The spatial pattern of growth and economic equality in Scotland, 1997-2010

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1. Introduction

Recently published Gross Value Added (GVA, a measure of economic output) data available at the statistical "NUTS3" level allow us to explore developments in the spatial distribution of economic activity across sub-regions of Scotland. Together with a second dataset on the distribution of household incomes, we can explore whether the observed spatial pattern in economic activity is mirrored by changes in household income for the same sub-regions. This gives an opportunity to explore Scotland's economic growth at the sub-regional level.

In addition it offers an opportunity to:

1 Explore the patterns of growth across the Scottish sub regions;
2 Examine the changing patterns in GVA per head across the Scottish sub regions;
3 Consider income trends across the regions;
4 Consider spatial economic inequality over time across these regions.

In this preliminary paper we outline these four areas and initial considerations as to the data. It is not the purpose of this short note to *explain* observed growth differences, but to understand the scale – and persistence – of economic outcomes across the sub-regions of Scotland between 1997 and 2010.

The working

GVA data at NUTS3 level across the UK were published by National Statistics on the 12th of December 2012. This gave GVA in current (i.e. cash) prices for ten industries in each of twenty-three sub-regions of Scotland. It is unfortunate that these sub-regions do not necessarily equate to those of the (32) Scottish local authorities as this could allow for better alignment of policy activities with outcome data. In some cases, data are available for aggregated local authority areas (for example, "Angus and Dundee City", "Clackmannanshire and Fife" and "Aberdeen City and Aberdeenshire") while others have groupings which go across two local authority areas (for example, "Lochaber, Skye and Lochalsh, Arran & Cumbrae and Argyll and Bute").

A few steps are required to adjust the data into a form appropriate for this analysis. Firstly, we convert the cash GVA series for each industry in each sub-region into a real series. We use a common set of prices to correct for changes in the price level over the period. This is done using UK industry-specific GVA deflators, obtained from UK current and constant price series' for each industries annual GVA to convert all prices to 2006. This gives us a real GVA series for each sub-region across Scotland. Secondly, we sum the sub-regional GVA data to a Scottish total and calculate the annual growth in real terms from this Scottish data series. For both the Scottish and sub-regional data series' we calculate the cumulative growth in real GVA from 1997. To show the performance of sub-regions relative to Scotland as a whole (Figure 1) we subtract the Scottish cumulative growth series from those for the sub-regions of Scotland. Scottish real GVA series we obtain is slightly different to that produced by the Scottish Government. However, the cumulative growth of the Scottish economy under both measures is broadly comparable (24.21% from summing the estimated real regional GVA and 22.74% from the Scottish government figures directly).

We begin by outlining what regional economic theory suggests about the likely spatial pattern of economic growth. We then explore the changing geography of Scotland's economic performance between 1997 and 2010.

2. An overview of growth and convergence in regional economic theory

Conventional neoclassical regional growth theory suggests that – in the absence of regional specialisations, and with labour and capital able to move between regions – GDP per head will equalise across regions in the long run. If, in the short run, one region sees a boost to growth – perhaps either through a productivity increase or following an increase in demand for that region's traded goods - this will impact on the relative productivity of capital and labour in that region (Armstrong and Taylor, 2000). Over time, capital flows and migration produce a correcting process by which per capita growth in lagging regions converges on the previously leading regions. The overall level of GDP, of course, may differ between regions but will be equalised on a *per capita* basis as population will be higher in the higher GVA region.

The view of whether equalisation of outcomes arises in more recent regional growth models is neatly summarised by Gardiner *et al* (2012, p. 6-7):

> *"Spatial differences in economic performance, rather than setting off automatic self-correcting processes, are likely instead to be self-reinforcing: spatial economic imbalance, in the sense of regional disparities in growth and incomes, may not only be persistent but may in fact intensify over time. More of these 'imbalance' theories predict that spatial agglomeration of economic activity is an inevitable result of increasing returns effects".*

The early regional growth models (for example, Kaldor, 1970; Dixon and Thirwall, 1975) speculated that differences in growth rates and per capita incomes may persist "as a consequences of a virtuous circle of growth, partly as a result of agglomeration economics, which emerge in high-growth regions as a result of the clustering of economic activities" (Gripaios *et al*, 2000, p. 1161).

The more recent New Economic Geography (NEG) literature (Krugman, 1991) formalised a "core-periphery" model of economic development. NEG theory suggests that the "geographic structure of the economy depend[s] on a few key parameters: transportation costs, economics of scale and factor mobility" (Krugman, 2011, p. 3). In the early NEG models, firms were subject to monopolistic competition, giving firms economics of scale and suggesting a concentration of production: "Under the right circumstances, this could produce a circular causation in which concentrating production fed on itself" (Krugman, 2011, p. 4). The key issue here is that sectors subject to increasing returns (which tend to be highly productive) become geographically concentrated. Of course, whatever leads to their being agglomeration economies its central proposition is that economic activity would concentrate in particular regions and we would not see convergence in GVA per capita.

Recent regional growth theories therefore suggest that market forces will not deliver growth which is evenly distributed across a country. However, it is not clear that concentration of activity helps or hinders the country's overall growth rate (Gardiner *et al*, 2012). Under certain assumptions, geographical concentration of activity could simultaneously benefit growth of the region and the nation (e.g. Baldwin et al, 2004). However, a large body of recent empirical work suggests policy aimed at dispersing activity across regions is the only way to both reduce growth differentials and increase the overall growth rate (Cerina and Mureddu, 2009).

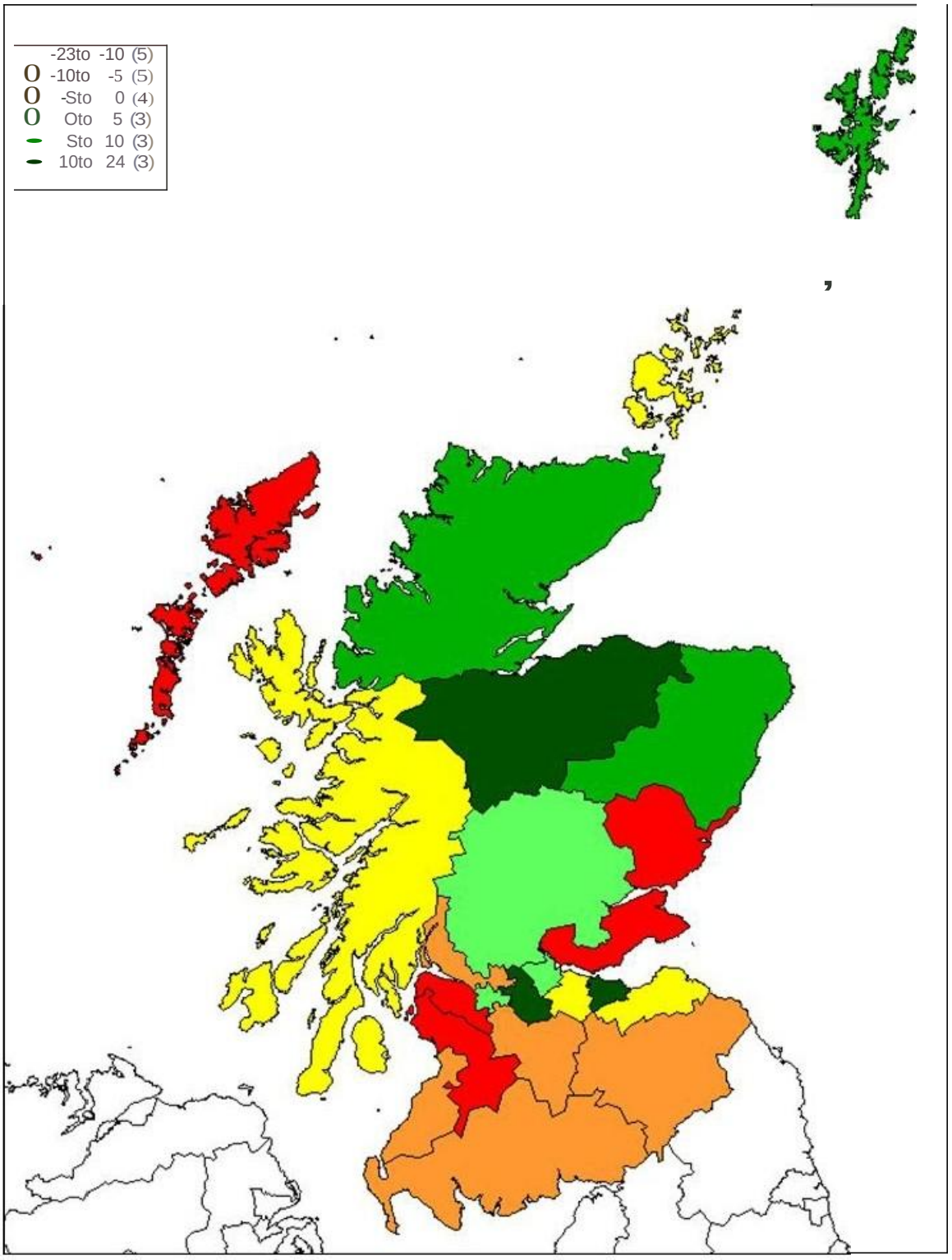
3. Growth across the sub-regions

We first begin our empirical analysis by looking at the differences in total (i.e. cumulative) economic output growth between each sub-region and the Scottish economy as a whole between 1997 and 2010. If the Scottish growth rate had been matched in each sub-region, then the growth differentials would be zero. Numbers above (below) zero indicate sub-regions with a stronger (weaker) growth performance over this period than the Scottish economy as a whole. The cumulative differences are mapped in Figure 1.

Figure 1 shows the striking disparity of economic outcomes across Scotland over this relatively short period of time. Recall from Box 1 that the Scottish economy grew by 24.2% in real terms over this period. There are five sub-regions with growth performances more than 10% worse than Scotland as a whole. The worst performing sub-region is "Inverclyde, East Renfrewshire and Renfrewshire" (-22.9%) with other poorly performing regions being "East Ayrshire and North Ayrshire mainland" (-18.0%) and "Angus and

Dundee City" (-12.6%). The "Inverclyde, East Renfrewshire and Renfrewshire" relative growth figure therefore suggests that in real terms the GVA in this sub-region expanded by less than 2% over the period. At the other end of the spectrum, in three sub-regions growth was more than 10% higher than growth in the Scottish econamy as a whole. Leading these was "Inverness & Nairn and Moray, Badenoch and Strathspey" (+23.5%), "North Lanarkshire" (+12.0%) and "City of Edinburgh" (+11.2%).

Figure 1: Cumulative real GVA growth for the 23 Scottish fi/UfS3 regions relative to Scotland as a whole, 1997-2010



Concentration in major city economies

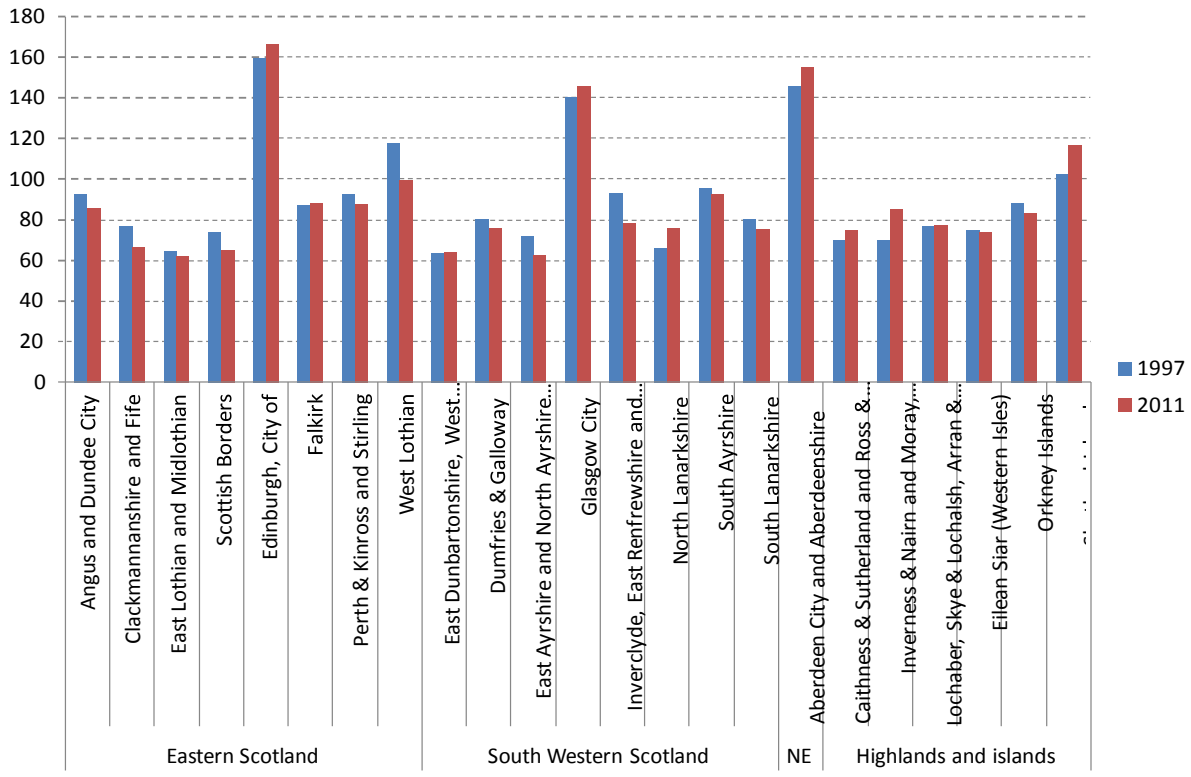
The performance of the cities of Scotland over this period is also evident from Figure 1. The regions containing Aberdeen, Glasgow and Edinburgh dominate the Scottish economy and have all grown relative to the Scottish economy over the period. The share of Scottish activity in the three regions containing these centres has gone from 43.0% to 45.8%, increasing by almost 2 percentage points since 2004.

Scottish economy moving northeast

Generalising across the sub-regional geography of Scotland, we can see an apparent northeast/southwest divide in terms of economic output growth. No sub-region below the central belt outperformed the growth seen across Scotland. The central economies between Glasgow and Edinburgh (including these areas) and those in the north and northeast of mainland Scotland have seen faster growth. This is not to understate the continued importance of those economies in the south and west, but to demonstrate just how far growth in the north and north east has dominated much of the recent growth of the Scottish economy. Interestingly, the island economies of Eilean Siar, Orkney Islands and the Shetland Islands have had a mixed outcome over this period, seeing output change of -11%, -3% and 6% respectively compared to the Scottish average.

4. GVA per head across the sub-regions

Figure 2: GVA per head by sub-region in 1997 and 2011 (Scotland = 100)



Note: "NE" refers to North Eastern Scotland, of which "Aberdeen City and Aberdeenshire" is the only NUTS3 sub-region.

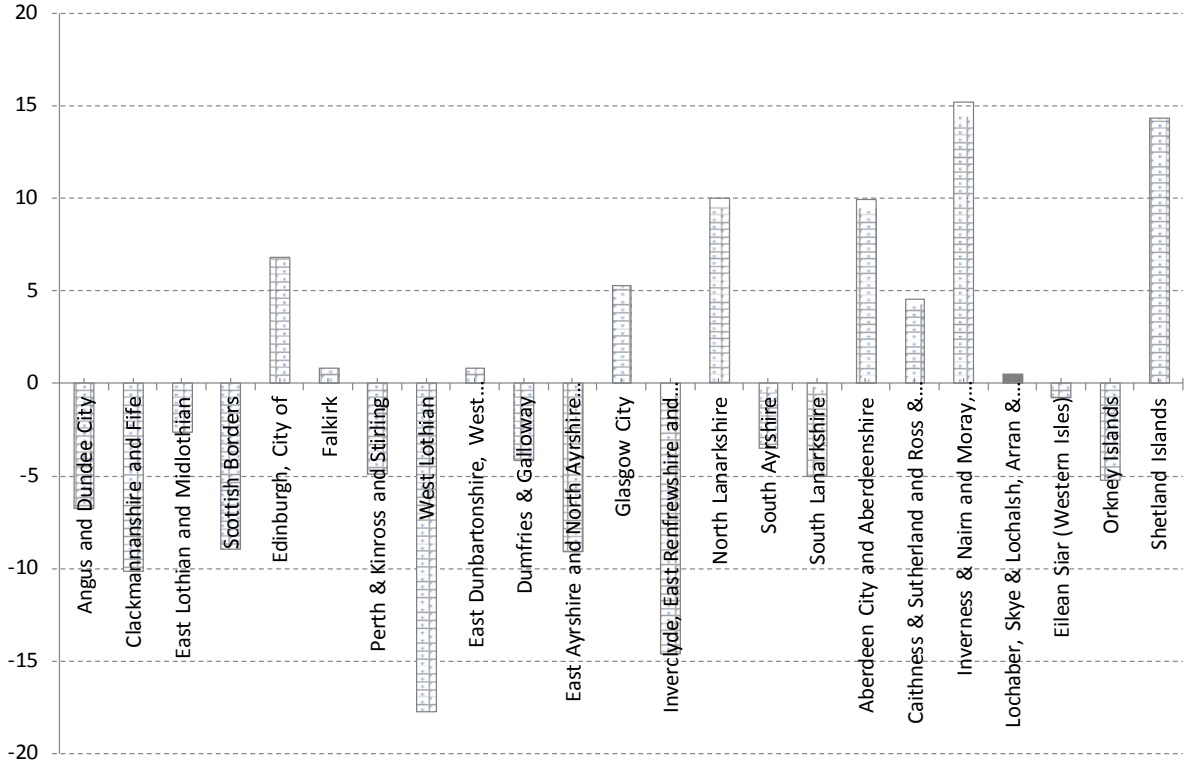
Figure 2 shows the level of GVA per head for each sub-region in 1997 and 2011. GVA is on a workplace basis, and so is earned where employees work, rather than where they live, while resident population figures for each sub-region are used to construct the per capita measures. What is striking is the sheer range of per capita economic outcomes across Scotland. As indicated earlier, the major city economies (Glasgow, Edinburgh and Aberdeen) dominate on this measure, with respective GVA per head measures in 2011 46%, 55% and 66% higher than the Scottish average. The lowest figures are found in the sub-regions of East Lothian and Midlothian (38% below the Scottish average for that year), East Ayrshire (37% below), East Dunbartonshire, West Dunbartonshire and Helensburgh and Lomond (36% below), Scottish

Borders (35% below) and Clackmannanshire and Fife (34% below). It might come as a surprise to some that no sub-region in the Highlands and Islands has a GVA per head more than 26% below the Scottish average.

Secondly, Figure 2 demonstrates the considerable persistence in sub-regions' relative economic position. No sub-region, for instance, has increased its GVA per head from below to above the Scottish average over this time period.

Figure 3, on the other hand shows the changes in sub-regions relative GVA per head figure (i.e. the percentage points difference between that regions GVA per head relative to the Scottish overall in 2011 minus the regions relative GVA per head in 1997). Positive values therefore indicate that the sub-region has improved on this measure between the start and end dates of these data.

Figure 3: Percentage points change in GVA per head for each sub-region relative to the overall Scotland average, 1997 and 2011



The results in Figure 3 show again the widening of economic outcomes across the sub-regions of Scotland over the period 1997-2011. The largest changes are seen in Inverness & Nairn and Moray, Badenoch and Strathspey (up 15 percentage points) and Shetland Islands (up 14 percentage points). What becomes striking from this chart is the relative increase in GVA per head of Edinburgh (up 7 points) and Falkirk (up 1 point) while all other "Eastern Scotland" sub-regions see a decline in GVA per head. In the West of Scotland, only Glasgow, North Lanarkshire and East Dunbartonshire see an increase while the other five sub-regions see a relative decline.

As Henley (2005) points out, however, commuting will affect the measured GDP per capita figures where the resident population is used as the denominator in this equation: "the published data are characterised by the feature that areas of high inward commuting and low resident population have significantly higher levels of GDP/GVA per capita than would be observed under a strictly residence-based definition" (p. 1249). This would not be a problem if each region identified a single travel-to-work area, and there was no commuting between regions.

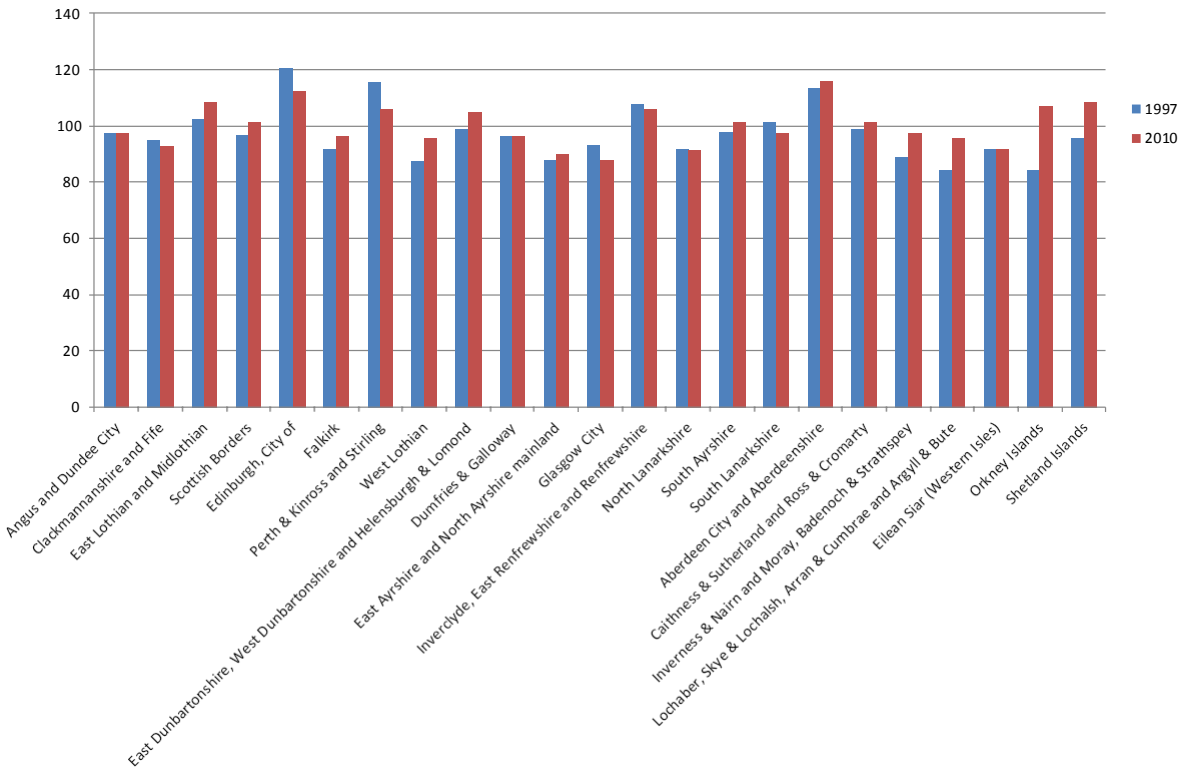
5. Income across the sub-regions

Of course, the Scottish economy is not distinctly separated into 23 separate labour markets, mapping to each of our sub-regions. In practice, there is extensive commuting activity between sub-regions, in particular from the areas around major cities. The most recent data for Scotland shows that for example, only 51% of those who work in Glasgow and 65% of those who work in Edinburgh actually reside in the city, with both having extensive commuting from neighbouring areas.

While economic activity has concentrated in the urban economies, commuting will mean that incomes earned in urban employment should be counted as accruing in the domestic sub-region. Of course, the measure of economic activity used earlier – GDP – is the sum of operating surplus and wage income. While there are no measures for operating surplus across the 23 regions of Scotland within the same dataset, we therefore examine household income alone. Of course, the income measure will include any such incomes accruing to households from operating surplus, for example through ownership profits, dividends, etc., as well as non-employment income such as (public and private) pensions and other transfers, such as welfare payments.

We can compare (current price) Gross Disposable Household Income (GDHI) across the same 23 sub-regions of Scotland. There are no price indices for the sub-regions, and so these differences do not necessarily represent differences in households' purchasing power. For ease of direct comparison to the earlier GDP per head figures (Figure 2), we show the figures relative to the Scottish average in 1997 and 2010.

Figure 4: GDHI per head by sub-region in 1997 and 2010 (Scotland = 100)



What is immediately clear from comparing Figure 2 and Figure 4 is the much more equal spread of income when compared to economic activity. No sub-region has an income per head figure which is further than 20% greater or lower than the Scottish figure. This contrasts significantly with the concentration seen earlier. Secondly, we can see that several regions in the "Highlands and islands" area of Scotland have made significant increases in their income per head over these years. GDHI per capita compared to the Scottish average in "Shetland Islands" and "Lochaber, Skye & Lochalsh, Arran and Cumbrae and Argyll

and Bute" has risen by over 10 percentage points over this period, while the largest rise was seen in Orkney Islands, increasing from 84 (Scotland=100) to 107 between 1997 and 2010.

What is surprising is that for the major cities of Glasgow and Edinburgh, income per capita of residents has actually fallen relative to the Scottish average between 1997 and 2008. The fall was of 9 percentage points for Edinburgh residents and 5 percentage points for Glasgow residents, relative to the Scottish average. Sub-regions neighbouring these cities have not seen such large reductions, perhaps suggesting that urban employment and suburban residence has become a growing phenomenon over this period.

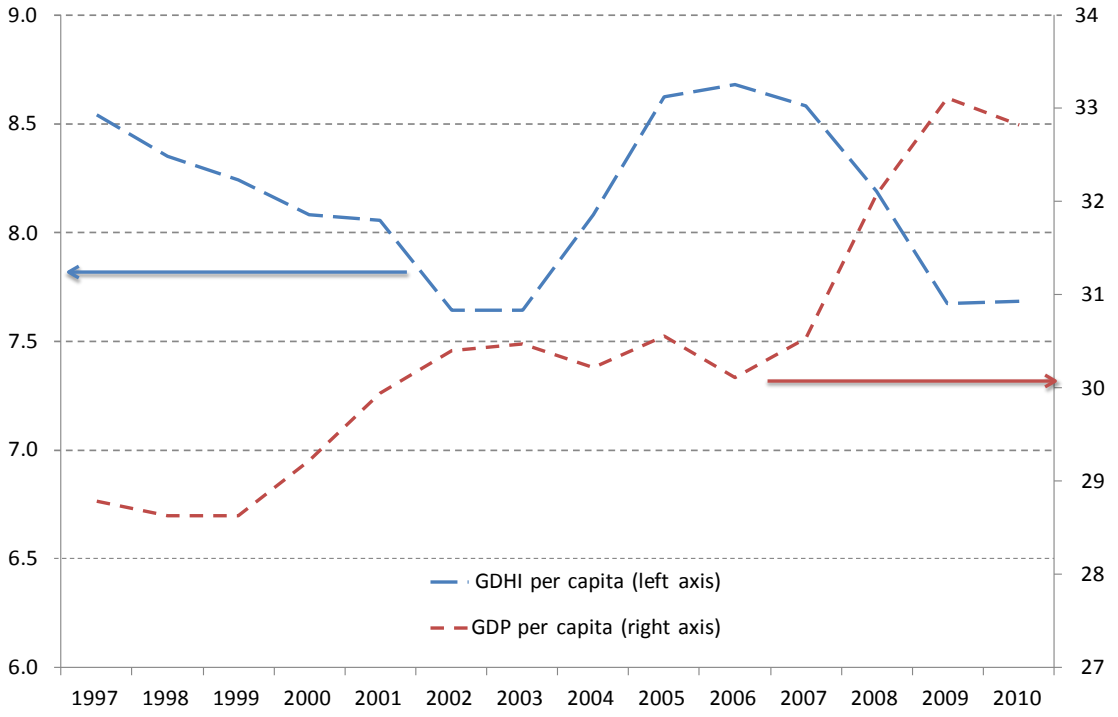
6. Spatial economic equality over time

We have argued in Sections 3 and 4, that there appears to have been increasing equalisation of household income across the sub-regions of Scotland, while economic activity has been increasingly concentration in the major cities. To confirm this, we should use a measure of dispersion which can be calculated over each year of the sample, rather than simply the start and end points. The EU used a "derived indicator" to show the dispersion of GDP per inhabitant across regions of each EU country (EU, 2012) for specific year, *t*. This measure takes into account the absolute difference between GDP per capita in each (sub) region, y_i, and the average GDP per head for the region/nation, Y, and the population size of the (sub) region, p_{it}, and the region/nation, P_t.

$$D_t = 100\frac{1}{Y_t}\sum_{i=1}^{n} \left| y_{it} - Y_t \right| (p_{it} / P_t)$$

If GDP per head is equal across all regions, the value for D falls to zero, while higher values will be consistent with a more unequal distribution. For example, a value of 10% indicates that the (population weighted) average of GDP per capita varies from the national average by 10%. By tracing the level of this variable in each year we can see how sub-regional economic equality has evolved over the period of our data.

Figure 5: Dispersion index for GDP per capita and GDHI per capita, 1997 to 2010



The dispersion indexes for GDP per capita and GHDI per capita in each year between 1997 and 2010 are shown in Figure 5. Note that the dispersion index for GDP per capita is shown in the red (dotted) line, with the scale on the right axis, while the index for GDHI per capita is shown in the blue (dashed) line with the scale on the left axis.

Firstly, from the scale of each axis in Figure 5 we can see that the level of dispersion across the sub-regions for income (GDHI) per capita is much lower than for GDP per capita. As discussed above, this in part reflects the pattern of economic activity in specific regions of Scotland, including the major cities. In 2010, GDP per capita in each sub-region differs from the national average by an average of 32.8%, while income per capita in each sub-region is on average 7.7% different from the national average.

Secondly, both series have quite different trajectories over the sample period. GDP per capita has become considerably more unevenly distributed, increasing from 28.7% to 32.8% (and actually falling back from 33.1% in 2009). Much of the increase in the index for GDP per capita occurs in 2008 and 2009, after staying relatively stable between 2002 and 2007.

Finally, the GDHI per capita series appears to be consistent with the findings of Dewhurst (1998)'s earlier work looking at the GB counties. That earlier research found that richer (poorer) regions do better than poorer (richer) regions during times of strong (weak) national growth. In the period of strong Scottish growth between 2000 and 2007, the dispersion of GDHI per capita increased from 8.1% to 8.5% indicating a growing inequality of incomes. Since 2008 and during the stages of the Great Recession, the dispersion of GDHI per capita has reduced. Of course, this analysis is only a first attempt at understanding the scale of economic inequality in Scotland over this time period and further work would be required to pin down the precise nature of changing income equalities.

7. Conclusions

We have examined the economic performance of twenty-three sub-regions of Scotland between 1997 and 2010. These recently published data have allowed us to investigate changes in GDP and household income per head of population, as well as the changes in the level of activity in each sub-region compared to the Scottish growth rate.

We have found that the spatial concentration of economic activity has increased over the last fourteen years, reflecting a growing spatial economic inequality across sub-regions in Scotland. The growth in economic activity in the major cities of Scotland – Glasgow, Edinburgh and Aberdeen – has outperformed the Scottish economy as a whole over this period. Over the last eight years, the share of Scottish output that is produced in these three sub-regions has increased, and now accounts for almost one half of all output in the Scottish economy. Such findings appear to be consistent with theories of cumulative causation of regional growth, where firms benefit from locating in urban areas through being able to take advantage of external economies, such as thick labour markets and being closer to larger product markets. Interestingly, over the period covered by data, the income per capita for *residents* of both Glasgow and Edinburgh relative to the Scottish average has actually fallen.

There has also been a widening over the last fourteen years of measured GVA per capita across the sub-regions of Scotland, although this does not take account of significant commuting patterns. Unlike measures of economic activity, the data suggest that the spatial equality of household income has actually improved between 1997 and 2010. Spatial equality in household per capita income appears to have slightly deteriorated between 2000 and 2007. Since 2008 however, income equality has improved, although the changes are relatively small. In the same period since 2008, equality of economic activity has sharply worsened.

The analysis in this paper suggests a number of areas for further research. First, it would be useful to understand more about whether the Scottish pattern of urban concentration of economic activity is replicated in other regions of the UK, and to what extent, if any, developments in Scotland are unique. Second, it would be revealing to explore how much of these observed sub-regional differences are the results of sectoral, demographic or other factors. To the extent that high-value service-sector activities, such as finance and business services, including IT, require access to pools of skilled talent, and benefit from proximity to the market for their products, then a sectoral explanation for concentration of activity in urban centres might be persuasive. Finally, and perhaps most importantly for policy, is the question of

whether concentration of activity in specific regions helps or hinders growth in Scotland, as a whole. There is persuasive evidence, including that by Professor Stiglitz of the Scottish Government's Fiscal Commission, that growing income inequality restricts economic growth and makes that less stable. Whether the same was true for spatial economic equality is an important issue for sub-regional government policy within Scotland.

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