REGIONAL CONVERGENCE IN AUSTRIA

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CONTENT

Abstract

This paper examines growth and dispersion of output per capita across Austrian regions and districts. We find only weak support for the convergence hypothesis. Data analysis of the Austrian regions find no evidence for cointegration between regional output and national output. The cross-sectional approach shows no significant relationship between average growth rates and level of regional per capita GDP in 1961. Similar results are found for the Austrian districts. The rate of convergence ß is about one percent a year and indicate a - if any - convergence pattern with a very slow pace.

Die vorliegende Arbeit untersucht die Unterschiede im Wachstum des regionalen Pro Kopf Einkommens für Österreich auf Bundesländer- und auf Bezirksebene. Es gibt nur schwache Hinweise auf die Gültigkeit der Konvergenzthese.

Wir finden keine Kointegration zwischen dem österreichischen BIP/Kopf und dem BIP/Kopf der einzelnen Bundesländer. Weiters besteht kein signifikanter linearer Zusammenhang zwischen der durchschnittlichen Wachstumsrate der regionalen BIP/Kopf und dem Niveau im Jahre 1961. Schätzt man hingegen die sogenannte "Konvergenzregression" erhält man eine Konvergenzrate von ca. einem Prozent, was auf einen extrem langsamen Konvergenzprozeß hindeutet. Auf Bezirksebene erhält man ähnliche Resultate.

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I Introduction

The question whether economies exhibit convergence - defined as a tendency of per capita output to equalize over time - has become a central topic for economists. In the regional context, it is assumed that the convergence of regional mean income will improve national equity by reducing overall inequality. For example, convergence between the member countries of the EC has become one of the fundamental objectives of the European Commission (see Sutherland 1986). The connection between regional dynamics and income distributions has been empirically investigated by a number of papers (see, for instance, Coelen 1978, Tam and Persky 1982, 1985). Recently, the economic interest switched to the comparison of growth rates between countries. Is there evidence, that poor countries grow faster than rich ones or is the growth rate independent of the level of per capita product? One had to distinguish two concepts of convergence (see Barro and Sala-i-Martin 1991): σ convergence involves a decline over time in the cross-sectional dispersion, while ß convergence implies that poor countries grow faster than rich ones.

The formal analysis of growth focuses on long-run economic progress. From the 1950's neoclassical exogenous growth models with unexplained technical progress were the dominant theoretical framework. Recently, endogenous growth models identify human capital as main source of economic growth (see Sala-i-Martin 1990 a,b for a theoretical survey). The former neoclassical growth models imply a tendency of convergence. If countries are similar with respect to preferences and technology, then poor countries tend to grow faster than rich countries, because of diminishing returns to reproducible capital (see Barro 1991). The question, whether a tendency for per capita output to equalize - as exogenous neoclassical growth models predict - exists or if the growth rate of per capita product is independent of the starting level - as can be inferred from recent models of endogenous modern growth theory - lead to a vast literature.

Starting with Baumol (1986), most investigators use cross-country regressions to measure the impact of the initial level on the growth rate of an economy. After controlling for the quality of human capital (measured by 1960 rates of school-enrollment rates) Robert Barro shows in his seminal paper (1991) evidence in favour of the convergence hypothesis of neoclassical growth models. For a given quality of human capital, a poor country tends to grow faster. Leamer (1991) reaximes Barro's finding with respect to error in variables problems and concludes that measurements are more reliable for the developing countries. Levine and Renelt (1992) examine whether the conclusions of existing studies are robust to changes in the information set. In accordance with Barro they find evidence of conditional convergence (i.e., a robust negative partial correlation between per capita income and initial income as long as the regression includes secondary school-enrollment rates in 1960). In contrast, Durlauf and Johnson (1992) report evidence in favour of local convergence. By local convergence, they refer to the case where there exist groups of countries such that convergence occurs within the group.

The assumption of similarities in terms of technology and preferences parameters is more satisfactory for different regions of one country than across countries. Therefore Barro and Sala-i-Martin (1991, 1992) apply the cross-sectional approach to 48 U.S. states. They exploit data on personal income since 1840 and gross state product since 1963 and find clear evidence that poor economies tend to grow faster than rich ones in per capita terms. Furthermore, Barro and Sala-i-Martin (1991) show that the process of convergence within 73 regions in Western Europe since 1950 is similar to that for the United States. In particular, the rate of convergence is about 2 percent a year. For Japan Shioji (1993) reports a similar result.

In contrast to the above mentioned studies Carlino (1992) uses the time-series approach to explain the tendency of per capita earnings to diverge across U.S regions in the last 10 years. This approach looks at the long term effects of economic shocks on a region's per capita income relative to the national average. Carlino argues that the widening of regional per capita earning differentials represents only short-run adjustments to a new long-run equilibrium, induced by supply shocks in the 70'ies. Carlino concludes that economic shocks have not had high persistent effects on relative per capita earnings.

To sum up, empirical tests of the "convergence hypothesis" have not yet reached a consensus. Apart from measurement and estimation problems there is evidence supporting conditional convergence (see Tallmann and Wang 1992).

This paper explores the dynamics of regional income per capita growth for Austria for the period from 1961 to 1989. We address the question, whether there is evidence for regional convergence in Austria. Section II of the paper shows stylized facts for regional GDP per capita in Austria. The development of the variation of relative per capita income, measured by the coefficient of variation, for the period 1961 to 1989 is discussed. Section III tests for stationarity of regional per capita GDP and for cointegration between regional per capita GDP and national per capita output. Section IV applies the cross-sectional approach to pattern of convergence across the nine regions. Section V extents the analysis to 84 districts of Austria. Section IV draws conclusions.

II Stylized facts of Austrian Regional Per Capita GDP

This paper uses yearly Austrian data of the contribution to the nominal GDP in the 9 Austrian states

[1] from 1961 to 1989. As these series are available only at current prices all series have been deflated with the GDP-Deflator for the Austrian aggregate GDP and divided by the resident population to get real regional per capita GDP's. All data are taken from the WIFO-database. The regional contributions to GDP are subject to a statistical break in 1972/73. Before 1973 sales taxes has been part of regional GDP, with the introduction of a value added tax system in 1973, value added tax has been excluded from regional GDP. We used regressions with dummy variables and nonlinear restrictions to take care of the break in growth rates.

In the last ten years regional per capita incomes in Austria have tended to diverge after a decade of convergence (see Table 1). In 1989 per capita income differ widely across regions, for instance, Vienna's per capita income (138) is well above, Burgenland (66), Styria and Carinthia (79) are well below the Austrian average (100). Since 1961 only the Burgenland as a low income country made substantial gains, but Styria lost ground. Upper Austria, Salzburg and Tyrol improved their relative per capita incomes.

Table 1: Regional Real Gross Domestic Product Per Capita

Region	1961	1970	1980	1989
Burgenland	44.5 (57.1)	63.1 (57.8)	106.2 (66.1)	125.7 (65.9)
Carinthia	63.6 (81.7)	91.4 (83.7)	129.4 (80.6)	150.0 (78.6)
Lower-Austria	68.9 (88.4)	91.4 (83.8)	139.1 (86.6)	168.0 (88.0)
Upper-Austria	74.0 (94.9)	104.0 (95.3)	162.6 (101.3)	194.1 (101.7)
Salzburg	78.4 (100.6)	118.1 (108.2)	176.1 (109.7)	211.0 (110.6)
Styria	66.2 (84.9)	86.4 (79.2)	128.2 (79.8)	141.2 (74.0)
Tyrol	72.2 (92.6)	108.2 (99.1)	164.5 (102.5)	194.0 (101.7)
Vorarlberg	82.1 (105.3)	114.4 (104.9)	177.1 (110.3)	199.4 (104.5)
Vienna	107.6 (138.1)	156.2 (143.1)	211.9 (132.0)	262.8 (137.7)
Austria	77.9 (100.0)	109.1 (100.0)	160.5 (100.0)	190.9 (100.0)

1) The states (Bundesländer) are referred to hereafter as regions.

Table 2: Dispersion of GDP/Capita across Regions 1961-1989

Year	Coefficient of Variation (in %) (1)	(2)
1961	21.3368	21.3368
1962	22.2597	22.2597
1963	22.6006	22.6006
1964	22.3994	22.3994
1965	23.1632	23.1632
1966	22.9810	22.9810
1967	22.5173	22.5173
1968	23.2989	23.2989
1969	23.2176	23.2176
1970	22.8772	22.8772
1971	22.5296	22.5296
1972	21.8392	21.8392
1973	20.7525	20.9649
1974	19.3975	19.5461
1975	20.1077	20.1732
1976	19.6488	19.6800
1977	20.2483	20.2900
1978	19.4266	19.4074
1979	18.9933	19.0602
1980	19.2704	19.3602
1981	19.1454	19.2103
1982	18.8135	18.8940
1983	19.5490	19.6072
1984	19.2753	19.3529
1985	19.9986	20.0054
1986	20.3763	20.3705
1987	21.2764	21.2323
1988	21.0526	21.0098
1989	21.0795	21.0516

Coefficient of variation with (1) and without control (2) for the break due to the change in added value tax system 1972/73.

The coefficient of variation (CV) is often used to measure the regional distribution of income (see e.g. Coelen 1978). Figure 1 shows the temporal behavior of the regional per capita income differentials. The empirical evidence can be split in three different periods. In the 60'ies there is a slight increase in the differences. In contrary the period from 1971 to 1982 shows a substantial drop in the differentials and clear evidence for convergence. The CV reach his minimum in 1982, after this year, however, per capita income tends to diverge across regions[2]. We examine the question if this evidence indicates non-convergence or only a temporary adjustment process.

2) In the last decade regional American differences increased after a period of gradual convergence, too (see Carlino 1992).

III Time Series Evidence

One of the concerns of regional economics is the temporal behavior of regional income in comparison to the development of national income. The time-series approach examines effects of shocks to regional income relative to the national average (see v.Watzdorf and Wörgötter 1990 for an analysis of the importance of global and regional shocks in Austria). If a shock has only a transitory effect on the series, we call the series stationary, integrated of order zero, denoted I(0), respectively. If a shock has a permanent effect on the level of the series but only a temporary effect on the growth rate of the series, that the series is called integrated of order 1 I(1). If two series are both I(1) and a linear combination of these two series exist, which is I(0) that the series are called cointegrated (see Engle and Granger 1987 for a more formal definition). Cointegration between two series, however, imply that an equilibrium relationship between this variables exist and therefore non-convergence. We test for the existence of an equilibrium relationship between regional and national Austrian income directly by using the Engle and Granger (1987) test procedure.

First, the series have been exposed to stationary tests. Table 3 exhibits the results of various unit root tests explained below.

A test statistic with a z in brackets refers to the absolute level, a dz in brackets indicates that the test has been applied to the first differences. The columns represent the regional Austrian GDP per capita and the Austrian GDP per capita, respectively.

Table 3: Dickey/Fuller-Stock/Watson Unit Root Tests (ARCORR=1)

	1	2	3	4	5
qf-tausq(z)	-8.06	-15.64	-7.76	-9.04	-12.01
qf-tau(z)	-2.26	-3.46	-2.76	-2.72	-4.32
qf-mu(z)	-0.88	-1.18	-0.57	-0.82	-1.14
qf-tau(dz)	-22.81[b]	-24.47[b]	-22.93[b]	-23.02[b]	-20.58[c]
qf-mu(dz)	-20.96[c]	-22.17[b]	-21.56[c]	-21.13[c]	-17.48
DF: t-tau(z)	-0.72	-1.37	-1.03	-0.93	-1.57
DF: t-mu(z)	-1.40	-2.02	-1.00	-1.35	-1.61
DF:t-tau(dz)	-3.09[c]	-3.87[b]	-2.37	-3.03	-3.59[b]
DF: t-mu(dz)	-2.84[c]	-3.15[b]	-2.50	-2.85[c]	-3.11[b]
time(z)	0.20	0.90	0.70	0.47	0.87
constant(z)	1.92	2.52	1.46	1.84	2.48
time(dz)	-1.24	-1.68	-0.78	-1.14	-1.22
constant(dz)	3.03	3.19	3.40	3.15	2.66

	6	7	8	9	A
qf-tausq(z)	-11.02	-12.85	-8.89	-8.24	-9.01
qf-tau(z)	-3.06	-3.54	-3.43	-4.08	-2.70
qf-mu(z)	-1.19	-1.21	-0.82	-0.65	-0.80
qf-tau(dz)	-22.70[b]	-21.51[c]	-17.45[b]	-23.29[b]	-21.15[c]
qf-mu(dz)	-21.07[a]	-13.52[c]	-14.59	-21.07[c]	-17.77[b]
DF: t-tau(z)	-0.99	-1.46	-1.15	-1.70	-1.06
DF: t-mu(z)	-1.66	-2.66c	-1.12	-1.37	-1.58
DF:t-tau(dz)	-3.91[b]	-3.29[c]	-2.88	-3.76[b]	-2.98
DF: t-mu(dz)	-3.32[b]	-2.26	-2.75[c]	-3.43[b]	-2.67[c]
time(z)	0.34	0.69	0.18	1.40	0.48
constant(z)	2.15	4.15	1.89	1.97	2.46
time(dz)	-1.41	-2.31	-0.87	-1.06	-1.35
constant(dz)	2.82	2.66	2.43	3.53	3.07

a,b,c means significant at 1 %, 5 % and 10 %, respectively

Critical values

	1%	5%	10%
qf-tausq(z)	-35.50	-27.90	-24.10
qf-tau(z)	-29.20	-21.70	-18.20
qf-mu(z)	-20.60	-14.10	-11.20
qf-tau(dz)	-29.20	-21.70	-18.20
qf-mu(dz)	-20.60	-14.10	-11.20
DF: t-tau(z)	-3.96	-3.41	-3.12
DF: t-mu(z)	-3.43	-2.86	-2.57
DF:t-tau(dz)	-3.96	-3.41	-3.12
DF: t-mu(dz)	-3.43	-2.86	-2.57

The Stock-Watson test statistic is called qf, the Dickey-Fuller test statistic is labeled DF. mu, tau and tauq indicate that a constant, a linear deterministic trend and a quadratic deterministic trend have been assumed. The four respectively two lines below the DF-tests present the t-statistics of the constant and the trend variable.

The tests uniformly cannot reject a unit root in levels. For the differences the results are not uniformly clear. In general, however, the results indicate that the first differences of the regional incomes are stationary. Therefore we can test if regional GDP/capita and national GDP/capita are cointegrated.

Testing for Cointegration

Let y_{it} be the regional per capita income of region i and y_{-it} be the Austrian regional per capita income (without the region i). As both series can be judged as I (1), we perform cointegration tests. Engle and Granger (1987) survey the testing of cointegrating systems. If cointegration between regional and national incomes is rejected, that means that no equilibrium relationship between the series exist, regional differentials can grow or decline. A regression $y_{it} = a + b\, y_{-it}$ is called a cointegrating regression because if a long run equilibrium exists such a regression will give a consistent estimate of it. If we cannot reject the null hypothesis that the residuals form a random walk sequence, we infer that there is no linear combination which defines an equilibrium of these variables. Several statistics are available for testing there is no unit root in the cointegrated residuals. We use Cointegrating Regression Durbin Watson test (CRDW) and the Engle-Granger test (EG) based on the augmented Dickey and Fuller regressions.

For every region one cointegrating regression was specified. The results are presented in Table 4. The CRDW statistic tests if the residuals from the cointegrating regression appear to be stationary. It rejects non-cointegration (finds co-integration) if DW is too big. The hypothesis of non-cointegration is two times rejected at a 5 % level and four times at a 10 % level. Because of its simplicity the CRDW might be used for a quick approximate result, however Engle and Granger (1987) does not recommend this test because the critical values are very sensitive to the particular parameters within the Null. Therefore we applied EG-tests, too. These tests show no evidence of cointegration. The time series approach clearly rejects a long run equilibrium relationship between regional per capita income and national per capita income. As the time series approach does not rule out convergence, the following section applies the cross-sectional approach to test for convergence directly.

Table 5: Testing for Cointegration between Regional GDP/Capita and Austrian GDP/Capita

REGION	CRDW	DF	ADF
Burgenland	0.71^{c}	-2.35	-2.15 (1)
Carinthia	0.82^{b}	-2.56	-2.27 (1)
Lower-Austria	0.98^{b}	-3.18	-2.38 (3)
Upper-Austria	0.74^{c}	-2.51	-2.43 (1)
Salzburg	0.53	-2.53	-2.83 (1)
Styria	0.48	-2.11	-1.85 (1)
Tyrol	0.64	-2.65	-3.15 (3)
Vorarlberg	0.56	-2.19	-2.20 (2)
Vienna	0.34	-1.43	-1.70 (1)

a,b,c means significant at 1 %, 5 % and 10 %, respectively

Critical Values	(1%	5 %	10%)
CRDW	1.00	0.78	0.69
DF	-4.31	-3.56	-3.20
ADF	-4.31	-3.56	-3.20

Critical values are taken from Engle/Yoo (CRDW) and calculated from MacKinnon (1991), respectively.

IV The cross-sectional approach

To test for regional convergence in Austria directly, we use cross-regions regressions. For cross-sectional convergence, regions with a high initial level of income should grow relatively slowly through time. The study examines the correlation between average growth rate and the level of per capita income. Convergence implies a negative correlation between region's level of per capita income and the average growth rate. Carlino (1992) finds evidence of cross-sectional convergence of regional per capita earnings during the 1929-90 period for the USA. Using a similar approach to measure the correlation between average growth rate (GR6189) and per capita income level in 1961 (GDPC61) we find almost no evidence for convergence during the 1961-89 period. The correlation between GR6189 and GDPC61 is -0.21. As Table 7 shows the coefficient is negative as expected but statistically insignificant. Repeating the analysis for all years between 1972 and 1988 there is no significant influence from the starting level to the average growth rate[3]. Figure 2 indicates one possible reason. Especially Styria has a low level in 1961 and has a very low growth rate (see Table 6). Excluding Styria and Carinthia[4] from the analysis, we got the following result:

$$GR6189_i = 1.04 - 0.0008\ GDPC61_i \qquad R^2 = 0.47,$$
$$(2.11)$$

where $GR6189_i$ represents average annual growth rates in region i between 1961-89 and $GDPC61_i$ represents the level of real per capita income in 1961 for region i. The coefficient is statistically significant at a 10 % level[5].

Barro and Sala-i-Martin (1991, 1992) based their analysis on a growth equation derived from a neoclassical growth model for the closed economy. The transitional growth process can be approximated as

$$(1/T)\ \log\ (y_{it}/y_{i,t-T}) = x^*_i + \log(Y^*_i/Y_{i,t-T})\ (1-e^{-ßT}) * (1/T) + u_{it},$$

where i indexes the economy, t indexes time, y_{it} is per capita output, x^*_i is the steady-state per capita growth rate, Y_{it} is output per effective worker, Y^*_i is the steady-state level of output per effective worker, T is the length of the observation interval, the coefficient ß is the rate of convergence and u_{it} is an error term.

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3) For the period from 1971 to 1989 the negative correlation between average growth rate and GDPC71 is stronger (-0.44). However, the estimated coefficient of GDPC71 is not significant at all conventional levels.

4) The method of Least Median of Squares (Rousseuw and Leroy 1987) identifies these two regions as outliers.

5) Statistically, we applied the least median of squares and reweighted least squares method (Rousseuw and Leroy 1987).

ß is estimated by running a so-called convergence regression. We strictly follow Barro and Sala-i-Martin and run the following nonlinear regression[6]:

$$(1/T)\ \log\ (y_{it}/y_{i,0}) = a - [\log(y_{i,0})]\ (1-e^{-ßT})*(1/T).$$

Table 8 contains the nonlinear least square results for the Austrian regions and for three time periods[7]. For the longest interval, 1961 to 1989 (for 9 observations), ß = 0.0035. Splitting up the sample in three periods only for the middle period from 1971-1980 we get a positive and significant ß. Restricting ß to be the same for all three periods, we get, however, a convergence rate of 1 %, which is statistically significant. The likelihood ratio statistic rejects the hypothesis that ß is the same for the three subperiods (7.75) at the 5 percent critical value from the CHI² distribution with two degrees of freedom 6.991. This result suggests a tendency for convergence, the pace, however, is extremely slow.

To check the sensitivity of our results, we apply the analysis to the behavior of net domestic product per employee in the 84 districts of Austria.

Table 6: GDP/Capita and Growth Rate across Regions

Region	Average Growth Rate		Per Capita GDP	
	61-89	71-89	1961	1971
Burgenland	3.78	3.71	44.517	65.27
Carinthia	3.11	2.68	63.643	93.22
Lower-Austria	3.23	3.12	68.922	96.70
Upper-Austria	3.50	3.18	73.999	110.56
Salzburg	3.60	2.84	78.437	127.45
Styria	2.74	2.53	66.171	90.13
Tyrol	3.60	2.88	72.178	116.46
Vorarlberg	3.22	2.77	82.064	121.90
Vienna	3.24	2.84	107.635	158.72
Austria	3.25	2.91	77.936	113.99

6) We plan to control for regional sectoral composition of output in further research. We expect, however, the use of control variables should not change our main results.

7) Constant terms are included in all following nonlinear regressions in these paper but their estimates are ommitted.

Figure 1: Growth Rate 1961-1989 and GDP/Capital 1961

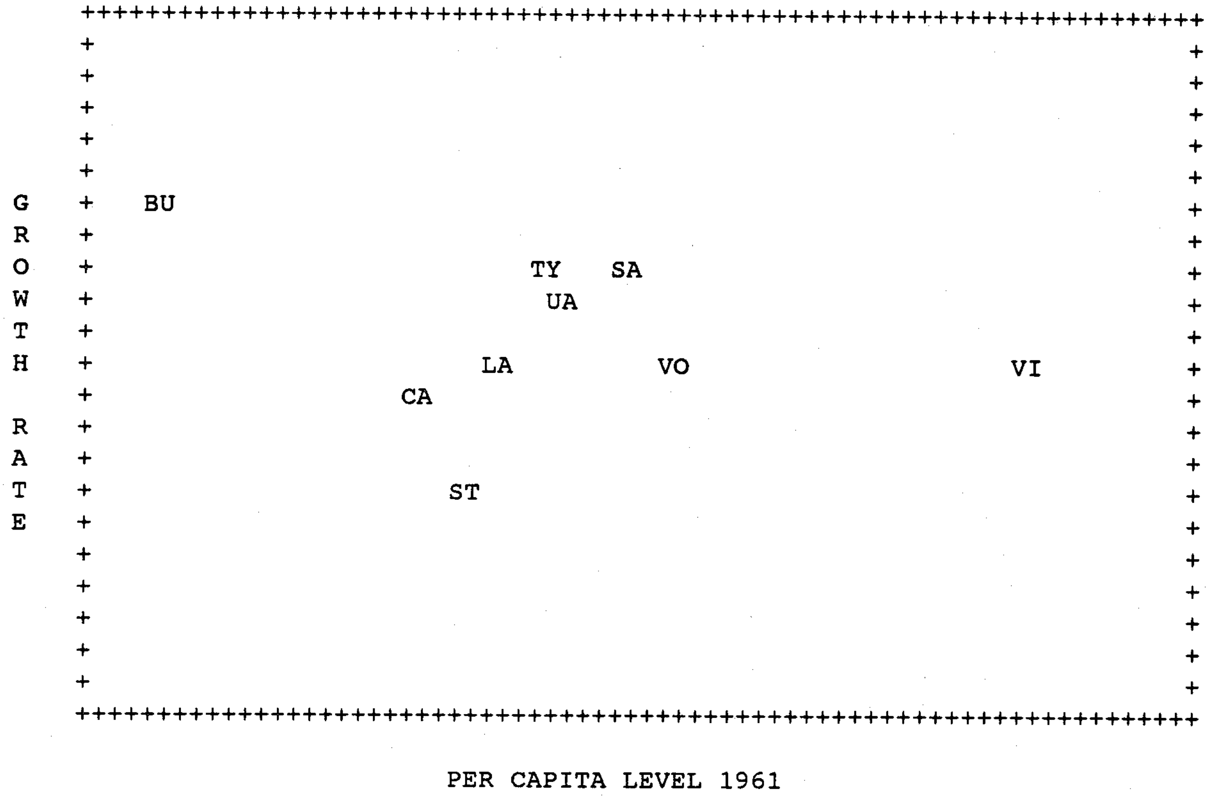

Table 7: Linear Regressions for GDP/Capita across Regions

Dep. Var.	CONSTANT	GDPC61	t-Value	R^2	SE
GR6189	1.04 (201)	-0.0397E-03	(-0.58)	0.05	0.0033
GR6188	1.04 (184)	-0.0445E-03	(-0.59)	0.05	0.0036
GR6187	1.04 (181)	-0.0393E-03	(-0.51)	0.04	0.0037
GR6186	1.04 (192)	-0.0586E-03	(-0.81)	0.09	0.0034
GR6185	1.04 (190)	-0.0687E-03	(-0.94)	0.11	0.0035
GR6184	1.04 (190)	-0.0914E-03	(-1.25)	0.18	0.0035
GR6183	1.04 (184)	-0.0844E-03	(-1.12)	0.15	0.0036
GR6182	1.05 (179)	-0.1141E-03	(-1.46)	0.23	0.0037
GR6181	1.05 (172)	-0.1084E-03	(-1.33)	0.20	0.0039
GR6180	1.05 (176)	-0.1026E-03	(-1.29)	0.19	0.0038
GR6179	1.05 (166)	-0.1181E-03	(-1.39)	0.22	0.0040
GR6178	1.05 (138)	-0.1225E-03	(-1.20)	0.17	0.0049
GR6177	1.05 (149)	-0.0847E-03	(-0.90)	0.10	0.0045
GR6176	1.05 (159)	-0.1160E-03	(-1.31)	0.20	0.0042
GR6175	1.05 (151)	-0.0918E-03	(-0.99)	0.12	0.0042
GR6174	1.05 (161)	-0.1248E-03	(-1.43)	0.23	0.0042
GR6173	1.05 (123)	-0.0659E-04	(-0.58)	0.05	0.0055
GR6172	1.04 (106)	0.0071E-04	(0.54)	0.00	0.0063

Table 8: Nonlinear Regressions for GDP/Capita across Regions (Estimated by NLS, N=9)

Period	ß	t-value	R^2
1961-1989	0.00347	(0.69)	0.07
Subsamples			
1961-1970	-0.00448	(0.62)	0.05
1971-1980	0.01927	(3.22)	0.64
1981-1989	-0.00837	(1.28)	0.18
RESTRICTED 1961-1989 $ß_1=ß_2=ß_3$	0.00931	(2.42)	

V Convergence of Districts

Data for net domestic product per employee for 84 districts are available for the years 1961, 1971, 1976 and from 1981 to 1986. Data for 1961 and 1971 are from Geldner and Jeglitsch (1976), data from 1971 to 1986 are from Jeglitsch (1989). To make data for 1961 consistent with the data from Jeglitsch (1989) we adjust the 1961 data in the following way: we use the growth rate from 1961 to 1971 from Geldner and Jeglitsch (1976) to compute data for 1961. We deflate the nominal values for each district by the national GDP-deflator.

Table 9 shows the dispersion of real net domestic product per employee (NIP) across districts. The coefficient of variation is heavily effected by the revision of the data in 1971. Therefore we conducted the analysis for the time period from 1961 to 1986 and from 1971 to 1986. The temporal behavior of the dispersion of NIP across districts is slightly different from the regional GDP's per capita, discussed in section 2. From 1961 to 1971 one can see a substantial drop in the dispersion, from 1971 to 1976 the CV increased almost to the level of 1961 and stays constant afterwards.

Table 9: Dispersion of Net Domestic Product per Employee

YEAR	DATA SOURCE	CV (in %)
1961	(Geldner/Jeglitsch)	30.24
1961	(own calculations)	23.08
1971	(Geldner/Jeglitsch)	24.19
1971	(Jeglitsch)	17.63
1976	(Jeglitsch)	21.09
1981	(Jeglitsch)	21.24
1982	(Jeglitsch)	21.31
1983	(Jeglitsch)	21.92
1984	(Jeglitsch)	21.45
1985	(Jeglitsch)	21.91
1986	(Jeglitsch)	21.62

Source: Data are taken from Geldner and Jeglitsch (1976) and Jeglitsch (1989), respectively, own calculations.

The correlation between the average growth rate from 1961 to 1986 (GRN6186) and the level of real net domestic product per employee 1961 (NIP61) is -0.45. For GRN7186 and NIP71 the correlation is positive and very small (+0.09). Table 10 shows various linear regression results. The results indicate convergence for the whole period from 1961 to 1986, for the subperiod from 1971 to 1986, however, the coefficient is positive and point to a non-convergence pattern.

Table 10: Linear Regression on NIP across Districts

Dep. Var.	GRN6186	GRN6186	GRN7186	GRN7186
Const.	7.50	5.31	0.34	-2.67
	(8.0)	(6.1)	(0.2)	(1.4)
NIP61	-0.91	-0.43	----	-----
	(4.5)	(2.3)		
NIP71	-----	----	0.36	0.93
			(0.9)	(2.5)
R^2	0.20	0.07	0.01	0.07
	OLS	LMS/RMS[8]	OLS	LMS/RMS[9]

Absolute t-values are given in parenthesis.

Table 11: Nonlinear Regressions NIP across Districts
(Estimated by NLS, N=84)

Period	ß	t-value	R^2
1961-1986	0.00999	(3.97)	0.20
1971-1986	-0.00345	(0.88)	0.01
SUBSAMPLES			
1961-1971	0.03856	(7.37)	0.51
1971-1981	-0.00802	(1.74)	0.03
1981-1986	0.00492	(0.92)	0.01
RESTRICTED 1961-1986 $ß_1=ß_2=ß_3$	0.01130	(4.59)	

Absolute t-values are given in parenthesis.

Table 11 contains nonlinear least-square regressions in the form of

$$(1/T)\ \log\ (y_{it}/y_{i,0}) = a - [\log(y_{i,0})]\ (1-e^{-ßT})*(1/T) + u_{it}$$

for the 84 Austrian districts. For the period 1961 to 1986 (for 84 observations), ß = 0.010. For the shorter period from 1971 to 1986 ß = -0.0034, but statistically insignificant. These results indicate an strong convergence process in the 60'ies[10]. Since 1971 the data do not show a tendency towards convergence.

8) LMS identifies Melk, Jennersdorf, Bruck/Mur, Knittelfeld, Leoben, Murau and Spittal as outliers.

9) LMS identifies Jennersdorf, Korneuburg, Völkermarkt and Lienz as outliers.

10) These result does not depend on our statistical transformation. Using the data from Jeglitsch and Geldner (1976) we get a similar result (ß=0.037).

VI Summary and Conclusions

This paper finds only weak support for the convergence hypothesis. After a period of diminishing regional differences in the last decade the gap between the regions grows. Data analysis of the Austrian regions find no evidence for cointegration between regional output and national output. The cross-sectional approach shows no strong relationship between growth rates and initial level. Only when we exclude Styria and Carinthia from the sample the data show a negative and significant correlation between average growth rate and level of regional per capita GDP in 1961 as convergence implies. Extending the analysis to districts shows a different picture. We find convergence in the sexties, but not later.

Our empirical results indicate convergence at least for some time periods. The rate of convergence ß is about 1 percent a year and therefore considerably slower than in America, Japan or Western Europe, where Barro and Sala-i-Martin (1991) estimate ß=2 %. The data show, however, a unstable convergence pattern across time periods. Table 12 contains the comparision of our findings for the regions with the results across districts. The results for the longest period are similar, however, ß's for subperiods are sharply different. For regions the convergence pattern occurs in the middle period, however for districts we observe a strong tendency for convergence only in the period from 1961 to 1971. This points out the importance of territorial aggregation. The growth pattern between regions seems to be different from the pattern within regions.

Table 12: Nonlinear Regressions for GDP/Capita and NIP

PERIOD	REGIONS		DISTRICTS	
	ß	t-value	ß	t-value
1961-1989(86)	0.00347	(0.69)	0.00999	(3.97)
Subsamples 1961-1970(71)	-0.00448	(0.62)	0.03856	(7.37)
1971-1980(81)	0.01927	(3.22)	-0.00802	(1.74)
1981-1989(86)	-0.00837	(1.28)	0.00492	(0.92)
RESTRICTED 1961-1989(86) ß1=ß2=ß3	0.00931	(2.42)	0.01130	(4.59)

Using our results to forecast the regional convergence process in Austria, a narrowing of regional differences may occur, but only at a very slow pace.

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