Spatial Inequality, Regional Growth and Economic Geography*

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This chapter explores the patterns of spatial income disparities within countries throughout the 20th Century. Following World War II, regional income gaps initially narrowed; however, the rate of convergence slowed in recent decades, with regional divergence evident in some countries. Despite narrowing income gaps, the incomplete nature of regional income convergence has led to persistent relative income disparities. We synthesize recent contributions seeking to explain these patterns, with an emphasis on insights from quantitative economic geography and macroeconomics. Finally, we examine the evidence on the impact of "place-based policies," focusing on large-scale programs designed to promote regional convergence.
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1 Introduction

Spatial disparities within countries are both ubiquitous and persistent. While there are widespread concerns about potential detrimental effects of uneven regional growth, there is less consensus about the key determinants of regional income differences, whether government intervention is warranted, and what form it should take. In this chapter, we synthesize important contributions to shed light on the drivers of regional income disparities, their evolution, and on the effectiveness of policy.

To support our discussion, we compile a dataset of regional income for 292 regions across 20 developed countries, with regions defined as the first administrative division below the national level. We combine this dataset with other sources to reproduce and explore some empirical regularities that have motivated much of the literature (see e.g. Barro and Sala-i Martin, 1992; Sala-i Martin, 1996*a*; Kim, 1998; Mitchener and McLean, 1999; Rosés and Wolf, 2021). Our review of the literature is structured around three facts. First, while there have been significant spatial income gaps within countries throughout the sample period, these gaps appear to have declined over time. Catch-up growth in poorer regions between 1950 and 1980 is particularly important for explaining regional convergence in many countries. Second, the rate of convergence has slowed since the 1980s. Although growth has declined in most countries in the sample, it fell relatively less in high-income regions. Specifically, regions with the highest

density of economic activity within each country experienced a smaller reduction in their growth rates, which in turn lowered the rate of convergence. Finally, due to the incomplete process of convergence, there is a high degree of persistence in relative regional income levels across the study period for most countries in our sample.

This chapter draws primarily from the literature on economic growth and economic geography to shed light on these patterns. Understanding the drivers of regional growth is essential for explaining regional income gaps, as even small differences in growth rates can rapidly alter regional income rankings. Additionally, regional economies can differ significantly in their natural endowments and tend to be more open to trade and migration than national economies. Therefore, insights from economic geography are equally crucial for understanding how regional income gaps evolve over time.

We begin by discussing the key factors contributing to regional income disparities, including human capital, institutions, and geographical fundamentals. Next, we examine the literature on regional convergence, which emphasises the importance of factor mobility, technology diffusion, and structural transformation in closing spatial income gaps. We then explore prominent explanations for the deceleration of regional convergence in recent decades, focusing on the impact of skill-biased technical change, globalization, and the proliferation of information and communication technologies (ICT). Lastly, we address the persistence of regional income gaps, highlighting the significance of location fundamentals and

agglomeration economies, which can lead to multiple spatial equilibria.

We also cover recent contributions that capture the interplay between aggregate economic growth and changes in the spatial distribution of economic activity. Substantial progress has been made in building models that incorporate realistic geographies and rich spatial heterogeneity, providing new insights into the determinants of regional convergence, divergence, and persistence.

Finally, we conclude the chapter by reviewing the evidence on the impact of policies in reducing regional disparities, focusing on large-scale programs that aimed to deliver regional convergence or transformational change. An increasing concern in high-income countries about economic and social outcomes in 'left-behind places' and resulting political discontent among residents, has brought 'place-based' policies to the fore (OECD, 2023). The descriptive picture with which we opened this chapter highlights the persistent nature of regional income gaps, illustrating the innate strength of economic forces that policy interventions seek to influence or overcome, and the magnitude of the task required were policy to be successful in narrowing spatial disparities.

This chapter is organised as follows. In Section 2, we begin by documenting stylised facts about patterns of convergence and divergence within countries throughout the 20th Century, and the construction of the dataset that supports our discussion. To understand these patterns, we synthesize insights from the literature on factors underpinning convergence, divergence, and persistence in Section 3. Finally, against the backdrop of slowing convergence, Section 4

provides an overview of policies aimed at mitigating regional disparities. Section 5 concludes.

2 Motivating Evidence on Regional Income Gaps and Convergence

2.1 Data

To support our review of the literature, we construct a dataset of GDP per capita for 20 high-income countries.[1] For each country we use data for the first administrative division below the national level, e.g. NUTS2 for European countries, states for the United States, and prefectures for the case of Japan. We henceforth refer to these as regions. In recent years, there have been several efforts to construct harmonized cross-country datasets of regional economic activity with large spatial and temporal coverage (see e.g. Rosés and Wolf, 2018*b*; Wenz et al., 2023). Our analysis leverages this work and results in a panel spanning a total of 292 regions across 20 countries, representing approximately 67% of global GDP and 15% of the worldwide population in the year 2000 (Bolt and Van Zanden, 2024). In the rest of this section, we discuss the data sources in more detail.

For Western Europe, we use GDP and population data from Rosés and Wolf (2020), which covers 173 regions across 16 Western European countries at the

[1]The dataset includes Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, Ireland, Luxembourg, United States, Japan, Canada, and Australia.

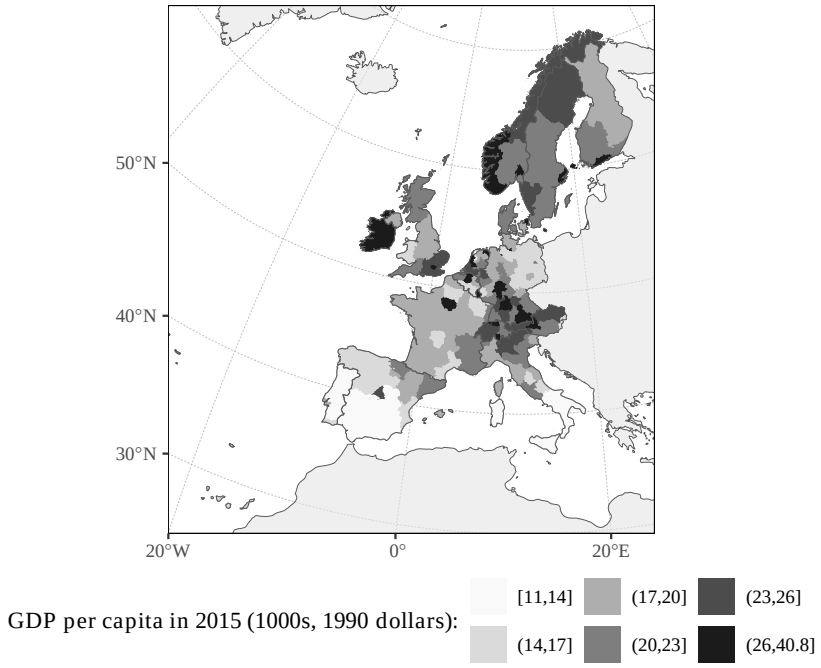

Figure 1. This figure depicts GDP per capita in 1990 dollars at the NUTS2 level for the year 2015. PPP adjustment at the country level. Source: Rosés and Wolf (2020).

NUTS2 level (see Figure 1).[2] Our analysis uses data for the years 1900, 1950, 1980, and 2010. In Rosés and Wolf (2020), regional GDP is constructed using various sources, expressed at purchasing power parity in 1990 international dollars. The price deflators are at the national level. For periods preceding the publication of national accounts, regional GDP per capita is imputed using the Geary-Stark method (Geary and Stark, 2002). We omitted Luxembourg and Ireland from the analysis since they only contain one region in the dataset.

[2]See Rosés and Wolf (2018*a*) for details on the construction of the data. Many papers have conducted country or region-specific analyses. See for example Rosés and Wolf (2018*a*) for European countries since 1900, Barro and Sala-i Martin (1992); Kim (1998); Mitchener and McLean (1999) for US states, and Sala-i Martin (1996*a*) for Japanese prefectures.

For regions outside Western Europe, we use data from the *Global Data Set of Reported Sub-National Economic Output* (DOSE) (Wenz et al., 2023). The dataset covers subnational regions (one level below the national level) across a broad range of countries from the 1960s. These data were assembled from various sources such as statistical agencies, yearbooks, and the academic literature. Regional GDP per capita is measured using data on gross regional product per capita in local 2015 prices and converted to US dollars using 2015 market exchange rates. The data is available at an annual frequency, and to remove high-frequency variation, we average GDP per capita by decade. Wenz et al. (2023) does not impute any data, resulting in a smaller temporal coverage for the countries outside western Europe.

We combine both these datasets with information on location fundamentals using a range of sources that we briefly summarise here. To calculate regional location fundamentals, we match Rosés and Wolf (2020) with a shapefile at the NUTS2 level provided by the authors and the data from DOSE with shapefiles from GADM (2024). These shapefiles allow us to calculate regional fundamentals, such as potential caloric yield (Galor and Özak, 2015, 2016), average elevation and terrain ruggedness (Amante and Eakins, 2009), proximity to major rivers, and distance to coastlines using Natural Earth data. As a proxy for a location's market access, we calculate the inverse average distance to all other regions.[3]

[3]Specifically, $\text{mp}_j = \sum_{i=1}^{R} d_{ji}^{-1}$ where R denotes the number of regions. For Western Europe R denotes all regions in Western Europe. For the remaining countries R denotes

Lastly, in the cases where we make comparisons to rates of convergence of GDP per capita at the national level, we use data from Bolt and Van Zanden (2024).

Since the subsequent analysis primarily focuses on within-country region comparisons, accurately accounting for cross-country price differences is less critical. However, the absence of regional price deflators remains a limitation, as regional GDP per capita differences may overstate real income disparities due to higher prices in wealthier regions. Nonetheless, differences in GDP per capita likely correlate with living standards across regions, supporting the relevance of our findings (see e.g. Gennaioli et al., 2014).

2.2 *The Size of Regional Income Differences*

We begin by examining income disparities among regions within each country. For each country, we calculate the ratio of GDP per capita in the highest-income region to that in the lowest-income region, focusing on the decades 1980 and 2010. The results, shown in Figure 2, reveal substantial GDP per capita variation across regions. In much of our sample, the GDP per capita in the wealthiest region is roughly double that of the poorest. Across the full sample, this ratio ranges from 1.2 to almost 5.2, which is comparable to income differences *between* countries. For instance, in our sample, Norway, the country with the highest GDP per capita in 2015, has around 3.3 times higher GDP per capita (adjusted for

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all the regions within the country.

purchasing power) than the poorest country, Portugal. While the magnitudes are sizeable, they should be interpreted as upper bounds since they are not adjusted for regional price differences.

How has this ratio evolved over time? Among countries with a long time-series of data, the United States exhibited the largest historical disparity, with the richest region's GDP per capita being 5.2 times higher than that of the poorest in 2010, up from 3.99 in 1980. Across the entire sample, the average ratio increased from 2.04 in 1980 to 2.21 in 2010. This suggests a widening income gap between regions over recent decades. Next, we examine how regional income disparities have evolved over time in greater detail.

2.3 Empirical Framework

To explore the evolution of regional income gaps over time, we examine whether regions with low GDP per capita tend to grow faster than regions with high levels of GDP per capita on average, a process that is known as β-convergence (see e.g. Durlauf, Johnson and Temple, 2005). This concept has been studied extensively, notably by Barro and Sala-i Martin (1992), which documents convergence across U.S. regions since 1840, and Rosés and Wolf (2018*b*), which provides a detailed analysis of convergence for a range of Western European countries since 1900. Following these contributions, our starting point is the following regression,

$$g_{rt,\tau} = \alpha_c + \beta \log\left(Y_{r\tau}\right) + \sum_{k=1}^{C} \beta_k \theta_k \log\left(Y_{r\tau}\right) + \gamma X'_{r\tau} + u_{r\tau}, \qquad (1)$$

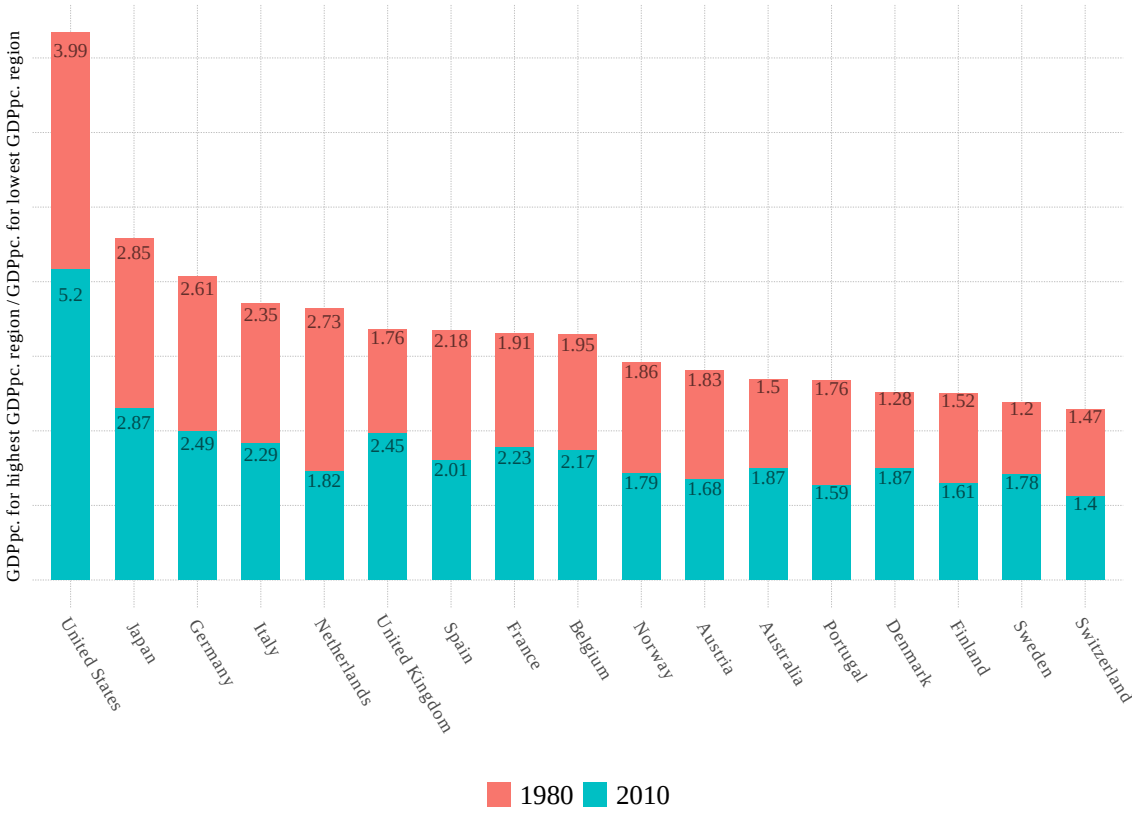

Figure 2. This figure depicts the ratio of the GDP per capita in the region with the highest GDP per capita to the GDP per capita in the region with the lowest GDP per capita for each country in the sample for the years 2010 and 1980. Sources: Rosés and Wolf (2020); Wenz et al. (2023).

where $g_{rt,\tau}$ denotes the average annual growth rate in GDP per capita for region r from year τ to year t.[4] Here, $Y_{r\tau}$ denotes the GDP per capita for region r at time τ. The parameter β captures the effect of a one hundred percent change in regional GDP per capita in year τ on the average annual growth rate between t and τ. A negative β indicates convergence, while a positive β indicates divergence. To capture regional convergence rates across countries, we interact GDP per capita in year τ with country-specific indiactors, θ_k, where C represents the number of countries inthe sample.

Our baseline specification includes a range of controls. The term α_c represents a country-fixed effect, controlling for unobserved, country-specific determinants of regional growth. X_r' is a $K \times 1$ vector of time-invariant location fundamentals at the regional level.[5] The rate of *conditional convergence* refers to the β coefficient when controls are included, while the rate of *unconditional convergence* is measured without controls. Lastly, $u_{r\tau}$ is an unobserved error term. Standard errors are clustered at the regional level. We estimate Equation 1 over extended time horizons, with $t - \tau$ ranging from 30 to 40 years, allowing us to capture low-frequency trends that shape patterns of regional convergence.

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[4] $g_{rt,\tau} = \left(\left(\frac{Y_{rt}}{Y_{r\tau}} \right)^{\frac{1}{t-\tau}} - 1 \right) \times 100.$

[5] In the baseline specification, the controls include an indicator for the region containing the capital city, distance to the coast, presence of a major river, elevation, terrain ruggedness, potential caloric yield, longitude, latitude, and an indicator for the region with the highest density of economic activity in period τ.

2.4 *The Evolution of Regional Income Gaps*

We begin by examining the evolution of spatial income gaps through convergence rates across the 20 countries from 1980 to 2015. Figure 3 displays the estimated country-specific β coefficients along with their corresponding 95 percent confidence intervals, revealing several important patterns. First, 14 countries experienced β-convergence in regional GDP per capita during this period. This is statistically significant for six of the countries. These 6 countries all have β coefficients less than or around -1. As a result, within these countries, regions with a ten percent difference in their regional GDP per capita in 1980, experienced a difference of 0.1 in their annual average rate of growth. Second, while five countries have β coefficients greater than zero, none of these are statistically significant. As such, we do not find strong evidence of regional divergence. However, it should be noted that many countries have few regions, and as a result, the coefficients are imprecisely estimated. Finally, when we estimate an average convergence rate without country-specific slopes, we find a convergence coefficient of -0.8. In the following section, we explore how these convergence patterns have shifted over time.

2.5 *Has the Evolution of Regional Income Gaps Changed?*

How have these income gaps evolved over time? To explore this, we estimate Equation 1 separately for the time periods 1900-1938, 1950-1980, and 1980-2010. In Figure 3, we present each β coefficient alongside their corresponding 95 percent

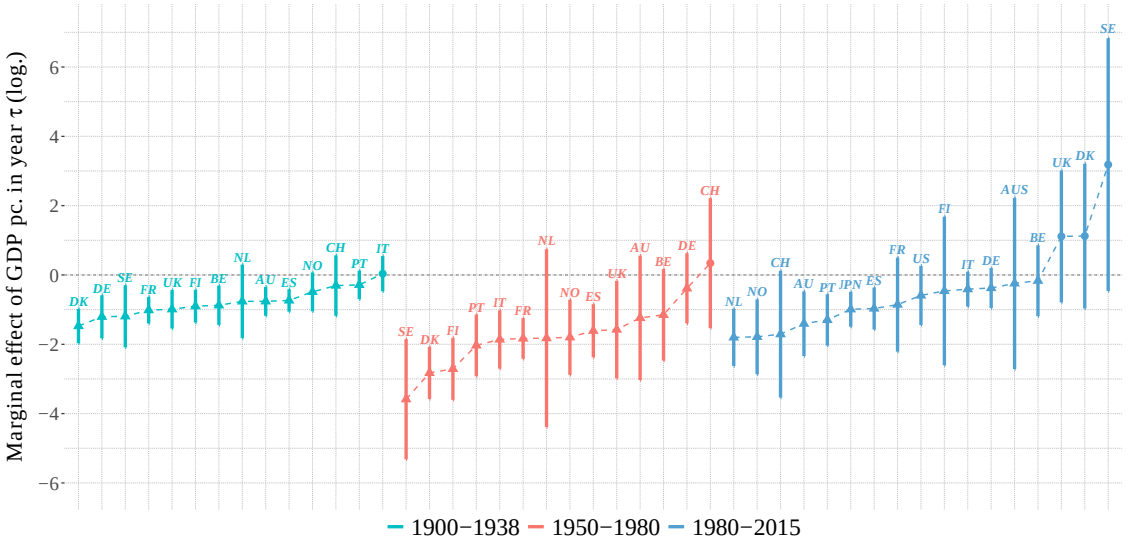

Figure 3. This figure depicts $\beta + \beta_k$ in equation (1), along with its corresponding 95 percent confidence interval. The model is estimated separately for 1900-1938, 1950-1980, and 1980-2010. France is the omitted category and is retained as the baseline. Ireland and Luxembourg are omitted from the regression since they only contain one region. Circles denote countries where $\beta + \beta_k$ is greater than zero (divergence) and triangles denote countries where $\beta + \beta_k$ is less than zero (convergence).

confidence intervals, revealing two notable patterns. First, over a longer period, convergence is common and comparable with the rates of convergence found *across* countries. Specifically, when estimating Equation 1 at the country-level using data from Bolt and Van Zanden (2024), we find a $\hat{\beta}$ of -0.8 between 1900 and 2000. Second, Figure 3 suggests that rates of convergence peaked during the period of rapid economic growth following World War II but have declined since the 1980s. While no country experienced divergence between 1950 and 1980, the number of countries exhibiting divergence has increased to six since 1980. During the 1950 to 1980 period, we find negative and statistically significant β coefficients in nine countries. Collectively, these findings suggest a slowdown in regional convergence since the 1980s. Excluding country-specific slope parameters, we

find a convergence coefficient of -1.46 between 1950 and 1980. As a result, the average rate of convergence for the 1980-2010 period (-0.8) is lower than that for the 1950-1980 period.

2.6 Why Has Unconditional Convergence Slowed?

Why has the rate of convergence slowed on average? While some of the coefficients in $X'_{r\tau}$ from the simplified regression remain stable across the 1950-1980 and 1980-2010 periods, we find a sizable change in the association between growth and the indicator for high economic density at the baseline. During the period of convergence from 1950 to 1980, this association was given by 0.32. For the period 1980-2010, it increases to 0.6.[6] This suggests a higher relative annual average growth rate in regions with high economic density in the baseline period. Since regions with high economic density tend to have higher GDP per capita, increased growth in these regions may help explain the lower observed rate of convergence.

To determine whether lower rates of absolute convergence can be attributed to accelerated growth in densely populated regions, we follow Kremer, Willis and You (2021) and decompose the change of absolute convergence into three components. Specifically, the rate of unconditional convergence between years t

[6]These findings are consistent with Rosés and Wolf (2018*b*), which document particularly high growth in capital regions after 1980.

and τ is given by

$$\beta^* = \beta + \sum_{k \in K} \gamma_{k\tau} \delta_{k\tau}, \tag{2}$$

where β denotes the rate of conditional convergence, $\gamma_{i\tau}$ represents the regression parameter of the i^{th} covariate in the simplified regression specification, and $\delta_{i\tau}$ denotes the regression parameter from a bivariate regression of covariate i on GDP per capita in year τ. Consequently, the change in the rate of unconditional convergence between the periods 1980-2010 and 1950-1980 can be expressed as

$$\Delta\beta^* = \Delta\beta + \Delta\gamma_{\mathrm{D}}\delta_{\mathrm{D}} + \sum_{i=1}^{K-1} \Delta\gamma_i \delta_i. \tag{3}$$

From Equation 3, we can conclude that changes in absolute convergence can be attributed to changes in conditional convergence ($\Delta\beta$), shifts in the association between covariates and GDP per capita, as well as the covariates and growth, ($\sum_{i=1}^{K} \Delta\gamma_i\delta_i$), and changes in the association between density and growth, as well as density and GDP per capita, ($\Delta\gamma_{\mathrm{D}}\delta_{\mathrm{D}}$).

We use this decomposition to quantify the impact of higher growth in high economic density locations on the decline in the unconditional rate of convergence. The results are presented in Figure 4. The first bar represents the total reduction in the rate of unconditional convergence during the period, which decreased from -1.27 to -0.4, resulting in a change of 0.87. The second column suggests that the most important contribution to this decline is a reduction in conditional convergence. Specifically, the rates of convergence across regions with similar

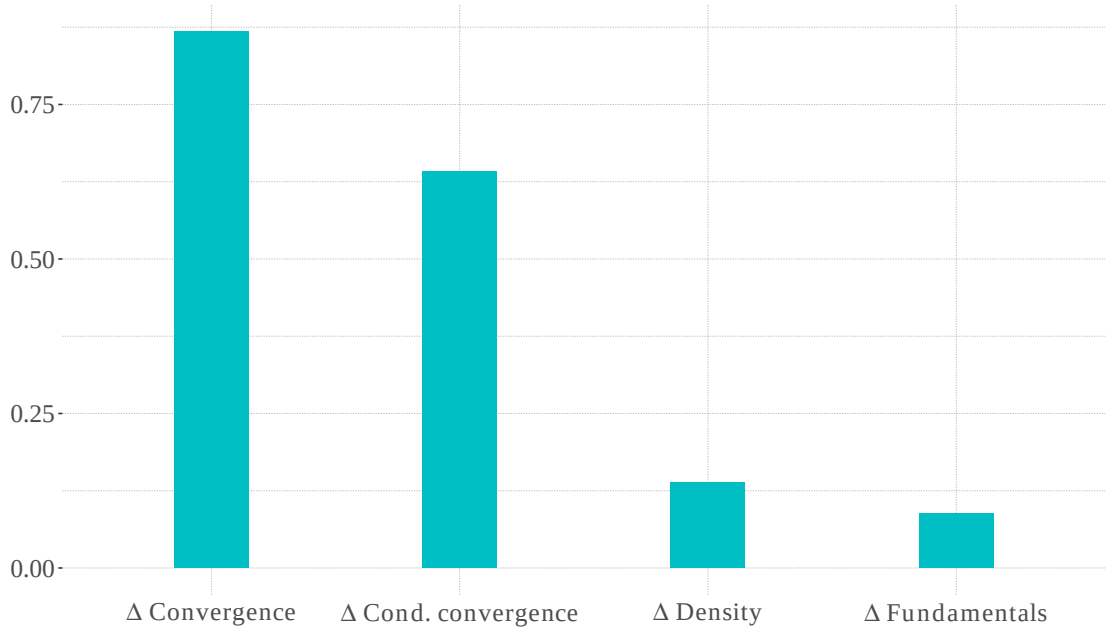

Figure 4. This figure depicts the decomposition of the change of the unconditional rate of convergence between the periods 1950-1980 and 1980-2010 using Equation 3.

observable location fundamentals accounts for approximately 73.83 percent of the total change. The third column illustrates the impact of changes in the role of high economic density regions. This factor contributes about 16 percent of the total change, exceeding the combined contributions of other location fundamentals. Since the association between high economic density and GDP per capita remains stable over the period (δ_D), this change is largely driven by the changing association between density and growth. Altogether, these findings suggest that the changing relationship between growth and economic density is a key factor in the observed decline in the rate of convergence identified in the previous section. However, a limitation of this analysis is that potentially significant factors explaining growth are unobserved at the regional level.

2.7 Persistent Regional Income Differences

Figure 3 and 4 suggest a deceleration of regional convergence since 1980, which potentially contributes to the persistence of spatial income gaps within countries. This section explores this issue by examining how GDP per capita rankings of regions evolve over time. Specifically, we categorize regions into quintiles based on GDP per capita for the first decade of available data and for 2010. The first quintile represents the poorest 20 percent of regions, while the fifth quintile represents the richest 20 percent. We then consider the correlation between a region's quintile in the initial year for which data is available and its corresponding quintile in 2010. This correlation will highlight the extent to which regions transition across different income quintiles within countries over time.

The results, presented in Figure 5, show two notable patterns. First, the poorest regions (first quintile) and the richest regions (fifth quintile) tend to maintain their relative positions throughout the period, as evidenced by a higher concentration of regions at both ends of the distributions. Second, while the relative positions of regions are stable, there is more movement in the rankings for the middle quintiles, indicating a degree of mobility and consistent with the average convergence rates estimated earlier. Overall, these findings suggest a tendency for regional rankings to persist over time. Rich regions are likely to remain rich, while poor regions are likely to remain poor. This pattern underscores the incomplete convergence of GDP per capita among the regions in

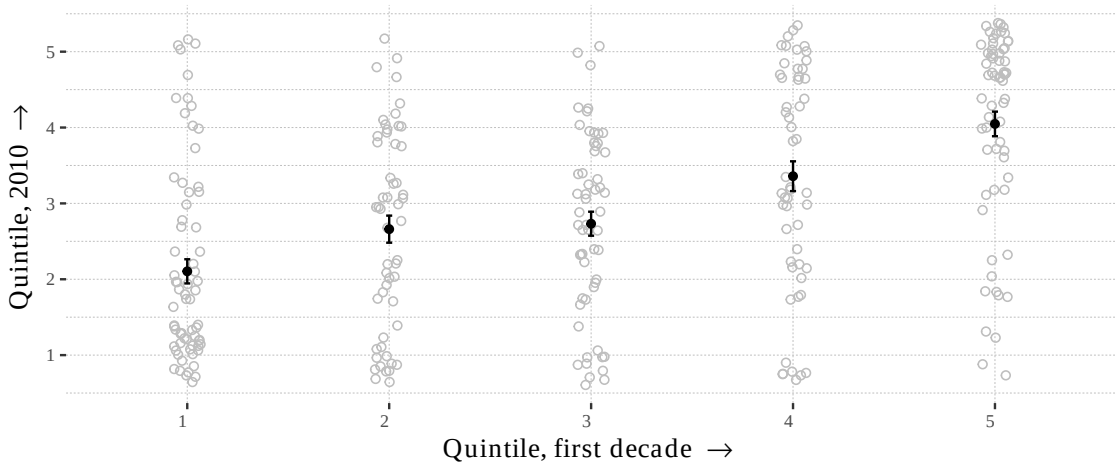

Figure 5. The figure depicts GDP per capita quintiles in the first year data is available and 2010. For each region in the sample, the quintiles in the first year data are available and 2010 are calculated. Quintiles are calculated within each country. The horizontal axis denotes the quintile in the first year data is available. The vertical axis denotes the quintile in 2010. 1 denotes the regions with the 20 percent lowest GDP per capita and 5 the regions with the 20 percent highest GDP per capita. The solid dots denote the average quintile in 2010 for each quintile in the first year with their corresponding 95 percent confidence intervals. The data are jittered.

our sample.

2.8 Summary

To conclude this section, we briefly summarise the empirical patterns we have documented. While countries in our sample differ in the prevalence of convergence, divergence, and persistence over time, several broad trends emerge. First, while significant spatial income gaps have persisted within countries throughout the sample period, these gaps have generally declined over time, with catch-up growth in poorer regions from 1950 to 1980 playing a key role in many cases. Second, since the 1980s, growth has slowed in most countries, with convergence decelerating as high-income regions (often those with the highest density of

economic activity) experienced smaller declines in growth rates. Finally, due to this incomplete nature of convergence, regional income levels exhibit considerable persistence across the study period for most countries. We now turn to the literature that aims to explain these patterns.

3 What Drives the Evolution of Regional Income Gaps?

We begin with a discussion of the key factors identified in the literature as contributors to regional income disparities, including human capital, institutions, and geography. Next, we consider the literature on regional convergence, focusing on the significance of factor mobility and technology diffusion. We then explore why regional convergence has decelerated in recent decades, with recent contributions emphasizing the role of skill-biased technical change and the widespread adoption of information and communication technologies (ICT). Finally, we address the issue of persistent regional income gaps, highlighting the importance of location fundamentals and agglomeration economies, which can give rise to multiple spatial equilibria.

3.1 Accounting for the Size of Regional Income Differences

What factors might explain the spatial income gaps documented in Section 2.4? A large body of literature in economic geography emphasizes the role of first- and second-nature geography in explaining the location of economic activity. First-nature geography includes factors that are largely exogenous to human

activity, such as a region's natural endowments. Henderson et al. (2018) find that these factors alone can account for roughly 47 percent of the global variation in nightlight luminosity, a proxy for economic activity. In contrast, second-nature fundamentals reflect features shaped by human intervention, including historically sunk investments, infrastructure access, or proximity to economic centers of activity (see e.g. Fujita, Krugman and Venables, 1999; Redding and Sturm, 2008). These endogenous factors are also influential. For example, Allen and Arkolakis (2014) use a quantitative spatial model to decompose income variation across U.S. counties in 2000. Their findings attribute part of this variation to intrinsic geographic fundamentals, such as local productivity and amenities, while another portion is explained by connectivity with other economic centers. They find that geographic location, specifically connectivity to other regions, accounts for around 20 percent of the observed income distribution.

Several contributions in macroeconomics have explored this question through the lens of development accounting (see e.g. Hsieh and Klenow, 2010). Using regional data spanning 110 countries, Gennaioli et al. (2013) and Gennaioli et al. (2014) find that human capital plays an important role in accounting for regional income differences and growth. Similarly, Acemoglu and Dell (2010) highlight the importance of institutional quality in addition to human capital, mirroring findings in the cross-country literature (see also Tabellini, 2010). The significance of regional differences in human capital and labor mobility underscores the importance of understanding sources of spatial frictions and their impact on

income disparities across locations (Combes, Duranton and Gobillon, 2008; Young, 2013).

3.2 Convergence

While the importance of geographical attributes can change over time, models highlighting the role of geographical endowments are less suited to explain fairly rapid changes in regional income gaps. We proceed by synthesizing explanations for regional convergence that are particularly relevant for our sample of countries.

Regional convergence has long received attention in macroeconomics (Barro et al., 1991; Barro and Sala-i Martin, 1992; Sala-i Martin, 1996*b*). These studies typically start from the closed economy Solow model, which emphasizes the role of factor accumulation in driving changes in spatial income gaps (Solow, 1956). While this literature has provided substantial evidence of regional convergence, it has drawn criticism for insufficiently accounting for regional interdependencies (see e.g. Magrini, 2004; Breinlich, Ottaviano and Temple, 2014). In particular, the mobility of factors of production and final goods will tend to erode differences in their rates of return across regions. Furthermore, trade in goods and factors can facilitate technology diffusion (Grossman and Helpman, 1991), narrowing regional disparities over time. Furthermore, Gennaioli et al. (2014) find that regional convergence is higher in countries with more developed financial markets.

Meanwhile, research in economic geography has examined how intranational trade costs and increasing returns contribute to regional income disparities (Krug-

man, 1991*b*; Fujita, Krugman and Venables, 1999). These models highlight the appeal of larger markets for both living and production, which generates a self-reinforcing cycle of migration and industry concentration. As trade costs diminish, convergence can emerge as industry relocates to regions with low wages or workers move to areas with high wages (Puga, 1999). Evidence consistent with these mechanisms can be found in Rosés, Martínez-Galarraga and Tirado (2010) and Combes et al. (2011). While this literature has provided important insights, these models often come with simplifications that limit their empirical applicability (see e.g. Redding and Rossi-Hansberg, 2017). In recent years, substantial progress has been made in understanding the properties of models with more realistic geographies and rich spatial heterogeneity (see e.g. Allen and Arkolakis, 2014). However, these models are mostly static and therefore lack many important mechanisms highlighted in the macroeconomic literature.

A key challenge in closing this gap has been to incorporate forward-looking behavior into models that capture detailed spatial heterogeneity. One approach is to reduce the dimensionality of the problem with structural assumptions. For instance, Allen and Donaldson (2020) impose an overlapping generation structure where each period is sufficiently long for agents to fully discount the future. Desmet and Rossi-Hansberg (2014) develop a spatial endogenous growth model where firms invest in technology. Other examples of this approach can be found in Trew (2014), Desmet, Nagy and Rossi-Hansberg (2018), and Peters (2022), which assumes that technology diffuses spatially and that innovation realizations

are spatially correlated, rendering the innovation decision static. Nagy (2020) embeds similar innovation dynamics in a model with complementarity between agricultural goods and labor, which introduces a positive relationship between the availability of agricultural goods and productivity growth. This mechanism accounts for rapid population convergence between macro-regions of the US between 1790 and 1860.

A recent important contribution by Kleinman, Liu and Redding (2023) embeds forward-looking investment decisions in a spatial model with rich spatial heterogeneity. Following Moll (2014), the model distinguishes between capital owners who invest to maximize expected net present income but are immobile across locations, and workers, who are mobile but live "hand-to-mouth". These assumptions allow the authors to characterize the dynamics of the model in closed form. They show that initial conditions, rather than the path of shocks to productivities, amenities, or trade costs, are crucial in accounting for convergence dynamics across US states since 1960. These results underscore the importance of incorporating capital accumulation in explaining patterns of regional convergence.

Finally, several important contributions emphasize the role of structural transformation in shaping regional convergence. Many of these models emphasise the role of low income elasticities of agricultural consumption and technological progress in the agricultural sector as key drivers (see e.g. Herrendorf, Rogerson and Valentinyi, 2014). However, Caselli and Coleman (2001) contend that this

would result in a decline in agricultural prices, contrary to the observed trend for the US since 1940. Instead, Caselli and Coleman (2001) show that improved access to human capital led to lower agricultural labor supply and to the convergence of agricultural and urban wages, explaining income convergence between northern and southern US states. Eckert and Peters (2022) highlight the significance of low initial productivity in rural sectors and regions as a key driver of regional convergence (see also Acemoglu, Aghion and Zilibotti, 2006). Building on the observation that rural locations experienced more rapid growth between 1880 and 1930, they construct a spatial model with non-homothetic preferences to explore the drivers of this convergence. Although lower demand for agricultural goods disadvantaged rural locations as incomes grew, a larger distance to the technological frontier also facilitated rapid productivity growth. Similar channels might have operated in other countries in our sample, many of which experienced rapid structural transformation since 1900 (Rosés and Wolf, 2021).

3.3 Divergence

While regional disparities have narrowed, especially after a period of rapid growth post-WWII, the analysis above suggests a slowdown in both absolute and conditional convergence across many countries since 1980. Growth decelerated mostly everywhere, but less in regions with the highest population density. In this section, we highlight a few prominent theories linking this phenomenon to concurrent trends in the last decades. These include skill-biased technical change,

the advent of information and communication technology (ICT), structural transformation toward services, and increased exposure to globalization.

A leading explanation for the slowdown in regional convergence in the U.S. since the 1980s is skill-biased technical change (see e.g. Katz and Murphy, 1992). Technological advancements disproportionately favoring skilled workers over their unskilled counterparts can widen the wage gap between the two groups.[7] The impact of skill-biased technical change is particularly pronounced in larger cities, where there is a higher concentration of skilled workers and advanced technologies.

The literature offers different explanations for why skill-biased technical change has a greater effect in larger cities. Diamond (2016) finds that skill-biased technical change is accelerated by endogenous amenities in large cities, creating a self-reinforcing cycle that attracts relatively more skilled labor. An influx of skilled workers further promotes higher productivity, widening the gap between large and small cities. Rubinton (2022) highlights a similar dynamic, showing that firms in larger cities, which benefit from bigger markets, better amenities, and higher productivity for skilled workers, are strongly incentivized to adopt skill-biased technologies. This trend leads to divergence between larger and smaller cities over time. Spillovers among high-skilled specifically workers in large cities may also be a factor. Giannone (2022) shows that a substantial

[7]This phenomenon has been extensively studied in the context of the labor market, with implications for regional economic disparities.

share of the reversal in regional convergence since the 1980s can be attributed to this subset of workers. To explain this phenomenon, Giannone (2022) uses a spatial framework that incorporates heterogeneous workers and skill-biased technical change, extending the work of Desmet, Nagy and Rossi-Hansberg (2018). The model suggests that the impact of skill-biased technical change is more pronounced in high-skill regions when local knowledge spillovers among high-skilled workers are substantial.

Another strand of literature highlights how technological advancements, especially in the form of information and communication technology (ICT), have contributed to regional divergence.[8] Eckert, Ganapati and Walsh (2022) investigate the geographic impact of the widespread adoption of ICT since the 1980s. They find that the accelerated growth in wealthier urban areas can be attributed to specific service industries that are intensive in the use of ICT. Their findings are explained through a model where the complementarity between labor and capital depends on the level of firm output. In high-productivity areas, labor demand therefore increases by more in response to declining ICT prices. This pattern is consistent with the observed trend of relatively faster growth since 1980 in regions with the highest density of economic activity.

Structural transformation towards services has played a significant role in

[8]This builds on a literature that documents the impact of ICT and skill-biased technical change as drivers of income inequality (see e.g. Autor, Levy and Murnane, 2003; Beaudry, Doms and Lewis, 2010)

shaping regional economic patterns in recent decades, as documented by Chen et al. (2023) for the case of France. As the country transitioned from a manufacturing to a service-oriented economy, this shift was concentrated in the largest cities with the highest density of economic activity, where the services sector grew disproportionately. In contrast, manufacturing reoriented towards less populous locations. This pattern was driven by the behavior of large firms, with large services firms expanding in urban areas and large manufacturing firms expanding in other parts of the country. A crucial factor contributing to this *urban biased* structural change was the strengthening of agglomeration externalities in services relative to manufacturing. Chatterjee, Giannone and Kuno (2023) also link the deceleration in regional convergence to structural transformation towards services, noting that service employment is more spatially concentrated than manufacturing or agriculture.

The spatial concentration of services employment can be linked to housing supply. Eeckhout, Hedtrich and Pinheiro (2021) demonstrate that the composition of production factors that firms choose varies geographically. Labor and ICT demand are shown to vary significantly with a city's cost of living, since workers must be compensated for local housing prices, while ICT is a highly tradable good that can be bought at similar prices everywhere. As a result, firms find it beneficial to use ICT more intensively in expensive cities, where house prices co-move with labor productivity and wages. As routine tasks disproportionately increase the cost of labor, firms in more productive areas are inclined to replace

such tasks with ICT.

Alongside the diffusion of information technology, the economies in our sample have also become more open to international trade. A growing literature has documented how differences in industry composition across locations mediate the impact of trade shocks. In an influential paper, Autor, Dorn and Hanson (2013) show that U.S. regions more exposed to import competition, due to their industry composition, experienced greater declines in manufacturing employment and wages. Given the substantial regional variation in industry composition and the challenges associated with labor mobility across sectors and regions, the effects of import competition can be highly localized (Caliendo, Dvorkin and Parro, 2019). In line with the literature's emphasis on skill-biased technical change, Burstein and Vogel (2017) argue that trade affects the skill premium through a differential impact on small and large firms. Since large firms are more intensive in the use of skilled workers and trade integration shifts factors of production towards larger firms, trade tends to increase the skill premium. This has potential implications for spatial inequality, especially given the increased degree of geographic sorting by skill highlighted in the aforementioned contributions.

Why are some regions more vulnerable to macroeconomic shocks and structural change? Several contributions have emphasized the adverse effects of specialisation on growth (Glaeser et al., 1992; Duranton and Puga, 2001). Increased specialisation can limit innovation, leading to lower long-term growth (Feldman and Audretsch, 1999). A narrower industrial base can also make a

region more vulnerable to macroeconomic shocks. For instance, Heblich et al. (2023) find that English and Welsh cities that specialized in a few industries in the late 19th century had more unskilled workers in the 1970s. The authors attribute this to dynamic agglomeration economies, which generate larger long-run productivity gains in cities with diversified industries.

The UK experience is particularly relevant, with acute shocks over a relatively short period of time and deindustrialisation arriving earlier than elsewhere (Rice and Venables, 2021). Since the 1970s, weaker economic regions have struggled to recover from these shocks, and the 2008 financial crisis further halted modest growth in these areas while more prosperous regions recovered more quickly. Unlike prior recoveries where productivity typically increased post-recession, productivity stagnated nationwide after 2008, with the most productive firms in weaker regions affected more than those in prosperous ones (McCann, 2020). This remains only partially understood but may relate to the highly centralized UK banking system, which Mayer, McCann and Schumacher (2021) suggests, tends to disadvantage SMEs in peripheral areas.

However, regions are not static entities; under certain conditions, they can adapt and recover from adverse shocks. A cross-country study by Gagliardi, Moretti and Serafinelli (2023) finds that some cities with historically high manufacturing employment have shown remarkable adaptability, managing to surpass pre-deindustrialisation employment levels. They estimate that approximately 34% of former manufacturing hubs experienced employment growth above their

national averages following industrial decline. However, this adaptability was not evenly distributed: in U.S. Rust Belt cities, recovery lagged compared to similarly affected areas in other advanced economies. A key determinant of these outcomes was human capital. Cities with a higher proportion of college-educated workers at the peak of manufacturing enjoyed significantly faster employment growth in the decades after industrial decline than those with lower education levels, with this gap widening over time.

The impact of localised shocks on regional wage disparities can be mitigated if they induce migration from low- to high-wage regions. However, evidence suggests that housing constraints often limit this movement, which can exacerbate income gaps. For instance, Ganong and Shoag (2017) show that migration to high-wage areas in the U.S. has decreased significantly since the 1980s, with housing supply restrictions reducing the net benefits of relocation for low-skilled workers. In the UK, a similar pattern emerges: Stansbury, Turner and Balls (2023) find that, despite relatively high interregional mobility, migration often moves in the "wrong" direction for convergence, as limited housing supply in high productivity areas reduce the wage premium for much of the income distribution. This is further compounded by the elasticity of local housing supply. Drayton, Levell and Sturrock (2024) decompose housing stock responsiveness in the UK and find that constraints, particularly in densely urbanized areas, dampen local housing stock growth. For instance, they estimate that if London's housing elasticity were at the national median, price growth there would have been 21

percentage points lower.

The factors we have discussed so far can also interact with each other to produce a spatially concentrated increase in inequality. The specific drivers of spatial inequality - whether increased regional worker sorting, increased regional sorting of firms, or spatially biased technological change – will have different implications for the redistributive effects of spatial policy, which we will return to in Section 4. To distinguish between these factors, Mann (2023) builds a search model of two-sided spatial sorting. Using West German data from 1975 to 2018, Mann (2023) finds that highly productive firms and workers concentrate disproportionately in affluent locations and that the spatial sorting of firms is significantly stronger than that of workers. The spatial sorting of firms is shown to be an important determinant of workers' job ladders and lifetime values.[9]

3.4 Persistence

While there is strong evidence of regional convergence across many countries, the studies cited in the preceding section suggests that this process has decelerated in recent decades and remains incomplete. This is reflected in the persistence of regional income gaps shown in Figure 5. In this section, we turn to a large theoretical and empirical literature in economic geography that studies the drivers of persistence.

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[9]See also Behrens, Duranton and Robert-Nicoud (2014) for a link between worker sorting, selection, and agglomeration economies.

As previously discussed, a substantial share of the spatial distribution of economic activity can be accounted for by location fundamentals or natural endowments (see e.g. Henderson et al., 2018). An influential study by Davis and Weinstein (2002) examines the determinants of city size in Japan over an extended period. The study finds that even in the aftermath of atomic bomb explosions, Japanese cities quickly reverted to their initial growth trajectories. This suggests that location fundamentals are an important determinant of the city size distribution. Similarly, Bosker and Buringh (2017) analyze the origins of Europe's urban network from 800-1800 AD, showing that medieval European cities emerged in response to favorable geography, such as river access, fertile land, and proximity to trade routes. These cities became "seeds" in a growing urban system, creating persistent regional hierarchies. Collectively, these findings underscore the importance of first-nature geography in shaping the location of economic activity. Since locational fundamentals can be highly persistent, these findings also provide a potential explanation for the high degree of persistence in the spatial distribution of economic activity observed in our sample.

While first-nature fundamentals can affect the initial distribution of economic activity, regions can also differ greatly in second-nature fundamentals, or factors that are shaped or influenced by human activity, such as infrastructure, institutions, social networks, and linkages to other locations (see e.g. David, 1985; Krugman, 1991*a*). These factors can also affect growth, potentially altering the spatial distribution of economic activity over time. In particular, in the presence

of strong agglomeration externalities, the location of economic activity may not be uniquely determined by first-nature fundamentals, leading to the possibility of multiple equilibria in the spatial distribution of economic activity. A large literature provides evidence for multiple spatial equilibria through case studies, showing how temporary shocks can result in permanent economic changes (see e.g. Kline and Moretti, 2014; Hanlon, 2016; Heblich, Trew and Zylberberg, 2021). This suggests that historical locational advantages can continue to influence outcomes even after those advantages subside. For instance, Bleakley and Lin (2012) show that portage sites predict population density a century after portage became irrelevant. These findings suggest that even when first and second-nature fundamentals do not persist, they can have a lasting impact on the spatial distribution of economic activity, contributing to the persistence of spatial income gaps.

How important are multiple spatial equilibria in shaping the location of economic activity? Allen and Donaldson (2020) study the prevalence of path dependence using U.S. data from 1800 to 2000. Their model incorporates rich spatial heterogeneity, agglomeration externalities, forward-looking agents, and heterogeneous locations interacting through costly trade and migration. While path dependence appears to be an important force shaping the geographic distribution of economic activity across U.S. counties, it is unclear how important multiple spatial equilibria are at more aggregate levels such as states. Nevertheless, the paper is an important step toward understanding the importance

of historical factors in explaining the persistence of spatial income gaps across regions.

4 The Challenge Faced by Big-push Policies

The highly persistent nature of spatial income inequalities highlights the scale of the task faced by any policy that aims to reduce them. One policy which has this aim is European Union (EU) Structural Funds, now known as Regional Development and Cohesion Funds and comprising the European Regional Development Fund and Cohesion Fund.[10] The rules on area eligibility have varied over time, but the programme has typically aimed to support economic growth and jobs in lagging areas, and has had specific convergence objectives. A large fraction of funds has historically flowed to regions with GDP per capita below a threshold, e.g. during 2000-2006 to Objective 1 Areas – regions within a country with GDP per capita less than 75 percent of the EU average, and eligibility for the Cohesion Fund is at the national level based on per capita GDP less than 90 percent of the EU average. For the period 2021-2027 the budget is nearly €400 billion, roughly a third of the total EU budget.[11] Much of the investment is on infrastructure, such as transport and renewable energy or funding towards innovation.

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[10] See Ehrlich and Overman (2020) and Neumark and Simpson (2015) for summaries of a wider set of place-based policies.

[11] https://eur-lex.europa.eu/summary/chapter/regional_policy.html?root_default=SUM_1_CODED=26&locale=en

EU Structural Funds have been the subject of multiple evaluations. Becker, Egger and von Ehrlich (2010, 2012) focus on the impact of Structural Funds expenditure on employment growth and growth in GDP per capita in Objective 1 regions.[12] Becker, Egger and von Ehrlich (2010) uses the (in principle) strict cut-off of GDP per capita below 75 percent of the EU average to implement a fuzzy regression discontinuity design. During the period in which regions receive funding the study finds a positive effect on growth in per capita GDP of around 1.6 percentage points per annum, with their calculations suggesting that the financial transfers are associated with a multiplier of 1.2, although they cannot reject a multiplier of 1.0.

Becker, Egger and von Ehrlich (2012) examine the effect of the intensity or generosity of EU Structural Funds on growth in income per capita and ask whether funds could have been distributed differently across regions to achieve higher aggregate growth at the EU level and faster convergence. The underlying idea is that Structural Funds might need to exceed some minimum level of funding in order to induce a "big push" and that there is also potential for diminishing returns once funding reaches a certain transfer intensity. During the period 1994-2006 the authors document substantial variation in annual transfers, from less than 0.0001 percent of GDP for a region in Sweden to 29 percent of

[12]Mohl and Hagen (2010) provide a thorough overview of EU Structural Funds evaluations, concluding that the majority of studies find positive effects on regional income growth or on convergence.

GDP for a region in Greece, with an average of around 0.8 percent.

The authors then estimate treatment effects at varying transfer intensities. Their analysis confirms that on average the effects of the transfers on regional growth are positive, and they find no evidence of a lower bound with even small transfers generating positive effects. Their analysis also allows them to draw conclusions on the optimal distribution of funds. For example, they find that around 18 percent of regions received funding above what they define as the "maximum desirable treatment intensity" (a level of transfers of 1.3 percent of GDP, beyond which they cannot reject that there are zero effects on growth). Had funds been redistributed away towards regions with lower transfer intensities average regional growth in income per capita would have been higher. The authors' wider results highlight a key trade off in policy making to reduce regional disparities – an increase in convergence may come at the expense of lower aggregate growth.

Blouri and Ehrlich (2020) come to a similar conclusion that a budget-neutral redistribution of Structural Funds could have resulted in higher welfare gains. They include regional transfers in a structural general equilibrium model which incorporates population mobility, inter-regional trade and agglomeration externalities. This allows them to derive an optimal allocation of the different EU funding streams and suggests that wage subsidies are best targeted to lagging peripheral regions, whereas transport investments lead to higher aggregate welfare gains in more productive, core regions, although in this case at the expense of increased

regional income inequality (see also Fajgelbaum and Gaubert (2020) who analyse a similar question in a US context).

Two examples of large-scale regional development programmes in the US are the Tennessee Valley Authority (TVA), the effects of which are evaluated in the Kline and Moretti (2014) and the Appalachian Regional Commission (ARC) analysed by Isserman and Rephann (1995) and Glaeser and Gottlieb (2008). The TVA involved very substantial investment in public infrastructure including transport, energy and schools with an aim of attracting manufacturing activity. Funding ran from the 1930s to 2000, with expenditure peaking in the 1940s and 1950s, (with transfers per household of around 10 percent of average income). The targeted area spanned four US States: nearly all of Tennessee plus parts of Kentucky, Alabama and Mississippi. In their evaluation, Kline and Moretti (2014) construct control areas from other potential regional authorities which were proposed but did not go head for political reasons. They find that over the long-run the investment did generate structural change – shifting employment from agriculture to manufacturing – and the change in the composition of employment led to increased household income growth. They identify a significant role for agglomeration externalities, with the TVA counties remaining an attractive location for new manufacturing even after the cessation of public funding.

Kline and Moretti (2014) also address the question of whether the benefits to the TVA counties came at the expense of the aggregate. The authors distinguish two channels through which benefits accrue – the direct effect of publicly-funded

infrastructure in raising private-sector productivity, and second the indirect effect arising from agglomeration externalities. They highlight that the second channel cannot have a positive effect on aggregate unless there exists heterogeneity in local agglomeration elasticities; if instead the elasticity is constant, a spatial redistribution of activity results in no aggregate benefit. Their evidence suggests that while the direct effects of the policy did not persist beyond the main period of funding up to 1960, the indirect effects from agglomeration externalities did. However, since they also find that the agglomeration elasticity is constant across locations they argue that spatial reallocation results in no aggregate benefit or cost, with benefits to the TVA counties offset by losses elsewhere (see Fajgelbaum and Gaubert (2020) for a model where transfers can lead to efficiency gains).

Isserman and Rephann (1995) and Glaeser and Gottlieb (2008) evaluate the effects of the ARC, which began in 1963 and provided federal funding for transportation infrastructure, health and education to counties spanning from Mississippi to New York, with the two papers coming to differing conclusions. While Isserman and Rephann find large positive effects on in income per-capita, Glaeser and Gottlieb (2008) find no statistically significant effects on growth in income per capita, although large standard errors mean they cannot rule out positive effects. The different conclusions may well be due to the use of different control groups, but also highlight the difficulty of analysing the long-run effects of large-scale, multifaceted expenditure programmes in terms of controlling for unobserved confounding factors and other policies that might influence growth.

Ehrlich and Seidel (2018) examine the long-run effects of the Zonenrandgebiet place-based policy in West-Germany implemented from the 1970s and (unexpectedly) ended following re-unification in locations close to the Iron Curtain, and hence cut-off from markets on their Eastern border. This policy aimed to stimulate economic development, and like the others surveyed, involved large-scale transfers – subsidies for firm investment and funding for public infrastructure. The authors find persistent effects on density likely arising through higher public investment. The study also finds evidence for exactly the type of (unwanted) effects that theory suggests such a policy might induce – local spatial displacement of economic activity, and capitalisation of benefits into land prices, offsetting nominal income gains.

Given the scale of expenditure associated with "big push" type policies, key questions are - where to push, and how much, and how to pinpoint any trade-offs between aggregate and regional welfare gains. Both Blouri and Ehrlich (2020) and Fajgelbaum and Gaubert (2020) aim to tackle these questions, with the latter proposing that incentives to induce transfers of high-skilled workers to lower-wage, low-skill intensive locations can be efficiency improving due to productivity spillovers, and that the current pattern of worker sorting in the US is inefficient. A second question is how such policies should be funded, with this in mind Gaubert et al. (2021) analyse optimal place-based redistribution via location-based transfers and taxation.

Finally, as noted above, structural and technological change together with

polices enacted at a national level, including in other countries, all affect regional inequality, very likely much more so over the long-run than place-based policies themselves. As discussed in Section 3, changes in trade policy have regional implications based on initial industrial structure (Autor, Dorn and Hanson (2013) for the US; Dix-Carneiro and Kovak (2017) for Brazil) or based on city size and market access (Brülhart, Carrère and Robert-Nicoud (2018) for Austria following the fall of the Iron Curtain). As a recent example, Beck and Doerr (2023) investigate the impact of banking deregulation in the 1980s at the state-level in the US and show that increased competition among banks in urban areas fueled growth and exacerbated within-state urban-rural inequalities. These findings once again highlight the strength of economic forces that shape changes in the spatial distribution of economic growth, that national and regional policies might work against each other, and given the persistence in spatial inequalities the sheer scale of the task for place-based policies seeking to turn the tide.

5 Conclusion

This chapter began with a descriptive overview of regional income gaps across developed economies over the last decades, documenting three stylized facts to organize our review of the literature. First, although substantial regional income gaps have existed within countries throughout the sample period, these disparities have generally narrowed over time. Regional convergence is largely attributed to catch-up growth in poorer regions, particularly between 1950 and

1980. Second, while growth slowed across most countries in the sample after the 1980s, high-income regions experienced relatively smaller declines. In particular, regions with the highest population density within each country experienced a smaller reduction in their growth rates. This unevenness in the deceleration of growth has lowered the rate of regional convergence. Finally, due to the incomplete process of convergence, relative regional income levels have shown a high degree of persistence across the study period for most countries in our sample.

To understand the underpinnings and evolution of regional disparities, we turned to the literature on economic growth and economic geography. Our review of the literature began with the key factors contributing to regional income disparities, including human capital, institutions, and geographical attributes. We then explored the literature on regional convergence, focusing the roles of factor mobility, technology diffusion, and structural transformation. We also investigated the recent slowdown in regional convergence, with particular emphasis on the impact of skill-biased technical change, globalisation, and the proliferation of information and communication technologies (ICT). Lastly, we considered the persistence of regional income gaps, highlighting the significance of location fundamentals and agglomeration economies, which can lead to multiple spatial equilibria. The persistent nature of spatial inequalities underscores the challenges faced by policies to mitigate them. We concluded this chapter with an overview of recent "big-push policies", evaluating their effectiveness and highlighting

important design considerations in light of potential trade-offs between regional convergence and aggregate growth.

Are we witnessing a temporary stall in the post-war process of convergence, or will divergence continue? Extrapolating from past experience, the future evolution of regional income gaps will depend on the direction of technological progress and how societies respond to the challenges and opportunities it brings. While current trends are not without precedent, projecting from past experiences may be misleading, as these developments can interact in complex ways.

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