-middle income level after 1950. The motivation to select these countries is to analyze the contribution of sophistication level of products produced and exported to the per capita GDP of these countries that avoided middle income trap successfully. Besides, it is also aimed to investigate whether these countries have the potential to increase of per capita GDP sustainably. The country group taken into consideration includes Austria, Belgium, Germany, Denmark, Finland, France, Hong Kong, Israel, Italy, Japan, the Netherlands, Norway, Singapore and Sweden. In line with the study of Stojkoski and Kocarev (2017), the impacts of export, fixed capital investment and economic complexity on per capita income was investigated for aforesaid countries. The regression model in Equation (2) below exhibits the relationship among the variables (Stojkoski ve Kocarev, 2017):

$$\log(PCGDP_{it}) = \alpha_i + \beta_1 ECI_{it} + \beta_2 \log(GFCF_{it}) + \beta_3 \log(EXP_{it}) + u_{it}. \qquad (2)$$

Detailed explanation of the variables and the data sources can be found in Table 2.

Table 2: Description of the data and relevant resource

Variables	Explanation of the data	Data source
LOGPCGDP	Logarithm of per capita income	World Bank
ECI	Economic complexity index	Massachusetts Institute of Technology - OEC
LOGGFCF	Logarithm of fixed capital investments	World Bank
LOGEXP	Logarithm of export	World Bank

In this study, annual data regarding the variables from countries included was analyzed for the period of 1980-2016 to the end that whether economic complexity levels of countries have an impact on their per capita income levels which made them shift to high-income country classification from upper-middle group along the concerned period. Positive contributions of export and fixed capital investments on GDP and GDP per capita have been reported through empirical studies repeatedly. Here, as the impact of the economic complexity level on GDP per capita is expected to be positive and significant based on theoretical studies, our study aimed to determine the impact of economic complexity levels of countries included along their period of enrichment from middle-income level to the high-income level.

However, some conditions have to be provided before regression analysis. Stationarity of the series over the time, as one of these conditions, is substantial in terms of

reliability of the results that will be obtained. The econometric analyses conducted on non-stationary series could yield spurious regression result. Therefore, stationarity of series is required to be ensured in panel data analysis process. Unit root tests employed in determination of stationarity of series are classified in first and second generation tests. Whereas the first generation tests assume non-existence of cross-sectional dependency among units, the second generations assume vice versa (Yerdelen Tatoğlu, 2013). Hence, before proceeding to regression estimation stage, unit root test is conducted on series individually depends on whether there is correlation (cross-sectional dependency) between units. In this study, MADF which is a second-generation unit root test is applied since there is cross-sectional dependence for all series. In the following section, some methodological information is given before presenting the findings.
Various tests are available in the current literature to test the cross-sectional dependency. The Lagrange Multiplier (LM), developed by Breusch and Pagan, is one of these tests. When time dimension of data set is greater than the cross-sectional dimension ($T > N$), LM test is employed. LM statistics ($CDLM_1$) is estimated according to the Equation (3) below (Pesaran, 2004):

$$CDLM_1 = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}^2 \tag{3}$$

where $\hat{\rho}_{ij}^2$ is estimation of dual correlation of residuals:

$$\hat{\rho}_{ij} = \hat{\rho}_{ji} = \frac{\sum_{t=1}^{T} e_{it} e_{jt}}{\left(\sum_{t=1}^{T} e_{it}^2\right)^{\frac{1}{2}} \left(\sum_{t=1}^{T} e_{jt}^2\right)^{\frac{1}{2}}} \tag{4}$$

where, $e_{it} = y_{it} - \hat{\alpha}_i - \hat{\beta}_i' x_{it}$; and u_{it} denotes the minimum coefficient value of error terms. LM test could be conducted in the cases where N is relatively low and T is adequately high. Breusch and Pagan showed under the H_0 hypothesis which refuses existence of cross-sectional dependency that CD_{lm} statistics is distributed asymptotically χ^2. Additionally, when $N \to \infty$, applicability of the test disappear. Pesaran showed for high N and T values that the test statistics of the scaled version of CD_{lm} in Equation (5) ($CDLM_2$) could be employed (Pesaran, 2004):

$$CDLM_2 = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (T \hat{\rho}_{ij}^2 - 1). \tag{5}$$

Furthermore, Pesaran developed an alternative test statistics in which coefficients of dual correlation coefficients used in LM test in order to resolve the deficiency of the Breusch-Pagan LM test, which arise in case of high values of N because of occurred notable scale disruption for large values of N and for small values of T (Pesaran, 2004). Yet, this test does not yield significant conclusion when average dual cross-sectional dependency were found to be different than zero. Thereafter, Pesaran et al. developed LM adjusted statistics (LM_{adj}), an altered version of the test whose deviation is adjusted (Pan et al., 2015):

$$LM_{adj} = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \frac{(T-k)\hat{\rho}_{ij}^2 - \mu_{Tij}}{\sqrt{\nu_{Tij}^2}}. \tag{6}$$

Unit root tests utilized in examination of stationarity of series are categorized in two: the first generation tests and the second generation tests. As the first generation tests assume that there is no cross-sectional dependency in series, the second generation tests assume vice versa (Yerdelen and Tatoğlu, 2013).
In this study, MADF (Multivariate ADF) test, the second generation unit root test developed by Taylor and Sarno, was conducted depending on the results of cross-sectional dependence tests. Taylor and Sarno (1998) developed a test allowing autoregressive parameters to differ from one unit to another (Breuer et al., 2002). The authors take $N \times 1$ dimensional stochastic vector given in Equation (7), where $i = 1, 2, ..., N$ denotes number of units and $t = 1, 2, ..., T$ denotes number of observation in the panel (Taylor and Sarno, 1998):

$$q_{it} = \mu_i + \sum_{j=1}^{k} p_{ij} q_{it-j} + u_{it}. \tag{7}$$

It is assumed with $u_t = (u_{1t} \ldots \ldots u_{Nt})$ that the error term is independent and distributed normally. The standard single-equation ADF unit root test requires estimation of N different equations individually and to apply following null hypothesis to N different units:

$$H_{0i} : \sum_{j=1}^{k} \rho_{ij} = 0. \tag{8}$$

In cases when square root of autoregressive process on each unit is close but different than 1, single-variable ADF test is found to be insignificant for accurate consideration. Therefore, Taylor and Sarno (1998) estimate the Equation (7) above by taking simultaneous correlations between error terms into consideration because the scale is disturbed when simultaneous correlations between error terms are not included into the panel unit root tests introduced by O'Connell. The null hypothesis is given by Equation (9) for N number of equations:

$$H_0 : \sum_{j=1}^{k} \rho_{ij} - 1 = 0, \quad \forall i = 1, ..., N. \tag{9}$$

Wald statistics estimated in this test is referred as MADF statistics. In estimation of the Equation (7) above, Seemingly Unrelated Regression (SUR) estimator which uses

estimation of error terms' simultaneous covariance matrixes and which is referred as multivariate generalised squares method, was employed (Taylor and Sarno, 1998).
In this study, Hadri - Kurozumi test was also applied to the variables. As a second-generation unit root test, null hypothesis of Hadri-Kurozumi test denotes stationarity. Hadri and Kurozumi propose a simple test for this null hypothesis in heterogeneous panel data with cross-sectional dependence in the form of a common factor. Allowing for also serial correlation in the disturbance, Hadri and Kurozumi developed two test statistics which are represented as Z_A^{SPC} and Z_A^{LA} (Hadri and Kurozumi, 2012).
If variations exist in a population depends on time or unit, then, it is difficult to have an opinion about this population. Accordingly, a model called *random coefficient model*, in which a stochastic specification relevant with the unit is applied, has been developed as an alternative to the fixed coefficient approach. While this model allows coefficients to differ from one unit to another or time to time, it significantly decreases number of parameters required to be estimated (Hsiao and Pesaran, 2004).
In line with the Swamy's (1970) suggestion, random coefficient model is exhibited in Equation (10) in matrix notation (Poi, 2003):

$$y_i = X_i\beta_i + \epsilon_i \tag{10}$$

where $i = 1, 2, ..., N$ denotes unit dimension; y_i denotes observation vector in $T_i \times 1$ dimension belongs to the i^{th} unit; X_i denotes non-stochastic variable vector in $T_i \times k$ dimension; β_i denotes the parameter vector in $k \times 1$ dimension specific to the unit i; ϵ_i is with zero average and $\sigma_{ii}I$ variance.
β_i, specific to each unit, is related with a joint β parameter vector (Poi, 2003):

$$\beta_i = \beta + \nu_i. \tag{11}$$

Swamy (1970) suggests that β_i parameter vectors are required to be tested to ensure whether they are fixed and equal to each other before estimation of the model. Thus, the null hypothesis to be tested is given by Equation (12) below:

$$H_0' : \beta_1 = \beta_2 = ... = \beta_N = \beta. \tag{12}$$

H_0' null hypothesis indicates that coefficient vectors are constant; and that the analyzed units are homogenous; accordingly if the hypothesis is accepted, single relationship could be estimated among variables. On the other hand, if H_0' hypothesis is rejected, then, it is not possible to pool data from each unit in order to estimate single relationship between the variables. The statistics utilized for estimation of homogeneity is exhibited in Equation (13) below (Swamy, 1970):

$$H_\beta = \sum_{i=1}^{N} \frac{(b_i - \hat{\beta})' X_i' X_i (b_i - \hat{\beta})}{s_{ii}} \tag{13}$$

where, $b_i = (X_i' X_i)^{-1} X_i' y_i$ and $\hat{\beta} = \left[\sum_{i=1}^{N} \frac{X_i' X_i}{s_{ii}}\right]^{-1} \sum_{i=1}^{N} \frac{X_i' X_i}{s_{ii}} b_i$. If H_0' hypothesis is accepted, then, b_i is independent N number of estimator of β parameter vector with no deviation for $i = 1, 2, ..., N$. In sum, before random coefficient panel regression model is estimated, parameters are required to be tested for constancy.

5 Findings

Table 3 exhibits test statistics to measure aforesaid cross-sectional dependency. In all tests applied, p-value estimated below 0.05 for each variable suggested that H_0 hypothesis implying non-existence of cross-sectional dependency was required to be rejected in all series. This finding revealed that there was cross-sectional dependency among the countries included in the study. That is, a shock that may occur in one of these countries will affect the others.

Table 3: Cross-sectional dependency test results

	ECI		LOGEXP		LOGPCGDP		LOGGFCF	
	Test statistics	p-value	Test statistics	p-value	Test statistics	p-value	Test statistics	p-value
$CDLM_1$	1149.665	0.000	3247.747	0.000	3114.842	0.000	2340.180	0.000
$CDLM_2$	77.436	0.000	232.956	0.000	223.104	0.000	165.683	0.000
LM_{adj}	77.241	0.000	232.956	0.000	222.910	0.000	165.488	0.000

Table 4: MADF and Hadri-Kurozumi panel unit root test results

Variables	MADF Test Results (Constant)		Hadri-Kurozumi Test Results (Constant and Trend)	
	MADF Test Statistics	Critical Value (5%)	Z_A^{SPC}	Z_A^{LA}
LOGPCGDP	118.574	24.36	−1.1148* (0.8675)	−2.485* (0.9935)
ECI	93.507	24.36	1.0513 * (0.1466)	3.0564 * (0.0011)
LOGGFCF	66.805	24.699	−1.5885* (0.9439)	−1.2454* (0.8935)
LOGEXP	77.81	24.36	−2.1762* (0.9852)	−1.4434* (0.9255)

In MADF test, the maximum lag length was taken as 4; and Bayes information criterion (BIC) and Akaike information criterion (AIC) were used for determination of optimum lag lengths. While the lag length determined for LOGPCGDP, ECI and LOGEXP variables was 1; for LOGGFCF was 2. In Hadri-Kurozumi test results, * denotes 0,05 significance level.

Determination of cross-sectional dependency was also important for conducting unit root test. Briefly, the second generation unit root tests seeking cross-sectional dependency was employed. According to MADF test results in Table 4, since test statistics was greater than the critical value, the null hypothesis indicating non-stationarity of the panel was rejected. When it comes to Hadri-Kurozumi unit root test results for constant and trend case, p-values higher than 0.05 indicate that the null hypothesis of stationarity cannot be rejected. Hence, all variables were found to be stationary at this level, which allows regression analysis to be conducted for variables with their level values. Descriptive statistics of the variables can be found in Table 5.

Table 5: Descriptive statistics

	LOGPCGDP	LOGEXP	LOGGFCF	ECI
Mean	10.129	26.770	25.424	1.488
Median	10.191	26.617	25.077	1.502
Maximum	11.540	32.087	28.112	2.625
Minimum	8.518	23.554	23.036	0.161
Standard deviation	0.603	1.693	1.223	0.502
Skewness	−0.470	1.163	0.554	−0.084
Kurtosis	2.736	4.888	2.369	2.524
Jarque-Bera	20.551	193.663	35.094	5.504
Probability	0.000	0.000	0.000	0.064
Observation	518	5.18	5.18	518

Table 6: Parameter constancy test results

Chi-square test statistics	7414.87
p-value	0.000

As it was mentioned in the econometric methodology section, before the estimation of the random coeffcient model, constancy of parameters was required to be tested. The null hypothesis for this pre-test was exhibited by Equation (12) (Swamy, 1970). This hypothesis indicates that coefficient vectors were constant and sample units were homogenous. In case the null hypothesis was rejected, estimation of the random coefficient model was regarded as reliable. Test results of parameter constancy in Table 6, in chi-square test statistics, p-value less than 0.05 suggested that H_0' null hypothesis was to be rejected. That is, coefficient vector was not constant and units did not display homogeneity. This heterogeneity is an expected result when the economical, institutional and cultural differences of the countries are taken into consideration. Even if all countries in the analysis are in high-income level, their socio-economical structures that also affect economic activities are completely different from

each other.
Table 7 exhibits the results of the random coefficient regression model. According to Table 7, fixed capital formation exhibited statistically significant impact on per capita income for all countries. When export variable was considered, it was seen that export variable of all countries except France was displaying statistically significant and positive impact on their respective per capita income levels. When coefficients relevant with the impact of economic complexity index on per capita income level was considered, number of countries displaying statistically significant relationship between two variables were found to be quite limited. Economic complexity index exerted positive impact on per capita income level for Austria, Finland, Japan and Sweden. As previously stated, positive relation between economic complexity level and per capita income level was expected beforehand.

Table 7: Estimation results of random coefficient model (dependent variable: LOGPCGDP)

Countries	ECI		LOGGFCF		LOGEXP	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Austria	1.094*	0.000	0.449***	0.100	0.974*	0.000
Belgium	0.063	0.740	1.385*	0.000	0.315***	0.082
Germany	0.306	0.136	1.480*	0.000	0.460*	0.000
Denmark	0.195	0.208	0.373***	0.097	0.896*	0.000
Finland	0.350***	0.065	0.701*	0.001	0.543*	0.000
France	0.078	0.729	1.481*	0.000	0.259	0.120
Hong Kong	−0.133**	0.029	1.102*	0.000	0.185*	0.009
Israel	0.168	0.396	0.676*	0.000	0.363*	0.000
Italy	0.095	0.672	0.674*	0.012	0.942*	0.000
Japan	0.284***	0.070	1.254*	0.000	0.565*	0.000
Holland	−0.005	0.982	0.597**	0.046	0.649*	0.000
Norway	−0.547*	0.009	1.035*	0.000	0.683*	0.000
Singapore	−0.367*	0.002	0.425*	0.001	0.667*	0.000
Sweden	0.588*	0.001	0.961*	0.000	0.434*	0.000

*, ** and *** denotes significance levels of 0.01, 0.05 and 0.10, respectively.

The relation that needs attention here was encountered with the findings related with Hong Kong, Norway and Singapore. Yet, while export variable in these countries displayed positive and significant impact on per capita income, economic complexity index displayed statistically significant but negative relation. If recalled once more that economic complexity level depends on sophistication level of export goods, this finding meant that export has contribution into generation of income and increasing level of per capita income but it does not display sustainable characteristic in nature.

Table 8: The first five export goods and their shares of respective countries (2016)

Austria		Finland		Japan		Sweden		Hong Kong		Singapore		Norway	
Medicine	4.2	Paper	7.7	Automobile	15	Automobile	5.4	Gold	24	Refined Oil	16	Crude Oil	24
Automobile Parts	3.4	Refined Oil	7.3	Integrated Circuit	4.9	Refined Oil	4.6	Diamond	6.3	Integrated Circuit	13	Petroleum Gas	23
Automobile	2.7	Stainless Steel	4.2	Automobile Parts	4.9	Medicine	4.3	Phone	4.5	Computer	3.9	Fresh Fish	5.6
Human/ Animal Blood	2.2	Processed Timber	3	Industrial Printers	1.8	Automobile Parts	3.7	Radio-TV Equipment	3.4	Oxygen Compounds	3.3	Refined Oil	3.5
Combustion Engines	1.9	Automobile	3	Cruise and Cargo Ships	1.8	Paper	2.2	Jewelry	3.2	Medicine	2.9	Raw Aluminum	2.8

Source: Observatory of Economic Complexity (2018), https://atlas.media.mit.edu/en/profile/country/ (22.12.2018).

6 Conclusions

As it is suggested by common theories, countries' competitive strength level and their utilization level from foreign trade are not determined by their export volumes within the global economic system. It has recently been recognized that quality of what countries export is more important than quantity of export. In this scope, countries' economic complexity levels of countries are found to be a factor dependent on sophistication level of exported goods of respective countries; and it could be considered that they play key role in acquisition of sustainable growth of countries.
Within the scope of the present study conducted on the countries which have succeeded to escape from middle income trap after 1950 and to reach high income level before 1990, the impact of economic complexity level on per capita income level was investigated. Obtained findings suggested that countries whose export portfolio comprises of more complex goods (Austria, Finland, Japan and Sweden) showed more significant and positive relation between two variables, while the ones whose export portfolio tends to include highly natural resources (Hong Kong, Singapore and Norway) showed negative significant relation between the two. Findings in this study are compatible with the findings of Fortunato and Razo (2014), Kocenda and Poghosyan (2017), Demir (2017) and Stojkoski and Kocarev (2017).
Table 8 presents some supportive information. The first five export goods of countries whose variables displayed statistically significant correlation is exhibited in Table 8. A notable difference existed among the countries displaying positive and negative correlations. It could be seen with the countries displaying positive correlations between economic complexity index and per capita income (Austria, Finland, Japan and Sweden) that the first five export goods include highly sophisticated items such as medicine, automobile, automobile parts, combustion engines, and integrated circuits manufactured with high technology level and that share of natural resources remains quite limited among their top export goods. On the other hand, the first five export goods of the countries displaying negative correlation between economic complexity index and per capita income (Hong Kong, Singapore and Norway) were dominated by natural resources. The first export item listed for Hong Kong was gold by 24%; refined oil for Singapore by 16%; and crude oil for Norway by 24%. Depending on these results, it can be concluded that it is not quite enough alone of export to have high volumes unless it is supported by the increase of sophistication level of goods that are produced and exported.

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