E C O N O M I C S B U L L E T I N

Regional Convergence in the European Union: Results from a Panel Data Model

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Abstract

This paper evaluates the convergence process for different samples of European Union regions during the period 1982-1999 by using fixed effects panel data regressions. This estimation method allows us to control for unobserved time-invariant heterogeneity in cross-sectional models. The results of growth rates are significantly negatively related to income levels and show that the convergence relationship holds. However when regions are bound to very different steady state positions, convergence to a common income level appears to be impossible.

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1. Introduction

Only recently, have panel data estimation techniques (see Hsiao 1986, Baltagi 1995) become influential in growth estimation. The main reasoning behind the use of this estimation technique is the desire to exploit panel data in order to control for unobserved time-invariant heterogeneity in cross-sectional models. This methodology is loosely linked to one strand of cross-section data literature known as *fixed effects models*. The assumption that economic-specific, time-invariant fixed effects exist, and which are responsible for individual steady state income positions, was adopted in several growth analyses (Björkstén, 2000, Canova and Marcet 1995, Fingleton et al. 1996, Giannetti, 2002, Islam, 1995, Philippe 1999, Tondl, 1999).

Differences in regional steady state incomes obviously have become increasingly important since the 1980s. These differences no longer appear to be linked to the characteristics of the country where the region is located. The cross-section regression analysis however does not allow us to estimate individual regional effects in conditional convergence to their full extent[1]. We thus aimed to employ an alternative framework for the estimation, one which was able to provide a direct estimate for individual regional factors, reflecting region-specific steady state differences. We estimated convergence again for the period 1982-1999, but this time exploiting the whole time series information for each region. Within the framework of the panel data, the individual regional effects that condition the regions specific steady state income can be estimated. The results show that the regions´ steady state incomes did indeed, drift apart. When regions are bound to very different steady state positions, convergence to a common income level appears to be impossible.

The rest of the paper is structured as follows. Section 2 describes the methodological approach used in our paper to analyse the convergence process among European Union regions. Section 3 describes the dataset we will use for our analysis. Section 4 contains the results of our convergence analyses. Finally, section 5 gives the conclusions.

2. Panel data estimation of convergence

Region-specific effects can be modelled by employing panel data estimation techniques. As a panel data estimation technique uses observations for several points in time, it builds on a richer information set[2].

The general econometric specification of a panel data model is the following one:

$$\frac{1}{T} * \log\left[y_{i,t+T} \Big/ y_{i,t} \right] = a_i - \frac{1}{T}(1 - e^{-\beta * t}) * \log\left[y_{i,t} \right] + \psi_{t,t+T} + u_{it,t+T} \qquad (1)$$

[1]Examples of cross-section studies of convergence among others are those of Barro and Sala-i-Martin 1991, Neven and Gouyette 1994, 1995, Button and Pentecost 1995, Fagerberg and Verspagen 1996.

[2] Islam (1995) and Canova and Marcet (1995) show that cross-section analysis lead to a systematic downward bias of the convergence coefficient due this technique neglects unobservable factors and hence suffers an omitted variable bias.

However in order to use OLS in the estimation, the coefficient $\frac{1}{T}(1-e^{-\beta * t})$ is changed by a general coefficient b and the equation can be rewritten in the following way.

$$1/T * \log\left[y_{i,t+T} / y_{i,t} \right] = a_i - b * \log[y_{i,t}] + \psi_{t,t+T} + u_{it,t+T} \qquad (2)$$

where the expression for the error is made up of a_i, an unobserved individual effect which is constant over time, a time-specific factor $\psi_{t,t+T}$ which equally effects all individuals, and a random error $u_{it,t+T}$.

The average growth rate between t and $t+T$ should be negatively related to the initial logarithm of the per capita income level $\log(y_{i,t})$. This relationship is represented by the common coefficient b. The region-specific fixed effect present over the whole sample period, is captured by the term a_i. The term $\psi_{t,t+T}$ represents the time-specific effect affecting all individuals in period $t, t+T$. This specification of the model means that we estimate convergence by using a two-way fixed effects model (see Hsiao 1986 and Baltagi 1995).

The speed of convergence β can be obtained from the following relationship between the coefficients of $\log(y_{i,t})$ in Eq. (1) and (2):

$$\beta = -\frac{1}{T}\ln(1-Tb) \qquad (3)$$

The region-specific fixed effect a_i determines the region´s steady state income. This fixed effect is a concept which is similar to using explanatory variables or country dummy variables in the conditional convergence analysis. The difference between this method and the conditional convergence analysis is that panel data estimation allows for continuous individual conditional effects while the former assumes to identify groups of individual units. With the time-specific effect ψ_t global shocks are captured.

3. The Data Set

We analyse regional convergence in Western Europe by using two different series of data. These data sets are used separately in order to avoid biases stemming from differences in the accounting systems employed in each of them (ESA79 and ESA95)[3].

[3] The main differences between ESA95 and ESA79 are the following: the inclusion of balance sheets; the introduction of a subsectoring of households; the introduction of a new concept of final consumption: actual final consumption; the introduction of the concepts of economically active population and unemployment; and the clear choice in favour of valuing output at basic prices.

Some studies (e.g Barro and Sala-i-Martín 1991,1995; Leonardi 1995) sometimes mix data from different data sets, which leads to a problem of data inconsistency.
For the investigation of the regional convergence in the period 1982-1997 we use data provided by the statistical office of the European Commission (EUROSTAT- REGIO) data base, which gives gross domestic product per capita (GDP p.c.) in different units (ECUS, EURO and PPS) and at different levels of desegregation[4] (NUTS I, NUTS II, NUTS III) for the fifteen European Union member states. This data set is based on the European System of Accounts ESA79. In reference to the availability of data for the NUTS II regions, commonly used in the studies of European regional convergence, there is no information for East Germany until 1991 and for some regions such as Chemnitz, Dresden and Leipzig until 1993. In the case of non-mainland France (Guadeloupe, Martinique, Guiana and Reunion) the data provides observations for a single point in time: 1994. In the case of the Netherlands the data does not provide observations at NUTS II level for Overijssel, Gelderland and Flevoland. In the case of Austria, Finland and the Portuguese islands the data provides observations for 1987 onwards. There are data for observations for Sweden from 1985. Finally, in the case of the United Kingdom, data became available in 1981. As it stated above there are some missing values, so some changes were necessary in order to have a larger time-series sample for the regions. In some cases we have to use the data available for a higher aggregate level as is the case of the data for United Kingdom.
For the convergence analysis for the period 1995-1999 we use data of all the NUTS II regions in the EU15, data which is also provided by the Eurostat-Regio database but in this case figures for the GDP are based on the new accounting system (ESA95).
The data sets are only used separately as they are based on different accounting systems. We checked the comparison of the GDP figures based on ESA79 and ESA95 in the time periods where the dataset overlap (1995, 1996, 1997) and for several regions the changes were very important. In some cases we found values of the GDP based on ESA95 that were 14.84% lower than the same values based on ESA79 as was the case of Luxembourg for the year 1995. In other cases the GDP values based on ESA95 were over 30% higher than these values computed under ESA 79 for Sterea Ellada, the region of Brussels, for example. This prevents us from forming an aggregate data set in order to create a larger time series for the regions.
In our analysis we use the GDP data standardized by purchasing power parities at constant 1985 prices (The use of PPPs, common in international comparison has the effect that poorer countries´ per capita incomes becomes higher than with current exchange rates).
In order to find an appropriate division of the 1980-1997 period covered by the Eurostat regio database based on ESA79 for the convergence analysis, the time series of growth

[4]Nomenclature of Statistical Territorial Units is a geographical division of the European Union´s Territory that subdivides each Member State into a whole number of regions at NUTS 1 level. Each of these is then subdivided into regions at NUTS 2 level and these in turn into regions at NUTS 3 level. For instance the whole European Union is divided into 78 NUTS 1 regions, 206 NUTS 2 regions and 1093 NUTS 3 regions.

rates were examined for turning points. It turned out that the selection of the periods 1982-1988, 1989-1992 and 1994-1997 would best satisfy the criteria to cover a similar cyclical path across regions in a subperiod. As regional growth rates slipped globally back in 1993 and during the following period due to a deceleration in the business cycle, the second subperiod only goes up to 1992. Moreover this division is compatible with the analysis of the impact that the new European Union regional policy has on the speed of convergence and the catch up process of the objective 1 regions to the average levels of European Union. The first two programming periods of the structural funds after their reform, takes in the years 1989-1994 for the first Delors package and 1995-1999 for the second Delors package. Due to the goals that the structural funds and the regional policy pursue in the objective 1 regions the results of our convergence regressions should be related to this structural policy.

4. Estimation results for the period 1982-1999

When a panel data regression of convergence is performed the concept of convergence is somewhat different to the classical approach of convergence in cross-section regressions in the sense that it is now regarded as convergence towards the region´s own steady state income. Consequently, as a region is closer to its own steady state than to the average steady state of a total group, the convergence coefficient is higher than in the cross-section analysis.

The results we obtain for this alternative estimation are shown in table 1. Overall, growth rates are significantly negatively related to income levels and show that the convergence relationship holds. We only report minimum and maximum values of the region-specific fixed effects, as 206 fixed effects would have to be listed.

The estimated coefficient b for the whole period 1982-1997 is 0.17, which corresponds to a convergence rate β of 8.7 per cent per annum implying that regions would be halfway from their steady state income in 7.96 years (the half-period for the complete closure of the income gap is calculated from the formula, $H = \log(2)/\beta = 0.69\beta$. Other studies with similar specifications, reported a rise in β using panel data estimations. De la Fuente (1996) found a rate of convergence of 12.7 per cent for the Spanish regions for 1955-91 when using a fixed effects model. Canova and Marcet (1995) showed that the convergence coefficient increases to 23 per cent when each region converges to its own steady state.

From the basic results for 1982-1997 it is clear that steady state incomes must have changed during this period of time, since if this was not the case then zero growth would soon have been observed. For the period 1982-1986, the estimation shows a convergence rate β of 40.49 per cent. The convergence coefficient implies that, on average, regions would have reached half of their steady state in about 1.71 years in 1982-1986. The estimated coefficient for the period 1986-1992 (1992-1997) is somewhat lower, implying a convergence rate of 20.85 (17.08 per cent) per cent, and the fixed effects are now less disperse than in the previous period.

We also estimated our fixed effects panel data model for the period 1995-1999 using the figures based on the EUROSTAT (ESA95). The results show a convergence rate of about 11.11 per cent per annum.

Table 1: Panel Data Convergence Estimates (EU15, 1982-1999)

Estimated Equation

$$LnY_{i,t} - LnY_{i,t-1} = a_i - b * LnY_{i,t-1} + u_{i,t}$$

	Periods of Time				
Regressors	(1982-1997)	(1982-1986)	(1986-1992)	(1992-1997)	(1995-1999)
Coefficient	-0,17**	-0,79**	-0,41**	-0,27**	-0,14**
	(0,01)	(0,06)	(0,02)	(0,01)	(0,02)
Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects
Min a_i	1,49	6,68	3,54	2,32	1,25
Max a_i	1,82	7,95	4,17	2,80	1,51
Std. Deviation	0,047	0,243	0,11	0,06	0,04
Convergence Rate	8,7	40,49	20,85	17,08	11,11
Estimation	PLS	PLS	PLS	PLS	PLS
R2	0.15	0.40	0.30	0,43	0,31
Prob (F-statistic)	0.000	0.000	0.000	0.000	0.000
Number of cross-section used	206	139	191	206	211
Number of panel observations	2592	538	1193	1191	844
Number observations	160	160	160	160	160

** indicates coefficient significant at 0.01 level
PLS: Pooled Least Squares

5. Conclusions

In this paper we have studied the regional convergence of the regions in the European Union since 1982 using panel data regressions. The results show that the regions steady state incomes drifted apart. When regions are bound to very different steady state positions, convergence to a common income level is therefore impossible. The figures obtained for the convergence rates are higher than in the typical cross-section regressions, since the specifications of the model implies convergence to each region´s own particular steady state income.

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