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EXTENDED ABSTRACT

Income Interdependence in the UK Multi-Regional Economy

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Abstract:
In recent years, there has been a growing awareness that interregional inequalities in the UK are not typical of other countries. The UK today is the most geographically unbalanced country among the OECD countries, with the highest Gini index from 2000 to 2016 and with this index growing through this period. These extreme interregional inequalities are a result of complex interrelationships between the effects of economic geography, modern production processes due to globalisation and issues of governance. This has led to the narratives of a UK economy with a picture of London versus the Rest of the regions. By means of an extended multiregional Input-Output model that endogenize household consumption and income, we explore the structural roots of these inequalities.

Consumer expenditures in the United Kingdom account for over 60% of Gross Domestic Product on the expenditure side, yet their impact on economic activity is often overshadowed by attention to technological change, value chain analysis and especially international trade. In this paper, a recently developed interregional model of the UK economy, SEIM (Socio-Economic Impact Model) will be used to provide some parallel perspectives to the role of interregional trade in goods and services by focusing on the interregional structure and impact of income and expenditures by households.

As an example of why it is important to account for household differences, urban and rural populations clearly differ in their lifestyles and, consequently, in their consumption patterns. According to the Living Costs and Food Survey data of 2017, while urban populations spend significantly more on Housing, Fuel and Power as well

as in Clothing and Footwear; rural households spend more on Transport. At the same time, urban regions depend on the primary products and energy produced in rural areas, while cities are mainly specialized in the provision of services. We can further control for differences in levels and sources of income, given divergences in rural and urban regions in terms of wage/salary, and asset-based income flows.

Divergent patterns of regional growth have long been noted in the United States. These divergences are regaining scholarly and popular attention more recently as divergences have become both clearer economically and have had significant political ramifications. The American 2016 presidential election was largely split along urban and rural lines, with the latter areas – which have outsized weight in the Electoral College system – voting strongly in favour of the winning candidate based on decades-long frustration with their increasingly lagging economic situations. Crystallizing research (e.g. Chetty et al., 2014; Chetty et al., 2018) is clearly demonstrating that the widening gap in wealth and income highlighted by Piketty's ground-breaking *Capital in the Twenty-First Century* monograph (Piketty and Goldhammer, 2014) at the individual level holds even more strongly at the regional level. These differences are particularly pronounced between rapidly-growing larger urban areas and economically stagnating rural regions, often literally bordering each other.

In this paper, we focus on the understudied consumption channel for such inter-regional growth prospects, leveraging the differences in consumption patterns and income sources between regions through and extended Input-Output (IO) model.

Methodology

Methodologically speaking, extended IO models provide an excellent systemic framework to understand how the income distribution work and why regional disparities are so difficult to counteract. This type of general equilibrium models shows a picture of the economy where richer and poorer households are endogenous, accounting for the interaction between the economic institutions and the industries involved in the production process. In this first approach, we close the circular flow of income regarding factorial income (Pyatt, 2001) to see how the system allocates the main direct, indirect and induced effects of the production process.

By means of a Miyazawa decomposition (Miyazawa, 1976; Miller and Blair, 2009), among other results, we are able to show the interrelational income multipliers, i.e. the total increase in the income of one group that results from expenditure of an additional unit of income by another group (Kim and Hewings, 2019). This relation between different household groups illustrates the income formation impacts across UK regions, providing a first look to the expected richer/poorer regions asymmetries (see Hewings et al. (2001) and Hewings and Parr (2007) for an example of the Chicago metropolitan area).

Miyazawa models (Miyazawa and Masegi, 1963; Miyazawa, 1976) address the problem of modeling the interactions between household categories among themselves and with the rest of the economy. As an alternative to the standard IO model, Miyazawa proposes to treat household consumption and their factor remuneration endogenously —i.e. not accounting for income transfers between institutions (Pyatt, 2001)—. That is, these activities are not assumed to be exogenous anymore, but are explained as a function of other variables. He thereby assumes that households can be sub-divided in *q* households groups by regions and that full information exists on workers consumption and payments patterns in each income group.

This leads to the expanded IO system

$$(1)\ \begin{pmatrix}\mathbf{x}\\ \mathbf{y}\end{pmatrix} = \begin{pmatrix}\mathbf{A} & \mathbf{C}\\ \mathbf{V} & \mathbf{0}\end{pmatrix}\begin{pmatrix}\mathbf{x}\\ \mathbf{y}\end{pmatrix} + \begin{pmatrix}\mathbf{f}^{*}\\ \mathbf{g}\end{pmatrix}$$

Here **x** again stands for the gross output vector, **y** is the vector of total income per income group, **f*** the vector of final demand excluding the *q* endogenized households categories, and **g** a vector of exogenous income (if any) for the income groups. Solving for $\begin{pmatrix}\mathbf{x}\\ \mathbf{y}\end{pmatrix}$ we have

$$(2)\ \begin{pmatrix}\mathbf{x}\\ \mathbf{y}\end{pmatrix} = \begin{pmatrix}\mathbf{I}-\mathbf{A} & -\mathbf{C}\\ -\mathbf{V} & \mathbf{I}\end{pmatrix}^{-1}\begin{pmatrix}\mathbf{f}^{*}\\ \mathbf{g}\end{pmatrix}$$

Again following Miyazawa decomposition, we now simplify the notation and write **L** = **VBC** and **K** = (**I** – **L**)$^{-1}$ = (**I** – **VBC**)$^{-1}$, where Miyazawa identifies **VBC** as the matrix of inter-income-group coefficients and the inverse (**I** – **VBC**)$^{-1}$ as the interrelational income multiplier matrix. This results in the familiar equation

$$(3)\ \begin{pmatrix}\mathbf{x}\\ \mathbf{y}\end{pmatrix} = \begin{pmatrix}\mathbf{B}(\mathbf{I}+\mathbf{CKVB}) & \mathbf{BCK}\\ \mathbf{KVB} & \mathbf{K}\end{pmatrix}\begin{pmatrix}\mathbf{f}^{*}\\ \mathbf{g}\end{pmatrix}$$

Compared to the standard IO model, the addition of the **BCKVB** component is a significant step towards further endogenization of an economy's main variables. The interpretation of the additional component is straightforward. Exogenous final demand will generate (through **B**) direct and indirect changes in production. The product **VB** provides the direct and indirect income that will be generated, and the product **CVB** tells us how that income is spent, via connections brought about by **K**, the interrelational income multiplier that indicates how income change in one household group will generate additional income in other groups. The total impact then is **BCKVB**. In this way, decomposing the Miyazawa approach provides a 'walk through the system', comparable to the $\mathbf{M}_3\mathbf{M}_2\mathbf{M}_1$ decomposition of SAMs by Pyatt and Round (1985).

Additionally, the **K** matrix shows very interesting insights on the relationships between the endogenous institutional sectors considered. In the previous literature, it has been used to present the income generation and distribution between households of different ages (Kim and Hewings, 2019), but also of different regions (Hewings et al., 2001; Hewings and Parr, 2007), revealing important asymmetries that otherwise would remain hidden.

Database

To perform our analysis we use the Socio-Economic Impact Model of the UK (SEIM-UK). The SEIM-UK is a MRIO model that covers 41 UK regions (NUTS2 classification) and 30 sectors. This model was built using information from the UK Supply and Use Tables (SUTs) for the year 2016. Hence, all estimations of the regional variables will be consistent with the national total for 2016. The sum of output and demand components by NUTS2 regions is equal to the total for the UK in the SUTs.

The SUTs and the regional UK information allow us to estimate regional weights for the MRIO margins (i.e. total primary inputs, imports and final demand) based on the most disaggregated information available from the Office for National Statistics (ONS). The constraint in the number of sectors considered in the SEIM-UK comes from the components of the value-added by industry (compensation of employees, gross operating surplus and mixed income) for NUTS2 regions.

For the inter-regional IO table, estimations are based on applying the relationships from UK national datasets to the NUTS2 level at a 68-industry level (from the Gross Value Added of the Regional Accounts (ONS)). When data is aggregated to 30 industries, the heterogeneity observed within industries across regions is mainly the result of different production and demand structures of industries within the 30 industry-level. In sum, sectoral mix and regional industrial specialisation will be the key element that would differentiate regional economic structures.

The Cross-Hauling Adjusted Regionalisation Method (CHARM) (Többen and Kronenberg, 2015) is used to construct the SEIM-UK model. Beyond the SUTs, other databases involved in the model development are: 1) the Regional Accounts (ONS) for the components of GVA, and for obtaining regional domestic output; 2) the Regional Household Final Consumption Expenditure, Regional Gross Disposable Household Income and Living Costs and Food Survey (LCFS) for the regional weights of the final consumption by region; 3) the Public Expenditure Statistical Analysis (PESA) released by HM Treasury for the public consumption by region; 4) the Regional Gross Fixed Capital Formation from ONS for the investment; and 5) HM Revenues and Customs information and the EUREGIO database for the exports and imports. The final adjustments to achieve global consistency have been made using the well-established RAS method (Bacharach, 1970; Stone, 1961).

Through this paper's analyses, this research will identify and empirically assess the potential sources of the interregional inequality trends in the UK through the generally-ignored channel of income interdependence differentiating consumption patterns and their implications for widening already-disparate economic prospects for richer and poorer regions. Preliminary, results show that, while the power of generate income is quite balanced along the UK regions; the spatial distribution of income recipients is quite asymmetric towards Inner London and the South East. These results illustrate how difficult it is to counteract interregional inequalities and why direct transfers to poorer regions can increase the disparities at the end.

These results should be of interest not only to scholars of regional inequalities, but also to policymakers' understanding of reinforcing causations for differing regional growth trajectories due to the potentially important implications of consumption patterns in determining longer-term economic prospects.

Keywords: *Input-Output model, income distribution, regional disparities, households*

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