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Regional Convergence in Finnish Provinces and Subregions, 1960-94.

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REGIONAL CONVERGENCE IN FINNISH PROVINCES AND SUBREGIONS, 1960-94.

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Abstract

This paper analyses convergence of regional products in Finland using two different data sets. Firstly, β - and σ -convergence was estimated for the 12 Finnish provinces during 1960-94. Convergence was found to be strong in 1960-80, but after 1980 regional disparities started growing again. Secondly, a similar study was made for the 88 small-scale subregions in 1988-94. In addition, the subregions' relative growth performance and cross-sectional convergence dynamics were evaluated using Markov chain transition matrices. No clear evidence for σ - or β -convergence was found here, but the dynamic analysis revealed a rapidly evolving regional distribution of productivity and also some potential for convergence. Thus the type of regional classification and method used can markedly affect the results obtained in a convergence study.

KEY WORDS: Regional convergence, Economic growth, Productivity, Gross regional product, Regional dynamics.

1. Introduction

The convergence of incomes and productivity has been one of the most debated economic issues in recent years. Studying convergence is interesting because of its theoretical and practical implications. Theoretically, convergence analysis can help to distinguish between alternative growth theories according to their predictions about economic growth. In practice, on the other hand, studying convergence can be of assistance in planning and evaluating (regional) policy measures, as we gain insight into how existing regional economic differences have developed. Thus convergence has been widely studied across countries and regions. Many studies have concentrated on the convergence of personal incomes, but, alternatively, the convergence of productivity provides equally important information. In Finland, results concerning convergence of regional products has not previously been published, and thus this study sheds new light on the development of Finnish regional structure. Moreover, it is interesting to compare convergence rates at different regional levels and see whether convergence is faster at one level of regions than another¹.

The aim of this study is to assess the extent to which Finnish provinces and subregions have converged in terms of their per capita gross regional products (GRP). We use two different data sets and a number of different methods. The longer data set consists of the GRPs of 12 Finnish provinces from 1960 to 1994. The second data set includes 88 small-scale subregions for which gross regional products have been collected from 1988 onwards. The latter data were produced only recently and provide a very interesting period for study, in the view of the fact that the economic slump of the 1990s was the deepest in the Finnish history since the Second World War. On the other hand, the boom in the late 1980s provides a good contrast with the recession years. Thus this paper presents new information about regional convergence on both the provincial and subregional levels.

The present study illustrates regional convergence from various aspects. Firstly, I estimate σ - and β -convergence from the provincial data, using the classical cross-section method of Barro and Sala-i-Martin (1991), and analyse other features of the relative growth patterns of the provinces. The main finding of this study is that regional growth and convergence behaviour changed dramatically around 1980. The first two decades (1960-80) show strong convergence and rapid productivity growth, whereas the years after 1980 are characterized by slower, divergent growth, and there is a clear end to the convergence period. This finding is in line with a number of regional convergence studies performed in other countries (see Hofer and Wörgötter, 1997, Neven and Goyette, 1995 and Persson,

1994). However, this result differs strikingly from earlier convergence studies in Finland (see Kangasharju 1997b) where the rate of convergence in the Finnish *subregions* was only found to diminish in the 1980s. Therefore we conclude that Finnish provinces and subregions show convergence properties which markedly differ from each other. The explanation for this could lie in the fact that the initial disparities between provinces are not as large as those between subregions, and thus there is less room for convergence in the first place.²

Secondly, this study uses alternative methods, introduced by Quah (1993b), for instance, to analyse convergence and distributional dynamics in the small-scale subregions³. It is interesting to compare the results of this method with the classical cross-section approach, as Quah is one of the main opponents of cross-section regressions (see Quah, 1993a). Moreover, this method takes into account situations where convergence occurs between some regions but not others, whereas such situations cannot be detected by cross-section regressions. Using the above methods in the analysis enables comparisons between this and other similar studies (for example Kangasharju, 1997 a and b). When used in analysing subregional products, the classical cross-section method points towards a stationary situation with no apparent convergence or divergence. However, when the alternative method was used we find that the situation is far from stagnated and that some convergence potential exists on the level of the subregions, too, but this potential cannot be revealed by standard convergence analysis. Thus I conclude that both the regional classification and the method used can affect the results obtained in a convergence study.

The second section of this paper briefly introduces the theoretical background and empirical methods used in the study. Section 3 investigates the convergence behaviour of the provinces and section 4 that of the subregions. Finally, section 5 provides some discussion and future considerations, and concludes the paper.

2. Theoretical and empirical background for convergence analysis

Generally, convergence is seen as an outcome of the neoclassical growth theory. According to the theory, for any set of economies, economic growth cannot continue indefinitely, but will eventually decline and growth rates of the economies in that set converge towards a certain *steady state*, as the production function implies diminishing returns to capital. If the set of economies were very similar in terms of their economic structures, they would converge towards the same steady-state, and this would lead to the diminishing of income disparities. In this case, convergence would be *absolute*. If, however, the economies are not identical, their steady states will differ, and the differences in income will not necessarily diminish even if (β -) convergence occurs. Thus we would have to analyse *conditional* convergence, where the steady state differences are proxied by a number of additional explanatory variables. (Barro and Sala-i-Martin 1991)

Despite recent criticism towards neoclassical growth theory and cross-section regressions it can be argued that they provide at least a good starting point for the analysis of regional disparities as they are straight-forward to use and enable comparisons between other similar studies, which still represent the majority of convergence empirics. Using such an approach is also well suited for the regional context, as differences in regional steady states are generally much smaller than those between countries, factors of production move relatively freely, technological diffusion operates more rapidly and regions of a small country (like Finland) are likely to be homogenous enough to justify even the assumption of unconditional convergence.

In a standard convergence analysis we study the existence of both σ -convergence (which refers to the narrowing of income disparities) and β -convergence (which tells whether the poor economies are growing faster than the rich ones). If we use conditioning variables, we will find out whether the poor economies approach their own steady states at a faster rate than the rich economies approach theirs. Such convergence analyses have been performed in, for example, Barro and Sala-i-Martin (1991) and a number of other studies. Firstly, for σ -convergence to occur across a given set of economies, we simply require that the standard deviation of per capita incomes diminishes over time. And secondly, the estimation of β -convergence is conducted using a non-linear least squares regression⁴, where we estimate the following empirical equation (1) derived from neo-classical theory (see for example Barro and Sala-i-Martin, 1995).

(1)
$$\left(\frac{1}{T}\right)\log\left(\frac{y_{i,t}}{y_{i,t-T}}\right) = a - \left[\log(y_{i,t-T})\right]\left(1 - e^{-\beta T}\right)\left(\frac{1}{T}\right) + other. \text{ var} iables$$

In the above equation, T is the length of the period under question and y denotes the per capita income of region i at the beginning (t-T) and end (t) of the period. The growth rate of an economy depends negatively on its initial income and declines as the difference between the steady state income level and the actual income level diminishes. We can also include a number of additional explanatory variables in the analysis, if we consider it necessary to allow for differences in regional steady states. We must remember, however, that several potentially important variables may suffer from the problem of endogeneity, if they are included in the above regression. Thus all the variables that are used in the analysis should be exogenous, meaning that they are not in any way determined by regional growth rates. Interestingly, studies using this classical cross-section method have obtained very similar results in many different countries. Table 1 displays some of the main results of such regional studies.

As indicated above, the present study also adopted an alternative approach to analyse the convergence behaviour of the subregions. This method was introduced by Quah (1993b) who believes that the traditional cross-section approach described above does not reveal the dynamic features of growth processes. The advantage of Quah's method is that it does not rely on regions to have identical steady states, but allows differences in regional structures. In order to find out how the distribution of incomes evolves across a set of economies Quah (1993b) forms a *Markov chain transition matrix*, which describes how the cross-section distribution transits from one state into another. Economies are divided into a number of income groups, between which mobility is observed. This matrix reveals how likely it is for economies in poor income groups to become rich, and, on the other hand, for rich economies to become poor. Convergence refers to the movement of probability mass of the distribution towards the middle income group. If, however, mobility is very low or it is directed towards the ends of the income range, the distribution is said to become twinpeaked.

The convergence of personal taxable incomes in the Finnish subregions has been analysed by Kangasharju (1997b), using the methods described above. He found that subregions were converging relatively rapidly in 1934-80, but that the rate of convergence slowed down considerably thereafter. It is interesting to compare my province-based findings with those of Kangasharju, and see whether

provinces and subregions in fact differ in terms of convergence. However, we must take into account that the present study analysed convergence using per capita gross regional product, meaning that the results are not fully comparable with Kangasharju's findings. Interestingly, Barro and Sala-i-Martin (1991) observed that the rate of regional convergence among the US states was virtually identical regardless of the data used (they used personal incomes and per capita gross state products). We may expect the same to be true in Finland, since GRPs and personal incomes are heavily correlated (Kangasharju, 1997b).

My data consisted of provincial and subregional per capita GRPs, which were collected from various publications of Statistics Finland.⁵ The GRPs of the provinces had to be deflated to make the yearly observations comparable. Thus the figures were converted into 1994 prices using a national cost-of-living -index. We must note that using such an index may induce a slight measurement error which tends to bias the β -coefficient upwards, as Barro and Sala-i-Martin (1995) warn. I was nonetheless obliged to use the national index, because no separate regional indices exist. Below, per capita GRP will be understood as a *logarithmic* transformation. The subregional data consisted similarily of gross regional products, which were normalized in order to separate the regional growth experience from the national economic growth common to all subregions. Normalization was done by dividing each subregion's GRP by the national average per capita GDP for each year.

3. Convergence in the Finnish provinces, 1960-94

The choice of data was motivated by the fact that I wanted to analyse convergence of regional products at both provincial and subregional level, and include all available data in the study. GRP data on the Finnish provinces were collected for the years 1960, 1970, 1973, 1976 and then every two years until 1994. There were, however, a number of problems involved in the use of this data. Firstly, the data suffered partly from a lack of homogeneity as far as changes took place in the way in which GRP was calculated from year to year. The biggest change occurred after 1970, when the prices used changed from factor to producer prices. However, in a convergence analysis the main focus is on the relative levels of GRP, as we wish to see if the initially poor regions have greater growth rates than the initially rich ones. Moreover, the data used in the present study are not susceptible to sample-selection bias, which is one of the main criticisms towards cross-section approach (see for example De Long, 1988) as all regions are included in the data set. Thus we could

rely on the data in the sense that the relative growth rates of the regions were largely comparable. Secondly, Åland proved to be a somewhat problematic region, as it differed from the ordinary provinces in many ways. Since it was a very exceptional region in the Finnish context, some trial convergence estimates were made excluding Åland from the set. When studying β -convergence, a dummy variable was included to control for Åland's special character, so that there was no need to exclude it from the data set. Furthermore, we must remember that 1994 was not the best possible end-year for the analysis, because it was the turning point of a severe economic recession, when many regions had begun to recover from the downswing but some had not. Bearing in mind the above difficulties imposed by the nature of the data, we can continue to follow the course of the empirical study.

The growth of regional products was fast until 1980. The annual logarithmic growth rates of the provinces ranged from 0,016 to 0,033. After 1980 growth slowed down markedly, with annual rates ranging between 0,002 and 0,006. In the beginning of the period (1960) the richest province was Uusimaa and the poorest was the province of Oulu. The GRP of the province of Oulu was 59 per cent of that of Uusimaa. In 1994, however, the richest region was Åland and the poorest was Pohjois-Karjala with a GRP of 57 per cent of that of Åland. Thus the gap between the richest and poorest region hardly diminished at all, despite a slight narrowing in the 1960s.⁶

First I analysed the existence of σ -convergence, that is the diminishing dispersion, or standard deviation, of gross regional products. No uniform trend appeared to exist, but the standard deviation fluctuated from year to year. When Åland was excluded (shown in figure 1), the dispersion of GRP diminished until 1980, meaning that σ -convergence occurred, but thereafter the GRP differences grew again until 1990 or so. During the 1990s the dispersion has remained unchanged. The results indicate that there has even been some divergence in productivity since 1980. Thus I conclude that the regional growth process in Finland seems to split in two very different periods around the year 1980.

After reaching the above conclusion I analysed the regional growth process in Finland to check whether regions which had a low level of GRP in 1960 have grown faster than the initially rich regions. If this was the case, I could expect to find absolute β -convergence across the Finnish provinces. Figures 2 and 3 divide the period into two parts and show the cross-plot of initial product and subsequent growth rate. During the first half there is a clear negative relationship between per

capita GRP in 1960 and growth, indicating that the poorer regions indeed grew faster than the rich ones. However, during 1980-94 no such relationship existed, but conversely it would seem that the two richest regions grew the fastest, with the remainder showing no apparent connection between their initial GRP and subsequent growth rates. Thus no absolute convergence looks likely after 1980, but, if anything, there is a positive correlation between a region's initial product and subsequent growth (figure 3).⁷

Following the above analysis I estimated β -convergence, first during the whole period and then in two subperiods. Finally, the period was divided into decades for which separate estimates are reported. The estimation process was conducted in three stages as follows. At first, I estimated absolute, unconditional, convergence according to the basic equation (1). Secondly, I found that a dummy variable was necessary to control for Åland, and finally, I added other explanatory variables to estimate conditional β -convergence. The results are reported below in table 2. Note that the first figure of each cell in the table is the estimate of β and the second one is R_a^2 , the explanatory power of the model. This coefficient of determination has been adjusted to take into account the number of explanatory variables used. Under β is reported the standard error associated with the estimate of β and under R_a^2 the standard error of the residual of the equation. The likelihood ratio test of equal β 's for the subperiods was rejected in all three specifications (statistic not reported, however).

For the whole period under question, the rate of absolute β -convergence was close to the often reported two per cent per annum⁸. Convergence was rapid, especially before 1980, but the β -coefficient acquires a negative sign in 1980-94, indicating that no productivity convergence occurred. The fast rate of convergence in 1960-80 is partly explained by the fact that Åland developed from one of the poorest provinces into the richest region of the country precisely during that period. I did a trial regression without Åland and obtained a significantly lower rate of convergence for the first two decades ($\beta = 0,028$). Thus I concluded that the exceptional character of Åland may affect the results, and included a dummy variable to control for that fact in the next stage. When considering the individual decades, I found that β -convergence was fastest in the 1970s (nearly 10 per cent per annum), but that it completely stopped in the 1980s and 1990s. The last two decades are also problematic in terms of the coefficient of determination, as the model adopted does not seem to explain regional growth patterns very well during that period. Note that the negative coefficients of determination in table 2 arise because of the adjustment of R² to take into account the number of explanatory variables. Note also that some of the estimates are not statistically significant,

because of the large standard errors.

As indicated above, the next step was to add a dummy variable to the analysis. The results of this operation are reported in the third column of table 2. The incorporation of the Åland-dummy clearly improved the explanatory power of the model, and the speed of convergence declined. Most of the earlier conclusions remain valid, but it should be noted that the sign in 1990-94 changed from negative to positive. However, the last two decades continue to remain problematic, and it seems that the regional growth process has been divergent since 1980.

The final step was to introduce further explanatory variables to estimate conditional convergence. I followed Barro and Sala-i-Martin (1995) and added a structural variable to proxy regional steady state differences in economic structures. The idea is to take into account the fact that aggregate shocks (like oil crises or changes in the prices of agricultural products) affect different regions differently, depending on their economic structures. The structural variable is calculated for each region i as follows:

(2)
$$\mathbf{S}_{i,t} = \sum_{i=1}^{3} w_{i,j,t-T} \times [\log (y_{j,t} / y_{j,t-T}) / T],$$

where j represents the sector (primary production, industry and services) and $w_{i,j,t-T}$ indicates the weight of that particular sector in the region's GRP at the beginning of the period. The average per capita GDP of Finland is y. The structural variable shows the growth rate of region i with the assumption that all its sectors grow at the same rate as the national average of those sectors. As the greatest regional differences in 1960 between the provinces were in the share of services, I also used a control variable for that sector.

The estimates for conditional convergence (table 2, final column) show positive signs for the β coefficient for all subperiods. For the whole period, the annual rate of convergence remained around the two per cent level, and the conclusion that the 1980s saw the end of the convergence period also remained valid. Before 1980 the Finnish provinces were converging relatively fast in terms of productivity, as expected. Note also that the explanatory power of the model for the years after 1980 was somewhat improved when I included the additional variables. Conditional convergence in regional products does not really seem to have occurred during the last two decades.

As the above analysis proved, there has been no uniform, continuous trend in the evolution of

provincial disparities in Finland. Instead, both σ - and β -convergence have fluctuated between subperiods, and even divergence seems to have occurred. The results clearly show that regional convergence was rapid in 1960-80 when all provinces were growing steadily in terms of gross regional product. The greatest convergence rates took place in the 1970s, but this development ended in 1980. Regardless of the explanatory variables used, I found little evidence for convergence in 1980-94, as the richest provinces were growing much faster than the poor ones. During the whole period the often reported result of an annual two per cent (absolute and conditional) convergence rate emerged (compare with Barro and Sala-i-Martin, 1991). The change in convergence rates before and after 1980 is partly explained by the fact that Åland experienced, especially during 1970s, very fast growth, growing from a poor region into the richest one of the country, in per capita terms. Other reasons for the change might lie in regional policy measures (the emphasis of regional policy may have somewhat changed even though no marked changes in the policy strength itself could be detected during 1972-92, see Tervo, 1992) and the economic structures of the regions (meaning that agricultural regions had somewhat lower growth rates as the size of agricultural sector as a whole was shrinking).

The former results are, unexpectedly, somewhat in conflict with Kangasharju (1997a and 1997b). Kangasharju studied the convergence of personal incomes in Finnish subregions and found that this occurred, especially in 1934-80, but slowed down markedly after that. He did not, however, observe any divergent patterns during the subperiods, but instead, even in 1983-93, found a rate of absolute β -convergence of 1,3 per cent per annum. Conditional convergence during 1983-93, on the other hand, was as high as 3,7 per cent. Thus the provinces show different convergence properties from those of the subregions, as the present study not only revealed a slow-down, but a complete reversal of convergence in the 1980s. I thus conclude that the regional classification used in a convergence study can markedly affect the results. The reason why convergence between provinces has been slower than that between subregions could be that the per capita GRP of a province does not perfectly represent each individual subregion's GRP. A province may be too a large unit and include very heterogeneous subregions. On the other hand, many of the poor subregions are concentrated in a few provinces, as many of the poorest subregions can be found in the eastern and northern parts of the country, and the richest subregions are largely located in southern and western Finland. It can be argued that using the more detailed regional classification (with 88 subregions) may produce more accurate results when studying convergence, because the subregions represent well the actual economic and commuting areas (see Kangasharju and Alanen, 1998), depending, of course, on the

purpose for which the results are to be used.⁹

4. Convergence in the Finnish subregions, 1988-94

The 88 small-scale subregions form the lowest regional level for which GRP data are available. This was also a relevant level at which to assess convergence (see the explanation above), as large intrasubregional disparities were unlikely to exist. This data provided an interesting object of study because it was only gathered recently and encompassed the deepest economic slump in Finnish history since the Second World War. However, as the time-series was so short (1988-94) σ - and β convergence were not analysed quite as thoroughly as was done above; instead, I experimented with some alternative empirics in analysing the convergence properties. β -convergence was estimated for the whole period just to see if there were differences in the growth and convergence patterns of the provinces and subregions, but a highly detailed analysis was not considered necessary, as none of the results were statistically significant. The annual rate of absolute β -convergence was more or less zero per cent, tending, if anything, to be slightly negative (table 3). This result is very similar to that obtained using the provincial GRPs, indicating that absolute convergence has not so far occurred in the 1990s. Moreover, the dispersion of GRP remained almost unchanged, at around 0.01, indicating that no σ -convergence occurred in the subregions either.

I used four regional dummies¹⁰, a structural variable and the shares of services and agriculture (called "services" and "agriculture" in table 3) in the regions' total product as control variables when estimating conditional convergence. Only the most interesting results of this operation are reported in table 3. The incorporation of the control variables did not improve the results markedly, but signalled that convergence was indeed non-existent. On the other hand, no clear divergent trend was apparent either. However, we must remember that a six-year period is too short to say anything conclusive about the rate regional convergence.¹¹ This is apparent from the explanatory power of the model, which shows that the regional growth process remains unexplained by the above analysis.

The principal aim of this section was to analyse the growth dynamics and convergence behaviour of the subregions which remained unexplained by the cross-section regressions. I assessed the distribution of products across the 88 subregions, to see whether it tended to be straight or twinpeaked. Markov chain transition matrices were formed, as in Quah (1996), in order to evaluate the growth and convergence dynamics. Firstly, I divided the subregions into five income groups defining the limits for the relative GRP so that the groups were roughly the same size.¹² The idea was to observe the movement of regions from one group to another and calculate the likelihoods of this mobility, and the likelihoods of regions to remain in their original group. Table 4 displays both the annual transitions and the six-year transition from 1988 to 1994. The upper matrix indicates that the Finnish subregions displayed quite a high degree of mobility in the six-year -period under question, as the diagonal entries range from only 0,440 to 0,790, and the off-diagonals are relatively large. These figures imply that there have also been a degree of convergence dynamics working across the subregions. The lower matrix shows the yearly transitions from one state into another, and leads to similar conclusions as the six-year matrix. The diagonal entries are again rather low, suggesting that the likelihood of regions to move away from their original group was noticeable. However, the shares of income groups remained relatively stable throughout the period, indicating that no group was vanishing. Also, some regions even moved more than one group up or downwards, which means that large changes in GRP occur from one year to another, indicating high mobility.

When compared internationally, the Finnish subregional data revealed a substantial likelihood of convergence to occur.¹³ This result is consistent with that obtained by Kangasharju (1997a) using regional per capita taxable incomes. When I compared the subregional figures with the above provincial convergence results, I noticed that the speed of convergence seemed to be faster, or the pace of divergence slower, when using a more detailed regional classification.¹⁴ As we already noted earlier, the convergence result obtained depends heavily on the statistical classification of regions, and it seems to be sensible to estimate convergence at low regional levels. These issues and the questions that could not be answered in this study are discussed in the following section which also concludes the study.

Let us now conclude the latter part of this study, which was done by adopting a more detailed regional classification and analysing the evolution of subregional productivity in 1988-94. As the above analysis showed, the estimation of β -convergence revealed little of the relative growth patterns among the Finnish subregions, mainly because the period under scrutiny was so brief. Alternatively, the end year 1994 may not be the best available, because it marked the end of a profound economic slump. Nevertheless, the message is that subregional growth patterns can be explained neither by differences in the initial productivity (GRP) levels nor by the differing economic structures of the regions.

The period 1988-94, however, was characterised by large fluctuations in the aggregate economy, and it is unlikely that all the subregions would have experienced the fluctuations in exactly the same way. It is more likely that some regions suffered more from the recession, or benefited from the boom, than others. Thus two Markov chain transition matrices were formed in order to see if this method would be more informative than the cross-section approach, which it indeed was. The analysis of cross-sectional dynamics revealed substantial movement, both upwards and downwards, on the part of the subregions, from one productivity group into another. My conclusion from this is that the Finnish subregions had the potential for convergence in 1988-94, and a relatively high at that, if compared internationally.¹⁵ This result conflicts with the rather stationary picture given by the β - and σ -estimates. I can therefore agree with Quah (1996) that it makes sense to use alternative methods in analysing regional growth dynamics, even though I would not go as far as to abandon the cross-section method completely, since it can give detailed estimates and does not require so much in terms of data. Instead, I would prefer to see these methods as complementary, since one of them can often complete the picture given by the other.

5. Discussion and conclusions

The aim of this study was to analyse convergence of regional products in the Finnish provinces and subregions. Both absolute and conditional β -convergence on the level of provinces were found to be strong in 1960-80, but to stop completely thereafter. In fact, a degree of divergence even occurred in the 1980s. The incorporation of control variables to proxy differences in regional steady-states improved the explanatory power of the model, but did not change the results markedly. It is possible, though, that the divergent trend came to an end in 1990. The analysis of σ -convergence proved that regional income disparities have fluctuated from decade to decade, and no uniform trend has existed. All the above findings imply that Finnish provinces were converging in terms of per capita gross regional products in 1960-80 and diverging in the 1980s. In the first half of the 1990s the situation remained rather stationary. This behaviour is very different from that displayed by the subregions during the same period, as we noted when comparing the results with Kangasharju (1997b). Thus even if convergence occurs on one regional level, it is possible that on another level income differences are growing.

The analysis of β - and σ -convergence in Finnish subregions did not reveal any clear convergenceor divergence patterns, but regional differences remained almost unchanged in 1988-94. However, the analysis of regional growth dynamics and mobility proved that the distribution of regional incomes was actually evolving throughout the period, but this mobility was not revealed by the cross-section method. In fact, the Finnish subregions proved to be highly mobile across regional income groups. This finding implies that regional convergence can and should be studied in more than just one way, as none of the available methods alone can produce a complete picture of relative regional growth patterns. Finally, it is acknowledged that a panel data model might have provided more insight into the convergence issue by solving at least a part of the problems associated with cross-section regressions, and such approaches have recently provided interesting results.¹⁶

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3.Unfortunately, it was not possible to use Quah's method in the case of the provinces, as there are only 12 of them, which is clearly not enough to construct Markov chains.

4. OLS could have been used as well, but NLS directly gives precise estimates for β 's whereas with OLS they need to be calculated from $b = -(1/t)[1-\exp(-\beta t)]$. See for example Sala-i-Martin (1996) for a more exact description of estimation methods.

5. For details see References on statistical sources.

6. The respective percentage was 61 in 1970 and 59 in 1980.

7. Note that the provinces of Mikkeli and Pohjois-Karjala, and, on the other hand, the provinces of Kuopio and Oulu have the same position in figure 3. They are shown by different symbols.

8.Note that this 2 per cent result has recently been challenged as studies using panel data report much higher estimates for convergence. See for example Caselli et al (1996) and Islam (1995).

9. Some policies may, for example, be implemented at provincial level. In this case it may be advantageous to know how the income disparities of the provinces have evolved, in order to make rational, well informed decisions about future regional policy.

10. Dummies were constructed according to the region's geographic position: south, east, west and north. However, only south and east dummies seemed to have any impact.

11. The use of further explanatory variables might also improve the results and clarify the convergence estimates. This was not done in this study, however, due to reasons stated above.

12. The limits were constructed as follows. Group 1: subregions with GRP above the national average (GRP \ge 1.00), Group 2: 1.00 < GRP > 0.85, Group 3: 0.85 ≤ GRP ≥ 0.75, Group 4: 0.75 < GRP > 0.65 and Group 5: GRP ≤ 0.65.

13. Compare these figures to those obtained by Quah (1996) for the world and the US states.

14. Recall that at the provincial level the 1980s and 1990s were a time of divergence, when absolute convergence was assessed. The subregions, however, showed no clear divergent trend during 1988-94.

^{1.} This assumption is quite sensible as it has been hypothesized that regional differences in incomes and economic structures are greater the smaller the size of regions into which a given country is divided (see for example Kangasharju and Alanen, 1998).

^{2.}Kangasharju and Alanen(1998) compare standard deviations of GRP at different regional levels and note that the variation is generally larger at lower regional levels (municipalities and subregions) that at higher levels. Thus the magnitude of regional disparities depends on the definition of regions.

15. See Quah (1993b) for comparisons. He forms Markov chain matrices for the US states and the world.

16.A panel data model is currently being used to analyse a longer subregional data set. The results will be available later in 1998.

Table 1: Rates of β -convergence	in recent	studies
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AUTHOR(S)	SAMPLE AND PERIOD	ABSOLUTE β	CONDITIONAL β
Armstrong (1994)	82 European regions, 1950-90.	0,0218	0,0155
Barro and Sala-i-Martin (1995)	48 US States, 1880-1990.47 Japanese prefectures, 1930-90.90 European regions, 1950-90.	0,0174 0,0279 0,0150	0,0220 0,0312 0,0180
Hofer and Wörgötter (1997)	9 Austrian regions, 1961-89. 84 Austrian districts, 1961-86.	0,00347 0,00999	- 0,02323
Kangasharju (1997b)	88 Finnish subregions, 1934-93. 88 Finnish subregions, 1964-93.	0,020 0,027	- 0,061
Persson (1994)	24 Swedish counties, 1906-90.	0,041	0,046

Table 2: Regressions for GRP across the Finnish provinces, 1960-94.

PERIOD	BASIC EQUATION	REGIONAL DUMMY	DUMMY AND CONDITIONING VARIABLES
	β Ra ² (σ)	β $Ra^{2}(\sigma)$	β Ra ² (σ)
1960-94	0,022 0,208	0,012 0,859	0,018 0,899
	(0,011) (0,002)	(0,0005) (0,001)	(0,0006) (0,0007)
1960-80	0,050 0,314	0,028 0,938	0,038 0,958
	(0,033) (0,003)	(0,001) (0,001)	(0,001) (0,0008)
1980-94	-0,008 0,125	-0,010 0,078	0,005 0,382
	(0,0003) (0,001)	(0,0003) (0,001)	(0,0003) (0,001)
1960-70	0,017 0,412	0,019 0,420	0,026 0,526
	(0,001) (0,001)	(0,001) (0,001)	(0,0008) (0,001)
1970-80	0,098 0,223	0,035 0,944	0,051 0,950
	(0,069) (0,007)	(0,003) (0,002)	(0,003) (0,002)
1980-90	-0,001 -0,098	-0,015 -0,204	0,007 0,083
	(0,003) (0,003)	(0,002) (0,003)	(0,002) (0,002)
1990-94	-0,004 -0,073	0,007 0,019	0,023 -0,152
	(0,009) (0,004)	(0,008) (0,004)	(0,011) (0,004)

Explanatory variables	β	Ra ²	St. Error	σ
GRP88	-0,0005	0,003	0,0057	0,0059
GRP + Dummies	0,0041	0,046	0,0070	0,0058
GRP + Structure	0,0037	0,003	0,0056	0,0058
GRP + Dummies + Services	-0,0008	0,068	0,0073	0,0057
GRP + Dummies + Services + Agriculture	-0,0015	0,057	0,0109	0,0058

Table 3: Estimates of β -convergence in the Finnish subregions, 1988-94.

Table 4a: Gross regional product per capita, relative to the Finnish average. A 5-state Markov Chain Matrix: A 6-year transition from 1988 to 1994.

		Upper end-point				
(Number)	65,0	74,9	85,0	99,9	145	
(16)	0,688	0,313				
(20)	0,300	0,550	0,150			
(15)		0,200	0,470	0,330		
(18)			0,220	0,440	0,330	
(19)				0,210	0,790	

*Notes: The group limits for relative GRP per capita, from richest to poorest, were constructed as: Group 1: GRP \geq 100, Group 2: 100 < GRP < 85, Group 3: 75 \leq GRP \leq 85, Group 4: 65 < GRP < 75 and Group 5: GRP \leq 65. The groups appear in increasing order, with the poorest group diplayed in the upper left-hand corner. The diagonal represents the likelihood of region to stay in its original income group. The off-diagonals show the likelihoods of regions to move into other income groups. The number in parentheses refers to the number of subregions in that particular group at the beginning of the period.

Table 4b: Gross regional product per capita, relative to the Finnish average. A 5-state Markov Chain Matrix: One-year transitions from 1988 to 1994.

		Upper end-point			
(Number)	65,0	74,9	85,0	99,9	145
(72) (135) (88) (118) (105)	0,750 0,141	0,250 0,778 0,114 0,008	0,081 0,739 0,085 0,009	0,136 0,746 0,162	0,011 0,161 0,829

*Notes: See Table 4a. Note that here the number in parentheses represents the sum of subregions belonging to that income group during the whole period.

Figure 1: Standard deviation of GRP in 1960-94



Figure 2: Initial GRP per capita and regional growth in 1960-80

