Regional Prices and Real Incomes in the UK

Official figures on regional incomes in the UK are compiled on a nominal basis. This article develops a contemporary measure of relative regional prices in the UK, which suggests that the impact on relative regional living standards is substantial. Inter-regional differences in real incomes are therefore considerably smaller than nominal ones. It is hoped that this work will stimulate further research. Insofar as prices are systematically higher in wealthier regions, there are important policy ramifications and public policy focussed on regional assistance and redistribution should take account of these.

Keywords: regional disparities, prices, UK, spatial inequalities, productivity

JEL classification codes: R12, R1, C43, J31

Introduction

Recent decades have seen growing awareness of sub-national disparities and spatial imbalances. The UK has a "regional problem" (McCann, 2016) with uneven patterns of development being reinforced since the recession of 2008 (Omstedt, 2016). The UK has thus long been an important focal point for academics interested in regional issues and a variety of explanations have been suggested for inter-regional disparities (Gardiner, Martin, Sunley, & Tyler, 2013). Moreover, recent political events have given the debate over what to do about regional differences an even greater salience.

Both the election of Donald Trump in the USA and the vote to leave the European Union in the UK have a strong regional dimension. Indeed, these populist movements have been widely ascribed to the idea that those living in regions that have felt increasingly disenfranchised in recent years (Rodríguez-Pose, 2018).

A relatively understudied aspect of this is the impact of differences in the cost of living on regional disparities in incomes. This analysis builds on and extends previous work on regional prices to add to that literature, finding that wealthier regions typically also have higher price levels. This analysis is likely to impact the UK Government's

agenda with regard to "levelling-up" the regions and its 'Industrial Strategy', and presents a clear research agenda moving forward. The conclusions are widely applicable, as in many countries data on regional prices are missing or incomplete (Laureti and Rao, 2018).

Outline

The article is structured as follows. The next section outlines the nature of the problem of subnational price variations, before considering both international evidence and previous attempts to tackle the issue within the UK. The third section presents the theoretical background to the method of calculation, noting the particular role of housing costs. A detailed discussion of the data sources used and limitations thereof is then included in the fourth section. The fifth section then presents the results and the impact of these on real regional wages and incomes is discussed in the sixth section. A discussion of the implications and future research agenda concludes.

The Problem

Regional economic data in the UK (whether on wages, household incomes or economic output) are not adjusted to take account of price differences between regions. This problem is not unique to the UK – significant differences in regional prices exist across the world, which has ramifications for national and European regional policies (Janský and Kolcunová, 2017).

In contrast, international comparisons between countries' real GDP now routinely adjust for purchasing power parity (PPP). At its most fundamental, this is a ratio between prices in different countries (or, in this case, subnational regions). For simple products – e.g. strong white flour – this might be clear, although for others (e.g. restaurant meals) it can be more complex. A meaningful price level comparison must

be between a basket of goods and services, and the need to aggregate these adds a great deal of complexity.

This article is specifically concerned with PPPs for personal consumption (Household Final Consumption Expenditure), which are necessary for the computation of real living standards (see Rao (2013b) for an interesting discussion of per capita actual individual consumption across the globe). To do so, it draws upon the same methodology used by the Eurostat and the OECD (2012) in international comparisons between countries and applies it to regions within the UK. The article then uses these PPPs for personal consumption to compare wages and incomes across the UK, finding that after adjusting for differences in the cost of consumption, inter-regional real wage and income differences are smaller than nominal ones.

Whilst data availability and quality on subnational price variations has improved dramatically in recent years in the UK, it is not perfect. In particular, published price data are unavailable below the division-level. Whilst this cannot be helped, the absence of fully disaggregated data does introduce a potential source of bias into the calculations. Nevertheless, this is likely to be modest in relation to the total size of the PPPs and compared to probable sampling errors. It is to be hoped that this article will stimulate further work both in the UK and elsewhere and ultimately lead to completely disaggregated data being available to researchers.

Previous International Work on Sub-National PPPs

Spatial price comparisons allow the relative purchasing power of any given quantity of money to be compared across regions. Whilst this has long been done for countries, the past decade has seen burgeoning interest in calculating sub-national PPPs. As Janský and Kolcunová (2017) argue, this has potentially very significant ramifications for EU cohesion policy. In the USA, the Bureau of Economic Affairs

(BEA) uses a combination of techniques to establish price levels for basic headings for 38 different areas, which are then aggregated to produce regional price parities (see Aten (2017) for details of the procedures).

Similarly, the Italian National Statistical Office is implementing work to calculate sub-national PPPs within Italy, using country-product-dummy models (see Biggeri, Laureti, & Polidoro (2017) for details). More generally, Laureti and Rao (2018) give an overview of the theoretical background to subnational price indices before examining the possibility of using a variety of "big data" (most notably scanner data) and noting the theoretical and practical opportunities and difficulties associated with their use.

In common with similar examples across Europe – most notably in Germany (Weinand and von Auer, 2020) and Italy (Amendola and Vecchi, 2017) – prices appear higher in the wealthier region. For example, in 2015, prices in Paris exceeded those in the remainder of metropolitan France by approximately 9% (Clé, Sauvadet, Jaluzot, Malaval, & Rateau, 2016). For evidence on the East-West divide in Germany see Dreger and Kosfeld (2010). As in the British case, there is some evidence that already wealthy German regions may have 'pulled further ahead' of the rest of the country (Geppert, Gornig, & Werwatz, 2008).

The topic has also generated academic interest within Eastern Europe, particularly as regards its implications for Cohesion Policy. Recent evidence from the Czech Republic suggests significant subnational variation in price levels (Cadil, Mazouch, Musil, & Kramulova, 2014; Kocourek, Šimanov, & Šmída, 2016), whilst contemporary work in the Polish case also finds substantial price variations across regions but also convergence over time (Rokicki and Hewings, 2019). There have been

a number of international efforts outside of Europe, including in a number of developing countries (see Laureti and Rao (2018) for further details).

Previous Evidence from the UK

In the UK there is substantial anecdotal evidence that prices of many goods and services are significantly higher in southern England than elsewhere. Given this, it is surprising that there are no official regional consumer price indices, despite clear interest in the subject as far back as the 1960s (RPI Advisory Committee, 1971). Nevertheless, there have been several attempts to calculate differences in consumer price levels across the UK. In most cases these have been used to estimate real regional wages and incomes. Borooah et al. (1996) and Martin and Tyler (1994) suggest that as early as the 1980s, significant differences in living costs were emerging and that housing costs were a particular driver of this. Similar work by Johnston, McKinney, & Stark (1996) also find that price levels diverged during the 1980s with London's price level increasing from 5% above the UK average in 1980 to around 7.5% above average a decade later. Like later work by Hayes (2005), all of these authors drew on regional price data published in the Croner-Reward Cost of Living Surveys.

As the only source of regional price data from the 1970s to the 1990s, these were an extremely useful source of data. However, they were understandably less detailed than official statistics, with a much smaller basket of goods and fewer price samplings. This led to extremely large standard errors on certain items of expenditure, as noted by Borooah et al (1996). Moreover, the Croner-Reward surveys were discontinued some years ago, and all of these articles relate to relative prices in the mid-1990s or earlier. There is substantial evidence to suggest that disparities in some relative costs (particularly housing) have widened considerably since then. Improved data availability and the UK's participation in Eurostat's purchasing power parity

programme mean that we are now able to calculate relative regional consumer price levels in a way that was impossible for practitioners 20 years ago.

There have been a handful of more recent attempts to construct indices of relative regional consumer prices. Rienzo (2017) and Hearne and De Ruyter (2019) both construct measures of regional prices. Both use expenditure weights from the Living Costs and Food survey (or its immediate predecessor) and regional rents (derived from the Family Resources Survey). However, where the former takes the form of a 'regional retail price index (RPI)' and assumes that only housing prices differ across regions, the latter uses aggregated data and adds housing costs. Neither approach is conceptually ideal – in the former case, a highly non-standard methodology is used resulting in price differences that are not scale invariant, whilst the latter adds housing costs in an ad-hoc manner, resulting in a price measure that has only 5 categories (3 of which relate to housing) although it does use a standard aggregation procedure (Èltetö-Köves-Szulc applied to a series of bilateral Fisher indices).

They could therefore understate or overstate price variations between regions for several reasons. The current work is conceptually closest to the latter approach, although it significantly strengthens the overall analysis in several key areas. Firstly, through the use of significantly more robust source data. Rather than using an 'ad-hoc' treatment of housing, mix-adjusted measures of both market and imputed rents are developed and combined with division-level expenditure and prices on other categories. Similarly, rather than survey data, the estimates of regional weights in this paper are sourced directly from data produced by the UK's national statistical agency – the Office for National Statistics (henceforth ONS) – and are compatible with their national counterparts (which are themselves used in international comparisons). This delivers

both significantly more robust estimates of regional prices and improves comparability with figures from elsewhere in Europe.

In addition to academic work, several more recent attempts have been made by the ONS to derive measures of regional price levels. In 2000, an attempt was made to calculate relative regional prices by using prices collected by the ONS in a special survey (Baran and O'Donoghue, 2002), but this didn't include owner-occupiers' housing costs (thus dramatically understating the price differences between regions). Additionally, the use of national expenditure weights was problematic (it fails to allow for the substitution effect).

A later attempt to update this analysis with a view to using it as a basis for a regional RPI used regional weights (Ball and Fenwick, 2004). In practice the intended RPIs were never produced and the work remained a one-off, although it was updated and extended a year later (Wingfield, Fenwick, & Smith, 2005). The 'regional RPIs' produced for 2004 show broadly similar results to those produced by researchers in the 1990s. These used mortgage interest payments as a proxy for regional housing costs.

Most recently, the ONS produced a set of Relative Regional Consumer Price Levels (RRCPLs) for 2010 (Office for National Statistics, 2011)and again for 2016 (Office for National Statistics, 2018b), using the same methodology as that used by the OECD for international comparisons between countries (Office for National Statistics, 2011, 2018b). However, these did not include either rent or owner-occupier's housing costs (Office for National Statistics, 2011, 2018b). This paper therefore extends that work by explicitly adding housing costs. After doing so, we show that prices vary significantly across the UK and this has a large impact on real household incomes.

Method

The best known international PPP comparisons are the Eurostat-OECD comparison and the International Comparison Program (ICP) from the World Bank. The data needed for high-quality PPPs are voluminous. The process of compiling PPPs is laborious and typically undertaken in stages. Firstly, price data on individual products are collected. These are then aggregated to the so-called "basic heading" level. This is the lowest level at which expenditure weights are available, and include well-defined products (bread is an obvious example). PPPs are then calculated for every basic heading and aggregated to classes (in this case bread, cereals, pasta and other bakery products), the "expenditure group" level (e.g. food) or to the division level (food and non-alcoholic beverages). Individual consumption expenditure by households is then the result of aggregating across all household expenditure.

Perhaps the greatest challenge of all is the very first stage – adequately aggregating to the basic heading level is both difficult (due to the absence of expenditure weights and non-comparability of many precise goods and services) and crucial. The ICP uses a country-product-dummy method applied to country average prices (see Rao (2013a) for details), although work has focussed on potential refinements (Hill and Syed, 2015). As noted by Aten (1996), there is evidence of spatial autocorrelation amongst prices even on an international level and this issue is likely to be even more acute on a regional level.

The Eurostat-OECD methodology, in contrast, uses a modified Èltetö-Köves-Szulc (EKS) method (Eurostat and the OECD, 2012) based on the geometric mean of products representative of country A and the geometric mean of products representative

of country B under each basic heading[1]. Beyond this, an aggregation procedure must be chosen for each level above the basic heading. The most common are the EKS procedure used by Eurostat, the Geary-Khamis procedure and the Iklé-Dikhanov-Balk method.

The stochastic approach suggested by Hajargasht and Rao (2016) has a number of strengths, most notably its hedonic characteristics and ability to allow for spatial dependence (Biggeri, et al., 2017; Montero, Laureti, Mínguez, & Fernández-Avilés, 2020). Most importantly of all, it allows computation of standard errors for the standard index number methods employed for aggregation above the basic heading level. Unfortunately, its use is not feasible in the context of this paper due to data limitations.

The aggregation method chosen should, however, fulfil certain basic criteria. It is preferable that any method should be scale invariant, ruling out indices such as the Geary-Khamis method, which approaches a Laspeyres index with the largest region as a base. In addition, it is desirable that the index chosen should be base invariant (i.e., it should not matter which region is chosen as Region 1). A symmetric[2], base-invariant index achieves this and the Fisher index is also homogeneous[3] being the geometric average of the Laspeyres and Paasche indices (ILO, 2004). It thus deals with the

---

[1] The modification made was introduced by Eurostat in the 1980 comparison in order to take into account the extent to which goods are representative in different countries (for example, different brands of cereal might be sold in different countries, even though the basic heading under which they fall is identical). As goods and services across regions in the UK are largely homogeneous, this is not a significant issue for subnational PPPs in the UK and consequently the EKS method in its original form is used by both the ONS and in this paper.

[2] Symmetric insofar as both regions have equal importance

[3] Doubling both the Laspeyres & Paasche indices should double the average

problem of the substitution effect identified whilst using the Laspeyres or Paasche indices as bases.

As quantities are not observed (but expenditure shares are), a straightforward rearrangement produces the following Laspeyres index. This can thus be seen as the arithmetic mean of the relative prices when weighted by Region 1's expenditures. Summation is over all expenditure categories and indices on the summation operators have been omitted for clarity.

$$Laspeyres_{2/1} = \frac{\sum(price_{region\ 2} \times quantity_{region\ 1})}{\sum(price_{region\ 1} \times quantity_{region\ 1})} = \frac{\sum(\frac{price_{region\ 2}}{price_{region\ 1}} * weight_{region\ 1})}{\sum weight_{region\ 1}} \quad (1)$$

Likewise, a rearrangement of the theoretical Paasche index gives a calculable expression. This can be seen as the harmonic mean of the relative prices when weighted by Region 2's expenditures. Equivalently, it is seen to be the inverse of the Laspeyres index for evaluating the prices of Region 1 at the weights of Region 2. Summation is similarly over all goods and subscripts have been omitted for clarity.

$$Paasche_{2/1} = \frac{\sum price_{region\ 2} \times quantity_{region\ 2}}{\sum price_{region\ 1} \times quantity_{region\ 2}} = \frac{\sum weight_{region\ 2}}{\sum(\frac{price_{region\ 1}}{price_{region\ 2}} \times weight_{region\ 2})} \quad (2)$$

The Fisher index is then the geometric mean of the two. The downside of a Fisher index when making comparisons when there are more than 2 regions in total is that it is not transitive. Thus, $RRCPL_{A/B} \neq RRCPL_{A/C} \times RRCPL_{C/B}$

One therefore needs a way of attaining transitivity. The EKS procedure adopted in this paper provides transitive price levels that are as close as possible to the bilateral Fisher relative price levels. This is the so-called property of characticity (see Eurostat and the OECD (2012) for further details) and is an important motivator in using the EKS method over alternatives. In particular, the EKS procedure minimises the sum of

squared differences between the resultant EKS index and the original Fisher index (whilst guaranteeing transitive results). As such, it minimises the expression:

$$\sum_{i=1}^{N}\sum_{j=1}^{N}(\ln EKS_{ij} - \ln Fisher_{ij})^2 \quad (3)$$

The practical method for calculating the price levels is somewhat more straightforward. It is given by the equation:

$$\left(\prod_{k=1}^{N}\frac{Fisher_{k/j}}{Fisher_{k/i}}\right)^{1/K} \quad (4)$$

The Eurostat-OECD PPP methodology was used by the ONS when calculating the RRCPLs in 2016. As this paper builds on these, it therefore adopts the same method.

Housing Costs

Housing represents a large proportion of total expenditure – almost 23% of total consumption in 2016, according to the ONS's Consumer Prices Index including owner occupiers' housing costs – the CPIH Office for National Statistics (2019c). As the cost of housing is therefore critical to assessing regional prices, it is now considered in greater detail.

As stressed previously, our measure of prices relates specifically to the cost of consumption. The measurement of housing in this article follows international best practice, using the same methodology as the Office for National Statistics (2016b, 2019b), the Eurostat and the OECD (2012), and as one of the two methods used by the World Bank (2013). For the rented sector the cost of housing services is relatively (although not completely) straightforward to measure: the cost of housing is simply the rental price. For owner-occupiers, the cost of housing is measured by the method of

rental equivalence – how much would it cost the homeowner to rent their home in the private market.

To see why this is the appropriate measure to use for the purposes of this paper, note that a house performs multiple functions for an owner-occupier; it is a financial asset as well as providing a roof over one's head. For the purposes of a PPP, what is of interest is the cost of the consumption service that a house provides. Moreover, the value of the housing services one consumes should not change dependent on the ownership structure.

In the past, the UK's measure of consumer prices – the RPI – used mortgage interest costs to measure the cost of owner-occupied housing, as did the Croner-Reward survey (Martin and Tyler, 1994). Mortgage interest costs measure the cost of borrowing to acquire an asset rather than the consumption cost of housing services (the latter being the rental equivalent) and are linked to both the present interest rate and past house prices. Partly as a result, the ONS has moved away from the RPI as a price index and the CPIH, which uses the rental-equivalence approach, is now the "lead measure of inflation based on economic principles" (Office for National Statistics, 2019b).

Borooah, et al. (1996) also investigated using the user cost as a measure of housing costs. This measures the opportunity cost of home ownership. However, it is heavily affected by capital gains, which are a reflection of changes in wealth[4] rather than the price of consumption. This points to an important but often neglected point: interregional changes in wealth via asset appreciation are likely to dwarf interregional differences in income. Since wealth is not included in conventional measures of

[4] The important distinction between capital gains and income being that whilst the latter can be spent immediately, the former requires sale of the asset in order to be realised.

household income or GDP, this is likely to be an important but hitherto understudied channel driving interregional disparities.

Defining the region

Setting the regional breakdown too finely runs the risk of overstating price differentials because areas with higher prices are typically more desirable. People pay for higher quality amenities. Equally, using regions that are too large fails to capture variation inside the region. Hedonic models indicate that a broad range of environmental and publicly provided amenities play a key role in real estate prices. Nevertheless, for larger regions amenities are unlikely to be the primary driving factor between price differences and the fact that immigrants and natives face different price structures is likely to be important in this regard (Monras and Albert, 2018).

Moreover the region is both an economic unit and a facet of identity (Roberts and Baker, 2006). Regional boundaries have been adjusted over the past century without adequate study as to what the true functional geography looks like. Measures of commuter flows might be an effective way to make this distinction and further research might seek to develop the present analysis along the lines of travel-to-work areas. In practice, the data needed to construct price indices are available at the NUTS1 level, which is a practical constraint. In an ideal world, 'Greater London' would include parts of Essex, Hertfordshire, Buckinghamshire, Berkshire, Surrey and Kent as these contain areas where one could realistically live whilst working in London. Additionally, there is likely to be significant urban-rural differences in prices. Unfortunately, there are not sufficient data available to quantify or model this effect, which future work will want to consider in greater depth. Nevertheless, one should not allow the perfect to be the enemy of the good and, these caveats notwithstanding, by

considering wages and incomes by place of residence rather than workplace one can still construct good estimates of real household incomes.

Data

Two sets of data are necessary to construct relative consumer price levels. Firstly, one needs data on the prices of different goods and services in each region. Secondly, one needs data on expenditure shares in each region. The most recent data on prices of different goods and services in regions of the UK comes from the RRCPLs produced by the ONS for 2016. These have already been aggregated to the division level using the same EKS aggregation procedure described earlier, which poses a challenge since integrating additional data to already aggregated data introduces an additional source of bias. As previously noted, the RRCPLs lack any data on housing costs or expenditure. Division level expenditure is given only for London, 'Rest of England', Scotland, Wales and Northern Ireland. Whilst this is clearly not ideal, the alternative does not allow one to aggregate by internationally recognised classification of individual consumption by purpose (COICOP) category (International Labour Organisation, 2004), which is a serious flaw.

Regional expenditure shares for each category are calculated from the 2016 data on Regional Household Final Consumption Expenditure (Office for National Statistics, 2020b). These are notably more robust source data than those used in previous studies, since they are consistent with national totals (Office for National Statistics, 2020a) and use several data sources to estimate regional household expenditure by COICOP category. These also distinguish between final consumption expenditure judged by the domestic concept and that calculated on a resident basis. Clearly, if one wishes to consider relative incomes then what matters is the purchasing power of those living in an area and it is therefore consumption expenditure on a resident basis that is of interest.

We also need to account for the fact that some spending takes place outside the region of residence (particularly holiday spending) and these data allow us to do so.

Education and health spending are modest. Prices for goods and services associated with the NHS (e.g., prescriptions, NHS glasses etc.) are set by the state and do not vary by region (policy differences in Scotland, Wales and Northern Ireland notwithstanding). Non-NHS medicines and glasses are fully tradable and therefore interregional price differences should be minimal. Few data exist on the relative costs of private healthcare and education across regions and so it has been assumed that prices are uniform across regions. Due to the low weight associated with these categories (under 3% of total household consumption expenditure) this is unlikely to have materially impacted the results.

All Britons (irrespective of region) face the same purchasing power when spending abroad. Therefore, holiday spending (plus spending on hotels) is assumed to be equally costly irrespective of region of residence. Finally, owner-occupied housing costs must be included in the expenditure set, for which this paper uses the rental equivalence approach as previously explained.

Costs associated with the acquisition of a house as an asset are excluded since this would involve "double counting" the cost of housing (Office for National Statistics, 2016b). Money transfers and gifts are also excluded as these entail (the transfer of purchasing power from one individual to another). Information on the proportion of total final consumption expenditure accounted by both rents and imputed rent are given by the regional Household Final Consumption Expenditure totals.

Data on regional rents are needed to estimate housing costs (both rented and for imputed owner occupied housing costs). Two options are available – one can use the figures produced directly by the Family Resources Survey (FRS) for private sector

rentals or attempt to use a variety of other administrative data - specifically data from the Valuation Office Agency (2017), Rent Services Scotland (2018), Statistics for Wales (2018) and the Northern Ireland Housing Executive (2017). Previously, the Family Resources Survey has always been the preferred data source due to the fact that, unlike the administrative data the sample is statistically chosen to be representative of regions and family type. The downside of the Family Resources Survey is its sample size: the total sample of private sector rents is around 3,300 for the entire UK compared with over 500,000 for administrative data sources.

However, there are further key limitations to the Family Resources Survey. Firstly, response rates are low (54% for the UK as a whole and considerably lower for certain regions) leading to heavy use of scaling and imputation. Secondly, whilst it is broadly representative for each region, the figures (including the relative amounts) move very considerably year-on-year. Finally, it takes no account of the fact that the property mix of housing varies by region (i.e. we are not comparing like-with-like since property in urban areas is typically smaller than that in more rural ones) and it forces one to assume that the property mix of owner-occupied housing is identical to its rented counterpart in any given region.

Where previous work (Hearne and De Ruyter, 2019; Rienzo, 2017) drew on this dataset, it has proven possible to work directly with administrative data for private and imputed rents, although for the social rented sector the Family Resources Survey remains the preferred source of regional prices.

Specifically, whilst administrative data are not representative by region, they are collected to set payment amounts for Housing Benefit (which depend on the number of bedrooms and the location). As such, they *are* broadly representative of the private rental market for each property size (measured by number of bedrooms) within each

"broad rental market area" (Valuation Office Agency, 2016). Census data (Office for National Statistics, 2016a) provides information on household size by number of bedrooms by tenure in each area for England and Wales. Although census data are not available for Scotland, closely related estimates (albeit with slightly lower reliability due to the use of a sample rather than a census) are available via the Scottish Household Survey (Scottish Government, 2017)[5]. The most problematic case is Northern Ireland where we also lack census data. In this case, census data on the number of *rooms* per dwelling have been used as a proxy, which is a clear weakness in this specific case[6]. Combined with administrative data on average rents, it is possible to construct average rental prices by number of bedrooms for each region[7]. The basic headings 11.04.11.1 and 11.04.21.1 relating to actual and imputed rents respectively (Eurostat and the OECD, 2012) can then be calculated[8]. For each region, actual rents are then a weighted

Commented [DH1]: Northern Ireland…
Regression (I think) but do draft data with total average rents.

[5] There is a minor issue here insofar as the Scottish tenure data is given at the level of the local authority whereas rental prices are given for Broad Rental Market Areas. In practice, many of these are fully coterminous whilst almost all of the remainder exhibit only very minor differences around the edges and have extremely similar rental prices for each class of property.

[6] In practice, the overall results are remarkably insensitive to extremely large changes in the estimated property mix in Northern Ireland giving confidence in the robustness of the approach.

[7] This uses a weighted geometric mean of average rents for each property size (by number of bedrooms) in order to aggregate to each region.

[8] As accurate weights exist (the weights in question being the proportion of individuals living in houses with each number of bedrooms in each region) below the basic heading level, we use these in place of assessing "representativeness". An alternative would be to use a weighted

average of private and social rents (where the weights are derived from the Family Resources Survey), whilst imputed rents are a mix-adjusted (by location and property size) weighted geometric mean of private property rental prices by region. The two basic headings are then directly combined with the remaining data via the EKS method outlined above, which are unfortunately only available at the division level.

Results

Table 1: Consumer Price Levels across the UK

Region	***Relative Consumer Price Level***
North East	93.9
North West	96.3
Yorkshire & Humberside	95.1
East Midlands	95.8
West Midlands	97.3
East	102.2
London	130.0
South East	105.8
South West	101.0
Wales	93.9
Scotland	99.0
Northern Ireland	94.4

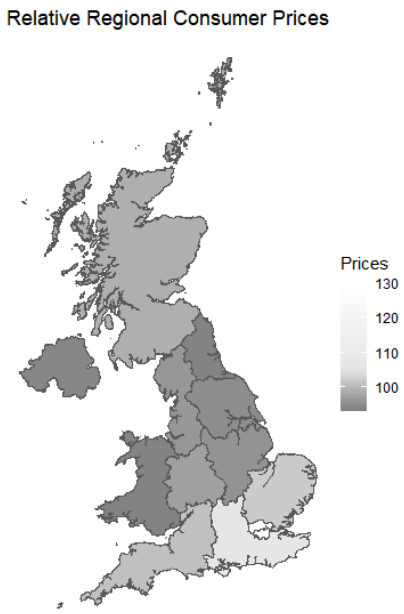
The broad picture is of substantial regional variation in consumer prices. London appears to be particularly expensive, although the gap between the northern

country-product-dummy regression. In the present case, the procedure outlined by Selvanathan and Rao (1994), which gives estimates equal to a Törnqvist-index based EKS procedure gives almost identical results to the present paper.

regions and the South East is also substantial at around 10%. This has a very real impact on real incomes across regions, illustrated by figure 1.

Of course, as previously stressed, there are notable imperfections due to limitations of the source data. The results rely on data that has already been aggregated to the 'division level' rather than the basic headings that would usually (and ideally be used). As a result, rather than having information on the PPPs of each of the 4 basic headings that make up "restaurants and hotels" division, we have to use the division-level figure – which is, for example, 113.0 in London compared to 95.1 in Wales. This repeated aggregation (rather than aggregating all basic headings) and adding actual and imputed rentals for housing adds bias. These (actual and imputed rentals) relate to basic headings 11.04.11.1 and 11.04.21.1 respectively (Eurostat and the OECD, 2012). It is difficult to assess the probable size of the bias induced by this effect, although as much of the price differences across regions are driven by differences in housing costs – which make up some 23% of overall household final consumption expenditure in the UK (Office for National Statistics, 2018a) – it is to be hoped that they are modest.

Figure 1: Consumer Price Levels across the UK



Nominal and Real Regional Incomes

Income data from two major sources is used. Wage and salary data come from the Annual Survey of Hours and Earnings (Office for National Statistics, 2019a) is a 1% survey of all Pay As You Earn taxpayers. This contains salary data for employees and can be regionalised on the basis of either workplace or residence. This is a major strength; commuters face the overwhelming majority of their costs in their region of residence and therefore this is the region to which we ought to ascribe salaries. These data allow us to analyse the labour market signals felt by participants: if real wages are systematically higher in certain regions then this forms a research agenda to try and understand why this might be the case. They also contain a wealth of data on salaries at different deciles, making them extremely useful for comparing income inequalities (tables 2 and 3).

	Annual Pay Relative to UK			
Region	**Mean**	**25th Percentile**	**Median**	**75th Percentile**
North East	87%	96%	93%	90%
North West	91%	95%	94%	93%
Yorkshire & Humberside	87%	92%	92%	91%
East Midlands	93%	97%	94%	94%
West Midlands	91%	96%	94%	93%
East of England	107%	101%	105%	107%
London	131%	122%	125%	124%
South East	112%	107%	110%	110%
South West	90%	95%	94%	92%
Wales	87%	96%	91%	91%
Scotland	96%	102%	100%	98%
Northern Ireland	87%	91%	91%	91%

Source: Annual Survey of Hours and Earnings – resident analysis

Purchasing Power Parity Adjusted Annual Pay Relative to UK Average

Region	**Mean**	**25th Percentile**	**Median**	**75th Percentile**
North East	93%	103%	98%	95%
North West	94%	99%	97%	97%
Yorkshire & Humberside	91%	97%	97%	95%
East Midlands	97%	101%	99%	98%
West Midlands	94%	98%	97%	95%
East of England	105%	98%	103%	104%
London	101%	94%	96%	96%
South East	106%	101%	104%	104%
South West	89%	94%	94%	91%
Wales	92%	102%	97%	97%
Scotland	97%	103%	101%	99%
Northern Ireland	92%	97%	96%	96%

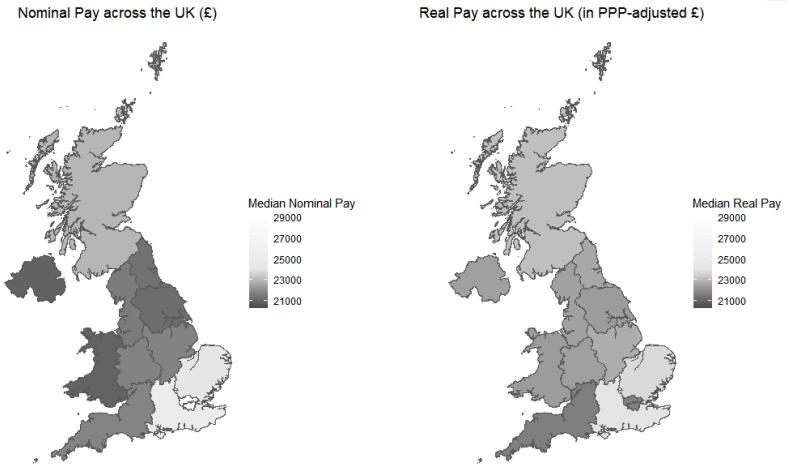
Source: Annual Survey of Hours and Earnings – resident analysis

As can be seen (table 1), mean annual salaries vary very substantially across the UK, whilst median annual salaries vary considerably less (table 2). This is due, in large part, to the fact that regional salary variation is particularly pronounced at high income

levels. Unsurprisingly, after accounting for differences in the cost-of-living, there are limited differences in salaries (table 3). In fact, even this fails to fully capture several aspects of welfare since commutes in higher wage regions – especially in the 'Greater South East' tend to be longer than those elsewhere, leading to a commensurate reduction in workforce welfare (Harvie, Slater, Philp, & Wheatley, 2009).

Figures 2 and 3 illustrate this effect graphically:

Figure 2: Nominal and PPP-adjusted wages in the UK



The major weakness of salary data is that it fails to capture any information on other sources of income. As the Annual Survey of Hours and Earnings only captures PAYE data, it also misses any individuals not in this category (most notably the self-employed). As such, wages and salaries alone are potentially poor measures of standards of living. However, it is possible to source data on other sources of relative regional incomes from Regional Gross Disposable Household Income – see West et al. (2016) for a detailed treatment of exactly what is comprised within GDHI and how it is calculated.

The treatment of income generated by asset ownership (particularly housing) is a key element of GDHI. Like GDP, regional income is a flow measure rather than a stock (and thus treats income but not wealth). The present period income arising from asset ownership is simply the rental equivalent (the running yield), namely: what rental income would the property in question fetch in the open market? "Imputed rent" attributable to owner-occupiers is regionalised in GDHI (West, et al., 2016), as are actual rentals (via "operating surplus" and "mixed income" respectively). This is also the manner in which real estate rewards are captured in GVA statistics whether regional or national under SIC code 68.2IMP.Naturally, deflating nominal GDHI by regional prices has a similar impact to that on wages. Indeed, differences in regional per capita consumer spending shrink remarkably when expenditure on housing is excluded, with the gap between London and the North East falling from £8,304 to just £1,476 (Office for National Statistics, 2020b).

These findings can be conveniently summed up by constructing a "regional Gini coefficient". The Gini coefficient for median nominal wages across the 12 Government Office Regions of the UK is 0.047[9] whereas for median real wages (as deflated by the regional price levels in this paper) it is just 0.017. Similarly, the regional Gini coefficient on GDHI per capita falls from 0.089 to 0.045 (its higher starting point being in large part due to the inclusion of imputed housing incomes), whilst that of relative household final consumption expenditure per capita falls from 0.075 to 0.038. The ramifications are profound: in spite of higher nominal wages in more productive

[9] Regional Gini coefficients tend to be low compared to the figures usually as within-region inequality is typically an order of magnitude greater than between-region inequality.

regions, the ultimate beneficiary is capital (as Ricardo (1821) once hypothesised in a very different context!)

Discussion and Conclusion

These findings suggest real incomes differ much less across the UK than official data imply. It is unsurprising that accounting for purchasing power reduces the difference in macro-level measures of income across regions relative to that believed heretofore, in line with other findings internationally (Aten, Figueroa, Mbu, & Vengelen, 2017; Chen, Wang, & Rao, 2020). In future, estimates of regional GVA and convergence should take into account regional price differences. This could be an explanatory factor in the 'winners circle' identified by Patacchini and Rice (2007). An important limitation of the article has been the absence of data at the basic heading level. As a result, this introduces some bias into the calculations and it is to be sincerely hoped that in future fully disaggregated data will be made available to researchers. An additional puzzle is to understand what factors are driving regional price differences. Restrictive planning legislation is an obvious culprit, but the extreme spatial concentration of power in the UK (whose executive, legislative, administrative, legal and financial centres are all located within a small area in central London) identified by McCann (2016) is also likely to be an important factor. If agglomeration is a further factor it is more subtle and specific than in the past (Krugman, 2011).

Similarly, the findings of this paper raise fundamental life-cycle issues. In the UK today inter-regional wealth changes are extremely large and discussion of these (and the life-cycle issues in question) lie beyond the scope of this paper. The same is true of the notable differences in labour market outcomes in the UK (Jones and Skilton, 2014). As noted in the literature, changes in employment opportunities in city-regions

often have a long-lasting impact upon economic activity rates, particularly for certain socio-economic groups (Bailey and Turok, 2000).

Far from reducing the scope for further regional research, these results suggest that an accelerated research agenda is needed. There is an urgent need for robust information on the evolution of regional prices in the 21st century and there is a strong research agenda in understanding the international context. Extending the work to calculate full regional PPPs across Europe should be high on the agenda. This poses very real questions for a wide gamut of questions on regional development and convergence in developed and developing countries alike.

References

Amendola, N., & Vecchi, G. (2017). The Cost of Living. In G. Vecchi (Ed.), *Measuring Wellbeing: A History of Italian Living Standards*. New York: Oxford University Press.

Aten, B. (1996). EVIDENCE OF SPATIAL AUTOCORREILATION IN INTERNATIONAL PRICES [Spelling in original]. *Review of Income and Wealth, 42*(2), pp. 149-163. doi:doi:10.1111/j.1475-4991.1996.tb00163.x Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1475-4991.1996.tb00163.x

Aten, B. (2017). Regional Price Parities and Real Regional Income for the United States. [journal article]. *Social Indicators Research, 131*(1), pp. 123-143. doi:10.1007/s11205-015-1216-y Retrieved from https://doi.org/10.1007/s11205-015-1216-y

Aten, B., Figueroa, E., Mbu, C., & Vengelen, B. (2017). Real Per Capita Personal Income and Regional Price Parities for 2015. Washington DC: US Department of Commerce, Bureau of Economic Analysis.

Bailey, N., & Turok, I. (2000). Adjustment to Job Loss in Britain's Major Cities. *Regional Studies, 34*(7), pp. 631-653. doi:10.1080/00343400050178438 Retrieved from https://doi.org/10.1080/00343400050178438

Ball, A., & Fenwick, D. (2004). Relative regional consumer price levels in 2003. *Economic Trends, 603*, pp. 42-51.

Baran, D., & O'Donoghue, J. (2002). Price levels in 2000 for London and the regions compared with the national average. *Economic Trends, 578*, pp. 28-38.

Biggeri, L., Laureti, T., & Polidoro, F. (2017). Computing Sub-national PPPs with CPI Data: An Empirical Analysis on Italian Data Using Country Product Dummy Models. [journal article]. *Social Indicators Research, 131*(1), pp. 93-121. doi:10.1007/s11205-015-1217-x Retrieved from https://doi.org/10.1007/s11205-015-1217-x

Borooah, V. K., McGregor, P. P. L., McKee, P. M., & Mulholland, G. E. (1996). Cost-of-living differences between the regions of the United Kingdom. In J. Hills (Ed.), *New inequalities: The changing distribution of income and wealth in the United Kingdom*. Cambridge: Cambridge University Press.

Cadil, J., Mazouch, P., Musil, P., & Kramulova, J. (2014). True regional purchasing power: evidence from the Czech Republic. *Post-Communist Economies, 26*(2), pp. 241-256.

doi:10.1080/14631377.2014.904109 Retrieved from https://doi.org/10.1080/14631377.2014.904109
Chen, M., Wang, Y., & Rao, D. S. P. (2020). Measuring the spatial price differences in China with regional price parity methods. *The World Economy, 43*(4), pp. 1103-1146. doi:10.1111/twec.12899 Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/twec.12899
Clé, É., Sauvadet, L., Jaluzot, L., Malaval, F., & Rateau, G. (2016). En 2015, les prix en région parisienne dépassent de 9 % ceux de la province (Vol. 1590). Paris: Institut national de la statistique et des études économiques.
Dreger, C., & Kosfeld, R. (2010). Do Regional Price Levels Converge? *Jahrbücher für Nationalökonomie und Statistik* (Vol. 230, pp. 274).
Eurostat, & the OECD. (2012). Eurostat-OECD Methodological Manual on Purchasing Power Parities. In Eurostat (Ed.). Luxembourg: Publications Office of the European Union.
Gardiner, B., Martin, R., Sunley, P., & Tyler, P. (2013). Spatially unbalanced growth in the British economy. *Journal of Economic Geography, 13*(6), pp. 889-928. doi:10.1093/jeg/lbt003 Retrieved from http://dx.doi.org/10.1093/jeg/lbt003
Geppert, K., Gornig, M., & Werwatz, A. (2008). Economic Growth of Agglomerations and Geographic Concentration of Industries: Evidence for West Germany. *Regional Studies, 42*(3), pp. 413-421. doi:10.1080/00343400701291518 Retrieved from https://doi.org/10.1080/00343400701291518
Hajargasht, G., & Rao, D. S. P. (2016). Stochastic approach to computation of purchasing power parities in the International Comparison Program (ICP). *Journal of Econometrics, 191*(2), pp. 414-425. doi:https://doi.org/10.1016/j.jeconom.2015.12.012 Retrieved from http://www.sciencedirect.com/science/article/pii/S0304407615002882
Harvie, D., Slater, G., Philp, B., & Wheatley, D. (2009). Economic Well-being and British Regions: The Problem with GDP Per Capita. *Review of Social Economy, 67*(4), pp. 483-505. Retrieved from http://www.jstor.org/stable/41288481
Hayes, P. (2005). Estimating UK regional price indices, 1974–96. *Regional Studies, 39*(3), p 11.
Hearne, D., & De Ruyter, A. (2019). *Regional Success After Brexit: The Need for New Measures* Bingley: Emerald.
Hill, R. J., & Syed, I. A. (2015). Improving International Comparisons of Prices at Basic Heading Level: An Application to the Asia-Pacific Region. *Review of Income and Wealth, 61*(3), pp. 515-539. doi:doi:10.1111/roiw.12116 Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/roiw.12116
International Labour Organisation. (2004). *Consumer Price Index Manual: Theory and Practice (2004)* Geneva: International Labour Organisation.
Janský, P., & Kolcunová, D. (2017). Regional differences in price levels across the European Union and their implications for its regional policy. [journal article]. *The Annals of Regional Science, 58*(3), pp. 641-660. doi:10.1007/s00168-017-0813-x Retrieved from https://doi.org/10.1007/s00168-017-0813-x
Johnston, R., McKinney, M., & Stark, T. (1996). Regional Price Level Variations and Real Household Incomes in the United Kingdom, 1979/80–1993. *Regional Studies, 30*(6), pp. 567-578. doi:10.1080/00343409612331349868 Retrieved from https://doi.org/10.1080/00343409612331349868
Jones, M. K., & Skilton, L. (2014). An Analysis of Labour Market Outcomes in the European Union Objective One Funding Area in Great Britain. *Regional Studies, 48*(7), pp. 1194-1211. doi:10.1080/00343404.2012.697992 Retrieved from https://doi.org/10.1080/00343404.2012.697992
Kocourek, A., Šimanov, J., & Šmída, J. (2016). Estimation of Regional Price Levels in the Districts of the Czech Republic. *Statistika: Statistics and Economy Journal, 96*(4), pp. 56-70. Retrieved from

https://www.ingentaconnect.com/content/doaj/0322788x/2016/00000096/00000004/art00004
Krugman, P. (2011). The New Economic Geography, Now Middle-aged. *Regional Studies, 45*(1), pp. 1-7. doi:10.1080/00343404.2011.537127 Retrieved from https://doi.org/10.1080/00343404.2011.537127
Laureti, T., & Rao, D. S. P. (2018). Measuring Spatial Price Level Differences within a Country: Current Status and Future Developments. *Estudios de economía aplicada, 36*(1), pp. 119-148.
Martin, R., & Tyler, P. (1994). Real Wage Rigidity at the Local Level in Great Britain. *Regional Studies, 28*(8), pp. 833-842. doi:10.1080/00343409412331348736 Retrieved from https://doi.org/10.1080/00343409412331348736
McCann, P. (2016). *The UK Regional-National Economic Problem: Geography, Globalisation and Governance* New York: Routledge.
Monras, J., & Albert, C. (2018). Immigrants' Residential Choices and Their Consequences. *CEPR Discussion Paper No. 12842*
Montero, J.-M., Laureti, T., Mínguez, R., & Fernández-Avilés, G. (2020). A Stochastic Model with Penalized Coefficients for Spatial Price Comparisons: An Application to Regional Price Indexes in Italy. *Review of Income and Wealth, n/a*(n/a)doi:10.1111/roiw.12422 Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/roiw.12422
Northern Ireland Housing Executive. (2017). Performance of the Private Rental Market in Northern Ireland: Research Report. Retrieved Date Accessed, 2020 from https://www.nihe.gov.uk/Working-With-Us/Research/Private-rented-sector-and-rents.
Office for National Statistics. (2011). UK Relative Regional Consumer Price levels for Goods and Services for 2010.
Office for National Statistics. (2016a). 2011 Census aggregate data. *Edition: June 2016*,
Office for National Statistics. (2016b). CPIH Compendium. Retrieved Date from https://www.ons.gov.uk/economy/inflationandpriceindices/articles/cpihcompendium/2016-10-13.
Office for National Statistics. (2018a). Regional household final consumption expenditure. Retrieved from https://www.ons.gov.uk/economy/regionalaccounts/grossdisposablehouseholdincome/datasets/regionalhouseholdfinalconsumptionexpenditure
Office for National Statistics. (2018b). *Relative regional consumer price levels of goods and services, UK: 2016*. https://www.ons.gov.uk/economy/inflationandpriceindices/articles/relativeregionalconsumerpricelevelsuk/2016/pdf
Office for National Statistics. (2019a). *Annual Survey of Hours and Earnings, 1997-2019* [Data set]. Retrieved from https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/bulletins/annualsurveyofhoursandearnings/2019
Office for National Statistics. (2019b). Consumer price inflation, UK: March 2019. Retrieved Date from https://www.ons.gov.uk/economy/inflationandpriceindices/bulletins/consumerpriceinflation/march2019.
Office for National Statistics. (2019c). Consumer price inflation, updating weights: Annex A, Tables W1 to W3. Retrieved from https://www.ons.gov.uk/economy/inflationandpriceindices/datasets/consumerpriceinflationupdatingweightsannexatablesw1tow3
Office for National Statistics. (2020a). Consumer trends time series. Retrieved from https://www.ons.gov.uk/economy/nationalaccounts/satelliteaccounts/datasets/consumertrends

Office for National Statistics. (2020b). Regional household final consumption expenditure, NUTS1 countries and regions. Retrieved from https://www.ons.gov.uk/economy/regionalaccounts/grossdisposablehouseholdincome/datasets/regionalhouseholdfinalconsumptionexpenditure

Omstedt, M. (2016). Reinforcing unevenness: post-crisis geography and the spatial selectivity of the state. *Regional Studies, Regional Science, 3*(1), pp. 99-113. doi:10.1080/21681376.2015.1116959 Retrieved from https://doi.org/10.1080/21681376.2015.1116959

Patacchini, E., & Rice, P. (2007). Geography and Economic Performance: Exploratory Spatial Data Analysis for Great Britain. *Regional Studies, 41*(4), pp. 489-508. doi:10.1080/00343400600928384 Retrieved from https://doi.org/10.1080/00343400600928384

Rao, D. S. P. (2013a). Computation of Basic Heading PPPs for Comparisons within and between Regions. In W. Bank (Ed.), *Measuring the Real Size of the World Economy* (pp. 93-120). Washington D.C.: World Bank.

Rao, D. S. P. (2013b). The Framework of the International Comparison Program. In W. Bank (Ed.), *Measuring the Real Size of the World Economy* (pp. 13-45). Washington D.C.: World Bank.

Rent Services Scotland. (2018). Private sector rent statistics: 2010 - 2018. Retrieved Date from https://www.gov.scot/publications/private-sector-rent-statistics-2010-2018/pages/15/.

Retail Prices Index Advisory Committee. (1971). *Proposals for retail prices indices for regions*. London: HMSO.

Ricardo, D. (1821). *The principles of political economy and taxation* ([3rd ed.] ed.) London: Empiricus Books.

Rienzo, C. (2017). Real wages, wage inequality and the regional cost-of-living in the UK *Empirical Economics, 52*(4), p 26.

Roberts, P., & Baker, M. (2006). Regions and regional identity. In I. Hardill, P. Benneworth, M. Baker & L. budd (Eds.), *The Rise of the English Regions?* London: Routledge.

Rodríguez-Pose, A. (2018). Commentary: The revenge of the places that don't matter (and what to do about it). *Cambridge Journal of Regions, Economy and Society*, pp. rsx024-rsx024. doi:10.1093/cjres/rsx024 Retrieved from http://dx.doi.org/10.1093/cjres/rsx024

Rokicki, B., & Hewings, G. J. D. (2019). Regional price deflators in Poland: evidence from NUTS-2 and NUTS-3 regions. *Spatial Economic Analysis, 14*(1), pp. 88-105. doi:10.1080/17421772.2018.1503705 Retrieved from https://doi.org/10.1080/17421772.2018.1503705

Scottish Government. (2017). Scottish Household Survey - Annual Report 2016 - LA Tables. Retrieved from https://www2.gov.scot/Topics/Statistics/16002/LAtables2016

Selvanathan, E. A., & Rao, D. S. P. (1994). *Index numbers : a stochastic approach* London: Macmillan.

Statistics for Wales. (2018). Private Sector Rents. Retrieved from https://statswales.gov.wales/Catalogue/Housing/Private-Sector-Rents

Valuation Office Agency. (2016). Understanding Local Housing Allowances rates and broad rental market areas. Retrieved Date from https://www.gov.uk/government/publications/understanding-local-housing-allowances-rates-broad-rental-market-areas.

Valuation Office Agency. (2017). Private rental market summary statistics: April 2016 to March 2017. Retrieved from https://www.gov.uk/government/statistics/private-rental-market-summary-statistics-april-2016-to-march-2017

Weinand, S., & von Auer, L. (2020). Anatomy of regional price differentials: evidence from micro-price data. *Spatial Economic Analysis*, pp. 1-28.

doi:10.1080/17421772.2020.1729998 Retrieved from https://doi.org/10.1080/17421772.2020.1729998

West, B., Richards, C., Thomas, F., Norris, F., Barnes, K., Carey, K., . . . Fenton, T. (2016). UK Regional Accounts Methodology Guide: Office for National Statistics.

Wingfield, D., Fenwick, D., & Smith, K. (2005). Relative regional consumer price levels in 2004. *Economic Trends, 615*, pp. 36-46.

World Bank. (2013). *Measuring the real size of the world's economy: the framework, methodology, and results of the International Comparison Program-ICP* Washington, DC: World Bank.