LIS
Working Paper Series

No. 841

Is Income Inequality Converging at the Regional Level? Evidence from LIS Data

Philipp Erfurth

June 2022

Luxembourg Income Study (LIS), asbl

Working Paper

Is income inequality converging at the regional level? Evidence from LIS Data

Philipp Erfurth*

Abstract

This study provides new insights into regional income inequality convergence across and within countries, building on the increased availability of Luxembourg Income Study (LIS) data. It finds evidence of regional income inequality convergence across countries, but finds heterogenous trends within countries. The study also explores the impact of state systems on regional income inequality convergence, providing evidence that the state system (federal, unitary or hybrid) matters for income inequality convergence, with unitary states being associated with regional income inequality convergence.

*perfurth@gradcenter.cuny.edu, CUNY Graduate Center, 365 5th Ave, New York
I would like to thank Janet Gornick, Branko Milanovic, Christos Giannikos, Paul Krugman, and Thom Thurston as well as participants of the 2021 LIS Virtual Summer Workshop for their useful comments and suggestions.

Contents

1 Introduction

The study of income inequality convergence at the subnational level, particularly the comparative study across countries, has long been hampered by a lack of quality, comparable data. As Atkinson (2004) noted, *"the importance of data comparability in such empirical studies of convergence was recognized clearly by Benabou: "the binding constraint ...is data". The aim of LIS is to ease that constraint"*(P. 182). This study will explore inequality convergence at the subnational level, building on the increased availability of LIS microdata for a range of developed and developing countries, which indeed has "eased the constraint" on studying regional inequality convergence.

In doing so, this study will seek to provide new insights into regional income inequality convergence across countries by adding a comparative study to the literature on income inequality convergence. The seminal studies on income inequality convergence, notably Benabou (1996) and Ravallion (2003) focused on national-level income inequality and faced limitations in terms of data availability. Studies on inequality convergence at the subnational level have thus far largely focused on individual countries (see for instance Savoia (2020) and Bournakis (2020). The greater availability of LIS data allows - for the first time - for a comparative study, as previously no comparable data was available at sufficient scale.

To study the determinants of convergence, this study also contributes to the research by focusing specifically on the role that state systems - federal, unitary or hybrid - play in fostering regional income inequality convergence. This study also contributes to the literature by applying the convergence club methodology to explore regional income inequality convergence within countries. Studying club convergence can provide additional policy insights, enabling policy makers to target policies to specific regions.

2 Literature Review

2.1 From convergence to inequality convergence

The foundational study on inequality convergence is the contribution of Benabou (1996), which lays the theoretical groundwork for convergence of inequality over time. In addressing the question on whether inequality converges among countries, Benabou seeks to go beyond *"the first moment of each countries income distribution"* (see P. 51), which is the main focus of the literature that studies convergence in per capita incomes, thus building upon the work of Barro and Sala-i-Martin (1992).

Benabou (1996) identifies three concrete arguments for moving beyond the first moment and for considering higher moments. First, it can provide important insights for policy and can help identify whether gaps in inequality between nations are permanent or narrowing. Secondly, it can collect evidence on the long-run linkages between credit market incompleteness on one hand, and inequality and social mobility on the other. Third, and perhaps most importantly, it can provide insights into dynamics within neoclassical growth models, which as Benabou (1996) argues *"imply convergence in distribution"* and could hint at *"the presence of some form of increasing return or complementarity in the economic or politico- economic structure"* (P. 51).

To study higher moments, Benabou uses the same approach as Barro and Sala-i-Martin (1992), i.e. using regression analysis of initial values and rates of change. Benabou uses a panel of OECD countries on the basis of LIS data as well as data by Deininger and Squire (1995). Benabou finds a negative coefficient indicating mean reversion in inequality between 1970 and 1980. A caveat of Benabou's study is the limited availability and lack of comparability of data across different countries, some of which based on expenditure and others on income data.

Another important study on inequality convergence is the work by Raval-

lion (2003), which seeks to explore whether there is evidence of unconditional inequality convergence across countries on the basis of greater data availability. The main channel according to Ravallion (2003) through which such unconditional convergence would take place is through liberalizing economic policy reforms. In countries with previous policies benefiting the rich and thus high inequality, economic policy reforms would lead to a decrease in inequality. In countries with previous pro-poor policies, the opposite effect would be in play. Ravallion (2003) finds evidence of unconditional convergence across different specifications. He finds an implied steady-state Gini between 0.4 and 0.41, close to the datasets mean. As noted by Ravallion (2003), *"the process of convergence toward medium inequality implied by these results is clearly not rapid, and it should not be forgotten that there are deviations from these trends, both over time and across countries"* (P. 355).

2.2 Regional inequality convergence

Over the past years, there has been a renewed focus on inequality convergence, particularly within countries and the European Union. Savoia (2019) studies convergence of income inequality across the EU. The research analyzes income inequality convergence from 1990 to 2013 with a focus on possible effects of the European Cohesion Policy funds. The study builds on LIS data on disposable household income for NUTS 2 units, using a top-bottom procedure for the removal of extreme values and LIS equivalence scale to equivalise. Savoia finds evidence of inequality convergence to higher levels of inequality across NUTS 2 units, which are thus becoming *"equally more unequal"*. This process is more pronounced for areas with comparable characteristics such as governance structures as well as eligibility for European Cohesion Policy funds.

There is also an increasing number of new studies of inequality convergence at the regional level for individual developing countries. One of them is the research by Bournakis et al. (2020), which studies income inequality

disparities and convergence across 27 Egyptian regions. The analysis is based on LIS data and finds evidence of unconditional income inequality convergence. Remington (2015) finds no evidence of regional convergence for Russia and China. Mendoza-Velazquez et al. (2020) study convergence of inequality across Mexican regions from 1940 to 2015. Most notably, the research also examines club convergence across Mexican states, the only comprehensive study to date to study club convergence in regional inequality for developing countries. The authors build on the methodology by Phillips and Sul (2007) to study club convergence, testing for club convergence of GDP per capita and the Euclidean Norm Index (ENI) index as measure of distribution. While the authors do not find evidence of inequality convergence over the entire sample, their results suggest that there are two convergence clubs.

2.3 Inequality and the state system

There is a large body of work on the impact of the state system on inequality. This includes both research that studies the impact of state systems on convergence in per capita incomes across regions (usually measured using GDP per capita) as well as studies that focus on the impact of the state system, and federalism in particular, on interpersonal income inequality at the national level. The former literature builds on public finance research that analyses the impact of decentralized policy making on inequality. Studies such as Rodriguez (2006) and Bolton and Roland (1997) note that decentralization of taxation in the absence of equalization policies that redistribute from richer to poorer regions is associated with higher disparities among regions. Poorer regions with a lower tax base and expenditures may then be less able to fund social services and invest in human capital and infrastructures which fosters interpersonal income inequality within poorer regions. On the other hand, decentralized decision making may enable regional policy makers to set more effective and context-specific regional policies which could reduce inequalities among regions (see for instance studies by Ezcurra and Pascual, 2008 and

Qian and Weingast, 1997). The study by Sorens (2014) finds that greater regional autonomy and fiscal federalism is associated with convergence in per-capita incomes across OECD regions. Van Rompoy (2020) finds that autonomous regional tax revenue and transfers are associated with convergence.

A number of studies also focus on developing countries, arguing that the mechanisms that foster convergence among decentralized regions in developed countries do not apply or apply to a lesser extent to developing countries. Studies (see for instance Lessmann, 2012; Tanzi, 1996 and Kyriacou et al., 2017) have pointed to a lack of institutional capacity, government "quality", and coordination issues as potential roadblocks to convergence among regions in federal systems in developing countries. Rodriguez-Pose and Ezcurra (2010) find evidence that decentralization reduces disparities in developed countries, while finding the opposite effect in developing countries, arguing that quality of government and institutions acted as the difference makers. Hanson (2006) provides evidence of the impact of weak institutional capacity on inequality for the case of Russia.

While the aforementioned research focuses on the impact of state systems on inequality among states, the evidence on income inequality within subnational regions is less clear cut. While decentralization and tax autonomy may be able to foster convergence among states, competition among decentralized regions often entails granting tax cuts to foster investment, which, while potentially narrowing gaps between regions may increase inequalities *within* regions. Some (see for instance Wildasky, 1986 and Linz and Stepan, 2000) have argued that federalism is associated with greater income inequality. Schapiro (2020) argues that a lack of equalization increases both social and economic inequalities in the United States. Morelli and Seaman (2007) find that decentralization has increased income inequality in the United Kingdom. There are also a number of studies hat have found a positive impact of fiscal decentralization on income inequality. Kelly and Witko (2012) for the

case of the United States have found evidence that income inequality may be reduced in states that prioritize policies that reduce income inequality most commonly associated with left political parties. For the case of Switzerland, for which data is available at a highly disaggregated cantonal level, Feld et al. (2021) find evidence that tax decentralization is associated with lower inequality mostly due to its effects on pre-tax income. Tselios et al.(2012) find that greater fiscal decentralisation reduces income inequality for the case of Western Europe. Sepulveda and Martinez-Vazquez (2011) conclude that for a panel of thirty-four countries decentralization is associated with lower income inequality.

While this body of work provides rich empirical evidence on the impact of federalism on both regional convergence and inequality, there is thus far limited evidence on the impact of federalism on income inequality convergence among states, i.e. the effects of federalism on regional income inequality levels in a comparative context. Indeed, building on the body of work on state systems and convergence in per-capita incomes, it can be assumed that unitary governance structures are more likely to be associated with regional income inequality convergence, as unitary systems reduce policy variation within a country. This is in line with research by Benabou (1996) and Savoia (2019), which highlight the role of comparable governance structures in fostering inequality convergence. In a unitary system, individual regions are less likely to "do better" or "worse" with regards to income inequality compared to other regions, as there is less policy autonomy and fiscal resources in a unitary state system that would enable an individual region to outperform others. In other words, in a unitary system income inequality is more likely to converge to a common level as there is no variation in regional policy. This does not necessarily entail that unitary systems foster inequality convergence to a lower level of inequality. As Savoia (2019) finds for the case of the EU inequality could also converge to higher levels.

From these three strands of literature, two main testable hypotheses can

be derived, which can be assessed using the methodologies and data described in the succeeding section:

Hypothesis 1: Income inequality converges across regions.

Hypothesis 2: Unitary state systems are associated with regional income inequality convergence.

3 Methodological Framework and Data

3.1 Inequality convergence

The "traditional" test for convergence builds on the work of Barro and Sala-i-Martin (1992) and regresses changes over a given time horizon on an initial level of the indicator under observation. In the case of Barro and Sala-i-Martin (1992) this latter indicator is income per capita. In the context of inequality convergence, the same principle can be applied to the Gini coefficient. As noted by Ravallion (2003), the equation to test for inequality convergence can be expressed as follows:

$$G_{iD} - G_{i0} = a + bG_{i0} + e_i \tag{1}$$

where G_{iD} denotes the Gini coefficient observed in time D and G_{i0} the Gini coefficient in the base year. b represents the parameter of interest, commonly referred to as the convergence parameter. If this parameter is negative and statistically significant, there is indication of convergence.

The Gini coefficient is defined as follows (see Cowell, 1995):

$$G = \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} |x_i - x_j|}{2n^2 x} \tag{2}$$

3.2 Inequality convergence clubs

The analysis of convergence clubs is based on the original contribution by Phillips and Sul (2007). The intuition underlying this research is to move beyond a conception of convergence that is homogenous. Instead of assuming that all units converge using a common transition path, Phillips and Sul (2007) provide a methodological approach that allows for the analysis of heterogenous paths. The method has been applied largely in the analysis of convergence in per capita incomes (see for instance Bartowska and Riedl, 2012) with a few exceptions, notably the aforementioned work by Mendoza-Velazquez et al. (2020), which studies inequality convergence clubs in the case of Mexico.

Following the methodology of Phillips and Sul (2007) the model of convergence clubs can be used for the specific case of inequality convergence, thus introducing the second moment, i.e. a Gini coefficient as measure of distribution, instead of the first moment, i.e. per capita income, used by the authors in the original 2007 paper. In line with Mendoza-Velazquez et al. (2020), a factor model can be specified as follows:

$$X_{it} = \delta_{it}\mu_t \tag{3}$$

with δ_{it} representing a transition parameter and μ_t a common growth component.

In line with Phillips and Sul (2007), a semi-parametric model can then be written to test for the hypothesis of convergence by looking at the parameter of interest, which is δ_{it}, i.e. the time-varying coefficient:

$$\delta_{it} = \delta_i + \frac{\sigma_i \xi_{it}}{L(t)t^{\alpha}} \tag{4}$$

with δ_i being a fixed parameter, σ_i an idiosyncratic scale parameter, ξ_{it} being

i.i.d (0,1), α the decay rate, and L(t) a varying function (see Bartowska and Riedl, 2012 and Mendoza-Velazquez et al., 2020).

A log-t test can then be performed with a null hypothesis:

$$H_0 : \delta_i = \delta \text{ and } \alpha \geq 0$$

and alternative hypothesis:

$$H_A : \delta_i \neq \delta \text{ and } \alpha < 0$$

For a model specified as follows that can be estimated using OLS:

$$log\frac{H_A}{H_t} = \alpha + \beta logt + u_t \tag{5}$$

with $\frac{H_A}{H_t}$ being the variance ratio for a cross sectional setting and β as the convergence parameter associated with the time-variant parameter δ_{it} (see Sichera and Pizzuto, 2019, P. 143).

3.3 Data availability and preparation

Before looking closer into the available data, it is imperative to establish the level of analysis and clearly define the geographic units that will be analyzed. While being a cross-national study, this study will look at subnational units, i.e. at state-level units, equivalent to US states. For Brazil, for instance, it will conduct analysis for the 27 regions that make up the Brazilian federal state. Throughout the paper the terms regional and subnational will be used interchangeably. In the context of this study, the term "region" exclusively refers to subnational geographic units.

In order to collect evidence on regional inequality convergence, LIS data represents an ideal starting point, given the rich disaggregation that the LIS micro-data offer, particularly with regards to regional disaggregation. For the

purpose of this study, all countries are selected for which data is available at the regional level that represent established policy units. This means that a small number of countries, most notably Peru and South Africa, for which the regional disaggregation in LIS data does not align with policy units are excluded from the sample. The need for regionally disaggregated units to represent policy units is an important assumption to ensure that the analysis captures actual policy units that could explain variations in regional policy making in federal or hybrid state systems. Table 1 below shows a short overview of the data available, including base and latest years, for which consistent regional data is available.

The key variables of interest from the LIS data for the scope of this study is disposable household income (dhi). A number of steps are implemented for data preparation of LIS microdata for the purpose of this study. All years are subject to top and bottom coding to eliminate data with extreme values. Moreover, the data is equivalised with the LIS equivalence scale, which equivalizes the disposable household income with the square root of individuals in a household. The income data is also adjusted by CPI and PPP using PPP deflators provided by LIS[2] to enable comparability between countries and regions.

Table 2 denotes a summary of key statistics for the selected LIS countries for the latest available year. In addition to the distributional data from LIS, Table 2 also contains data on the state system in the column entitled "Unitarism", which contains a measure of the state system devised by Gerring and Thacker (2004), for which higher values denotes greater unitarism and conversely lower values greater federalism. In the subsequent estimations, this study also draws on IMF data for tax decentralization and expenditure decentralization, defined as the percentage of regional tax revenue and expenditure in total national revenue and expenditure (IMF, 2022).

[2]see www.lisdatacenter.org/resources/ppp-deflators/

Table 1: Data availability for convergence analysis

Country	Base year	Latest year	Number of regions
Australia	1981	2018	7
Austria	1995	2019	9
Brazil	2006	2016	27
Canada	1971	2018	10
China	2002	2013	15
Colombia	2004	2016	23
Czech Republic	2002	2016	14
Estonia	2000	2016	16
Finland	2000	2016	21
France	1996	2018	21
Georgia	2010	2019	10
Germany	1991	2019	16
Greece	2004	2010	13
Guatemala	2006	2014	22
Hungary	1999	2015	20
India	2004	2011	33
Israel	2012	2018	19
Italy	1987	2016	19
Japan	2008	2013	8
Lithuania	2009	2018	10
Luxembourg	2007	2019	12
Mali	2011	2020	9
Mexico	1984	2018	32
Panama	2007	2016	12
Paraguay	2000	2016	16
Poland	1999	2020	16
Russia	2013	2019	54
Serbia	2013	2019	5
Slovakia	1996	2018	8
Spain	1980	2016	17
Sweden	2000	2005	21
UK	1969	2018	12
US	1974	2020	51
Uruguay	2004	2016	19
Vietnam	2005	2013	8

Table 2: Summary Statistics

Country	Latest Year	Mean (dhi)	Median (dhi)	P90/P50 ratio (dhi)	Gini (dhi)	Unitarism
Australia	2018	39031	33330	1.98	0.329	1
Austria	2019	37774	34097	1.80	0.274	4
Brazil	2016	10046	6939	2.91	0.482	1
Canada	2018	39444	34754	1.91	0.306	3
China	2013	8478	6738	2.42	0.399	N/A
Colombia	2016	8194	5598	2.86	0.474	2
Czech Republic	2016	21336	19155	1.74	0.254	5
Estonia	2016	20522	18286	2.03	0.314	5
Finland	2016	31380	28139	1.71	0.258	5
France	2018	31130	26971	1.87	0.303	4
Georgia	2019	6716	5428	2.33	0.379	5
Germany	2019	35349	31484	1.80	0.296	1
Greece	2016	16362	14151	1.95	0.323	5
Guatemala	2014	6050	4465	2.37	0.411	5
Hungary	2015	14378	12675	1.79	0.268	5
India	2011	4297	2673	3.34	0.501	1
Israel	2018	27385	23810	2.05	0.342	5
Italy	2016	22350	19504	2.00	0.339	3
Japan	2013	28311	24576	1.88	0.316	4
Lithuania	2018	20352	16773	2.26	0.359	5
Luxembourg	2019	49823	43199	1.91	0.296	5
Mali	2020	3430	2733	2.33	0.365	5
Mexico	2018	8967	6530	2.56	0.426	1
Panama	2016	16942	11974	2.87	0.461	5
Paraguay	2016	11871	7995	2.86	0.489	3
Poland	2013	14748	12633	1.95	0.318	4
Russia	2019	19942	16615	2.10	0.323	1
Serbia	2016	9582	8494	1.94	0.328	N/A
Slovakia	2018	15719	14901	1.63	0.236	5
Spain	2016	26403	23048	2.02	0.341	3
Sweden	2005	24661	22953	1.62	0.237	5
UK	2018	31659	26554	2.07	0.317	4
US	2020	52610	42786	2.23	0.374	1
Uruguay	2016	15290	12178	2.31	0.360	5
Vietnam	2013	9449	7799	2.15	0.350	N/A

In interpreting the results in the subsequent section, it is critical to keep in mind that disaggregated indicators are not designed to be representative surveys at the subnational level. It is thus important to take a close look at the number of observations within the subnational units, which represent the basis for the calculation of the Gini coefficient. Table 3 below shows the average number of households by region for the latest year available. As the table suggests the number varies across countries. In Colombia, there are in excess of 9600 households on average for each region, while in Georgia only 299. This impacts the accuracy of the Gini coefficient and should be taken into account when interpreting the results for the various countries.

Table 3: Average number of households within regions

AUS	AT	BRA	CAN	PRC	COL
1758	669	5489	4086	1193	9632
CZ	EST	FIN	FRA	GEO	GER
622	385	537	2309	299	1176
GRE	GUA	HUN	IND	ISR	ITA
5686	524	139	1278	463	371
JPN	LIT	LUX	MAL	MEX	PAN
294	513	232	745	2333	887
PAR	POL	RUS	SER	SLK	ESP
639	2096	767	1614	699	723
SWE	SWI	UK	US	URU	VIE
775	999	1597	1213	830	1174

4 Results

4.1 Regional inequality convergence: Pooled estimations

A first set of results can be drawn from a pooled regression that pools all available regions within one estimation. The results are reported in Table 4.

The model is estimated using a number of specifications, which differ with regards to the independent variables and controls. In order to take account

Table 4: Cross-Country Pooled Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Base-year Gini	-0.0241***	-0.0535***	-0.0093***	-0.0062	-0.0259***	-0.0247***	-0.0254***	-0.0264**
	(0.0022)	(0.0031)	(0.0008)	(0.0039)	(0.0027)	(0.0052)	(0.0015)	(0.0108)
Unitarism			-0.0010***	0.0006				
			(0.0001)	(0.0004)				
BaseGini*Unitarism				-0.0052***				
				(0.0013)				
Tax Decentralization					-0.0006	0.0017		
					(0.0010)	(0.0046)		
BaseGini*TaxDecentr						-0.0041		
						(0.0161)		
Expenditure Decentr.							0.0018	0.0009
							(0.0024)	(0.0093)
BaseGini*ExpDecentr								0.0026
								(0.0288)
Country Dummies	No	Yes	No	No	No	No	No	No
Intercept	0.0065***	0.0186***	0.0093***	0.0051***	0.0066***	0.0063***	0.0058***	0.0061*
	(0.0007)	(0.0016)	(0.0008)	(0.0013)	(0.0008)	(0.0015)	(0.0015)	(0.0036)
R^2	0.1523	0.5574	0.191	0.2123	0.156	0.15965	0.1526	0.1526
N	621	621	593	593	486	486	339	339

of issues relating to heteroskedasticity in the distribution of error terms, all model specifications are estimated using weighted least squares (WLS). In analysing the results, there is strong evidence in these pooled estimations that income inequality is converging across regions. All specifications, with the exception of specification 4, show significant negative beta coefficients, which is associated with convergence. This result is robust to the inclusion of country control dummies in specification 2.

An important result is also the statistical significance of the unitarism variable. As shown in specifications 3 and 4, the coefficient for unitarism is significant and negative, suggesting that a larger value for unitarism is associated with lower growth in income inequality and importantly, as suggested by the interaction term between the base Gini and the unitarism variable - called BaseGini*Unitarism - is also statistically significant, suggesting that regional income inequality convergence is indeed associated with unitary state systems. The two additional variables tax decentralization and revenue decentralization are not statistically significant.

4.2 Regional inequality convergence: Within-country evidence

The Pooled estimations come with the important caveat that they weigh different countries differently as countries with more regions will be "over-represented" in the dataset. It is thus instructive to analyse whether the trend of convergence is also visible at the national level. The disaggregation of LIS data to the regional level allows for an in-depth insight into subnational inequality convergence. Table 5 reports the convergence coefficients for the set of countries. A large number of countries show significant negative convergence coefficients, suggesting regional inequality convergence within these countries. A number of countries however also fail to show evidence of regional income inequality convergence, including Australia, Austria, France,

Italy and Poland, suggesting that trends observed in the pooled estimation are not universal and there is heterogeneity at the within-country level.

Table 5: Within-country Beta Coefficients

AUS	AT	BRA	CAN	PRC	COL
-0.0110	0.0023	-0.037	-0.0317***	-0.0370**	-0.0684***
CZ	EST	FIN	FRA	GEO	GER
-0.0644***	-0.0469***	-0.0086	-0.0245	-0.0042	-0.0251
GRE	GUA	HUN	IND	ISR	ITA
-0.1490***	-0.1137***	-0.0674***	-0.0945***	-0.0593***	-0.0157
JPN	LIT	LUX	MAL	MEX	PAN
-0.1201	-0.0886***	-0.0643***	-0.0136	-0.0298***	-0.0634***
PAR	POL	RUS	SER	SLK	ESP
-0.0397***	-0.0032	-0.1396***	-0.2448	-0.0620***	-0.0201***
SWE	UK	US	URU	VIE	
-0.0714***	-0.0003	-0.0167***	-0.0713***	-0.1290*	

An interesting insight that can be calculated using the regression coefficients is the Gini coefficient to which regions will converge to. As suggested by Bournakis et al. (2020), this can be deduced by dividing the absolute value of the intercept coefficient by the absolute value of the beta coefficient. Table 6 reports these values for the set of countries under review. For the Czech Republic, for instance, this value suggests a convergence to a Gini coefficient of 0.2429, while for Mexico 0.4.

Table 6 is color-coded to show which countries' regions converge to Gini coefficients that are above the global level of 0.2888, as suggested by the pooled estimations in the preceding subsection. It suggests that a large number of countries converge to levels of regional income inequality that are above the level that regions are converging to globally and thus to a higher steady state. There is scope for further research into the determinants of lower and higher steady state levels at the national level compared to the global convergence level. The large difference between countries like Sweden and Paraguay, with convergence "targets" of 0.2 and 0.49, respectively, high-

light the importance of underlying structural factors that determine what levels region converge to.

Table 6: Gini coefficients that regions converge towards:

AUS	AT	BRA	CAN	PRC	COL
-	-	-	0.3028	0.4144	0.4407
CZ	EST	FIN	FRA	GEO	GER
0.2429	0.2864	-	-	-	0.3075
GRE	GUA	HUN	IND	ISR	ITA
0.3070	0.3764	0.2387	0.4651	0.2709	-
JPN	LIT	LUX	MAL	MEX	PAN
-	0.3401	0.2698	-	0.4009	0.3752
PAR	POL	RUS	SER	SLK	ESP
0.4867	-	0.2517	-	0.2352	0.3228
SWE	SWI	UK	US	URU	VIE
0.2010	-	-	0.3749	0.3070	0.3407

4.3 Convergence club analysis

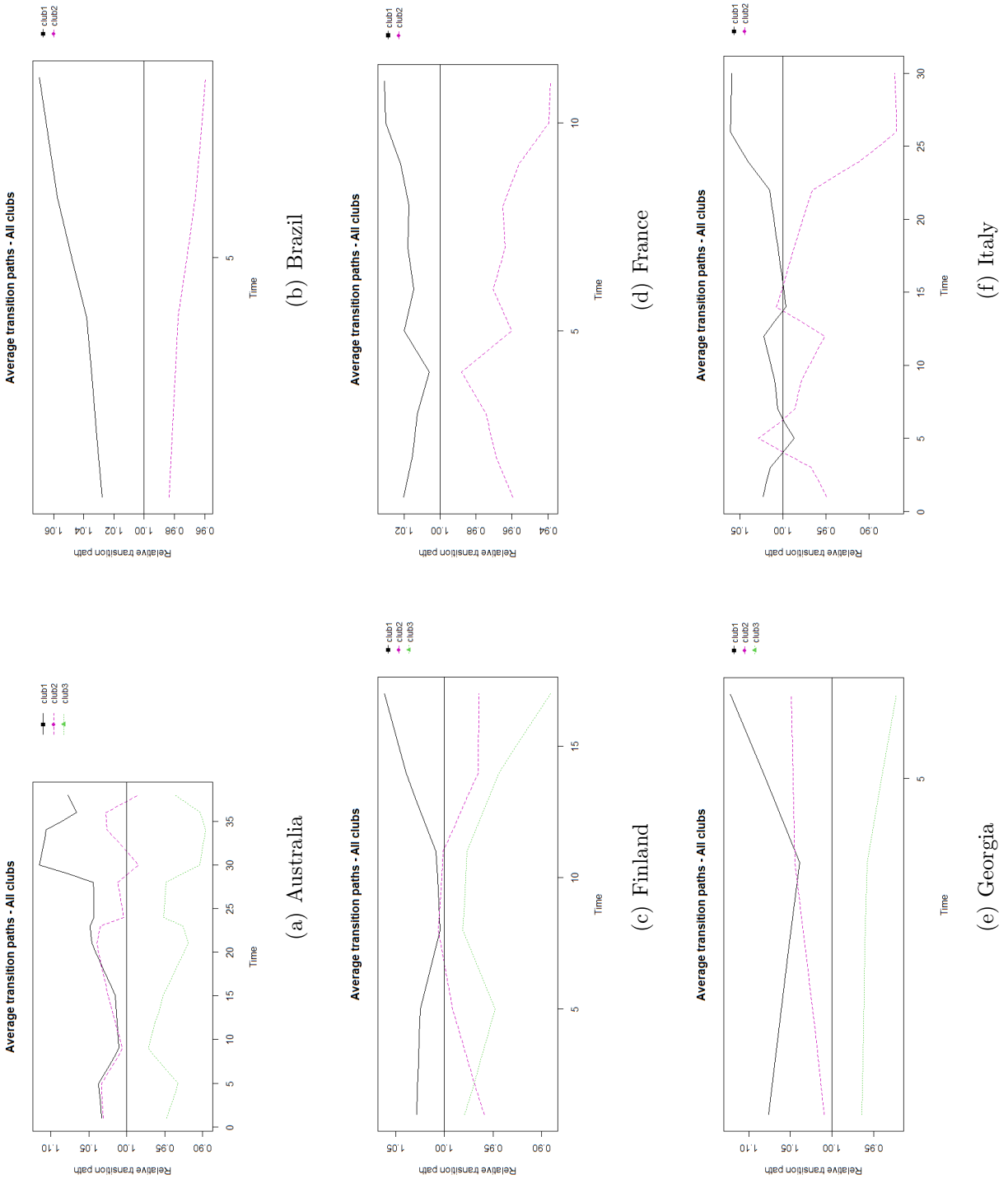
The convergence club analysis enables the researcher and policy practitioner to gain insights into whether there are heterogenous inequality convergence paths in countries that do not exhibit evidence of convergence. Table 7 shows the convergence clubs of the countries that do not display a homogenous convergence path. Figures 1 and 2 show the respective paths of convergence for different clubs. The Annex reports the regions that represent the members of the individual convergence clubs and shows their individual transition paths. The analysis suggests that Germany, the UK, and Austria show evidence of convergence as only one convergence club can be identified, although Austria also shows two divergent units (Vienna and Burgenland).

It is noteworthy that a number of regions that have outperformed or underperformed other regions are located in federal countries, such as Santa Caterina in Brazil - an example of the former - or South Australia for the latter. Thus, while unitary systems may foster convergence on homogenous transition paths, policy autonomy in federal systems may be associated with

more positive and negative outliers. The policies and factors that lead to an above average reduction in inequality could provide useful policy lessons that could be replicated in other regions. Further research on individual countries could identify such regional strategies.

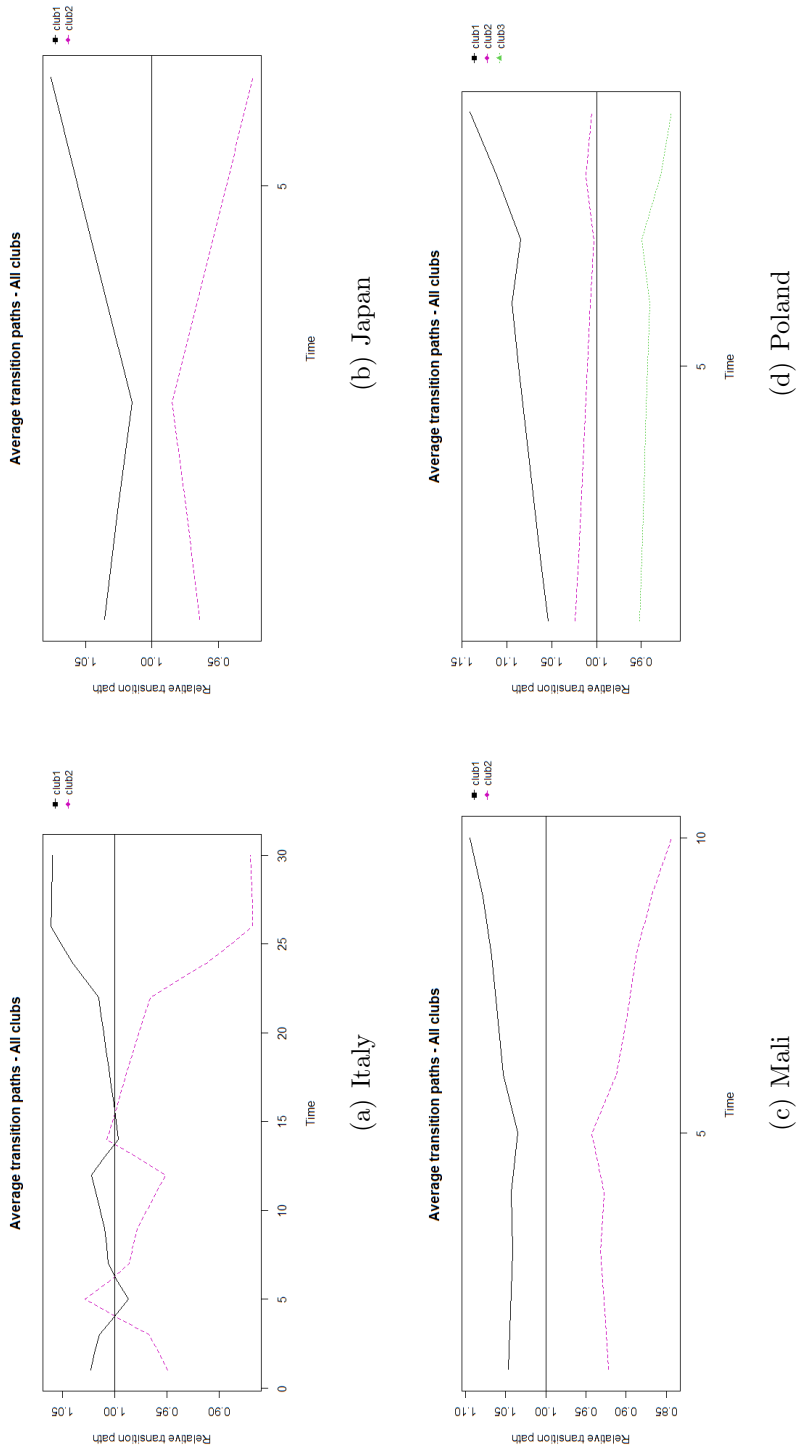
Table 7: Convergence Clubs

Country	Conv. Clubs	Nr. of units	Beta	Std. Error	t-Value
Australia	Club 1	2	-0.322	0.695	-0.464
	Club 2	2	-1.97	1.352	-1.457
	Club 3	2	-1.226	1.982	-0.619
	1 divergent unit				
Austria	Club 1	7	-0.571	0.546	-1.046
	2 divergent units				
Brazil	Club 1	10	-0.466	0.287	-1.62
	Club 2	17	-0.231	0.212	-1.089
Finland	Club 1	10	-0.226	0.377	-0.601
	Club 2	5	-1.09	0.75	-1.454
	Club 3	4	0.456	1.077	0.424
France	Club 1	14	-0.821	0.529	-1.551
	Club 2	7	-0.514	0.605	-0.849
Georgia	Club 1	2	-0.841	2.693	-0.312
	Club 2	3	1.3	0.839	1.548
	Club 3	5	0.189	0.924	0.204
Germany	Club 1	16	-0.658	0.403	-1.634
Italy	Club 1	13	0.023	0.184	— 0.124
	Club 2	6	-0.1	0.528	-0.19
Japan	Club 1	4	-2.727	1.807	-1.509
	Club 2	4	3.489	0.492	7.096
Mali	Club 1	5	0.151	1.296	0.116
	Club 2	3	-0.49	0.879	-0.558
Poland	Club 1	4	0.327	0.411	0.796
	Club 2	5	-0.861	0.545	-1.579
	Club 3	7	-0.26	0.324	-0.802
UK	Club 1	11	0.273	0.232	1.178



(a) Australia (b) Brazil (c) Finland (d) France (e) Georgia (f) Italy

Figure 1: Convergence club transition paths



(a) Italy (b) Japan

(c) Mali (d) Poland

Figure 2: Convergence club transition paths

5 Concluding Remarks

The preceding research has found evidence of regional inequality convergence in line with hypothesis 1, particularly in the pooled estimations that contain 621 regions for which comparable Luxembourg Income Study (LIS) data is available. Within countries, the evidence is mixed: 25 out of 36 countries under review show evidence of inequality convergence within the country. A small number of countries have more than 2 distinct convergence clubs, namely Australia, Finland, Georgia and Poland.

What insights can the results yield on the role of subnational policy making and the effect of the state system on inequality convergence? This is an important question for researchers and policy makers alike. Is there evidence that the state system matters with regards to inequality convergence as stated in Hypothesis 2? The findings suggest that unitarism is associated with inequality convergence across regions. It is critical to keep in mind that convergence does not necessarily mean that inequality decreases. As Savoia (2019) has found, convergence across NUTS2 regions in Europe is making states *"equally more unequal"*. The results suggest that there is evidence that unitarism plays a role in fostering homogeneous subnational inequality convergence, while under federal systems different regional policies may lead to heterogenous regional inequality trends. This result should be further scrutinized through additional research using a larger panel of countries, which will be possible once further LIS data becomes available going forward.

The paper suggests that convergence club analysis can provide a useful complementary tool to explore inequality trends at the national level and thus inform and help target regional inequality policy. Researchers and policy practitioners alike can use convergence clubs to study the heterogeneity of convergence paths and identify regions that provide case studies that can be emulated. In ending this paper in the same way that it began, the following quote from Atkinson (2004) captures the way forward for inequality

convergence analysis and the need for further quality, comparable data from a source like LIS: *"With each Wave, the data from a new year become more valuable"* (P. 182). This is certainly true for the study of regional inequality convergence.

References

[1] Atkinson, Anthony B. (2004): The Luxembourg Income Study (LIS): past, present and future. *Socio-Economic Review, 2*,pp. 165-190.

[2] Barro, Robert, J. and Xavier Sala-i-Martin (1992): Convergence. *Journal of Political Economy, Vol. 100, No. 2,* pp. 223-251.

[3] Bartkowska, Monika and Aleksandra Riedl (2012): Regional convergence clubs in Europe: Identification and conditioning factors. *Economic Modelling, 2012, vol. 29, issue 1,* pp. 22-31.

[4] Benabou, Roland (1996): Inequality and Growth. *NBER Macroeconomics Annual 1996, Volume 11.*

[5] Bolton, Patrick and Gerard Roland (1997): The breakup of nations: a political economy analysis, *Quarterly Journal of Economics* 112(4), 1057?1090.

[6] Bournakis, Ioannis; Mona Said, Antonio Savoia and Francesco Savoia (2020): Regional Income Inequality in Egypt: Evolution and Implications for Sustainable Development Goal 10, *LIS Working Paper Series, No. 798.*

[7] Cowell, Frank A. (1995): *Measuring Inequality*, Hemel Hempstead, Harv. Wheatsheaf.

[8] Deininger, Klaus and Lyn Squire (1995): *Measuring income inequality: A new database,* World Bank.

[9] Ezcurra, Roberto and Pedro Pascual (2008): Fiscal decentralization and regional disparities: evidence from several European union countries, *Environment and Planning A 40(5)*, 1185?1201.

[10] Feld, Lars P.; Christian Frey, Christoph Schaltegger and Lukas A. Schmid (2021): Fiscal federalism and income inequality: An empirical analysis for Switzerland, *Journal of Economic Behavior and Organization.*

[11] Gerring, John and Strom C. Thacker (2004): Political Institutions and Corruption: The Role of Unitarism, and Parliamentarism, *British Journal of Political Science.*

[12] Hanson, Philip (2006): Federalism with a Russian face: regional inequality, administrative capacity and regional budgets in Russia, *Economic Change*, 39:191-211.

[13] International Monetary Fund (IMF) Database of Fiscal Decentralization, https://data.imf.org/?sk=1C28EBFB-62B3-4B0C-AED3-048EEEBB684F. Washington, DC: IMF.

[14] Kelly, Nathan J. and Christopher Witko (2012): Federalism and American Inequality, *The Journal of Politics*, Vol. 74, No. 2, pp. 414-426.

[15] Kyriacou, Andreas; Leonel Muinelo-Gallo and Oriol Roca-Sagales (2017): Regional inequalities, fiscal decentralization and government quality, *Regional Studies,*51(6), pp. 945-957.

[16] Lessmann, Christian (2012): Regional inequality and decentralization: an empirical analysis, *Environment and Planning A, 44 (6),* pp. 1363-1388.

[17] Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries and years, May-June 2022). Luxembourg: LIS.

[18] Stepan, Alfred, and Juan J. Linz (2011): Comparative Perspectives on Inequality and the Quality of Democracy in the United States. *Perspectives on Politics* 9,pp. 841-56.

[19] Mendoza-Velazquez, Alfonso; Vicente German-Soto, Mercedes Monfort and Javier Ordonez (2020): Club convergence and inter-regional inequality in Mexico, 1940-2015. *Applied Economics, 52:6,* pp. 598-608.

[20] Morelli, Carlo and Paul Seaman (2007): Devolution and inequality: a failure to create a community of equals?, *Transactions of the Institute of British Geographers*, pp. 523?538.

[21] Phillips, Peter and Donggyu Sul (2007): Transition Modeling and Econometric Convergence Tests. *Econometrica, Vol. 75, No. 6 (November, 2007),*pp. 1771-1855.

[22] Qian, Yingyi and Barry R. Weingast (1997): Federalism as a commitment to preserving market incentives, *Journal of Economic Perspectives*, 11(4), pp. 83-92.

[23] Ravallion, Martin (2003): Inequality convergence. *Economics Letters 80 (2003),* pp. 351-356.

[24] Remington, Thomas (2015): Why is interregional inequality in Russia and China not falling. *Communist and Post-communist Studies 48*, pp. 1-13.

[25] Rodriguez, Gabriel (2006): The role of the interprovincial transfers in the beta-convergence process, *Journal of Economic Studies*, 33(1), pp. 12-29.

[26] Rodriguez-Pose, Andres and Roberto Ezcurra (2010): Does decentralization matter for regional disparities? A cross-country analysis. *Journal of Economic Geography,* 10 (5), pp. 619-644.

[27] Savoia, Francesco (2020): Income Inequality Convergence Across EU Regions, *LIS Working Paper Series, No. 760.*

[28] Schapiro, Robert A. (2020): States of Inequality: Fiscal Federalism, Unequal States, and Unequal People, *California Law Review*, 1531.

[29] Sepulveda, Cristian F. and Jorge Martinez-Vazquez (2011): The consequences of fiscal decentralization on poverty and income equality, *Environment and Planning C: Government and Policy*, 29, pp. 321-343.

[30] Sichera, Roberto and Pietro Pizzuto (2019): ConvergenceClubs: A Package for Performing the Phillips and Sul's Club Convergence Clustering Procedure. *The R Journal Vol. 11/2, December 2019.*

[31] Sorens, Jason (2014): Does Fiscal Federalism Promote Regional Inequality? An Empirical Analysis of the OECD, 1980?2005, *Regional Studies,* Vol. 48, No. 2, pp. 239-253.

[32] Tanzi, Vito (1996): Fiscal decentralization: A review of some efficiency and macroeconomic aspects. In: M. Bruno and B. Pleskovic (Eds.), Annual World Bank Conference on Economic Development, pp. 539-567.

[33] Tselios, Vassilis, Andres Rodriguez-Pose, Andy Pike, John Tomaney, and Gianpiero Torrisi (2012): Income Inequality, Decentralisation, and Regional Development in Western Europe, *Environment and Planning A: Economy and Space* 44, no. 6.

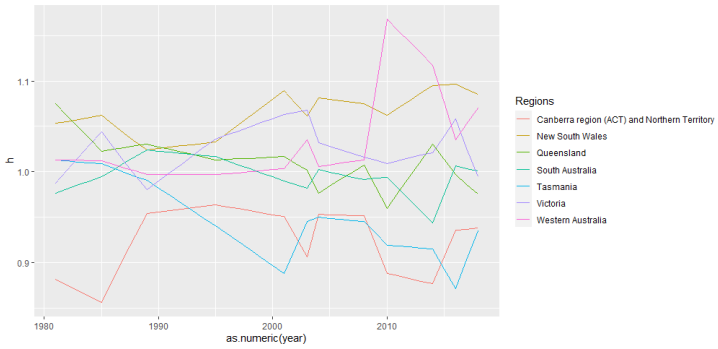
[34] Van Rompuy, Paul (2020): Does subnational tax autonomy promote regional convergence? Evidence from OECD countries, 1995?2011. *Regional Studies 55*, pp. 234-244.

[35] Wildasky, Aaron (1986): Federalism Means Inequality, *Society,* pp. 41-49.

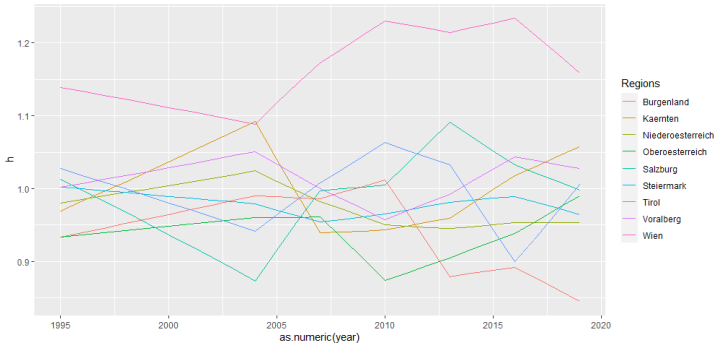
Annex

Table 8: Convergence Clubs

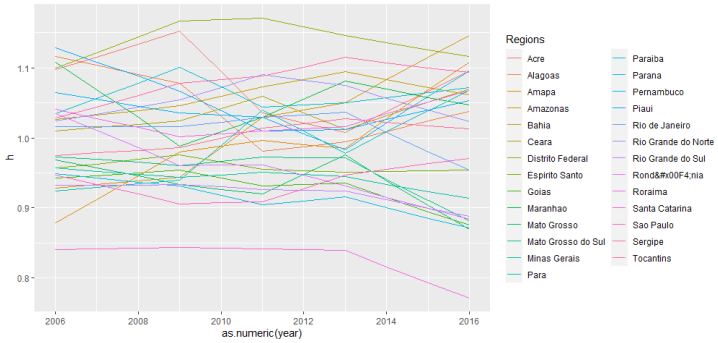
Country	Conv. Clubs	Regions
Australia	Club 1	New South Wales, Western Australia
	Club 2	Victoria, Queensland
	Club 3	Canberra region (ACT) and Northern Territory, Tasmania
	Divergent unit	South Australia
Austria	Club 1	Kaernten, Voralberg, Tirol, Salzburg, Oberoest., Steiermark, Niederoest.
	Divergent units	Wien, Burgenland
Brazil	Club 1	Distrito Federal, Sergipe, Bahia, Maranhao, Rio Grande do Norte
	Club 1 (cont.d)	Amazonas, Paraiba, Rio de Janeiro, Tocantins, Roraima
	Club 2	Piaui, Ceara, Acre, Alagoas, Amapa, Pernambuco, Para, Mato Gr., Goias
	Club 2 (cont.d)	Esp. Santo, S. Paulo, Minas Gerais, Rondonia, Rio Gr., Parana, S. Catarina
Finland	Club 1	Uusimaa, Pohjanmaa, Pirkanmaa, Varsinais-Suomi, Ahvenanmaa
	Club 1 (cont.)	Pohjois-Karjala, Keski-Suomi, Satakunta, Pohjois-Pohjanmaa, Kainuu
	Club 2	Pohjois-Savo, Kymenlaakso, Etelo-Pohjanmaa, Paijat-Hame, Kanta-Hame
	Club 3	Keski-Pohjanmaa, Lappi, Etelo-Karjala, Etela-Savo
France	Club 1	Ile-de-France, Limousin, Languedoc-Roussillon, Champagne-Ardenne
	Club 1 (cont.d)	Provence-Cote d'Azur, Poitou-Charentes, Midi-Pyrenees, Lorraine
	Club 1 (cont.d)	Alsace, Rhone-Alpes, Auvergne, Centre, Nord-Pas de Calais, Bourgogne
	Club 2	Picardie, Aquitaine, Bretagne, Haute-Normandie
	Club 2	Franche-Comte, Pays de la Loire, Basse-Normandie
Georgia	Club 1 & 2	Kakheti, Adjara, Mtskheta-Mtianeti, Kvemo Kartli, Tbilisi
	Club 3	Shida Kartli, Imereti, Samegrelo-Zemo
	Club 3 (cont.d)	Svaneti, Guria, Samtskhe-Javakheti
Italy	Club 1	Basilicata, Campania, Sicilia, Veneto, Lazio, Calabria, Lombardia
	Club 1 (cont.d)	Sardegna, Puglia, Emilia Romagna, Friuli, Piemonte, Umbria
	Club 2	Abruzzo, Liguria, Toscana, Trentino, Marche, Molise
Japan	Club 1	Chugoku, Kyushu, Kanto, Shikoku
	Club 2	Chubu, Hokkaido, Kinki, Tohoku
Mali	Club 1	Gao, Bamako, Mopti, Sikasso, Kayes
	Club 2	Tombouctou, Segou, Koulikoro
Poland	Club 1	Mazowieckie, Pomorskie, Kujawsko-Pomorskie, Podlaskie
	Club 2	Lubelskie, Swietokrzyskie, Lodzkie, Opolskie, Dolnoslaskie
	Club 3	Zachodnio-Pomorskie, Wielkopolskie, Malopolskie,
	Club 3 (cont.d)	Warminsko-Mazurskie, Podkarpackie, Slaskie, Lubuskie



(a) Australia

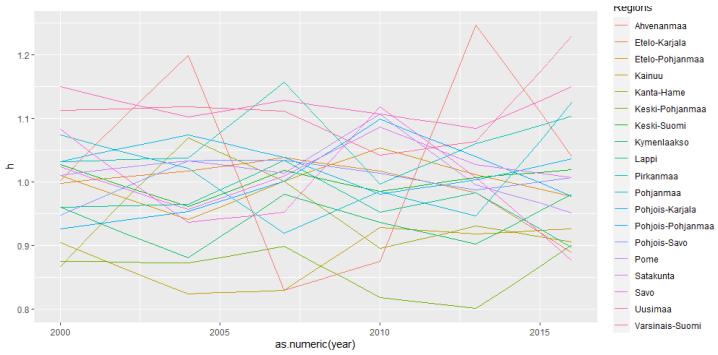


(b) Austria

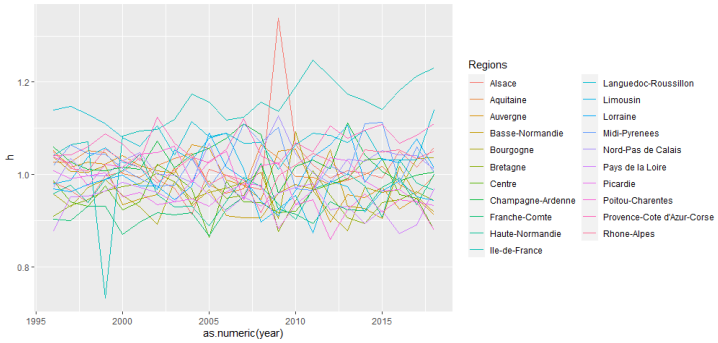


(c) Brazil

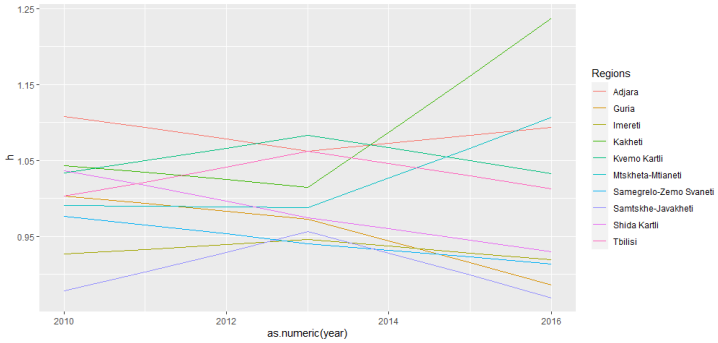
Figure 3: Convergence club regional transition paths



(a) Finland

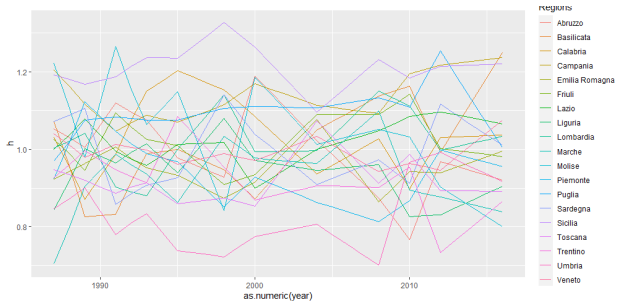


(b) France

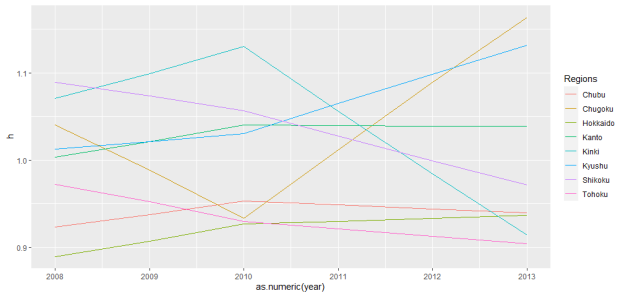


(c) Georgia

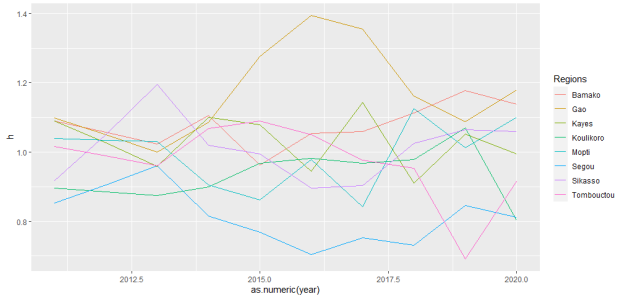
Figure 4: Convergence club regional transition paths



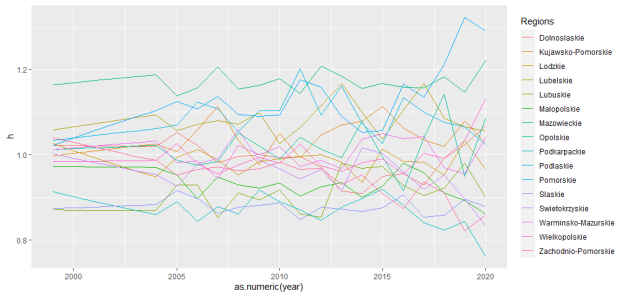
(a) Italy



(b) Japan



(c) Mali



(d) Poland

Figure 5: Convergence club regional transition paths