UCD CENTRE FOR ECONOMIC RESEARCH

WORKING PAPER SERIES

2024

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WP24/11

June 2024

UCD SCHOOL OF ECONOMICS
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Abstract

This paper constructs the first estimates of Irish regional GDP over the twentieth century and traces the relative economic performance of Ireland's regions since independence. Using an array of data sources available at a county level, output in Agriculture, Industry and Services in benchmark census years is estimated. Applying a variety of alternative measures, we find a reduction in regional inequality over the period that is similar to the broader European pattern. Regional convergence over the period 1926-1991 was driven by both within-sector convergence in productivity and structural change. Our paper helps to understand the regional dimensions to Irish economic development from the birth of a newly independent state up to the eve of Ireland's growth 'miracle' in the 1990s, when the first official efforts were initiated to construct these figures. Finally, we connect our estimates to these official figures to examine GDP at the level of NUTS regions up to 2021.

KEYWORDS: Regional GDP; Ireland, Economic History; Inequality; Economic Growth.

JEL CODES: N34, N94, O18, R11, R12

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We thank John FitzGerald, Frank Geary, Cormac Ó Gráda and seminar and conference participants at University College Dublin, University College Cork, Trinity College Dublin, Lund University, Economic History Society, European Historical Economics Society, Economic and Social History Society of Ireland and the Irish Economic Association for their thoughts and suggestions. We also thank the CSO and Kerstin Enflo for data assistance. The paper benefitted from funding from the Science Foundation of Ireland-Irish Research Council Pathways Initiative (SFI-IRC 21/PATH-A/9390). Any and all errors remain those of the authors and theirs alone.

1. Introduction

Over the last three decades, a sustained increase in Irish economic growth rates has placed it amongst the richest countries in the world, when measured in terms of GDP per capita. The most recent revisions to the Maddison (2020) database rank it second only to Norway in 2018, having surpassed other economies such as Switzerland, Sweden, Luxemburg, the Netherlands and Germany in recent years. This dramatic transition transpired against the backdrop of the 1980s, during which the case for the Republic of Ireland representing a "failed economic entity was a strong one" (Ó Gráda and O'Rourke, 2021). The remarkable story of Ireland's relatively recent convergence has not gone unrecognised, with one study claiming that "Ireland started out poor, converged from below and forgot to stop" (Caselli and Tenreyro, 2005).

However, in the century that has passed since political independence, a new consensus has emerged among Irish economic historians that while the character of progress since the 1920s was "uneven" (Ó Gráda, 2011), Ireland's economic performance over the whole century was not especially unique (O'Rourke, 2017). According to O'Rourke's (2017) convergence-based study, "over the long run, [Ireland's] economic performance was just about exactly what you would have predicted" given Ireland's starting point in the 1920s. Contemporary work has supported this viewpoint with newly developed annual (national) GDP data spanning the century since independence (Kenny, 2024). Key to placing Ireland's seemingly astonishing performance in the correct context is a recognition of the distortion of Ireland's national statistics by the activities of multinational corporations, particularly over the last few decades. While Ireland's GDP per capita ranks among the highest in the world, when measured by a more appropriate measure of living standards such as modified domestic demand, Ireland's economic standing looks solidly average among its European peers (Ó Gráda and O'Rourke, 2021; Honohan, 2021).[3]

As the picture of Ireland's long run national growth record has become clearer in recent years, we remain in the dark as to how Ireland's regions performed relative to one another or in the context of a European pattern. Were initially unequal regions converging upon one another since the 1920s, despite a lack of national convergence until the 1990s? Were there distinctive periods with alternate drivers of change? How important was structural change at a regional level? Were some regions left behind by the take-off that occurred in the 1990s? To date, these questions remain largely unanswered.

[3] Modified domestic demand or GNI* is now routinely computed by Ireland's Central Statistics Office (CSO).

For other countries, we know significantly more about the evolution of regional inequality. In a recent collaborative effort involving scholars from a wide range of European countries, regional GDP was calculated for the EU's NUTS2 regions in their current classification from 1900 to the present (eds Rosés and Wolf, 2021). It was regretted in the introduction that for "the Republic of Ireland, we have no further regional breakdown" [than national] (Rosés and Wolf, 2021, p.4). While the Irish Central Statistics Office publishes a regional GDP database for Ireland with data commencing in 2000, no attempt has yet been made to extend this back to the independence era.

This paper attempts to fill this gap in the literature and produces GDP estimates for Ireland's regions at the EU NUTS2 and NUTS3 level for the period spanning 1926-2021.[4] We do this by assembling a wide range of existing official county level data for the three sectors- agriculture, industry and services. The appendix to this paper documents the sources and methods used for constructing GDP for each region and sector. We apply a mixed method approach (Enflo and Missiaia, 2019), adopting varying strategies to the three sectors, based upon the nature and availability of the data. The paper joins a growing tradition of research in Irish economic history that attempts to form a picture of the Irish economy through the construction of macroeconomic variables such as financial market data (Foley-Fisher and McLaughlin, 2016; Hickson and Turner, 2005; Grossman et al, 2014), monetary data (Kenny and Lennard, 2018; Gerlach and Stuart, 2015; O'Rourke, 1998), banking sector and credit data (Kenny and Turner, 2020; Kenny et al. 2021; McLaughlin, 2014; Moynihan, 1975; Stuart, 2017), fiscal data (FitzGerald and Kenny, 2019), consumption/price data (Stuart, 2017, FitzGerald et al, 2022), wealth and genuine savings estimates (Daly and Morgan, 2023; Cummins and Ó Gráda, 2021; McGrath et al, 2021) and various alternative measures of output (Kenny, 2024; Bielenberg, 2009; O'Rourke, 1998; Andersson and Lennard, 2018; Kenny et al, 2022; Turner, 1996).

Our newly-constructed GDP data at county level reveal that Ireland's regions generally converged upon the national average (in both GDP per capita and per worker) over the period 1926-91. We find strong evidence for both beta convergence – initially poorer regions growing faster – and sigma convergence – a reduction in the dispersion of GDP per capita over time. At a county level, these changes were primarily driven by convergence in productivity within sectors, a finding consistent with neoclassical theory. Nonetheless, we find that structural change also played an important role. By examining the drivers of convergence at a county

[4] The NUTS acronym stands for 'Nomenclature of Territorial Units for Statistics' https://ec.europa.eu/eurostat/web/nuts/history

level, we see that convergence in industrial productivity was a powerful source of convergence among the best performing counties, while structural change and productivity catch-up in agriculture helped initially lagging regions make progress. Both structural change and industrial productivity growth were crucial to understanding arguably the most successful example of convergence, namely the western county of Galway. Ireland's reduction in regional income inequality closely mirrored Britain's, while the level of Irish spatial inequality tended to be in the middle of the range recorded by its European peers.

Analysis of both disaggregated county-level data and aggregated NUTS-level data adds further depth to Ireland's convergence story. Though *count*y GDP per capita convergence stalls from 1981, convergence continues until 1991 using the NUTS classifications. After 1991, the distortions arising from GDP affect *regional* GDP statistics to an even greater extent than national level, overstating the share of those regions in which multinational firms reside. Our modified approach (to GDP) shows regional divergence from the 1990s that is in line with most of Ireland's European peers. Again, Ireland's long-run performance is respectable but not extraordinary.

The remainder of the paper is structured as follows. Section 2 discusses the literature to date as it relates to regional GDP and the Irish context. Section 3 briefly discusses the data construction. Section 4 presents the headline estimates for counties and NUTS and analyses the new data in the context of the literature. Section 5 offers a brief conclusion and outlines some areas for future research.

2. Reconstructing Historical National Accounts

Since the publication of Angus Maddison's (1995) first historical GDP estimates, a new wave of literature has spawned that has attempted to develop original, and improve existing, historical national accounts for a growing sample of countries. For European states in particular, researchers now have access to a wide range of historical GDP series spanning centuries (c.f Broadberry and Fouquet, 2015; Krantz and Schön, 2015; Broadberry et al., 2015; van Zanden and van Leeuwen 2012, Álvarez-Nogal and Prados de la Escosura, 2013). In addition to reviewing many other topics, these data have enabled researchers to explore the origins of modern economic growth (Broadberry and Wallis, 2017; Crafts, 1985; Broadberry et al. 2014, Lindert and Williamson, 2016) , the changing nature of the business cycle (Broadberry and Lennard, 2023), the Great Divergence debate (Broadberry et al. 2021), the Golden Age of economic growth (Crafts, 1995; Temin, 2002), long run productivity performance (Abramovitz and David, 2002; Crafts and O'Rourke, 2020; Crafts and Toniolo, 2008), the question of

economic convergence (Barro and Sala-i-Martin, 1992; O'Rourke, 2017) and income inequality (Piketty, 2014; Milanovic, 2016). In sum, these monumental improvements in national level production data have raised the standards by which we measure and compare economies over the long run.

As others have noted, taking the nation state as the principal unit of comparison is a logical choice. Political history has invariably played out in the context of national borders and the statistical agencies which have compiled economic data form part of the relevant *national* body politic (Rosés and Wolf, 2019, p. 3). In Europe, national borders have experienced continually disruptive change over the previous centuries, which poses some challenges in achieving consistency. However, during the last ten years in particular, a new strand of research has emerged which attempts to measure long-run economic performance at the *regional* level. As has been recognised in a European context, regional income per capita and productivity differences are often larger and more resilient than differences across countries (Rosés and Wolf, 2019, p. 4). In this sense, policy makers relying exclusively on national level data will not accurately observe growing regional inequality, which has exhibited stronger effects on voting behaviour than interpersonal inequality (Rodríguez-Pose, 2018). Underpinning the recent emphasis on long-run regional performance is the European Union's Regional Policy and its official division of Europe into NUTS regions from July 2003. These regional classifications have created a new set of territorial units for which production and demographic statistics could be developed and compared through time to assess convergence/divergence dynamics (See eds. Roses and Wolf, 2019).

A key methodology for constructing historical regional GDP was provided by the pioneering approach of Geary and Stark (2002), who constructed measures of productivity and output for the four regions of the United Kingdom over the period 1861-1911. The Geary and Stark (G-S) method distributed national (UK) output per sector according to employment and wages at a regional and sectoral level, with employment by sector obtained from national *Census* benchmarks and regional wages used to adjust for productivity differentials. This approach has been classified as a "regional employment-based method" (Enflo and Missiaia, 2019) and others have applied it to arrive at regional GDP estimates for a growing sample of European countries (Enflo, Hening and Schön, 2014; Roses, Martinez-Galaragga and Tirado, 2010, Janisse et al, 2019). The G-S method can be seen as a top-down method as it relies upon the quality of national GDP measures as a starting point from which it ultimately allocates across regions and sectors (Enflo and Missiaia, 2019).

In contrast, a bottom-up approach seeks to obtain direct measures of output where possible, though this data is rarely available before the twentieth century at the level of the regional economy. However, official data for industrial production is often superior to those produced for the other sectors and this sector's value-added is sometimes disaggregated per region in production *Censuses*. For example, in the case of Italy, these bottom-up industrial production figures have been obtained and incorporated into regional GDP estimates (Felice, 2011, 2018), which have consequently been regarded as "the most precise ever produced for any given country" (Enflo and Missiaia, 2019). The advantage of the G-S method is that it allows for such a "mixed method" approach to estimating regional GDP (Schulze, 2007); namely it accommodates a merging of sectors that have been constructed using alternative methods (Enflo and Missiaia, 2019). In this paper, we take advantage of this feature and apply a mixed method approach to Irish regional GDP. Specifically, we calculate i) regional agricultural output through county-level stocks, ii) regional industrial output through direct *Census* estimates and iii) service sector output using regional wage and employment differentials.

We are certainly not the first to consider Ireland's economy in a spatial framework. In his *New Economic History of Ireland, 1780-1939*, Ó Gráda (1994, pp. 32-4) described four zones of different types of economic activity on the island as follows: the pastoral, the tillage, the small farm and the proto-industrial zones. These did not map on neatly to county or provincial boundaries, but were a product of geology, climate, topography and historical settlements. Subsequent work made use of county-level vehicle registration data to infer convergence in living standards (Ó Gráda 1997). Lynch and Vaizey (1960, p. 10) also recognized a significant rural-urban divide arguing that Ireland was a 'dual economy', with 'around 6 million people living in the subsistence economy when the Great Famine came in 1845, and about 2 million in the maritime economy around Dublin, Belfast, Cork, Waterford, Limerick and Galway. Other scholars have produced important economic histories of regional industries (Bielenberg, 1991; eds. Kennedy and Ollerenshaw, 1985; FitzGerald, 1981) and financial services (Ollerenshaw, 1987; O'Kelly, 1959).

In terms of sectoral economic performance, the volumes of Meenan (1970) and Kennedy et al (1988) both provided detailed, if understandably somewhat pessimistic, assessments of the Irish economic record since political independence (1922). A high concentration of labour in agriculture should, in theory, have allowed for rapid structural change upon independence. However, as O'Rourke (2017) noted, Ireland remained a de facto region of the UK economy (until the 1970s) where its comparative advantage remained within agriculture. Considering

the policies of the 1930s, Neary and Ó Gráda (1991) concluded that the protection of Irish industry was generally welfare improving, though they noted that the government preference for labour intensive tillage (rather than pastoral agriculture) may have reduced the pace of structural change. Barry's (2023) recent assessment of industrial policy for the first fifty years is also broadly positive, though it was not until the 1960s and 1970s that Irish manufacturing expanded as a significant share of employment and value added (CIPI 1961, CIPI 1971).

Turning to studies in Irish regional economic performance, Strobl's (2004) work on the location of Irish industry over the period 1926-96 found that it was more regionally dispersed than it had been at independence. Subsequently, Morgenroth (2008) presented a detailed analysis of the dispersion of employment across Ireland in 2006 and found that the spatial distribution of employment differs significantly between sectors. However, over the decades since the work of Meenan (1970) and Kennedy (1971), little formal analysis has been conducted on measuring the effects of general structural change over time on the Irish economy. This is somewhat puzzling given the magnitude of change that transpired since the 1970s.

Turning to regional economic performance, the first official regional GDP estimates for Ireland become available in 1991 (CSO 1996). The earliest estimates (on an all-island basis) come from the work of Geary and Stark (2002, 2016, 2019) for the years 1861-1911, who pioneered the G-S method to study regional economic differences in the United Kingdom as a whole. In their most recent (2019) analysis, those authors show that GDP per capita in Ireland remained at 60 per cent of the UK level between 1861 and 1911, despite a population fall of 25 per cent over the same period. As Ó Gráda and O'Rourke (1998) noted, Ireland did begin converging upon the UK in the 1960s and upon its international peers from the 1970s (O'Rourke, 2017). However, in all regional analyses of European economies, the Republic of Ireland has been treated as an equivalent to other EU (NUTS) regions, as no regional data has yet been constructed for Ireland (Roses and Wolf, 2019, p. 4). While there does exist a small number of studies that have examined regional differences in incomes at particular points in time (Attwood and Geary 1963; Ross 1972; Ross 1980) or using individual series over time (Ó Gráda 1997), a comprehensive treatment is lacking. Understanding the dynamics of regional inequality in Ireland over the twentieth century therefore requires the construction of new data and it is to this task that we now turn.

3. Data

As described in detail in the data appendix, a mixed-method approach (Enflo and Missiaia, 2019) was applied to calculating Irish regional GDP in this paper. For calculating regional agricultural value-added, we were guided by the CSO's (1996) method which relied extensively upon county level stocks (*Agricultural Statistics; Statistical Abstract)*. For industry, the majority of the data were hand collected directly from the *Censuses of Industrial production*. For services, wage data can be used to arrive at county level relatives (Geary and Stark, 2002) from official sources (*e.g. Censuses of Distribution, Estimates of Public Services*) while for employment by subsector we relied on census information. As all the data collected were initially documented and constructed at county level, it was subsequently necessary to aggregate these up to groups based upon the NUTS region classifications that they belonged to. Finally, national-level sectoral GDP (from Kenny, 2024) was distributed across regions using the relative weights obtained from the county and regional level data construction. The population and employment data are taken directly from the *Censuses of Population* (various years), with the exception of industrial employment, for which we rely upon the *Censuses of Industrial Production* (Barry, 2023).

Armed with the new data, we trace county-level output per worker in each sector in the period up to 1991 (we leave the post 1991 analysis to the next section, in which we present NUTS2 and NUTS3 estimates for the full period 1926-2021). We then consider trends in GDP per capita and per worker convergence and study the key contributors to regional inequality. Finally, we measure the extent to which cross regional convergence can be explained by sectoral productivity improvements and structural change.

4. Analysis

County-level output per worker by Sector

Our analysis of trends in comparative regional performance over time begins with an examination of relative output per worker in each sector. Tables 1-3 present the results of our data construction, where output per worker in each county is presented relative to the national figure in each benchmark year, giving us a sense of the degree of "sigma-convergence", or changes in cross-sectional dispersion over time.

<TABLE 1 HERE>

Starting with industry, Table 1 reveals that in the early years of the Free State, Dublin enjoyed a distinct lead in terms of labour productivity in that sector, before converging towards the

national average over the period. Other counties, such as Galway and Tipperary, converged from below, reaching levels of labour productivity that were above the national average by 1991, despite starting at levels that were around half the national average. The convergence paths of other counties were less consistent. A number of initially less productive counties, such as Cavan, Leitrim, Donegal and Monaghan enjoyed a degree of convergence up until the 1960s or 1970s, before falling behind again by the 1990s. We summarize changes in degree of dispersion in county labour productivity in industry using the coefficient of variation, a statistic commonly used in the regional economics literature.[5] In the early years of the state, county variation in labour productivity in industry was relatively high. After WWII however, regional inequality fell and remained stable until the 1980s. However, from this point, inequality began to increase again, with a greater degree of dispersion evident in 1991 than at any point in the post-independence period.

<TABLE 2 HERE>

Turning to agriculture, Table 2 summarises differences in county level output per worker through time. As might be expected, differences in agricultural productivity are more muted and also more consistent over time than in industry, with a relatively stable advantage for counties in the South and East relative to the North and West. A notable exception is Monaghan, whose agricultural productivity went from 12 percentage points below the national average to over 50% above the national average.[6] It is also worth remembering that these productivity changes occurred against the backdrop of marked structural change over the period, with agriculture representing over 50% employment in the 1920s, before falling to 12% by the 1990s.

<TABLE 3 HERE>

Finally, we review the same process in services in Table 3. The first observation that is apparent is the relatively low level of dispersion in output per worker in services relative to industry and agriculture. The Coefficient of Variation is low at the start of our period and declines steadily over time. Although Dublin begins with a sizeable productivity advantage in 1926,

[5] The Coefficient of Variation (CV) is calculated at the ratio of the standard deviation to the mean. We use an unweighted statistic here but also report a weighted (by population) CV, which is common in the literature, albeit not universally supported (Williamson, 1965; Gluschenko, 2017). A relatively similar pattern emerges over time, albeit inequality is greater at the start of the period and lower at the end due largely to changes in Dublin's population and relative position. Figure 2 shows the weighted (population) and unweighted CV for GDP per capita.

[6] This surge in agricultural productivity occurred from the 1970s, driven largely by an increase in less labour-intensive poultry farming.

this advantage is gradually eroded by 1991. There is also evidence of convergence from below, with many initially less-productive counties experiencing relative gains. The convergence of services productivity, particularly in the post-WWII period, coincides with the process of structural change and the modernisation of the Irish economy (see figure 1). The spread of the public sector and commercial and profession activities and the decline of domestic service were likely to have been forces of convergence over the period. It should also be noted that services employment in absolute terms actually fell slightly over the period, 1926-1971, reflecting the unusual decline in population experienced by Ireland during the twentieth century.

<FIGURE 1 HERE>

Moving beyond sectoral level figures, tables 4 and 5 provide details on the evolution of regional inequality in aggregated county GDP per worker (productivity) and GDP per capita over the twentieth century, respectively. Focusing on table 5 we can see that dispersion of GDP per capita was greater in the pre-WWII period than in any of the subsequent decades. While both measures indicate a sustained reduction in regional inequality over the full period, the trend is reversed (divergence in county GDP) between 1981 and 1991 reflected in the upturn in the CV that terminates in 1991.

<TABLES 4 AND 5 HERE>

The Coefficient of Variation fell markedly after WWII and this is clearly visible in Figure 2. Looking at cross-county differences, we see Dublin's initial advantage eroding over time while counties such as Galway display strong convergence. Figure 3, summarises regional inequality in a somewhat different way using the Gini coefficient.[7] However, the general pattern is very similar: relatively high inequality prevailing in the pre-WWII era was followed by greater regional equality in the post-war decades.

<FIGURES 2 AND 3 HERE>

Next, we turn to decompositions of long run patterns of regional inequality in Ireland over the twentieth century. As a first step, we decompose inequality in GDP per capita into changes due to productivity and changes due to labour participation (Cappelli et al. 2018). Equation 1 shows how output per capita can be split into the product of output per worker (productivity)

[7] Our statistics were calculated using the *REAT: Regional Economic Analysis Toolbox* package in R (Weiland, 2022)

and the working population relative to the population (employment rate), where Y_{it} is GDP in county i in year t, N_{it} is the population in county i in year t and L_{it} is the number employed in county i in year t.[8]

$$\frac{Y_{it}}{N_{it}} = \frac{Y_{it}}{L_{it}} \times \frac{L_{it}}{N_{it}} \tag{1}$$

The results of this decomposition are reported in figure 4.

<FIGURE 4 HERE>

Evidently, changes in the dispersion of GDP per capita are driven almost exclusively by change in the dispersion of labour productivity. The county employment rate may have been somewhat stabilised by the majority of rural counties experiencing a fall in their population that matched local employment availability.

Based on the predictions of the neoclassical growth model, a second measure of convergence employed in the literature is the extent to which initially poorer areas grow faster than initially richer areas. 'Beta-convergence' is typically estimated using regression analysis, specifically regressing regions' annual average growth rate on the initial level of GDP per capita.[9] We run such a regression using our county-level data and plot the results in figure 5.

<FIGURE 5 HERE>

The figure shows strong evidence for beta-convergence over the period 1926-1991. Most counties' growth performance is largely as predicted by the model, lying close to the regression line. Some notable outliers are apparent too, particularly the relative overperformance of Galway and the underperformance of Offaly. Nonetheless, on average, initially poorer countries tended to grow faster over the period.

Decomposing Convergence

With a number of sources of convergence proposed in the literature, we attempt to disentangle the sources of convergence among Irish counties over the period 1926-1991 by undertaking a

[8] Our denominator is the total population and not the working age population, as is often used. As such our estimate of the employment rate incorporates the impact of demographic changes.
[9] A we do not include any other controls in our OLS regression, our results relate to 'unconditional' convergence and assume that different areas have the same steady-state. Although this is a strong assumption, it is less of a concern at the subnational level where institutions are more similar and barriers to technological transfer are less explicit.

Caselli-Tenreyro decomposition. This widely employed approach decomposes overall sigma convergence of GDP per worker into within-sector convergence, labour reallocation and between-industry convergence, relative to a leading region (in our case Dublin), as shown in equation 2 (*inter alia* Caselli-Tenreyro 2006; Enflo and Rosés, 2015; Cappelli et al. 2018).[10]

$$\begin{aligned} \text{Convergence in labour productivity}_{i,Dub} &= \text{within-sector convergence}_{i,Dub} \\ &+ \text{labour reallocation}_{i,Dub} \\ &+ \text{between-industry convergence}_{i,Dub} \end{aligned} \quad (2)$$

Within-sector convergence is convergence that is due to relative improvements in labour productivity within agriculture, industry and services. Within-sector productivity convergence can occur if productivity differences in industry between a county and Dublin narrow over the period. As such it is consistent with convergence predicted by both the neoclassical (capital-deepening) and endogenous growth models (technology catch-up or 'leap-frogging'). Relatedly, while the Heckscher-Ohlin theory predicts convergence due to trade and factor-price equalisation, New Economic Geography models highlight the potential for market integration to be a force for divergence. Within-sector convergence can also arise due to within-sector changes in products produced. For example, this would arise when counties shift the bulk of agricultural production from labour-intensive tillage to higher-productivity dairy production. Importantly in the case for Ireland, it also captures the impact of migration and relative population change, for example through a change in capital-labour or land-labour ratios (Enflo and Rosés, 2015).

The labour reallocation component captures convergence that is due to workers moving from low-productivity sectors to high-productivity sectors (e.g. from agriculture to industry). As such it captures convergence forces highlighted in growth models focusing on structural change. Ireland experienced a somewhat delayed structural change relative to early-industrialising countries, retaining a share of employment in agriculture that was over 50% in 1926 and was still relatively high as late as the mid-1970s (Crafts and Toniolo, 2008).

Finally, between-sector convergence accounts for catch up in labour productivity that is due to the reduction in productivity differentials across industries. Convergence of this type may be an indirect result of reallocation of labour or the imposition of policies to directly influence

[10] Dublin has the highest labour productivity over the period, save for Louth and Cork in 1991.

the wage differentials across industries, such as benchmarked minimum wages. Between-industry divergence may also occur if productivity growth rates are inherently different across sectors.

The results of this decomposition exercise are presented in table 6.[11] Column 1 gives the total convergence in output per worker relative to Dublin for each county over the period 1926-1991, with counties sorted from most convergence to least.[12] Column 2 shows the proportion of labour productivity convergence that is due to within-sector convergence, while columns 3-5 break this contribution down by industry (and so add up to column 1).

<TABLE 6 HERE>

It is immediately clear that within-sector convergence accounts for a significant share of overall convergence for all counties, on average representing almost two-thirds of total convergence. For some counties, it is more than four-fifths. In only two western counties does within-industry converge not represent the most important driver of convergence. Decomposing further by sector reveals a somewhat more variable pattern, but convergence in agricultural productivity explains a significant share of overall convergence. On average, across all counties, this represents just over a third of convergence. The pattern is mixed when it comes to industrial convergence. Counties such as Cork, Louth and Galway exhibit strong convergence in industrial labour productivity, whereas in other countries it is less significant. Some counties, such as Laoighis and Offaly experience divergence from Dublin. Meanwhile convergence in services productivity is responsible for just under a fifth of total convergence over the period on average.

We repeat this decomposition to examine the sources of convergence over different periods.[13] We first examine the period 1926-1946, a period over which we observe a distinct drop in the dispersion of regional output per worker. Convergence over this period is similar across a large group of counties, with most closing the productivity gap on Dublin by around 10 percent. While some counties such as Louth experienced strong convergence in industrial productivity, agriculture was the greatest source of convergence for most counties, both within

[11] We follow closely the approach of Enflo and Rosés (2015). Further details of the decomposition are contained in their appendix and we refer the reader there rather than reproduce the equations here.
[12] These correspond to the information in table 4. One drawback of the exercise is that when overall convergence is close to zero, the decomposition can create large shares attributable to different sources. In such cases the figures should be interpreted with caution.

[13] We also present the equivalent figures at the NUTS3 level in the appendix.

agriculture and the productivity of agriculture relative to other sectors (between-sector). Agricultural productivity as a driver of convergence in this period likely reflects the impact of World War II on the Irish economy.[14]

<TABLE 7 HERE>

We turn next to the period 1946-1971, when Ireland's agricultural employment declined from just under 50% to 27% and industrial employment peaked. Not surprisingly then, industrial productivity growth and structural change accounted for a large share of convergence for many counties. The best performer in terms of convergence over the period, Clare, is noteworthy as the location of arguably the world's first 'Special Economic Zone' established in 1959 and a precursor of similar zones across the world (Arthur, 2017).

<TABLE 8 HERE>

For completeness we present a decomposition of convergence over the period 1971-1991 in Table 9, a period during which Ireland attained membership of the EEC and continued to underperform, although some hints as to the rapid convergence to follow were apparent, at least retrospectively (Ó Gráda and O'Rourke, 2022). For this period, the sources of convergence are more mixed, with industrial productivity growth an important driver of convergence for the best performing counties and source for productivity divergence from Dublin for other less-developed counties. Notably, structural change continued to be an important source for convergence for many of these counties.

<TABLE 9 HERE>

Population change 1926-1991

An additional potentially relevant aspect that we have yet to discuss is the impact of population change over the period - a crucial part of the story of Ireland's economic development over the last two centuries. The Great Famine of the 1840s saw Ireland's population (26 counties) decline from 6.5 million in 1841 to 5.1 million in 1851. However, over the next 100 years population would continue to decline such that by 1961 the population had reached a low point of 2.8 million, before recovering to 3.5 million in 1991. Although the overall population decline was dramatic and unprecedented by international standards, the redistribution of population within Ireland was also considerable. Table 10 displays population change by county over the period 1926-1991. The figures are a stark illustration of

[14] Indeed the share of agricultural output in GDP increased marginally from 31% to 32% over this period, with industry's share increasing from 16% to 23% and services falling from 52% to 46%.

the contrasting experiences of eastern and western counties in particular. While counties such as Dublin and Kildare saw their populations double over the period, counties such as Leitrim saw their population decline by half.

<TABLE 10 HERE>

To estimate the impact of these demographic changes, we follow Geary and Stark (2015) and assess the effect of labour force decline, either through emigration or out-migration, on GDP per worker using a counterfactual estimated through a growth accounting exercise. We consider the case of Leitrim which, alongside experiencing the greatest loss in population also suffered the greatest loss in employment (-70%) over the period 1926-1991.[15] Employing a simple Cobb-Douglas production function, output is determined by:

$$Y = AK^{1-\alpha}L^{\alpha}$$

It follows, assuming an elasticity of output with respect to labour (α) of 0.5 and holding all else equal, a fall in the labour force of 70.4%would have translated into a decline of GDP from 100 in 1926 to 64.8 in 1991. Correspondingly, GDP per worker would have risen from 100 in 1926 to 219 in 1991 (64.8/29.6). This compares to the actual increase in GDP over the period to 205 and GDP per worker to 693[16]. As such, given our assumptions, the fall in the Leitrim labour force can account for perhaps 20 per cent (119/593) of the rise in GDP per worker over the period. Given an alternative parameterisation where α = 0.7, labour decline would account for 12 percent of the increase in GDP per worker. Thus, between 12 and 20 per cent of Leitrim's labour productivity gain could be accounted for by a fall in labour supply (migration), leaving between 80 to 88 per cent to be accounted for by an upward shifting aggregate production function.

Replicating the thought experiment on post famine Ireland conducted by Geary and Stark (2015), we look at the convergence in GDP per worker of Leitrim upon the Dublin equivalent over the period 1926-91. In 1926, Leitrim's labour productivity stood at about 26 per cent of Dublin's, rising to 57 per cent by 1991. Leitrim's labour productivity increased by 593 per cent over those decades. In order to maintain its 1926 proportion of Dublin's level of labour productivity, Leitrim's GDP per worker needed to rise by 223 per cent. The additional 370 percentage points can be regarded as catch-up growth and is equivalent to 62 per cent of the total achieved (370/593). With an α = 0.5 then, the decline in Leitrim's labour force would only

[15] We undertook this exercise for all 26 counties but describe the case of Leitrim here for the sake of brevity. Full results available on request.
[16] 1926=100

have accounted for about one-third of convergence on Dublin, leaving around two-thirds to other forces.

NUTS2 and NUTS3 Level GDP for Ireland, 1926-2021

One of the key motivations for this work was to bring Ireland's historical regional GDP data into line with her European peers. In their collaboration with a number of international scholars from 15 European nations, Roses and Wolf's (eds. 2019) volume, *The Economic Development of Europe's Regions* constructs and presents regional GDP for 172 regions since 1900, applying current EU classifications.[17] The EU sub-national units are known as NUTS2 (aggregated) and NUTS3 (disaggregated) regions and these classifications are presented for Ireland in Table 11.[18] The Roses and Wolf (eds. 2019) collaboration and subsequent database (2020) estimated European regional GDP at the level of NUTS2. In this paper, due to our bottom up (county-level) approach, we are able to construct and present consistent data between 1926-1991 at both levels (NUTS2 and NUTS3).[19]

<TABLE 11 HERE>

The Central Statistics Office maintains a database providing regional GDP shares of total GDP spanning 2000-21 with the existing classifications of NUTS2 and NUTS3.[20] We start by employing the regional weights from these for the years 2001, 2011 and 2021. For 1991, two subsequent CSO publications (1996, 2001) were drawn upon to obtain regional weights. However, adjustments were required (see Appendix) to these numbers, based upon our own county calculations, due to subsequent alterations to classification of the regional unit in 2014. The aggregate national (current price) GDP series is taken from Kenny (2024) which, for the period 1947-2022, draws on various CSO publications. The regional GDP weights for each of the benchmarks before 1991 (1926, 1936, 1946, 1951, 1961, 1971, 1981) are obtained directly from the aggregations of our county level GDP estimates to the appropriate NUTS region of which they form a component part. In a similar fashion, regional populations are aggregated from the combination of county level figures (*Censuses of Population*, various years).

[17] Ireland is included in this number, but due to its small size and the lack of regional GDP estimates, the data are national.
[18] The NUTS acronym stands for 'Nomenclature of Territorial Units for Statistics' https://ec.europa.eu/eurostat/web/nuts/history
[19] Our benchmark years are slightly different however but are generally within one year of the Roses and Wolf benchmarks.
[20] 'Gross Value Added- Taxes and Subsidies' NUTS3 Region RAA05; NUTS 2 Region RAA07. https://data.cso.ie/

GDP per capita at NUTS3 and NUTS2 (1926-2021), relative to the national figure, are presented in Tables 12 and 13 respectively.

<TABLE 12 AND TABLE 13 HERE>

In order to consider the evolution of regional inequality in line with other studies (Roses and Wolf, 2019; Enflo and Roses, 2015), we again plot the coefficient of variation in Figure 6. Between 1926 and 1981, the use of the NUTS classification does not change the picture presented at the county level outlined above. However, at the level of the EU NUTS regions, it is apparent that Ireland experiences a decline in regional inequality which, unlike the result obtained from the county level data, continues in to the early 1990s.

<FIGURE 6 HERE>

We provide an international backdrop to our results in figure 7. Combining the new Irish data with existing NUTS2 data from the Rosés and Wolf (2020) database, we can trace the trend of Irish regional inequality against a group of peripheral European peers, with historical trading links to the UK. As Figure 7 reports, in the 1920s the dispersion of Irish regional incomes was about average for the group, with Denmark, the UK and Sweden displaying the lowest inequality in regional incomes. In the period up to 1970, Spain and Portugal are outliers in terms of high regional inequality. Throughout the twentieth century, the degree of variation of regional incomes in Ireland sits in the middle of the sample while mirroring the UK trend, though Ireland starts out at a higher level of inequality. Irish regional GDP per capita is most equally dispersed in 1990, though it never reaches the equality reached by Denmark (1925-38, 1960, 1980) or Sweden (1950-1990). If we rely solely on the metric of GDP, which becomes less representative of domestic activity for Ireland from the 1990s (FitzGerald, 2023; Kenny, 2024), then regional incomes are more unequal than at any time since independence. Further, Ireland's spatial inequality has been greater than any of its peer group since 2010.

However, as mentioned previously and discussed at length in the appendix, GDP becomes increasingly problematic as a measure of Irish domestic activity from the 1990s (FitzGerald, 2020, 2023), largely due to the growing importance of multinational firms. In regional terms, distortions will arise in those areas where multinational firms have concentrated (Dublin; South-West). In response to this measurement problem, a new measure named modified Gross National Income (GNI*) has been recently developed to strip out items considered unrepresentative of true domestic production (see Appendix for further information). If we instead employ that measure for the period 1991-2021 and splice this on to the national GDP

series 1924-91 (Kenny, 2024), we are left with a more representative hybrid series (see Appendix). But the distortion problem persists if we *weight* regions in the modified series by their *shares in GDP*. In an attempt to address this, we collect the available data on county incomes published by the CSO and aggregate these to obtain new regional weights. The results can be seen in Figure 8, in which we calculate the coefficient of variation for the modified measure and overlay the NUTS2 equivalent.

<FIGURE 8 HERE>

The result of using the hybrid measure of regional value-added shows a sustained plateauing of inequality between 1981 and 2011, before a slight reversal in the decade following the financial crisis, where regional inequality increased. Taken together, the data for Ireland largely fit the European pattern outlined by Roses and Wolf (2019, p 34). Ireland's regional income inequality declined throughout the twentieth century while it stalled in the 1980s and began to go into reverse in the decade following the financial crisis. However, Ireland's most marked increase in regional convergence occurred in the decade 1936-46 in contrast to the European pattern which experienced this in the following decade. The explanation for this likely lies in the wartime damage and capital destruction that Ireland largely avoided as a neutral. As can be observed in the coefficients of variation, alternative degrees of granularity can suggest slightly different conclusions. If one drills down to the level of county, a rise in inequality can be observed as early as the 1980s. This is similar to the case of Sweden for which county level data was constructed (Enflo et. al, 2019). At the regional level, this divergence begins in the 1990s with NUTS3 experiencing a sharper rise in inequality than is the case with NUTS2. Indeed, when one applies the hybrid measure, regional convergence is halted with the reversal occurring after 2011.

5. Conclusion

This paper constructs the first regional GDP estimates for Ireland for the period 1926-91 and links them to the earliest official estimates published by the Central Statistics Office in 2001. Using county level GDP, as well as current EU NUTS (2 and 3) classifications, we provide a consistent set of regional benchmarks from which to trace Ireland's spatial economic development over the century since independence.

Our analysis of county-level data has revealed beta and sigma convergence overall among Irish counties over the period 1926-1991. Not all counties had the same experience, however. Some counties became relatively worse-off over the full period, while others started behind

before ultimately overshooting the national average. Decomposing convergence reveals that productivity improvement within sectors was the prime determinant of Irish convergence, with structural change also playing an important role.

Was Ireland different to its European peers when it came to the dynamics of regional inequality over the last 100 years? We find that when looking across NUTS regions (1926-2021), Ireland had a similar experience to the rest of Europe. Inequality was relatively high before WW2 before declining in the post-war period, although Ireland's decline occurred immediately while the rest of Europe experienced something of a delay. Overall however, the Irish pattern fits the European one neatly and adds strength to O'Rourke's (2017) claim that Ireland's long run growth was not unique. However, our study highlights that even in the absence of national convergence upon a group of peers (1926-91), regional convergence at the subnational level can continue to occur.

As with the national figures, regional GDP estimates after 1991 are problematic due to the prominence of multinationals and net transfers abroad. Using the NUTS2 and 3 classifications conveys a sharp increase in regional inequality, unmatched anywhere in Europe over the past three decades. This is largely due to the concentration of large multinationals residing in Dublin and the South West. However, when we instead use county income weights and apply these to modified Gross National Income (GNI*) instead of regional GDP shares of national GDP, we observe that regional inequality remained relatively stable. Finally, our work has revealed patterns and dynamics of regional convergence/divergence, but we have said little about the ultimate causes. Were the patterns we observe a consequence of market forces or deliberate policy? How did industrial policy or EU membership affect the distribution of economic activity across Ireland? It is these important questions we aim to address in future research.

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Table 1.

Output per Worker in Industry (Ireland =100)

	1931	**1936**	**1946**	**1951**	**1961**	**1971**	**1981**	**1991**
Carlow	69	127	110	93	126	122	77	57
Dublin	135	121	120	114	105	104	87	94
Kildare	74	82	84	88	115	92	89	93
Kilkenny	60	80	81	101	94	122	83	101
Laoighis	110	94	82	104	87	78	77	56
Longford	46	38	81	53	73	70	72	73
Louth	89	101	107	98	114	117	112	195
Meath	66	58	76	90	80	81	114	94
Offaly	58	67	87	59	76	81	78	46
Westmeath	56	71	88	88	73	75	85	75
Wexford	79	77	78	84	94	84	76	61
Wicklow	64	62	71	81	86	103	104	106
Clare	49	72	61	80	102	137	125	83
Cork	93	100	96	99	110	97	158	153
Kerry	65	72	61	80	88	87	66	68
Limerick	93	95	87	93	97	98	101	89
Tipperary	64	88	87	92	92	111	131	124
Waterford	94	100	90	106	96	102	88	69
Galway	50	77	80	70	76	95	124	173
Leitrim	44	46	64	54	65	72	53	37
Mayo	53	77	65	62	78	71	83	84
Roscommon	86	68	80	81	70	86	75	55
Sligo	64	84	77	81	78	80	70	48
Cavan	59	59	62	86	91	108	101	78
Donegal	35	42	68	69	73	69	62	45
Monaghan	63	60	73	83	83	77	71	54
CV	0.31	0.28	0.18	0.18	0.17	0.20	0.26	0.45

Source: Authors' calculations. See Appendix. Note: All aggregates normalised to relatives against national average (100).

Table 2

Output per Worker in Agriculture (Ireland =100)

	1926	**1936**	**1946**	**1951**	**1961**	**1971**	**1981**	**1991**
Carlow	142	136	139	132	146	153	127	124
Dublin	112	103	92	104	116	84	64	51
Kildare	122	131	103	128	145	143	110	98
Kilkenny	117	123	125	129	139	136	131	126
Laoighis	118	129	123	129	127	129	116	116
Longford	81	87	88	84	86	76	79	87
Louth	99	109	116	112	117	127	108	124
Meath	110	117	106	103	122	127	117	125
Offaly	111	116	99	115	120	120	113	109
Westmeath	92	95	94	99	108	102	106	108
Wexford	124	128	122	124	129	145	130	117
Wicklow	114	114	111	100	118	122	124	101
Clare	92	87	95	89	86	80	76	84
Cork	131	133	126	135	133	136	127	117
Kerry	112	108	109	107	103	89	90	89
Limerick	126	121	115	118	114	110	121	110
Tipperary	122	120	112	119	124	124	120	115
Waterford	126	125	123	135	135	138	149	143
Galway	84	84	90	84	69	68	66	70
Leitrim	74	70	74	68	65	62	71	73
Mayo	75	70	80	69	61	58	62	63
Roscommon	83	81	85	80	70	67	68	67
Sligo	81	78	81	77	72	65	63	72
Cavan	86	88	89	83	84	86	102	107
Donegal	68	64	67	66	64	65	79	78
Monaghan	88	88	84	80	91	117	122	151
CV	0.20	0.21	0.18	0.22	0.25	0.29	0.25	0.25

Source: Authors' calculations. See Appendix. Note: All aggregates normalised to relatives against national average (100).

Table 3

Output per Worker in Services (Ireland =100)

	1926	**1936**	**1946**	**1951**	**1961**	**1971**	**1981**	**1991**
Carlow	94	90	81	84	85	89	91	94
Dublin	131	128	127	120	119	116	115	114
Kildare	97	93	90	82	75	88	91	93
Kilkenny	83	85	81	87	86	89	89	89
Laoighis	89	91	80	87	84	80	90	92
Longford	81	79	70	72	83	85	84	92
Louth	93	90	92	92	94	92	94	90
Meath	81	79	85	85	84	80	89	90
Offaly	105	101	84	88	88	88	87	93
Westmeath	91	89	81	85	84	88	93	97
Wexford	77	77	79	81	83	81	86	84
Wicklow	92	89	96	90	94	82	86	90
Clare	78	77	72	78	93	88	92	88
Cork	90	90	90	92	92	89	90	92
Kerry	78	77	78	86	86	89	81	85
Limerick	91	89	87	88	87	96	89	94
Tipperary	78	76	79	82	85	88	84	92
Waterford	87	96	95	95	94	92	93	90
Galway	78	79	80	92	92	101	97	94
Leitrim	77	73	86	86	85	91	86	91
Mayo	79	79	81	87	87	93	87	90
Roscommon	81	78	82	88	87	95	88	86
Sligo	89	87	80	81	86	90	95	97
Cavan	78	77	79	81	83	77	84	87
Donegal	77	74	80	79	82	81	84	91
Monaghan	86	83	88	89	91	88	87	87
CV	0.13	0.13	0.12	0.10	0.09	0.08	0.07	0.06

Source: Authors' calculations. See Appendix. Note: All aggregates normalised to relatives against national average (100).

Table 4

Output per Worker All Sectors (Ireland =100)

	1926	**1936**	**1946**	**1951**	**1961**	**1971**	**1981**	**1991**
Carlow	104	107	104	99	112	108	90	85
Dublin	200	193	163	147	136	128	115	112
Kildare	110	103	92	98	104	99	93	92
Kilkenny	87	86	92	97	99	102	89	91
Laoighis	90	89	90	100	91	83	84	79
Longford	62	58	68	64	70	67	73	80
Louth	108	117	117	110	119	118	114	153
Meath	84	78	84	85	88	85	98	92
Offaly	90	87	83	85	90	87	84	76
Westmeath	83	79	81	85	84	83	89	89
Wexford	88	84	90	91	93	90	84	77
Wicklow	98	94	98	92	98	97	98	94
Clare	66	60	71	72	78	95	98	85
Cork	108	107	105	107	109	100	118	117
Kerry	78	70	80	82	81	78	72	75
Limerick	106	98	96	97	94	97	95	95
Tipperary	87	83	87	92	93	96	100	103
Waterford	108	112	106	112	106	105	101	91
Galway	62	61	73	72	67	77	89	110
Leitrim	53	46	60	56	56	59	62	64
Mayo	55	50	63	59	58	60	70	74
Roscommon	61	52	67	66	60	63	67	64
Sligo	68	64	68	69	70	71	76	76
Cavan	63	58	68	70	72	75	85	81
Donegal	54	49	61	62	64	66	72	72
Monaghan	71	64	72	72	78	83	82	82
CV	0.34	0.37	0.25	0.23	0.22	0.20	0.16	0.21

Source: Authors' calculations. See Appendix. Note: All aggregates normalised to relatives against national average (100).

Table 5

GDP per capita (Ireland =100)

	1926	**1936**	**1946**	**1951**	**1961**	**1971**	**1981**	**1991**
Carlow	103	104	102	95	108	100	90	88
Dublin	185	186	156	151	142	134	127	121
Kildare	109	100	96	95	94	94	88	88
Kilkenny	90	87	93	94	100	99	83	85
Laoighis	88	88	91	101	87	77	79	73
Longford	66	60	72	64	68	65	75	76
Louth	101	114	112	106	121	127	116	145
Meath	84	80	87	85	84	79	90	87
Offaly	91	91	93	83	83	75	69	63
Westmeath	86	75	83	82	80	77	85	88
Wexford	89	81	85	85	88	83	74	70
Wicklow	89	85	90	83	92	91	90	86
Clare	67	60	74	74	81	105	104	90
Cork	102	103	102	106	109	100	116	115
Kerry	76	68	78	77	75	74	65	70
Limerick	100	88	86	85	85	88	87	92
Tipperary	89	84	88	91	90	94	96	102
Waterford	105	106	98	108	103	105	107	93
Galway	67	66	77	75	69	77	87	111
Leitrim	60	53	68	65	64	64	63	62
Mayo	59	54	67	63	60	60	66	69
Roscommon	68	58	75	71	64	64	68	65
Sligo	72	67	72	70	71	73	79	78
Cavan	69	63	76	78	78	83	93	83
Donegal	58	53	61	60	61	61	57	62
Monaghan	76	69	77	77	83	89	84	84
CV	0.29	0.33	0.21	0.22	0.22	0.21	0.20	0.23

Source: Authors' calculations. See Appendix. Note: All aggregates normalised to relatives against national average (100).

Table 6

Caselli-Tenreyro decomposition of convergence in labour productivity 1926-1991

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Within-sector					
	Overall	All sectors	Agriculture	Industry	Services	Labour reallocation	Between-sector
Louth	0.83	69.72	11.39	52.81	5.52	29.96	0.32
Galway	0.67	57.17	12.45	31.49	13.23	47.85	-5.03
Cork	0.51	70.05	17.21	40.53	12.31	33.35	-3.40
Tipperary	0.49	74.56	25.30	30.75	18.51	30.49	-5.06
Clare	0.43	58.92	24.56	18.05	16.31	47.34	-6.26
Cavan	0.41	72.35	46.34	11.85	14.16	35.50	-7.85
Meath	0.41	75.02	36.55	19.02	19.45	31.77	-6.78
Longford	0.41	64.22	33.50	14.76	15.96	42.54	-6.76
Mayo	0.39	53.26	23.65	13.56	16.06	56.79	-10.05
Monaghan	0.38	84.54	71.91	1.25	11.38	21.73	-6.27
Westmeath	0.38	67.86	33.36	13.72	20.78	39.36	-7.21
Kilkenny	0.38	81.88	39.79	24.13	17.96	26.14	-8.02
Donegal	0.37	59.02	31.74	5.62	21.65	46.11	-5.12
Wicklow	0.35	62.87	21.75	25.49	15.64	46.46	-9.34
Sligo	0.34	45.38	26.02	-2.09	21.45	64.43	-9.80
Limerick	0.32	62.40	25.80	15.99	20.61	42.53	-4.93
Leitrim	0.31	61.56	40.68	-1.95	22.83	50.39	-11.96
Waterford	0.28	64.58	42.70	-1.62	23.50	35.08	0.34
Kerry	0.28	64.71	32.04	8.22	24.44	48.14	-12.85
Kildare	0.28	59.96	20.68	20.45	18.82	52.27	-12.22
Roscommon	0.27	48.37	33.84	-4.19	18.73	68.38	-16.75
Laoighis	0.26	65.34	55.77	-13.02	22.60	49.30	-14.64
Wexford	0.25	78.78	50.28	0.39	28.12	33.53	-12.32
Carlow	0.24	64.53	42.72	2.29	19.52	36.91	-1.44
Offaly	0.23	57.87	55.12	-2.46	5.20	52.48	-10.34

Table shows sources of convergence to Dublin labour productivity over the period 1926-1991. Overall rate is given in column 1 with contributions to convergence decomposed into shares in columns 3-7. Source: Authors' calculations.

Table 7

Caselli-Tenreyro decomposition of convergence in labour productivity 1926-1946

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Within-sector					
	Overall	All sectors	Agriculture	Industry	Services	Labour reallocation	Between-sector
Louth	0.18	63.77	26.74	31.69	5.34	23.96	12.26
Galway	0.14	58.44	38.64	12.90	6.90	10.84	30.72
Kilkenny	0.13	76.32	55.15	18.26	2.91	-2.52	26.20
Carlow	0.12	70.84	50.10	39.95	-19.21	3.58	25.58
Waterford	0.11	73.15	32.56	6.12	34.47	6.90	19.95
Mayo	0.11	51.14	39.13	5.44	6.57	7.51	41.34
Wexford	0.11	66.52	48.62	5.03	12.87	4.27	29.22
Wicklow	0.11	64.52	30.63	9.42	24.47	14.60	20.88
Cork	0.11	63.91	36.46	15.56	11.90	12.51	23.57
Cavan	0.11	54.59	43.44	3.56	7.60	4.91	40.50
Longford	0.11	55.24	50.32	15.72	-10.80	5.97	38.79
Donegal	0.11	49.97	17.08	21.01	11.89	10.37	39.65
Clare	0.10	55.40	50.02	7.88	-2.49	4.76	39.83
Roscommon	0.10	47.70	41.39	0.73	5.59	8.06	44.24
Leitrim	0.10	52.04	29.04	8.37	14.63	2.32	45.65
Tipperary	0.10	66.80	30.73	23.94	12.12	0.87	32.33
Laoighis	0.10	52.77	73.30	-10.25	-10.28	10.01	37.22
Kerry	0.10	59.06	48.96	0.70	9.40	3.01	37.93
Meath	0.10	72.25	41.82	12.32	18.11	-8.32	36.07
Monaghan	0.09	49.21	27.97	8.01	13.23	7.28	43.50
Sligo	0.08	37.07	37.61	11.49	-12.04	13.49	49.44
Westmeath	0.08	60.69	50.00	29.78	-19.09	1.45	37.85
Offaly	0.06	36.78	33.81	53.33	-50.36	2.38	60.85
Limerick	0.06	51.89	46.65	6.83	-1.59	2.16	45.95
Kildare	0.01	85.10	57.10	90.29	-62.29	-138.41	153.32

Table shows sources of convergence to Dublin labour productivity over the period 1926-1946. Overall rate is given in column 1 with contributions to convergence decomposed into shares in columns 3-7. Source: Authors' calculations.

Table 8

Caselli-Tenreyro decomposition of convergence in labour productivity 1946-1971

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Within-sector					
	Overall	All sectors	Agriculture	Industry	Services	Labour reallocation	Between-sector
Clare	0.31	59.99	-6.04	52.12	13.91	37.49	2.52
Kilkenny	0.24	75.78	20.42	39.55	15.80	18.15	6.07
Tipperary	0.21	70.55	22.13	29.83	18.59	22.46	6.98
Kildare	0.21	67.67	37.50	22.78	7.40	26.42	5.91
Monaghan	0.21	69.00	48.27	13.78	6.95	22.87	8.12
Louth	0.21	66.02	9.82	46.16	10.03	44.42	-10.44
Carlow	0.20	69.38	24.64	25.47	19.27	25.25	5.37
Limerick	0.17	63.69	5.30	27.39	31.01	25.94	10.37
Waterford	0.17	70.73	21.93	39.75	9.04	26.61	2.66
Cavan	0.17	55.92	7.37	45.77	2.78	34.13	9.95
Offaly	0.17	66.17	39.86	11.79	14.52	28.36	5.47
Westmeath	0.16	50.71	20.37	2.49	27.85	31.06	18.23
Wicklow	0.16	66.20	20.14	63.94	-17.88	25.60	8.19
Galway	0.16	39.54	-24.43	21.65	42.32	45.78	14.68
Wexford	0.15	81.48	46.70	21.08	13.69	5.31	13.21
Meath	0.15	66.73	44.58	21.94	0.20	22.75	10.53
Donegal	0.14	33.72	5.44	18.47	9.80	54.47	11.81
Sligo	0.14	28.71	-17.58	17.19	29.10	55.26	16.03
Cork	0.13	64.31	23.93	27.84	12.54	30.90	4.79
Kerry	0.12	55.22	-22.29	43.86	33.65	26.98	17.80
Longford	0.11	35.97	-12.28	4.93	43.32	40.23	23.80
Laoighis	0.10	67.23	39.14	16.57	11.51	13.67	19.11
Leitrim	0.09	19.39	-20.69	19.94	20.14	54.40	26.21
Mayo	0.09	9.15	-53.23	22.84	39.55	62.34	28.50
Roscommon	0.09	18.75	-41.80	16.72	43.82	48.26	33.00

Table shows sources of convergence to Dublin labour productivity over the period 1946-1971. Overall rate is given in column 1 with contributions to convergence decomposed into shares in columns 3-7. Source: Authors' calculations.

Table 9

Caselli-Tenreyro decomposition of convergence in labour productivity 1971-1991

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Within-sector					
	Overall	All sectors	Agriculture	Industry	Services	Labour reallocation	Between-sector
Louth	0.44	126.00	3.79	120.74	1.48	-37.98	11.97
Galway	0.38	66.26	15.13	55.92	-4.78	49.63	-15.89
Cork	0.27	112.40	6.89	95.30	10.21	-8.69	-3.71
Longford	0.19	63.00	43.46	1.81	17.74	64.88	-27.88
Mayo	0.19	54.93	40.98	12.86	1.09	84.57	-39.50
Tipperary	0.17	91.31	25.30	50.14	15.87	28.44	-19.76
Meath	0.16	94.40	30.00	30.08	34.32	28.29	-22.69
Westmeath	0.15	75.25	34.25	0.98	40.01	58.92	-34.17
Cavan	0.14	76.13	81.57	-38.38	32.93	59.50	-35.63
Donegal	0.13	20.14	51.66	-70.56	39.04	99.71	-19.85
Sligo	0.12	22.24	50.08	-63.61	35.76	121.48	-43.72
Leitrim	0.11	32.77	90.53	-70.89	13.12	137.41	-70.17
Limerick	0.09	49.65	43.30	-0.99	7.34	81.84	-31.49
Wicklow	0.09	135.43	14.86	54.71	65.87	-8.19	-27.24
Monaghan	0.08	66.55	142.89	-88.28	11.94	66.15	-32.71
Roscommon	0.08	19.22	91.96	-51.00	-21.74	196.05	-115.27
Kerry	0.06	38.97	100.35	-65.15	3.78	162.80	-101.77
Laoighis	0.06	99.25	73.64	-90.57	116.17	106.18	-105.43
Kildare	0.05	119.22	-13.08	49.76	82.53	25.93	-45.15
Clare	0.02	-266.27	316.32	-663.52	80.93	459.97	-93.70
Kilkenny	0.01	347.37	341.62	-110.11	115.86	124.75	-372.12
Offaly	0.00	-1196.72	1220.12	-3474.75	1057.91	2278.42	-981.70
Waterford	0.00	2860.92	-1483.01	4578.36	-234.42	-1787.78	-973.14
Wexford	-0.01	71.36	-135.49	454.77	-247.92	-379.02	407.66
Carlow	-0.09	192.76	-13.91	244.16	-37.48	-86.38	-6.38

Table shows sources of convergence to Dublin labour productivity over the period 1971-1991. Overall rate is given in column 1 with contributions to convergence decomposed into shares in columns 3-7. Source: Authors' calculations.

Table 10
Population Change, 1926-1991

	Population change (1926 =100)							
	1926	**1936**	**1946**	**1951**	**1961**	**1971**	**1981**	**1991**
Carlow	100	100	99	99	97	99	116	119
Dublin	100	116	126	137	142	169	198	203
Kildare	100	100	112	114	111	124	179	211
Kilkenny	100	97	94	92	87	87	100	104
Laoighis	100	97	96	94	87	88	99	102
Longford	100	95	91	87	77	71	78	76
Louth	100	103	106	110	107	119	141	145
Meath	100	98	105	105	103	114	152	167
Offaly	100	98	102	100	98	99	111	111
Westmeath	100	96	97	96	93	94	108	109
Wexford	100	98	96	94	87	90	103	106
Wicklow	100	102	105	109	102	115	152	169
Clare	100	95	89	86	78	79	92	96
Cork	100	97	94	93	90	96	110	112
Kerry	100	94	90	85	78	76	82	82
Limerick	100	101	102	101	95	100	115	115
Tipperary	100	98	96	95	88	88	96	94
Waterford	100	99	97	96	91	98	113	117
Galway	100	99	98	95	88	88	102	106
Leitrim	100	91	80	74	60	51	49	45
Mayo	100	93	86	82	71	63	66	64
Roscommon	100	93	87	82	71	64	65	62
Sligo	100	94	87	85	75	70	78	77
Cavan	100	93	85	81	69	64	65	64
Donegal	100	93	89	86	75	71	82	84
Monaghan	100	94	88	85	72	71	79	79
MEAN	100	97	96	95	88	90	105	108

Source: Authors' calculations. See Appendix. Note: Population normalised according to 1926 population = 100).

Table 11
NUTS Regions

NUTS2 Code	NUTS 2 Name	NUTS3 Code	NUTS 3 Name	County
IE04	Northern & Western	IE041	Border	Donegal
				Sligo
				Leitrim
				Cavan
				Monaghan
		IE042	West	Galway
				Mayo
				Roscommon
IE05	Southern	IE051	Mid-west	Clare
				Tipperary
				Limerick
		IE052	South East	Waterford
				Kilkenny
				Carlow
				Wexford
		IE053	South-West	Cork
				Kerry
IE06	Eastern & Midland	IE061	Dublin	Dublin
		IE062	Mid-East	Wicklow
				Kildare
				Meath
				Louth
		IE063	Midlands	Longford
				Westmeath
				Offaly
				Laois

Source: 'Information Note for Data Users: revision to the Irish NUTS2 and NUTS3 Regions.' Central Statistics Office https://www.cso.ie/en/methods/informationnotefordatausersrevisiontotheirishnuts2andnuts3regions/

Table 12
GDP per capita – NUTS3 (Ireland =100)

	1926	*1936*	*1946*	*1951*	*1961*	*1971*	*1981*	***1991***	*2001*	*2011*	*2021*
Border	66	60	69	68	70	72	72	72	56	48	30
Dublin	185	186	156	151	142	134	127	121	157	177	162
Mid East	96	95	97	93	98	98	96	100	73	61	49
Midlands	84	80	86	84	81	75	77	75	56	46	30
Mid West	87	80	84	85	86	94	94	95	74	68	72
South East	96	92	93	95	98	96	88	83	66	56	44
South West	94	94	95	98	100	93	104	105	122	121	185
West	64	60	73	69	65	69	77	90	57	58	54
State	100	100	100	100	100	100	100	100	100	100	100
Mean	96	93	94	93	92	91	92	93	83	80	78
SD	36	37	25	24	22	20	17	15	35	43	57
CV	**0.37**	**0.40**	**0.27**	**0.26**	**0.24**	**0.21**	**0.18**	**0.16**	**0.42**	**0.54**	**0.73**

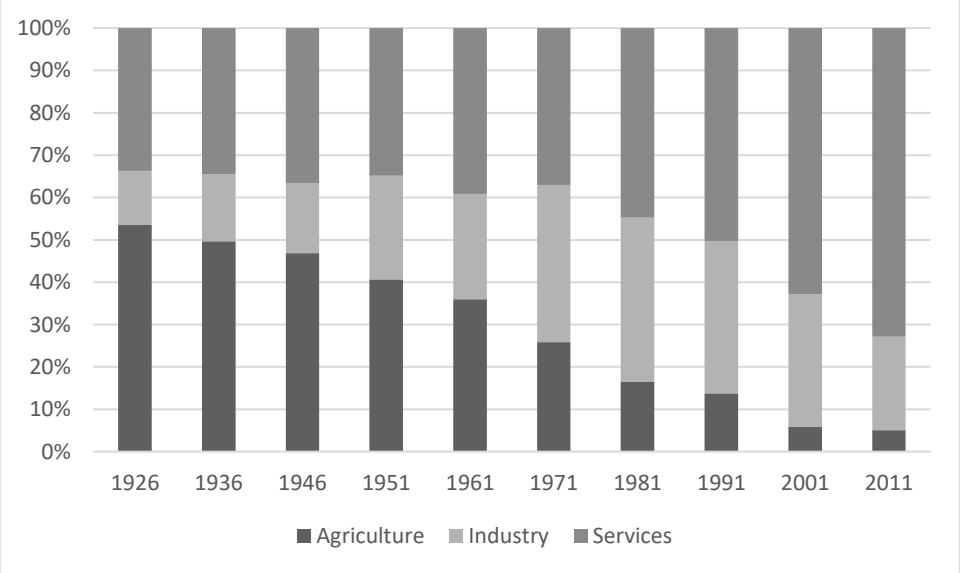
Source: Authors' calculations. See Appendix. Note: All aggregates normalised to relatives against national average (100).

Table 13
GDP per capita – NUTS2 (Ireland =100)

	1926	*1936*	*1946*	*1951*	*1961*	*1971*	*1981*	***1991***	*2001*	*2011*	*2021*
Northern and Western	65	60	71	69	67	70	74	81	57	53	43
Southern	92	89	91	93	95	94	97	96	93	88	114
Eastern and Midland	141	144	129	126	122	118	113	110	122	126	111
State	100	100	100	100	100	100	100	100	100	100	100
Mean	99	98	97	96	95	94	95	96	90	89	89
SD	32	35	24	24	23	19	16	12	27	30	33
CV	**0.32**	**0.36**	**0.25**	**0.24**	**0.24**	**0.21**	**0.17**	**0.12**	**0.29**	**0.33**	**0.37**

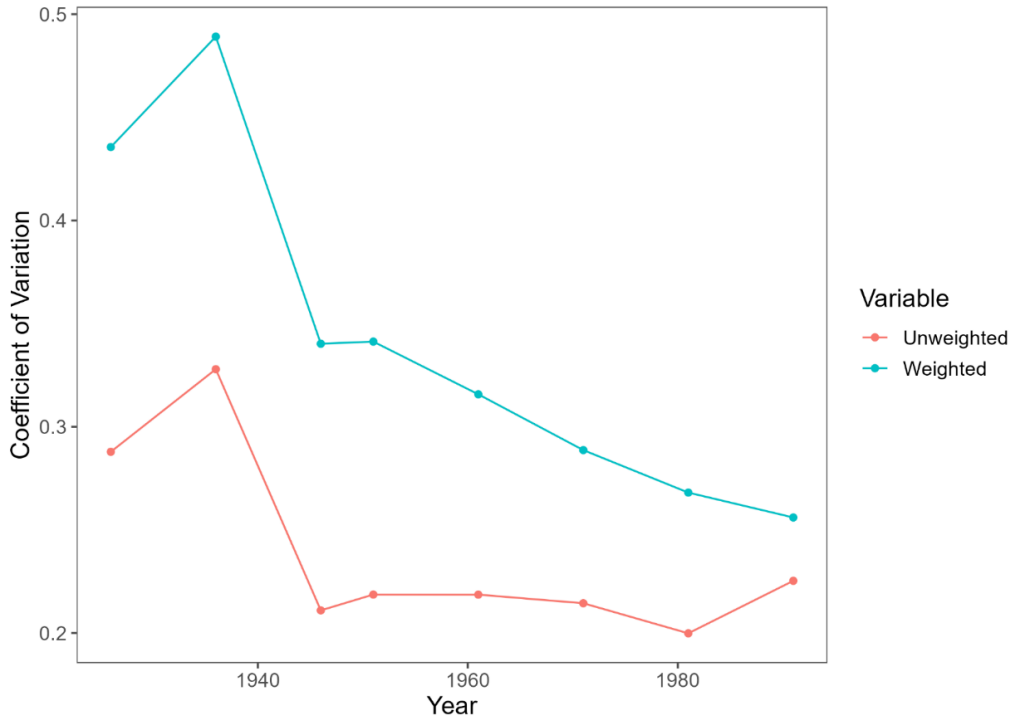
Source: Authors' calculations. See Appendix. Note: All aggregates normalised to relatives against national average (100).

Figure 1
Employment shares, 1926-2011



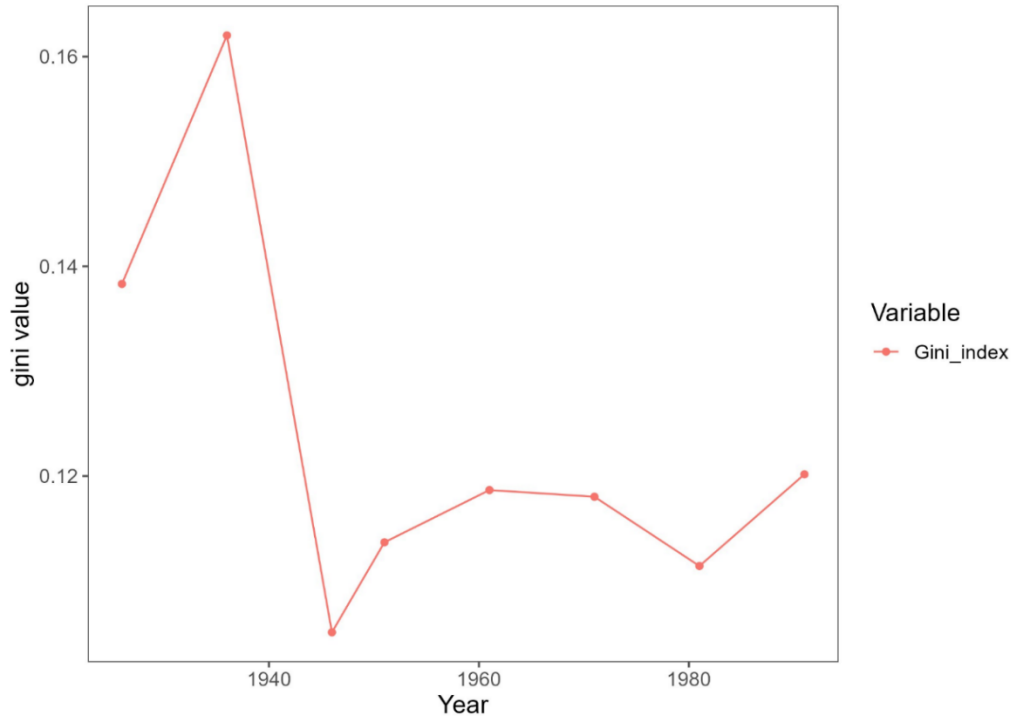
Source: Census of Population (various years)

Figure 2
Coefficient of Variation, County-level GDP per capita



Source: Source: Authors' calculations. See appendix. Unweighted and population weighted coefficient of variation.

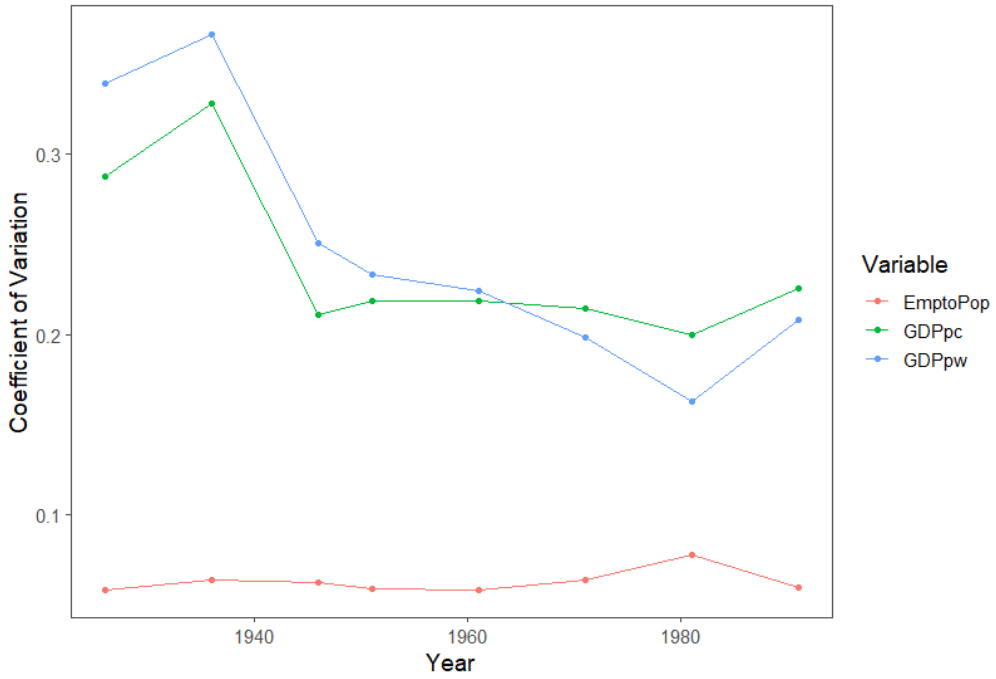
Figure 3
Gini Coefficient, County-level GDP per capita



Source: Authors' calculations. See appendix.

Figure 4

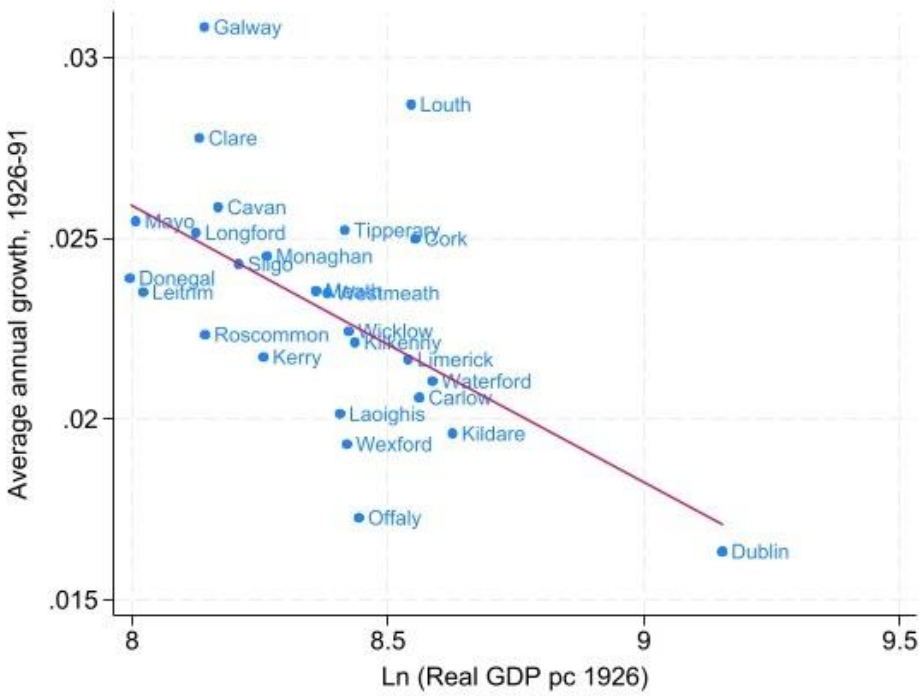
Coefficient of Variation: GDP per capita, GDP per worker and Employment



Source: Authors' calculations. See appendix.

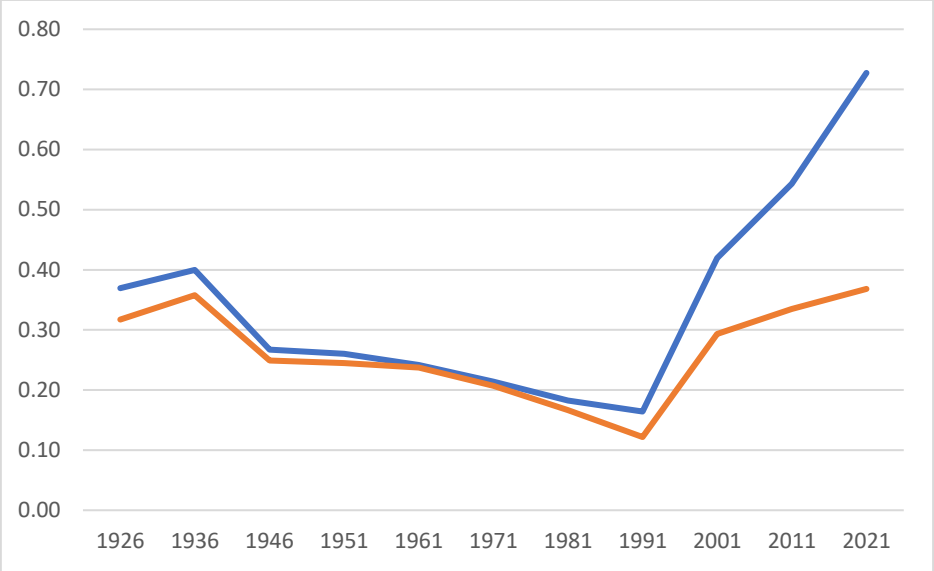
Figure 5

Beta-Convergence, 1926-1991



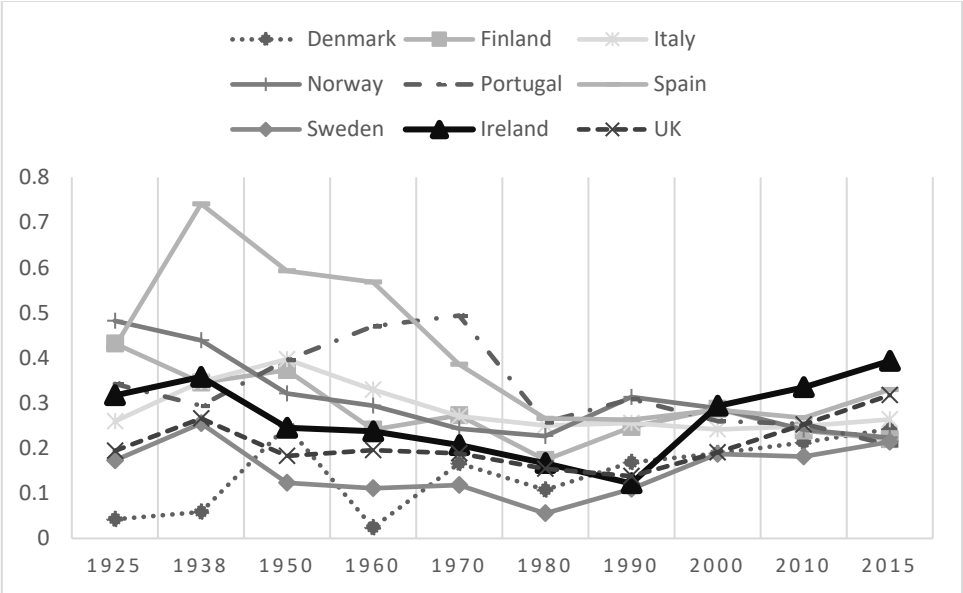
Source: Authors' calculations based on an OLS regression of average annual growth in real GDP per capita 1926-1991 on (log) real GDP per capita in 1926. Real GDP per capita from Kenny (2024)

Figure 6
NUTS2 and NUTS3 Sigma-Convergence, 1926-2021



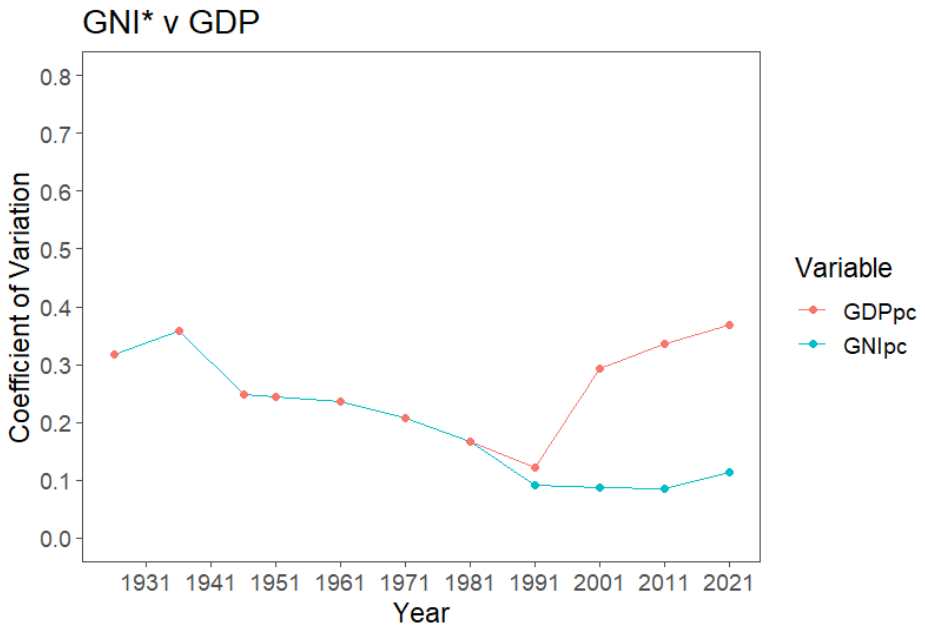
Source: Source: Authors' calculations. See appendix. Note: Coefficient of Variation (unweighted) for NUTS3 in blue, NUTS2 in orange.

Figure 7
The Dispersion of Regional GDP (NUTS2), 1925-2015 (CV)



Source: For Ireland, see text and appendix. For 2015, NUTS2 weights and population obtained from CSO. For all other countries, CV (unweighted) calculations obtained from Rosés and Wolf (2020) database. Data for Denmark from Janisse et al (2019), for Finland from Enflo (2019), for Italy from Felice (2019), for Norway from Modalsli (2019), for Portugal from Badia-Miró and Guilera (2019), for Spain from Martínez-Galarraga, Rosés and Tirado (2019), for Sweden from Enflo, Henning and Schön (2019), for UK from Geary and Stark (2019).

Figure 8
NUTS2 and Hybrid GNI* Sigma-Convergence, 1926-2021



Source: Source: Authors' calculations. See appendix. GNI* pc is coefficient of variation (unweighted) obtained from Hybrid Series, 1991-2021.

Data Appendix

To generate estimates of regional GDP for Ireland over the twentieth century we rely on the 26 counties that make up the Irish state. Irish counties are an administrative unit of Ireland which originated with the Norman conquest in the 12th century and have undergone relatively minimal changes in terms of boundaries over the last few hundred years. As such they represent the unit of aggregation that form the basic building blocks of our data collection and analysis. Regional aggregations, such as NUTS-2 and NUTS-3 are formed through the aggregation of counties making it straightforward to aggregate up from the county level to match these modern boundaries.

Our approach involves disaggregation not just by regions but also by sectors: Agriculture, Industry and Services are estimated separately by county. Though this detailed approach we can decompose the trends in regional inequality over time to gain a better understanding of the process of regional convergence and divergence in Ireland over the last one hundred years. As with other attempts to reconstruct national or sub-national accounts in other areas or periods, our approach is data-intensive. In what follows we describe our data collection and construction in detail.

Agriculture

To estimate the value of agricultural output for each county, 1926-1991 we relied on the Agricultural Statistics collected by the Irish statistical agencies as collected in 'Farming Since the Famine, Irish Farm Statistics 1847-1996'. For each benchmark census year we collected statistics for each county on the area under 10 categories of crops and the numbers of 10 categories of livestock and produce (CSO, 1997, Table 7 and Table 8). Alongside this, we collected information on the value of crops and livestock and produce across similar categories at a national level for each benchmark year, available in various issues of the Statistical Abstract.

For the value of crops produced we distributed the value for each crop by county, using the county share of total acreage of that specific crop. For example, the total value of wheat produced in Ireland in 1926 was £142,000. County Wexford constituted 17% of national acreage of wheat in 1926. We therefore assign a value of wheat produced in Wexford of £24,000 in 1926. We repeat this process across all crops, including non-industrial turf production, and sum all values by county to give value of crop output by county.[21]

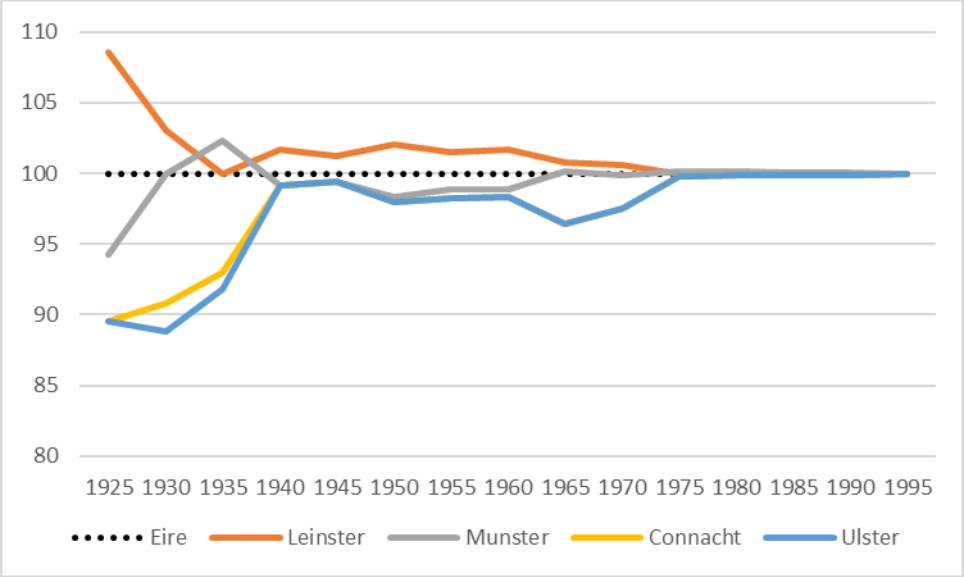
[21] Turf production volumes by county were not collected in the Agricultural Statistics alongside other crops. To distribute the value of national turf production by county we relied on county-level turf production figures contained in the Statistical Abstracts and other sources.

We construct estimates of the value of livestock output by county in a similar way.[22] We take the national-level value of livestock and livestock products production for each category and benchmark year from the Statistical Abstract and distribute these values according to the number of livestock. For example, the total value of Cattle and Calves output in Ireland in 1926 was £13,809,000. County Wexford constituted 3% of the national total number of Cattle in 1926. We therefore assign a value of Cattle produced in Wexford of £476,000 in 1926. For livestock products, such as milk or eggs, we distribute total value by the county's national share of the corresponding animal. For example, the total value of Milk, Cream and (farmer's) Butter output in Ireland in 1926 was £13,318,000. County Wexford constituted 3% of the national total number of (Milch) Cows in 1926. We therefore assign a value of Milk, Cream and Butter produced in Wexford of £394,000 in 1926. We repeat this process across all livestock and livestock products, and sum all values by county to give value of livestock output by county. We sum the value of crops and livestock (as calculated above) and express county agricultural output as a share of the national total in each year. Finally, we take the national figure for value added in agriculture in Kenny (2024) and distribute by county based on these shares.

We also considered using regional agricultural wages to proxy productivity differences (Geary and Stark, 2002). Agricultural wages are available since 1925 on an annual basis at the level of *the province* (Leinster, Munster, Connacht, Ulster) from the *Statistical Abstract* (various years). Figure A1 documents, the evolution of provincial agricultural wages relative to the national level (Eire = 100) over five-year intervals. According to this yardstick, the most notable period of convergence occurred in the immediate post-independence decades. Agricultural wages in Leinster, Munster, Connacht and Ulster converged rapidly on the national level in the first decades of the IFS. However, in the period during and after the Second World War, agricultural wages in Leinster remained at a higher level until those of Munster converged in the mid-60s and Connacht and Ulster (which moved in tandem) in the mid 1970s. Ulster lost some ground in the 1960s but reverted to the mean in the mid-1970s.

[22] Our approach mimics the method employed by the CSO in their first efforts to estimate regional GDP figures in 1996, albeit with more limited data (CSO, 1996)

Figure A1: Agricultural Wages per Province relative to National level, 1925-95



Source: Statistical Abstract, various years. Note: Figures reported every five years. Wages indexed to national level (Eire = 100) which was provided by the Statistical Abstract.

Nonetheless, there are problems with relying on these wage data exclusively. First, they relate only to agricultural wages earned by male labourers over 19 years of age without free house or allowance. In other words, they are not representative of any family member/proprietor on the farmstead and cannot be said to accurately reflect or proxy agricultural output or value added. Second, the Agricultural Wages Act (1936) appointed a statutory body, the Agricultural Wages Board, to set a floor to regional agricultural wages regularly until 1976 (Curtis, 2007). The board provided the rates that were formalised annually in legislation as Agricultural Wages (Minium Rates) Orders in accordance with the 1936 Act. In other words, after 1936 market forces that might convey convergence or divergence in agricultural wages are blurred by legislation and are not a reliable indicator of regional variation. Furthermore, these effective minimum wages were proscribed for four agricultural areas which did not map neatly on to existing (county or provincial) or subsequent (NUTS) regional with the provinces reported in the *Statistical Abstract*.[23] As Table A1 demonstrates, in the case of Areas C and D, at least two provinces fall under a single designated area, while there are some counties that appear in at least two areas.

[23] Between 1936 and 1945, there had been three Areas. As from 24 June 1946, the system changed to four agricultural regions (*Some Statistics of Wages and Hours of Work in 1949*, 1949, p. 103).

Table A1: Designated Agricultural Areas for Wage Setting Purposes.

Area	**Designated**	**County**	**Province**
Area A	Dublin Co. Borough	Dublin	Leinster
	Urban District of Bray	Wicklow	Leinster
Area B	The remainder of Dublin (excluding that in Area A)	Dublin	Leinster
	Rural Districts of		
	Leixlip		
	Maynooth	Kildare	Leinster
	Celbridge	Kildare	Leinster
	Donaghcumper	Kildare	Leinster
	Donaghmore	Kildare	Leinster
	Dunboyne	Meath	Leinster
		Meath	Leinster
Area C	*Specified Rural Areas in County Boroughs of*		
	Cork		
	Limerick	Cork	Munster
	Waterford	Limerick	Munster
	Dundalk	Waterford	Munster
	Drogheda	Louth	Leinster
	Certain Rural Areas in Counties	Louth	Leinster
	Clare	Clare	Munster
	Kildare	Kildare	Leinster
	Kilkenny	Kilkenny	Leinster
	Louth	Louth	Leinster
	Meath	Meath	Leinster
	Wicklow		

		Wicklow	Leinster
Area D	The whole state excluding A,B,C	Remaining 16 counties	Munster, Leinster, Ulster, Connacht

Taking these limitations into consideration, it was deemed appropriate to follow the *Central Statistics Office* methodology (outlined above) of utilising regional stocks and agricultural land areas to estimate county regional agricultural value added.

Industry

Since political independence in 1922, the *Censuses of Industrial Production* have provided extensive data on Irish industrial output since the first issue was published in 1926. For the purposes of this paper, the variable of interest from these official sources is "net output," which represents industrial value-added. In order to arrive at this figure, intermediate inputs/materials were deducted from Gross Output by the *Censuses* and every *Census of Industrial Production* contains these three headline variables on a *national* basis in real and nominal terms. Total industrial production was divided between transportable (primarily manufactured) and non-transportable goods (construction and utilities).

In the first Censuses of 1926 and 1929, early efforts were made to collect data reflecting the geographical distribution of national industrial output. This information can be found in the last paragraphs describing each of the 26 sub-sectors comprising "Transportable Goods Industries" under the heading "The Location of Industry." Unfortunately, the data provided and the type of region which they were related to were not consistent across time and space. For example, in some cases, the number of firms or the quantities of a component of output in a sector might be provided on a local basis, while in other instances the value added may be reported. In many cases, the variation in the classification of regional units was too inconsistent or vague to reliably distribute total (national) value added. For example, the *Census* might provide information regarding the number of firms in Dublin, Cork and Limerick in one sector, and classify the remainder of firms as "rest of Ireland" or "rest of Ulster and Connacht". In the subsequent *Census*, the regions for which data were reported in the previous source could disappear or change from a county to provincial basis.

The Industrial Census of 1931 was the first to attempt at recording regional variation in industrial output (value-added) on a consistent basis and every subsequent *Census*

produced direct estimates of industrial value added per county thereafter. While ideally, one would prefer county estimates of value added from the 1926 Census (as subsequently reported for 1931), we only possess a *national* industrial value-added estimate for 1926. This is distributed using the 1931 county shares of value added (*Census of Industrial Production*, 1931). County employment data was also consulted in the *Population Censuses* for 1926 and 1936, though Barry (2023, p. 67) has questioned the reliability of these as a basis for accurately observing industrial employment. Nonetheless, the change in the shares of industrial employment per county between 1926 and 1936 (*Censuses of Population*, 1926, 1936) closely resembles the change in the share of value-added (*Censuses of Industrial Production*, 1931, 1936). This supports our choice of the 1931 value-added shares obtained from the *Census of Industrial Production* as a relatively reliable means of gauging 1926 employment/value added shares. It also suggests that the bulk of regional changes in industrial value-added/employment over this time occurred in the period 1931-6, when the nature of industrial policy shifted substantially (Barry 2023, Barry and Devlin, 2018; Daly, 1992).

From 1931 onwards, county level industrial value added was reported in *Censuses of Industrial Production,* which we rely upon as the basis of our estimates. However, the value-added figures that *were* reported in the summary tables omitted a subcategory of "industries not included" that were a component of total industrial value added. These were reported separately on a *national* basis and it was therefore necessary to distribute these aggregates across counties. They typically fell under the category of non-transportable goods and over the period 1931-91, they represented an average of 11 per cent of total industrial value added. The following paragraphs list these industries per census and describe how these were allocated across counties on a case-by-case basis.

For 1931 and 1936, "industries Not Included" were Electricity Undertakings, Railways, Canals/Docks/Harbours and Government departments (*Census of Industrial Production* 1936, pp. 33-4). With the exception of electricity, work carried on in the other sectors refers to repair and construction/maintenance and thus seems likely to be a function of the amount employed in building generally. "Total industries not included" was therefore distributed amongst the 26 counties in accordance with the numbers employed in Construction/Building plus Electricity, Gas, Water and Sanitary Services from the *Population Census* of 1936.

For 1946 and 1951, the picture did not change. "Industries Not Included" in value added were Electricity Undertakings, Railways, Canals/Docks/Harbours and Government departments (*Statistical Abstract*, 1954, p. 105; *Census of Industrial Production 1945-7*, pp. 47-8). Again, construction employees per county was used to distribute output across regions for all sectors except electricity (which was distributed using county shares of employees in electricity and gas). The employee figures were

taken from the *Population Census* taken for the same years (1946 and 1951). An identical manner of distribution of national output across counties was undertaken for 1961, though added to "industries not included" was the peripheral turf production and bog developments sector (*Statistical Abstract*, 1964, p. 130).

In 1971, construction was removed from the traditional measure of total industry and re-allocated to "industries not included". This produced a marked rise in the share of industries not included (out of total industry) from 13 per cent in 1961 to 20 per cent in 1971. However, it was relatively straightforward to distribute this and the remainder of "industries not included" output across counties, using the same method of allocation as described in the preceding paragraphs.

In 1981 and 1991, the *Censuses* changed in format and began to include domestic industries "not attributable to any region". These were distributed across counties by the employment share of each county in total employment (*Censuses of Population*, 1981 and 1991). The category averaged 9 per cent of total value added for those benchmarks. In 1981 and 1991, the two local units of county Tipperary (South Riding and North Riding) were combined into a single county for the purposes of our paper.

The numbers employed in industry per county were collected from the *Censuses of Industrial Production* (various years) in this paper. As Barry (2023, p. 8) notes, these Censuses provide a greater insight into the evolution of the industrial structure, when compared to the *Censuses of Population*. As already reported however, in some instances where there is no better alternative, we use employment *shares* obtained from the latter in order to distribute various national aggregate categories from the *Census of Industrial Production* (e.g. "industries not included").

Services

Value Added in services is not available at the county level for Ireland over the 20th century from official statistics. To calculate services output at a county level we had to rely on the method of Geary and Stark (2002), whereby output for services is estimated by combining information on occupations by county with corresponding wage data for each benchmark census year.

We began by dividing services employment by county in each census year into five subcategories; Transport, Commerce, Public Administration and Defence, Profession and Personal. We next constructed wage series for each of these subcategories at a county level, taking a representative wage for each subcategory in each county as set out in table A2 below. Where national wages were set by the government, as for teachers and members of the defence forces, this wage rate was applied to all

counties.[24] While the availability of local wage data for other subcategories were reasonably good over the period, some interpolations were required. For example, local wage data for the transport sector is only available from 1931. To reach a figure for transport wages in 1926, we inflated 1931 rates by 5% inline with the change in industrial wages 1926-31.[25]

We multiplied the number of workers per county for each subcategory by the representative wage for each county in each year before expressing this county-level estimate as a share of the total for all counties. Finally we take the national-level estimates of services output for each of our benchmark census years produced by Kenny (2024) and distribute this figure by county according to our calculated county shares.

As a check on the accuracy of our services data we utilised data collected by Ross (1972) for county incomes in 1960 and compare the county share of the national total using our simplified approach and Ross' detailed analysis. The results of the cross-check are reassuring. Our estimates of the share of services by county are very close, as can be seen in table A3.

Regional GDP beyond 1991

Our county GDP estimates terminate in 1991, the year that the first official estimates of regional GDP were produced by the Irish Central Statistics Office (CSO, 1996). The shares of value-added for the eight NUT3 regions in 1991 (CSO 1996) are compared with our independent estimates in Table A4. These shares were obtained using the old (pre-2014) NUTS3 Regional Classifications.

Upon first inspection, the largest deviation in the regional shares of value-added appears to arise between the 'South East' and 'Mid West'. Our new shares are 2.3 percentage points lower in the former case and 2.1 percentage points higher in the latter. However, this anomaly is primarily due to a difference in attribution across the two sources. Our estimates have included the entire county of Tipperary in the

[24] Teachers and Army pay rates were calculated as the national teacher pay bill divided by the total number of teachers and the national pay bill for Army Privates divided by the total number of Army Privates, respectively.

[25] We employed a rule whereby if an observation was with 1 year of the benchmark no adjustments were made. E.g. wages of lorry drivers in 1970 is applied to counts of the number of transport workers in 1971. For transport we also had to take a representative wage figure for a county from the closest county-town reported. An adjustment is also made to reallocate Teachers and Post and Telegraph employees to the *Professional* and *Commerce* subcategories respectively from 1951, as they were included in the *Public Administration and Defence* subcategory in earlier censuses. Finally, as we attempted to estimate the modal wage for *Public Administration and Defence* and *Professional*, we underestimate Dublin wages for these subcategories, as Dublin has systematically higher wages in these employments. To correct this we applied a 'Dublin uplift' of 33% to these two subcategories over our period. This brings the weight assigned to Dublin in 1961 closer to the estimate made by Ross (1972).

Table A2 – Representative wage series for Services

Transport	Commerce	Public Admin & Defence	Professional	Personal
Lorry Drivers	Grocery Retail	Army (Private)	Teachers	Public House

Sources for services wage data, 1926-1991

1926	*Some Statistics of Wages and Hours of Work in 1937* (1938), Department of Industry and Commerce, Dublin; *Census of Distribution, 1933* (1936), Department of Industry and Commerce, Dublin; *Estimates for Public Services, 1927-28 (1927),* Saorstát Éireann, Dublin
1936	*Some Statistics of Wages and Hours of Work in 1937* (1938), Department of Industry and Commerce, Dublin; *Census of Distribution, 1933* (1936), Department of Industry and Commerce, Dublin; *Estimates for Public Services, 1936-37 (1936),* Saorstát Éireann, Dublin
1946	*Some Statistics of Wages and Hours of Work in 1946* (1948), Department of Industry and Commerce, Dublin; *Census of Distribution, 1951-54* (1956), Central Statistics Office, Dublin; *Estimates for Public Services, 1946-47* (1946), Dáil Éireann, Dublin
1951	*Some Statistics of Wages, Earnings and Hours of Work in 1951* (1951), Central Statistics Office, Dublin; *Census of Distribution, 1951-54* (1956), Central Statistics Office, Dublin; *Estimates for Public Services, 1951-52* (1951), Dáil Éireann, Dublin
1961	*Some Statistics of Wages, Earnings and Hours of Work in 1962* (1962), Central Statistics Office, Dublin; *Census of Distribution and Services, 1966* (1971), Central Statistics Office, Dublin; *Estimates for Public Services*, 1961-62 (1961), Dáil Éireann, Dublin
1971	*Some Statistics of Wages, Earnings and Hours of Work in 1970* (1971), Central Statistics Office, Dublin; *Census of Distribution, 1971* (1977), Central Statistics Office, Dublin; *Estimates for Public Services*, 1971-72 (1971), Dáil Éireann, Dublin
1981	*Some Statistics of Wages, Earnings and Hours of Work in 1970* (1971), Central Statistics Office, Dublin (Carried forward using Transport Wage series in *Statistical Abstract*, 1981); *Census of Distribution, 1977* (1982), Central Statistics Office, Dublin; *Estimates for Public Services, 1981* (1981), Dáil Éireann, Dublin
1991	*Some Statistics of Wages, Earnings and Hours of Work Hours of Work in 1970* (1971), Central Statistics Office, Dublin (Carried forward using Transport Wage series in *Statistical Abstract*, 1981 and Public Sector wage growth 1981-1991); *Census of Services, 1988* (1991), Central Statistics Office, Dublin; *Revised Estimates for Public Services, 1991* (1991), Dáil Éireann, Dublin

Table A3 – County Shares of Services (%), 1960/1961

	Our estimates	Ross (1972)
Carlow	0.8	0.8
Dublin	46.7	47.8
Kildare	1.7	2.2
Kilkenny	1.5	1.3
Laoighis	1.0	0.9
Longford	0.6	0.6
Louth	2.3	2.2
Meath	1.5	1.3
Offaly	1.1	1.0
Westmeath	1.5	1.8
Wexford	2.1	2.0
Wicklow	2.1	1.6
Clare	1.6	1.5
Cork	10.7	10.8
Kerry	2.5	2.3
Limerick	4.0	4.3
Tipperary	2.9	2.8
Waterford	2.5	2.3
Galway	3.5	3.4
Leitrim	0.6	0.6
Mayo	2.2	2.1
Roscommon	1.1	1.0
Sligo	1.3	1.2
Cavan	1.1	1.1
Donegal	2.3	2.3
Monaghan	1.2	1.1
TOTAL	100	100

Source: Author's calculations and Ross (1972) Table 3:
Distribution of Personal Incomes ("Other Sectors"), 1960

Table A4: Share of Gross Value added per NUTS3 Region in 1991.

	CSO (1996)	Our Estimates
Border	9.3	10.1
Dublin	37.0	35.3
Mid East	6.7	8.0
Midlands	4.4	4.3
Mid West	8.3	10.4
South East	9.6	7.3

South West	16.4	15.8
West	8.0	8.8
Total	*100*	*100*

Source: 'Regional Accounts 1991' (CSO, 1996). See Appendix and Paper for Our new Estimates. Note: Numbers for the Mid West and South East are not strictly comparable. In the new estimates, we allocated the entire county of Tipperary to the Mid West, consistent with the current NUTS classification. The old NUTS classification had split county Tipperary into North and South and it was not possible to achieve a reliable estimate of GDP for both localities.

Mid West region, as it was not possible to calculate GDP at a sub-county level. In the first official estimates (CSO 1996), that county had been split into North (included in Mid West) and South (included South East). Apart from this misattribution issue, our independently generated estimates are reassuringly close to the first official accounts for 1991 (CSO, 1996).

While this offers some support to our approach in the decades prior to the 1990s, the nature of Irish GDP began to change considerably at this point as others have stressed (FitzGerald, 2020). This may explain some of the variance between the two sources in Dublin's share of GDP, where our method generates a slightly lower share of value added of the total (difference of 1.7 percentage points). We instead find a slightly higher share for Dublin's hinterland in the Mid East (difference of 1.3 percentage points).

While the traditional national accounting method had been developed as recently as 1979 (ESA79), by the mid-1990s, that system was discarded in favour of the European System of Accounts (ESA 95). The new system placed greater emphasis on measuring the changes in quality of fixed capital formation (investment), which included expenditure on items such as computer software and patents (ESA 1995, c. 6; ECB 1999, pp. 21-5). While invariably, the inclusion of these new items tended to increase the *level* of GDP across the board (ECB, 1999, p. 21), it was not believed that it would change the "relative position of the regions" (CSO 2001, p. 1). Nonetheless, it is likely that such investments are likely to be greater in capital cities with a larger pool of university graduate service workers. [26] This was reflected in the subsequent official (CSO 2001) revision to the 1991 regional GDP estimates, using the newly adopted ESA95 approach (Table A5). Indeed, the ranking of the regions does not alter, though all NUTS3 regions

[26] The assumption in this paper is that the strong growth in other intangibles during the 1990s period is less likely to be a feature of the previous decades.

lose ground to varying degrees to Dublin (which increases from 37 to 40 per cent), though the Border region remains broadly unchanged.

Table A5: Share of Gross Value added per NUTS3 Region in 1991 (ESA1995 Revision)

	CSO (2001)	Our Estimates
Border	9.5	10.1
Dublin	40.1	35.3
Mid East	6.2	8.0
Midlands	4.3	4.3
Mid West	8.2	10.4
South East	9.1	7.3
South West	15.1	15.8
West	7.5	8.8
Total	100	100

Source: 'Regional Accounts 1998' (CSO, 2001). See Appendix and Paper for New Estimates. Note: Numbers for the Mid West and South East are not strictly comparable. In the new estimates, we allocated the entire county of Tipperary to the Mid West, consistent with the current NUTS classification. The old NUTS classification had split county Tipperary into North and South and it was not possible to achieve a reliable estimate of GDP for both localities.

However, the subsequent CSO (2001) revision is inconsistent with the current classification of NUTS3 regions. In 2014, the NUTS3 regional classifications in use since 2003 were updated. As stated on the CSO's website, the main changes at NUTS 3 level are the transfer of South Tipperary from the South-East into the Mid-West NUTS 3 region and the movement of Louth from the Border to the Mid-East NUTS 3 Region. The revisions made to the NUTS boundaries have been given legal status under Commission Regulation (EU) 2016/2066.[27]

These regions are presented in Table A6:

[27] https://www.cso.ie/en/methods/informationnotefordatausersrevisiontotheirishnuts2andnuts3regions/

Table A6: NUTS2 and NUTS3 Regions, Ireland.

NUTS2 Code	NUTS 2 Name	NUTS3 Code	NUTS 3 Name	County
IE04	Northern & Western	IE041	Border	Donegal
				Sligo
				Leitrim
				Cavan
				Monaghan
		IE042	West	Galway
				Mayo
				Roscommon
IE05	Southern	IE051	Mid-west	Clare
				Tipperary
				Limerick
		IE052	South East	Waterford
				Kilkenny
				Carlow
				Wexford
		IE053	South-West	Cork
				Kerry
IE06	Eastern & Midland	IE061	Dublin	Dublin
		IE062	Mid-East	Wicklow
				Kildare
				Meath
				Louth
		IE063	Midlands	Longford
				Westmeath
				Offaly
				Laois

Source: Central Statistics Office of Ireland. Information Note for Data Users: revision to the Irish NUTS 2 and NUTS 3 Regions - CSO - Central Statistics Office

In an effort to adjust the official (CSO, 2001) update to 1991 to reflect the regional changes, we incorporate our independently estimated county GDP shares and impose these weights on the NUTS3 regions that need to be changed (South East [-], Mid West [+], Border [-], Mid East [+]), holding the others constant as they are reported. We assume that Tipperary North and South each account for half of the total county's GDP, given the close similarity in their respective geographical size and total workforce. The results are reported in Table A7.

Table A7: Share of Gross Value added per NUTS3 Region in 1991 (LGA 2014 Reclassification)

	CSO (2001) adjusted	Our Estimates
Border	6.0	6.4

Dublin	40.1	35.3
Mid East	9.7	11.8
Midlands	4.3	4.3
Mid West	10.2	10.4
South East	7.2	7.3
South West	15.1	15.8
West	7.5	8.8
Total	100	100

Source: 'Regional Accounts 1998' (CSO, 2001). See Appendix text for adjustment. Note: CSO 2001 adjustment assumes Tipperary North and South have identical GDP.

The major difference remains the larger share allocated to Dublin in the official accounts (CSO, 2001) and the adjusted approach did not concern that region. However, our estimates persist with a higher amount of GDP emanating from the Mid East region (2 per cent difference). If the accounting changes introduced in ESA1995 are responsible for the most material variances, it will be reflected in official *GDP* comparisons, in contrast to other available regional aggregates. In a crude exercise to assess whether this accounting change might contribute to the regional variances reported above, we collect the first available local estimates for total income per person for 1995. These in turn were multiplied by county populations obtained from the *Census of Population* (1996) in order to obtain county weights and were subsequently summed to the NUTS3 region equivalents for 1995. The results are reported in Table A8.

Table A8: Share of Gross Value added per NUTS3 Region in 1991 and Income Per Person 1995

	CSO (2001) adjusted	Our GDP Estimates	Income per Person 1995
Border	6.0	6.4	7.7
Dublin	40.1	35.2	33.9
Mid East	9.7	11.8	11.9
Midlands	4.3	4.3	4.9

Mid West	10.2	10.4	10.3
South East	7.2	7.3	7.9
South West	15.1	15.8	14.6
West	7.5	8.8	8.6
Total	100	100	100

Source: 'Regional Accounts 1998' (CSO, 2001); Census of Population 1996. See Appendix text for adjustment. Note: CSO 2001 adjustment assumes Tipperary North and South have identical GDP. Income per person multiplied by county population to obtain county Incomes and weighted according to NUTS3 (post 2014) Classification.

Taking into consideration the four years separating the estimates, local (county) incomes for 1995 produce regional shares that are closer to our estimates for 1991, which may imply that regional GDP estimates began to suffer from the same difficulties as Irish national GDP from that juncture (FitzGerald 2020, Kenny 2024). The distortions arise primarily from Net Factor Income from abroad (NFI_{fgn}), which is typically deducted from Gross National Product (in market prices) to arrive at Gross Domestic Product (in market prices).

In most countries, this implies that GDP will typically be lower than GNP, as countries deduct foreign inflows to reflect truer domestic activity (equation 1).

$$1. \quad GDP_{mp} = GNP_{mp} - NFI_{fgn}$$

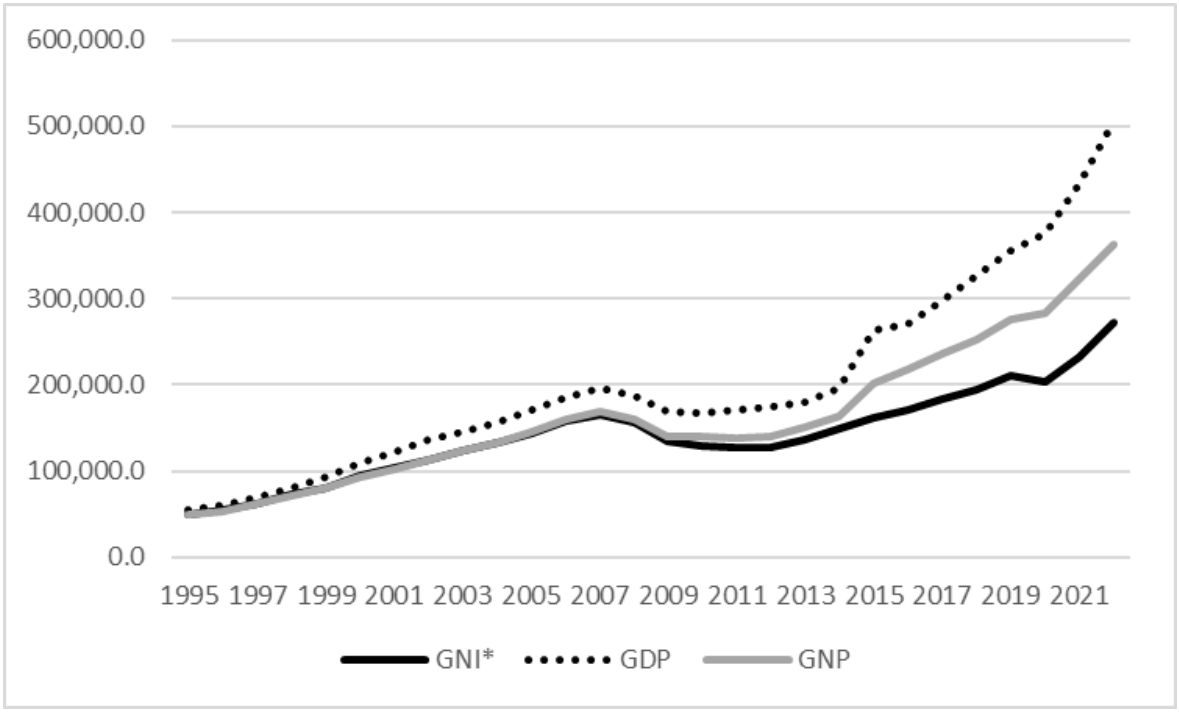
In Ireland's case, where a proliferation of multinational companies implies a transfer of incomes *out* of Ireland, net factor income from abroad turns negative in the equation, leading to inflated GDP. As outlined in Kenny (2024), as recently as 15 years ago, this measure (GNI or GNP) was considered representative until it in turn was overtaken by economic forces hitherto less relevant (FitzGerald 2020). The inadequate measurement of the increasingly globalized nature of the Irish economy became subject to international criticism as it reported growth of over 20 per cent in 2015 using traditional methods of national accounts. Since then, a modified version of Gross National Income (GNI*) has attempted to remove further distortions inherent in existing accounting practices with respect to Ireland's economy in three key areas: 1) the retained earnings of firms that have re-domiciled to Ireland RE_{rd}, 2) depreciation of aircraft owned by aircraft-leasing companies operating in Ireland d_{air} and 3) depreciation of foreign-owned intellectual assets located in Ireland d_{ip}. Equation 2 states the aggregate formally.[28]

[28] The paragraph borrows from Kenny, 2024 (Appendix).

2. $GNI* = GNI - (RE_{rd} + d_{air} + d_{ip})$

The differences between the aggregates are presented in Figure A2

Figure A2: The Evolution of Nominal GDP, GNP and GNI* since 1995

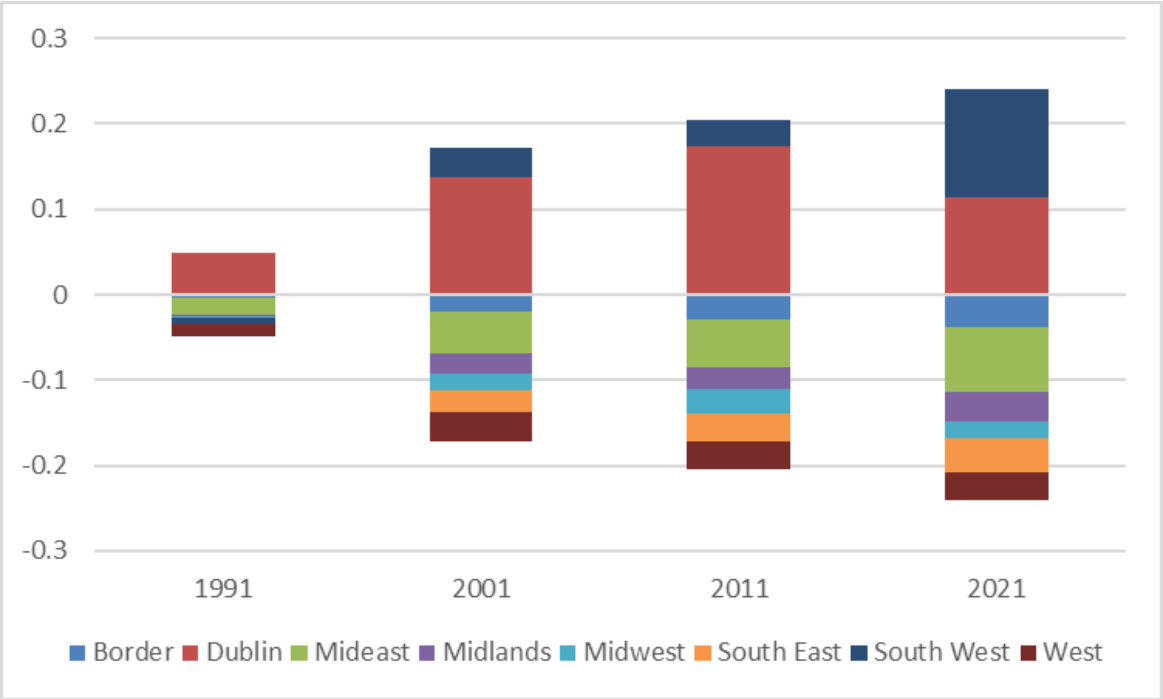


Source: ANA 2021. Note: Expressed in Current Prices (€ millions)

Taking the distortions to GDP into consideration, in our desire to achieve a broadly consistent measure of regional value added, we take GNI* from 1995 and splice the series back to 1991 using changes in GNP (Kenny, 2024). Regional shares of GNI* for the years 2001, 2011 and 2021 are then calculated in an identical manner to our estimate for 1995 outlined above. Namely, we distribute GNI* across NUTS regions using shares that are calculated by multiplying county *incomes* per head by county populations. These are then aggregated up to the relevant NUTS region.

The GDP distortions arising from multinationals are most notable in their concentration in the regions of the South-West and Dublin. The GDP shares (of the total state) of both regions have grown from 15 to 28 per cent and 40 to 45 per cent respectively over the years 1991 to 2021. The variance between the shares obtained using GDP and our preferred method of distributing GNI* by county incomes shows up significantly from 2001 as demonstrated in Figure A3.

Figure A3: Difference in Regional Shares of Value Added using GDP instead of Modified Approach



Source: See Appendix for details of Modified Approach and CSO 2001 (adjusted) for 1991 NUTS3 GDP. For all subsequent years, see CSO (2024) for NUTS3 GDP. Note: Calculated as GDP (NUTS3) shares of total GDP minus equivalent regional shares using modified approach.

It is evident that all other regions "lose" shares of value added to these regions since 2001 when relying exclusively on standard GDP estimates. *Ceteris paribus*, this conveys a significant increase in inequality between the regions over the period (using shares alone). If we track the trajectory of regional inequality through per capita GDP using the traditional measure of the coefficient of variation, the reversal after 1991 is more dramatic than any other European state. If we instead apply our modified version (GNI* weighted by county incomes per head) from 1991, the increase in inequality more closely resembles the European pattern (see Figure 6 in Main Text).

Table A9: Caselli-Tenreyro decomposition of convergence in labour productivity 1926-1946 (NUTS3)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			Within-sector				
	Overall	*All sectors*	*Agriculture*	*Industry*	*Services*	*Labour reallocation*	*Between-sector*
West	0.12	53.58	39.28	7.85	6.45	9.87	36.55
South East	0.12	71.66	46.48	13.83	11.34	3.04	25.30
South West	0.11	61.25	39.37	10.95	10.92	11.72	27.03
Border	0.10	49.94	28.94	12.86	8.14	7.85	42.21
Mideast	0.10	66.76	32.79	23.17	10.80	7.22	26.02
Midlands	0.09	53.78	53.34	20.61	-20.18	4.97	41.25
Midwest	0.09	57.34	40.80	12.06	4.48	5.15	37.51

Table shows sources of convergence to Dublin labour productivity over the period 1926-1946. Overall rate is given in column 1 with contributions to convergence decomposed into shares in columns 3-7. Source: Authors' calculations.

Table A10: Caselli-Tenreyro decomposition of convergence in labour productivity 1946-1971 (NUTS3)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Within-sector					
	Overall	All sectors	Agriculture	Industry	Services	Labour reallocation	Between-sector
Midwest	0.22	64.53	7.74	36.04	20.75	29.05	6.42
Mideast	0.19	61.52	25.76	34.08	1.68	36.33	2.16
South East	0.19	73.91	28.10	32.26	13.55	19.30	6.79
Border	0.15	45.24	10.80	23.31	11.13	42.73	12.03
South West	0.14	58.92	12.58	29.79	16.55	33.79	7.29
Midlands	0.14	56.64	26.16	8.26	22.22	28.79	14.57
West	0.12	29.18	-32.40	21.21	40.38	50.87	19.95

Table shows sources of convergence to Dublin labour productivity over the period 1946-1971. Overall rate is given in column 1 with contributions to convergence decomposed into shares in columns 3-7. Source: Authors' calculations.

Table A11: Caselli-Tenreyro decomposition of convergence in labour productivity 1971-1991 (NUTS3)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Within-sector					
	Overall	All sectors	Agriculture	Industry	Services	Labour reallocation	Between-sector
West	0.28	59.76	23.74	39.62	-3.60	65.27	-25.02
South West	0.22	104.71	12.96	82.07	9.67	4.67	-9.38
Mideast	0.16	124.87	10.64	90.02	24.21	-20.85	-4.02
Border	0.12	41.28	76.27	-66.74	31.75	91.96	-33.24
Midwest	0.10	58.64	46.40	-2.88	15.12	68.71	-27.35
Midlands	0.09	66.22	54.63	-40.54	52.13	84.61	-50.82
South East	-0.01	344.89	-227.99	721.45	-148.56	-384.74	139.84

Table shows sources of convergence to Dublin labour productivity over the period 1971-1991. Overall rate is given in column 1 with contributions to convergence decomposed into shares in columns 3-7. Source: Authors' calculations.

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