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Economic integration and income convergence in the EU and the ASEAN

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Abstract. In this paper, examine per capita income convergence among the countries of the EU and the ASEAN during 2000-2014 using both beta and sigma convergence and theil index of inequality in order to to explain the process of structural change contributing to the process of income convergence. Our analysis of theil index of inequality indicates that the inter-country inequality, in general, has been decreasing for GDP in the EU and the ASEAN, which is in line with the findings of β- and σ- convergence for these two groups of countries during 2000-2014. While in the case of EU, reduction in inequality in the industrial sector has positively affected the reduction in inequality in income; for ASEAN, industrial and services sector have contributed to income convergence.
Keywords. Convergence, EU, ASEAN, Theil Index of Inequality.
JEL. O00, O10, O40.

1. Introduction

In the recent years economists have attempted to analyze whether economic integrations, like that of the European Union (EU) and the Association of South East Asian Nations (ASEAN), have contributed to greater cohesiveness among the member countries, where increased cohesiveness refers to the tendency towards achieving per capita income convergence across the member countries. In other words, the issue being raised is whether convergence in per capita income takes place as result of formation of economic integration.

There is of course a large body of study purporting to examine income convergence in the Europe, but there is no consensus on the results. Many find evidence of convergence (Armstrong, 1995; Ben-David, 1993, 2001; Dewhurst & Mutis-Gaitan, 1995; Leonardi, 1995; Yin *et al.,* 2003), while others find both the tendencies of convergence and divergence, depending on the period and countries included, (Marques & Soukiazis, 1998; Dunford, 1996), and still others predict divergence (Arestis & Paliginis, 1995; Hallett, 1981; Slaughter, 1997, 2001). Studies carried out post -2000 generally find evidence of economic convergence in per capita income in the long run (see ECB 2008, Kutan & Yigit, 2009; Boldrin & Canova, 2001; Baruah *et al.,* 2006; Villaverde & Maza, 2008; Rapacki & Prochaniak, 2009; Szeles & Marinescu, 2010; Cavenaile & Dubois, 2011; Kaitila, 2013), due to the catch up in growth of the poorer countries (Greece, Ireland, Portugal and Spain in the earlier period, and Eastern Europe more recently).

Literature on income convergence in Asia and ASEAN is relatively sparse as compare to that of the EU. Lim & McALeer (2003) have done a study on five founding members of ASEAN[i]. The study revealed a negative correlation between the average growth in income and its initial level for ASEAN-5 countries, but the estimates were found to be insignificant. A clear and robust finding of the study by Korshed (2005) suggests rising per capita income dispersion in the region. On a positive note, some recent studies find that more rapid rates of economic growth in

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the CLV countries (Cambodia, Lao PDR, Vietnam) since the 1990s—driven by trade, investment, and other market reforms—have reduced income differences between ASEAN countries leading to income convergence (see, for instance, Chowdhury *et al.,* 2011; Menon, 2012; Mu, Shun, & Wang, 2012; Sperlich & Sperlich, 2012; Solarin *et al.,* 2014 etc.)

The literature is limited not only by inconclusive findings, but also, to application of traditional concepts of beta(β) and sigma (σ) convergence of Barro & Sala-i-Martin (1991, 1992) to analyze regional disparities in the context of the EU and the ASEAN. However, this approach is not suitable for analyzing the underlying process of dynamic structural change that an economy experiences in response to changes in policies in the integration process. Also, owing to insufficient data, prior studies have restricted their analysis to pre- or early 2000s and not all the countries of the EU and the ASEAN have been included in the analysis. As all the countries in the both the regions are now actively involved in the integration process, therefore excluding any deserving country from the analysis may bias the results.

The basic objective of this paper is to do a comparative assessment of the process of per capita income convergence in the EU and the ASEAN in the recent period of 2000-2014[ii], as during this period the EU and ASEAN countries witnessed major economic developments. We will try to include all countries in our analysis and re-examine the phenomenon of per capita income convergence using the concepts of β- and σ- convergence and then use theil index of inequality index to explain the process of structural change contributing to the process of income convergence.

The remainder of the paper is organized as follows. The chapter is organized into seven sections including introduction. The next section describes the data and methodology. The results are reported and discussed in detail in section 3. The last section 4 summarizes the major findings and concludes the paper.

2. Data and Methodology

2.1. Beta and Sigma Convergence

The work of Barro & Sala-i-Martin (1991, 1992) proposed two types of convergence – beta (β) and sigma (σ) convergence. On one hand, β- convergence considers whether the growth rates of countries exhibit a negative correlation with the initial level of real Gross Domestic Product (GDP) per capita, that is, β-convergence implies that countries with low real GDP per capita possess more potential for faster growth rates than countries with high real GDP per capita. On the other hand, σ-convergence measures the dispersion of real per capita income whether it is falling over time. Quah (1995) and Sala-i-Martin (1996) show that a necessary condition for the existence of σ- convergence is the existence of β-convergence, since for the dispersion of per capita GDP to decline between two countries, the initially poorer countries should grow faster than the initially richer ones. The former is, however, a necessary but not sufficient conditition for the latter, since there may be economic shocks that push countries or regions apart even as β-convergence works to bring them together. The data on GDP per capita has been sourced from World Development Indicator (WDI) of World Bank.

2.2. Theil Index of Inequality

In order to capture structural change and consequent dynamic shifts that might be taking place in an economy, a simplified Solow model (1956) of growth underlying the Barro- Sala-i- Martin analysis of convergence will not suffice and we have to employ multi-sectoral analytical framework, which allows us to examine the structural transformation of economies in response to changes in economic policies over time. Hence, we will re-look at the phenomenon of income convergence using theil index of inequality. Also, attempt is made to examine the

structural shift by decomposing outputs into three major sectors (agriculture, industry and services).

The Theil or entropy measure of inequality, Tx, is defined as follows:

$$T_x = \sum x_i \log\left(\frac{x_i}{p_i}\right),$$

where x is an indicator such as per capita GDP, agriculture, industry and services, and i stands for a country in the region(ASEAN/EU), p_i is country i's share in total population of the region, and x_i is country i's share in various economic activities like GDP, agriculture, industry and services in the region. The data for value added shares of agriculture, industry and services in GDP have been sourced from WDI, World Bank.

3. Results

3.1. Evidence of beta and sigma convergence in the EU and the ASEAN

The relationship between the log of per capita GDP in the year 2000 (initial GDP per capita) and the growth rate of per capita income between 2000 and 2014 and the evolution of the standard deviation of logarithms of GDP per capita from 2000 to 2014 for the EU and the ASEAN countries are presented in Figures 1,2 3 and 4 respectively.

The analysis of the relationship between the initial log of per capita income and the average growth of per capita income between 2000 and 2014 for the EU countries has given a negative relationship between these two variables which indicates that the countries which have low per capita income in the initial stages generally grew faster than the countries with high per capita income, validating β-convergence. The regression result of the cross-section convergence test for the 28 countries shown in Figure 1 yields a negative β-estimate of –34.47 (t-ratio = –3.43), which is highly significant (at 1 per cent level of significance). Figure 2 shows the dispersion of per capita GDP for EU fell gradually from 0.82 in 2000 to 0.64 in 2014. Further, a negative trend of log per capita GDP provides stronger empirical support of σ-convergence.

Figure 1: GDP Per Capita Growth Rates in EU during 2000-2014

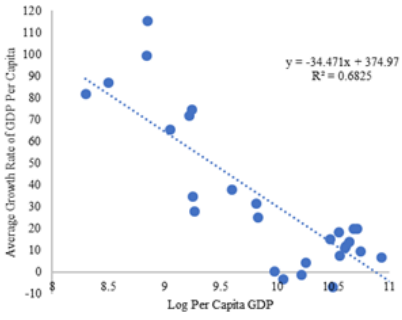


Figure 2: EU- Real GDP Per Capita Dispersion 2000-2014

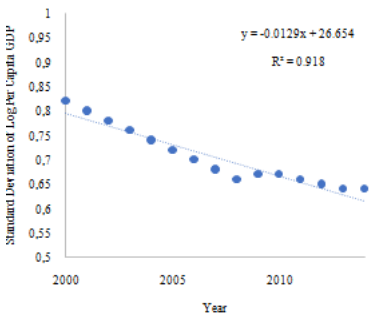


Figure 3: GDP Per Capita Growth Rates in ASEAN during 2000-2014

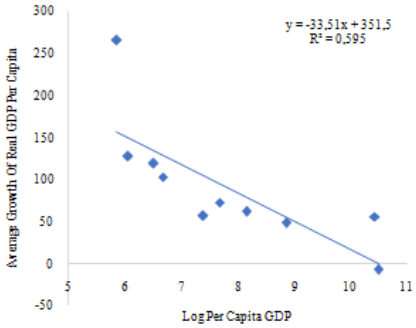
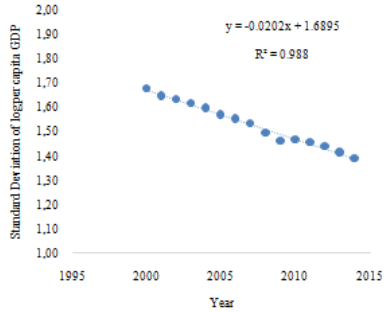


Figure 4: ASEAN- Real GDP Per Capita Dispersion 2000-2014



Similarly, the analysis of the relationship between the initial log of per capita income in ASEAN countries and the average growth of per capita income between 2000 and 2014 for these countries has given a negative relationship between these two variables, showing evidence of β-convergence within ASEAN. The regression result of the cross-section convergence test for the ten countries shown in gives a negative β- estimate of –33.52 (t-ratio = –3.43), which is highly significant (at 1 per cent level of significance).Figure 4 shows the dispersion of per capita GDP for ASEAN fell gradually from 1.68 in 2000 to a low of 1.46 in 2009, remained at 1.46 till 2011 before falling further to 1.39 in 2014 and a negative trend of log per capita GDP provides stronger empirical support of σ-convergence.

3.2. Theil Index of Inequality and their Trends

3.2.1. EU

Table 1 gives the Theil indices of inequality in terms of GDP per capita and shares of agriculture, industry and services for the EU countries over the period from 2000 to 2014[iii].

Table 1. *Theil Index of Inequality, EU 2000-2014*

Year	GDP	Agriculture	Industry	Service
2000	0.11	0.12	0.11	0.13
2001	0.11	0.11	0.10	0.12
2002	0.11	0.12	0.10	0.12
2003	0.10	0.12	0.09	0.12
2004	0.10	0.09	0.09	0.11
2005	0.09	0.11	0.08	0.11
2006	0.09	0.10	0.08	0.11
2007	0.09	0.09	0.08	0.10
2008	0.08	0.07	0.07	0.10
2009	0.08	0.09	0.07	0.10
2010	0.08	0.09	0.07	0.10
2011	0.08	0.07	0.08	0.10
2012	0.08	0.08	0.08	0.09
2013	0.08	0.06	0.08	0.09
2014	0.08	0.07	0.08	0.09

Source: Author's calculation using WDI, World Bank Database

The values shown in Table 1 indicate that the inter-country inequality in general has been decreasing for GDP per capita, which is in line with the findings of β- and σ- convergence for the EU countries during 2000-2014. Also, inter-country inequality for services has been decreasing while there is no such discernible trend for inter country inequality with respect to agriculture and industry.

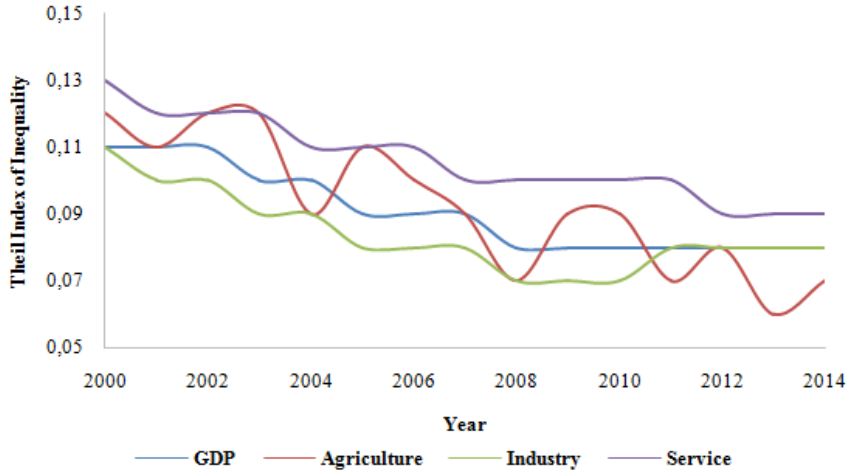


Figure 5. *EU- Sectoral Inequalities*

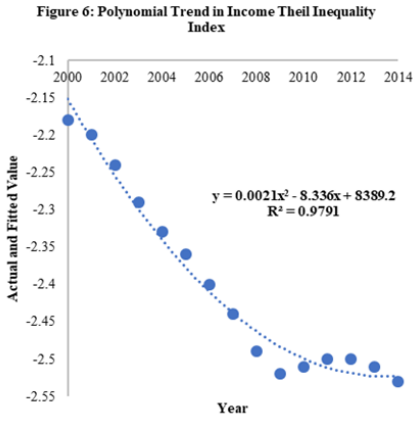
Figure 5 shows the inequality levels for GDP and its various components. It can be seen that the levels of inequality are the lowest for industry followed by GDP and services. As far as the inter-country inequality for agriculture is concerned, there seems to be a lot of fluctuation between 2000-2014. Post-2010, inequality with respect to industries becomes aligned with that with respect to GDP.

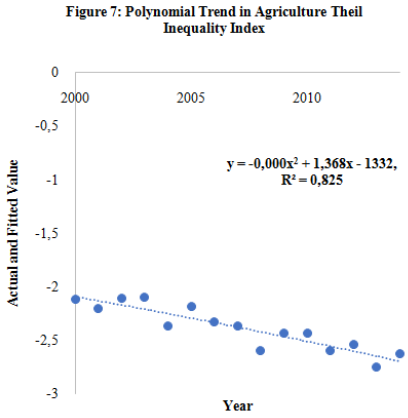
Table 2. *Theil Inequality Trends, EU 2000-2014*

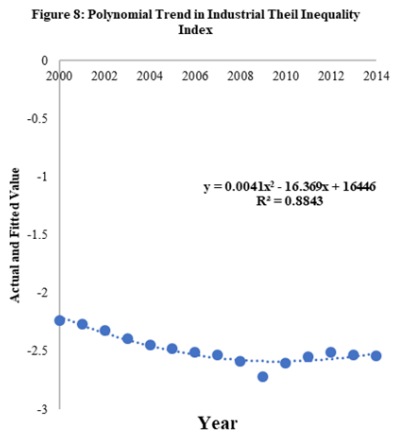
Inequality Index	Average Annual Growth Rate	t-value	Adj. R-Squared
GDP	-0.026	-10.69	0.898
Agriculture	-0.043	-7.82	0.825
Industry	-0.022	-4.36	0.594
Service	-0.024	-13.86	0.937

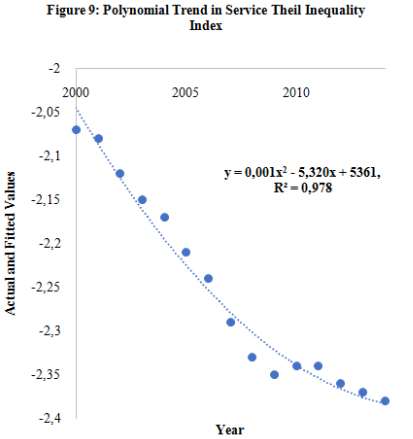
Source: Author's calculation using WDI, World Bank Database

The estimates of the Theil inequality measures have been further analyzed and linear trends for inequality indices are estimated and presented in Table 2. It can be noted from table that the Theil inequality indices have shown a negative trend for GDP and all its components- agriculture, industry and services and all the estimates are significant. This suggest that inter-country inequality has come down in all the sectors of the economy, with inequality in the agricultural sector witnessing higher rate of decline. The linear trend results, particularly in case of agriculture, convince us that some measure of nonlinearity may exist in the behavior of inequality over time and therefore non-linear polynomial trend is estimated for all theil indices. It is found that the coefficient of time and its higher value up to second degree are significant for all the theil indices. The figures 6,7, 8 and 9 provide the curves based on the polynomial regression coefficients of GDP and its components respectively.









It must, however, be noted that since the measure of inequality is only a statistical construct, it does not by itself provide any explanation of the causes of a decreasing trend of inter-country income disparity and income convergence in ASEAN. As a preliminary investigation into the relationship between income inequality and the inequalities in its various components, a cross-sectional regression analysis is performed where theil index of income inequality is regressed on the theil inequalities in its components. The results of Ordinary Least Squares (OLS) regression are reported in Table 3.

Table 3. *Regression Results of Income Inequality: EU*

Income Theil Ratio	Coefficient
Theil Index of Agriculture	0.1173
	(0.1057)
Theil Index of Industry	0.5676**
	(0.1293)
Theil Index of Services	0.2956
	(0.2108)
Constant	0.0008
	(0.0102)
N	15
R-Squared	0.9393
Adjusted R-Squared	0.9227

Note: Standard errors in parenthesis. **significant at 1% level of significance.

The regression results show that only the coefficient pertaining to theil index of industrial inequality is positive and highly significant. Thus, reduction in inequality in the industrial sector has positively affected the reduction in inequality in income. Though the coefficient for agricultural inequality and service inequality are positive, they are not significant. This signifies that agriculture and services sectors didn't impact income inequality in the EU during 2000-2014.

3.2.2. ASEAN

Table 4 gives the Theil inequality indices of inequality with respect to GDP and its components for the ASEAN countries over the period from 2000 to 2014. The data for share of agriculture, industry and services[iv] is not available for Vietnam and hence while calculating theil indices of inequality of these components, Vietnam is excluded from the sample. However, we believe that this should not alter the inferences much.

Table 4. *Theil Index of Inequality, ASEAN 2000-2014*

Year	GDP	Agriculture	Industry	Service
		(Excluding Vietnam due to unavailability of data)		
2000	0.406	0.207	0.570	0.687
2001	0.386	0.201	0.529	0.683
2002	0.383	0.209	0.529	0.668
2003	0.381	0.213	0.532	0.657
2004	0.386	0.210	0.547	0.656
2005	0.384	0.203	0.524	0.670
2006	0.385	0.208	0.519	0.680
2007	0.387	0.220	0.495	0.707
2008	0.368	0.215	0.465	0.709
2009	0.345	0.205	0.440	0.686
2010	0.363	0.217	0.458	0.693
2011	0.363	0.233	0.442	0.701
2012	0.354	0.225	0.435	0.681
2013	0.348	0.220	0.419	0.678
2014	0.341	0.214	0.416	0.661

Source: Author's calculation using WDI, World Bank Database

The values shown in Table 4 indicate that the inter-country inequality in general has been decreasing for GDP, which is in line with the findings of β- and σ- sigma convergence for the ASEAN countries during 2000-2014. Also, inter-country

inequality for industries has been decreasing while for agriculture it seems that the inequality has been increasing. There is no such discernible trend for services.

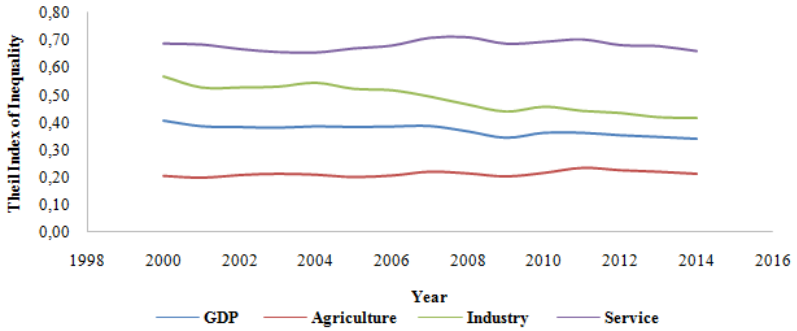


Figure 10. *Sectoral Inequalities*

Figure 10 shows the inequality levels for GDP and its various components. It can be seen that the levels of inequality are the lowest for agriculture followed by GDP and industry. However, as noted in Table 4 and is also shown in Figure 10 agricultural inequality has an increasing trend while inequality in terms of GDP and industry has a declining trend.

Table 5. *Theil Inequality Trends, ASEAN 2000-2014*

Inequality Index	Average Annual Growth Rate	t-value	Adj. R-Squared
GDP	-0.011	-7.310	0.789
Agriculture	0.005	2.710	0.312
Industry	-0.022	-11.800	0.908
Service	0.001	0.560	-0.051

Source: *Author's calculation using WDI, World Bank Database*

The estimates of the Theil inequality measures have been further analyzed and linear trends for inequality indices are estimated and presented in Table 5. It is apparent that the Theil inequality indices have shown a negative trend for GDP and industry and positive trend for agriculture and services. The annual average rate of growth of inequality -0.01, 0.01, -0.02 and 0.001 for GDP, agriculture, industry and services respectively. However, the estimates are significant for GDP, agriculture and industry and insignificant for services. This suggest that there could be significant non-linear trend with respect to services and therefore non-linear polynomial trend is estimated for all Theil indices. It is found that only in the case of theil index of services, the coefficient of time and its higher value up to second degree are significant. Non-linearity in remaining variables is found to be insignificant. The figures 11, 12, 13 and 14 provide the curves based on the regression coefficients of GDP and its components respectively.

Figure 11: Linear Trend in GDP Theil Inequality Index

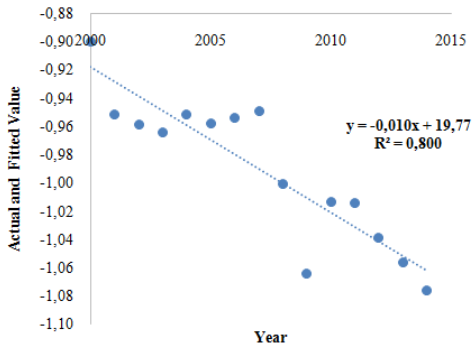


Figure 12: Linear Trend in Agricuture Theil Inequality Index

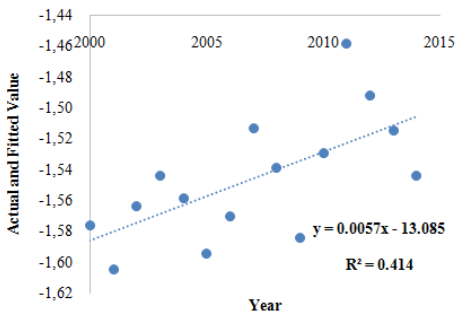


Figure 13: Linear Trend in Industrial Theil Inequality Index

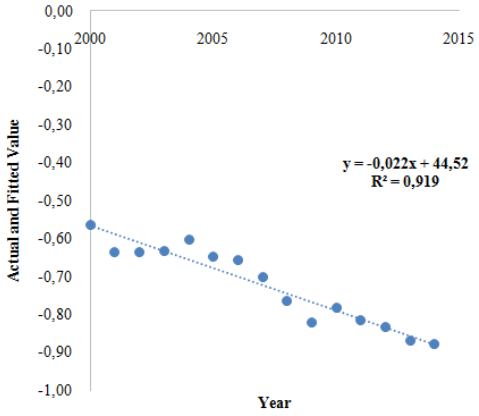


Figure 14: Polynomial Trend in Services Theil Index

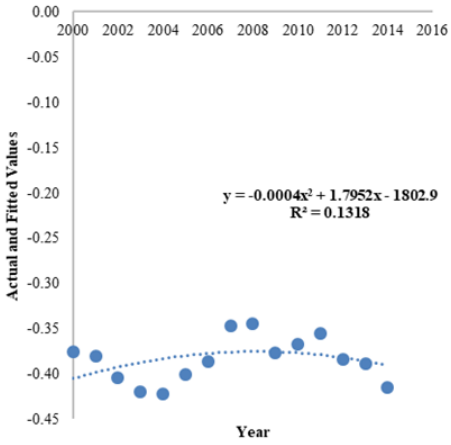


Table 6. *Regression Results of Income Inequality: ASEAN*

Income Theil Ratio	Coefficient
Theil Index of Agriculture	0.1555
	(0.1742)
Theil Index of Industry	0.4097**
	(0.0251)
Theil Index of Services	0.2972**
	(0.0718)
Constant	-0.0633
	(0.0539)
N	15
R-Squared	0.9693
Adjusted R-Squared	0.961

Note: Standard errors in parenthesis. **significant at 1% level of significance.

In order to do a preliminary investigation of the relationship between income inequality and the inequalities in its various components, a cross-sectional regression analysis is performed and the results of OLS regression are reported in Table 6. The regression results show that industry and services inequalities positively affect income inequality; their coefficients being highly significant and positive. Though the coefficient for agricultural inequality is positive, it is not significant. Even though the inter-country inequality in agriculture has risen, its impact on offsetting the GDP inequality has been insignificant. This is because there has been a secular decline in the share of agriculture in GDP, with a consequent increase in the combined share of industry and services

4. Conclusion

The objective of this paper was to empirically test for per capita income convergence in the EU and the ASEAN countries in the recent period i.e., 2000-2014. Studies on income convergence in the advanced EU countries outnumbers those in the ASEAN nations. Previous studies to assess income convergence in the EU and the ASEAN have not included all the countries of the group, were limited to time period prior to 2000 and are inconclusive. Moreover, most of these studies have employed the traditional concepts of beta and sigma convergence for their analyses. In the paper, in addition to testing for β- and σ-convergence, we have also analyzed the theil inequality indices for evidence of income convergence.

We find evidence of both β- and σ- convergence in the EU and ASEAN during 2000-2014. Our analysis of theil index of inequality indicates that the inter-country inequality, in general, has been decreasing for GDP in the EU and the ASEAN, which is in line with the findings of β- and σ- convergence for these two groups of countries during 2000-2014. In case of the EU, the levels of inequality are the lowest for industry followed by GDP and services. Also, inter-country inequalities with respect to agriculture, industry and services have significant and negative linear trends. In addition, when non-linear trend is estimated for the inequality with respect to GDP and its components it is found that the coefficients of time and its higher value up to second degree are significant. Inequality levels in ASEAN are the lowest for agriculture, followed by GDP and industry. In case of the ASEAN, theil index of inequality have shown a negative linear trend for GDP and industry and positive linear trend for agriculture and services. Non-linearity is found in all the variables, except for services is found to be insignificant.

As a preliminary investigation into the relationship between income inequality and the inequalities in its various components, a cross-sectional OLS regression analysis is performed where theil index of income inequality is regressed on the theil inequalities in its components. In case of EU, only the coefficient pertaining to theil index of industrial inequality is positive and highly significant. Thus, reduction in inequality in the industrial sector has positively affected the reduction in inequality in income. Though the coefficient for agricultural inequality and service inequality are positive, they are not significant. In case of ASEAN, industry and services inequalities positively affect income inequality; their coefficients being highly significant and positive. Though the coefficient for agricultural inequality is positive, it is not significant.

Notes

i The five founding members of the ASEAN are- Indonesia, Malaysia, Philippines, Singapore and Thailand.

[ii] The Maastricht Treaty, signed in 1993, proved to be the major milestone establishing the EU and setting clear rules for the future single currency. This was followed by the completion of the Single Market which implemented the “four freedoms”—of people, goods, services, and capital within EU, introduction of Euro as single official currency and inauguration of European Central Bank (ECB) in Frankfurt, Germany which was charged with the responsibility for framing and implementing the EU’s monetary policy and managing the euro. Post the Maastricht Treaty, the period 2000-2014 saw the biggest enlargement of EU to date, with now 28-member countries (starting with initial 6 founding members), with considerably less developed economies joining the EU.

As far as ASEAN is concerned, Data prior to 2000 will reflect confounding impact of trade and other factors of per capita income convergence as the impact of East Asian Crisis of 1997 will overshadow the impact of these factors considered for the study. After the East Asian Financial Crisis of 1997, a revival of the Malaysian proposal was put forward, calling for better integration of the economies of ASEAN and avoid a future recurrence of Asian Financial Crisis. The ASEAN Free Trade Area (AFTA), which was established on 28 January 1992, includes a Common Effective Preferential Tariff (CEPT) to promote the free flow of goods between member states. The full import of AFTA will be reflected in post 2000 data. Also, ASEAN has been moving towards the creation of a single market and production base and a competitive economic region. Since 2007, ASEAN countries have gradually lowered their import duties to member nations. The target is zero import duties by 2016. The Jakarta Charter, 2008 aims at moving closer to "an EU-style

community". The charter turned ASEAN into a legal entity and aimed to create a single free- trade area.

Thus, the ASEAN and EU nations have witnessed major economic developments post 2000, making 2000-2014 an interesting period to attempt a comparative analysis.

[iii] Agriculture's share in GDP has been substantially low as compared to the shares of industry and services in GDP for EU and it further declined from 3.9 per cent in 2000 to 2.5 per cent in 2014. Also, industry's share declined over the period 2000-2014 from 29.03 per cent to 25.3 per cent. The services sector, which has been the largest share in GDP, saw an increase of around 5.5 percentage points in its share. Bulgaria saw the largest fall in the share of agriculture in GDP and Malta saw the largest fall in the share of industry in GDP followed by Finland, Ireland and Czech Republic. The growth of the share of services has been largest in Malta, Finland and Ireland, followed by Cyprus and Spain.

[iv] Agriculture's share in GDP for ASEAN has declined sharply by 6.7 percentage points from 20.9 per cent in 2000 to 14.2 per cent in 2014. Strikingly, industry's share increased by 2.3 percentage points in 2000-2014. The services sector, on the other hand, saw a significant increase of 4.2 percentage points in its share in this period. The fall in agriculture share has been largest in Myanmar (from 57.2 per cent in 2000 to 27.8 per cent in 2014) and Lao PDR (from 44 per cent in 2000 to 19.7 per cent in 2014), and smallest in Singapore and Brunei Darussalam, countries which already had the lowest share of agriculture of 1 per cent in GDP in ASEAN. The growth of the share of industry has again been largest in Myanmar and Lao PDR, followed by Brunei Darussalam and Cambodia, whereas Indonesia, Malaysia and Philippines saw a decline in share of industry. In 2014, Brunei Darussalam and Indonesia had substantially larger GDP shares of industry than the other countries, followed by Malaysia and Thailand. The growth of the share of services has been largest in Lao PDR and Malaysia, followed by Singapore.

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