Per capita income convergence across countries and across regions in the European Union. Some new evidence.

Alfredo Marques and Elias Soukiazis*

1. Introduction

There is a great interest in the EU for measuring disparities between countries and between regions. The preoccupation for sustainable regional growth, especially for the less developed economies is manifested earlier during the effort for the completion of the single market and more recently during the process which will establish the economic and monetary union. In the economic literature devoted to the integration theory, there are two distinct positions relative to the process of regional growth and the catching up hypothesis. The first, is the thesis of regional divergence, which argues that a higher integration towards a single currency is expected to increase factor mobility which can be in favour of the prosperous regions. Concentration of economic activity to these attractive centres which dispose more developed markets and higher level of industrialisation can create additional difficulties to the less developed regions and delay their catching up process. The second, is the thesis of regional convergence arguing that a higher integration will attenuate the initial regional disparities and in the long run the tendency is regional convergence rather than divergence. According to the convergence argument the fact that the USA shows lower regional disparities than the European Union is the result of a deeper economic integration, including monetary integration and a common currency. Consequently, there are additional reasons for a faster integration in the EU through the establishment of the monetary union.

Therefore, it is important to measure the real convergence between regions within the EU, in terms of per capita income especially for the late period where all member countries make a strong effort to satisfy the macroeconomic criteria for the achievement of the nominal convergence. This analysis will help us to derive some conclusions for the Agenda 2000 which is presently under discussion and prepares the future of the regional policy . To do such a measurement a neo-classical approach to convergence is

used here based on the simple idea that convergence implies that poor regions grow faster than rich regions in terms of their per capita income. Accordingly, a strong negative relationship between the growth of per capita income and the initial level of income is expected to be found, in a cross-section analysis of different economies.

In this study, the hypothesis of convergence is tested empirically for countries and for regions in the EU, using the most recent data available on the per capita income in purchasing power parity terms. The structure of the study is the following: Section 2, makes an overview of the neo-classical framework of real convergence and some recent empirical results are discussed. In section 3, the hypothesis of convergence is tested for 12 countries of the EU, over the whole period 1975-1995 and the sub-periods 1975-1984 and 1985-1995. In section 4, the model of convergence is estimated for 175 regions at the NUTS 2 level, over the short period, 1987-1995. The whole sample is divided in three sub-sets, regions with per capita income less than 75% of the EU average, regions with per capita income less than the EU average and higher than the EU average, respectively, and their convergence behaviour is explained. Section 5 concludes with the main findings.

2. An overview of the convergence theory.

Two main approaches are used to quantify the extent to which the growth process is leading to convergence or divergence in regional performance over time. The traditional approach which is referred as to "sigma" convergence and the neo-classical approach known as the "beta" convergence. The "sigma" convergence measures the dispersion of real per capita income or product between regions based on the standard deviation of the cross-section series. When the standard deviation tends to fall over time, such a result indicates that the differences of the per capita income between regions in absolute terms decrease with the passage of time, which is an evidence of convergence. On the other hand, divergence implies that the standard deviation of the series in terms of per capita income increases over time. In the case where the standard deviation does not show any clear tendency, but instead, increases or decreases alternatively, we can say that a mixed process of converge and divergence is taking place. An alternative way of measuring the "sigma " convergence is to use the coefficient of variation which is obtained by dividing the standard deviation of the series by the mean of the sample. Similarly, a decreasing

value of the coefficient of variation over time reflects regional convergence, an increasing value reflects divergence, and a no stable tendency is taken as evidence of both, convergence and divergence during the period in consideration.

The "beta" convergence of the neo-classical approach is obtained by a regression analysis estimating the growth of per capita income of a certain period of time on the initial level of per capita income. The regression coefficient "beta" with a negative sign indicates that regions with a lower initial level of per capita income grow more rapidly than regions with a higher initial level of per capita income. The general aspect of the estimated equation has the following non linear specification[1]:

$$1/T \log(Y_{it}/Y_{i0}) = \alpha - 1/T(1-e^{-\beta T}) \log Y_{i0} + \gamma X_{it} + u_{it} \qquad (1)$$

where Y_{it} is real per capita income of region i at time t, Y_{io} is the initial per capita income of region i, X_{it} is a set of structural exogenous variables which can influence the growth of per capita income, T is the time length in which the growth of per capita income is measured, u_{it} is the stochastic error of the equation, α is the constant term which according to the neo-classics is influenced by the rate of technological progress and the steady-state growth rate of per capita income[2], and β is the convergence coefficient which is obtained by a non linear estimation. The coefficient β in this specification has a positive sign and reflects the annual rate of convergence or speed of convergence.

The neo-classical theory distinguishes two types of convergence, unconditional and conditional convergence[3]. When it is assumed that all regions (countries) converge to the same terminal point (the steady state point) the convergence is said to be unconditional. In this case, β is obtained without considering in the estimation the set of the structural variables X_{it}, since it is assumed that the economies do not differ significantly in their levels of technology, investment ratio, industrial structure, human capital qualification and other structural factors. In this context, it is more likely to find unconditional convergence when the model is tested for regions of the same country which are more homogeneous, since they share the same legal system, similar

---

[1] For this specification see the original article of Barro R. and Sala-i-Martin Xavier(1992)

[2] Barro and Sala-i-Martin(1992) assume that α is the same for all regions when the steady-state value and the rate of technological progress do not differ significantly across regions.

[3] For this argument see Sala-i-Martin Xavier(1994)

technology, similar educational level, etc. On the contrary, when the economies have different structures, it is assumed that they converge to a different steady state point. In this case convergence is said to be conditional and β is obtained by considering in the estimation the set of the conditioning structural factors (X_{it} in equation (1)) which are supposed to influence the growth of the per capita income.

In the neo-classical model, diminishing returns to capital is the explanation why poor regions (countries) grow faster relatively to the rich regions in terms of their per capita income showing "beta" convergence. Diminishing returns of capital implies that the rate of return is negatively related to the stock of capital per head so that, other things being equal, countries with low amount of capital per head are predicted to grow faster.

Equation (1) has been estimated in different ways and with different purposes. Barro and Sala – i –Martin (1992) have estimated the model to study convergence in per capita personal income across 48 states of the USA during a very long period, 1880-1988, and found evidence of "beta" convergence which runs at a rate of 2% per year. Similar estimates for the "beta" coefficient have been found when a different set of data are used referring to the per capita gross state product of the 48 states over the period 1963- 1986. However, the rate of convergence is not stable over time and is shown to be sensitive to the chosen periodicity.

Dewhurst J. H. and Mutis-Gaitan (1995) used the same approach to test the convergence of GDP per capita among 63 regions of the EU (at NUTS1 level), over the period 1981-1991. Estimating the above equation (1) (in a more simplified form) they found a conditional convergence across regions in the EU for the whole period at a slow rate of less than 1% per annum. The conditional variables they used include regional population, working-age population, participation rate, regional unemployment rate and the share of employment in agriculture and services. The regions were converging at varying speed heavily dependent on national economic performance.

Armstrong (1995) has tested the convergence hypothesis of GDP per capita across 85 regions (at NUTS 1 level) within the European Union over the period 1950-1992. He finds a slow regional convergence process for the whole period (at about 1% per year) and evidence of a falling convergence rate in the 1970s and 1980s. He finds no evidence to support the existence of separate convergence clubs (between north-south or core-peripheral regions) within the EU.

There are many other studies testing the hypothesis of "beta" convergence across regions in the EU. A common finding of these studies is that there is a significant negative relation between the growth of per capita income and the starting level of per capita income which confirms the neo-classical hypothesis of convergence. However, all studies agree that the process of convergence is very slow or dramatically slow in the EU. A speed of 2% (or less than that) of convergence per year found in most studies since 1950 implies that it will take 50 or more years to eliminate the asymmetries between the regions of the EU, a fact which calls for a more active regional policy in order to accelerate the catching up process of growth between regions.

Meanwhile, with regard to "sigma" convergence the European Commission itself has provided evidence which show the following performance: from the beginning of the 1960s to the middle of the 1970s the per capita income disparities across countries in the EU(12) reduced significantly. Since then and up to the middle of the 1980s the tendency has been reversed and a process of divergence took place (CEC,1987). In the second half of the1980s the disparities decreased again but at a slower rate. Finally, this less intensive convergence disappeared in the first half of the 1990s, period in which the disparities across countries remained constant. At the same time, if we consider the disparities across regions (at NUTS2 level) the evidence show that the tendency towards convergence is even lower, especially in the 1980s and 1990s (CEC,1996).

Concerning the "beta" and "sigma" convergence an interesting question is to know which of the two concepts is preferable. According to Sala-i-Martin (1994), both concepts are useful since they measure convergence or divergence in a different manner and they give different information. However, he suggests that "beta" convergence is a more interesting concept since it responds to questions, such as, whether poor economies (countries or regions) are predicted to grow faster than rich ones, how fast the convergence process is, whether the convergence process is conditional or unconditional and whether there is a different convergence process between groups of economies with different structures. All these questions can be answered independently of whether the "sigma" convergence predicts that the aggregate cross-sectional variance is falling or rising over time. The same author underlines (Sala-i-Martin,1996) that the relation between the two concepts is accurate only to a certain extent which means that "beta" convergence is a necessary but not a sufficient condition for "sigma"

convergence. Therefore, in our view the two concepts seem to be complementary and do not replace each other.

3. **Country convergence of per capita income. New evidence for the EU.**

In this study we explore some recent data provided by Eurostat (REGIO data base 1998)[4] referring to the per capita income in Purchasing Power Parity terms. The data cover all regions of the EU which belong to the NUTS 2 Level, including also the individual countries. It was possible to construct a sample of only 12 countries of the EU over the period 1975-1995, since data for the three new member states are not available for the whole period[5]. As a first attempt, "sigma" convergence has been calculated based on the coefficient of variation and the results are exposed in Table 1. There is evidence of "sigma" convergence in two distinct periods: the period 1975-1982 with a higher fall in the dispersion of per capita income and the period 1986-1991 with a lower fall in the disparities of the per capita income across countries. On the other hand, one can say that there is a divergence in the per capita income for the years 1983-85 and a new divergence since 1991. For the whole period 1975-1995 the figures show a moderate divergence which means that the dispersion of the per capita income across countries in absolute terms increased. Figure 1, gives a clearer view of the tendency of the "sigma" convergence and divergence, where the coefficient of variation (CV) of the cross- country income per capita is plotted over the whole period.

A more formal approach to detect the convergence or divergence process over time is to plot annualised growth rates against initial levels of per capita income. This has been done for the whole period 1975-1995 (Figure 2) and separately for the periods 1975-1984 and 1985-1995 (Figures 3 and 4). In each case the vertical axis measures the log of the (annualised) growth rate $(1/T)\log(Y_{it}/Y_{i0})$, (where Y_{it} and Y_{i0} are the per capita income in PPP terms of the individual country i in the last year and the initial year respectively, and T is the length of the period considered) and the horizontal axis

---

[4] The authors are grateful to Patrick de Ridder for his collaboration in providing the data base.
[5] The data for Ireland have been taken from CEC, *European Economy*, nb.59, 1995

measures the log of the base-year income per capita of the respective countries. The most obvious feature of the three Figures is the negative relationship between annual growth rates and initial levels of per capita income, which confirms the idea of cross-country convergence of the neo-classical type suggesting that poor countries grow faster in their per capita income than wealthy countries. The negative relation is stronger for the second period 1985-1995 suggesting a faster cross-country convergence in the per capita income in this period relatively to the first period 1975-1984. A linear regression analysis, estimating the annualised growth of per capita income on the initial level of income gives a negative "beta" coefficient showing an annual convergence rate of 1.33% for the whole period, 1.68% for the first sub-period and 1.76% for the second sub-period.

Similar evidence is obtained through a non linear regression analysis. Equation (1) has been estimated in a modified form where the growth of per capita income is related to its initial level in a no linear form of the type[6]:

$$\log(Y_{it}/Y_{i0}) = \alpha + (1\text{-}\exp^{-\beta T})\log Y_{i0} + u_{it} \qquad (2)$$

In this equation, Y is the per capita income (in purchasing power parity terms), i is the individual country (12 countries of the EU), 0 is the base year, t is the final year, T is the length of the time where the growth of per capita income is calculated, α is the constant term (autonomous growth) and β measures the rate of convergence or the annual speed of convergence. Equation (2) is estimated by a non linear least squares method, for three different periods: (i) the whole period 1975-1995, (ii) the first sub-period 1975-1984, and (iii) the second sub-period 1985-1995. The estimated results are presented below with a summary of the most important statistics (t-ratio in brackets):

Period 1975-1995

$$\log(Y_{1995}/Y_{1975}) = 4.01 - 0.01175 \, \log Y_{1975} \qquad R^2=0.348$$
$$\qquad\qquad (4.15) \quad (\text{-}2.61) \qquad\qquad DW=2.2$$

Period 1975-1984

$$\log(Y_{1984}/Y_{1975}) = 2.469 - 0.01558 \, \log Y_{1975} \qquad R^2=0.234$$
$$\qquad\qquad (3.21) \quad (\text{-}1.89) \qquad\qquad DW=1.96$$

---

[6] For this specification see Dewhurst and Gaitan(1995)

Period 1985-1995

$$\log(Y_{1995}/Y_{1985}) = 2.348 - 0.01609\ \log Y_{1985} \qquad R^2=0.221$$
$$\qquad\qquad\quad (2.23)\quad (-1.84) \qquad\qquad DW=1.96$$

The regression results confirm the convergence hypothesis in all cases with "beta" coefficient being negative and statistically significant (at 10% significance level). For the whole period, countries converge at a speed of 1.18 percent per year. In the first sub-period, the rate of convergence is 1.55 percent per year while in the second sub-period the convergence is a bit higher, 1.61%. Generally, the estimation results are satisfactory and no serial correlation has been found in all cases. Finally, the results are partially consistent with the "sigma" convergence where we found a fall in the dispersion of per capita income in both sub-periods 1975-1984 and 1985-1995. However, the "sigma" divergence for the whole period is not consistent with the "beta" convergence indicating that the rate of "beta" convergence was not sufficient to ensure a close approximation in the absolute levels of the per capita income("sigma" convergence)[7].

4. Convergence of per capita income across regions. New evidence for the EU.

The same source of statistics is used, referring to the per capita income in PPP terms of the NUTS 2 level, to test the convergence hypothesis across regions in the EU. The available data allow us to construct a sample of 175 regions over the short period 1987-1995. Table 2 and Figure 5, expose the results of "sigma" convergence using the coefficient of variation for such a measurement. It can be seen that between the starting (1987) and the final year (1995) there is little regional convergence since the coefficient of variation falls from 0.26205 to only 0.26042. However, during the whole period the movement of "sigma" convergence is not regular and it shows especially for the most recent years a tendency for divergence which is in accord with the "sigma" divergence we found across countries.

---

[7] It is important to note that "beta" convergence, even at a minimum rate, is always sufficient to ensure approximation in the levels of per capita income in relative terms

Figure 6, where the annualised growth of per capita income is plotted against the starting level of income of the respective regions shows evidence of "beta" convergence. The negative relation is confirmed which suggests that poor regions grow faster in terms of their per capita income than rich regions, over the period 1987-1995. A more formal way to find evidence of "beta" convergence is to estimate equation (2) using now regional data. The estimation of this equation by a non linear least squares method gave the following results:

$$\log(Y_{1995}/Y_{1987}) = 1.653 - 0.0139 \log Y_{1987} \qquad R^2 = 0.155$$
$$\qquad\qquad (7.49) \quad (-6.00) \qquad\qquad DW=1.04$$

The regression results suggest a "beta" regional convergence at an annual rate of 1.39 percent, during the period 1987-1995. Although the statistical significance of the estimators is high, the degree of explanation is low and there is evidence of positive serial correlation. The low explanatory power of the estimation suggests that additional structural variables can influence the growth performance of regions, such as the degree of industrialisation, the employment rate, the educational level, technical progress, etc. The purpose of this study is not to consider such factors, so we restrict our empirical analysis to the notion of unconditional convergence. The serial correlation problem is taken as evidence of spatial autocorrelation indicating that it is possible that regions of the same country to behave in a similar way in the growth process, which raises the problem of the existence of club convergence[8].

An interesting issue to consider is to see whether the poorest regions behave differently from the set of the whole regions or from other particular group of regions in the process of growth. For this reason, we divided the whole sample in three sets: the first set includes regions whose per capita income is less than 75% of the EU average (37 regions), the second set contains regions whose per capita income does not over-come the EU average (113 regions) and the third set involves regions with per capita income higher than the EU average (63 regions). The estimated results of the non linear convergence equation (2) are the following:

---

[8] It is supposed that regions of the same country follow the growth process of the nation they belong. In this sense there is a different steady-state growth process between countries. For this issue see Armstrong (1995).

1st set : 37 Regions with per capita income less than 75% of the EU average

$$\log(Y_{1995}/Y_{1987}) = 4.07 - 0.0378 \log Y_{1987} \qquad R^2 = 0.343$$
$$\qquad\qquad (4.85) \quad (-5.05) \qquad\qquad DW = 1.15$$

2nd set: 113 regions with per capita income less than the EU average

$$\log(Y_{1995}/Y_{1987}) = 2.71 - 0.0248 \log Y_{1987} \qquad R^2 = 0.304$$
$$\qquad\qquad (8.26) \quad (-7.77) \qquad\qquad DW = 1.21$$

3rd set: 63 regions with per capita income higher than the EU average

$$\log(Y_{1995}/Y_{1987}) = -0.73 + 0.0138 \log Y_{1987} \qquad R^2 = 0.0365$$
$$\qquad\qquad (-0.99) \quad (1.43) \qquad\qquad DW = 1.26$$

The first observation to make is that the set of the 37 poorest regions show a faster steady- state growth (4.07%) than the set of the regions with per capita income less than the EU average (2.71%) and even faster than the set of the regions with per capita income above the average (which is negative but not statistically significant) and also faster than the whole group (1.65%). We also can see through the "beta" coefficient obtained from the non linear estimation, that the convergence rate is stronger across the 37 poorest regions (3.8%) than the convergence rate across the 113 regions with per capita income below the average (2.5%) and even stronger than the performance of the 63 rich regions showing divergence, which however is not statistically significant. Therefore we can argue that the forces of convergence are stronger in lower levels of per capita income, are less intensive in intermediate levels and even weaker in higher levels of income. Figures 10,11 and 12 show the same performance as "beta" convergence where the annualised growth of per capita income is found to be negatively related to the initial level of income in the case of the 1st and 2nd set of regions but not such a negative correlation can be found in the case of the rich regions.

The same conclusions are obtained if one considers the "sigma" convergence. Looking at Table 3 and Figure 7 referring to the 37 poorest regions we can see that there is a sharp fall in the coefficient of variation which is greater than the fall of the same parameter shown in Table 4 and Figure 8 which illustrate the performance of regions with per capita income below the average. On the other hand, in Table 5 and Figure 9 the coefficient of variation is rising, indicating a divergence among rich

regions. Therefore, in this empirical analysis of the three groups of regions we find that the two approaches of "beta" and "sigma" convergence are consistent to each other.

5. Concluding remarks

In this study we tested empirically two approaches for measuring convergence between countries and across regions, based on the notions of "sigma" and "beta" convergence. The results across countries show that there was a moderate "sigma" divergence in the period 1975-1995, reflecting an increase in dispersion of per capita income in absolute terms. If we look at different sub-periods we find convergence in the years 1975-1982 and 1986–1991 and divergence over the periods 1983-1985 and 1991-1995. With regard to the "beta" convergence the evidence is different, suggesting a convergence for the whole period which appears to be stronger in the years 1985-1995 and weaker in the period 1975-1984. This discrepancy in the results of the two approaches shows that the rate of "beta" convergence was not sufficient to ensure the approximation of the levels of per capita income in absolute terms.

The analysis of regions at NUTS 2 level gives some interesting results. With regard to the period 1987-1995, the evidence for "sigma" convergence show a decreasing dispersion of per capita income which however is not very significant. It is important to note that in the 1990s the tendency is towards divergence. For the same period, the evidence reveal a "beta" convergence suggesting that poor regions grow faster than rich regions. However the rate of convergence is low (1,39% per year) which is in accord with the weak performance of sigma convergence. The evidence is even more interesting if we look at separate sets of regions. The poorest regions with per capita income less than 75% of the EU average show a strong "beta" and "sigma" convergence, while the total of regions with per capita income below the average converge at a lower rate and in rich regions with per capita income above the average there is no convergence.

In general, the results both across countries and across regions suggest that in the long run convergence is not ensured. The uncertainties of this process are obvious in the 1990s which raises the problem of the efficiency of regional policies exercised by the individual member states and by the European Union. The fact that the convergence is stronger in the group of regions with per capita income less than 75% of the EU

average, means that the poorest regions are becoming more homogeneous in their standards of living than the total of regions. This indicates that it is easier to pass from the lowest level of poverty to an intermediate level (which corresponds in the EU to a per capita income of approximately 75% of the average) than to a level of income close to the average and even more difficult to reach the levels of income of the rich regions.

These results should be taken into account in the discussions about the means and orientations of the EU regional policy for the coming years which are taking place in the framework of the Agenda 2000. The financial support to the less developed regions (with per capita income below 75% of the average) should not be reduced, on the contrary more funds should be concentrated to these regions in order to facilitate their catching up effort. At the same time, a particular attention should be given to the difficulties involved in the transition process from the intermediate level of poverty (corresponding to a standard of living around 75% of the average) to higher levels of per capita income.

REFERENCES:

Armstrong, H., W., 1995, An appraisal of the evidence from cross-sectional analysis of the regional growth process within the European Union, in *Convergence and Divergence among European Regions*, Eds Armstrong H., and Vickerman, R. (Pion Limited), p.41-65.

Barro, Robert and Sala-I-Martin, Xavier, 1992, *Convergence,* Journal of Political Economy, vol. 100, nb.2, p.223-251.

CEC, 1995, *European Economy*, nb.59.

CEC, 1987, *Troisième rapport périodique sur la situation et l'évolution socio-économique des régions de la Communauté*, Brussels.

CEC, *First Report on Economic and Social Cohesion*, Brussels, 1996.

Chatterji, Monojit, 1992, *Convergence clubs and endogenous growth*, Oxford Review of Economic Policy, vol.8, nb.4, p.57-69.

Dewhurst, J. and Mutis-Gaitan, 1995, Varying speeds of regional GDP per capita convergence in the European Union, 1981-91, in *Convergence and Divergence among European Regions*, Eds Amstrong, H. and Vickerman,R. (Pion Limited), p.23-39.

EUROSTAT, 1998, *Regio data base.*

Quah, Danny, 1993, *Empirical cross-section dynamics in economic growth*, European Economic Review, 37, p.426-434.

Quah, Danny, 1996, *Empirics for economic growth and convergence*, European Economic Review, 40, p.1353-1375.

Sala-i-Martin, Xavier, 1994, *Cross-sectional regressions and the empirics of economic growth*, European Economic Review, 38, p.739-747.

Sala-i-Martin, Xavier ,1996, *Regional cohesion: Evidence and theories of regional growth and convergence*,,European Economic Review, 40, p.1325-1352.

Table 1. "Sigma" convergence for 12 countries of the EU, over the period 1975-1995, in terms of per capita income(PPP).

Years	Coefficient of variation[9]	Years	Coefficient of variation
1975	0.26392	1986	0.27528
1976	0.25757	1987	0.26240
1977	0.24342	1988	0.26074
1978	0.24622	1989	0.26142
1979	0.24973	1990	0.26050
1980	0.24540	1991	0.25392
1981	0.23857	1992	0.25660
1982	0.23898	1993	0.26487
1983	0.24373	1994	0.26906
1984	0.24969	1995	0.26542
1985	0.26352		

Table 2. "Sigma" convergence for 175 regions of the EU (NUTS 2 level), over the period 1987-1995 in terms of per capita income.

Years	Coefficient of Variation
1987	0.26205
1988	0.25533
1989	0.25410
1990	0.25724
1991	0.25923
1992	0.26069
1993	0.25683
1994	0.25927
1995	0.26042

Table 3. "Sigma" convergence for 37 regions with per capita income less than 75% of the EU average, over the period 1987-1995.

Years	Coefficient of Variation
1987	0.17275
1988	0.15987
1989	0.16353
1990	0.15899
1991	0.15841
1992	0.15279
1993	0.14499
1994	0.14568
1995	0.14808

---

[9] The coefficient of variation is obtained by the ratio of the standard deviation to the mean of the sample.

Table 4. "Sigma" convergence for 113 regions with per capita income below the EU average, over the period 1987-1995.

Years	Coefficient of variation
1987	0.20038
1988	0.19319
1989	0.19247
1990	0.19017
1991	0.18461
1992	0.18559
1993	0.17759
1994	0.17860
1995	0.17875

Table 5. "Sigma" convergence for 63 regions with per capita income above the EU average, over the period 1987-1995.

Years	Coefficient of variation
1987	0.14779
1988	0.14650
1989	0.14893
1990	0.15776
1991	0.17623
1992	0.18293
1993	0.18882
1994	0.18918
1995	0.18575

Figure 1. Sigma convergence across countries
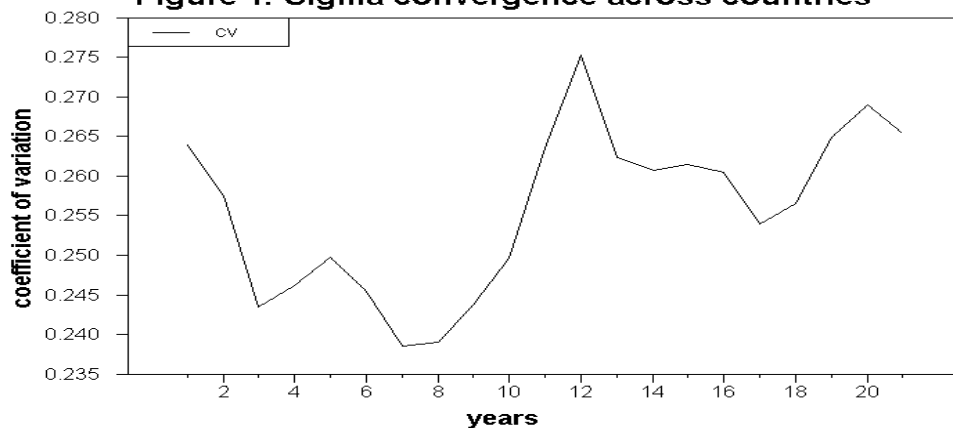
Figure 2. Country convergence,1975-1995
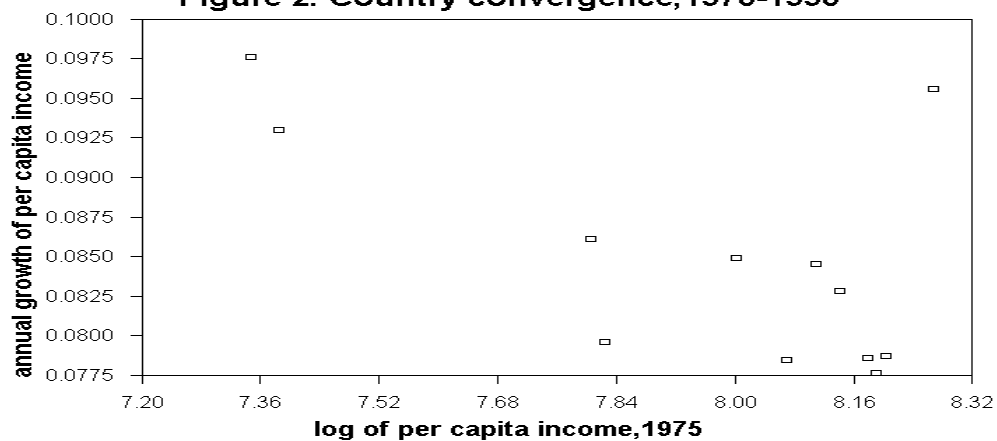
Figure 3. Country convergence,1975-1984
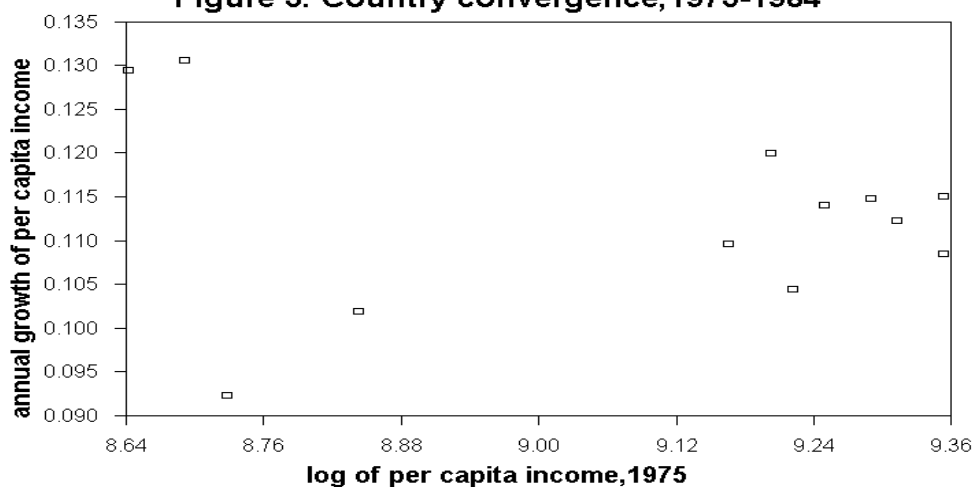
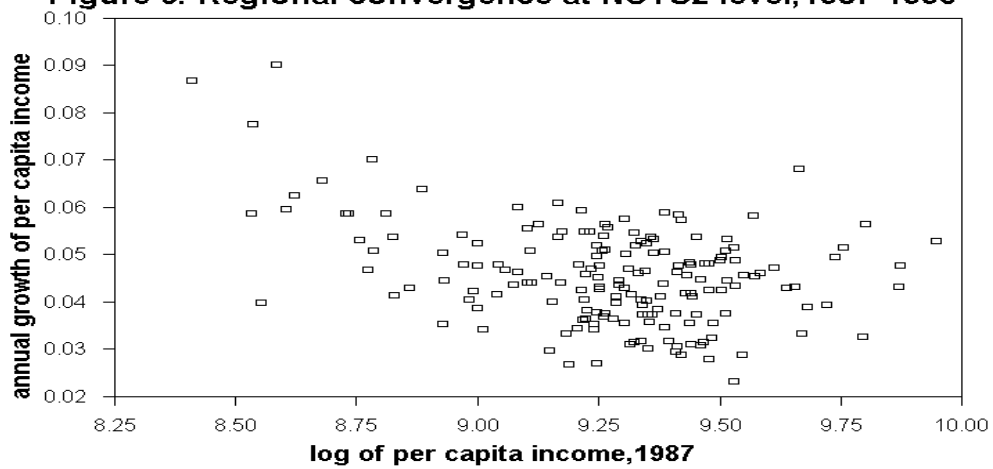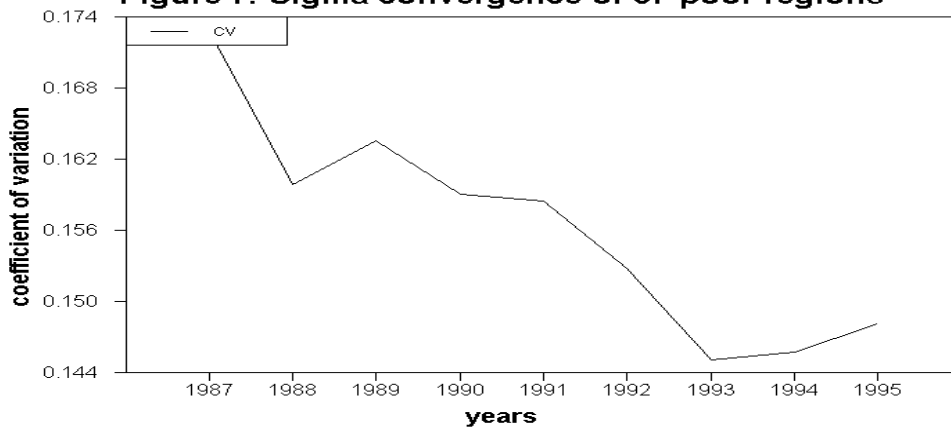**Figure 4. Country convergence,1985-1995**
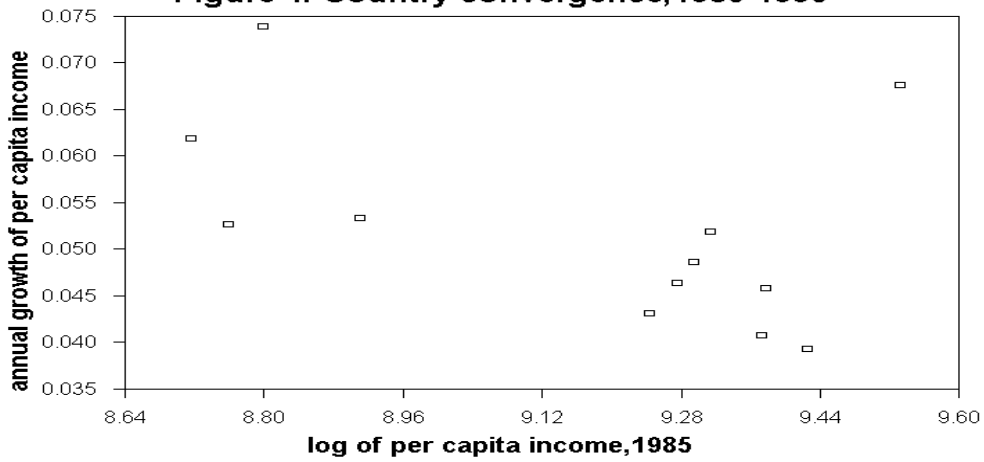
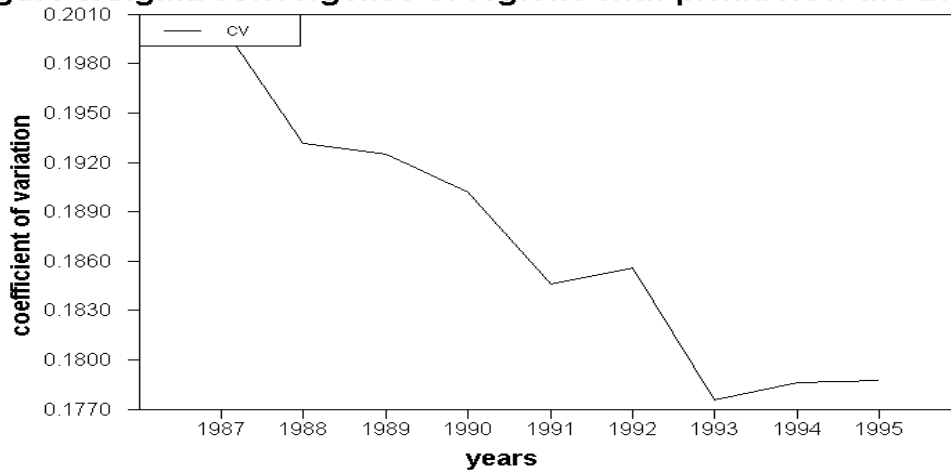**Figure 5. Sigma convergence across 175 regions in the EU**
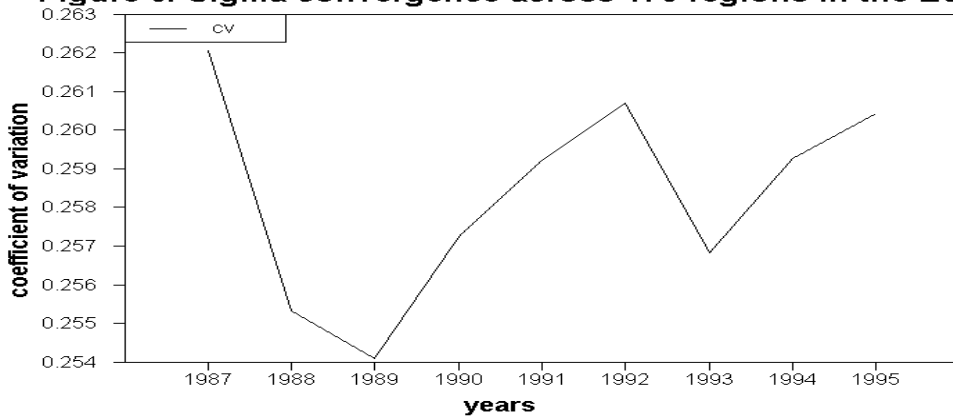
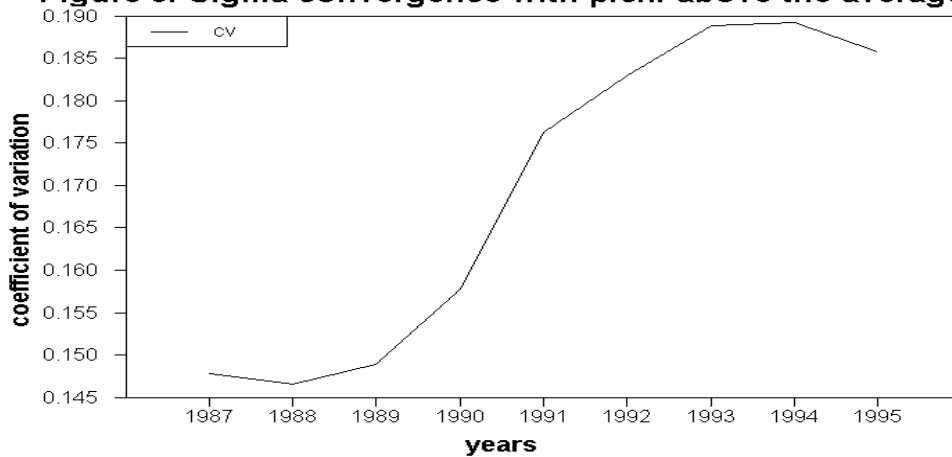**Figure 6. Regional convergence at NUTS2 level,1987-1995**
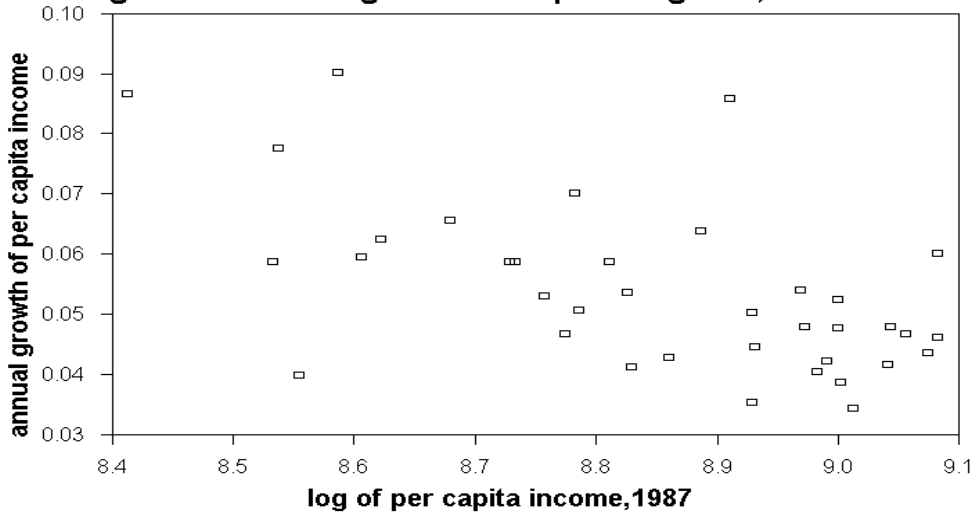
Figure 7. Sigma convergence of 37 poor regions

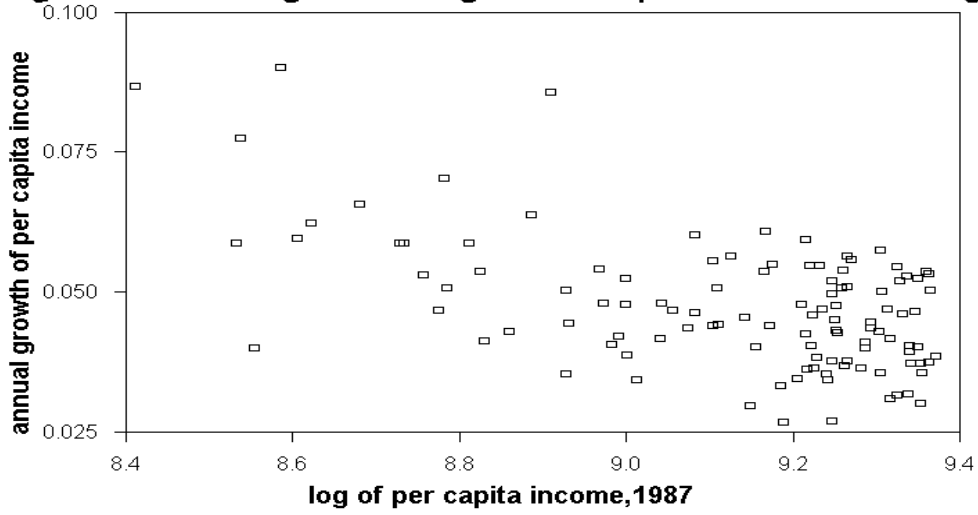**Figure 8.Sigma convergence of regions with p.c.i.below the average**

Figure 9. Sigma convergence with p.c.i. above the average

18

Figure 10. Convergence of 37 poor regions,1987-1995

Figure 11. Convergence of regions with p.c.i. below the average

Figure 12.Convergence of regions with p.c.i.above the average