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# Regional GDP in OECD countries: How has inequality developed over time?

**Felix Arnold,**

**Hansjörg Blöchliger**

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**By Felix Arnold and Hansjörg Blöchliger**

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*Authorised for publication by Christian Kastrop, Director, Policy Studies Branch, Economics Department.*

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## ABSTRACT

### Regional GDP in OECD countries: How has inequality developed over time?

This paper surveys the state and evolution of GDP per capita in 281 regions of OECD countries for the time period 1995 – 2013. It puts a special focus on the disparities between the regions. These can be substantial: In 2013, GDP per capita of the least and most developed region varied by a factor of roughly ten. Using standard inequality measures like the coefficient of variation or the Gini coefficient, it is found that inequality has been decreasing between countries, while within-country disparities have often widened. Furthermore, transition matrices reveal that mobility within the distribution over time is higher in countries with larger degrees of fiscal decentralisation. This suggests that decentralisation allows regions to "take matters into their own hands". Implications of other factors that correlate with the level of economic development are also discussed.



Keywords: GDP per capita, inequalities, disparities, regions, OECD countries

JEL-Codes: D30; E01; H70; I31; O10; O57; R11; R12


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## RESUME

### Le PIB régional dans les pays de l'OCDE : comment les inégalités ont-elles évolué au fil du temps ?

Nous étudions dans ce document l'état et l'évolution du produit intérieur brut (PIB) par habitant dans 281 régions de pays de l'OCDE au cours de la période 1995-2013. Nous mettons l'accent sur les disparités entre régions, qui peuvent être substantielles. En 2013, le PIB par habitant variait d'un facteur de 1 à 10 environ entre les régions les moins développées et les plus développées. À partir de mesures classiques des inégalités telles que le coefficient de variation ou le coefficient de Gini, nous parvenons à la conclusion que les inégalités ont diminué entre les pays, tandis que les disparités se sont souvent accentuée à l'intérieur de chaque pays. En outre, des matrices de transition montrent que la mobilité à l'intérieur de la distribution au fil du temps est plus forte dans les pays caractérisés par un degré relativement élevé de décentralisation budgétaire. Cela laisse à penser que la décentralisation permet aux régions de « prendre les choses en mains ». Nous examinons également les implications d'autres facteurs corrélés au niveau de développement économique.



Mots-clés : PIB par habitant, inégalités, disparités, régions, pays de l'OCDE

Classification JEL : D30 ; E01 ; H70 ; I31 ; O10 ; O57 ; R11 ; R12

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# REGIONAL GDP IN OECD COUNTRIES: HOW HAS INEQUALITY DEVELOPED OVER TIME?

By Felix Arnold and Hansjörg Blöchliger[1]

## 1. Introduction and main findings

1. This paper surveys level and evolution of disparities in GDP per capita between 281 OECD regions for the time period 1995-2013. It provides background information on inequality between countries and regions and analyses changes in the distribution of regional GDP over time as a function of the degree of fiscal decentralisation.

2. The main findings are as follows:

- In 2013, GDP per capita varies by a factor of four between the richest (Luxemburg) and poorest (Chile) country. It varies by a factor of 10 between poorest (Araucania, Chile) and richest (Luxemburg, Luxemburg) region.
- Between 1995 and 2013, GDP per capita has increased in all countries except Greece. The increase is relatively larger in less developed countries (catching-up-effect or beta-convergence, see (OECD, 2009)).
- Inequality of GDP, as measured by the Gini coefficient, has gone down between 1995 and 2013 when comparing all 281 regions with each other. However, country specific Gini coefficients have gone up in the majority of countries. Put differently, between country inequality has decreased, while within country inequality has increased.
- The amount of inequality between regions and the level of GDP within a country are negatively related, indicating that countries in the sample lie on the downward-sloping side of the Kuznets curve (Kuznets, 1955).
- Transition matrices reveal that quite many regions change position in the rank ordering of all regions over time. This "mobility" is higher for regions located in countries with a high degree of

1. Felix Arnold was a staff member of the OECD Economics Department when writing the paper. Hansjörg Blöchliger is Senior Economist at the OECD Economics Department. They are grateful for comments from David Bartolini (Public Governance and Territorial Development Directorate), Peter Hoeller (Economics Department) and Sibylle Stossberg (German Federal Ministry of Finance (*Bundesministerium der Finanzen*), as well as from the delegates of the OECD Fiscal Network on earlier drafts. This paper is part of an OECD project on fiscal decentralisation and inequality. The other papers include an OECD Economic Policy Paper (Blöchliger, Bartolini and Stossberg, 2016), a working paper on fiscal decentralisation and regional disparities (Bartolini, Stossberg and Blöchliger, 2016) and a working paper on fiscal decentralisation and income inequality (Stossberg, Bartolini and Blöchliger, 2016).

fiscal decentralisation, suggesting that decentralisation may help regions to "take matters into their own hands".

- Regional GDP positively correlates with education, innovation and $CO_2$ emissions. It negatively correlates with unemployment rates and mortality. Political participation and GDP are unrelated.

3. The remainder of this paper is organised as follows. Section 2 reviews the literature and shortly introduces the data and inequality measures that will be employed throughout the paper. Section 3 gives an overview of the existing disparities in regional GDP per capita today. Section 4 surveys inequalities over time within and between countries. In Section 5, the level of economic development is contrasted with the extent of inequalities. Section 6 introduces the concept of a transition matrix and evaluates which factors explain changes in the rank ordering of the regions. Section 7 shows correlations of GDP per capita with other important variables that determine the quality of daily life in a country. Finally, Section 8 concludes.

## 2. Literature, data and inequality measures

### *2.1. Literature*

4. The literature on inequalities in terms of GDP per capita between regions is vast. While there are many country-specific reports on geographical disparities, only a few studies compare regions lying in several countries. (Monfort, 2008) surveys disparities between EU-27 NUTS2 regions for the years 1995-2005. He concludes that convergence between regions is stronger than previously assumed if one considers movements within the distribution over time instead of classic summary indicators of inequality. He uses Markov chain analyses to identify mobility within the distribution.[2] In a similar study for EU regions, (European Parliament, 2007) shows that there is still a strong imbalance in terms of economic development between regions in old and new member states. Furthermore, metropolitan and rural areas differ strongly in terms of GDP per capita. For OECD countries, (OECD, 2013) observes that within country inequalities are often larger than the differences between countries. This is especially true for the emerging economies of Indonesia, Russia, Colombia and Brazil. Furthermore, from 1995 to 2010, regional disparities have increased in 20 of the 33 countries considered.

5. How can one observe convergence between countries but a lack thereof at the regional level within countries at the same time? (Giannetti, 2002) offers one potential explanation: If international knowledge spillovers accrue differently to regions as a function of their specialization, this may exacerbate regional disparities. Likewise, agglomeration economies have been hypothesized to contribute to within-country inequality, while European integration probably brings countries closer together (Geppert and Stephan, 2008).

6. The European Union employs several policies to help lagging regions. These latter can receive grants from the EU structural or cohesion fund. Several papers have investigated the effect of these transfer payments on various regional outcomes, including economic growth. Using propensity score matching methods, (Becker, Egger and von Ehrlich, 2012) find that EU transfers enable faster growth in targeted regions. Using similar data but a different empirical methodology, (Mohl and Hagen, 2010) confirm the growth-enhancing effect of regional transfer payments. There is, however, also some evidence pointing in a different direction: (Checherita, Nickel and Rother, 2009) observe that transfers can cause a so-called "immiserising convergence". In their empirical model, growth rates of receiving regions decline by less than growth rates of giving regions as a consequence of the transfer payments. Still, both growth rates decline.

2. A similar approach has been taken by Le Gallo (2001), albeit for earlier years.

### *2.2. Data*

7. The main variable of interest will be regional GDP per capita, measured in 2010 USD and purchasing power parities. GDP is the standard measure of the value of the production activity (goods and services) of resident producer units. It is measured according to the definition of the System of National Accounts (SNA). To make comparisons over time and across countries, it is expressed at constant prices (year 2010), using the OECD deflator and then it is converted into USD purchasing power parities to express each country's GDP in a common currency. GDP per capita is calculated by dividing the GDP of a country or a region by its population. The data come from the OECD regional database, are available for the period 1995-2013, and comprise a balanced panel of 281 regions in 28 OECD countries.[3] The countries included in the analysis are Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxemburg, Netherlands, New Zealand, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom and the United States.

### *2.3. Inequality measures*

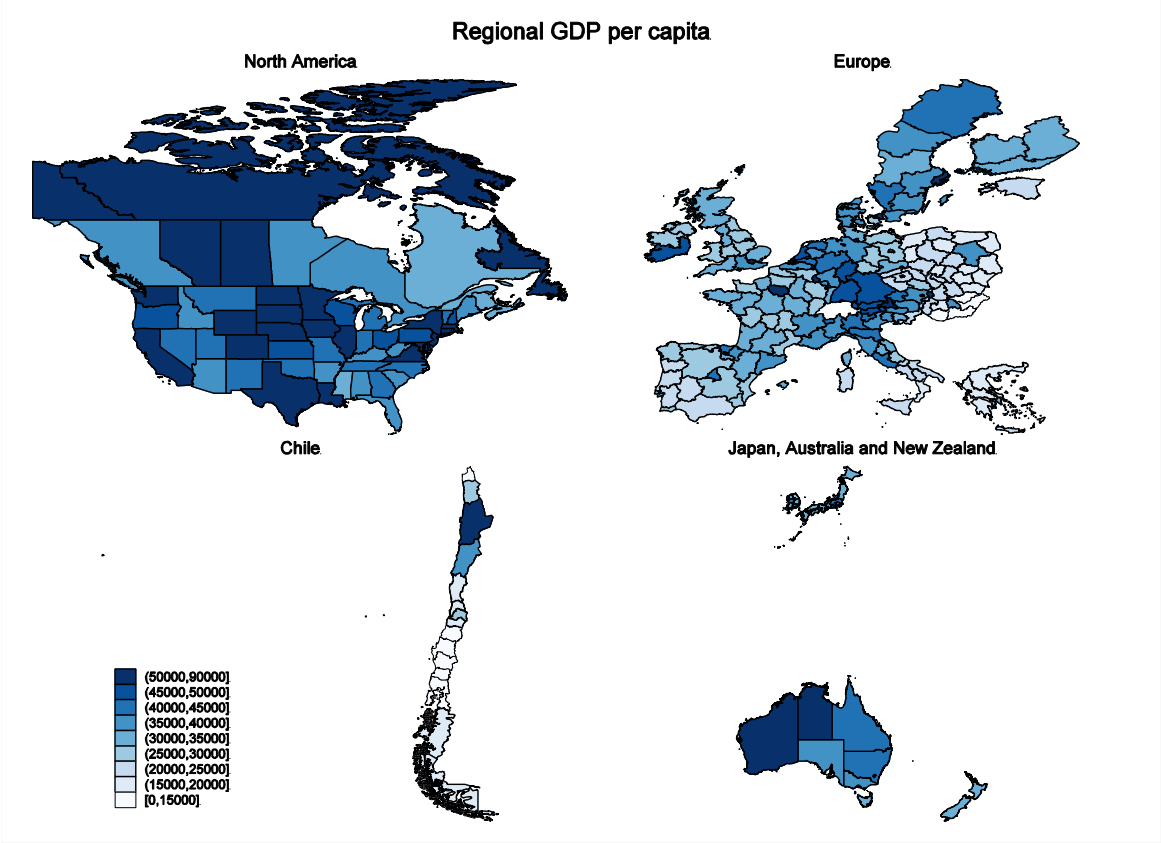
8. The extent of output disparities will be analysed using three measures commonly used in the literature: The coefficient of variation (CV), the Gini coefficient (Gini) and the range (R). The CV is defined as the standard deviation divided by the mean. It is hence a standardized measure of dispersion as it shows the extent of variability relative to the mean of the population. It takes only positive values, in theory varying between zero and infinity, where higher values mean higher disparities. The Gini is one of the most commonly used measures of inequality. It has a minimum of zero and a maximum of one. A Gini of zero expresses perfect equality, implying that all values are the same (for example, all regions have the same GDP per capita). A Gini of (close to) one, on the contrary, expresses maximal inequality of values (one region with very high GDP per capita, all others with very low GDP per capita). Finally, the range is used as a third indicator of inequality. It is defined as the maximum minus the minimum value in the distribution and therefore gives an easy-to-interpret measure of the spread of the distribution.

## 3. Current disparities in regional GDP

9. To get a first glimpse of different levels of economic development around the world, Figure 1 visualises GDP per capita in the year 2013 for all regions in the sample. Darker shades of blue on the map indicate higher levels of GDP per capita, while lighter shades represent lower levels. Countries where no data are available have been deleted from the map for reasons of space. The legend in the bottom left corner indicates which colours correspond to which interval of GDP per capita (again measured in 2010 USD and PPPs).

3. Some region-year observations are missing, which is why some values have been predicted using linear interpolation. In total, this concerns roughly 2% of all observations.

**Figure 1. Map of regional output disparities**

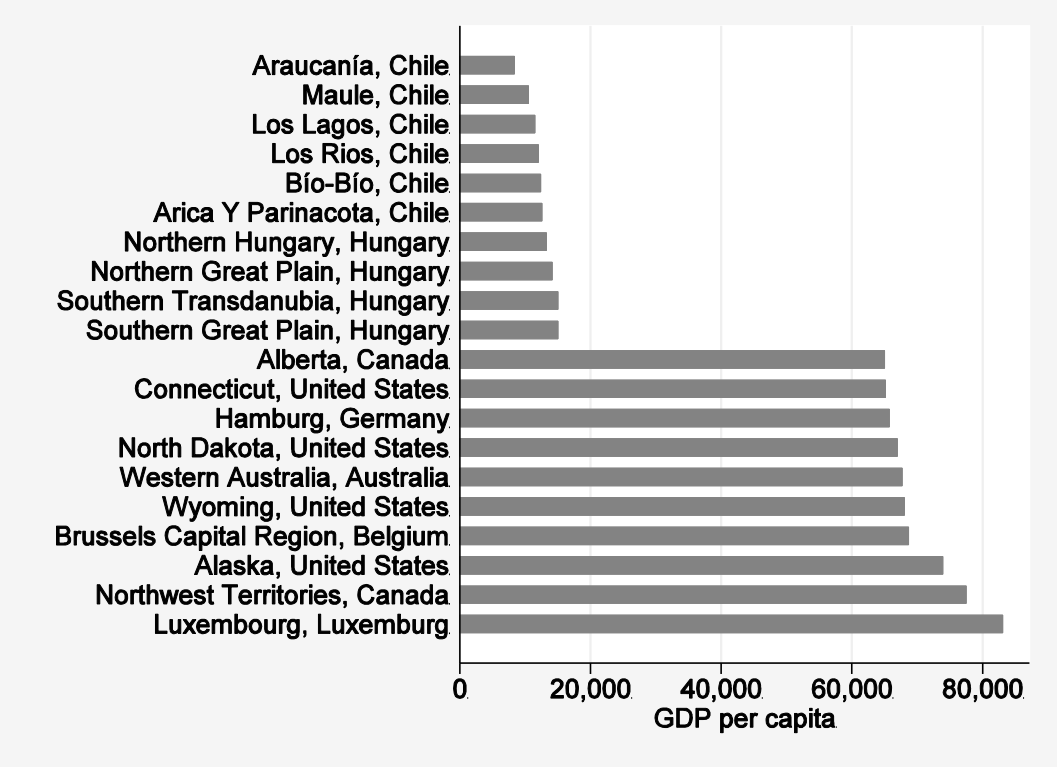



*Source*: Own illustration. The underlying geo data have been produced by the OECD Regional Development Policy Division through the information provided by National Statistical Offices and FAO Global Administrative Unit Layers (GAUL). This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

10. Disparities between countries, but also between regions within countries, are directly discernible. While North America and Australia have rather high levels of GDP per capita in almost all regions, the picture is somewhat less clear in Europe. Here, the south of Germany, the north of Italy, parts of Austria and the metropolitan regions of London, Paris and Stockholm display very high levels of economic development, while other regions in Poland, Greece or the south of Spain tend to be relatively poor. Inequalities are most striking in Chile, where the north and south diverge by large amounts.

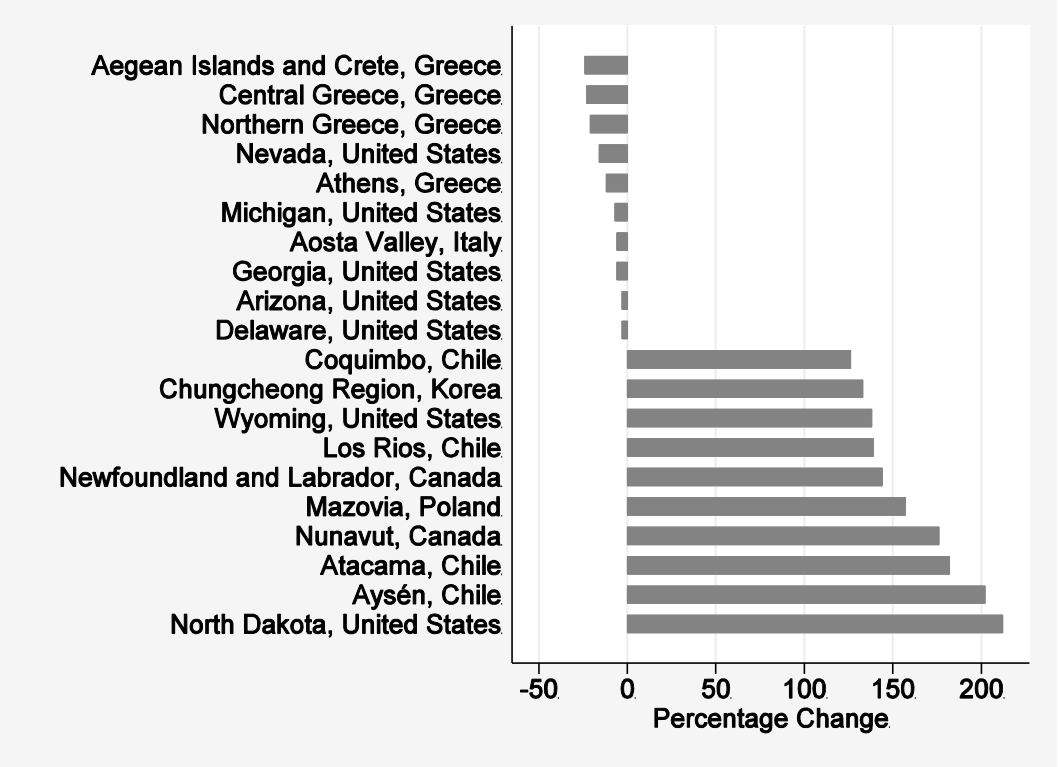
11. Figure 2 provides a list of the regions which are on the top and the bottom of the distribution in 2013. The ten least developed regions are located in only two countries, namely Chile and Hungary. The GDP of the least developed region, Araucania, was only USD 8 349 per capita in 2013. On the other end of the distribution, there is Luxemburg with USD 83 045 per capita. The two extremes thus differ by a factor of approximately ten. Other highly developed regions lie predominantly in the United States or Canada. To belong to the top ten, a GDP of at least USD 65 000 per capita was necessary in 2013.

**Figure 2. Highest / lowest 10 levels**




12. The level of development is important for daily life, but equally important are the changes over time. Regions can have a low level of development, but nevertheless be very dynamic in the sense that their GDP grows fast over time. Therefore, Figure 3 show again a top/flop list of the regions that saw the biggest changes in terms of GDP per capita over the period 1995-2013.

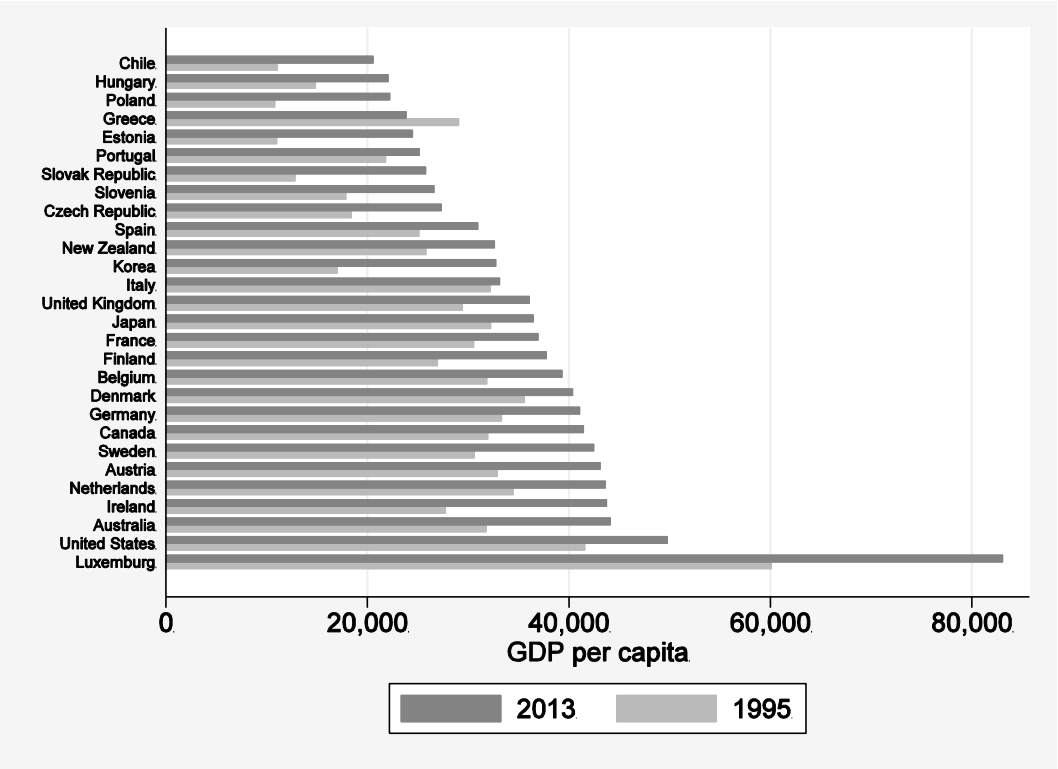
**Figure 3. Highest / lowest 10 changes**




13. This provides a very different picture. There are even some regions that have been shrinking over time, notably in Greece. But also in the United States, a country that is highly developed, there are some regions that saw their GDP decrease over the sample period. On the other end of the distribution, there are some regions that doubled their output, that is, they grew by more than 100% over the 18 years. Lesser developed regions from Chile or Poland are quite prominently placed among the top ten. For regions with a low starting level of GDP per capita, higher increases are relatively easier to achieve. North Dakota is the region that, according to the data, saw the biggest increase in its GDP per capita over time.

14. Aggregating all regions within a country gives the national GDP numbers. Figure 4 visualises the differences between the 28 countries in the sample with a bar graph and also shows the changes from 1995 to 2013. The countries have been ordered according to their level of GDP per capita in 2013.

**Figure 4. Cross-country differences in GDP per capita**




*Source*: Own calculations. Data are from OECD (2016), "Regional economy", *OECD Regional Statistics* (database), DOI: http://dx.doi.org/10.1787/region-data-en.

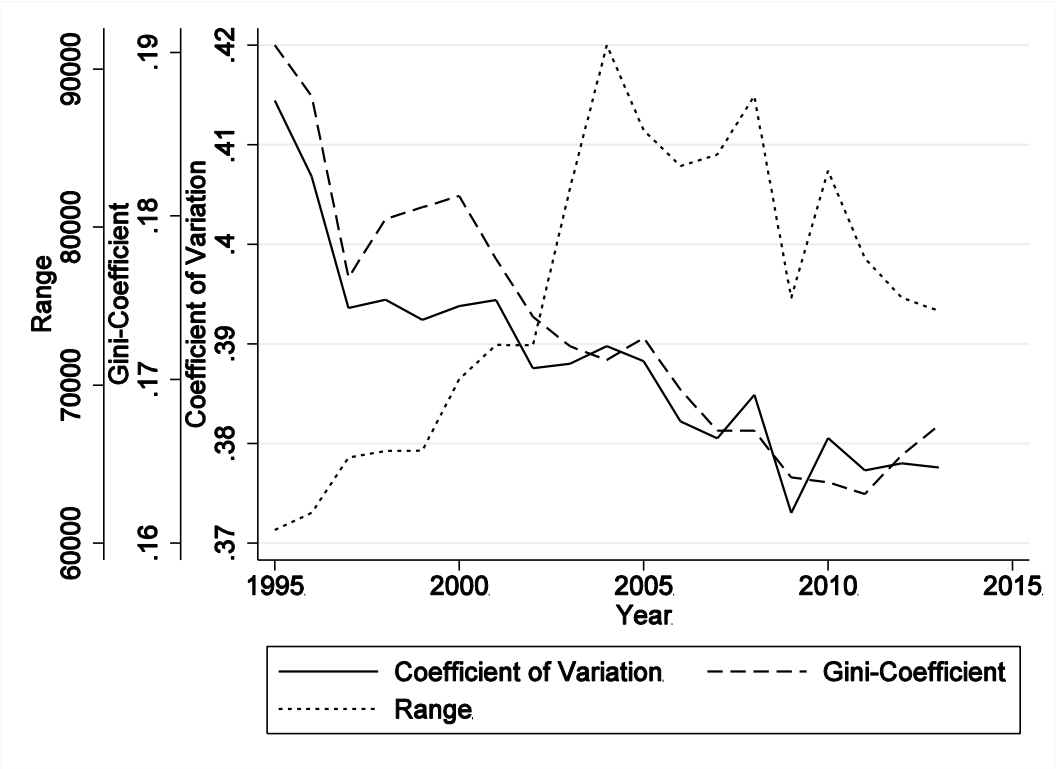
15. In the year 2013, Luxemburg had the highest GDP per capita with more than USD 83 000 per capita. A word of caution is in order, however, because many residents of neighbouring countries commute to work in Luxemburg and hence contribute to the country's GDP; they are, however, not counted in the population statistic, which artificially inflates the numbers of GDP per capita. Chile is the country with the lowest GDP per capita in the sample (around USD 20 000). The top and bottom of the distribution thus differ by a factor of more than four. The former Eastern Bloc countries can be found near the bottom of the distribution, whereas central European countries as well as the English-speaking countries are located closer to the top. The comparison with the baseline year 1995 also reveals some interesting insights: GDP per capita has grown in all countries except Greece. Furthermore, countries with lower levels of GDP per capita seem to have experienced a relatively larger increase over time, a phenomenon referred to as beta-convergence or catch-up-effect in the literature (OECD, 2009).

## 4. Evolution of inequality over time

### *4.1. Between all regions*

16. The previous figure provided only a snapshot of existing inequalities between *countries* in the first and last year of the sample period. It is, however, equally interesting to quantify the inequalities between all 281 regions in the sample over the whole sample period. Figure 5 provides estimates of the CV, Gini and R between all regions for each year of the sample period. It allows drawing conclusions about the general trends in regional inequality.

**Figure 5. Inequality measures of regional output disparities over time**




*Source*: Data are from OECD (2016), "Regional economy", *OECD Regional Statistics* (database), DOI: http://dx.doi.org/10.1787/region-data-en.

17. As evident from the graph, the CV and Gini tell a consistent story of slowly declining inequality over time, as the curves parallel each other. The Gini coefficient has dropped from 0.190 to 0.165 over the years. This reflects the catching up of less developed regions already mentioned above: If units with low GDP per capita display higher growth rates than more developed units, inequality between all regions should become smaller as the gap between the bottom and top shrinks. The R tells a somewhat different story. It started declining only in 2004 after experiencing rapid increase in the ten preceding years. However, the range only takes the difference between the most and the least developed regions into account and neglects all movements in the middle of the distribution. The CV and Gini thus seem more suited to evaluate the overall extent of inequality. Nevertheless, the R provides the interesting information that the extremes of the distribution have moved further away from each other.

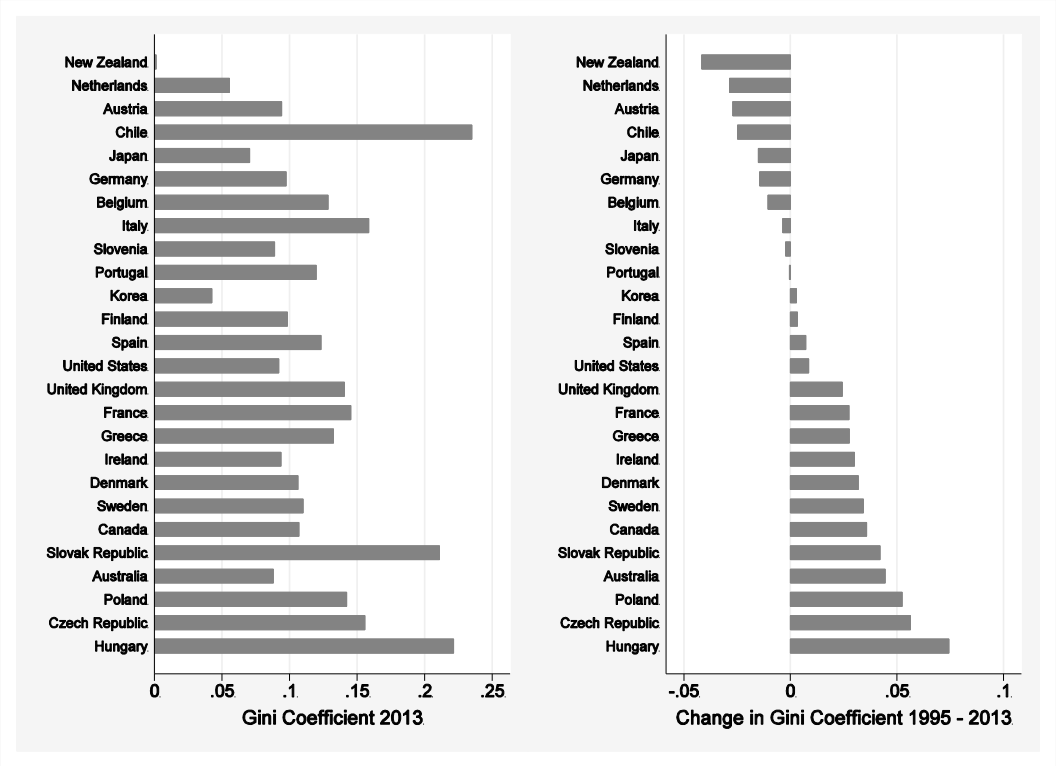
### *4.2. Between regions within a given country*

18. What about inequalities between regions *within a single country*? Figure 6 shows the Gini coefficients for the regions *within* the respective country. Levels are depicted in the left panel, while changes between 1995 and 2013 are shown in the right panel. Countries are ordered by absolute decreases or increases between the two years.

19. Several observations can be made. First, there are important inequality differences between countries. Chile, the Slovak Republic and Hungary have Gini coefficients of regional GDP per capita that are higher than 0.2, whereas Korea and New Zealand have coefficients that are smaller than 0.05. Second, the biggest increases in the Gini between 1995 and 2013 have mostly taken place in countries of the former Eastern Bloc, namely Poland, Czech Republic and Hungary. New Zealand saw the biggest decrease. However, this country consists of only two regions, so the numbers should be interpreted with caution.

Third, the level of the Gini in 2013 does not seem to be related to the size of the increase or decrease between beginning and end of the sample period.

**Figure 6. Gini of regional output disparities within countries**



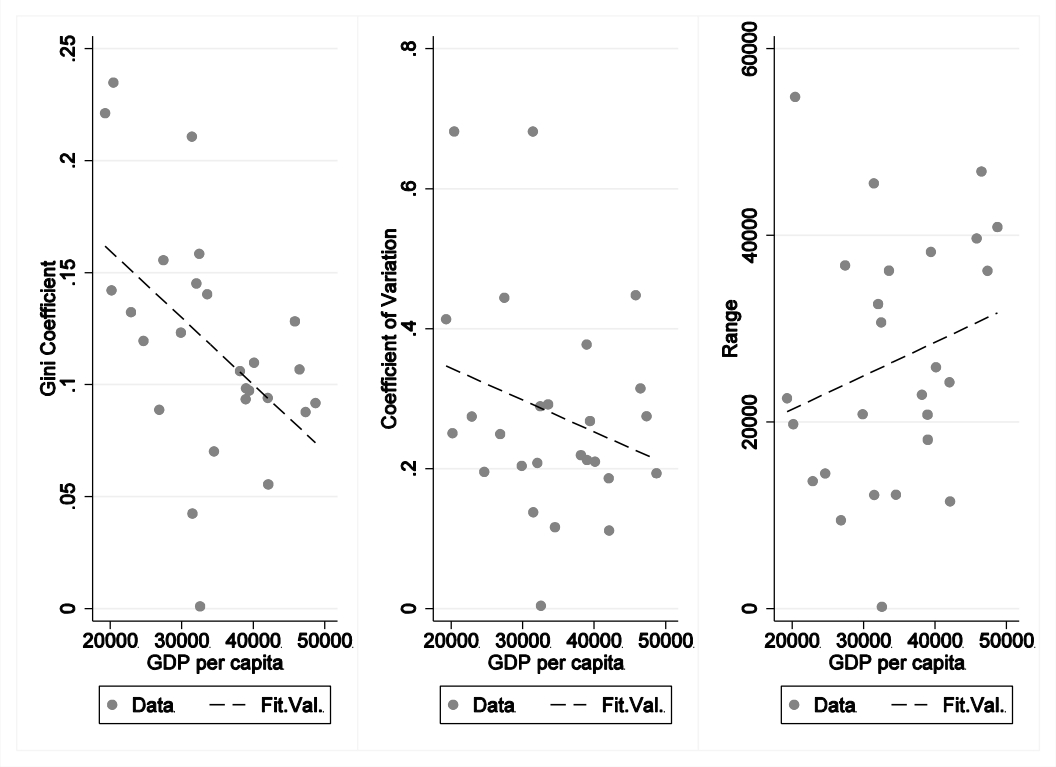

*Source*: Data are from OECD (2016), "Regional economy", *OECD Regional Statistics* (database), DOI: http://dx.doi.org/10.1787/region-data-en.

20. An interesting puzzle emerges when comparing Figures 5 and 6. On the one hand, the Gini between all regions has been steadily declining over time (Figure 5). On the other hand, the majority of countries – 16 out of 28 – saw an increase in the Gini between regions *within* their country (right panel of Figure 6). This implies that overall inequality (between all regions in the sample) has been decreasing, while – at the same time – regions within a given country have often been diverging, corresponding to increasing country specific inequality. Both phenomena can be observed simultaneously.

## 5. Development versus inequality

21. Do the inequalities within a country depend on the country's level of economic development? Simon Kuznets argued that inequality first increases and then decreases as the economy develops and grows over time. If this hypothesis were true, one would observe an inverse U-shaped relationship between inequality and GDP per capita (the so-called Kuznets Curve, see (Kuznets, 1955)). Figure 7 plots regional inequality (again measured by the three measures Gini, CV and Range) within countries as a function of the level of GDP of the country in question. Each dot represents one country and the lines are linear fits. Data are from the year 2013.

**Figure 7. Level of development and inequality**



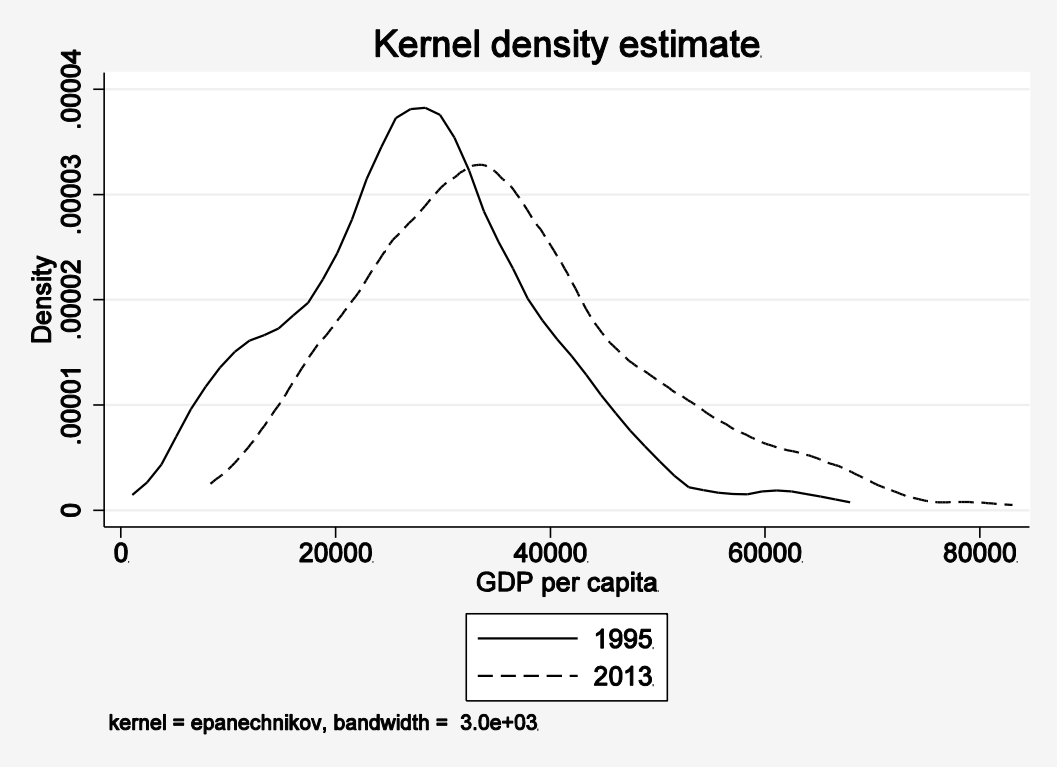

22. The Gini and CV display a negative relationship with GDP per capita. The graph thus suggests that the sample of countries in question seem to lie on the downward-sloping part of the Kuznets curve. Given that OECD countries tend to belong to the most developed countries across the world, this seems intuitive. The R is again somewhat different and shows a slightly positive relationship with GDP per capita. However, bivariate regressions of the respective inequality measures on GDP per capita demonstrate that only the Gini coefficient has a significant (negative) relationship with the level of economic development.

## 6. A closer look at changes within the regional GDP distribution

23. One drawback of commonly used inequality measures like the Gini is that they are summary indicators. If the Gini changes over time, one does not know *how* inequality changed: Was the distribution of regions altered in the middle or at the tails? How susceptible to change is the whole distribution of regions in terms of GDP per capita? Are lagging regions able to catch up over time? Do units change position in the rank ordering of all regions? Do richer regions always stay at the top or can they be overtaken by their neighbours?

24. Figure 8 provides a quick glance at the shape of the distribution in the first and last year of the sample period. The solid line depicts the distribution of regions in the year 1995, while the dashed line shows the year 2013. Three general observations can be made. First, both distributions look approximately normal. Second, there is a right shift from 1995 to 2013, implying that regional GDP has been growing on average over the sample period. Third, the variance of regional GDP has increased a bit. This is reflected by the fact that the support of the 2013 distribution is larger and the maximum density is lower.

**Figure 8. Distribution of regions**




### *6.1. Transition matrices*

25. A convenient way to visualise changes in the distribution over time is the use of so-called transition matrices. The working principle is as follows: First, order all regions in the starting and end year (1995 and 2013) according to their level of GDP per capita and divide them into four quartiles in each year. The first quartile collects the 25% of the regions with the lowest GDP per capita while the fourth quartile includes the regions with the highest GDP per capita. Then, construct a matrix with the quartiles in 1995 in the rows and the quartiles in 2013 in the columns. The matrix has 4*4=16 cells which contain information about the mobility between the quartiles over the period 1995-2013.

26. Table 1 shows a transition matrix for regional GDP per capita between 1995 and 2013. The rows can be read as follows: Of all 281 regions, 71 are in the first quartile in 1995. Fifty-nine of these 71 regions did not change quartiles between 1995 and 2013. However, 7 regions managed to move up to the second quartile in 2013, and even 4 (1) advanced to the third (fourth) quartile. The interpretation is that there is some upward mobility in the distribution, as some regions are able to gain ground relative to others during the sample period. The columns can be read analogously: Of all 71 regions in the first quartile in 2013, 59 were already there in 1995. However, there are also 11 (1) regions that lost ground as they had been in a higher – namely the second (or even third) – quartile in 1995. There were no regions that fell all the way from the fourth to the first quartile.

**Table 1. Transition matrix**

Regional GDP per capita, 281 TL2 Regions

| | | Distribution 2013 | | | | |
|---|---|---|---|---|---|---|
| | | 1. Quartile [8 349; 26 767] | 2. Quartile [26 920; 34 441] | 3. Quartile [34 456; 43 325] | 4. Quartile [43 418; 83 045] | Total |
| Distribution 1995 | | | | | | |
| 1. Quartile | [4 072; 20 580] | 59 | 7 | 4 | 1 | 71 |
| 2. Quartile | [20 771; 27 599] | 11 | 47 | 10 | 2 | 70 |
| 3. Quartile | [27 641; 34 522] | 1 | 15 | 39 | 15 | 70 |
| 4. Quartile | [34 558; 64 901] | 0 | 1 | 17 | 52 | 70 |
| Total | | 71 | 70 | 70 | 70 | 281 |

Note: In brackets are the quartile boundaries for GDP per capita levels in USD at national-level purchasing power parity.

*Source*: Data are from OECD (2016), "Regional economy", *OECD Regional Statistics* (database), DOI: http://dx.doi.org/10.1787/region-data-en.

27. To get a sense for the extent of movement or mobility within the distribution, it is instructive to compare these numbers to two hypothetical scenarios. If there was no mobility at all, implying that each region keeps its relative position within the distribution over the years, all entries would lie on the main diagonal of the matrix, whereas the off-diagonal cells would contain zeros. The other extreme of perfect mobility would imply that units are equally distributed over all 16 cells. The scenario above is a mixed case: The bulk of observations can be found on the main diagonal, but there is quite some mobility. However, this mobility is mostly confined to "neighbouring" quartiles. Changes from the top to the bottom of the distribution or vice versa are very rare.

28. It remains to note that transition matrices are a relative concept. A region can grow a lot in terms of GDP per capita over the years but not change quartile (or even descend in the distribution). This happens when other regions grow by even more. To illustrate this, the quartile boundaries are also indicated in Table 1. While it was sufficient to have a GDP per capita of at least USD 34 558 to be in the fourth quartile in 1995, USD 43 418 were needed to be in the same quartile in 2013. The intervals thus give a sense of how large average regional growth was in the quartiles between 1995 and 2013.

### *6.2. The role of fiscal decentralisation*

29. How does mobility within the distribution depend on fiscal decentralisation? Decentralisation implies giving more responsibilities to regions, allowing them to "take matters into their own hands". One might thus expect more mobility in the distribution in a decentralised environment, as regions have policy options to pursue their own fiscal and growth strategies, contrary to a more centralised setting where an overarching administration restricts regional policy options.

30. Table 2 therefore shows two transition matrices, for country groups of low and high levels of tax decentralisation, respectively. Countries were split at the median average value of tax decentralisation in the sample period.[4] To account for the fact that the number of regions is not equal in both groups (smaller countries with less regions tend to have lower degrees of tax decentralisation), the cell values are transformed into percentages. In this way, both the upper and lower matrices are directly comparable.

4. Low decentralisation countries include Austria, Belgium, Chile, Czech Republic, Greece, Hungary, Ireland, the Netherlands, Portugal, Slovenia, the Slovak Republic and the United Kingdom. High decentralisation countries are Australia, Canada, Germany, Denmark, Spain, Finland, France, Italy, Japan, Korea, New Zealand, Sweden and the United States.

**Table 2. Fiscal decentralisation and mobility**

Low Tax Decentralisation, 77 TL2 Regions

| | Distribution 2013 | | | |
|---|---|---|---|---|
| Distribution 1995 | 1. Quartile | 2. Quartile | 3. Quartile | 4. Quartile |
| 1. Quartile | 85% | 10% | 0% | 5% |
| 2. Quartile | 5% | 74% | 21% | 0% |
| 3. Quartile | 11% | 11% | 63% | 16% |
| 4. Quartile | 0% | 5% | 16% | 79% |

High Tax Decentralisation, 186 TL2 Regions

| | Distribution 2013 | | | |
|---|---|---|---|---|
| Distribution 1995 | 1. Quartile | 2. Quartile | 3. Quartile | 4. Quartile |
| 1. Quartile | 74% | 17% | 2% | 6% |
| 2. Quartile | 24% | 50% | 22% | 4% |
| 3. Quartile | 2% | 32% | 40% | 26% |
| 4. Quartile | 0% | 0% | 37% | 63% |

*Source*: Own calculations. Data are from OECD (2016), "Regional economy", *OECD Regional Statistics* (database), DOI: http://dx.doi.org/10.1787/region-data-en.

31. As evident from Table 2, there is more movement across the distribution of regions in the group of highly decentralised countries, implying that relatively more units change position over time. This can mainly be seen by comparing the elements on the main diagonal, which are always smaller for the high decentralisation group. There are thus more units that switch quartiles between 1995 and 2013. For example, in the less decentralised countries, 85% of all regions in the first quartile in 1995 remain in the first quartile in 2013. For high decentralisation countries, this number is only 74%.

### *6.3. Regression Results*

32. How important are rank changes within the distribution over time and what are the factors that explain these rank changes? Table 3 shows results of a multiple regression that allows to isolate the marginal effect of changes in several explanatory variables on movements within the distribution of regions. The dependent variable is the change in rank between 1995 and 2013, which is positive for regions that improved their position, zero for regions that kept their place and negative for regions that lost ground.

**Table 3. Explaining rank changes**

| VARIABLES | (1) Change in Rank | (2) Change in Rank | (3) Change in Rank | (4) Change in Rank |
|---|---|---|---|---|
| GDP in 1995 | -0.813*** | -0.976*** | -1.372*** | -1.007*** |
| | (0.154) | (0.183) | (0.255) | (0.355) |
| Population | | -0.048 | -0.062 | -0.061 |
| | | (0.044) | (0.046) | (0.046) |
| Surface | | 0.440*** | 0.345*** | 0.280** |
| | | (0.104) | (0.087) | (0.131) |
| Tax Decentr. | | | 79.068*** | |
| | | | (25.877) | |
| Constant | 22.553*** | 23.887*** | 20.933*** | 35.041** |
| | (5.322) | (5.356) | (5.274) | (16.830) |
| Country FE | No | No | No | Yes |
| Observations | 281 | 279 | 277 | 279 |
| R-squared | 0.053 | 0.156 | 0.200 | 0.484 |

*Source*: Own calculations. Data are from OECD (2016), "Regional economy", *OECD Regional Statistics* (database), DOI: http://dx.doi.org/10.1787/region-data-en. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

33. Column (1) of the table shows that the level of GDP per capita in the base year 1995 predicts a negative rank change. This is consistent with the catch-up hypothesis of beta convergence: Less developed regions grow faster on average, which implies that they move up the ranking of all regions. Hence, already developed regions (those with a high level of GDP per capita in 1995) lose ground. The point estimate suggests that an increase of USD 1 000 in GDP per capita in 1995 leads to a decline of 0.8 rank positions over the sample period.

34. Column (2) adds population and surface of the region as control variables, thereby increasing the R-Squared by about 10 percentage points. While population numbers (also measured in 1995) seem to have no impact on movements within the distribution, it is estimated that a larger regional surface is beneficial for potential rank improvements. This finding is lacking a theoretical explanation so far.

35. In column (3), the average level of tax decentralisation between 1995 and 2013 is added as an additional control variable. This variable, which is defined as the sub-central level tax revenue as a percentage of the total general government tax revenue, does only vary on the country level. The positive and highly significant coefficient suggests that regions located in countries with larger degrees of tax decentralisation perform relatively better and improve their position in the rank ordering over time. A hypothetical switch from no to total tax decentralisation (i.e. a variable change from zero to one) is estimated to lead to an improvement of 79 rank positions. More realistically, an increase of one standard deviation in tax decentralisation (+0,12) would lead to an improvement of 0,12*79 = 9,48 rank positions over the sample period.

36. The tax decentralisation variable is replaced with country fixed effects in column (4) (both cannot be included at the same time), which leads to an R-Squared of about 0,48. All previously estimated effects keep their sign and significance.

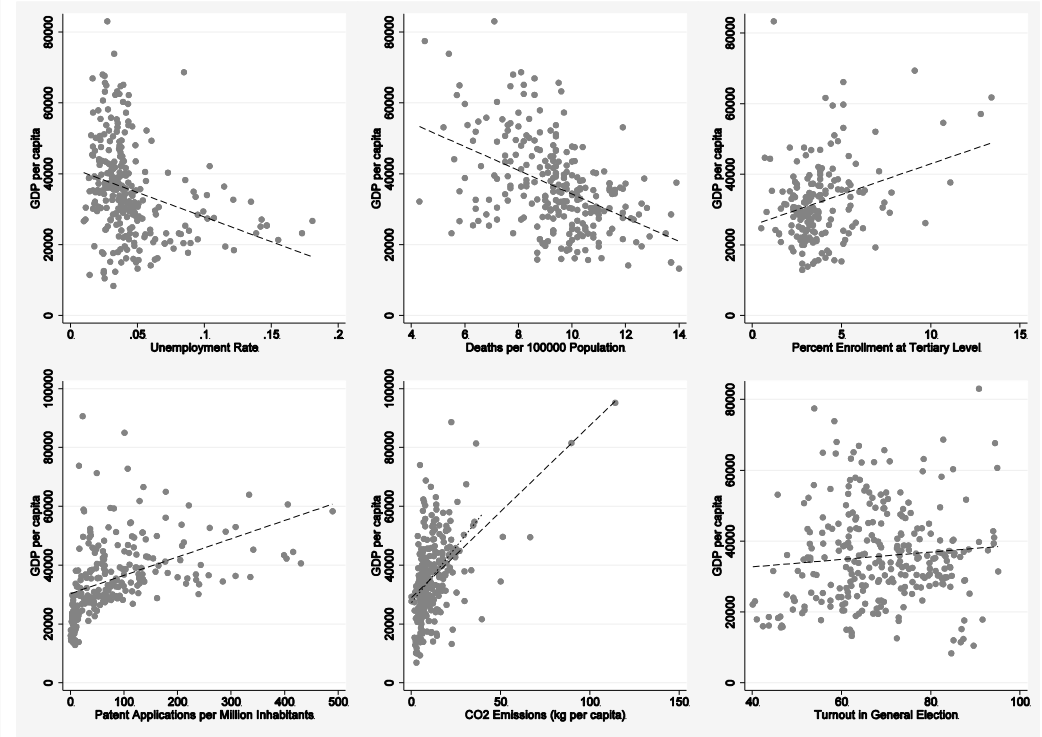
**7. What do different levels of development imply for daily life?**

37. While the previous sections of this paper were rather concerned with describing level and development of GDP per capita in the regions over time, the current section puts its focus on the covariates of economic development. It thereby gives a quick overview of what different levels of GDP per capita imply for other regional outcomes. To this end, Figure 9 shows six different scatterplots. It shows correlations of GDP per capita with several other variables of interest, including unemployment (top left panel), mortality (top centre), education (top right), R&D (bottom left), $CO_2$ emissions (bottom centre) and turnout (bottom right). Each point marks one observation and the lines are linear fits. A note of caution: The relationships should not be interpreted as causal effects, but rather as general associations between two variables.

38. As evident from the top left panel, GDP and the unemployment rate are negatively related. Intuitively, regions that do not use all of their productive resources tend to be lagging in terms of economic development. Furthermore, mortality is lower in highly developed regions (top centre panel), suggesting that higher income can be used to improve health care systems. An alternative channel might be that higher income changes preferences towards a healthier lifestyle, which results in lower mortality rates.

39. The level of GDP per capita is positively correlated with education levels, as the top right panel shows. A larger share of each cohort receives tertiary level education in high GDP regions. This education also seems to pay off in terms of research and development outcomes, as the bottom left panel shows. The number of patent applications per capita is higher in more developed regions.

**Figure 9. Covariates of GDP per capita**




40. A negative by-product of economic activity is environmental decline. Despite all efforts to limit the use of natural resources by making growth "green", there still seems to be an association between the level of GDP per capita and the amount of greenhouse gas emissions, as the bottom centre panel shows. Economic development still goes hand in hand with $CO_2$ emissions. Importantly, the linear fit is little influenced by the five outlier regions, because the same fit line for all regions with less than 50kg per capita $CO_2$ emissions has almost the same slope (dotted line versus dashed line).

41. The bottom right panel of Figure 5 shows that there is no correlation of economic development and political participation. The turnout rate in general elections is quite variable and shows no clear relationship with GDP per capita.

## 8. Conclusion

42. This paper has provided an updated review of regional disparities in OECD countries employing data up to the year 2013. Thereby, it has confirmed an ongoing trend already identified in work using earlier data: Between country disparities are decreasing, but within country disparities are increasing at the same time. Furthermore, transition matrices uncover quite some movement within the distribution over time that has not been identified with summary indicators of inequality previously.

43. If – from a normative perspective – regional inequalities are considered as a "bad", further research should investigate how existing disparities can be reduced. Many countries have already implemented transfer schemes that are supposed to reduce disparities between the regions. Interestingly, the data tell a story of increasing within country inequality – despite the numerous transfer schemes. This allows for two different interpretations: Either the transfers work well and the inequalities would have been even larger without them, or the transfers do not work well, creating poverty traps rather than allowing lagging regions to grow. The empirical evidence for the EU structural and cohesion funds seems to suggest that transfers do have some positive effects (see discussion in the literature part), but the evidence is far from conclusive.

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