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Does export diversification converge? Evidence from cross-country analysis

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Abstract

This study examines the export diversification convergence across a broad set of countries. In particular, it focuses on whether the 127 Non-OECD countries are converging with 34 OECD countries in terms of export diversification. The study uses the annual data of 161 countries from 1995 to 2016. Techniques such as panel unit root tests, panel data models, and panel club convergence technique are applied for analysis. The results derived from these techniques support the evidence of export diversification convergence. This implies that the lower export diversified (Non-OECD) countries are 'catching up' with the higher export diversified (OECD) countries. Further, the findings suggest that Non-OECD countries should diversify their export with a speed of more than 3% to catch the OECD countries in order to achieve high and stable economic growth

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Does export diversification converge? Evidence from cross-country analysis

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Abstract

This study aims to examine the export diversification convergence across a broad set of countries. In particular, this paper focuses on whether export diversification of 127 Non-OECD countries converges to 34 OECD countries. The study uses the annual data from 1995 to 2016 for 161 countries. I employ numerous techniques such as panel unit root tests, panel data models and a panel club convergence technique propounded by Phillips and Sul (2007). The results based on these techniques support the evidence of convergence in case of export diversification which implies that countries with having lower export diversification (Non-OECD) countries are catching-up the higher diversified (OECD) countries. The study suggests that Non-OECD countries should diversify their exports with a speed of more than 3% to catch up the OECD countries in order to achieve high and stable economic growth.

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1. Introduction

Although, the standard international trade theory postulates that specialization helps countries to gain from trade through comparative advantages, but in the recent years, the trade pattern has seen vastly different from the classical trade theories which were based on the perfect competition, comparative advantage and constant returns to scale (Krugman, 1980). It has also been argued that the developing countries can grow faster than the rich countries by modifying the composition of their exports (Prebisch-Singer Hypothesis).

In the literature, an important question is raised whether trade openness or trade integration leads to income convergence across the economies (Ben-David, 1993, 1996; Ben-David and Loewy, 1998; Slaughter, 1997, Silvestriadou and Balasubramanyam 2002; Hallett and Piscitelli, 2002; Chatterjee and Shukayev, 2012; Song, 2014; Guillo and Perez-Sebastian, 2015). A few other studies examined the vital role of trade in the process of income convergence (Murthy and Chien, 1997; McCoskey, 2002; Stroomer et al. 2003; Vollmecke et al. 2016; Li et al. 2016). Additionally, Sachs and Warner (1995) studied the income convergence across a group of countries which were relatively open to each other whereas Ben-David (1993) examined the income convergence of those countries which followed trade liberalized policy.

Notwithstanding trade plays a significant role in the income convergence (Vollmecke et al. 2016; Li et al. 2016), the convergence of export diversification is found to be largely ignored by the earlier studies. In recent years, the export diversification has become one of the important economic issues for maintaining high and sustainable economic growth, particularly in the developing countries because of the following reasons. First, a diversified bundle of export products protects a country against frequent price variation in the global commodity markets and shocks in specific product markets (Bertinelli et al., 2006; Levchenko et al., 2010). Second, an expansion in the production basket increases the economic growth by reducing the unit production prices (Helpman and Krugman, 1986; Hausmann et al., 2007; Bagci, 2010; Cadot et al., 2011; Hammouda et al. 2010). Third, export diversification expands the trade between the domestic and foreign markets that enlarges the openness which eventually boosts economic growth.

Though a strand of empirical studies examined that export diversification significantly influences the economic growth (see, for example, Al-Marhubi, 2000; Hammouda et al. 2010; Cadot et al., 2011; Rath and Akram, 2017; Akram and Rath, 2017), there is hardly any study which addresses the 'catch up' hypothesis of export diversification between developing and developed countries, where export diversification is a key factor of economic growth. Therefore, this study complements the existing literature by examining the 'catch up' hypothesis between 127 Non-OECD and 34 OECD[1] countries. Further, this study estimates the speed of convergence.

To examine the aforementioned objective, the present study employs three tests. First, this study adopts the unit root tests which are based on the stochastic properties. In a time series framework, the stochastic convergence implies that export diversification among economies cannot contain the unit root. Second, the pooled ordinary least squares (OLS) model, fixed-dynamic model and dynamic panel data (based on system-GMM) are used to find the speed of convergence. Third, this study applies a new panel convergence methodology developed by Phillips and Sul (2007, PS hereafter) which adds a methodological contribution to the existing

[1]The explanation for choosing the OECD (Organization for Economic Co-operation and Development) countries as a benchmark is given in section 2. The selection of the sample is solely based on the data availability.

literature of trade-income convergence. The PS method has several advantages over the traditional neoclassical growth model (Solow, 1956) which are as follows: The PS approach helps in testing the overall absolute convergence; this approach finds clubs convergence endogenously in a very simple and convenient manner in a time series regression. This approach not only identifies a country's convergence to a common steady state, but it also examines the multiple steady states based on their level of export diversification to which countries have the similar transition path of convergence.

The paper is organized as follows: In section 2, it discusses the preliminary analysis. Section 3 presents the methodology. The empirical results are discussed in section 4, and section 5 provides the concluding observations.

2. Preliminary analysis

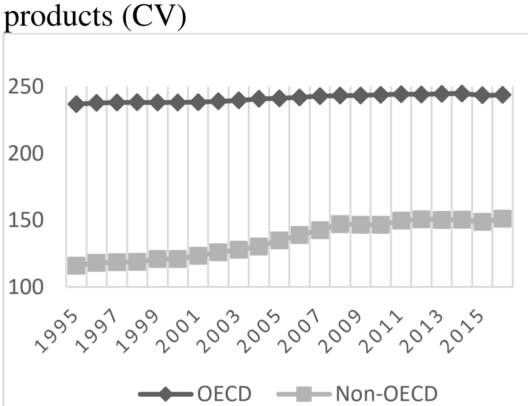
Export diversification is defined as the change in the structure of a country's existing export product basket or export destination (Ali and Siegel, 1991). In other words, the export diversification means broadening the products range that a country exports (Dennis and Shepherd, 2007). The diversification index (XDI) is computed by measuring the absolute deviation of the trade structure of a country from world structure:

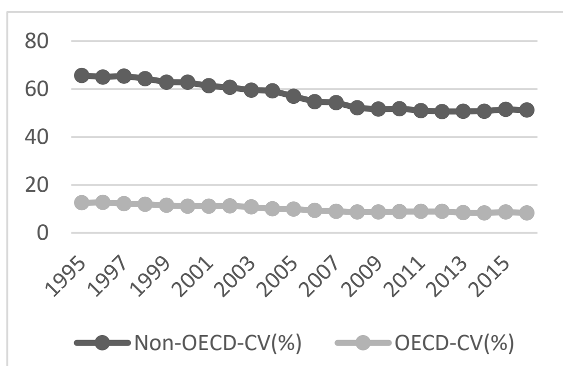
$$XDI_j = \frac{\sum_i \left| h_{ij} - h_i \right|}{2} \tag{1}$$

Where, h_{ij}= share of product i in total exports of country j; h_i= share of product i in total world exports. The diversification index takes values between 0 and 1. A value closer to 1 indicates greater divergence from the world pattern (Finger, and Kreinin, 1979).

Next, this section shows the average export product trends for both OECD and Non-OECD countries. To show this trend, the data were collected on a number of export products for each of the OECD (34 countries) and Non-OECD (127 countries) countries from UNCTAD database. It is observed from the Figure-1 that the OECD countries are exporting a large number of products as compared to Non-OECD countries. In Figure-2, the coefficients of variation (CV) are plotted, over the years. Figure 2 shows that the gap between Non-OECD and OECD is suppressing which gives the sign of 'catch up' hypothesis.

Figure-1: Average of number of export products **Figure-2**: Average of number of export products (CV)





Source:Author's own calculation using UNCTAD database.

The growth rate of a number of export products is presented in Table 1. The results indicate that the growth of export products on an average in Non-OECD countries is substantially higher than the OECD countries. These results reveal that Non-OECD countries are increasing their number of export products at a higher rate than OECD countries. For the purposes of comparison, the growth rate of export products for G7 and BRICS countries has been computed.

Table 1: Growth rates of export diversification

OECD	Non-OECD	G7	BRICS
2.88 %	30.34 %	-0.01 %	1.99 %

Source: Author's own calculation based on UNCTAD database.

The preliminary results clearly indicate that: (a) export diversification in Non-OECD countries is lower than the OECD countries, (b) the growth rates of export diversification in Non-OECD countries are faster than OECD countries. These findings offer an initial sign of export diversification convergence between OECD and Non-OECD countries.

3. Methodology

This section describes the formal methods of examining the convergence hypothesis of export diversification between Non-OECD countries and OECD countries over the period 1995–2016. The data used in the analysis was collected from UNCTAD[2] for 161 countries[3].

The analytical framework is based on the economic growth literature (Nahar and Inder, 2002; Bentzen, 2005), which extensively summarizes the 'catch up' hypothesis of per capita GDP growth. The central idea of this hypothesis is that developing countries tend to 'catch up' with rich countries, over time. In this case, there is an income convergence to some common value (steady state). This approach is also consistent with the neoclassical growth model, which predicts the differences in per capita income across different economies that tend to decrease, over time (Solow, 1956). In this paper, the approach for examining the export diversification convergence is as follows:

$$lnRXD_{i,t} = ln\left[\frac{XD.OECD_t}{XD_{i,t}}\right] \tag{2}$$

Where $lnRXD_{i,t}$ stands for logarithm of relative export diversification in country $i=1,2,\ldots,N$ countries and time $t=1,2,\ldots,T$, $XD.OECD_t$ indicates averge of export diversification of 34 OECD countries. If $lnRXD_{i,t}$ series is found to be stationary then conlcusion can be drawn in favour of export diversification convergence.

3.1. Panel unit root test approach for convergence

To test whether $lnRXD_{i,t}$ is stationary, this study uses three well known unit root tests: Levin et al., (2002), Im et al., (2003), and cross-sectional augmented IPS (Pesaran, 2007). The IPS (Im et al., 2003) panel unit root test accounts heterogeneous adjustment by pooling t-statistics from univariate independent ADF regressions. The IPS and cross-sectional augmented IPS tests relax the restricted assumption of the first order autoregressive coefficient across the country unlike Levin et al., (2002) unit root test. For a sample of N countries observed over T time periods, the IPS panel unit root regression of the conventional ADF test is written in the following form:

[2]The export diversification is measured through mean absolute deviation (MAD). The data are provided by United Nations Conference on Trade and Development (UNCTAD). Go through the link for more details http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx.

[3]List of the countries are provided in Appendix-A

$$\Delta lnRXD_{i,t} = \alpha_i + \beta_i lnRXD_{i,t-1} + \sum_{j=1}^{k} \psi_{i,j} \Delta lnRXD_{i,t-j} + \varepsilon_{i,t} \tag{3}$$

Where *RXD* denotes the relative export diversification, Δ is a first difference operator, $\varepsilon_{i,t}$ is a white noise disturbance term with variance, $\sigma^2, i = 1,2, \dots, N$ and $t = 1,2, \dots, T$. N and T stands for cross-section and time, respectively. The $\Delta lnRXD_{i,t}$ term on the right-hand side in Eq. (3) allows serial correlation to achieve white noise disturbance term. The IPS (Im et al., 2003) panel unit root test is shown to be more powerful than the Levin et al., (2002) unit root test. Further, the cross-sectional augmented IPS (CIPS) tests developed by Pesaran (2007) are used. Pesaran suggests a cross-sectional augmented Dickey-Fuller (CADF) test in a panel data, where the standard regressions are augmented with cross-sectional averages of lagged levels and first differences of the individual series. The CIPS unit root test is a simple average of the individual CADF-test. In this test, the error term follows an unobserved common factor structure to account for the cross-sectional correlation and idiosyncratic component.

3.2. Absolute convergence

Further, pooled OLS (POLS), fixed-dynamic, and dynamic panel data model (based system-GMM) are used to investigate the export diversification convergence and its speed. The system-GMM model (Arellano and Bover, 995; Blundell and Bond, 1998) uses over differenced-GMM (Arellano and Bond, 1991) because the differenced-GMM model suffers from the sample biases. Therefore, system-GMM estimator avoids the finite sample bias and suggests the inclusion of momentum conditions. To do so, this study uses the following dynamic panel equation:

$$lnRXD_{i,t} = \beta \; RXD_{i,t-1} + \mu_i + \varphi_i + \varepsilon_{i,t} \tag{4}$$

Where *i=1, 2…, N* and *t=1,2…, T*. *N* and *T* denotes for a number of countries and time, respectively. μ_i is a country-specific effect, and φ_i is time dummy. $\varepsilon_{i,t}$ represents the error term which varies across the country *i* and time *t*.

To compute the speed of convergence, the Eq.5 is used:

$$\lambda = \left(\frac{1 + \hat{\beta}}{22} \right) \tag{5}$$

Where λ repersents the speed of convergence. $\widehat{\beta}$ indicates the estimated coffiecient from Eq.4. And 22 repersents the available time periods of the country.

After confirming the convergence hypothesis, the study further employs Philips and Sul (2007) procedure to estimate the clubs convergence which cannot be captured through conventional unit root tests and dynamic panel data models.

3.3. Phillips and Sul (2007) technique

The Phillips and Sul (2007)[4] test applies to discover the convergence and to identify the cluster convergence endogenously in a panel. This technique helps to capture the idiosyncratic element which estimates the heterogeneity across the country using nonlinear time-varying factor. This test is free from many assumptions such as trend stationarity (or stochastic non-stationarity) and

[4]See Phillips and Sul (2007) article for more details.

the common factor in a panel of countries. The relaxation of the above assumptions makes this test unique and resolves the issue of unit roots and cointegration in a time series panel.

The RXD_{it} series is used for a panel of 127 countries and further disaggregated into two components: systematic (G_{it}) and transitory (B_{it}):

$$RXD_{it} = G_{it} + B_{it} \tag{6}$$

The Eq.6 can be rewritten in such a way that systematic and transitory components in the panel are separated:

$$RXD_{it} = \left(\frac{G_{it} + B_{it}}{\mu_t}\right)\mu_t = \gamma_{it}\mu_t, \qquad \forall\, i, t \tag{7}$$

The term γ_{it} indicates an idiosyncratic element that captures both the time and individual specific effects, and measures the distance between RXD_{it} and μ_t (common factor) which specifies the common stochastic trend in the panel of the countries. The coefficients of γ_{it} measures the share of the common factor μ_t for each individual in the panel data. The convergence is a dynamic process, hence γ_{it} shows the transition paths. The convergence can be obtained from the temporal relative evolution of γ_{it}. Further, PS assumes a semiparametric form for γ_{it} which permits construction of a formal test for convergence. In particular, the common component μ_t is eliminated through rescaling by panel average:

$$h_{it} = \frac{RXD_{it}}{\frac{1}{N}\sum_{i=1}^{N} RXD_{it}} = \frac{RXD_{it}}{\frac{1}{N}\sum_{i=1}^{N} \gamma_{it}} \tag{8}$$

Where h_{it} is the relative measure that captures the transition path with respect to the average of the panels. The following assumption is required for the algorithm club convergence for γ_{it}:

$$\gamma_{it} = \gamma_i + \sigma_{it}\xi_{it} \tag{9}$$

Where $\sigma_{it} = \frac{\sigma_i}{L(t)t^2}, \sigma_i > 0,\ t \geq 0$ and ξ_{it} are weakly dependent over *t*, and they are independent identically distributed (iid) (0, 1) over *i*. The function L(t) varies gradually which increases and diverges at infinity. The null hypothesis of convergence for all *i* under the specific form of $\gamma_{it}\ is$: $H_0\colon \gamma_i = \gamma,\ a > 0$, whereas the alternative hypothesis is: $H_1\colon \gamma_i \neq \gamma,\ or\ a < 0$. According to PS approach, the null is convergence, and it can be tested by the following regression model:

$$ln\left(\frac{V_1}{V_t}\right) - 2lnL(t) = \hat{c} + \hat{b}\ln t + \hat{u}_t \tag{10}$$

for $t = [rT], [rT] + 1, \dots\dots, T$ and $r > 0$. On the recommendation of PS test, the chosen *r* value is 0.33. Where $V_t = \frac{1}{N}\sum_{i=1}^{N}(v_{it} - 1)^2$ and $\hat{b} = 2\hat{a}$. $\hat{a}$ represents the estimated least square parameter of *a*. Under the null hypothesis, the RXD_{it} diverge if *a*>0 or *a=0.* In this case, the convergence can be tested by *t*-test with the inequality *a*>0. The t-test statistic follows the standard normal distribution asymptotically, and it is constructed using heteroscedasticity and autocorrelation. Phillips and Sul (2007) call it as one-sided t-test which is based on $t_{\hat{b}}$.

4. Empirical results

This section presents the empirical results derived from various techniques used in the analysis. The results of three-panel unit root tests are reported in Table 2. The results of LLC, IPS, and CIPS unit root tests suggest the rejection of the null of a unit root for both constant and constant with the trend at 1% level of significance. The, relative export diversification series is found stationary. These results confirm the evidence in favour of 'catch up' hypothesis which implies that Non-OECD countries are converging towards the OECD countries. Since 127 countries are considered as a panel in the analysis, there may be heterogeneity in the data. To account for the unit root in the presence of heterogeneity, the CIPS unit root test is applied. Again, the null of a unit root is rejected with homogeneity, and results indicate the presence of export diversification convergence.

Table 2: Panel unit root

	LLC		IPS		CIPS	
	Constant	Constant+Trend	Constant	Constant+Trend	Constant	Constant+Trend
lnRXD	-6.95***	-7.54***	-6.75***	-8.33***	-2.42***	-3.39***
	(0.00)	(0.00)	(0.00)	(0.00)		

Note: critical values for CIPS are -2.08(10%), -2.16(5%), and -2.3(1%) at constant. The critical values with trend are -2.59(10%), -2.65(5%), and -2.77(1%). *** stand for 1% level of significance. P values are given in the parenthesis.

The presence of heterogeneity in the data further motivates to apply a dynamic panel (System-GMM) model, pooled OLS (POLS) and fixed-dynamic (OLS) model to examine the convergence and its speed. These methods are useful when there are heterogeneity and endogeneity problems in the data. The results of these models are presented in Table 3. The results derived from pooled OLS regression (POLS) show a negative and significant coefficient, which infers that Non-OECD countries are converging with OECD countries, thereby, it confirms the 'catch up' hypothesis.

Similarly, the results from fixed-dynamic regression and system-GMM model also indicate that the coefficients are negative and significant which conclude the convergence of export diversification. Also, the speed of convergence is estimated using Eq.5. The speed of convergence is found to be around 3% across the model which suggests that Non-OECD countries are converging to OECD countries at a speed of 3%.

Table 3: Absolute convergence

Variables	POLS	Fixed-dynamic	System-GMM
$lnRXD_{t-1}$	-0.27***(0.00)	-0.29***(0.00)	-0.24***(0.00)
Constant	-0.002***(0.00)	-0.002***(0.00)	-0.002***(0.00)
Saran Test	-	-	125.01 (1.000)
AR(1)			-3.99***(0.00)
AR(2)	-	-	-1.42 (0.15)
Speed of convergence	3.31%	3.22%	3.45%

Note: *** stand for 1% level of significance. P values are given in the parenthesis. Results are in favor of convergence.

Table 4: Club convergence

Club	$t_{\hat{b}}$-[log(t)]
Full Sample	2.32 [1.48]**

Note: the critical value is −1.65 at 5% level of significance. ** indicates the acceptance of null of convergence at 5 % level of significance.

Finally, the PS panel convergence test is employed to check the robustness of the results. The PS results are reported in Table 4. It is found that $\log(t)$ statistic is equal to 1.48, which is greater than the critical value (i.e., -1.65, at 5% level of significance). Hence, the null of convergence is accepted at 5% level of significance which infers that Non-OECD countries are significantly converging with OECD countries by forming a full sample club. The findings obtained from PS are consistent with the earlier findings as given in Tables 2 and 3. From the policy perspective, Non-OECD (lower diversified) countries should diversify their export basket further to 'catch up' the OECD countries.

5. Concluding remarks

There is a plethora of studies in the literature which examine the 'convergence hypothesis' using many variables like income, output, productivity, trade, health expenditure, ICT development, and financial development. But a little attention has been paid to examine the export diversification convergence. Although there is no clear-cut theoretical framework on the notion of trade convergence, a large number of studies have empirically tested the trade convergence hypothesis and have found mixed evidence. This paper is an attempt to examine whether lower diversified countries are 'catching up' with higher export diversification considering 161 countries. This research idea is investigated using various methods which are based on the panel unit root tests, dynamic panel data models, and Philips and Sul (2007) panel convergence test. The empirical findings based on aforementioned econometrics methods support the evidence of export diversification convergence. These findings signify that lower diversified countries (Non-OECD) are converging with higher diversified countries (OECD) by expanding their export products basket. Moreover, the findings of export diversification convergence suggeste that Non-OECD countries should diversify their export basket more than 3% to 'catch up' the OECD countries to achieve high and stable economic growth, and expand the economy in terms of openness.

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Appendix A: List of the countries

Albania, Algeria, Andorra, Angola, Antigua and Barbuda, Argentina, Armenia, Azerbaijan, Bahamas, Bangladesh, Barbados, Belarus, Belize, Benin , Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei Darussalam, Bulgaria, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Chad, China, Colombia, Comoros, Congo, Dem. Rep., Costa Rica, Cote d'Ivoire, Croatia, Cuba, Cyprus, Djibouti , Dominica, Dominican Republic, Ecuador, Egypt, Arab Rep., El Salvador, Equatorial, Guinea, Ethiopia, Fiji, Gabon, Gambia, Georgia , Ghana , Greenland , Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Iran, Islamic Rep., Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Kuwait, Lebanon, Lesotho, Liberia, Lithuania, Madagascar, Malawi, Malaysia, Mali , Malta, Marshall Islands, Mauritania , Mauritius, Mongolia , Morocco, Mozambique, Myanmar, Namibia, Nepal, Nicaragua, Niger , Nigeria, Oman, Pakistan, Palau, Panama , Papua New Guinea, Paraguay, Peru, Philippines, Romania, Russian Federation, Rwanda, Samoa, Saudi Arabia, Senegal , Seychelles , Sierra Leone , Singapore , Solomon Islands, South Africa, Sri Lanka, Suriname, Swaziland, Tajikistan, Thailand, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkmenistan, Tuvalu, Uganda, Ukraine, United Arab Emirates, Uruguay, Uzbekistan, Vanuatu, Vietnam, Yemen, Rep., Zambia, Zimbabwe, Australia, Austria, Belgium, Canada, Chile, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.