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GROWTH AND CONVERGENCE IN FINLAND: EFFECTS OF REGIONAL FEATURES*

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This paper analyses convergence across the 88 subregions in Finland from 1934 to 1993. The results indicate a rather strong σ convergence and intra-distribution dynamics of income levels. This indicates that, although the dispersion in subreional income levels has diminished, some of the poorer subregions have risen into a higher income category, whereas some of the middle income subregions have fallen into a lower category. Since this development has not been deterministic, the paper also tests for the existence of distinct regional features that determine growth and convergence. Major finding is that though some regional features tend to determine growth, only a few of them actually pass the test of robustness. (JEL O4, R1)

1. Introduction

The convergence behaviour of regions and countries has been widely studied during recent years. The literature usually divides convergence into two types: σ and β convergence. The former is characterised by a diminishing dispersion of income distribution and implies that poorer economies grow faster than their richer counterparts. In the latter case economies approach their own, possibly differing, steady states at a common speed, β. In empirical studies, σ convergence has been found nationally across regions and internationally where the analysis has been confined to relatively homogeneous countries (see e.g. Barro and Sala-i-Martin, 1991 and Mankiw, Romer and Weil, 1992). σ convergence has not been found across highly heterogeneous countries (see e.g. Barro, 1991). A general finding of both international and regional studies has been that β convergence tends to about 2 percent annually.

According to neoclassical theory, both types of convergence occur because of diminishing returns to capital, implying that an economy approaches its steady state at a declining speed of growth. convergence occurs across homogeneous regions and countries because their steady states are fairly close to each other. Across heterogeneous countries, however, differences in steady states may prevent the occurrence σ convergence, since they imply that poorer countries may not be any further away from their steady states than richer countries, and hence, do not out-grow the richer. The effect of economic shocks, which can of course occur both regionally and internationally, will be similar to the effect of differences in steady-states. However, differences in steady states or economic shocks will not prevent the occur-

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rence of β convergence, because, in spite of the steady state differences or temporary shocks, economies tend to approach their own steady states in the long run.

The present study explores, firstly, Finnish regional σ convergence. In previous Finnish studies, the focus has strictly been on the investigation of income dispersion over time (see Kangasharju, 1998a and 1998b). Here, the focus is primarily on intra-distribution dynamics, which is investigated by means of Markov chain matrixes. In other words, the objective is to study the possible criss-crossing and leapfrogging of the regional economies under investigation, regardless of possible σ convergence (see Quah, 1996). The results indicate that both convergence and intra-distribution dynamics are rather strong.

This rather strong intra-distribution dynamics implies that, besides diminishing returns to capital, growth differences can also be explained by other factors. If only diminishing returns to capital would be present, intra-distribution dynamics would be low. Therefore, the second objective of the present study is to investigate whether such factors can be identified in the Finnish regional context when estimating cross-sectional growth regressions derived from the Solowian growth model. A general view in regional analysis is that explanatory variables in these regressions mainly capture economic shocks rather than more fundamental regional determinants of growth, as regions within a country are fairly homogeneous (see e.g. Sala-i-Martin, 1996). Kangasharju (1998a), however, found some indication that such determinants might also be present in the regional context. In particular, the present study provides a test of robustness for these variables proxying those determinants. Following the work of Levine and Renelt (1992), the study uses a variant of Edward Leamer's (1983) extreme-bounds analysis (EBA) in the testing procedure. The results indicate that only a few robust variables can in fact be identified in the regional context.

Utilising further the Solowian growth model, the present study also tests the robustness of the estimates for Finnish regional β convergence. In other words, it tests the robustness of the most important variable in the Solowian growth model. The result of the sensitivity analysis is that β estimates are rather insensitive to small changes in other explanatory variables. Finally, the paper compares Finnish β estimates with those for other countries during growth periods of up to 10 years from the 1960s to the 1990s. The results show that β convergence in Finland has been fairly similar to that in other countries.

The present study is organised as follows. Section 2 investigates Finnish regional σ convergence, section 3 seeks to identify the regional factors responsible and carries out the test of robustness, section 4 compares Finnish β convergence with that abroad, and section 5 concludes the paper.

2. *σ convergence and intra-distribution dynamics*

Convergence was investigated within 88 subregions[1] whose average population in 1993 was 57 500 inhabitants (range 2 407 to 1 038 851). Unlike its predecessors, this study did not use per capita gross regional product as a measure of regional prosperity, but approximated regional income levels by locally levied taxable per capita income. At the subregional level, this data is available from 1934 whereas GRP data is only available from 1988[2]. Taxable income depicts the level of prosperity of the subregions and refers to gross income accruing from personal, corporate and property sources less de-

[1] *The 88 Finnish subregions have been drawn up by the Finnish Government on the basis of small economic areas. These subregions reflect real commuting and trading areas. The subregions are parts of the 19 regions which constitute the basic units of Finnish and European regional policy in Finland.*

[2] *At the regional and provincial level, GRP has been compiled over a longer period. Neither the regional nor provincial levels were used, however, because Finland is divided into only 12 provinces and 19 regions, both of which are too small in number in terms of statistical inference. In the year 1990, the correlation between the subregions' GRP per capita and taxable income per capita was 0.91. After weighting by population the correlation reached 0.97. More than three-quarters of taxable income is derived from personal income.*

duction. The source of this data is Statistics Finland.

Table 1 gives summary statistics for subregional income levels and growth rates. The standard deviation of the growth rates was highest in the 1960s and 1970s, implying the highest possibility for convergence. Moreover, mean taxable per capita income rose and the standard deviation fell monotonously from 1934 to 1993 indicating a declining dispersion of income, i.e. σ convergence. Particularly since the 1960s, σ convergence in Finland has been faster than in several other European countries, the USA or Japan (see Kangasharju, 1998a). In contrast, during the 1980s σ convergence slowed down, a result which accords with the experience of other countries. This development may be explained by evolution in the flow of migration, the effectiveness of regional policy in Finland (see e.g. Tervo, 1991), and a relatively high dispersion of subregional income levels in the 1960s. On the one hand, all three factors have probably contributed to the emerged high overall convergence. On the other hand, a high level of migration particularly during the 1960s and early 1970s, followed by low migration during the late 1970s and 1980s may have accounted for the slower σ convergence during the 1980s. Another related reason for a slower rate of σ convergence is that the dispersion of regional income levels was no longer particularly high in Finland after the 1970s. Therefore, it was evident that the speed of σ convergence would slow down in Finland at some stage. To properly answer the question of the extent to which each of these possible factors eventually contributed to σ convergence calls for further investigation using data sets which include appropriate variables for the analysis.

Applying Markov chain transition matrixes, one obtains a different perspective on the development of income dispersion. Let F_T denote the income distribution of economies at a time T and let us describe the evolution of F_T by the law of motion which resembles the standard first-order autoregression

$$(1) \qquad F_{T+1} = M^*F_T,$$

where M maps one distribution onto another (Quah, 1993a). The evolution of a subregion

Table 1: Means and standard deviations for per capita income levels and average annual growth rates.

Levels Year	Mean	Standard deviation	Growth rates Growth periods	Mean	Standard deviation
1934	1.195	0.469	1934–1993	0.044	0.0056
1964	2.815	0.324	1934–1964	0.054	0.0069
1973	3.371	0.261	1964–1993	0.034	0.0063
1983	3.688	0.174	1964–1973	0.062	0.0103
1993	3.795	0.160	1973–1983	0.032	0.0099
			1973–1993	0.021	0.0058
			1983–1993	0.011	0.0051

through the various classes is assumed to be a stochastic process where the transition from one class to another depends only on income level in the previous period and not further back. Iteration of the matrix M over time leads to a determination of the distribution of subregions in income classes, which corresponds to a structure of a long-run dynamic equilibrium. A property of the model is that the forces operating during the period under observation will continue until equilibrium is reached. This solution is more valid, the longer the period under scrutiny. In the present study this is 59 years. In other words, M says whether or not two initially equal rich economies will end up with similar or very different income levels and, therefore, reveals intra-distribution dynamics, which are not revealed by looking at the evolution of the standard deviation of income over time.

The matrix M was estimated using a method that is connected with the mover-stayer models (see e.g. Goodman, 1961). Specifically, the distributions (F_T) were divided into income classes, which make M a transition probability matrix and the F_T's nonnegative vectors on the unit simplex. Although this categorisation distorts the underlying model, the distortions in this context are probably not important (Quah, 1996). The matrix of the subregions transiting between income classes was computed for each pair of consecutive years in the data set[3]. Summarising the corresponding cells of these matrixes over the years, the matrix of the absolute

[3] *Because the data set used did not include all the years from 1934 to 1993, the transition matrixes were computed on the basis of the years available.*

movement was obtained. This matrix shows the total number of movements, which have occurred during the whole period. The probability matrix M was obtained by proportioning each sell to row total, that is, to the total number of subregions that located in the income class considered during any of the periods under investigation.

Following the work of Quah (1993b), the present study divided the Finnish subregions into four and five equal sized classes according to their income levels relative to the national average. In other words, each class contained 25 or 20 percent of the subregions, respectively. Before turning to the investigation of transition probabilities, the four-class division can be used to show the convergence behaviour obtained also in previous studies. It appears that in 1934 per capita income level in the poorest 25 percent state was 45 percent or less relative to the country average whereas in 1993, having risen by 27 percentage points, it was as high as 72 percent or less. These figures also reveal a feature which could not be seen above: the figure for the poorest state compares favourably with that for the third state (i.e. subregions with an income level between 50 and 75 percent relative to the national average). In 1934 the income level of the third state was 89 percent, whereas in 1993 it was 93 percent, a rate of gain of only 4 percentage points. This result of a non-linear catching up process has also been obtained elsewhere (Kangasharju, 1998b).

Tables 2 and 3 show the transition probability matrixes, M, for the period 1934–1993, where entry (j,k) is the probability that a subregion in state j transits to state k in the long run. In Table 2, each state contains 25 percent of the subregions and in Table 3, 20 percent. Both tables imply rather high intra-distribution mobility as indicated by relatively low diagonal entries and high off-diagonals. Thus, as can be expected, the convergence behaviour is not deterministic in the sense that the poorer a subregion is initially, the faster the subsequent catching up; but rather it shows strong turbulence between the income states.

Table 3 shows more detailed transition information than Table 2. In Table 2, the probability of moving up out of the poorest state into the second poorest is as high as that of moving out of the second poorest down to the very poorest. Similarly, equal transition probabilities obtain between the other three states in Table 2. This pattern was slightly broken when the five-state fractiles were used; as Table 3 shows, there is a small probability that those subregions that were initially in either of the two poorest states, would shift upwards by as much as two states. In addition, Table 3 shows more balanced transition probabilities than Table 2. In Table 3, the probability for subregions initially in the middle income (third) state to transit upwards or downwards is equally high; subregions initially in the second state have a higher probability of moving downwards than upwards, whereas the opposite applies for subregions initially in the fourth state. Conversely in Table 2, in both middle states (second and third) the probability of moving downwards is higher than that moving upwards. Another difference between the tables is that in the middle states of Table 2 the chance of staying put is lower than in the upper and lower end states. This is not the case in Table 3 where the probability of staying in the middle income state is higher that that for staying in the richest state.

To sum up, these rather high transition probabilities between income classes imply the existence of other determinants of growth in addition to the diminishing marginal product of capital described by neoclassical theory. This means that those other determinants may be the reason why growth rates differ from those implied by the relative level of income and thus why so many subregions have moved between the relative income classes in the long run. In the absence of such determinants, the transition

Table 2: Subregional per capita income, relative to country average 4-state fractile Markov Chain, 1934–1993.

		Fractiles		
State	[0.25]	[0.50]	[0.75]	[1.00]
(1)	0.81	0.19		
(2)	0.19	0.64	0.17	
(3)		0.17	0.71	0.13
(4)			0.13	0.88

Note: The states are in ascending order; thus the first column for state (1) shows transition probability from poor to poor.

Table 3. Subregional per capita income, relative to country average 5-state fractile Markov chain, 1934–1993.

	Fractiles				
State	[0.20]	[0.40]	[0.60]	[0.80]	[1.00]
(1)	0.79	0.18	0.03		
(2)	0.21	0.71	0.07	0.01	
(3)		0.11	0.78	0.11	
(4)			0.13	0.64	0.24
(5)				0.24	0.76

probabilities would be very low and the growth differences would be such that the poorer the subregion, the faster its growth. Because of this implication, the next section investigates whether it is possible to identify in a robust way the regional features that determine growth rates.

3. *Effects of regional features on growth*

The estimated equation for the analysis of economic growth and β convergence has usually been derived from the Solowian growth model of neoclassical theory. This section adopts this framework and accordingly tests whether there exist any robust explanatory variables that determine growth as implied by the results obtained above, or whether the growth differences in the Finnish regional context can be explained solely by the diminishing marginal product of capital as advocated by the pure Solowian growth model.

The equation usually derived from neoclassical theory states that economies converge towards their own steady states in accordance with the following equation:

(2) $$dy_i/dT = -\beta\ (y_i - y_i^*),$$

where the economy's i growth rate of income per effective labour force[4] (y_i) is determined by the fraction (β) according to which the deviation (y_i-y_i^*) decreases over time (see Barro and Sala-i-Martin, 1995). y_i^* indexes the steady state. This equation says that if β were constant, the growth rate would be higher, the larger the deviation of y_i from its steady state value y_i^*.

After manipulation, equation (2) can be expressed as equation (3)[5]:

(3) $$1/t\ [\ln(Y/L)_{i,T} - \ln(Y/L)_{i,0}] = a_i + b\ \ln(Y/L)_{i,0},$$

where $a_i = x_i + 1/t\ (1 - e^{-\beta t})\ \ln(y_i^* + x_{i,0})$

and $b = -\ 1/t\ (1 - e^{-\beta t})$.

If the steady states y_i^* and the speed of the technological progress x_i were the same in all the economies under investigation, then the term a_i=a and, when β is positive (and hence the coefficient b is negative), the poorer economies would outgrow the richer ones. If the speed of technological progress or steady states differ among the economies, σ convergence does not necessarily emerge, because the poorer economies may not be any further away from their steady states than their richer counterparts. Where this is the case, β can be estimated by adding variables that proxy the differences. The differences in the steady states imply that growth rates are not solely determined by the diminishing marginal product of capital, but also by other factors.

In empirical studies, possible differences in the speed of technological progress have usually not been proxied because of the assumption of exogenous technological progress. Possible differences in the determinants of steady states are usually proxied by the savings rate, population growth rate and human capital variables (share of highly educated workers or population). Regression periods in these studies have usually been no shorter than 20 years (see e.g. Barro and Lee, 1994). Control of steady state differences means that economies whose

[4] *y=Y/AL, where Y= total income, A= level of technology and L = labour force.*

[5] *Equation (3) is obtained by taking a log-linear approximation of equation (2), solving a differential equation in the logarithm of income (ln $y_i(t)$), subtracting the logarithm of initial income from both sides of the equation, expressing the income level by income per labour force (Y/L), and expressing the dependent variable as the average growth rate over the time period between any initial and terminal date.*

savings rate, population growth rate and human capital are favourable, will grow faster than the others, but that each economy will nonetheless converge towards its own steady state at a speed, β, common to all.

The need to control for steady state determinants, i.e. the need to use additional variables to explain growth differences, is obviously lower in regional than international analysis. In regional analysis, therefore, additional variables have been seen as control variables for economic shocks, which may have affected convergence in the short run, i.e. in growth periods up to 10 years. Economic shocks are seen as biasing β estimates, because they affect initial income values by having a correlative influence on a certain group of regions. Consecutively, the objective has been to use additional variables to stabilise the β estimates so as to facilitate them to be compared over different growth periods. This has been done, although the theory does not imply that β would remain entirely stable over time (see e.g. Barro and Sala-i-Martin, 1995). The most commonly used shock variables have been a variable for the initial levels of a given sectoral share (e.g. the share of agriculture of total employment at the beginning of the growth period) and regional dummy variables (see e.g. Armstrong and Vickerman, 1995). For example, the agricultural share variable has been used to control for harvest failures, and regional dummy variables for other shocks that have affected one subgroup of regions differently from another.

The analysis of Markov chain transition probabilities above implies that there may be some distinct regional factors, which account for differences in regional growth rates. To put it another way, the question to be answered here is to what extent steady state differences exist in the regional context or do they mainly exist between countries as argued e.g. by Barro and Sala-i-Martin (1992). Kangasharju (1998a) found that, although less than in a cross-country context, some growth determinants (steady state differences) can be identified in the regional context. In a 20-year growth regression (1973–1993), the most significant and robust variables, from among nearly 30 variables, proxied three dimensions, viz. initial production structure, distinct geographical regions and technological progress[6]. However, in that study the robustness of the results was not subjected to a rigorous test. The present section takes up that task and provides a coherent test of robustness for those variables using Levine and Renelt's (1992) version of extreme-bound analysis (EBA).

Specifically, the most robust variables in Kangasharju (1998a) were, first, regional dummies (the minus-signed dummies for the continental regions of Finland are replaced here by a single dummy for the Ahvenanmaa region (AHVENANMAA)[7]), second, the annual average change in the agricultural share of employment (GRAGR), and third, the initial share of employment in industry (IND73). Next, EBA is applied to test the sensitivity of these variables to small alterations in the other explanatory variables. Subsequently, the analysis is carried out for two other widely used variables as described below.

The estimated equations consist of four 'basic' variables, including the three variable described above together with the variable for initial income, and a subset of other variables chosen from a pool of variables identified by former studies as potentially important explanatory variables of growth. The method of analysis is such that firstly a 'base' regression is run which includes only the four 'basic' variables in the equation. This equals the estimation of equation 3, which also includes three linearly added variables. Secondly, regressions are run which also includes all the possible linear combinations of one up to the three other variables meaning that the total number of variables ranges from five to seven. Finally, the highest and lowest values (extreme bounds) are identified for the coefficient on each variable. If the coefficient for the variable of interest remains significant at the 0.05 significance level and is of the same sign at the extreme bounds, then that coefficient is regarded as robust. If the

[6] *Kangasharju (1998a) chose this growth period for data availability reasons.*

[7] *Ahvenanmaa region consists of the small islands located in the southwestern Finland. The Dummy for Ahvenanmaa is expected to receive a positive sign.*

Table 4. Sensitivity results for the 'basic' variables (NLS-estimation).

Variables	Coefficient	t-value	Adj. R^2	Other variables	Robust/ fragile
AHVENANMAA	high: 0.0066	4.6	0.93	SERV73, GRPOP, GREDU	robust
(Dummy)	base: 0.0036	3.0	0.93		
	low: 0.0036	2.9	0.93	GRPOP	
GRAGR	high: –0.0671	–2.6	0.93	AGR73	
	base: –0.0904	–3.5	0.93		robust
	low: –0.1063	–4.2	0.93	EDU73, GRPOP, GREDU	
IND73	high: –0.0044	–1.3	0.93	SERV73, GRPOP, GREDU	fragile
	base: –0.0154	–6.8	0.93		
	low: –0.0171	–7.2	0.93	AGR73, GRPOP, GREDU	
INC73	high: 0.0295	9.3	0.93	AGR73	robust
(β)	base: 0.0193	14.0	0.93		
	low: 0.0189	13.1	0.93	GRPOP	

Note: Each equation includes four 'basic' variables, viz. initial income (INC73), regional dummy (AHVENANMAA), growth rate of agricultural share (GRAGR) and initial share of industry (IND73).

coefficient does not remain significant or it changes sign at the extreme bounds, then it is regarded as fragile.

To avoid excessive multicollinearity, which is one possible objection to the method, this study follows the example of Levine and Renelt (1992) and restricts the analysis in two ways. First, the number of other variables in the equations is restricted to three. Second, the pool of possible variables, from which the other variables are chosen, is restricted to only six variables that can be argued to represent a reasonable conditioning set and which proxy as far as possible different regional aspects.

Former empirical growth studies (such as those referred above and Levine and Renelt, 1992) and the literature on endogenous growth (see e.g. Krugman, 1991; Harrison, Kelley and Gant, 1996; and Nijkamp and Poot, 1996) imply that the pool of other possible variables, which may determine growth rates, could include a variable for education and human capital, population growth, production structure, and a variable which proxies agglomeration benefits. Therefore, the pool of other variables includes 1) the initial share of the highly educated population (EDU73); 2) the annual average growth rate of that share (GREDU); 3) the annual average growth rate of the population (GRPOP), the initial share of 4) agricultural (AGR73) and 5) service employment (SERV73); and 6) population density (PDEN73) at the initial date[8].

Table 4 gives the sensitivity results for the four 'basic' variables. First, the base equation indicates that the steady state in the Ahvenanmaa region would have been higher than elsewhere in Finland, a result which is in accordance with the common knowledge that the standard of living is higher in Ahvenanmaa than elsewhere in Finland. Moreover, this result is robust as shown by the unchanged sign and significant coefficients at both extreme bounds. Second, the base equation tends to show that the faster the speed of technological progress (i.e. the faster the reduction in the agricultural share), the higher the rate of economic growth (the average annual reduction in the agricultural share was 2.6 percent), a result which also is robust. Third, the base equation indicates that subregions with initially a higher share of industry would have had a lower steady state than those with a smaller industrial share, a result which might indicate that since 1973 industrially oriented subregions have periodically been facing difficulties. This result is fragile, as the

[8] *Those specifications, which would simultaneously include all three production structure variables (the initial share of agriculture, industry and services), were excluded from the analysis.*

Table 5. Sensitivity results for human capital and population growth variables.

Variables	Coefficient	t-value	Adj. R^2	Other variables	Robust/ fragile
EDU73	high: 0.0835	3.4	0.93	GRPOP, PDEN73	fragile
	base: 0.0349	1.4	0.93		
	low: –0.0102	–0.4	0.93	AGR73, GRPOP, PDEN73	
GRPOP	high: –0.0239	–0.6	0.93	EDU73	fragile
	base: –0.0253	–0.7	0.93		
	low: –0.5185	–0.5	0.93	PDEN73, GREDU	

Note: The annual average growth rate of per capita income level is the dependent variable. The base equation for EDU73 includes EDU73 and the 'basic' variables. Similarly the base equation for GRPOP includes also the 'basic' variables.

higher extreme-bound estimate is not significant at the 0.05 level.

The EBA was also broadened to test the robustness of two other available and widely used variables, viz. the initial level of human capital proxied here by the share of the highly educated the population[9]and population growth rate. The method of analysis is similar to the analysis above except that now the base equation has five variables, which also include one or other of the two variables of interest in each equation. The pool of other variables then contains five variables. Thus, the total number of variables ranges from six to eight.

Table 5 shows the results for the two variables. The base equation for the educational variable indicates a positive though insignificant relation between the initial level of the educational variable and growth. In some specifications the variable enters the equation as significantly positive, but because together with other plausible conditioning variables (e.g. at the low extreme bound) the sign of the coefficient is of the opposite sign and not significant, the variable has to be regarded as fragile. Therefore, the present analysis ends up with a result opposite to that obtained in cross-country studies (see e.g. Barro, 1991). The base equation for the growth of population indicates a slightly negative relation between population and economic growth. This result of a negative partial correlation is insignificant and fragile, however, as indicated by insignificant coefficients at both extreme bounds, a result which is in accordance with that obtained in other studies (see e.g. Levine and Renelt, 1992).

To sum up, only one regional dummy was found which determines regional steady states in a robust way. In addition, the variable proxying technological progress was found to be robust. This rather low number of robust growth determinants accords with the widely applied perception that there are much wider differences in steady states between countries than between regions within a country.

In addition to the variables for regional features, the sensitivity analysis was carried out for the initial income variable to test the robustness of this most essential variable in the Solowian growth model. In other words, a test was conducted to determine how robust the estimates are for conditional β convergence in a 20-year regression period. The base equation at the bottom of Table 4 shows that conditional β convergence was 1.93 percent annually. The variations in the other possible variables change the estimated (s between 1.89 and 2.95 percent. This positive β is also a robust result since the coefficient remains positive and significant at the 0.05 level. The next section analyses how this robust result for Finnish regional β convergence compares with that obtained for other countries.

4. *A comparison of regional β convergence between countries*

Table 6 reports short run β estimates for regions in selected countries. Absolute βs have

[9] *The use of share of the highly educated population instead of the secondary school enrolment rate is justified by the fact that there is regionally more variation in the former than latter variable in Finland.*

6. Regional short run β convergence within several countries since the 1960s.

Country, authors and periods	Absolute β (%)	Conditional β (%)	Control variables used
Finland, Kangasharju (1998a)			
1964–1973	2.7	6.1	Regional dummies + share of agriculture
1973–1983	4.3	2.0	
1983–1993	1.3	3.7	
Sweden, Persson (1995)			
1960–1970	6.7	6.6	Share of agriculture + migration
1970–1980	9.6	11.3	
1980–1990	–0.1	3.0	
Spain, Mas et al. (1994)			
1967–1973	3.9	7.5	Share of agriculture + public capital + regional dummy
1973–1979	3.2	7.0	
1979–1985	–0.6	0.2	
1985–1991	0.7	–0.1	
Japan, Barro et al. (1995)			
1965–1970	–0.1	3.8	Structural variables + regional dummies
1970–1975	9.7	6.6	
1975–1980	3.4	4.7	
1980–1985	–1.2	1.0	
1985–1990	0.1	0.9	
Europe, Armstrong (1995)			
1960–1970	3.2	2.3	Share of agriculture + share of industry + country dummies
1970–1980	1.5	1.4	
1980–1990	1.2	0.8	
USA, Barro et al. (1995)			
1960–1970	2.5	1.7	Structural variables + regional dummies
1970–1980	2.0	0.4	
1980–1990	0.1	1.3	

been obtained by estimating equation 3 and conditional βs by linearly adding control variables to the equation. Estimates of absolute β have direct implications for σ convergence. A positive value for absolute β implies σ convergence as then the initially poorer regions have outgrown the richer. This indeed was the case in most of the regression periods. Absolute β will not show the unbiased speed of convergence towards steady states, where the steady states or rates of technological progress differ, or if economic shocks have affected the variables at the initial date. This has in fact been the case as implied by conditional β estimates, which are different from absolute ones. A general outcome is that since 1964 both absolute and conditional speeds of convergence have been slightly faster in Finland than either in Europe as a whole or in the USA (only exception is the estimate of absolute β for Europe in the 1960s). On the other hand, Finnish β convergence does not seem to differ substantially from Swedish, Japanese or Spanish regional convergences. This result seems to imply that since the 1960s the short run conditional convergence has been higher in the smaller countries than either in the larger one (the USA) or within a group of regions in different countries (Europe).

As found in Kangasharju (1998a), a comparison of β and σ convergence between Finland and some other countries yields an interesting observation: Finnish σ convergence was found to be higher than in the other countries since the 1960s, whereas short run β convergence has tended to exceed only that in the USA or in Europe as a whole, but not that in Sweden, Spain or Japan. Although conditional β convergence is a different concept from σ convergence, they are nonetheless interrelated: σ convergence also implies β convergence (as a diminishing distribution of income levels directly leads to positive β convergence), unlike β convergence, which only yields σ convergence if obtained in the absolute sense. Conditional β convergence does not lead to σ convergence if the steady states between the economies under investigation widely differ (the poorest regions are perhaps nearer to their steady states than their richer counterparts). In fact, a given conditional β convergence corresponds to a lower σ convergence, the greater the difference in steady states among the economies under investigation (see e.g. Mankiw, Romer and Weil, 1992). Thus, because a rather similar conditional β corresponds to a higher σ convergence in Finland than in Sweden, Spain or Japan, one can plausibly infer that more interregional differences in steady states exist in those countries than in Finland.

5. Conclusion

The primary aim of the study was to shed light on the Finnish regional convergence and growth and test the robustness of previous finding suggesting the presence of regional features, which affect growth and β convergence. The findings indicate that the distribution of regional income levels has diminished and that intra-distribution dynamics has been strong in Finland, implying that in real life catching up is not a one-way movement; instead there have been both successful and unsuccessful subregions. The results also indicate the Finnish regional σ convergence has been even stronger than in other countries and that β convergence has been robust and strongly resembles β convergence in other countries.

The sensitivity tests for regional factors revealed that some of the previously found significant determinants of growth and steady state differences are not actually robust regressors. The regional dummy, AHVENANMAA, was the only robust regressor among those which proxied steady state differences. Variables for the initial share of employment in industry, a highly educated population and annual population growth turned out to be fragile. The results for the variable that proxies technological progress (GRAGR) were robust, however. These findings imply that there are much larger differences in steady states between countries than between regions within a country. The findings also call for further research with even longer growth periods and with further regional variables.

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