Disaggregated Economic Accounts*

Asger Andersen Kilian Huber Niels Johannesen
Ludwig Straub Emil Toft Vestergaard

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Abstract

We develop a proof of concept for a system of disaggregated economic accounts. The system breaks down national accounting positions into bilateral flows between consistently defined groups of consumers ("consumer cells"), groups of producers ("producer cells"), the government, and the rest of the world. We disaggregate the full circular flow of money, including consumer spending, labor compensation, firm profits, trade in intermediates, foreign trade, and government transactions, while satisfying all national accounting identities. We implement the disaggregated system for small region-by-industry cells in Denmark and present stylized facts, including variation in domestic spending shares, local and urban bias in consumer spending, and a pattern of "triangular flows" across regions. Cell-level measures of "spending intensity" capture to what extent spending by a cell contributes to the income of cells experiencing unemployment after a shock. Using a general equilibrium model, we show that fiscal transfer programs are more effective in stimulating aggregate GDP when they target cells with high spending intensity on unemployed cells. Knowledge of the disaggregated economic accounts can thus help governments select more effective policies.

*Andersen (asger.lau.andersen@econ.ku.dk) is at the Center of Economic Behavior and Inequality (CEBI) at the University of Copenhagen. Huber (kilianhuber@uchicago.edu) is at the University of Chicago. Johannesen (niels.johannesen@sbs.ox.ac.uk) is at the University of Oxford. Straub (ludwigstraub@g.harvard.edu) is at Harvard University. Vestergaard (eth@nationalbanken.dk) is at Danmarks Nationalbank. We are grateful to Rodrigo Adão, Hassan Afrouzi, Pol Antràs, Robert Barro, Adrien Bilal, Vasco Carvalho, Raj Chetty, Gabriel Chodorow-Reich, Arnaud Costinot, Jonathan Dingel, John Friedman, Edward Glaeser, Sarah Griebel, Erik Hurst, Greg Kaplan, Alexandre Kohlhas, Marc Melitz, Brent Moulton, Holger Mueller, Andrés Rodríguez-Clare, Esteban Rossi-Hansberg, Andrei Shleifer, Mauricio Ulate, Jose P. Vasquez, Eric R. Young, and many seminar audiences for helpful comments. We thank Adam Sheridan for his contributions, Danske Bank for supporting the data work, and Amalie S. Jensen, Claus T. Kreiner, David D. Lassen, and Søren Leth-Petersen for sharing survey data. Agustín Barboza, Jan Ertl, Samuel Goldrup, Jonathan Hyatt, Jason Jia, Rodolfo Rigato, Pier-Giuseppe Sarzotti, and Samuel Zhao provided outstanding research assistance. Data processing of Danske Bank customer records was conducted by authorized Danske Bank personnel, following the bank's strict data privacy guidelines. All data have been anonymized and no individual customer can be traced in the data. We gratefully acknowledge funding from the Becker Friedman Institute, Danish Innovation Fund, Danish National Research Foundation, Domenic and Molly Ferrante, Economic Policy Research Network Denmark, Fama-Miller Center, Macro Finance Research Program, Washington Center for Equitable Growth, and William S. Fishman Fund. The activities of CEBI are financed by the Danish National Research Foundation Grant DNRF134.

I Introduction

National accounts, pioneered by Simon Kuznets and Richard Stone in the 1930s and 1940s, measure aggregate flows—most notably national consumption, income, and output—as well as input-output trade among producer industries. However, modern national accounts contain little disaggregated data on flows connecting smaller groups in the economy, for example, which consumers purchase goods from which producers and which producers pay income to which consumers. The absence of comprehensively disaggregated data limits our understanding of how shocks to individual producers and consumers propagate across the economy and affect aggregate outcomes.

In this paper, we develop a proof of concept for a full system of disaggregated economic accounts. The system breaks down key national accounting positions into bilateral flows among consistently defined groups of consumers ("consumer cells"), groups of producers ("producer cells"), the government, and the rest of the world. For each cell, the system reveals the sources of all inflows (e.g., which producer cells pay labor and profit income to each consumer cell) and the destinations of all outflows (e.g., which producer cells receive spending from each consumer cell).[1] Combining the new data with a general equilibrium model, we show that knowledge of the disaggregated economic accounts can help governments identify fiscal policies with high multipliers, thereby improving the cost effectiveness of government interventions.

Recent work has made substantial progress in creating disaggregated data beyond national accounts, including high-frequency trackers (Chetty et al. 2024), distributional accounts (Piketty et al. 2018), cross-region trade data (Giesecke and Madden 2013; Redding and Turner 2015; Caliendo et al. 2018; Rodríguez-Clare et al. 2025), and income flows (Card et al. 2013; Monte et al. 2018; Adão et al. 2022; Paweenawat and Townsend 2024). The disaggregated economic accounts studied in this paper build on existing work in three dimensions. First, we disaggregate all the positions that make up the classical circular flow of money (Lahn 1903) into bilateral flows between small groups, including consumer spending, labor income, profit income, and government transactions. This approach implies that researchers do not have to impose simplifying assumptions on parts of the circular flow when analyzing the propagation of shocks. Second, all individual flows add up to the corresponding national aggregates, thereby linking bilateral cell-to-cell flows to macroeconomic policy objects. Third, all accounting identities are satisfied at the level of individual cells (e.g., each cell's inflows equal its outflows) and for national aggregates, implying that the system is nationally comprehensive and internally consistent.

Measurement. We implement the system in Denmark using a range of data sources, including geo-coded transaction data from the largest bank in Denmark and government registers. We assign every Danish adult to one of 2,700 consumer cells based on their industry of main employment and

[1] Data are available at disaggregatedaccounts.com.

region of residence, and every Danish production establishment to one of 2,600 producer cells based on their industry and region. These cells are small, with the median consumer cell containing 658 adults and the median producer cell containing 47 establishments. We also include one cell each for the Danish government, the rest of the world, and transactions related to capital accumulation. The region-by-industry grouping is useful because, as we illustrate below, many flows vary strongly with geography and industry and many shocks, such as fiscal policy or trade tariffs, affect regions and industries heterogeneously.

We assemble an aggregate circular flow of money including all 36 positions from the production, income distribution, income redistribution, and use of income accounts of the standardized UN System of National Accounts. These positions make up the classical circular flow of money, including consumers spending on producers, producers paying labor and profit income to consumers, trade between domestic producers, foreign trade, and transactions with the government. We ensure that all national accounting identities hold at the aggregate level and at the level of individual cells (e.g., a consumer cell's income equals all expenditures plus saving).

We use two general approaches to disaggregating a national accounting position. A "bottom-up" approach uses microdata on individual flows (e.g., consumer payments to producer establishments) to calculate cell-to-cell flows. Alternatively, a "top-down" approach distributes an aggregate flow across cells using an assignment algorithm informed by microdata. We rely on the former approach for most positions and utilize the latter in a few cases.

Facts. We present stylized facts about disaggregated spending patterns. We first document that the share of consumer spending going to domestic producers, rather than abroad, ranges from 75% to almost 100% across consumer cells. The domestic spending share is higher for consumer cells in rural regions, those with high average age, and those with a low share of college-educated consumers. These consumer cells also spend disproportionately on nearby producers, rather than in more distant locations in Denmark. Consumer spending is characterized by mild assortative spending, so that consumers tend to spend on producer cells employing workers with similar characteristics to the consumers.

We subsequently focus on cross-region spending patterns that hold for all types of consumers. We find a pattern of "triangular flows" across regions. Spending by consumers and producers disproportionately flows from rural regions to large urban regions, driven by urban consumption amenities (Glaeser et al. 2001; Handbury and Weinstein 2015) and business services (Glaeser and Kohlhase 2004; Eckert 2019; Rossi-Hansberg et al. 2025). In turn, urban regions tend to spend more on foreign imports, partly driven by foreign travel, whereas foreign countries mainly spend on rural regions, largely driven by manufacturing exports.

To summarize differences across cells in the allocation of consumer spending, we construct measures of "spending intensity" at the level of consumer cells. These measures capture to what extent spending by a given consumer cell contributes to the income of a group of consumer cells. One can construct different measures of spending intensity that vary depending on which recipient cells are of interest, for example, whether the focus is on all cells in the same country ("spending intensity on domestic cells") or a subgroup of cells experiencing unemployment after a demand shock ("spending intensity on slack cells"). All measures of spending intensity take into account all higher-order connections in the disaggregated system. Differences across cells in spending intensity are solely driven by variation in how cells allocate their spending across other cells, that is, variation measured in the disaggregated system. Spending intensities tend to vary systematically across consumer cells. For instance, the spending intensity on domestic cells is larger for rural, old, and less college-educated cells. The patterns arise because the direct, first-order domestic spending share of these cells is higher and because the mild assortative spending implies that higher-order connections do not undo the first-order pattern.

Model. To understand whether the disaggregated economic accounts can matter for policymakers, we develop a general equilibrium model of an open macroeconomy, inspired by Acemoglu et al. (2012), Caliendo and Parro (2015), and Baqaee and Farhi (2019b, 2024). The model contains many domestic region-by-industry consumer and producer cells, foreign consumers and producers, and a government. It can be directly calibrated using the measured disaggregated economic accounts.

The aim of the model is to evaluate cell-level fiscal multipliers, that is, how fiscal transfers to a consumer cell affect aggregate output. We set up a model with New Keynesian nominal wage rigidities at the cell level, inspired by Rodríguez-Clare et al. (2025), so that we can study demand-driven recessions with unemployment. When a consumer cell experiences large declines in labor income, the wage rigidity binds and some workers in that cell become unemployed. We call a consumer cell experiencing such demand-driven unemployment "slack." Fiscal transfers are more effective at increasing aggregate output if they raise the demand for the labor supplied by slack consumer cells, thereby increasing the labor income and employment of slack cells.

Our approach of using a calibrated general equilibrium model to quantify shock propagation across regions and industries builds on a large literature (e.g., Nakamura and Steinsson 2014; Farhi and Werning 2016; Chodorow-Reich 2019; Beraja et al. 2019; Faber and Gaubert 2019; Liu 2019; Adão et al. 2020; Galle et al. 2023).[2] In comparison to this existing work, our model incorporates bilateral linkages between cells for all positions of the circular flow and uses the disaggregated system to calibrate the linkages. Our work also relates to an empirical literature using quasi-experimental techniques to estimate spillover effects across or within regions, but this work typically cannot

[2]Other related papers have investigated the macroeconomic effects of cross-industry and cross-regional trade among producers (Long Jr. and Plosser 1983; Horvath 2000; Jones 2011; Caliendo and Parro 2015; Baqaee and Farhi 2019a, 2020; Caliendo et al. 2019; Bigio and La'O 2020; Bachmann et al. 2024) as well as linkages in the presence of Keynesian frictions (Miyazawa 1976; Farhi and Werning 2014; Flynn, Patterson and Sturm 2024; Guerrieri, Lorenzoni, Straub and Werning 2021, 2022; Baqaee and Farhi 2022; La'O and Tahbaz-Salehi 2022; Woodford 2022; Rubbo 2023b). See Baqaee and Rubbo (2023) for a review.

identify all general equilibrium mechanisms that connect different cells (e.g., Greenstone et al. 2010; Huber 2018, 2023; Giroud and Mueller 2019; Aghion et al. 2024; Carvalho et al. 2021; Gabaix and Koijen 2024).

Fiscal Multipliers. Through the lens of the model, we analyze cell-level fiscal multipliers—the effect of transfers to one consumer cell on aggregate GDP—during recessions. We show analytically that the cell-level multipliers depend on a disaggregated factor demand matrix, which describes how income shocks to one cell affect the incomes of slack domestic cells.

Initially, we study an economy-wide recession where every consumer cell is slack. When we evaluate the model using the measured disaggregated economic accounts, we find a wide range of multipliers from below 1 to above 2. We show that a cell's multiplier in an economy-wide recession is closely linked to the cell's spending intensity on domestic cells. Intuitively, a greater domestic spending intensity means that domestic incomes increase by more when the cell's spending rises. Since every cell is slack, greater domestic incomes imply greater domestic employment and thus a higher GDP multiplier. Consistent with the role of domestic spending intensity, the multiplier is higher for old, rural, and less college-educated cells. We also find that cells with a higher multiplier are more likely to vote for right-wing populists and feel politically disenfranchised, according to survey data. The results suggest a distinct economic rationale for why transfers to "left behind" social groups (Autor et al. 2020; Rodrik 2021; Guriev and Papaioannou 2022) may be beneficial for the aggregate economy during recessions.

With the multipliers in hand, we score the effectiveness of actual transfer policies conducted by the Danish government in the past. We find multipliers to be high when transfers disproportionately reach consumer cells with high domestic spending intensity (e.g., the 2022 inflation relief targeting the rural and elderly), but low for other policies (e.g., the 2023 housing rent inflation support targeting urban and young consumers). If the Danish government wanted to raise GDP by 5%, it could save 0.4% of GDP by adopting the 2022 policy targeting cells with high domestic spending intensity instead of the 2023 policy targeting cells with low domestic spending intensity. In contrast, multipliers in a model calibrated using the standard national accounts are identical for every consumer cell because there is no heterogeneity in consumer spending. These findings suggest that the disaggregated economic accounts can help governments select more effective policies.

We also consider multipliers during a recession where only a subset of cells are slack. Motivated by the 2025 Greenland conflict and U.S. tariffs, we analyze a hypothetical recession in a subgroup of cells caused by higher tariffs on Danish products exported to the U.S. The direct exposure of producer cells to the shock varies substantially, depending on their export shares to the U.S. As a result, the U.S. tariff shock renders some consumer cells slack and others not. Consumer cells with high spending intensity on slack cells (whose spending raises the labor demand for slack cells) have high transfer multipliers after the U.S. tariff shock. Direct exposure to the shock or the individual slackness of cells does not explain much variation in the multiplier because cells with these characteristics do not necessarily contribute to the labor demand for slack cells. Hence, transfers to cells experiencing unemployment do not guarantee a high multiplier. Instead, a cell's spending intensity on slack cells—whether the cell contributes to the income of slack cells—largely determines the multiplier.

In our baseline analysis, we use an intentionally simple model with homogeneous propensities to consume and no dynamics. This approach allows us to analytically isolate the main mechanisms driven by disaggregated spending allocations. However, we show that the mechanisms are similarly important in a dynamic model aimed at more elaborate quantification, where consumer cells can save and have heterogeneous marginal propensities to consume (MPCs). We calibrate the dynamic model using newly estimated MPCs based on a 2009 Danish policy. The results suggest that MPCs and spending intensities are distinct and complementary determinants of multipliers. While a large literature has explored the role of MPCs (e.g., Kaplan et al. 2018; Auclert et al. 2024), including MPC variation in a disaggregated economy (Flynn et al. 2024), our focus lies on variation in the multiplier driven by disaggregated spending allocations.

We show that specific patterns in the disaggregated system, in particular related to consumer spending, determine the variation in multipliers. For instance, the multipliers are substantially different when we analyze hypothetical, counterfactual accounts with reversed stylized patterns and when we impose simplifying assumptions commonly made in the absence of disaggregated spending data (e.g., consumer spending only flows to local producers). We also decrease foreign trade shares and show that domestic spending intensity can play an important role in economies less open than Denmark. Finally, we show that the main findings are robust to different sets of substitution elasticities, ranging from relatively low elasticities (to capture short-run behavior) to relatively high elasticities (to capture long-run behavior).

Taken together, the findings imply that the disaggregated economic accounts can yield policy-relevant insights in economies with different structures, openness, and time horizons. Our analyses are a proof of concept that relies on existing micro data. Further measurement of disaggregated linkages, for example, surveys by statistical agencies and additional transaction data, may be worthwhile in light of the potential benefits to policy effectiveness implied by our findings.

Literature. The idea of the national economy as a set of bilateral flows among small cells with consistent accounting identities goes back to Richard Cantillon (1755) and François Quesnay (1758). However, modern national accounts, as standardized in the United Nations System of National Accounts (SNA, Stone 1961), only disaggregate flows between producer groups. There is currently no system of accounts that comprehensively measures bilateral consumption and income flows between disaggregated groups within a country.

Our system of disaggregated economic accounts is not the first to provide more disaggregated data than standard national accounts. Several existing innovations have made substantial progress. First, Chetty et al. (2024) develop high-frequency accounts for small groups of consumers and producers. Second, distributional national accounts document income and wealth across consumer groups (Saez and Zucman 2016; Piketty et al. 2018; Blanchet et al. 2021), including top wealth shares (Saez and Zucman 2022; Smith et al. 2023) and saving of the rich (Mian et al. 2021).

A third set of contributions constructs cross-region and international trade matrices (e.g., Leontief and Strout 1963; Caliendo and Parro 2015; Caliendo et al. 2019; Eckert 2019), often by combining data on cross-region shipments (e.g., the U.S. Commodity Flow Survey), international trade, input-output trade between producers, and regional labor or output shares. For instance, Rodríguez-Clare et al. (2025) measure industry-level trade across all U.S. region pairs, which inspires our approach to measuring disaggregated producer flows in Section III.C. Fourth, regional "social accounting matrices" also record cross-region trade among producers, often with the aim of informing computational general equilibrium (CGE) models (Reinert and Roland-Holst 1997; Giesecke and Madden 2013), but do not measure disaggregated consumer flows across or within regions.[3]

A fifth related literature uses government registers, often tax data, to measure income flows between producers and consumers (e.g., Card et al. 2013; Adão et al. 2022) and trade between producers (e.g., Huneeus 2018; Dhyne et al. 2021; Bernard et al. 2022). Paweenawat and Townsend (2024) describe how integrated financial accounts can improve analyses of inequality. Sixth, several contributions highlight that financial transaction data can improve our understanding of national consumption dynamics (Aladangady et al. 2022; Ehrlich et al. 2022; Buda et al. 2022), heterogeneous consumption responses to shocks (e.g., Baker 2018; Vavra 2021; Cox et al. 2020; Baker and Kueng 2022; Andersen et al. 2023), business entry and exit (Glaeser et al. 2022), spending patterns across space (Davis et al. 2019; Agarwal et al. 2020; Dunn and Gholizadeh 2020; Allen et al. 2023; Miyauchi et al. 2025), and living standards across regions (Diamond and Moretti 2024). Seventh, Gabaix (2011) highlights that granular patterns shape macroeconomic outcomes. Finally, recent work by Atkin et al. (2025) quantifies the heterogeneous incidence of distortions by measuring detailed bilateral transactions between individuals, firms, and the government in Chile.

The disaggregated economic accounts in this paper develop previous approaches further in three dimensions. First, we disaggregate the full circular flow of money, including all positions in the four opening accounts of the SNA, rather than focusing on a subset of national accounting positions. The disaggregation of the full circular flow and heterogeneity on both consumer and producer sides implies that the propagation of shocks can be studied without simplifying assumptions.[4] Second, the measurement is nationally comprehensive, so that the sum of disaggregated flows

[3]CGE models usually assume a representative consumer in each region who consumes only locally. In that sense, disaggregated economic accounts could serve as a more refined input into CGE models. See also Costinot and Rodríguez-Clare (2014) who compare CGE models to quantitative trade models.

[4]Commonly made assumptions in existing systems are that consumer spending flows only to local producers, across regions in proportion to producer trade, or with identical shares to producers, as described in Appendix W.B.

equals national aggregates and satisfies accounting identities within and across groups. This feature implies that the disaggregated economic accounts simultaneously match the levels of flows for each cell and the relative shares going from each cell to every other cell, which is not always the case for measurement systems based on cell-to-cell shares. Third, all accounting identities are satisfied at the level of individual cells and the national level, implying that the system is internally consistent.

II The Methodology of Disaggregated Economic Accounts

In this section, we describe three steps taken to develop our proof of concept for a system of disaggregated economic accounts: defining the level of disaggregation, assembling an aggregate circular flow, and applying either "top-down" or "bottom-up" disaggregation approaches.

II.A Defining the Level of Disaggregation

In the first step, we choose the level at which we will disaggregate the circular flow of money. Concretely, this means that we group all parts of the economy—including individual persons, firm establishments, and government divisions—into cells. In principle, one can pick the level of cells flexibly. The most extreme choice would be to define cells at the level of individual persons and establishments, although data availability would make this approach difficult to implement.

In our measurement in Denmark, we define many cells for domestic producers and many for domestic consumers, one cell for the Danish government, one cell for all capital accumulation transactions, and one cell for the rest of the world.

For consumer cells, we assign all Danish adults to cells based on their region of residence and the industry paying the largest share of their income. There are 2,744 domestic consumer cells in total. The cells are formed from the interaction of 98 regions, one for each of the Danish municipalities, and 28 industries (listed in Table A.I). The industry classification includes industries selling directly to consumers and producers (e.g., food away from home, grocery stores, airlines), non-consumer-facing industries selling to producers (e.g., wholesale, manufacturing), and four industries for the non-working parts of the population (retired, students, long-term unemployed, out of workforce).[5]

For producer cells, we assign firm establishments to 2,646 cells, based on their region and production industry. There are 24 producer industries paying labor compensation to consumers ("work industries") as well as three producer industries providing housing services without any employees (private landlords, owner-occupied housing, government-owned housing). The individual producer and consumer cells are small, with 658 adults in the median consumer cell and 47 establishments in the median producer cell.

[5]The long-term unemployed cell captures only individuals fully dependent on benefits without any labor income throughout the year. It is not meant to include workers in "slack" cells that become unemployed due to a temporary demand shock.

The region-by-industry breakdown is useful because, as we will illustrate below, many flows depend in important ways on geography (such as consumer spending) or industry (such as export shares). Moreover, many shocks, such as trade shocks or targeted fiscal policy, affect regions and industries heterogeneously. There is also a practical benefit to our cell definition, as we can observe region and industry across all underlying datasets. However, in general, it is not necessary to define the consumer and producer cells symmetrically. One could, for instance, choose a regional cut for consumers and an industry cut for producers. More generally, one could also define consumer cells by education, income, wealth, or other individual characteristics. These other characteristics may be useful for specific analyses, although they may also be less stable than region and industry.

We include one cell for the rest of the world, which represents all foreign consumers and producers, and one government cell, which represents the entire public sector and non-profit institutions serving households (NPISH). The government cell taxes consumers and producers and sends transfers and subsidies. It also purchases output from domestic government-operated producers (so-called "domestic government spending" or "government consumption") and from abroad ("government imports"), and provides this output to consumers free of charge or at low nominal fees ("consumption of government output"). Government-operated producers are primarily in healthcare, public administration, education, and national defense. We combine the government cell with NPISH, since both carry out similar activities and since the NPISH sector is very small. Finally, we include one capital accumulation cell, whose role we describe in Section II.B below.[6]

An important question when setting the level of disaggregation is whether consumer cells consist of individuals or households. It is difficult to draw the right boundaries of a household and to define consistent region and industry cells based on households, as household members may live in different regions (such as children supported by parents) and work in different main industries. By grouping individuals into cells, we circumvent these issues. One concern with an individual-level grouping is that there exist transfers between individuals (e.g., a parent supporting an adult child). Such transfers are recorded in the disaggregated economic account as transfers between disaggregated consumer cells and the capital accumulation cell. In future work, one could directly measure disaggregated transfers between household members (or, more generally, between any two individuals) as a separate disaggregated flow (as in Andersen et al. 2020). In this paper, we carry out several robustness checks showing that none of the facts and application results hinge on the way we treat transfers.

A similar issue applies to producers, where one could use establishments or firms to define producer cells. The establishment-level grouping is natural for the analysis of region and industry

[6]In the UN SNA, the government, NPISH, and household sectors are all simultaneously producers and consumers of output. In comparison, our disaggregated consumer cells do not produce output and our disaggregated producer cells include all producing establishments, including privately-owned businesses, government-owned firms (which sell output at market prices), and government-operated firms (which provide mostly non-market output to consumers, e.g., public administration).

cells, since establishments of one firm can belong to multiple regions and industries and since within-firm intermediates trade is already part of national input-output tables. In our system of disaggregated economic accounts, other types of within-firm transfers would appear as transfer flows between disaggregated producer cells and the capital accumulation cell, including transfers of internal capital (e.g., Matvos and Seru 2014; Biermann and Huber 2024), resources (e.g., Giroud and Mueller 2019), and technology (e.g., Giroud et al. 2024). In future work, one could measure such within-firm transfers in separate disaggregated datasets. Robustness checks below show that the facts and applications in this paper are not driven by the treatment of within-firm transfers.[7]

II.B Assembling an Aggregate Circular Flow

In the second step, we identify the national accounts positions that we want to disaggregate and assemble an aggregate circular flow of money for these positions. We build on the globally standardized definitions from the UN SNA. The SNA consists of a sequence of accounts, each of which contains one type of position. The first four accounts record national income and production; the subsequent accounts capture the accumulation and valuation of capital; and the final account measures foreign trade.

We disaggregate all positions found in the four opening accounts of the SNA: production, income distribution, income redistribution, and use of income, as well as foreign trade. We do not disaggregate transactions related to the accumulation and valuation of capital. Instead, we measure the saving of each disaggregated cell as a cell-level position vis-à-vis one aggregated capital accumulation cell for the whole economy. We make this choice because capital transactions are conceptually different: they capture changes in the balance sheets of disaggregated cells, rather than bilateral flows related to income, spending, and production. Moreover, disaggregating capital-related transactions requires a host of different micro data (e.g., individual-to-individual trades of financial assets). Just like the SNA, we differentiate between the finance industry, which we include as a producer cell selling financial services and advice, versus the capital accumulation cell, which records transactions related to the accumulation and ownership of capital for the entire economy.[8]

Overall, we disaggregate the 36 SNA positions listed in Table I. For each position, we identify which type of disaggregated cell originates the flow ("outflow from") and which receives the flow ("inflow to"). Constructing an aggregate circular flow requires manipulating some SNA positions. The SNA production account and the input-output tables generally report pre-tax values, for instance, for intermediates trade. In contrast, the use of income account reports tax-inclusive values,

[7] Some flows are originally recorded at the firm level, for example, taxes. In such cases, we use Danish institutional rules and proportionality assumptions to allocate the flows across establishments, as detailed in Section III.C.

[8] An extended system of disaggregated economic accounts could include multiple capital accumulation cells, one for each type of capital-accumulating institution (e.g., commercial versus investment banks) and for different producer cells trading investment goods with each other (vom Lehn and Winberry 2022). The SNA positions that we disaggregate allow us to inform a disaggregated business cycle model.

Table I: All flows in the Danish disaggregated economic accounts

	Disaggregated flow name	Related SNA code	Outflow from	Inflow to	Total value (bn DKK)
1	Domestic consumer spending	P.3[a]	Consumers	Producers	771.9
2	Foreign consumer spending	P.3[a,b]	Consumers	Rest of world	81.9
3	Consumer product taxes paid	D.21	Consumers	Government	173.2
4	Consumer non-product taxes paid	D.5	Consumers	Government	566.4
5	Consumer social contributions paid	D.61	Consumers	Government	181.1
6	Consumer interest paid	D.41	Consumers	Capital acc.	29.7
7	Consumer natural resource rents paid	D.45	Consumers	Capital acc.	3.4
8	Consumer other financial transfers paid	D.7	Consumers	Capital acc.	44.8
9	Consumer gross saving	B.8g	Consumers	Capital acc.	130.0
10	Labor compensation paid by domestic producers	D.1	Producers	Consumers	1,132.9
11	Mixed income from non-corporate producers	B.3g	Producers	Consumers	80.7
12	Surplus of corporate producers to consumers (dividends)	D.42	Producers	Consumers	38.4
13	Surplus of owner-occupied housing to consumers	B.2g	Producers	Consumers	83.3
14	Consumer social benefits received	D.62	Government	Consumers	422.2
15	Consumer adjustment for pension entitlements received	D.8	Government	Consumers	92.5
16	Consumer interest received	D.41	Capital acc.	Consumers	5.3
17	Consumer pension investment income	D.44	Capital acc.	Consumers	75.5
18	Consumer natural resource rents received	D.45	Capital acc.	Consumers	3.4
19	Consumer other transfers received	D.7	Capital acc.	Consumers	39.2
20	Labor compensation paid by foreign producers	D.1	Rest of world	Consumers	8.9
21	Domestic intermediates	P.2[c]	Producers	Producers	1,423.4
22	Dividends and surplus of government-owned/operated producers to government	D.42	Producers	Government	67.9
23	Producer product and import taxes paid	D.21	Producers	Government	71.9
24	Producer net production-related taxes	D.29 - D.39	Producers	Government	20.9
25	Producer taxes paid on income	D.5	Producers	Government	61.9
26	Producer net interest, transfers, and saving	(D.41 + D.43 + D.44+ D.7) [net outflow] + D.45 + B.8g - D.42 rec.+ D.42 to rest of world[b]	Producers	Capital acc.	409.9
27	Producer foreign imports	P.7[c]	Producers	Rest of world	792.3
28	Labor compensation paid to foreign workers	D.1	Producers	Rest of world	21.4
29	Domestic government spending	P.3[c]	Government	Producers	572.3
30	Domestic capital accumulation spending	P.1[c]	Capital acc.	Producers	359.5
31	Producer foreign exports	P.6[c]	Rest of world	Producers	1,077.9
32	Government imports	P.7[c]	Government	Rest of world	4.3
33	Government net interest, transfers, and saving	(D.41 + D.7) [net outflow] + B.8g - D.44 - D.45[d]	Government	Capital acc.	52.0
34	Capital accumulation cell imports	P.7[c]	Capital acc.	Rest of world	98.9
35	National net saving	P.6 - P.7[b]	Capital acc.	Rest of world	88.0
36	Consumption of government output	P.3	Provided free of charge to consumers		578.6

The table lists all the individual flows that make up the measured disaggregated economic accounts in Denmark. “Related SNA code” indicates the closest analog to the disaggregated flow in the UN SNA. “Total value” is the total in the Danish disaggregated economic accounts for 2018. Outflows/inflows are defined in terms of financial flows, so goods flow in the opposite direction. a: disaggregated flow excludes product taxes, unlike SNA (Section III.A). b: net-of-tax foreign consumer spending is greater in disaggregated flow than in SNA (Footnote 15 and Appendix Q). c: disaggregated flow is constructed by measuring output of consumer-facing producers in terms of sales, whereas SNA measures output using trade margins (Section III.C). d: disaggregated flow uses a different definition of government saving than SNA (Appendix Q).

for instance, for consumer spending. We represent all flows in pre-tax values, which requires calculating total taxes paid by different cell types.

We ensure that all accounting identities hold at the aggregate and cell level, that is, that all the inflows and outflows for every cell type exactly balance. The full T-tables are in Appendix B. To summarize, for consumer cell i and producer cell j,

$$\begin{aligned}
&\text{Domestic consumer spending}_i + \text{Foreign consumer spending}_i \\
&+ \text{Consumer taxes}_i + \text{Interest, transfers, and saving paid}_i \\
&= \text{Labor comp}_i + \text{Producer dividends, mixed inc, and surplus}_i \\
&+ \text{Government benefits}_i + \text{Interest and transfers rec}_i,
\end{aligned} \tag{1}$$

$$\begin{aligned}
&\text{Domestic intermediate spending}_j + \text{Labor comp}_j \\
&+ \text{Producer dividends, mixed inc, and surplus}_j + \text{Producer net interest, transfers, and saving}_j \\
&+ \text{Dividends and surplus of government producers}_j + \text{Producer net taxes}_j + \text{Imports}_j \\
&= \text{Domestic intermediate sales}_j + \text{Domestic consumer spending}_j \\
&+ \text{Domestic government spending}_j + \text{Domestic capital acc. spending}_j + \text{Exports}_j.
\end{aligned} \tag{2}$$

We include one cell for the Danish government,

$$\begin{aligned}
&\text{Domestic government spending} + \text{Government imports} \\
&+ \text{Government benefits} + \text{Government net interest, transfers, and saving} \\
&= \text{Consumer taxes} + \text{Producer net taxes} + \text{Dividends and surplus of government producers},
\end{aligned}$$

and one cell for the rest of the world,

$$\begin{aligned}
&\text{Foreign consumer spending} + \text{Producer imports} + \text{Government imports} \\
&+ \text{Capital acc imports} + \text{National net saving} + \text{Labor comp to foreign workers} \\
&= \text{Producer exports} + \text{Labor comp paid by foreign producers}.
\end{aligned}$$

Finally, we include one capital accumulation cell, which serves as the counter-party for all capital-related transactions of consumers, producers, and the government. Interest, resource rents, and financial transfers (e.g., accident relief in D.7) flow from the capital accumulation cell to consumers and producers. In return, saving by consumers and producers as well as payments for financial interest flow to the capital accumulation cell.[9] National net saving captures net outflows from the

[9]Investment transactions by consumers and producers, such as purchases of financial assets, housing, or productive machinery, are transactions within the capital accumulation cell.

capital accumulation cell to the rest of the world,

$$\begin{aligned}&\text{Consumer interest and transfers rec} + \text{Domestic capital acc spending}\\&+\text{Capital acc imports} + \text{National net saving}\\&=\text{Consumer interest, transfers, and saving} + \text{Producer net interest, transfers, and saving}\\&+\text{Government net interest, transfers, and saving.}\end{aligned}$$

II.C "Bottom-Up" and "Top-Down" Disaggregation Approaches

The goal of the measurement is to disaggregate the 36 SNA positions of Table I. Typical national accounts based on the SNA contain about 10,000 entries. In contrast, our disaggregated economic accounts in Denmark include around 43 million entries.

We employ two approaches to disaggregating a national accounting flow: "bottom-up" and "top-down." The bottom-up approach uses detailed microdata on individual transactions between consumers and producers, such as individual spending transactions. Adding up all transactions between two cells and, if appropriate, weighting to match the underlying population produces a cell-to-cell bilateral flow. The top-down approach decomposes an aggregate position into bilateral flows using an algorithm, which needs to be calibrated using economic parameters (e.g., the effect of distance on trade) and microdata on cell characteristics (e.g., total employment of cells). We discuss in the measurement section how researchers can estimate the necessary parameters and apply them in algorithms.

III Measurement of Disaggregated Economic Accounts in Denmark

We implement a measurement exercise for the Danish economy in 2018. We outline the main steps in this section and provide details as laid out in Appendix C. The disaggregated data are available at disaggregatedaccounts.com.

III.A Disaggregated Consumer Spending

The disaggregated consumer spending flows are the most novel parts of our measurement, since nationally representative data linking consumers and producers are not commonly available. We measure how much each consumer cell spends on every domestic producer cell and the rest of the world. The closest corresponding position in the UN SNA is P.3, which includes both consumer spending and product taxes (e.g., value added taxes). In contrast, disaggregated consumer spending and taxes appear in separate disaggregated flows. We take four steps to disaggregate consumer spending, detailed in Appendix E and building on recent work on cross-region spending (e.g., Agarwal et al. 2020; Dunn and Gholizadeh 2020; Aladangady et al. 2022).

Step 1: Bank transactions. The first step uses administrative transaction-level data from Danske Bank. The sample covers 20% of Danish consumers and is broadly representative in terms of age, income, and asset holdings (Table A.II). We infer consumers' home region from their address and their work industry from incoming salary payments. The data are available for all adults who held their main bank account at Danske Bank and conducted at least one spending transaction per month in 2018 and 2019.[10]

Crucially, the data allow us to identify the merchant establishments receiving payment for a wide range of transactions, including payments by credit and debit cards, direct debits, bank transfers to producers, and mobile applications. We observe transaction-level information on the merchant independent of whether the merchant is a Danske Bank customer or not. We extract the merchant's address and category code (MCC, indicating the type of merchant) from strings associated with transactions. We then develop a novel cross-walk between MCC and industry codes (ISIC/NACE), so that we can match the industry of the merchant to the industry codes used in the disaggregated income and trade flows. In a few cases, we do not observe merchants' region and/or industry, so we assign these transactions to merchants in proportion to the observed spending of the same consumer cell using the same means of payment.

We observe cash withdrawals but not the merchants receiving cash payments, so we assume that consumers spend cash withdrawals in proportion to in-person card payments (separately for withdrawals in Denmark and abroad). Cash withdrawals are only 7% of aggregate transaction value, so the patterns in the data are relatively insensitive to this assumption.

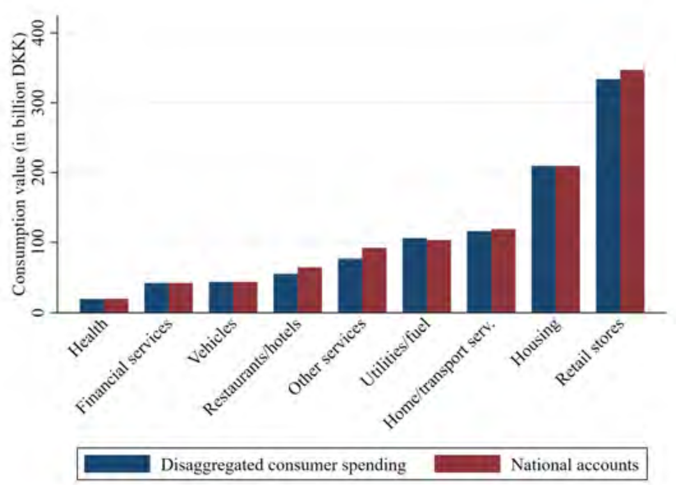
We mostly treat online spending the same way as in-person spending, so the region of online merchants refers to the distribution centers delivering the good. We make an exception to this general rule for online spending on a few subindustries where the delivery of goods or services is entirely in person (e.g., cinemas, hotels). For these industries, discussed in Appendix E.E, we assign online spending across regions using the regional distribution of in-person spending, which avoids errors due to the location of remote payment terminals. For the largest online merchants in each industry, we check by hand that the merchant addresses are indeed locations of relevant distribution centers.

As an additional accuracy check, we verify that the within-industry distribution of spending received by different regions is close to the within-industry share of labor compensation paid (Figure A.III). Hence, the disaggregated spending flows are assigned to regions where establishments actually produce goods and services. This finding implies that the disaggregated consumer spending flows are consistent with other disaggregated flows, in particular labor compensation and intermediates trade. In that sense, we trace the flow of money across producer establishments in a consistent way.

To complete the first step, we aggregate all spending transactions going from a consumer cell to

[10]Our aim is to measure the disaggregated economic accounts for 2018 and we use only 2018 data for most positions. The one exception is consumer spending, for which we use 2018 and 2019 in the sample to maximize observations.

Figure I: Consumer spending in the disaggregated accounts versus national accounts



The figure compares spending aggregated by receiving industry from the disaggregated spending flows with national accounts consumption data. Housing spending is constructed using a bottom-up approach for owner-occupied housing and a top-down approach for rented housing. Vehicles, financial services, and water and waste (part of utilities) are constructed using a top-down approach, so aggregates in the transaction data and national accounts match by construction. The remaining categories are constructed using a bottom-up approach, so there is no mechanical reason that these aggregates should match. For details, see Appendix E.

a producer cell and then scale up by each cell's ratio of consumers in the Danske Bank sample to the population.

Step 2: Spending outside bank transactions. In the second step, we use government data on purchases of housing, financial services, vehicles, and water and waste services. Spending on these four types of goods is not comprehensively observed in bank transactions, so we remove spending on merchants providing these goods from the bank data and instead measure such spending by combining government and bank data (see details in Appendix E.F). Notably, the government registers directly record the rental value of owner-occupied housing, interest expenses, and vehicle registrations for every individual.[11]

We compare the disaggregated consumer spending flows produced after the second step with national accounts personal consumption data from 2018. Both include product taxes paid. Spending patterns by industry are very similar (Figure I). It is not clear to what extent remaining differences reflect errors in the disaggregated flows or the national accounts, since both contain some statistical error due to sampling and assumptions.[12] Spending shares by consumer region in the disaggregated

[11]According to national accounting conventions, homeowners living in their own property rent to themselves, so that owner-occupied rents are simultaneously counted as consumer spending and rental income. In the disaggregated economic accounts, consumer cells transact with the producer cell "owner-occupied housing" to pay rent and receive income for their owner-occupied housing (see Appendix E.F.1).

[12]For instance, national accounts in part rely on retail sales indices to measure consumer spending, which requires

flows and the Danish household budget survey are also similar (Figure A.I). We additionally have access to a longer time series of aggregate card spending in the Danske Bank data, which evolves similarly to card spending recorded by Statistics Denmark (Figure A.II).

Step 3: Rescaling. In the third step, we scale every cell-to-cell spending observation by a common scaling factor, so that, in aggregate, our disaggregated consumer spending flows match national gross spending in 2018 (SNA P.3). Aggregate spending according to the unscaled disaggregated flows is 3% larger than the 2018 national accounts value, largely because we include both 2018 and 2019 in the bank data sample.

Step 4: Subtracting product taxes. In the fourth and final step, we measure product taxes paid by Danish consumers as part of their consumer spending (SNA D.21). National accounts data allow us to calculate the product tax rate paid on each industry's products as well as the import tax rate paid on products of foreign industries (details in Appendix F). We subtract product taxes from each gross consumer spending flow to produce the final disaggregated consumer spending flows.

III.B Disaggregated Consumer Outflows and Income

We detail the measurement of flows from consumers to the government in Appendix G and to the capital accumulation cell in Appendix H. Our methods build on existing work using government data to capture these types of flows (e.g., Adão et al. 2022; Blanchet et al. 2021).

As an example for a flow to the government, we observe individual income taxes in the government registers and use a bottom-up summation to calculate total taxes paid per cell (SNA D.5). The aggregate of the bottom-up summation is slightly lower than the national accounts aggregate, mostly because our sample contains only adults, so we scale each cell-level observation by a common scaling factor of 1.09 to match the national accounts aggregate exactly. By far the largest flow from consumers to the capital accumulation cell is financial interest paid, which we measure using individual-level interest payments reported in the government tax register (SNA D.41).[13]

We record different types of income paid to each consumer cell by each domestic producer cell and by foreign producers (details in Appendix J and Appendix I). For instance, we measure labor compensation flows bottom-up, drawing on the administrative tax and employment registers (SNA D.1). We scale each cell-level observation by 1.01 to match the national accounts aggregate, since we only sample adults and therefore slightly underestimate the national aggregate. Similarly, we record

assumptions on spending by foreigners. In contrast, we directly observe spending by Danes and can exclude spending by foreigners.

[13]The tax register contains the full nominal interest paid, which is composed of financial interest plus an implicit payment for the services provided by banks. In line with the national accounts, we assume that the ratio of financial interest to bank service payments is constant across consumer cells and equal to 0.58. This assumption allows us to back out the financial interest paid by each consumer from total interest payments.

mixed income bottom-up to capture the income of owners of privately owned, non-corporate firms (SNA B.3G), scaling each observation by a factor of 1.13. We observe individual-level operating surplus (SNA B.2G), which corresponds to the surplus of homeowners letting housing to themselves, in the government income register, exactly matching the aggregate. To assign dividends of Danish corporations (SNA D.42), we rely on individual-level data on dividend income and assume that all cells hold a diversified portfolio of Danish corporations.

Consumers receive income from the government through various benefit programs, which we measure bottom-up using government registers (SNA D.62, see Appendix K) and scaling by a factor of 1.03. We disaggregate flows received from the capital accumulation cell, such as interest (SNA D.41), using procedures analogous to the ones for interest paid (see Appendix L).

We also document consumer characteristics for each cell, including average debt and asset holdings (e.g., housing, cars, pensions, bank deposits, stocks, bonds), the share with college education, and the share doing manual/managerial/agricultural work, as described in Appendix M.

III.C Disaggregated Producer Flows

We measure trade in intermediate goods between each producer cell and every other domestic producer cell, net of product taxes (SNA P.2). Unlike for consumer spending, we do not have nationally representative microdata. Instead, we build on a top-down approach frequently used in spatial economics (e.g., Caliendo et al. 2019; Rodríguez-Clare et al. 2025), as detailed in Appendix N.

The approach employs a gravity model to convert the cross-industry table of intermediates trade, provided in the national accounts, to a region-by-industry matrix. We estimate how trade varies with distance separately for every combination of supplier and user industries, using data on 5 million producer-to-producer transactions from the business service provider CrediWire (see Figure A.V and Appendix N.B). We then apply an iterative algorithm that ensures the trade flows are consistent with the estimated distance elasticities and with the labor compensation shares of different regions within the same industry. We start the regional disaggregation procedure with 173 fine industries and then aggregate, so that the resulting trade flows contain substantial heterogeneity across cells.[14]

We observe firm-level micro data on the exports (SNA P.6) and imports (SNA P.7) of manufacturing firms and assign these to establishments using information on the labor compensation shares and occupations of workers (details in Appendix O, sales shares are not available at the region or establishment level). For non-manufacturing exports and imports, we rely on regional labor compensation shares within fine industries. We allocate spending by foreign consumers in Denmark using industry-level tourist purchases and regional hotel stays.

[14]We also face the challenge that national accounts do not report the sales value of goods sold by consumer-facing industries, but only “trade margins” (final value minus purchase value of goods). We convert the disaggregated intermediates trade flows so that they measure actual sales values for consumer-facing industries, thereby making it consistent with our consumer spending flows.

To disaggregate sales to the government ("domestic government spending," SNA P.3) and to the capital accumulation cell ("domestic capital accumulation spending," SNA P.1), we assume that a producer cell's share in the total sales of its industry to the government or capital accumulation equals its labor compensation share in the industry (at the level of 173 industries, details in Appendix N). We additionally measure dividends paid to the government using hand-collected data on government-owned corporations (SNA D.42, details in Appendix P).

For taxes paid (e.g., on value added, payroll) and subsidies received (e.g., agriculture support transfers) by producers, we allocate industry totals across producer cells using each cell's within-industry share in labor compensation paid (details in Appendix F). The only exception is income taxes, which we allocate in proportion to accounting income (sales minus intermediates minus labor compensation). Finally, we calculate the net of interest, transfers, and saving of each producer cell as the difference between total inflows and outflows of each cell (see Appendix Q).

We additionally measure the average characteristics of producers in each cell, including tangible and intangible assets, debt, accounts payable, equity, and turnover, as described in Appendix R.

III.D Remaining Government, Rest of the World, and Capital Accumulation Flows

The remaining flows include imports of the government and capital accumulation cells, which are directly reported in the national accounts, and government net interest, transfers, and saving, which we capture as the difference between all other government outflows and inflows (see Appendix Q). Finally, we define national net saving as the money entering Denmark due to its net exports and net labor compensation received from abroad.[15]

We also measure each consumer cell's consumption of government output by combining individual-level government and Danske Bank data (details in Appendix S). Since there are no financial flows associated with this consumption, it does not appear in the consumer account (Equation 1).

IV Stylized Facts on Disaggregated Flows in Denmark

The disaggregated economic accounts measure how every cell in the economy is connected to every other cell through different types of flows. In this section, we begin by visualizing the full circular flow of money, illustrating the rich variation in the data. Subsequently, we reduce the dimensionality of the data and present stylized facts about consumer spending.

The stylized facts illustrate variation across consumer cells in: (1) domestic spending, the share of consumer spending staying in the country; (2) gravity, the share of consumer spending going to nearby regions; and (3) urban bias, the share of consumer spending going to large regions. We also

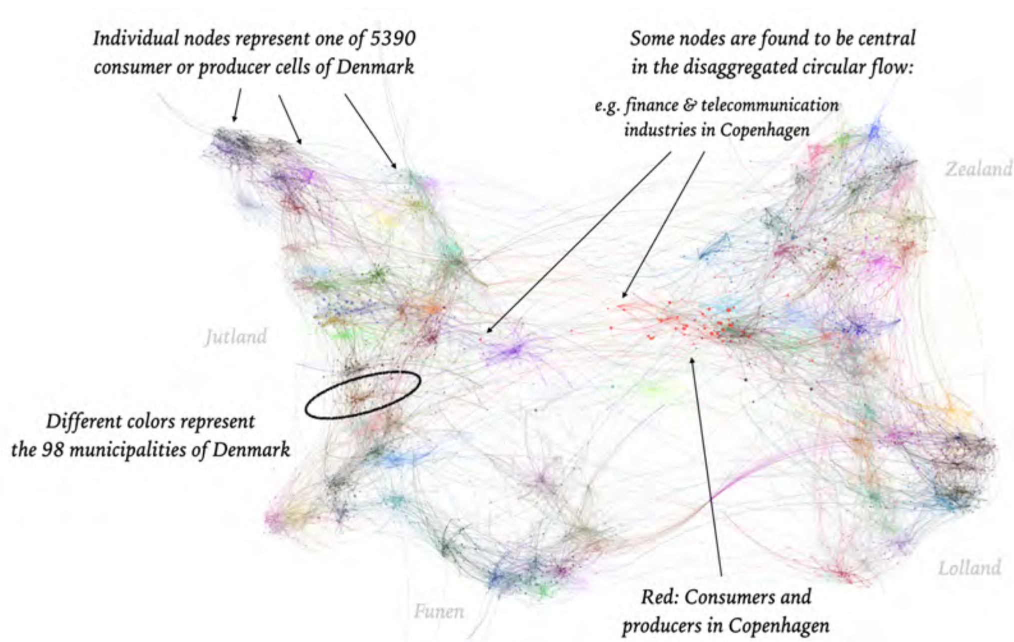
[15]Net national saving in our data is slightly below the national accounts trade balance (SNA P.6 - P.7) because the disaggregated spending flows imply higher foreign consumer spending (see Appendix Q).

document: (4) "assortative spending", the tendency of consumer spending to flow toward workers with similar characteristics; and (5) a pattern of triangular flows across urban regions, rural regions, and the rest of the world.

We end the section by presenting measures of "spending intensity." These measures capture to what extent spending by a given consumer cell contributes to the income of another set of cells, for example, all cells in the same country ("spending intensity on domestic cells") or a subgroup of cells with a given characteristic (e.g., "spending intensity on slack cells"). Measures of spending intensity take into account all higher-order connections in the disaggregated accounts and vary systematically across consumer cells. These facts are relevant for our applications in Section VI and VII, where we show that the effects of fiscal transfers on aggregate output depend on the spending patterns of the consumer cells receiving the transfers.

IV.A Visualizing the Disaggregated Circular Flow in Denmark

Figure II: The disaggregated circular flow of money



Nodes are all consumer and producer cells in Denmark. Nodes in the same region share the same color. The "ForceAtlas 2" algorithm arranges nodes nearby each other if the flows between the two nodes are large relative to the total flows of the nodes.

We visualize the full disaggregated circular flow of money in Figure II. Classical circular flows, inspired by Lahn (1903), Foster (1922), and Knight (1933), contain a handful of nodes for consumer and producer groups at the national level. In contrast, our disaggregated circular flow contains 5,390 nodes, one for each region-by-industry consumer and producer cell in Denmark. Nodes lying in the same region share the same color. Node size on the plot is proportional to a cell's economic size, measured as the square root of all inflows into the cell.

We visualize cell-to-cell flows by letting an algorithm ("ForceAtlas 2", Jacomy et al. 2014) arrange the nodes, so that two cells with large bilateral flows are located nearby each other. The algorithm draws a line between two cells if the sum of all flows between the two cells is large relative to the total flows of the source cell or the recipient cell.

Nodes in the same region (and of the same color) cluster together, even though we do not impose any restrictions on the arrangement. The shape of the graph resembles the geography of Denmark: the large cluster of nodes on the left is the continental western part of the country, the cluster at the bottom is the central island Funen (with major city Odense), and the large eastern island Zealand with the capital Copenhagen (red) lies on the right. However, there are notable deviations from the geography of Denmark. For example, all Copenhagen cells, especially the Copenhagen airline, shipping, telecommunications, insurance, and finance industries (red central nodes), sit much more centrally in the plot than the eastern location of Copenhagen would suggest, mirroring their central position in the disaggregated circular flow.

IV.B Domestic Share of Consumer Spending

We reduce the dimensionality of the data and present systematic patterns in consumer spending. To start, we find substantial variation in how much consumer cells spend on domestic producers, rather than abroad. We calculate the domestic consumer spending share of cell i as

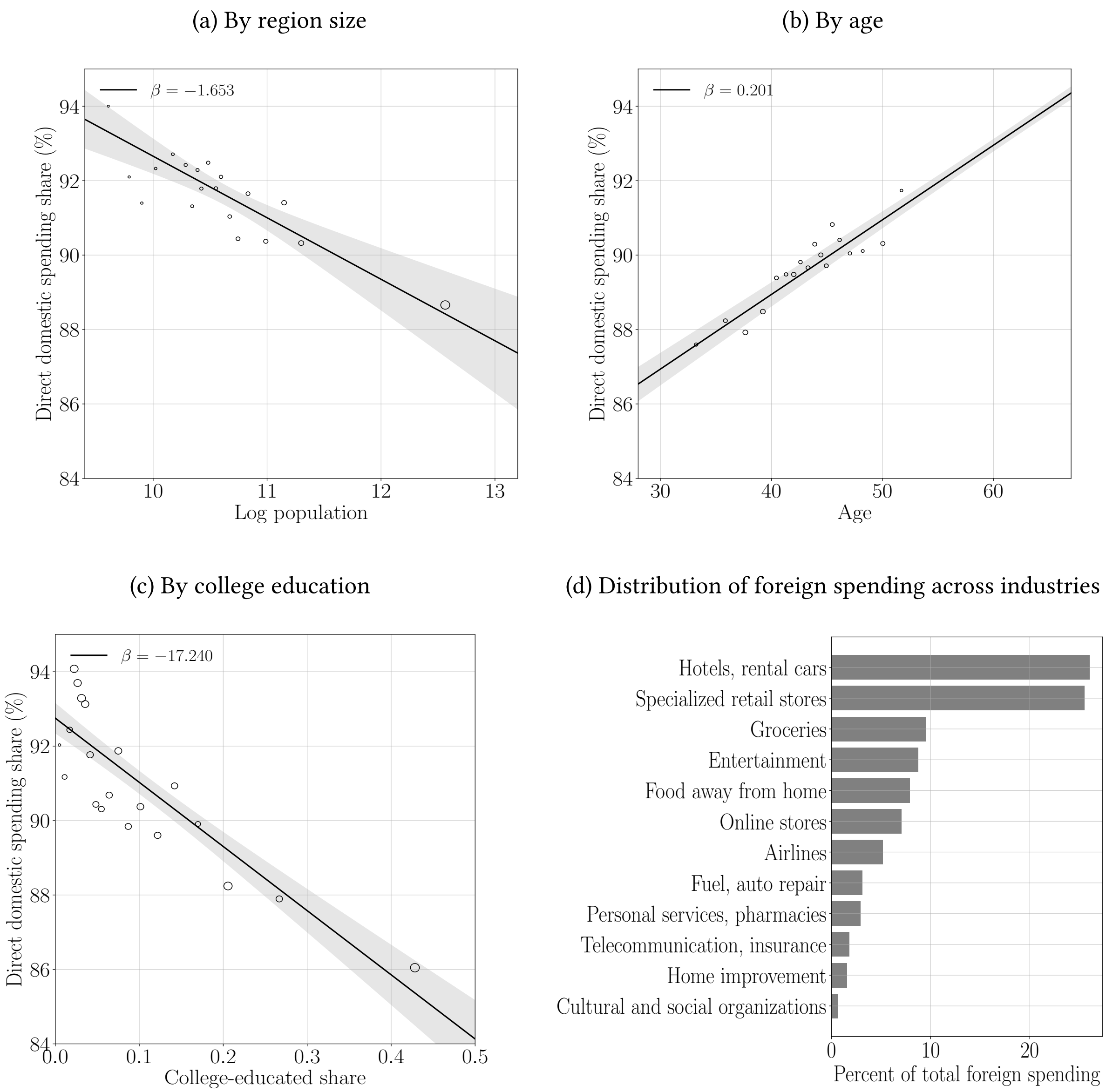
$$ShareDomestic_i = \sum_{j \in \mathcal{J}} \alpha_{ji}, \tag{3}$$

where α_{ji} equals consumer spending by consumer cell i on domestic producer cell j as a fraction of the total consumer spending of cell i. The set of domestic consumer cells is $\mathcal{I}$ (indexed by $i \in \mathcal{I}$) and the set of domestic producer cells is $\mathcal{J}$ (indexed by $j \in \mathcal{J}$). Equation (5) sums over domestic producer cells $\mathcal{J}$, but does not count spending on the rest of the world.

The domestic spending share of consumer cells ranges from 75% to almost 100% and averages 92%. It is greater for consumer cells in rural regions, those with high average age, and those with a low share of college-educated consumers, as shown in Panels a to c of Figure III. The three variables jointly explain around half of the total variation in domestic spending shares, as shown by the R^2 in Table A.III. We use low population size to identify rural regions, but the results are similar when we use low population density (Figure A.VI and Table A.III, column 2).[16] The majority of foreign

[16]Population size is a better proxy for urban regions than population density in Denmark because the municipal boundaries of some large cities also include much unpopulated hinterland, implying that the observed density of some regions containing a large city is relatively low. In contrast, regions with large size capture regions containing cities relatively well. The results throughout the paper are similar using population density instead of size.

Figure III: Domestic spending share and consumer cell characteristics



Panel a shows a binned scatter plot of the raw direct domestic spending share of a consumer cell against log population of the home region. Panel b shows a binned scatter plot of the raw direct domestic spending share of a consumer cell against the average age in the cell. Panel c shows a binned scatter plot of the raw direct domestic spending share of a consumer cell against the share of college-educated consumers in the cell. Panel d shows the percent of foreign spending by the foreign industry receiving the spending. The solid lines are the lines of best fit, estimated using the cell-level data. Each circle contains the same number of cells. The size of a circle is proportional to the population size of cells in the circle. The regressions are weighted by population in the consumer cell. Standard errors are clustered by consumer cell. The error bands are 95% confidence intervals.

spending goes to travel-related stores (e.g., hotels, rental cars, food away from home, airlines) and specialized stores (e.g., clothing, electronics), as shown in Figure IIId.

The associations between domestic spending shares and consumer characteristics are similar controlling for industry fixed effects and, in the case of age and education, controlling for region fixed effects (Table A.III, columns 3 and 4). Hence, even when comparing consumers within the same industry of employment and within the same region, there are substantial differences in domestic spending shares along the consumer characteristics. The results are also robust to controlling for distance to the closest border, average consumer income in the cell, and average asset positions in the cell, measured using leverage, liquid assets, and illiquid assets (columns 5 and 6). Conditional on size, age, and college share, there is no evidence that income and asset positions are significantly associated with domestic spending shares.[17]

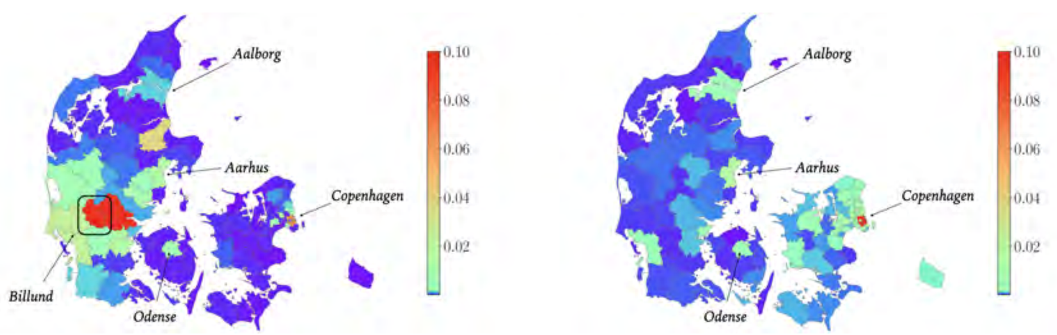
IV.C Gravity of Consumer Spending

We show the distribution of consumer spending across domestic regions for two examples of cells in Figure IV. The figures suggest that geographic distance is an important determinant of domestic consumer spending. On average, around half of a cell's consumer spending stays in the home region and an additional 10% goes to other regions whose center is within 25 kilometers of the home region.

Figure IV: Examples of spending shares across regions

(a) Manufacturing workers in Billund

(b) Restaurant workers in Copenhagen



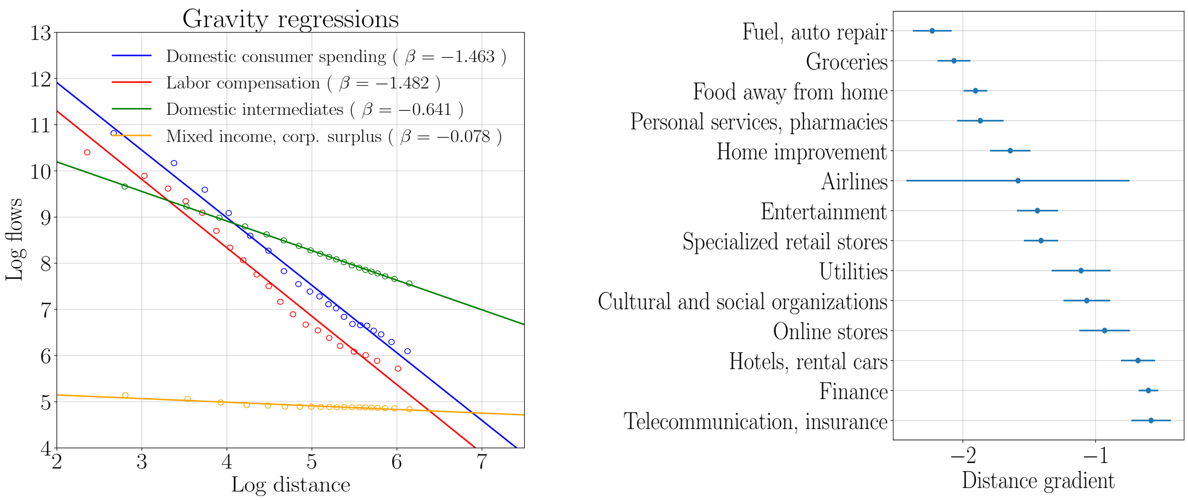
Note: The figure show the share of domestic spending received by producers in each region for spending by two consumer cells: manufacturing workers living in Billund, the location of the Lego headquarter (panel a), and restaurant workers living in the capital Copenhagen (panel b). The scale is truncated at the top at 10%.

[17] Existing work does not observe direct domestic and foreign spending shares. Our analysis complements recent work on the consumption of goods imported by producers (Borusyak and Jaravel 2021).

Figure V: Gravity equations

(a) Across types of flows

(b) Across receiving industries for consumer spending



Panel a shows binned scatter plots estimated separately for different flows using Equation (4). Flows on the vertical axis are in log DKK and capture the flow minus the estimated region and industry fixed effects. Distance on the horizontal axis is log driving time in Google Maps between region centers. We exclude observations with zero flows or zero distance. The solid line is the line of best fit, estimated using the cell-level data. Panel b uses only consumer spending flows. It plots the coefficient on log distance for each receiving industry. Each circle contains the same number of cells. The size of a circle is proportional to the population size of cells in the circle. The regressions are weighted by population in the consumer cell. The horizontal lines show 95% confidence intervals. Standard errors are two-way clustered by origin and destination cell.

Table II: Consumer spending gravity regressions

	(1)	(2)	(3)	(4)
	Log consumer spending			
Log distance	-1.33***	-1.49***	-1.35***	-1.43***
	(0.084)	(0.029)	(0.032)	(0.031)
Log distance * log population		0.17***		
		(0.012)		
Log distance * age			-0.0052*	
			(0.0028)	
Log distance * college share				1.39***
				(0.081)
Observations	2,262,078	2,262,078	2,262,078	2,262,078
Consumer FE	Yes	Yes	Yes	Yes
Producer FE	Yes	Yes	Yes	Yes
R^2	0.78	0.78	0.78	0.78

The table reports estimates of Equation (4). Consumer spending is in log DKK. Distance is log driving time in Google Maps between region centers. We exclude observations with zero flows or zero distance. The regressions are weighted by population in the consumer cell. Standard errors are two-way clustered by origin and destination cell. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

We formally estimate the effect of distance on spending using a standard gravity specification

$$\log\,\alpha_{ji} = \delta_i + \delta_j + \beta \times \log\,\text{distance}_{ji} + \epsilon_{ji}, \tag{4}$$

where the outcome is spending going from consumer cell i to producer cell j and distance between i and j is measured as driving time in Google Maps. The fixed effects control for size and other determinants of total spending entering or leaving a cell. The relation between log spending and log distance is close to linear with a gradient of -1.5, as shown in Figure Va. The distance gradient is similar for labor compensation (Monte et al. 2018), but shallower for intermediates trade as well as mixed and surplus (i.e., profit) income. Figure Vb shows that the consumer spending gradient varies substantially by type of good. The gradient is steep for spending on fuel and groceries, which often involves in-person card payments, consistent with the analysis of card spending by Agarwal et al. (2020). In contrast, the gradient is shallow for spending on telecommunication and insurance, which is often conducted remotely via bank transfers, and for spending on hotels and rental cars.

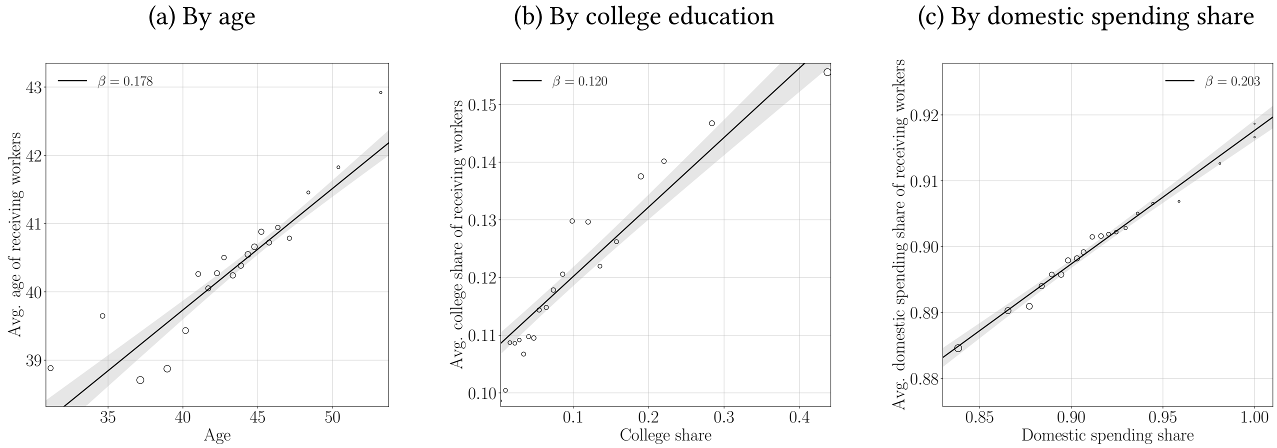
The extent of local spending varies with consumer characteristics. Rural, old, and less college-educated consumers spend locally to a larger extent, as shown in Table II. For example, the positive interaction coefficients for population size and college share imply that distance matters more for consumers in small, rural regions and with low college share, so these consumers spend more locally. In addition, the negative interaction coefficient for age implies that distance matters more for older consumers. Taken together, the stylized facts presented so far imply that the spending of rural, old, and less college-educated consumers is more likely to reach cells in the home country and in nearby locations.

IV.D Assortative Consumer Spending

We find evidence for mild "assortative spending" in Figure VIa: consumer cells tend to spend on producer cells whose workers have similar characteristics as the consumers. For instance, consumer age is positively associated with the average age of workers employed in producer cells receiving the consumer cell's spending. Similarly, college education shares of consumers and receiving workers are positively correlated, as are domestic spending shares of consumers and receiving workers.

The slopes are far below one, as most consumers purchase from a wide range of producer cells and therefore the measures for receiving workers are weighted averages over a wide range of worker characteristics. Nonetheless, the mild assortative spending matters because it implies that spending by consumers with a given characteristic does not disproportionately contribute to the income of workers with the opposite characteristic. As a result, higher-order connections mildly enforce the spending patterns of a given group of consumers, which is relevant for the propagation of shocks through the disaggregated system.

Figure VI: Assortative consumer spending



The panels show binned scatter plots of a characteristic of workers in the producer cells that receive spending from a consumer cell, weighted by the spending going from the consumer cell to the producer cell, against the same characteristic of the consumer cell. The characteristic in panel a is average age of workers in the producer cell and of consumers in the consumer cell. In panel b, the characteristic is the share of workers with a college degree and in panel c, the characteristic is the domestic spending share. The samples include only consumer cells whose main employment is in an industry producing output, so we exclude out of the workforce, retired, and students. The detailed construction of the figure is as described in Figure III.

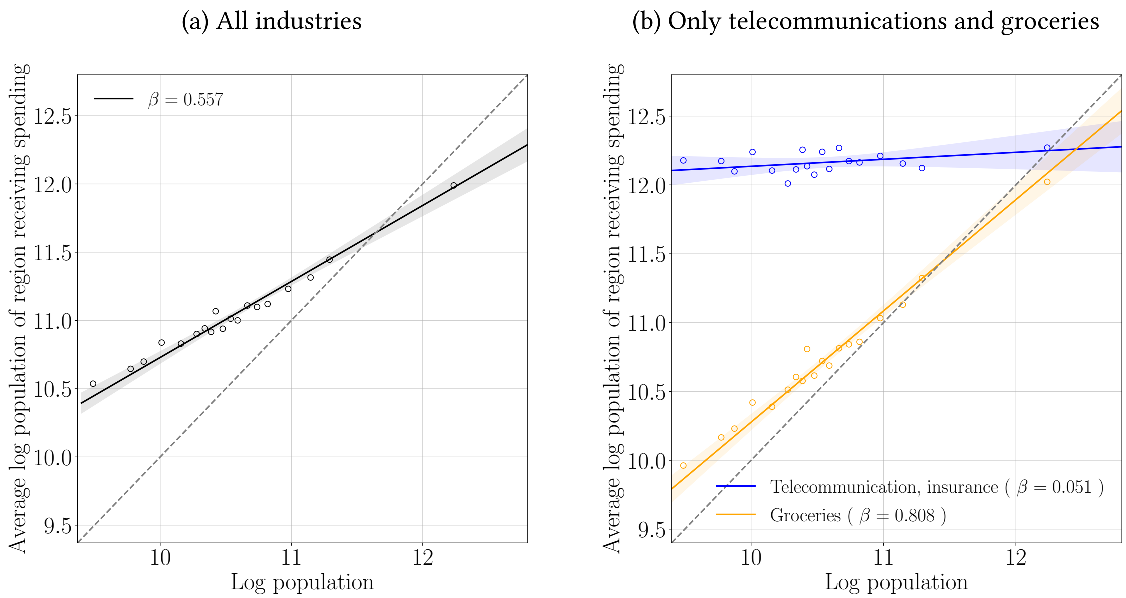
IV.E Urban Bias of Consumer Spending

The two maps in Figure IV suggest that consumer spending disproportionately flows from rural regions, such as Billund, to large cities, such as Aalborg, Aarhus, Copenhagen, and Odense. Cities receive more than they buy: the share of national consumer spending received by the 15 largest regions is 34%, whereas the share of national spending coming from consumers living in these regions is only 27%. Consistent with urban bias in consumer spending, Figure VIIa shows that the average size of producer cells receiving spending is almost always greater than the size of the consumer home region (i.e., most points lie above the 45 degree line).

Urban bias does not exist for everyday purchases, such as groceries, but is stronger for remotely-purchased services, such as telecommunication, and for irregular purchases, such as specialized retail, as shown in Figures VIIb and A.IXa.[18] We find similar patterns of urban bias when analyzing only in-person spending in Figures A.VII and A.VIII, suggesting that rural consumers also disproportionately travel to urban regions to spend. Urban regions attract spending from nearby and far away, so distance matters less for inflows into urban regions. In that sense, urban bias represents a statistically and economically significant deviation from the gravity equation, as reported in Table A.IV.

[18] Glaeser et al. (2001) emphasize that households permanently relocate to cities as a consequence of urban consumption possibilities. Our findings additionally suggest that consumers living in rural regions disproportionately spend in cities, likely by visiting multiple urban producers on a single in-person trip (Shoag and Veuger 2018; Miyauchi et al. 2025) and by purchasing from urban producers remotely.

Figure VII: Population of home region and region receiving consumer spending



The panels show binned scatter plots of the average log population of regions receiving consumer spending, weighted by the spending going from the consumer cell to the producer cell, against the log population in the region of the consumer cell. Panel a includes total consumer spending. Panel b includes only spending on telecommunication and insurance (flatter line) and on groceries (steeper line). The detailed construction of the figure is as described in Figure III.

IV.F Triangular Flows Across Regions

Having documented patterns in consumer spending across regions, we investigate other flows across regions. To this end, we combine the disaggregated flows into six broad categories at the region level. We plot these regional flows normalized by GDP against region size in Figure VIII. As just discussed, domestic consumer spending flows on net from small rural toward large urban regions, leading to a greater internal trade surplus on final goods in urban regions. In addition, spending on intermediates also flows on net from rural toward urban regions, implying that urban producers have a greater internal intermediate trade surplus than rural producers (e.g., due to sales of consulting and financial services, as shown in Figure A.IXb).[19]

In contrast, rural regions receive greater inflows from the rest of the world, implying that net foreign exports are larger in rural regions.[20] Rural regions export more than they import because Danish manufacturers often produce outside cities (e.g., Novo Nordisk produces pharmaceuticals in Kalundborg and Vestas produces wind turbines in Nakskov). Payments to labor and capital owners

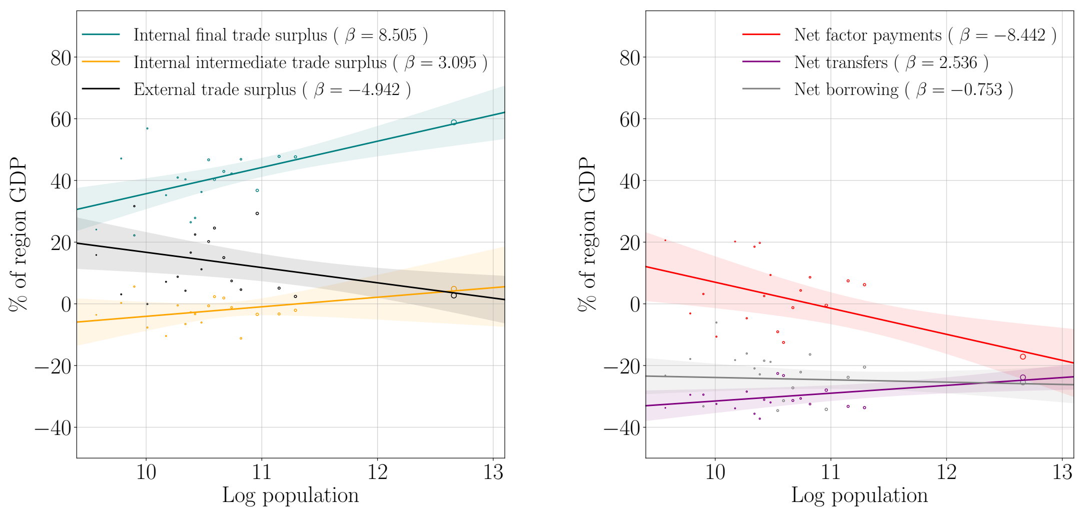
[19]The internal trade surpluses do not average out to zero in Figure VIII because the trade surpluses include spending by the capital accumulation and government cells. Since those two cells do not have a region assigned to them, their negative internal surpluses do not appear in Figure VIII.

[20]The external and internal trade surpluses show the same pattern when not normalized by GDP, as documented in Tables A.VI and A.VII.

Figure VIII: Regional balance of payments

(a) Internal and foreign trade surplus

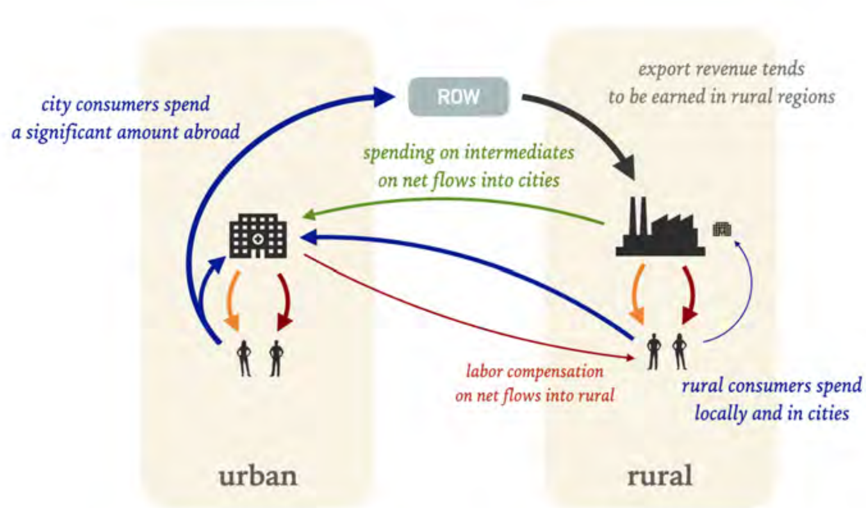
(b) Factor payments, transfers, and borrowing



The panels show the five components of the regional balance of payments, normalized by regional GDP. The five components are: internal final trade surplus (net revenue from sales to domestic consumers, the government, and the capital accumulation cell); internal intermediate trade surplus (net revenue from sales to domestic producers); external trade surplus (producer exports − producer imports − foreign consumer spending); net factor payments (net receipts of labor compensation, producer dividends, mixed income, surplus, natural resources rents); net transfers (net receipts of social benefits − payments for taxes and social contributions); net borrowing (negative of interest, transfers, and saving by consumers and producers). The five components add up to zero for each region. We compute regional GDP as total production value net of domestic and foreign intermediate purchases. Each circle contains the same number of regions. The size of a circle is proportional to the population size of regions in the circle. Weights are regional GDP. The shaded areas represent 95% robust confidence intervals.

are slightly larger in rural regions (on net), as consumers living in rural regions tend to commute to urban regions. Net government transfers and net borrowing are similar in rural and urban regions.

Figure IX: Stylized overview of triangular flows across regions



The figure plots a stylized overview of the flows connecting urban regions, rural regions, and the rest of the world, based on the facts presented in Sections IV.B, IV.C, IV.E, and IV.F.

Taken together, the patterns across rural and urban regions suggest a triangular flow, as stylized in Figure IX. Inflows from abroad are largest in rural regions, contributing to rural consumers' income. Consumer spending and intermediates trade expenditures flow from rural regions toward urban regions where they contribute to the income of urban consumers. Finally, urban consumers spend a relatively large share of income abroad.

IV.G Measures of Spending Intensity

The stylized facts reveal substantial heterogeneity in how consumer cells allocate their spending. We construct cell-level measures of "spending intensity," which capture, in an accounting sense, to what extent spending by a consumer cell contributes to the income of a given group of consumer cells. Spending intensities summarize the spending allocations of a consumer cell in one, easy-to-calculate statistic. They are intuitively linked to policy-relevant objects, such as the aggregate multiplier of fiscal transfers, in a range of model formulations, as we show in subsequent sections.

We begin by measuring a "spending intensity on domestic cells," which captures how strongly spending by cell i contributes to the income of cells in the same country as opposed to leaving the country. The raw domestic spending share of a cell (as analyzed in Section IV.B) does not fully capture this concept because it takes into account only first-order, direct spending on domestic producers. Instead, we also need to incorporate higher-order connections to understand the full contribution to domestic incomes. For example, to what extent do the producer cells receiving spending in the first round contribute to domestic incomes? Following on, to what extent do these second-round recipients spend domestically, and so on?[21]

We define the domestic spending intensity of consumer cell i recursively, by considering the spending behavior of all the producer cells j receiving i's spending:

$$IntensityDomestic_i = \sum_{j \in \mathcal{J}} \left[\alpha_{ji} \times IntensityDomestic_j \right]. \tag{5}$$

The consumer spending share α_{ji} equals the share of cell i's total consumer spending going to producer cell j, as introduced in Equation (3). The equation implies that direct spending on a domestic producer with zero domestic intensity (e.g., a producer sending all of its sales revenue abroad in exchange for foreign intermediates) does not contribute to cell i's domestic spending intensity because such spending does not reach any domestic consumer's income. In contrast, spending on a producer that passes some of its sales revenue to domestic consumers (through labor or profit income) contributes to i's domestic spending intensity.

The potential recipients of outflows from cell j are defined in the accounting identity for cell j in Equation (2). To ease notation and without loss of generality, we can rewrite the accounting identity in terms of shares of outflows to potential recipient cells, the recipient cells' domestic spending intensity, and proportional tax rates, where the tax rates capture all types of taxes paid by a cell in one term:

$$\begin{aligned} IntensityDomestic_j = & \sum_{i \in \mathcal{I}} \left[\lambda_{ij} \times (1 + IntensityDomestic_i \times (1 - \tau_i)) \right] \\ & + \sum_{i \in \mathcal{I}} \left[\gamma_j \times \kappa_{ij} \times (1 - \tau_j) \times (1 + IntensityDomestic_i \times (1 - \tau_i)) \right] \\ & + \sum_{j' \in \mathcal{J}} \left[\omega_{j'j} \times IntensityDomestic_{j'} \right]. \end{aligned} \tag{6}$$

The first line in Equation (6) captures labor compensation flows. The share λ_{ij} equals labor compensation paid by producer cell j to consumer cell i as a fraction of the total costs of cell j (where total costs are payments to labor, owners, and intermediates). The labor compensation received by cell i contributes fully to the income of cell i, so a 1 appears in the equation. In addition, the labor compensation reaching cell i may subsequently get spent and reach other domestic consumers, depending on cell i's domestic spending intensity and how much is left after i pays taxes on its income. Hence, an additional term gets added, the domestic intensity of cell i multiplied

[21] Consider a simple example of a hypothetical three-cell economy. Consumer cell A spends only on domestic producer cell B. In turn, domestic producer cell B spends all of its revenue on income to consumer cell C, whereas cell C spends all its income on goods from abroad. In this economy, cell A and cell B would have a domestic spending intensity of 1, since their spending fully contributes to the income of exactly one domestic consumer cell. In contrast, cell C would have a domestic spending intensity of 0, since its spending contributes to the income of zero domestic cells.

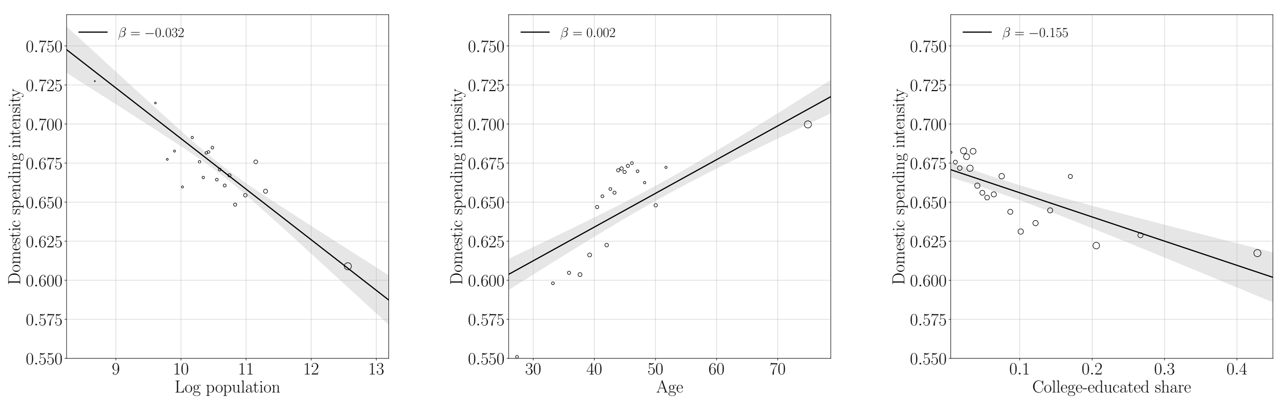
by the net-of-consumer tax rate $1 - \tau_i$.

The second line in Equation (6) analogously captures which consumer cells receive profit income (dividends, mixed income, surplus) paid by cell j, where γ_j is the profit share of cell j as a fraction of total costs and κ_{ij} equals profit income paid by cell j to cell i as a fraction of the profits of cell j. Cell j pays a proportional tax rate τ_j on its profits, implying that the profit payout needs to be multiplied by the net-of-tax rate $1 - \tau_j$ to arrive at the amount that gets paid to firm owners. Finally, the third line captures intermediates trade, where $\omega_{j'j}$ equals payments for intermediates from producer cell j to producer cell j' as a fraction of the costs of cell j. By combining Equations (5) and (6), we can solve for the domestic spending intensity of each consumer cell.[22]

The domestic spending intensity of consumer cells varies systematically with consumer characteristics.[23] It is larger for rural, old, and less college-educated cells, as shown in Figure X. These patterns exist because the direct, first-order domestic spending shares of rural, old, and less college-educated consumers are higher and because there is mild assortative spending, so that higher-order connections do not undo the first-order pattern.

Figure X: Domestic spending intensity and consumer cell characteristics

(a) By region size (b) By age (c) By college education



Panel a shows a binned scatter plot of domestic spending intensity against log population of the cell's region. Panel b shows a binned scatter plot of domestic spending intensity against the average age in the cell. Panel c shows a binned scatter plot of domestic spending intensity against the share of college-educated consumers in the cell. The solid lines are the lines of best fit, estimated using the cell-level data. The detailed construction of the figure is as described in Figure III.

[22]Our domestic spending intensity is related to "upstreamness" as in Antràs et al. (2012) but tailored to consumer spending and the disaggregated circular flow instead of producer input-output tables.

[23]The average domestic spending intensity ranges from roughly 0.4 to 0.9, as plotted in Figure A.X. The values are below 1 for three reasons: consumer cells directly allocate part of their spending to foreign producers, domestic producers receiving spending also allocate part of their intermediates spending to foreign producers, and outflows to the government in the form of taxes do not contribute to other domestic consumer cells' income in our definition of spending intensity. These three reasons also explain why a cell's domestic spending intensity can be below its direct domestic spending share.

In addition to the domestic spending intensity, one can construct alternative measures of spending intensity with respect to subgroups of cells. For example, policymakers may observe high unemployment in a subset of consumer cells following a demand shock, suggesting that these labor markets are "slack." A shock-specific "spending intensity on slack cells" can then capture to what extent spending by a consumer cell contributes to the incomes of consumers in high-unemployment cells. To define such a measure, we simply replace the "1" in (6) by an indicator $1_{\{i \in \text{group}\}}$ that is equal to 1 precisely when consumer cell i's labor supply is slack. We analyze such a case in Section VII where some cells experience demand-driven unemployment due to U.S. tariffs on Danish products.

In our definition in Equations (5) and (6), only flows between consumer cells and producer cells contribute to spending intensities. Of course, the disaggregated economic accounts also measure flows to the government and the capital accumulation cell. These flows could in principle be allowed to contribute to spending intensities, under various potential assumptions on how these flows reach consumer cells. We have experimented with various definitions and found that they all have similar properties.

V Baseline Theoretical Model

Having measured the disaggregated economic accounts and documented stylized facts, we now analyze whether the disaggregated data can be useful for policy. In this section, we develop a model that can be used to evaluate how fiscal transfers to different consumer cells affect aggregate output. The model largely matches the structure of the disaggregated economic accounts and can be calibrated using the new data. We set up a model with New Keynesian nominal rigidities, so that we can study fiscal transfers during demand-driven recessions with unemployment. The model in this section is intentionally simplified (e.g., it is static). This approach allows us to present analytical results on the main mechanism: how disaggregated spending patterns shape fiscal multipliers.

In the subsequent sections, we use the model to evaluate fiscal policies by calculating the multiplier of transfers targeted at different consumer cells. We focus on transfers during an economy-wide recession in Section VI and during a recession with heterogeneous incidence across cells in Section VII. In Section VIII, we extend the model by making it dynamic, incorporating consumer saving and heterogeneous marginal propensities to consume, which allows for more elaborate quantification.

V.A Overview

We model a small open economy composed of region-by-industry consumer and producer cells. The cells are linked via bilateral flows, such as consumer spending, labor compensation, profit income, and intermediates trade. The region-by-industry cells also transact with the government and the rest of the world. The model builds on existing work modeling disaggregated economies, among others by Acemoglu et al. (2012), Caliendo and Parro (2015), Baqaee and Farhi (2019b), and Rodríguez-Clare et al. (2025).

There exists a set $\mathcal{I}$ of consumer cells (indexed by $i \in \mathcal{I}$) and a set $\mathcal{J}$ of producer cells (indexed by $j \in \mathcal{J}$). The (large) representative consumer who populates the rest of the world is labeled $i = \mathcal{R} \notin \mathcal{I}$ and the foreign representative producer is $j = \mathcal{R} \notin \mathcal{J}$. We write $\mathcal{I} \cup \{\mathcal{R}\}$ and $\mathcal{J} \cup \{\mathcal{R}\}$ whenever the rest of the world is included in the set of indices. We use the price level of goods produced by the rest of the world as numeraire and denote all prices and wages in those units. This assumption is not only convenient but also realistic for the Danish economy, which effectively operates a fixed exchange rate against the Euro.

V.B Setup

We describe consumer and producer cells in turn.

Consumer cells: utility. A representative consumer lives in each consumer cell i maximizing a homothetic utility function

$$U_i = C_i \left(\{c_{ij}\}_{j \in \mathcal{J} \cup \{\mathcal{R}\}} \right) \tag{7}$$

where $c_{i\mathcal{R}}$ is consumer cell i's consumption of foreign goods and c_{ij} is consumer cell i's consumption of goods produced by domestic producer cell j.

Consumer cells: budget constraint. Consumer cell i can supply labor N_i up to a labor endowment of $\overline{N}_i$. Without any binding wage rigidity, labor supply always equals the endowment, $N_i = \overline{N}_i$. However, when labor demand falls short of $\overline{N}_i$, due to a binding wage rigidity, N_i falls below $\overline{N}_i$ and is determined by labor demand instead (see below). The wage for labor supplied by consumer cell i is denoted by W_i. In addition to labor income, consumer cells earn profit income $\sum_{j \in \mathcal{J}} \kappa_{ij} (1 - \tau_j) \Pi_j$. The total pre-tax profit of producer cell j is Π_j, on which the corporate tax rate $\tau_j \in [0, 1)$ is paid. The share of producer cell j's profits earned by consumer cell i is $\kappa_{ij} \in [0, 1]$. Further, consumer cell i pays a proportional income tax rate $\tau_i \in [0, 1)$ and receives a government transfer $T_i \geq 0$. Without loss and to ease notation, τ_i includes both income taxes and value added taxes. Total nominal income of consumer cell i before consumer taxes is therefore

$$Y_i = N_i W_i + \sum_{j \in \mathcal{J}} \kappa_{ij} (1 - \tau_j) \Pi_j + T_i. \tag{8}$$

The consolidated budget constraint of cell i is then

$$\sum_{j \in \mathcal{J} \cup \{\mathcal{R}\}} P_j c_{ij} \leq (1 - \tau_i) Y_i. \tag{9}$$

Producer cells. There is a representative firm in each producer cell $j \in \mathcal{J}$. It produces quantity Q_j of its good j with technology

$$Q_j = Z_j F_j \left(\{N_{ji}\}_{i \in \mathcal{I}}, \{X_{jj'}\}_{j' \in \mathcal{J} \cup \{\mathcal{R}\}} \right), \tag{10}$$

where Z_j is total factor productivity, and F_j is a continuously differentiable production function that is homogeneous of degree $1 - \gamma_j \in (0, 1]$, possibly allowing for decreasing returns in production. Producer cell j uses N_{ji} units of labor supplied by consumer cell i and $X_{jj'}$ units of intermediate goods from producer cell j'. Pre-tax profits are

$$\Pi_j = P_j Q_j - \sum_{i \in \mathcal{I}} W_i N_{ji} - \sum_{j' \in \mathcal{J} \cup \{\mathcal{R}\}} P_{j'} X_{jj'}. \tag{11}$$

We consider profits as remuneration for a fixed factor that causes the production function (10) to have decreasing returns to scale. We assume each producer cell uses at least some labor, $\partial F_j / \partial N_{ji} > 0$ for some $i \in \mathcal{I}$, or some of the fixed factor, that is, it has decreasing returns to scale $\gamma_j > 0$.

Wage rigidity. We assume that wages are downwardly rigid, that is,

$$W_i \geq (1 - \delta) \underline{W}_i \tag{12}$$

where $\underline{W}_i$ is some pre-determined reference wage for consumer cell i. In the static model, we set $\underline{W}_i$ equal to the wage without any shock. The nominal wage rigidity then restricts the wage from falling more than δ relative to the no-shock wage, following Barro and Grossman (1971) and Schmitt-Grohé and Uribe (2016). When the nominal wage rigidity binds for a consumer cell i, the consumer cell's labor supply is "slack," that is, the labor endowment by the consumer cell exceeds labor demand. In this case, labor supply N_i is demand-determined and we think of some workers in the consumer cell as unemployed due to a negative demand shock.

Rest of the world. We assume the economy operates a fixed nominal exchange rate, $\mathcal{E} = 1$. Domestic consumers and producers buy foreign goods at exogenous price $P_{\mathcal{R}}$. Export demand for domestically produced goods is

$$x_j = \tilde{x}_j \cdot (P_j / P_{\mathcal{R}})^{-\tilde{\sigma}}, \tag{13}$$

where the elasticity of exports to the terms of trade is equal to $\tilde{\sigma} > 0$ and $\tilde{x}_j$ is a shifter for the rest of the world's preference for good j.

Government. The government pays (nominal) transfers T_i, spends on domestically produced goods G_j, and imports goods $G_{\mathcal{R}}$, all financed by tax revenue. The government budget constraint is

$$\sum_{j \in \mathcal{J} \cup \{\mathcal{R}\}} P_j G_j + \sum_{i \in \mathcal{I}} T_i = \sum_{i \in \mathcal{I}} \tau_i Y_i + \sum_{j \in \mathcal{J}} \tau_j \Pi_j + \Delta. \tag{14}$$

We allow for an international transfer Δ to the government that is zero in our calibrated economy but that we can use to cleanly study transfer multipliers below.

Current account. The current account is balanced in equilibrium because the model is static, implying there is no saving and no capital accumulation cell,

$$\underbrace{\sum_{j \in \mathcal{J}} P_j x_j}_{\text{exports}} + \underbrace{\Delta}_{\text{transfers}} = \underbrace{\sum_{i \in \mathcal{I}} P_{\mathcal{R}} c_{i\mathcal{R}} + P_{\mathcal{R}} G_{\mathcal{R}} + \sum_{j \in \mathcal{J}} P_{\mathcal{R}} X_{j\mathcal{R}}}_{\text{imports}}. \tag{15}$$

Equilibrium. We define equilibrium as in a standard competitive model.

Definition 1. A *competitive equilibrium* in the economy consists of prices and wages $\{P_j, W_i\}$ and an allocation $\{Q_j, N_{ji}, X_{jj'}, \Pi_j, T_i, G_j, Y_i, c_{ij}, x_j\}$ such that (a) income is given by (8); (b) all consumer cells maximize utility (7) subject to (9); (c) all producer cells maximize profits (11); (d) the downward nominal wage rigidity (12) holds; (e) the government's budget (14) is balanced; (f) exports are given by (13); (g) labor markets clear for each consumer cell,

$$N_i = \sum_{j \in \mathcal{J}} N_{ji}; \tag{16}$$

(h) the goods market clears for each producer cell,

$$Q_j = \sum_{j' \in \mathcal{J}} X_{j'j} + x_j + \sum_{i \in \mathcal{I}} c_{ij} + G_j; \tag{17}$$

and (i) the current account is balanced as in (15).

V.C Calibration with Disaggregated Economic Accounts

We calibrate the model to match the observed disaggregated economic accounts, as summarized in Table A.VIII. In the baseline calibration, we assume that consumer cell i's consumption C_i is Cobb-Douglas, with spending share α_{ji} on products from producer cell j. We collect the domestic spending shares after taxes in the column-substochastic $\mathcal{J} \times \mathcal{I}$ matrix $\mathbf{A} \equiv (\alpha_{ji}(1-\tau_i))$. We collect profit shares after taxes in the $\mathcal{I} \times \mathcal{J}$ matrix $\mathbf{K} \equiv (\kappa_{ij}(1-\tau_j))$. The production function F_i is Cobb-Douglas with decreasing returns to scale $1-\gamma_j$. The labor share λ_{ij} is labor compensation paid by producer cell j to consumer cell i as a fraction of total costs of cell j (where total costs are payments to labor, owners, and intermediates) and $\omega_{j'j}$ is intermediates spending from producer cell j to producer cell j' as a fraction of total costs of cell j. We collect labor shares λ_{ij} in the $\mathcal{I} \times \mathcal{J}$ matrix Λ and domestic intermediate input shares $\omega_{j'j}$ in the $\mathcal{J} \times \mathcal{J}$ matrix Ω.[24]

There remains uncertainty about the right elasticities of substitution in consumption and production in the literature. Our Cobb-Douglas assumption implies that the elasticities are 1 in the baseline calibration. Elasticities of 1 represent an intermediate case between the short-run elasticities below 1 occasionally assumed in the macroeconomic literature (e.g., Atalay 2017; Baqaee and Farhi 2024; Gourinchas et al. 2021; Boehm et al. 2023) and the long-run elasticities above 1 typically assumed in the trade literature (e.g., Costinot and Rodríguez-Clare 2014; Caliendo and Parro 2015). We choose this baseline because it may be appropriate for the time horizon of a typical business cycle recession-recovery period (3-5 years). A further advantage of this calibration is its analytical tractability, allowing us to cleanly shed light on the main mechanisms. Having said that, we re-calibrate our model in Section IX (and Appendix W) both with short-run and long-run elasticities from the literature, and show that our conclusions do not change materially.

We calibrate all spending and income shares $\alpha_{ji}, \kappa_{ij}, \lambda_{ij}, \omega_{j'j}$ to match their respective counterparts in the disaggregated accounts. For α_{ji}, we use consumer spending paid from cell i to cell j as a fraction of total domestic and foreign spending of cell i; for κ_{ij}, we use the sum of dividend income, mixed income, and owner-occupied housing surplus paid from j to i as a fraction of the total profits of cell j; for λ_{ij} we use labor compensation as a fraction of the total costs of cell j; for $\omega_{j'j}$, we use intermediates purchases as a fraction of the total costs of cell j.

We choose τ_i to match the income tax and value added tax payments made by consumer cell i as a fraction of the total income of cell i. We calibrate τ_j to match the fraction of producer cell j's pre-tax profits Π_j that are paid to the government in the form of dividends and surplus paid to the government as well as producer product and non-product taxes paid, less subsidies. We set T_i to match cell-level government transfers as a share of total government revenue. We choose G_j to match government final consumption expenditure on producer cell j and government imports as a share of government revenue.

Finally, we choose the relative magnitudes of the export demand shifters $\tilde{x}_j$ to match the distribution of exports across producer cells j. We choose the level of $\tilde{x}_j$ to match aggregate GDP. We do not have to calibrate the quantities Z_j and N_i, as they do not matter for any of our results (for the same reason that steady-state productivity and labor supply do not matter for the linearized New-Keynesian model in Galí 2015).

The calibrated model closely matches the Danish disaggregated economic accounts. The only major difference is the absence of a capital accumulation cell in the model because the model is

[24] To simplify the exposition of our results below, we count labor payments to foreign employees working in Denmark towards intermediate imports. Those are small and we have checked that counting them separately does not alter our results in any meaningful way.

static. In Figure A.XI, we compare model-implied producer sales and consumer spending to their data counterparts. The correlation between model and data is close to 1 both for producer sales and for domestic consumer spending, with residual sums of squares around 2-3%.

V.D Factor Demand Matrix $\mathbf{M}$

A crucial object in our theoretical analysis of fiscal transfers is a matrix $\mathbf{M}$ that summarizes the flows between the two types of production factors: labor provided by each consumer cell and the fixed factor of each producer cell. We henceforth call $\mathbf{M}$ the *factor demand matrix*.[25] $\mathbf{M}$ is of dimension $(|\mathcal{I}| + |\mathcal{J}|) \times (|\mathcal{I}| + |\mathcal{J}|)$, so it includes only domestic consumer and producer cells. It can be written as

$$\mathbf{M} = \underbrace{\begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix}}_{(|\mathcal{I}|+|\mathcal{J}|)\times|\mathcal{J}|} \underbrace{(\mathbf{I} - \Omega)^{-1}\mathbf{A}}_{|\mathcal{J}|\times|\mathcal{I}|} \underbrace{\begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix}}_{|\mathcal{I}|\times(|\mathcal{I}|+|\mathcal{J}|)}, \tag{18}$$

where $D(\gamma_j)$ denotes the diagonal matrix with diagonal entries equal to the profit shares γ_j in production.

$\mathbf{M}$ is a product of three matrices. We discuss each in turn, from right to left. The rightmost matrix captures how changes in the factor income of labor and the fixed factor translate into changes in pre-tax consumer cell income. Labor income accrues fully to domestic consumer cells, so we simply have the identity $\mathbf{I}$. For fixed factor income (i.e., profits), we subtract corporate taxes and distribute the income, both captured by the profit distribution matrix $\mathbf{K}$. The matrix in the middle captures how a given increase in income is spent on the value added of different producer cells. We first subtract consumer taxes and distribute the spending according to consumer cell preferences, both captured by the spending matrix $\mathbf{A}$. We then multiply with the Leontief inverse of the input-output matrix $(\mathbf{I} - \Omega)^{-1}$ to get the effect on the value added of each producer cell. The leftmost matrix determines how value added is split into labor income (Λ) and profit income ($D(\gamma_j)$).

All in all, $\mathbf{M}$ shows how a set of factor income changes flows through the disaggregated economic accounts to create another set of factor income changes. In that way, $\mathbf{M}$ allows us to calculate how a given income shock to a set of cells affects the income of other cells. In the next section, we show that $\mathbf{M}$ helps to characterize the effects of fiscal transfers on aggregate income and output.

VI Fiscal Transfers in an Economy-Wide Recession

We show that the disaggregated economic accounts can help in the evaluation of government policies. We use the model developed in Section V to analyze fiscal multipliers—the effect of transfers to consumer cells on aggregate output— during an economy-wide recession where every

[25] Our matrix is conceptually similar to the flows in the international factor demand system by Adão et al. (2022).

consumer cell is slack and experiences unemployment. We show that the multiplier of a transfer program depends on which specific consumer cells receive the fiscal transfers. The multiplier is associated with the positions of targeted cells in the disaggregated circular flow of money and, specifically, the cells' domestic spending intensity defined in Section IV.G.

At the end of the section, we evaluate actual policies conducted by the Danish government through the lens of our model. We show that the assessment of policies changes substantially once one considers the structure of disaggregated flows.

VI.A Setup of the Fiscal Transfers Problem

Our aim is to calculate the multiplier of cell i, defined as the dollar-to-dollar effect of a transfer by the government to consumer cell i on aggregate GDP.[26] We use the calibrated model developed in Section V. We assume that downward nominal wage rigidity binds in every cell (see Equation 12). This assumption implies that changes in labor demand have first-order effects on the quantity of labor rather than on wages. We analyze the effect of a small, first-order transfer dT_i on domestic GDP. Specifically, we compute the transfer multiplier

$$\mu_i \equiv \frac{dGDP}{(1-\overline{\tau}_i)\, dT_i} \tag{19}$$

for each consumer cell i. Here, $dGDP$ denotes the change in real GDP (see, e.g., Baqaee and Farhi 2019b),

$$dGDP \equiv \sum_{j\in\mathcal{J}} P_j dQ_j - \sum_{j\in\mathcal{J}} \sum_{j'\in\mathcal{J}\cup\{\mathcal{R}\}} P_{j'} dX_{j'j}, \tag{20}$$

and $\overline{\tau}_i$ denotes the fiscal externality of the transfer, that is, the fraction that is recouped by the government through tax revenue as the transfer gets spent. We assume for now that whatever is not recouped is financed by a transfer from abroad (say, the European Union), $d\Delta = (1-\overline{\tau}_i)dT_i$. Taken together, μ_i equals the dollar change in GDP for each dollar increase net fiscal outlays. We collect all the cell-level multipliers in the vector $\boldsymbol{\mu}$.[27]

We choose to analyze externally funded transfers so the results cleanly capture the effects of transfers, rather than the joint effects of transfers and potentially distortionary taxes. However, we could just as easily analyze the effects of a taxation policy or the effects of a joint transfer and taxation policy, such as a balanced-budget policy, using the model. In fact, balanced-budget policies are simple combinations of individual transfer multipliers μ_i. For instance, $\mu_i - \mu_{i'}$ would be the

[26] In a previous working paper version (Andersen et al. 2022), we also computed the effect of transfers on welfare, the "marginal value of public funds" as in Hendren and Sprung-Keyser (2020). As we showed there, welfare effects exceed GDP effects due to favorable terms of trade effects.

[27] Using the dynamic model in Section VIII, we show that the multipliers in the static model are close to the cumulative multipliers in the dynamic model in year 4 after the transfer. In that sense, the multipliers in the static model have a policy-relevant interpretation as approximate multipliers over the 4-year duration of a typical business cycle.

multiplier of a transfer to cell i funded by increased taxes on cell i'.

VI.B Transfer Multipliers in Theory

To state our result on fiscal multipliers, we define a vector of effective tax rates $\boldsymbol{\mathcal{T}} \in \mathbb{R}^{|\mathcal{I}|+|\mathcal{J}|}$ on labor income and profits. The effective tax rate on labor income is simply τ_i, $\mathcal{T}_i = \tau_i$, but since profits are taxed twice, first at the producer level and then at the consumer level, we define $\mathcal{T}_j = \tau_j + \sum_i \tau_i \kappa_{ij} (1 - \tau_j)$.

We then have the following proposition characterizing fiscal multipliers.

Proposition 1. *Assume Cobb-Douglas preferences and production, with all consumer cells spending a positive amount abroad, $\alpha_{\mathcal{R}i} > 0$. The vector of transfer multipliers defined in (19) is finite and given by*

$$\boldsymbol{\mu}' = \begin{pmatrix} \mathbf{1}' & 0 \end{pmatrix} (\mathbf{I} - \mathbf{M})^{-1} \mathbf{M} \begin{pmatrix} D\left((1 - \overline{\tau}_i)^{-1}\right) \\ 0 \end{pmatrix} \tag{21}$$

where $D\left((1 - \overline{\tau}_i)^{-1}\right)$ is a diagonal matrix with the fiscal externalities $\overline{\tau}_i$,

$$\overline{\boldsymbol{\tau}} = (\overline{\tau}_i)_{i \in \mathcal{I}} = \boldsymbol{\mathcal{T}}' (\mathbf{I} - \mathbf{M})^{-1} \begin{pmatrix} \mathbf{I} \\ 0 \end{pmatrix} \tag{22}$$

The proposition shows that the factor demand matrix $\mathbf{M}$ is the crucial determinant of transfer multipliers.[28] The middle term $(\mathbf{I} - \mathbf{M})^{-1} \mathbf{M}$ in Equation (21) equals a geometric sum:

$$(\mathbf{I} - \mathbf{M})^{-1} \mathbf{M} = \mathbf{M} + \mathbf{M}^2 + \mathbf{M}^3 + \ldots$$

Recall that $\mathbf{M}$ measures how a set of income changes creates another set of income changes through the disaggregated flows. Multiplying a transfer schedule with $\mathbf{M}$ only a single time yields the income change due to the fiscal transfers driven by only first-order spending connections. But we are interested in incorporating the full set of higher-order connections, so we sum all powers of $\mathbf{M}$ to arrive at the income changes driven by all higher-order connections.

The geometric sum of $\mathbf{M}$ is multiplied with two other terms in Equation (21). On the left, a row vector of $|\mathcal{I}|$ 1s followed by $|\mathcal{J}|$ 0s captures that labor is slack in the economy-wide recession, while the fixed factor is not; additional labor demand thus raises employment and GDP. On the right, a matrix with net-of-tax-rates captures the fiscal externality of a transfer. The fiscal externality depends on the effective tax rates $\boldsymbol{\mathcal{T}}$ and on the geometric sum $(\mathbf{I} - \mathbf{M})^{-1}$, as shown in Equation (22).

[28] The formula (21) is similar to the Katz-Bonacich centrality of a network with matrix $\mathbf{M}$.

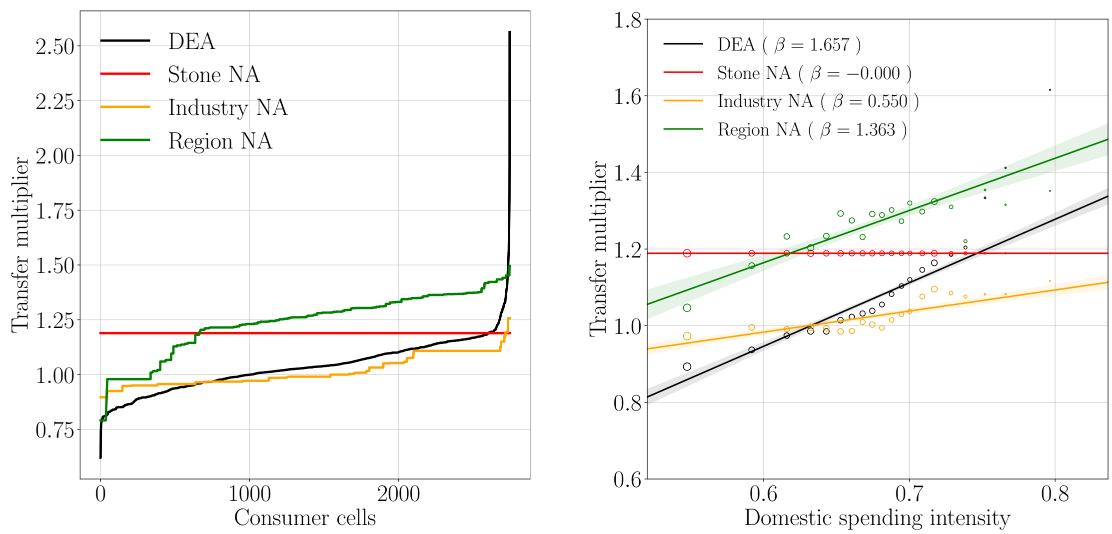
VI.C Transfer Multipliers in the Calibrated Model

We evaluate the multiplier formula (21) using the observed factor demand matrix $\mathbf{M}$. Figure XIa plots the distribution of multipliers across consumer cells. The mean multiplier is 1.2 with a standard deviation of 0.2. The multipliers range from below 1 to above 2, implying that a transfer to a high-multiplier cell has substantially larger effects on aggregate GDP than a transfer to a low-multiplier cell.

Figure XI: Targeted transfer multipliers

(a) Distribution across consumer cells

(b) Multipliers by domestic spending intensity



Panel a plots the distribution of the transfer multiplier in the static model for different measurement systems. DEA is the full system of disaggregated economic accounts as measured in Section III. Stone NA is the standard national accounts following the UN SNA with a representative consumer. Industry NA uses the DEA system but aggregates all the regional variation to the national level, so there is only heterogeneity across consumers and producers in different industries. Regional NA uses the DEA system but aggregates all the industry variation to the national level, so there is only heterogeneity across consumers and producers in different regions. Panel b plots the multiplier calculated in the different systems against domestic spending intensity calculated using the full DEA system. The detailed construction of the figure is as described in Figure III.

The figure also plots the distribution of multipliers using three alternative accounts with more aggregated data. The standard national accounts developed by Stone include only one representative consumer cell, so there is no heterogeneity in transfer multipliers across consumers. A further alternative uses the disaggregated economic accounts, but aggregates all the regional variation to the national level and only allows for variation across consumers and producers in different industries. Similarly, we also construct an alternative using only regional variation and aggregating the industry variation. We observe less heterogeneity using the industry and regional variation, relative to the full disaggregated accounts, implying that both dimensions capture variation that affects multipliers.[29]

Next, we analyze which cells have high multipliers. Figure XIb shows a strong correlation between the transfer multiplier and domestic spending intensity, as measured in Section IV.G. Intuitively, transfers to cells with higher domestic spending intensity affect the labor income and employment of more domestic cells instead of "leaking abroad." Since the labor market is slack in every cell, greater employment directly raises aggregate GDP.[30] Formally, the domestic spending intensity can be expressed as

$$\begin{pmatrix} \mathbf{1}' & \mathbf{1}'\mathbf{K} \end{pmatrix} (\mathbf{I} - \mathbf{M})^{-1} \mathbf{M} \begin{pmatrix} D\left((1-\tau_i)^{-1}\right) \\ 0 \end{pmatrix}. \tag{23}$$

Domestic spending intensity is not identical to the multiplier because the multiplier is based on a general equilibrium model, so it incorporates potential price changes (e.g., even when all cells are slack, the price of the fixed factor may still change). Hence, (21) does not feature the $\mathbf{1}'\mathbf{K}$ term that appears in (23). The fiscal externality $\overline{\tau}_i$ in (21) also differs from τ_i in (23). Still, domestic spending intensity and the multiplier are closely linked because they both measure the impact of a cell's spending on other domestic cells, taking into account all higher-order connections, as captured by the infinite sum $(\mathbf{I} - \mathbf{M})^{-1} \mathbf{M}$. We view domestic spending intensity as a useful statistic that can complement formal model insights, can be calculated relatively easily without a formal model, and is relevant in different types of models, as we exemplify in Sections VIII and IX below.

What characterizes consumer cells with high multipliers? Rural, old, and less college-educated consumer cells tend to have higher multipliers, as shown in Figure A.XII, consistent with the association between these characteristics and domestic spending intensity. We also investigate the beliefs of high-multiplier consumers by merging survey responses at the individual level to the multiplier calculated at the cell level. The survey was answered by 6,000 Danish adults in 2016, respondents were guaranteed anonymity, and the data are stored on secure government servers (Kreiner et al. 2019; Alt et al. 2022).

As we show in A.XIII, we find that consumers in high-multiplier cells are significantly more likely to vote for the right-wing populist Danish People's Party, believe that immigration is economically harmful, that everyone in a country should share the same values, and that daily politics are not important, consistent with a sense of disenfranchisement. Right-wing populists have played an important role in many countries in recent years. The literature suggests that their supporters have

[29] The average multiplier differs in the accounts using only industry or regional variation because there is a tendency for local spending and assortative spending in the fully disaggregated accounts, as shown in Section IV. These facts imply that high-multiplier cells disproportionately spend on other high-multiplier cells in the fully disaggregated system. By removing levels of disaggregation, some of this pattern disappears, leading to lower spending among high-multiplier cells and a lower average multiplier.

[30] The role of domestic spending intensity for the Keynesian multiplier is related to the role of industry "upstreamness" in models of production and trade networks. For example, in Liu (2019), subsidies to production costs of more upstream sectors have larger aggregate benefits in a neoclassical model.

Table III: Multipliers for fiscal transfer programs

Transfer policy	**Multiplier**	**Cost to raise GDP by 5% (in bn DKK)**
Uniform	1.04	96.08
10% highest spending intensity	1.21	81.99
2018 child tax credit	1.02	97.85
2022 inflation relief to elderly	1.13	88.11
2023 housing rent inflation support	1.03	96.45
Construction worker support	1.23	81.16
Consulting / IT worker support	0.95	105.22

The table lists the transfer multiplier and the expenditure required to raise GDP by 5% for different transfer policies, calculated using the model developed in Sections V and VI.

been disproportionately "left behind" due to economic shocks, including globalization, technological change, and the 2008-09 crisis, and has debated whether they should be targeted by economic policies (Charles et al. 2019; Autor et al. 2020; Rodrik 2021; Guriev and Papaioannou 2022). Our results suggest that the spending of the "left behind" creates a larger multiplier during recessions, in part because of their preference for local and home-country spending. In that sense, our analysis suggests a distinct rationale for why transfers targeted at these groups can benefit the domestic economy during demand-driven recessions.

VI.D Policy Evaluation

We show that the multipliers implied by the disaggregated economic accounts can be useful in evaluating fiscal transfer policies. Table III lists several hypothetical and actual policies, and computes their multipliers during an economy-wide recession.

The table shows that a uniform transfer to all adults, a baseline policy similar to the stimulus checks often sent in the U.S. during recessions, yields a multiplier of 1.04.[31] If only the cells with the 10% highest domestic spending intensity receive equally-sized transfers, the multiplier rises to 1.21.

We compare these numbers to actual policies that the Danish government has used over the past 15 years. Government registers allow us to measure the actual transfers received by each consumer as a result of each policy, as detailed in Appendix T. In addition, we analyze two industry-specific transfers, where workers employed either in the construction industry or in the consulting/IT industry receive income support.[32]

[31] Each Danish adult receives a transfer in this uniform policy. We measure the number of adults per cell using data on the actual population of each consumer cell.

[32] Industry-specific transfers are relatively common in Europe, for example, in the form of short-time work schemes that replace incomes in industries hit by negative demand shocks.

The multipliers are high for policies targeting consumer cells with high domestic spending intensity. Transfers targeting old, rural consumers (e.g., 2022 inflation relief to elderly) and non-college-educated consumers (e.g., construction worker support) have high multipliers. In contrast, transfers targeting urban consumers (e.g., 2023 housing rent inflation support), young consumers (e.g., 2018 child tax credit), and college-educated consumers (e.g., consulting/IT worker support) have lower multipliers.

The range in multipliers corresponds to substantial differences in the "bang for the buck" effectiveness of different policies. For each policy, we consider how much it would cost to stimulate GDP by 5% if the policy were enacted in 2018. The cost is 81 bn DKK for the construction worker support, 88 bn DKK for the 2022 inflation relief to elderly, and 96 bn DKK for the 2023 housing rent inflation support. Hence, the government could save between 7 bn and 15 bn DKK (1.2 bn to 2.4 bn USD) by selecting a program with a higher multiplier, which amounts to saving 0.4% to 0.7% of Danish GDP.

The government may not be able to design policies solely with the aim of maximizing the multiplier due to various political feasibility constraints. However, disaggregated economic accounts could provide an additional source of information and help governments select more effective policies among those that are politically feasible. We show that the variation in multipliers—and thus in policy effectiveness—is similar using a dynamic model in Section VIII and alternative calibrations in Section IX.

VII Fiscal Transfers in a Heterogeneous Recession: U.S. Tariff Shock

In the previous section, we analyzed multipliers during an economy-wide recession, in which every cell suffered from demand-driven unemployment and every labor market is slack. In this section, we consider multipliers in the face of a recession with heterogeneous direct incidence, where only a subset of cells are slack. We analyze one particular hypothetical shock as an illustrative example: a recession induced by greater tariffs on Danish products exported to the U.S.

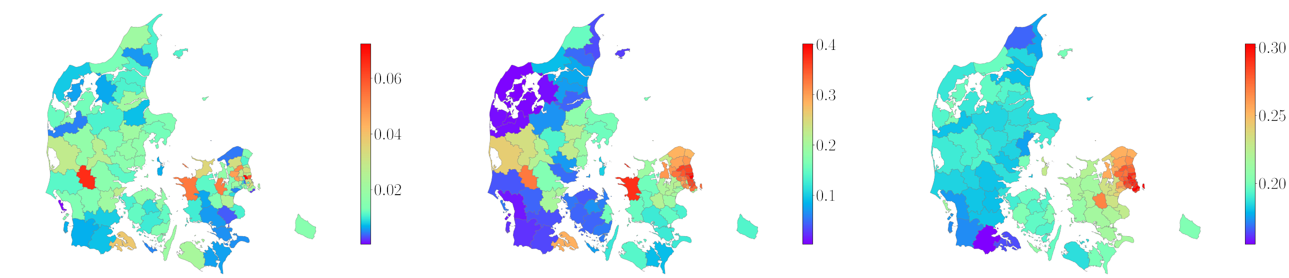
We show that the disaggregated economic accounts allow us to trace out the effects of the shock on different cells, as both directly and indirectly exposed cells turn slack in response to the shock. Moreover, cell characteristics observed in the disaggregated economic accounts have strong explanatory power for the transfer multiplier. Cells with high spending intensity on slack cells have particularly high multipliers, an insight that can help in the evaluation of fiscal policies.

VII.A Description of the U.S. Tariff Shock

We consider a scenario where the U.S.-Denmark conflict over Greenland and trade tariffs escalates, such that the U.S. imposes a tariff rate of 41% on Danish exports to the U.S., matching the effective tariff rate threatened on Chinese exports to the U.S. in July 2025 (Fitch 2025). We model this scenario as an increase in the price of Danish exports in the U.S. such that for any producer cell j, export revenue from the U.S., $P_j x_j^{US}$, falls by 41% (see Equation 13). We measure $P_j x_j^{US}$ using firm-level data on exports by destination countries, as described in Appendix O.D. We view this shock as an illustrative example that can generate a recession with heterogeneous incidence across Danish cells, rather than a case study of recent U.S. trade and foreign policy.

Figure XII: Direct exposure, slackness, and multipliers for the U.S. tariff shock

(a) Direct exposure through U.S. exports (b) Labor market slackness (c) Transfer multipliers



Panel a shows the fraction of regional sales going to the U.S. out of total regional sales. Panel b shows the fraction of regional labor income that is in slack cells after the U.S. tariff shock out of total regional labor income. A cell is slack if its income falls by more than 4% due to the U.S. tariff shock. Panel c shows the average regional transfer multiplier for the U.S. tariff shock, calculated as in Proposition 2 and weighted by cell population. The detailed construction of the figure is as described in Figure III.

Figure XIIa shows the direct incidence of the shock across Danish regions. While some regions are barely affected, others see a decline in total regional sales of 8%. Regions with high direct incidence include Billund (where Lego is located, center of western part), Kalundborg (where several Danish pharmaceutical companies are located, northwest of eastern island), and a small manufacturing belt in the hinterland of Copenhagen.

The shock does not just affect directly exposed producer cells, but propagates through the disaggregated flows and reduces incomes in consumer cells. If the reduction in a consumer cell's income is greater than δ, we call that cell "slack", as explained in Section V. For this analysis, we set δ to 4%. Standard annual calibrations of δ are around 1% (e.g., Rodríguez-Clare et al. 2025), and we view our static model as capturing effects over a horizon of roughly 4 years.

Figure XIIb plots regional slackness, defined as the fraction of regional labor income that is in slack cells relative to total regional labor income. The regions with directly affected producers experience greater slackness, but the shock also propagates to other regions. For instance, the shock affects regions nearby the most directly affected ones, due to the local nature of spending and labor income flows documented in Section IV.C. The shock also disproportionately propagates to urban regions, thanks to the urban bias of spending documented in Section IV.E. Some rural regions, such as Billund, have high direct exposure but are located far from other high-exposure regions and far from cities. The slackness in Billund is thus less strong compared to its high direct exposure, because the disaggregated flows do not reinforce the direct exposure.

VII.B Transfer Multipliers for the U.S. Tariff Shock

We analyze to what extent transfers to different consumer cells mitigate the negative impacts of the tariff shock on GDP. We denote by $\boldsymbol{\phi}$ a vector of slackness indicators for consumer cells, where $\phi_i = 1$ if consumer cell i is slack (i.e., its labor income drops by more than 4% due to the U.S. tariff shock) and 0 otherwise. The economy-wide recession that we studied in Proposition 1 is a special case where $\boldsymbol{\phi} = \mathbf{1}$. The following proposition defines the transfer multipliers for a recession with heterogeneous slackness across consumer cells.

Proposition 2. *Assume Cobb-Douglas preferences in consumption and production. We analyze small, first-order transfers. The vector of transfer multipliers, as defined in (19), is*

$$\boldsymbol{\mu} = \begin{pmatrix} \boldsymbol{\phi}' & 0 \end{pmatrix} (\mathbf{I} - \mathbf{M})^{-1} \mathbf{M} \begin{pmatrix} D\left((1-\overline{\tau}_i)^{-1}\right) \\ 0 \end{pmatrix}, \tag{24}$$

where $\overline{\tau}_i$ are the fiscal externalities defined in (22).

The first term in the proposition is the slackness indicator $\boldsymbol{\phi}$, implying that the multipliers are larger if the fiscal transfers raise the labor income and employment of slack consumer cells.

Figure XIIc plots regional multipliers $\boldsymbol{\mu}$ for the U.S. tariff shock, averaged within regions using population weights. The multipliers are high in regions with high slackness, but there remains substantial variation not explained by slackness. Indeed, the distribution of multipliers for non-slack cells is similarly dispersed as that for slack cells, as shown in Figure A.XIV. This finding implies that a transfer to a slack cell does not always yield a high multiplier because spending by a slack cell does not necessarily generate labor demand for itself or other slack cells. Hence, "naive" transfers to cells facing income reductions or demand-driven unemployment do not guarantee a high multiplier. Instead, the multiplier is high for cells that generate labor demand for the workers in slack cells.

For example, Billund (center of western part) is not among the highest-multiplier regions, despite its high direct exposure and slackness. The intuitive reason is that Billund is not nearby other slack regions. As a result, the spending by Billund consumers, which is often local, does not contribute to the labor demand for many other slack cells, apart from Billund itself. In contrast, regions on the eastern island are nearby many other slack regions, giving these cells a high multiplier. In fact, some of the highest-multiplier regions are not slack themselves, but simply lie surrounded by multiple slack regions, resulting in a high multiplier. In Table IV, we confirm this result formally. A cell's spending share and its spending intensity on slack cells, defined as in (6) only with indicator $1_{\{i\,\text{slack}\}}$ instead of 1 for slack consumer cells, have strong explanatory power for the multiplier,

Table IV: Multipliers after U.S. tariff shock: Role of spending patterns

	(1)	(2)	(3)	(4)
	Multiplier			
Consumer cell is slack	0.029***	0.003	-0.010**	-0.013***
	(0.007)	(0.006)	(0.005)	(0.003)
Spending share on directly exposed cells (%)		0.326***	-0.194***	-0.140***
		(0.028)	(0.029)	(0.022)
Spending share on slack cells (%)			0.029***	0.014***
			(0.001)	(0.001)
Spending intensity on slack cells				1.047***
				(0.082)
Observations	2,744	2,744	2,744	2,744
R^2	0.035	0.310	0.800	0.867

The table reports regressions of the cell-level multiplier after the U.S. tariff shock on measures of cell-level spending patterns. The spending share on directly exposed cells is the weighted average direct exposure to the U.S. tariff shock of producer cells receiving spending from a consumer cell, weighted by the amount of spending going from the consumer cell to the producer cell. The regressions are weighted by population in the consumer cell. Standard errors are clustered by consumer cell. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

whereas a cell's direct shock exposure has weak power.[33]

Taken together, the analysis suggests that disaggregated economic accounts can be useful during a recession with heterogeneous direct incidence. First, the accounts show which cells become slack in response to a heterogeneous shock. And second, they inform which policies—in particular, those targeting cells with high spending intensity on slack cells—deliver the greatest "bang for the buck."

VIII Fiscal Transfers in a Dynamic Model

In this section, we extend our model by including dynamics, allowing consumers to save, and incorporating newly estimated heterogeneous marginal propensities to consume. Analyzing an economy-wide recession, we find that domestic spending intensity is still closely associated with the fiscal transfer multiplier in the dynamic model. The multipliers in the dynamic model in year 4 are close to the multipliers in the static model of Section VI. In the long run, the multipliers in the two models are exactly equal. We keep this section deliberately brief, with details in Appendix V.D.

VIII.A Dynamic Multipliers in Theory

The dynamic model differs from the baseline model of Section V in three main ways. The most important difference is that we turn every consumer cell into a continuum of consumers with overlapping generations (OLG), as in Blanchard (1985) and Yaari (1965). This assumption allows us to generate marginal propensities to consume (MPCs) matching those commonly observed in the data (e.g., see discussion in Auclert et al. 2024), with each consumer cell i having an MPC m_i out

[33]In Table A.IX, we find that rural, old, and less college-educated cells have high multipliers for the U.S. tariff shock, conditional on their distance to slack cells. Intuitively, rural, old, and less college-educated cells have high domestic spending intensity, which is positively associated with the multiplier even in a recession with heterogeneous direct incidence, once one conditions on the cells' relation to slack cells.

of wealth changes. The second difference to the baseline model is that consumer asset positions, government debt, and aggregate foreign asset positions can be non-trivial, non-zero, and change over time. Third, we allow for a dynamic downward nominal wage rigidity à la Schmitt-Grohé and Uribe (2016).

We feed into the dynamic model the same transfer shocks as in Section VI. The vector of transfers at date t is denoted by $d\mathbf{T}_t$. Transfers arrive in period 0 only, that is, $d\mathbf{T}_t = 0$ for $t > 0$. We again study an economy-wide recession, as in Section VI, and assume each consumer cell is slack in all periods t up to some horizon H. We then define the H-horizon cumulative multiplier of a small transfer to consumer cell i at date 0 as

$$\mu_i^{pv}(H) \equiv \frac{\sum_{t=0}^{H} (1+r^*)^{-t} \frac{dGDP_t}{dT_{i0}}}{1 - \sum_{t=0}^{H} (1+r^*)^{-t} \frac{d\text{tax}_t}{dT_{i0}}}, \tag{25}$$

so that $\mu_i^{pv}(H)$ computes the present value of the real GDP response $\frac{dGDP_t}{dT_{i0}}$ in periods $t = 0, \ldots, H$ that is generated by a unit-sized transfer. The fiscal externality is the present value of the responses of tax revenue, $\frac{d\text{tax}_t}{dT_{i0}}$. r^* is the nominal interest rate.

In Appendix V.F, we formally prove that the ∞-horizon cumulative multipliers of the dynamic model $\mu_i^{pv}(\infty)$ exactly coincide with the multipliers in the static model characterized above. The intuition for this result is that in the long run, consumers spend the transfer in full, so the effects on the economy are identical to a static model where consumers spend the transfer in full.

VIII.B Evaluating Dynamic Multipliers

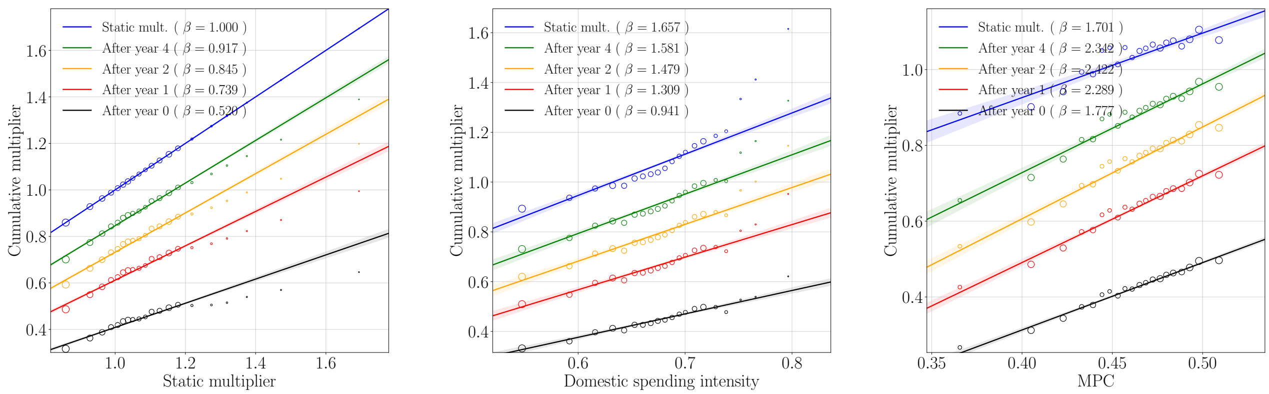
We calibrate MPCs and solve the dynamic model numerically. We describe in detail how we measure the MPCs in Appendix U. We initially use MPCs estimated from a Danish policy during the 2009 recession, but the findings are robust to alternative measures of MPCs estimated in the literature, as we show in Figures A.XVI and A.XVII.

Figure XIIIa shows that the multipliers from the static model are larger than the cumulative ones with a finite horizon from the dynamic model. However, static and dynamic multipliers are closely correlated at every horizon. After around year 4, the cumulative multipliers resemble the static ones in terms of magnitude and the linear association is close to one-to-one. The multipliers in the static model can thus be approximately interpreted as multipliers after year 4.

The structure of disaggregated economic accounts shapes dynamic multipliers similarly to how it shapes static multipliers, as shown by the relation between domestic spending intensity and dynamic multipliers in Figure XIIIb. Rural, old, and non-college-educated cells also have high dynamic multipliers, as shown in Figure A.XV. These findings suggest that disaggregated economic accounts are useful at all horizons.

Figure XIIIc shows that MPCs are also associated with dynamic multipliers. In that sense, spend-

Figure XIII: Dynamic multipliers



(a) Dynamic and static multipliers (b) Multipliers and domestic spending intensity (c) Multipliers and MPCs

Panel a plots the transfer multiplier in the dynamic model for different time horizons against the multiplier in the static model. Panel b plots the transfer multipliers against domestic spending intensity. Panel c plots the transfer multipliers against the marginal propensity to consume (MPC). All panels use MPCs estimated as in Appendix U.A. We show results for alternative MPCs in Figures A.XVI and A.XVII. The detailed construction of the figure is as described in Figure III.

ing patterns in the disaggregated economic accounts and MPCs are complementary determinants of fiscal multipliers. We do not focus on MPCs since a large literature has explored the benefits of MPC-based targeting (see Flynn et al. 2024) and the practical implementation challenges associated with estimating and identifying high-MPC groups (Lewis et al. 2025). MPCs are less important for long-run multipliers because all consumer cells spend the transfer in full in the long run.

IX Discussions of Alternative Accounts and Elasticities

We summarize how changes to the disaggregated economic accounts affect the conclusions on multipliers, with detailed analyses in Appendix W.

First, counterfactual accounts with reversed stylized patterns lead to substantially different multipliers, implying that it is indeed the specific patterns in the disaggregated data documented in Section IV that determine multipliers. Second, we cannot understand the variation in multipliers to the same extent when we impose simplifying assumptions about consumer spending, for example, consumer spending only flows to local producers or to other regions in proportion to intermediates trade. Such assumptions are commonly made in the literature in the absence of disaggregated spending data. Third, domestic spending intensity can also play an important role in less open economies with less foreign trade. Finally, our conclusions about multipliers are robust to using lower and higher elasticities, which are relevant for shorter and longer time horizons.

Taken together, the results imply that we need to measure the fully disaggregated circular flow, including consumer spending, to capture the rich variation in multipliers. Disaggregated economic accounts continue to yield policy-relevant insights in economies with different structures, openness, and time horizons.

X Conclusion

Modern national accounts mostly contain aggregate data, such as national income, consumption, and output, and data on disaggregated flows among producers. However, there is currently no internally consistent system that documents bilateral consumption and income flows between disaggregated groups within a country and fulfills all national accounting identities. The aim of the paper is to develop a proof of concept for such a system and to gauge how it may inform policy.

Using a range of micro data, we measure a system of disaggregated economic accounts in Denmark. The system breaks down national consumer spending, labor and profit income, intermediates trade, taxes, and transfers into bilateral flows among small region-by-industry consumer cells, region-by-industry producer cells, the government, and the rest of the world.

The new data reveal stylized facts on the disaggregated structure of the economy. For instance, we document variation in the share of consumer spending staying in the country, an "urban bias" of consumer spending, and a pattern of triangular flows across urban regions, rural regions, and the rest of the world. We construct measures of "spending intensity" at the cell level, which summarize to what extent spending by a consumer cell accounts for the income of a given group of consumer cells, taking into account all higher-order connections in the disaggregated system.

We develop a general equilibrium model to evaluate how the disaggregated economic accounts can inform fiscal policy. The model includes nominal rigidities, so we can study fiscal transfers during demand-driven recessions where "slack" labor markets experience unemployment.

Through the lens of the disaggregated economic accounts, we find substantial variation in the "bang for the buck" effectiveness of different real-world policies enacted in Denmark. The variation is driven by the disaggregated spending patterns of the consumer cells receiving fiscal transfers. The aggregate GDP multiplier is higher for fiscal transfers targeting cells with high spending intensity on slack cells. The disaggregated economic accounts can yield policy-relevant insights in economies with different structures, openness, and time horizons. In each case, we need to incorporate the full disaggregated system, especially consumer spending patterns, to capture the rich variation in multipliers. In that sense, a disaggregated system can provide additional information that helps governments select more effective policies.

The measurement in this paper relies on existing data and is only a first step toward a fully satisfactory system of disaggregated economic accounts. The potential cost savings implied by our analysis are large, so further measurement efforts may be worthwhile. As transaction-level micro data become widely available and as national agencies find ways to measure disaggregated flows through refined surveys, more precise ways of measuring disaggregated economic accounts may yield even larger benefits.

References

Acemoglu, D., V. M. Carvalho, A. Ozdaglar, and A. Tahbaz-Salehi (2012): "The Network Origins of Aggregate Fluctuations," *Econometrica*, 80, 1977–2016.

Adão, R., C. Arkolakis, and F. Esposito (2020): "General Equilibrium Effects in Space: Theory and Measurement," NBER Working Paper 25544.

Adão, R., P. Carrillo, A. Costinot, D. Donaldson, and D. Pomeranz (2022): "Imports, Exports, and Earnings Inequality: Measures of Exposure and Estimates of Incidence," *Quarterly Journal of Economics*, 137, 1553–1614.

Agarwal, S., J. B. Jensen, and F. Monte (2020): "Consumer Mobility and the Local Structure of Consumption Industries."

Aggarwal, R., A. Auclert, M. Rognlie, and L. Straub (2023): "Excess Savings and Twin Deficits: The Transmission of Fiscal Stimulus in Open Economies," *NBER Macroeconomics Annual*, 37, 325–412.

Aghion, P., C. Antonin, S. Bunel, and X. Jaravel (2024): "Modern Manufacturing Capital, Labor Demand, and Product Market Dynamics: Evidence from France."

Aladangady, A., S. Aron-Dine, W. Dunn, L. Feiveson, P. Lengermann, and C. Sahm (2022): "From Transaction Data to Economic Statistics: Constructing Real-Time, High-Frequency, Geographic Measures of Consumer Spending," in *Big Data for Twenty-First-Century Economic Statistics*: University of Chicago Press, 115–145.

Allen, T., S. Fuchs, S. Ganapati, A. Graziano, R. Madera, and J. Montoriol-Garriga (2023): "Urban Welfare: Tourism in Barcelona."

Alt, J. E., A. Jensen, H. Larreguy, D. D. Lassen, and J. Marshall (2022): "Diffusing Political Concerns: How Unemployment Information Passed Between Social Ties Influences Danish Voters," *Journal of Politics*, 84, 383–404.

Andersen, A. L., K. Huber, N. Johannesen, L. Straub, and E. T. Vestergaard (2022): "Disaggregated Economic Accounts," NBER Working Paper 30630.

Andersen, A. L., A. S. Jensen, N. Johannesen, C. T. Kreiner, S. Leth-Petersen, and A. Sheridan (2023): "How Do Households Respond to Job Loss? Lessons from Multiple High-Frequency Data Sets," *American Economic Journal: Economic Policy*, 15, 1–29.

Andersen, A. L., N. Johannesen, and A. Sheridan (2020): "Bailing out the Kids: New Evidence on Informal Insurance from One Billion Bank Transfers."

Antràs, P., D. Chor, T. Fally, and R. Hillberry (2012): "Measuring the Upstreamness of Production and Trade Flows," *American Economic Review*, 102, 412–16.

Atalay, E. (2017): "How Important Are Sectoral Shocks?" *American Economic Journal: Macroeconomics*, 9, 254–280.

Atkin, D., B. Bernadac, D. Donaldson, T. Grag, and F. Huneeus (2025): "The Incidence of Distortions."

Auclert, A., M. Rognlie, and L. Straub (2020): "Micro Jumps, Macro Humps: Monetary Policy and Business Cycles in an Estimated HANK Model."

——— (2024): "The Intertemporal Keynesian Cross," *Journal of Political Economy*, 132, 4068–4121.

Autor, D., D. Dorn, G. Hanson, and K. Majlesi (2020): "Importing Political Polarization? The Electoral Consequences of Rising Trade Exposure," *American Economic Review*, 110, 3139–3183.

Bachmann, R., D. Baqaee, C. Bayer, M. Kuhn, A. Löschel, B. Moll, A. Peichl, K. Pittel, and M. Schularick (2024): "What If? The Macroeconomic and Distributional Effects for Germany of a Stop of Energy Imports from Russia," *Economica*, 91, 1157–1200.

Baker, S. R. (2018): "Debt and the Response to Household Income Shocks: Validation and Application of Linked Financial Account Data," *Journal of Political Economy*, 126, 1504–1557.

Baker, S. R., and L. Kueng (2022): "Household Financial Transaction Data," *Annual Review of Economics*, 14, 47–67.

Baqaee, D. R., and E. Farhi (2019a): "The Macroeconomic Impact of Microeconomic Shocks: Beyond Hulten's Theorem," *Econometrica*, 87, 1155–1203.

——— (2019b): "Macroeconomics with Heterogeneous Agents and Input-Output Networks," NBER Working Paper 24684.

——— (2020): "Productivity and Misallocation in General Equilibrium," *Quarterly Journal of Economics*, 135, 105–163.

——— (2022): "Supply and Demand in Disaggregated Keynesian Economies with an Application to the Covid-19 Crisis," *American Economic Review*, 112, 1397–1436.

——— (2024): "Networks, Barriers, and Trade," *Econometrica*, 92, 505–541.

Baqaee, D., and E. Rubbo (2023): "Micro Propagation and Macro Aggregation," *Annual Review of Economics*, 15, 91–123.

Barro, R. J., and H. I. Grossman (1971): "A General Disequilibrium Model of Income and Employment," *American Economic Review*, 61, 82–93.

Beraja, M., E. Hurst, and J. Ospina (2019): "The Aggregate Implications of Regional Business Cycles," *Econometrica*, 87, 1789–1833.

Bernard, A. B., E. Dhyne, G. Magerman, K. Manova, and A. Moxnes (2022): "The Origins of Firm Heterogeneity: A Production Network Approach," *Journal of Political Economy*, 130, 1765–1804.

Biermann, M., and K. Huber (2024): "Tracing the International Transmission of a Crisis through Multinational Firms," *Journal of Finance*, 79, 1789–1829.

Bigio, S., and J. La'O (2020): "Distortions in Production Networks," *Quarterly Journal of Economics*, 135, 2187–2253.

Blanchard, O. J. (1985): "Debt, Deficits, and Finite Horizons," *Journal of Political Economy*, 93, 223–247.

Blanchet, T., L. Chancel, I. Flores, M. Morgan, F. Alvaredo, A. B. Atkinson, L. Bauluz, M. Fisher-Post, B. Garbinti, J. Goupille-Lebret, C. Martínez-Toledano, T. Neef, T. Piketty, A.-S. Robilliard, E. Saez, L. Yang, and G. Zucman (2021): *Distributional National Accounts Guidelines*: World Inequality Lab.

Boehm, C. E., A. A. Levchenko, and N. Pandalai-Nayar (2023): "The Long and Short (Run) of Trade Elasticities," *American Economic Review*, 113, 861–905.

Boehm, J., E. Fize, and X. Jaravel (2025): "Five Facts About MPCs: Evidence from a Randomized Experiment," *American Economic Review*, 115, 1–42.

Borusyak, K., and X. Jaravel (2021): "The Distributional Effects of Trade: Theory and Evidence from the United States."

Broda, C., and J. A. Parker (2014): "The economic stimulus payments of 2008 and the aggregate demand for consumption," *Journal of Monetary Economics*, 68, S20–S36.

Buda, G., V. M. Carvalho, S. Hansen, Á. Ortiz, R. Tomasa, and J. V. Rodríguez Mora (2022): "National Accounts in a World of Naturally Occurring Data: A Proof of Concept for Consumption."

Caballero, R. J., E. Farhi, and P.-O. Gourinchas (2008): "An equilibrium model of global imbalances and low interest rates," *American economic review*, 98, 358–393.

Caliendo, L., M. Dvorkin, and F. Parro (2019): "Trade and Labor Market Dynamics: General Equilibrium Analysis of the China Trade Shock," *Econometrica*, 87, 741–835.

Caliendo, L., and F. Parro (2015): "Estimates of the Trade and Welfare Effects of NAFTA," *Review of Economic Studies*, 82, 1–44.

Caliendo, L., F. Parro, E. Rossi-Hansberg, and P.-D. Sarte (2018): "The Impact of Regional and Sectoral Productivity Changes on the U.S. Economy," *Review of Economic Studies*, 85, 2042–2096.

Cantillon, R. (1755): *Essai sur la Nature du Commerce en Général*: Fletcher Gyles.

Card, D., J. Heining, and P. Kline (2013): "Workplace Heterogeneity and the Rise of West German Wage Inequality," *Quarterly Journal of Economics*, 128, 967–1015.

Carvalho, V. M., M. Nirei, Y. U. Saito, and A. Tahbaz-Salehi (2021): "Supply Chain Disruptions: Evidence From the Great East Japan Earthquake," *Quarterly Journal of Economics*, 136, 1255–1321.

Charles, K. K., E. Hurst, and M. Schwartz (2019): "The Transformation of Manufacturing and the Decline in US Employment," *NBER Macroeconomics Annual*, 33, 307–372.

Chetty, R., J. N. Friedman, N. Hendren, M. Stepner, and Opportunity Insights Team (2024): "The

Economic Impacts of COVID-19: Evidence From a New Public Database Built Using Private Sector Data," *Quarterly Journal of Economics*, 139, 829–889.

Chodorow-Reich, G. (2019): "Geographic Cross-Sectional Fiscal Spending Multipliers: What Have We Learned?," *American Economic Journal: Economic Policy*, 11, 1–34.

Costinot, A., and A. Rodríguez-Clare (2014): "Trade Theory With Numbers: Quantifying the Consequences of Globalization," in *Handbook of International Economics* Volume 4, 197–261.

Cox, N., P. Ganong, P. Noel, J. Vavra, A. Wong, D. Farrell, F. Greig, and E. Deadman (2020): "Initial Impacts of the Pandemic on Consumer Behavior: Evidence from Linked Income, Spending, and Savings Data," *Brookings Papers on Economic Activity*, 2020, 35–82.

Davis, D. R., J. I. Dingel, J. Monras, and E. Morales (2019): "How Segregated Is Urban Consumption?" *Journal of Political Economy*, 127, 1684–1738.

Dhyne, E., A. K. Kikkawa, M. Mogstad, and F. Tintelnot (2021): "Trade and Domestic Production Networks," *Review of Economic Studies*, 88, 643–668.

Diamond, R., and E. Moretti (2024): "Where Is Standard of Living the Highest? Local Prices and the Geography of Consumption."

Dunn, A., and M. Gholizadeh (2020): "The Geography of Consumption and Local Economic Shocks: The Case of the Great Recession."

Eckert, F. (2019): "Growing Apart: Tradable Services and the Fragmentation of the U.S. Economy."

Ehrlich, G., J. C. Haltiwanger, R. S. Jarmin, D. Johnson, and M. D. Shapiro (2022): "Reengineering Key National Economic Indicators," in *Big Data for Twenty-First-Century Economic Statistics*: University of Chicago Press, 25–68.

Faber, B., and C. Gaubert (2019): "Tourism and Economic Development: Evidence from Mexico's Coastline," *American Economic Review*, 109, 2245–2293.

Farhi, E., and I. Werning (2014): "Labor Mobility Within Currency Unions," NBER Working Paper 20105.

——— (2016): "Fiscal Multipliers: Liquidity Traps and Currency Unions," in *Handbook of Macroeconomics* Volume 2: Elsevier, 2417–2492.

——— (2019): "Monetary policy, bounded rationality, and incomplete markets," *American Economic Review*, 109, 3887–3928.

Fitch (2025): "US Effective Tariff Rate May Jump to 19.4% with New Reciprocal Levies," FitchRatings, https://www.fitchratings.com/research/sovereigns/us-effective-tariff-rate-may-jump-to-19-4-with-new-reciprocal-levies-17-07-2025.

Flynn, J. P., C. Patterson, and J. Sturm (2024): "Fiscal Policy in a Networked Economy."

Foster, W. T. (1922): "The Circuit Flow of Money," *American Economic Review*, 12, 460–473.

Gabaix, X. (2011): "The Granular Origins of Aggregate Fluctuations," *Econometrica*, 79, 733–772.

Gabaix, X., and R. S. Koijen (2024): "Granular Instrumental Variables," *Journal of Political Economy*, 132, 2274–2303.

Galí, J. (2015): *Monetary policy, inflation, and the business cycle: an introduction to the new Keynesian framework and its applications*: Princeton University Press.

Galle, S., A. Rodríguez-Clare, and M. Yi (2023): "Slicing the Pie: Quantifying the Aggregate and Distributional Effects of Trade," *Review of Economic Studies*, 90, 331–375.

Giesecke, J. A., and J. R. Madden (2013): "Regional Computable General Equilibrium Modeling," in *Handbook of Computable General Equilibrium Modeling* Volume 1, 379–475.

Giroud, X., S. Lenzu, Q. Maingi, and H. Mueller (2024): "Propagation and Amplification of Local Productivity Spillovers," *Econometrica*, 92, 1589–1619.

Giroud, X., and H. M. Mueller (2019): "Firms' Internal Networks and Local Economic Shocks," *American Economic Review*, 109, 3617–3649.

Glaeser, E. L., H. Kim, and M. Luca (2022): "Nowcasting the Local Economy: Using Yelp Data to Measure Economic Activity," in *Big Data for Twenty-First-Century Economic Statistics*: University of Chicago Press, 249–273.

Glaeser, E. L., and J. E. Kohlhase (2004): "Cities, Regions and the Decline of Transport Costs," in *Fifty Years of Regional Science*: Springer, 197–228.

Glaeser, E. L., J. Kolko, and A. Saiz (2001): "Consumer City," *Journal of Economic Geography*, 1, 27–50.

Gourinchas, P.-O., Á. Kalemli-Özcan, V. Penciakova, and N. Sander (2021): "Fiscal Policy in the Age of COVID: Does it 'Get in All of the Cracks?'."

Greenstone, M., R. Hornbeck, and E. Moretti (2010): "Identifying Agglomeration Spillovers: Evidence from Winners and Losers of Large Plant Openings," *Journal of Political Economy*, 118, 536–598.

Guerrieri, V., G. Lorenzoni, L. Straub, and I. Werning (2021): "Monetary Policy in Times of Structural Reallocation," *Proceedings, Economic Policy Symposium 2021, Jackson Hole.*

——— (2022): "Macroeconomic Implications of COVID-19: Can Negative Supply Shocks Cause Demand Shortages?" *American Economic Review*, 112, 1437–1474.

Guriev, S., and E. Papaioannou (2022): "The Political Economy of Populism," *Journal of Economic Literature*, 60, 753–832.

Handbury, J., and D. E. Weinstein (2015): "Goods Prices and Availability in Cities," *Review of Economic Studies*, 82, 258–296.

Head, K., and T. Mayer (2014): "Gravity Equations: Workhorse, Toolkit, and Cookbook," in *Handbook of International Economics* Volume 4: Elsevier, 131–195.

Hendren, N., and B. Sprung-Keyser (2020): "A Unified Welfare Analysis of Government Policies," *Quarterly Journal of Economics*, 135, 1209–1318.

Horvath, M. (2000): "Sectoral Shocks and Aggregate Fluctuations," *Journal of Monetary Economics*, 45, 69–106.

Huber, K. (2018): "Disentangling the Effects of a Banking Crisis: Evidence from German Firms and Counties," *American Economic Review*, 108, 868–898.

——— (2023): "Estimating General Equilibrium Spillovers of Large-Scale Shocks," *Review of Financial Studies*, 36, 1548–1584.

Huneeus, F. (2018): "Production Network Dynamics and the Propagation of Shocks."

Jacomy, M., T. Venturini, S. Heymann, and M. Bastian (2014): "ForceAtlas2, a Continuous Graph Layout Algorithm for Handy Network Visualization Designed for the Gephi Software," *PloS one*, 9, e98679.

Jones, C. I. (2011): "Intermediate Goods and Weak Links in the Theory of Economic Development," *American Economic Journal: Macroeconomics*, 3, 1–28.

Kaplan, G., B. Moll, and G. L. Violante (2018): "Monetary Policy According to HANK," *American Economic Review*, 108, 697–743.

Knight, F. H. (1933): "The Economic Organization."

Kreiner, C. T., D. Dreyer Lassen, and S. Leth-Petersen (2019): "Liquidity Constraint Tightness and Consumer Responses to Fiscal Stimulus Policy," *American Economic Journal: Economic Policy*, 11, 351–79.

Lahn, J. J. O. (1903): *Der Kreislauf des Geldes und Mechanismus des Sozialebens*: Puttkammer & Mühlbrecht.

La'O, J., and A. Tahbaz-Salehi (2022): "Optimal Monetary Policy in Production Networks," *Econometrica*, 90, 1295–1336.

vom Lehn, C., and T. Winberry (2022): "The Investment Network, Sectoral Comovement, and the Changing U.S. Business Cycle," *Quarterly Journal of Economics*, 137, 387–433.

Leontief, W., and A. Strout (1963): "Multiregional Input-Output Analysis," in *Structural Interdependence and Economic Development*: Springer, 119–150.

Lewis, D., D. Melcangi, and L. Pilossoph (2025): "Latent Heterogeneity in the Marginal Propensity to Consume."

Liu, E. (2019): "Industrial Policies in Production Networks," *Quarterly Journal of Economics*, 134, 1883–1948.

Long Jr., J. B., and C. I. Plosser (1983): "Real Business Cycles," *Journal of Political Economy*, 91, 39–69.

Matvos, G., and A. Seru (2014): "Resource Allocation Within Firms and Financial Market Dislocation: Evidence from Diversified Conglomerates," *Review of Financial Studies*, 27, 1143–1189.

Mian, A. R., L. Straub, and A. Sufi (2021): "The Saving Glut of the Rich," NBER Working Paper 26941.

Miyauchi, Y., K. Nakajima, and S. J. Redding (2025): “The Economics of Spatial Mobility: Theory and Evidence Using Smartphone Data.”
Miyazawa, K. (1976): “Input-Output Analysis and Interrelational Income Multiplier as a Matrix,” in *Input-Output Analysis and the Structure of Income Distribution*, 22–42.
Monte, F., S. J. Redding, and E. Rossi-Hansberg (2018): “Commuting, Migration, and Local Employment Elasticities,” *American Economic Review*, 108, 3855–3890.
Nakamura, E., and J. Steinsson (2014): “Fiscal Stimulus in a Monetary Union: Evidence from US Regions,” *American Economic Review*, 104, 753–792.
Parker, J. A., N. S. Souleles, D. S. Johnson, and R. McClelland (2013): “Consumer Spending and the Economic Stimulus Payments of 2008,” *American Economic Review*, 103, 2530–2553.
Paweenawat, A., and R. M. Townsend (2024): *Inequality and Globalization: Improving Measurement through Integrated Financial Accounts*: Princeton University Press.
Piketty, T., E. Saez, and G. Zucman (2018): “Distributional National Accounts: Methods and Estimates for the United States,” *Quarterly Journal of Economics*, 133, 553–609.
Quesnay, F. (1758): *Tableau Economique.*
Redding, S. J., and M. A. Turner (2015): “Transportation Costs and the Spatial Organization of Economic Activity,” *Handbook of Regional and Urban Economics*, 5, 1339–1398.
Reinert, K. A., and D. W. Roland-Holst (1997): “Social Accounting Matrices,” *Applied Methods for Trade Policy Analysis: A Handbook*, 94.
Rodríguez-Clare, A., M. Ulate, and J. P. Vasquez (2025): “Trade With Nominal Rigidities: Understanding the Unemployment and Welfare Effects of the China Shock,” *Journal of Political Economy*, forthcoming.
Rodrik, D. (2021): “Why Does Globalization Fuel Populism? Economics, Culture, and the Rise of Right-Wing Populism,” *Annual Review of Economics*, 13, 133–170.
Rossi-Hansberg, E., P.-D. Sarte, and F. Schwartzman (2025): “Cognitive Hubs and Spatial Redistribution,” *American Economic Journal: Macroeconomics*, forthcoming.
——— (2023b): “Networks, Phillips Curves, and Monetary Policy,” *Econometrica*, 91, 1417–1455.
Saez, E., and G. Zucman (2016): “Wealth Inequality in the United States Since 1913: Evidence from Capitalized Income Tax Data,” *Quarterly Journal of Economics*, 131, 519–578.
——— (2022): “Top Wealth in America: A Reexamination.”
Schmitt-Grohé, S., and M. Uribe (2016): “Downward Nominal Wage Rigidity, Currency Pegs, and Involuntary Unemployment,” *Journal of Political Economy*, 124, 1466–1514.
Shoag, D., and S. Veuger (2018): “Shops and the City: Evidence on Local Externalities and Local Government Policy from Big-Box Bankruptcies,” *Review of Economics and Statistics*, 100, 440–453.
Silva, J. S., and S. Tenreyro (2006): “The Log of Gravity,” *Review of Economics and Statistics*, 88, 641–658.
Simonovska, I., and M. E. Waugh (2014): “The Elasticity of Trade: Estimates and Evidence,” *Journal of International Economics*, 92, 34–50.
Smith, M., O. Zidar, and E. Zwick (2023): “Top Wealth in America: New Estimates under Heterogeneous Returns,” *Quarterly Journal of Economics*, 138, 515–573.
Stone, R. (1961): *Input-Output and National Accounts*: Organisation for European Economic Co-operation.
Vavra, J. (2021): “Tracking the Pandemic in Real Time: Administrative Micro Data in Business Cycles Enters the Spotlight,” *Journal of Economic Perspectives*, 35, 47–66.
Woodford, M. (2022): “Effective Demand Failures and the Limits of Monetary Stabilization Policy,” *American Economic Review*, 112, 1475–1521.
Yaari, M. E. (1965): “Uncertain Lifetime, Life Insurance, and the Theory of the Consumer,” *Review of Economic Studies*, 32, 137–150.

Online Appendix to

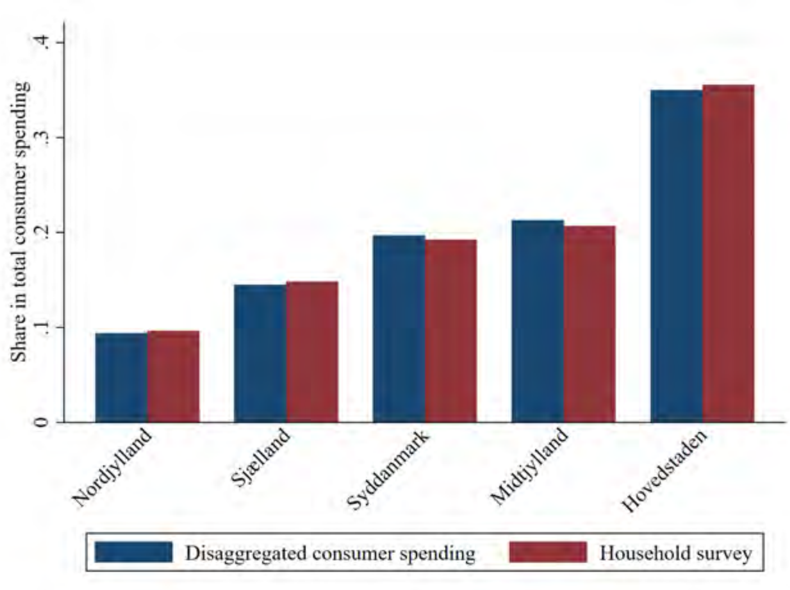
Disaggregated Economic Accounts

Appendix Contents

Appendix A Additional Figures and Tables

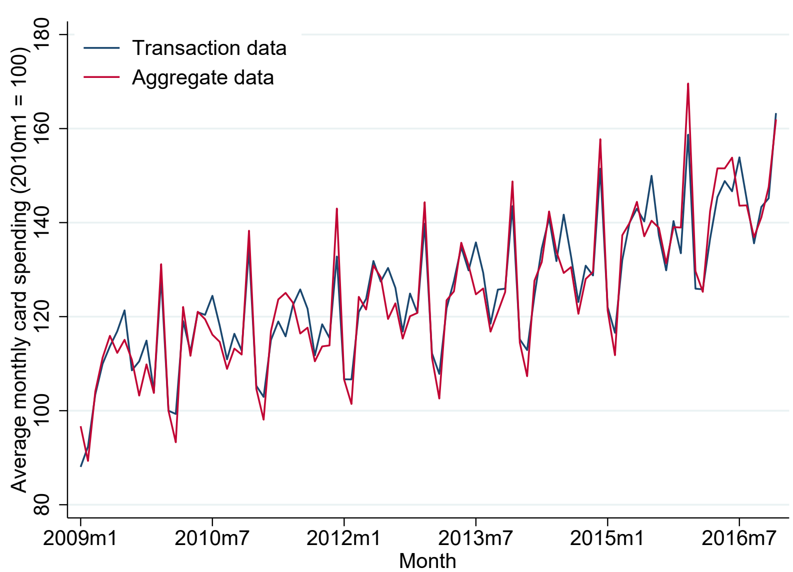
Appendix A.A Measurement

Figure A.I: Consumer spending shares in the disaggregated accounts and a household survey



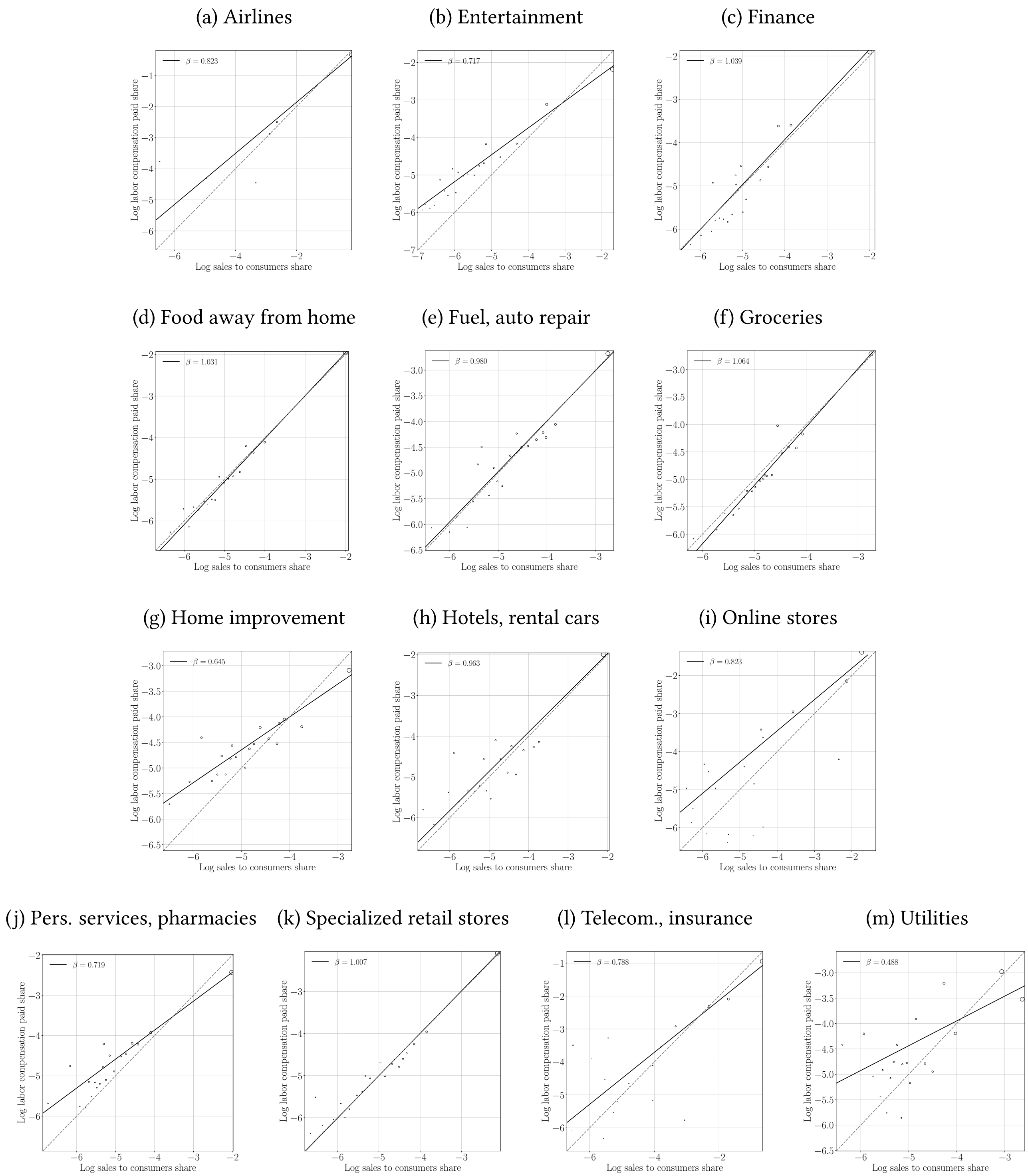
The figure compares consumer spending shares at the level of aggregated regions from the disaggregated consumer spending matrix to the Danish household budget survey.

Figure A.II: Consumer card spending over time



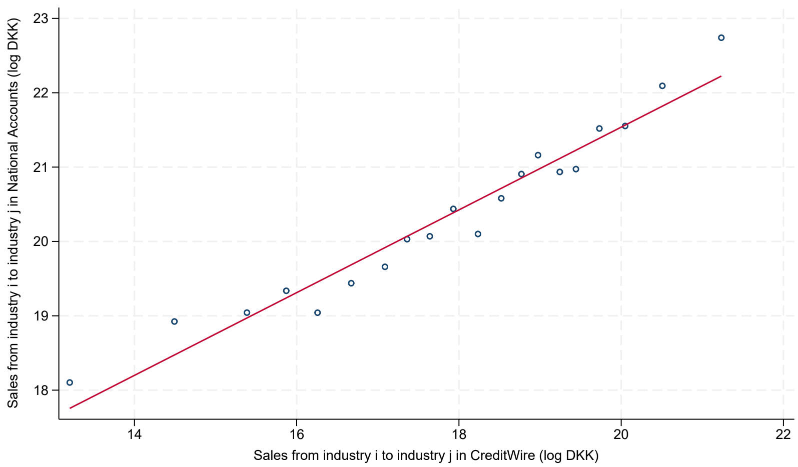
The figure compares aggregated consumer card spending over time in data from Danske Bank and Statistics Denmark (statistikbanken.dk/MPK60).

Figure A.III: Labor income shares and consumer spending shares across regions



The panels show binned scatter plots using data for one industry each. Each panel plots log labor compensation paid by producers in the region (as share of total labor compensation in an industry) against log consumer spending received by producers in the region (as share of total consumer spending in an industry). The solid lines are the lines of best fit, estimated using the cell-level data. Each circle contains the same number of regions. The size of a circle is proportional to the population size of cells in the region. The regressions are weighted by population in the region. Standard errors are clustered by region. The error bands are 95% confidence intervals.

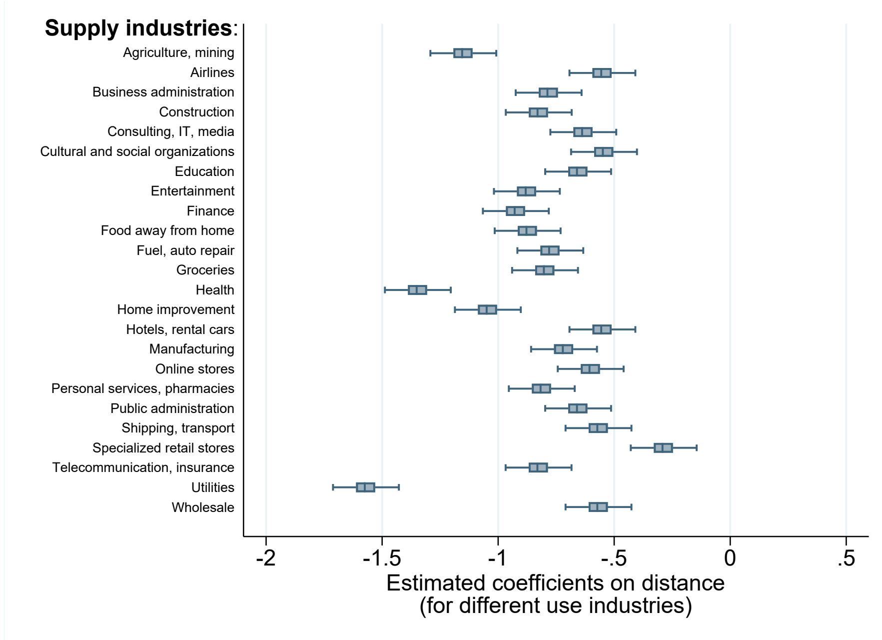
Figure A.IV: Industry-to-industry sales in CrediWire and national accounts



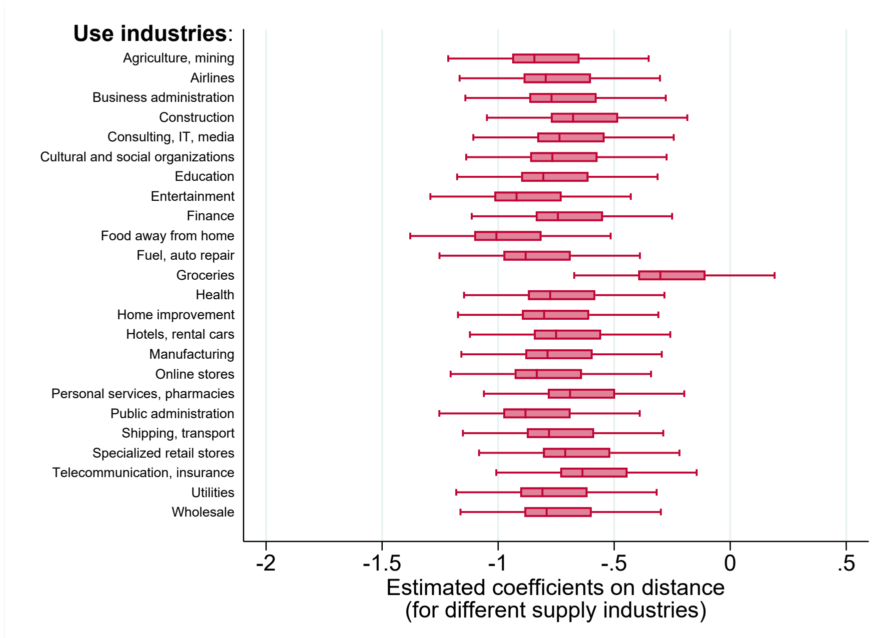
We construct a matrix of industry-to-industry intermediates transactions using the CrediWire data by aggregating transactions in CrediWire. We then plot a binned scatter plot of entries in the matrix using CrediWire data against the corresponding entries in the national accounts input-output table for intermediates trade. The high correlation suggests that the Crediwire data are broadly representative in terms of the distribution across supply and use industries.

Figure A.V: Distance coefficients for different industries

(a) By supply industry



(b) By use industry



The figure illustrates how the effect of distance on producer-to-producer trade varies across industries in the CrediWire data. We use a gravity specification to obtain estimates of the elasticity of trade with respect to distance for each combination of supply industry and use industry (576 estimates). Panel a shows the distribution of distance elasticity estimates for each supply industry separately (24 estimates in each case). Panel b shows the distribution of distance elasticity estimates for each use industry separately (24 estimates in each case). The box plots indicate the median elasticity estimate (the line inside the box), the quartiles (the edges of the box), and the upper and lower adjacent values (the whiskers).

Table A.I: Classification of industries

	Producer industry	Produces output	Sells directly to consumers	Pays labor compensation to consumers ("work industry")
1	Food away from home	Yes	Yes	Yes
2	Entertainment	Yes	Yes	Yes
3	Groceries	Yes	Yes	Yes
4	Personal services, pharmacies	Yes	Yes	Yes
5	Vehicles, fuel, vehicle repair, public transport	Yes	Yes	Yes
6	Hotels, rental cars	Yes	Yes	Yes
7	Airlines	Yes	Yes	Yes
8	Telecommunication, insurance	Yes	Yes	Yes
9	Online stores	Yes	Yes	Yes
10	Utilities	Yes	Yes	Yes
11	Specialized retail stores	Yes	Yes	Yes
12	Home improvement	Yes	Yes	Yes
13	Consulting, information technology, media	Yes	No	Yes
14	Business administration and janitorial services	Yes	No	Yes
15	Manufacturing	Yes	No	Yes
16	Wholesale	Yes	No	Yes
17	Finance, real estate	Yes	Yes	Yes
18	Cultural and social organizations	Yes	Yes	Yes
19	Agriculture, mining	Yes	No	Yes
20	Construction	Yes	No	Yes
21	Shipping, transport	Yes	No	Yes
22	Out of workforce and others	No	No	No
23	Retired	No	No	No
24	Health	Yes	No	Yes
25	Students	No	No	No
26	Education	Yes	No	Yes
27	Public administration	Yes	No	Yes
28	unemployed	No	No	No
29	Private landlords	Yes	Yes	No
30	Owner-occupied housing	Yes	Yes	No
31	Government-owned housing	Yes	Yes	No

The table lists the industry classification used throughout the paper. Specialized retail stores include shops selling a specialized set of goods not listed in another industry, e.g., books, computers, shoes, clothing.

Table A.II: Summary statistics on the population and Danske Bank sample

	Full population	Danske Bank sample
Number of adults	4,367,226	858,409
Mean age	48.56	49.97
Mean income (DKK)	298,834	281,039
Age distribution		
18-39	0.35	0.34
40-59	0.35	0.32
60+	0.30	0.34
Income distribution		
Quintile 1	0.20	0.22
Quintile 2	0.20	0.23
Quintile 3	0.20	0.21
Quintile 4	0.20	0.18
Quintile 5	0.20	0.17
Ratio of liquid assets to income distribution		
Quintile 1	0.20	0.20
Quintile 2	0.20	0.21
Quintile 3	0.20	0.19
Quintile 4	0.20	0.20
Quintile 5	0.20	0.20

The table compares summary statistics for the Danish population from administrative registers with our sample of Danske Bank customers.

Appendix A.B Stylized Facts

Table A.III: Determinants of domestic spending shares

	(1)	(2)	(3)	(4)	(5)	(6)
	Domestic spending share					
Log population in region	-1.10***		-0.83***		-1.08***	-1.16***
	(0.21)		(0.19)		(0.15)	(0.18)
Age	0.19***	0.20***	0.23***	0.36***	0.18***	0.18***
	(0.029)	(0.029)	(0.042)	(0.049)	(0.023)	(0.033)
College-educated share	-8.77***	-7.29***	-12.4***	-5.03*	-7.61***	-6.64***
	(1.89)	(2.24)	(1.83)	(2.60)	(2.40)	(1.96)
Log density		-0.60***				
		(0.15)				
Distance to border					1.01***	1.03***
					(0.19)	(0.21)
Income (std.)					0.16	
					(0.40)	
Leverage (std.)						-0.13
						(0.34)
Liquid assets (std.)						-0.15
						(0.11)
Iliquid assets (std.)						-0.024
						(0.32)
Observations	2,523	2,523	2,523	2,523	2,523	2,523
Industry FE	No	No	Yes	Yes	No	No
Region FE	No	No	No	Yes	No	No
R^2	0.45	0.44	0.65	0.74	0.49	0.49

The outcome is the share of spending going to domestic producer cells relative to total spending. Distance to border is the driving duration from the region center to the nearest of eight foreign addresses (Malmø, Helsingborg, Rostock, Puttgarden, and four large border shopping centers along the Jutland-Germany border) on Google Maps. Income, leverage, liquid assets, and illiquid assets are standardized to have a mean of 0 and standard deviation of 1. Income is average total post-tax income of consumers in the cell. Leverage is total debt divided by total assets (liquid plus illiquid assets). Liquid assets is the average value of total financial assets (including bank deposits, stocks, bonds, investment funds) owned by consumers in the cell. Illiquid assets is the average value of non-financial assets (including housing, cars, pensions) owned by consumers in the cell. Standard errors are clustered by consumer region and consumer industry. The regressions are weighted by population in the consumer cell. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

Table A.IV: Consumer spending gravity regression for inflows into urban regions

	Log spending	
	(1)	*(2)*
Log distance	-1.463^{***}	-1.782^{***}
	(0.028)	(0.119)
Log distance $\times$ log dest. pop.		0.573^{***}
		(0.209)
Origin FE	Yes	Yes
Destination FE	Yes	Yes
Observations	2561036	2561036
R^2	0.332	0.333

Distance is measured as driving distance on Google Maps between region centers. For the interaction terms, we normalize log population to range from 0 to 1 across regions. The interaction coefficient therefore shows the change in the distance gradient when moving from lowest to highest population size. We include only spending to Danish producers in the regressions.Standard errors are clustered by consumer region and consumer industry. The regressions are weighted by population in the consumer cell. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

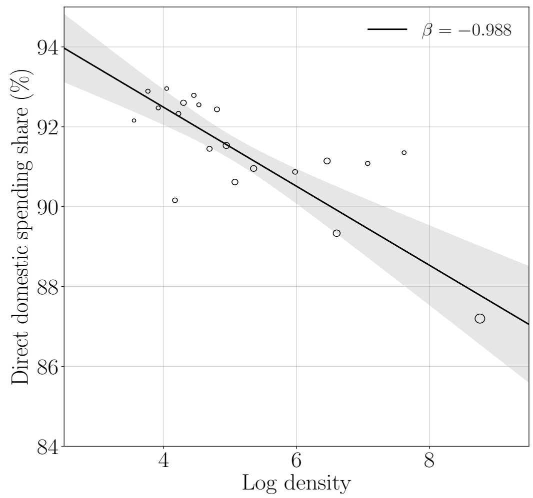
Table A.VI: External trade surplus across regions by region size

Regions	Adult population	External trade surplus	External trade surplus per adult
15 most populous regions	1,962,365	27.39 bn DKK	13,956 DKK
70 least populous regions	1,970',472	124.47 bn DKK	63,166 DKK

Table A.VII: Internal trade surplus across regions by region size

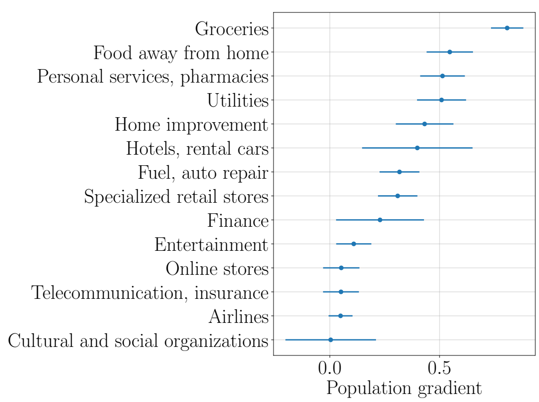
Regions	Adult population	Internal trade surplus	Internal trade surplus per adult
15 most populous regions	1,962,365	534.87 bn DKK	272,564 DKK
70 least populous regions	1,'970,472	297.00 bn DKK	150,724 DKK

Figure A.VI: Domestic spending share by log density



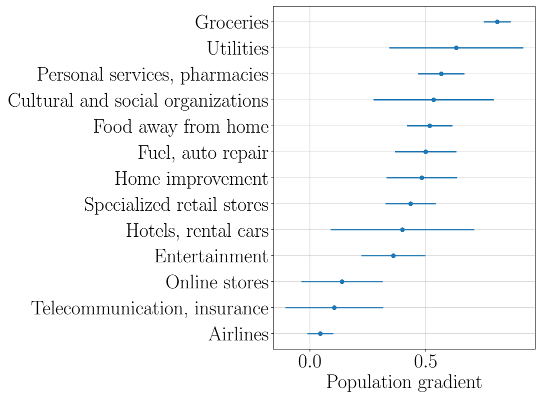
The figure replicates Figure III using log population density on the horizontal axis.

Figure A.VII: Population of home and receiving region: all spending



This plot shows coefficients from regressions of the average log population of regions receiving consumer spending from a consumer cell on the log population of the consumer cell's region. Each coefficient comes from a different regression using only data for one industry. The regressions are weighted by consumer cell population. Standard errors are two-way clustered by producer cell and consumer cell. The error bands are 95% confidence intervals.

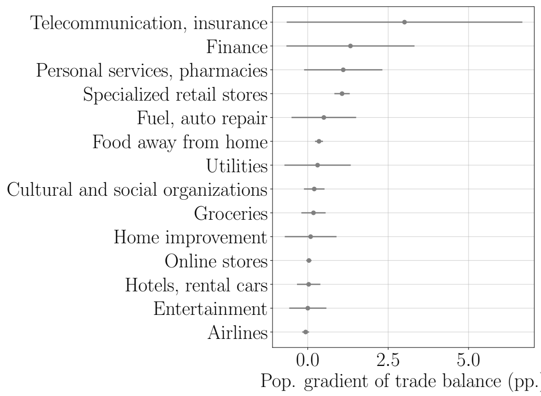
Figure A.VIII: Population of home and receiving region: only in-person spending



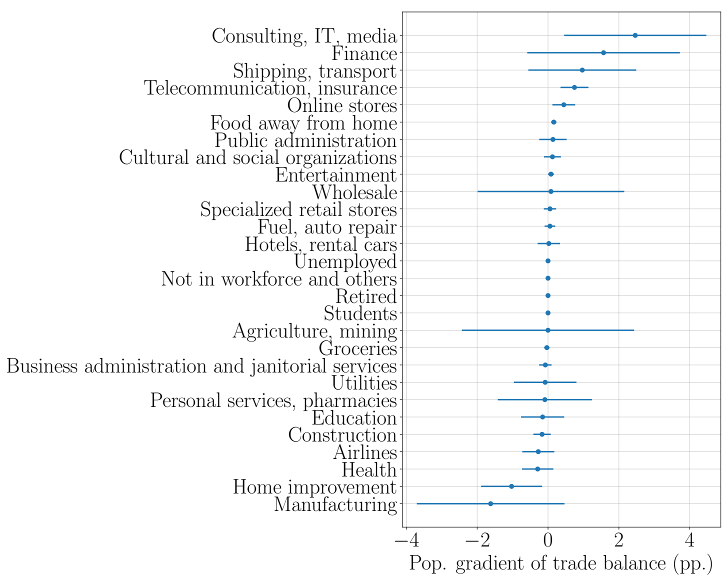
This plot replicates Figure A.VII using data for only spending carried out in person. We exclude finance since offline spending is rarely observed for the finance industry.

Figure A.IX: Internal trade surpluses and population size by industry

(a) Consumer spending

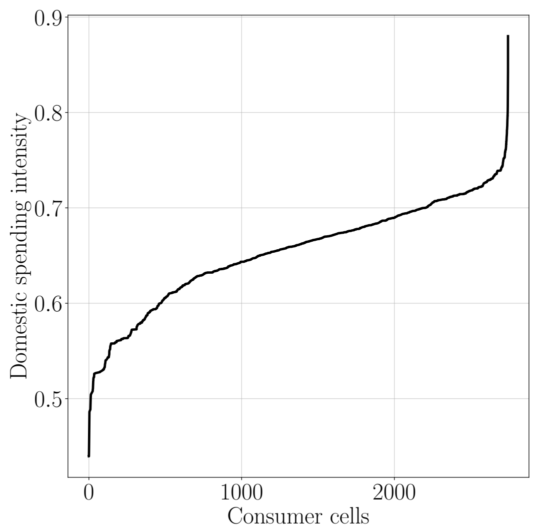


(b) Intermediates trade



This plot shows estimated coefficients of a regression of the internal trade surplus (sales to other domestic regions minus purchases by other domestic regions) on log population. Each coefficient comes from a different regression using only data for one industry. Panel a uses data on consumer spending and panel b on intermediates trade. The regressions are weighted by population in the region. Standard errors are clustered by region. The error bands are 95% confidence intervals.

Figure A.X: Distribution of domestic spending intensity



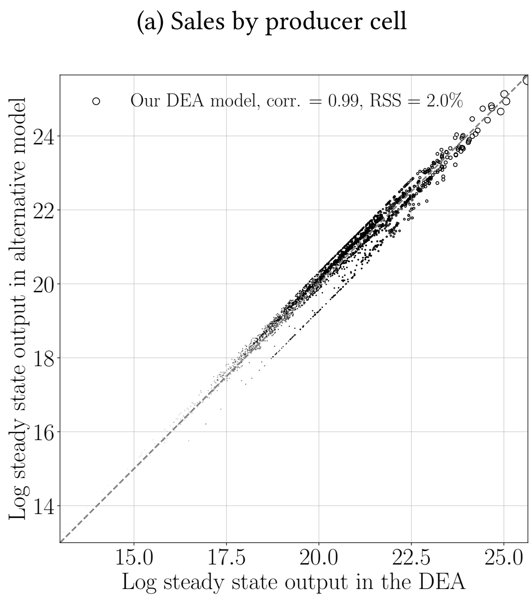
The figure plots the distribution of domestic spending intensity across consumer cells.

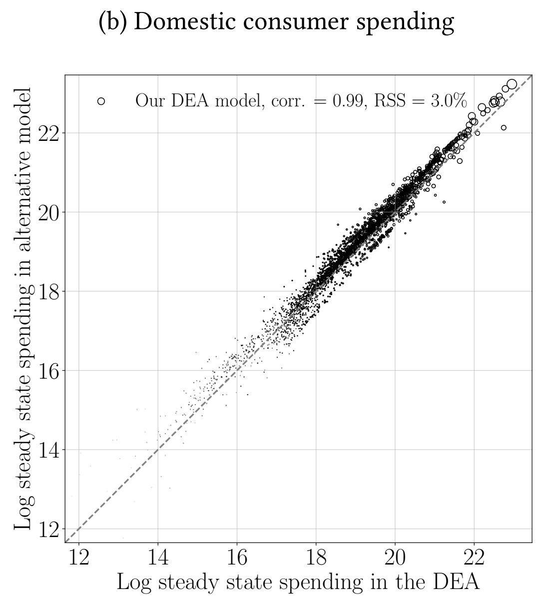
Appendix A.C Details on Calibration

Table A.VIII: Overview of baseline calibration

Parameter(s)	Symbol	Calibration target	Flow numbers from Table I
Spending shares	α_{ji}	Disaggregated consumer spending flows	1, 2
Consumer tax rate	τ_i	Consumer product taxes paid	3, 4, 5
		Consumer non-product taxes and social contributions	
Corporate tax rate	τ_j	Dividends and surplus from gov. enterprises, taxes	22, 23, 24, 25
Labor compensation shares	λ_{ij}	Disaggregated labor comp. flows, incl. to foreign workers	10, 28
Profit income shares	κ_{ij}, γ_j	Mixed income, surplus to consumers	11, 12, 13
Intermediate input shares, imports	$\omega_{j'j}$	Trade flows in domestic intermediates, producer imports	21, 27
Gov. transfer share of gov. revenue	$\frac{T_i}{\sum_{i\in\mathcal{I}} \tau_i Y_i + \sum_{j\in\mathcal{J}} \tau_j \Pi_j}$	Consumer social benefits received, pension adjustment	14, 15
Gov. spending share of gov. revenue	$\frac{P_j G_j}{\sum_{i\in\mathcal{I}} \tau_i Y_i + \sum_{j\in\mathcal{J}} \tau_j \Pi_j}$	Domestic government spending	29
Relative distribution of exports	$\tilde{x}_j / \tilde{x}_{j'}$	Producer exports	31
Gov. import share of gov. revenue	$\tilde{g}$	Government imports	32
Aggregate export flows	$\tilde{x}_j$	Aggregate GDP	
Elasticity of export demand	$\tilde{\sigma}$	Cobb-Douglas (1) as baseline, higher in robustness	
Transfer from abroad	Δ	Zero absent any transfer shock	

Figure A.XI: Match between model economy and disaggregated accounts



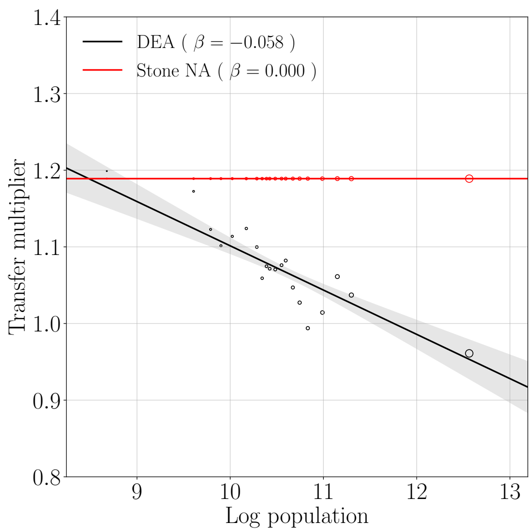


Panel a shows a scatter plot of log producer cell output in the model relative to the disaggregated accounts. Node size is proportional to producer cell output in the disaggregated accounts. Panel b shows a scatter plot of log consumer spending in the model relative to the disaggregated accounts. Node size is proportional to domestic spending in the disaggregated accounts. "corr" stands for correlation. "RSS" stands for the residual sum of squares. RSS captures the variance in the data not explained by the model, var$(y^{data} - y^{model})$, for any variable y, in percent of variance in the data var(y^{data}). RSS larger than 100% would imply that the variation in the model does not explain the data well.

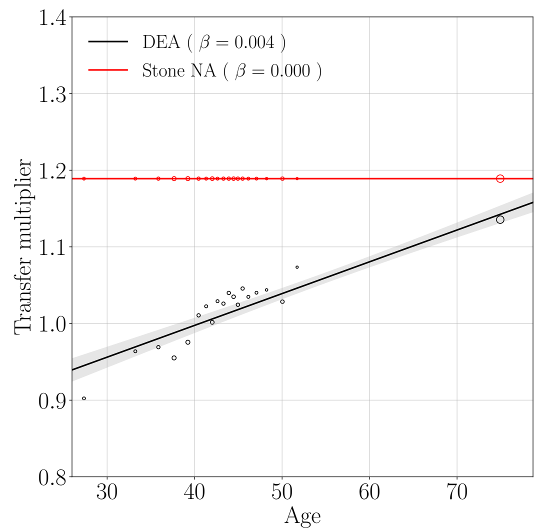
Appendix A.D Fiscal Transfer Multipliers

Figure A.XII: Multipliers and consumer characteristics

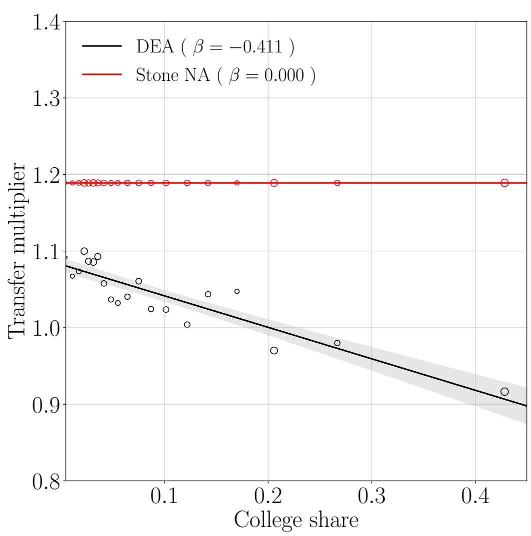
(a) By region size



(b) By age



(c) By college education



(d) By region density

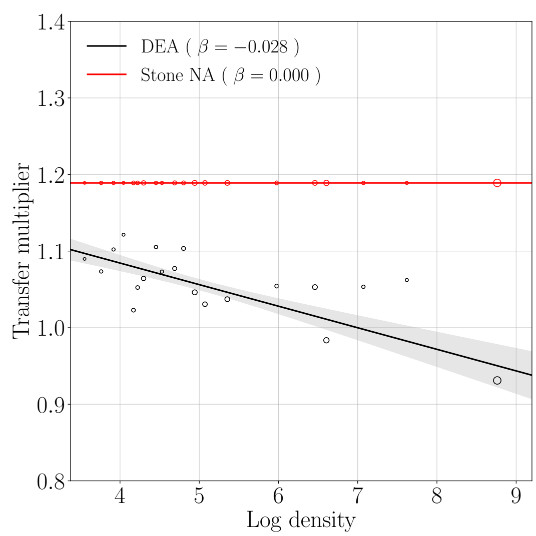
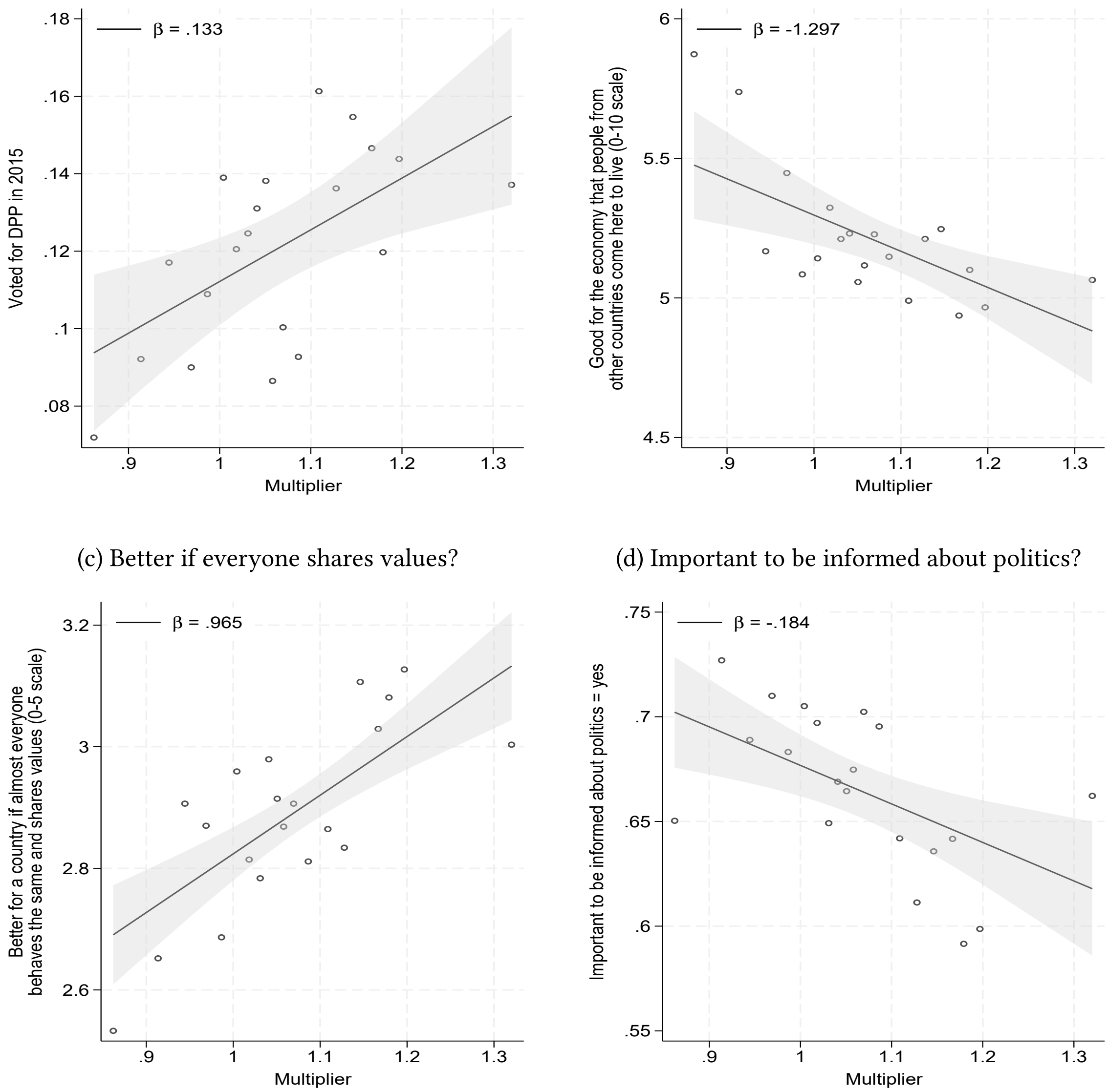


Figure A.XIII: Political and social preferences of high-multiplier cells



(a) Vote for right-wing populist party?

(b) Immigrants are bad for the economy?

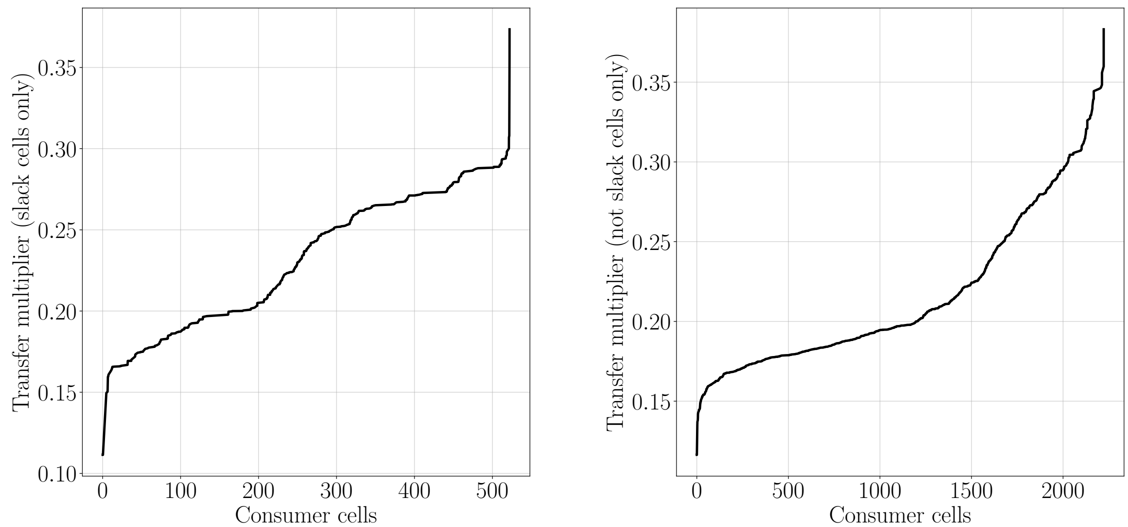
(c) Better if everyone shares values?

(d) Important to be informed about politics?

The panels report binned scatter plots of survey responses at the individual level against the multiplier of the individual's consumer cell. The relevant survey question is reported on the vertical axis. DPP is a right-wing populist party called Danish People's Party. The solid lines are the lines of best fit, estimated using the individual-level data. Each circle represents the same number of individuals. Standard errors are clustered by consumer cell. The error bands are 95% confidence intervals.

Figure A.XIV: Distribution of multipliers after U.S. tariff shock

(a) Multipliers among slack cells (b) Multipliers among non-slack cells



Panel a plots the distribution of the transfer multiplier in the static model for cells that are slack due to the U.S. tariff shock. Panel b plots the distribution of the transfer multiplier for cells that are not slack due to the U.S. tariff shock.

Figure A.XV: Dynamic multipliers by consumer cell characteristics

(a) By region size (b) By age (c) By college share

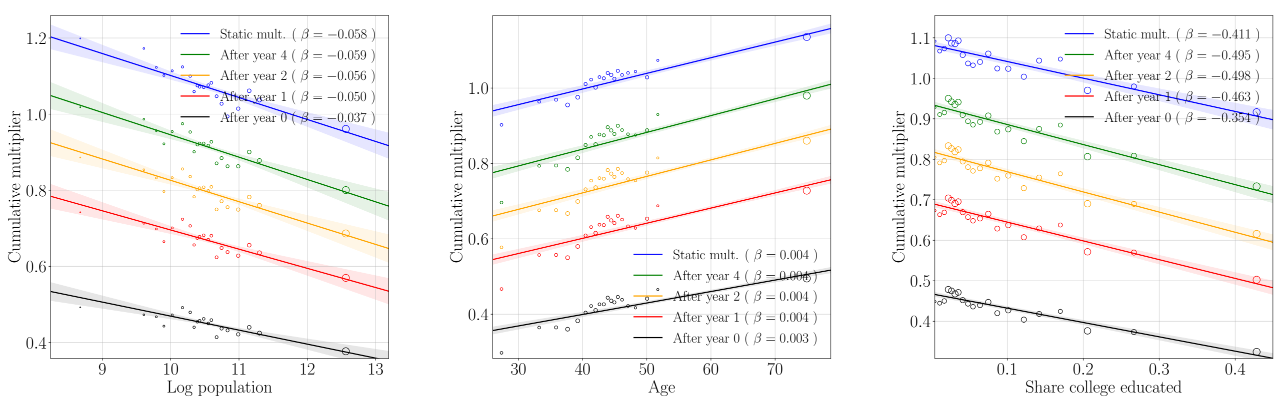
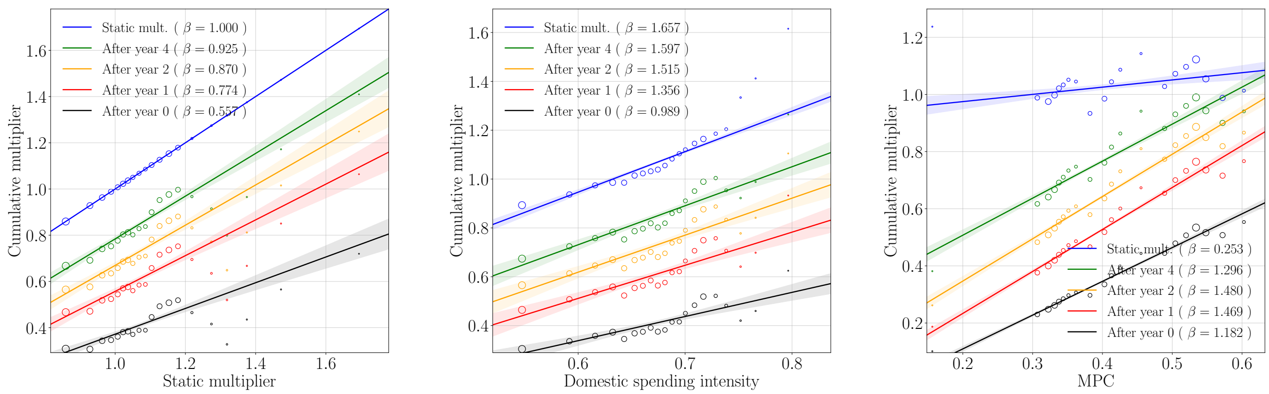


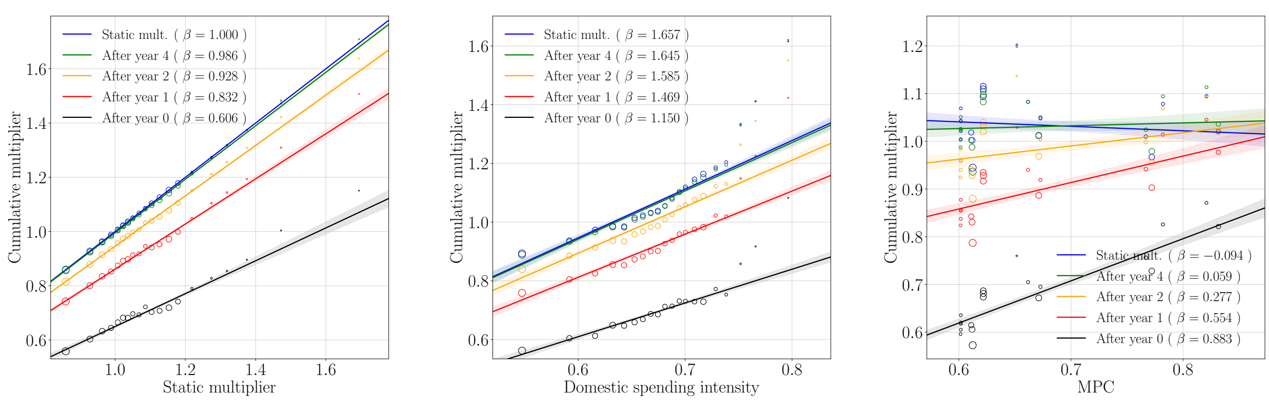
Figure A.XVI: Dynamic multipliers using MPCs from Lewis et al. (2025)



(a) Dynamic and static multipliers (b) Dynamic multipliers and domestic spending intensity (c) Dynamic multipliers and MPCs

The figure replicates Figure XIII but using the MPCs described in Appendix U.B.

Figure A.XVII: Dynamic multipliers using MPCs from Boehm et al. (2025)



(a) Dynamic and static multipliers (b) Dynamic multipliers and domestic spending intensity (c) Dynamic multipliers and MPCs

The figure replicates Figure XIII but using the MPCs described in Appendix U.C.

Table A.IX: Multipliers after U.S. tariff shock: Association with cell characteristics

	(1)	(2)	(3)	(4)
	Multiplier			
Avg. log distance to slack cells	-0.068***	-0.073***	-0.071***	-0.074***
	(0.002)	(0.002)	(0.002)	(0.002)
Age	0.001***			0.001***
	(0.000)			(0.000)
Share college educated		-0.107***		-0.037***
		(0.013)		(0.013)
Log population			-0.014***	-0.010***
			(0.002)	(0.002)
Observations	2,744	2,744	2,744	2,744
R^2	0.869	0.836	0.849	0.895

The table reports regressions of the cell-level multiplier on cell characteristics after the U.S. tariff shock. The specifications compare consumer cells in a similar geographic position with respect to slack cells. We control for the distance to slack cells using the average distance to other regions, weighted by regional slackness and setting distance to the home region to 1 kilometer. The regressions are weighted by population in the consumer cell. Standard errors are clustered by consumer cell. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

Appendix B Accounting Identities and T-Tables by Cell Type

Table A.X: Aggregate consumer account

Outflows			Inflows		
Outflow	Outflow to	Value (bn DKK)	Inflow	Inflow from	Value (bn DKK)
Domestic consumer spending	Producers	771.9	Labor compensation paid by domestic producers	Producers	1132.9
Foreign consumer spending	Rest of the world	81.9	Mixed income from non-corporate producers	Producers	80.7
Consumer product taxes paid	Government	173.2	Surplus of corporate producers to consumers (dividends)	Producers	38.5
Consumer non-product taxes paid	Government	566.4	Surplus of owner-occupied housing to consumers	Producers	83.3
Consumer social contributions paid	Government	181.1	Consumer social benefits received	Government	422.2
Consumer interest paid	Capital accumulation	29.7	Consumer adjustment for pension entitlements received	Government	92.5
Consumer natural resource rents paid	Capital accumulation	3.4	Consumer interest received	Capital accumulation	5.3
Consumer other transfers paid	Capital accumulation	44.8	Consumer pension investment income	Capital accumulation	.5
Consumer gross saving	Capital accumulation	130.1	Consumer natural resource rents received	Capital accumulation	3.4
			Consumer other transfers received	Capital accumulation	39.2
			Labor compensation paid by foreign producers	Rest of the world	8.9
Total value outflows		1982.4	**Total value inflows**		1982.4

Table A.XI: Aggregate producer account

Outflows			Inflows		
Outflow	Outflow to	Value (bn DKK)	Inflow	Inflow from	Value (bn DKK)
Labor compensation paid to domestic employees	Consumers	1132.9	Domestic consumer spending	Consumers	771.9
Mixed income from non-corporate producers	Consumers	80.7	Domestic intermediates	Producers	1423.4
Surplus of corporate producers to consumers (dividends)	Consumers	38.5	Domestic government spending	Government	572.3
Surplus of owner-occupied housing to consumers	Consumers	83.3	Domestic capital accumulation spending	Capital accumulation	359.5
Domestic intermediates	Producers	1423.4	Producer exports	Rest of the world	1077.9
Dividends and surplus of government-owned/operated producers to government	Government	67.9			
Producer product and import taxes paid	Government	71.9			
Producer net production-related taxes	Government	20.9			
Producer taxes paid on income	Government	61.9			
Producer net interest, transfers, and saving	Capital accumulation	409.9			
Producer imports	Rest of the world	792.3			
Labor compensation paid to foreign workers	Rest of the world	21.4			
Total value outflows		4205	**Total value inflows**		4205

Table A.XII: Aggregate government account

Outflows			Inflows		
Outflow	Outflow to	Value (bn DKK)	Inflow	Inflow from	Value (bn DKK)
Consumer social benefits received	Consumers	422.2	Consumer product taxes paid	Consumers	173.2
Consumer adjustment for pension entitlements received	Consumers	92.45	Consumer non-product taxes paid	Consumers	566.4
Domestic government spending	Producers	572.3	Consumer social contributions paid	Consumers	181.1
Government imports	Rest of the world	4.3	Dividends and surplus of government-owned/operated producers to government	Producers	67.9
Government net interest, transfers, and saving	Capital accumulation	52	Producer product and import taxes paid	Producers	71.9
			Producer net production-related taxes	Government	20.9
			Producer taxes paid on income	Government	61.9
Total value outflows		1143.2	**Total value inflows**		1143.2

Table A.XIII: Aggregate rest of the world account

Outflows			Inflows		
Outflow	Outflow to	Value (bn DKK)	Inflow	Inflow from	Value (bn DKK)
Producer exports	Producers	1077.9	Net national saving	Capital accumulation	88
Labor compensation paid by foreign producers	Consumers	8.9	Foreign consumer spending	Consumers	81.9
			Producer imports	Producers	792.3
			Labor compensation paid to foreign workers	Producers	21.4
			Government imports	Government	4.3
			Capital accumulation cell imports	Capital accumulation	98.9
Total value outflows		1086.9	**Total value inflows**		1086.9

Table A.XIV: Aggregate capital accumulation account

Outflows			Inflows		
Outflow	Outflow to	Value (bn DKK)	Inflow	Inflow from	Value (bn DKK)
Consumer interest received	Consumers	5.3	Consumer interest paid	Consumers	29.7
Consumer pension investment income	Consumers	.5	Consumer natural resource rents paid	Consumers	3.4
Consumer natural resource rents received	Consumers	3.4	Consumer other transfers paid	Consumers	44.8
Consumer other transfers received	Consumers	39.2	Consumer gross saving	Consumers	130.1
Domestic capital accumulation spending	Producers	359.5	Producer net interest, transfers, and saving	Producers	409.9
Capital accumulation cell imports	Rest of the world	98.9	Government net interest, transfers, and saving	Government	52
Net national saving	Rest of the world	88			
Total value outflows		670	**Total value inflows**		670

Appendix C Overview of Data Sources

We rely on several types of data to construct the disaggregated economic accounts. First, we use data from Danske Bank containing information about individual consumers and their transactions and producer-to-producer transaction data from CrediWire. Second, we use administrative data from government registers, such as the population, income, and employment registers. Third, we use publicly available aggregate statistics, such as housing, healthcare, and financial securities statistics.

In the following appendices, we provide details about the data sources and the disaggregated measurement. Table A.XV lists all the data sources and the relevant Appendix containing details of the measurement.

We strive for consistency across all the disaggregated measurement by relying, whenever possible, on the same sample of individuals, the entire adult population in 2018, and a uniform assignment of individuals and firm establishments to cells based on government registers. The only instance where we need to deviate from these general rules is when we construct the disaggregated consumer spending flows. Here, we work with the sample of Danske Bank customers, roughly 20% of the national adult population, and we assign individuals and firm establishments to cells using the bank's internal data, as confidentiality concerns prevent us from merging the bank data and government registers.

The aggregates of our bottom-up calculations are typically slightly lower than the national accounts aggregate, mostly because our sample contains only adults, so we ultimately scale each cell-level observation by a common scaling factor to match the national aggregate exactly.

Table A.XV: Overview of data sources

Disaggregated data type	Microdata from private sources	Microdata from the government	Aggregate statistics	Details
Region-by-industry cells	Danske Bank customer records and incoming transactions, customer records	Population register (BEF), labor market register (AKM), income register (IND), employment registers (BFL, IDAN)		Appendix D
Consumer spending	Danske Bank customer records and payment transactions	Income register (IND), credit register (URTE), auto register (DMR)	National housing statistics (BOL101)	Appendix E
Consumer and producer product taxes	Danske Bank payment transactions	Income register (IND), employment register (BFL)	Input-output table (NIO3)	Appendix F
Consumer and producer non-product taxes		Income register (IND), pension contribution register (INPI), population register (BEF)		Appendix G
Consumer interest, transfers, and saving (paid)		Population register (BEF), income register (IND)		Appendix H
Labor compensation		Income register (IND), pension contribution register (INPI), employment register (BFL)		Appendix I
Consumer dividend, mixed income, and surplus		Income register (IND), employment register (IDAN)	General firm statistics (GF5), registered securities statistics (DNVPDKS)	Appendix J
Government benefits to consumers		Income register (IND), pension contribution register (INPI), population register (BEF)		Appendix K
Consumer interest, transfers, and saving (received)		Population register (BEF), income register (IND)		Appendix L
Intermediates trade	customer records and transaction-level data on payments	Income register (IND)	Input-output tables (NIO1, NIO2, NIO3)	Appendix N
Exports and imports	Danske Bank payment transactions	Foreign trade registry (UHDI), firm sales and purchases registry (FIKS), income register (IND)	Input-output tables (NIO1, NIO2, NIO3), overnight stays by foreigners from VisitDenmark	Appendix O
Government dividend and surplus income		CVR register (hand-collected)		Appendix P
Consumption of government and NPISH output	Danske Bank customer records and incoming transactions	Population register (BEF), education register (UDD), income register (IND)	Public expenditure statistics (SYGU1), health statistics (INDAMP01), education statistics (UDDAKT20), child care statistics (BOERN4), culture and leisure statistics (BIB1)	Appendix S

Appendix D Defining Region-by-Industry Cells

The unit of our measurement is region-by-industry cells, the interaction of geographical regions and economic industries. Specifically, we define 99 regions (98 Danish municipalities and one foreign region) and 31 industries (Table A.I). We choose this definition of region and industries because we can observe it consistently across all underlying datasets and because it reveals a large degree of heterogeneity in disaggregated flows.

There are 24 industries that pay labor compensation to consumers. They include retail industries selling directly to consumers (e.g., food away from home, entertainment, grocery stores, drug stores), non-retail industries transacting mostly with firms (e.g., wholesale, agriculture, manufacturing, business services), and government-operated industries (e.g., public administration, health, education). We map six-digit NACE industry codes to the 24 industries that employ workers. Additionally, there are 4 separate industries for the non-working parts of the population (e.g., retired, students, long-term unemployed, out of workforce) and 3 industries providing housing without employees.

In the government registers, we assign all adults to a region based on their home address at the start of 2018, as observed in the administrative population register (BEF), and to an industry based on the NACE code of the firm establishment responsible for the largest part of their 2018 labor income, as observed in the labor market register (AKM). Individuals without labor income are assigned to an industry based on their age, observed in the administrative population register (BEF), and other income sources, observed in the income register (IND). Specifically, individuals without labor income are assigned to the industry "retired" if they are older than 65 years; to the industry "students" if they receive a government stipend (for which higher education students are almost universally eligible); to the industry "long-term unemployed" if they receive unemployment or cash benefits; and otherwise to the industry "out of workforce." The long-term unemployed cell captures only those individuals fully dependent on benefits without any labor income through the entire year. We assign firm establishments to producer region-by-industry cells using information from the employment registers (BFL and IDAN). To ensure anonymity, we censor information for the (very few) consumer cells containing fewer than 3 individuals or establishments in all datasets. In the Danske Bank, CrediWire, and firm export and import data, we follow similar procedures, as outlined below.

Appendix E Measuring Disaggregated Consumer Spending

Appendix E.A Data and Sample

To construct the disaggregated spending flows, we rely on data from Danske Bank for 2018 and 2019. We observe transaction-level information on consumers and merchants only for this period. Our sample consists of adult customers who conducted at least one transaction per month and registered their main bank account at Danske Bank throughout 2018 and 2019.[A1] For each customer, we observe all incoming and outgoing transactions. Card payments accounted for 47% of the total value of payment transactions. The most common card was Dankort (debit cards issued by Nets A/S), followed by MasterCard (debit and credit cards) and Visa (debit and credit cards). Cash withdrawals accounted for 7% of transaction value, whereas bill payments (direct debits and bank transfers to merchants) accounted for 45%. Mobile applications, such as Apple Pay or the Denmark-specific MobilePay, made up 1%.

Appendix E.B Identifying Consumer Region and Industry

We identify consumers' industry by extracting the name of the employer from incoming labor compensation payments and by identifying incoming government transfers (retired, students, government stipend, unemployment benefits). We use the banks' customer records to identify their region of residence. The address register in the bank is linked to the government's address registers and updated on a monthly basis. To ensure that moves across regions do not distort the spending patterns, we update an individual's region every month when constructing the disaggregated spending data. However, consistent with the assignment in the government registers, we define the industry of main employment on an annual basis as the industry paying the largest share of annual consumer income.

Appendix E.C Identifying the Merchant Region

We extract the address of the merchant establishment (i.e., the store) from the string that accompanies payment transactions in the bank's internal computer system. The information for card and mobile payments differs slightly by payment type.

- Dankort statements include a unique ID number for each merchant establishment for transactions in Denmark and the country name for transactions abroad. We match the Danish merchant IDs to the exact merchant address using a table issued by Nets A/S.
- MasterCard includes a detailed merchant address directly in the transaction string in the following format: merchant ID, shop name, street name, house number, postal code, country.
- Visa reports the merchant ID, shop name, and town for each transaction. The merchant IDs used by Visa and MasterCard generally coincide. Based on the MasterCard data, we can therefore construct a table matching merchant ID and detailed address. In very few cases, a merchant ID gets used twice for a Danish merchant and a foreign merchant. In these cases, we assume that the transaction was with the Danish merchant.

[A1] All adults register one "main" account with the Danish government, through which they conduct all financial interactions with the government.

- Some transactions in MobilePay and Apple Pay contain merchant addresses, but some do not.

For all card and mobile payments, we extract the merchant address and convert it to a consistent format using an API service provided by the government agency Styrelsen for Dataforsyning og Effektivisering (dawa.aws.dk/dok/api/adgangsadresse). This conversion identifies precise geocodes for each merchant while accounting for misspelled addresses and addresses that appear twice due to minor differences in formatting or spelling. The API compares the merchant address from a transaction with its database of official addresses. It iterates in a Levenshtein manner (i.e., it calculates the number of letters/digits that must be exchanged before one string is equal to another). We force the Levenshtein process to consider only addresses with exactly identical postcodes. Municipalities are combinations of several postcodes. By restricting to the same postcode, we ensure that the Levenshtein process cannot change the municipality information, the key information that we use to construct the disaggregated spending flows.

If the API cannot match the address unambiguously (so-called C-match), we remove the first line of the address, which often combines abbreviations of merchant and street name, making it difficult to recognize automatically. We also check whether the address contains the name of a shopping mall, rather than an official address. If so, we replace the name of the mall with the mall's address and rerun the API process. Finally, we manually research the official address of the 100 most common unmatched addresses.

Using this procedure, we identify the official shop address for 95% of card and mobile spending. We assume that the remaining 5% go proportionally to the same regions as other card and mobile spending. These remaining 5% also include cases where mobile applications (e.g., MobilePay) and online services (e.g., PayPal) do not directly send the purchase amount to a sales terminal, but transfer to a central account first before paying the merchant.

For bill payments, we use a slightly different approach. We directly observe the merchant's postal code for recurrent bill payments, which make up 67% of all payments. These observed postal codes allow us to infer the merchant region for the majority of remaining bill payments. Specifically, we split merchants into 48 industries. We calculate the number of transactions from each consumer region going to each of these 48 industries. To minimize noise, we keep industries where at least 50% of incoming bill payments contain postal code information and where we observe at least 200 incoming transactions from every consumer region. (Industries receiving 80% of total bill transaction value satisfy these two requirements.) For these industries, we then assume that bill payments flow to the same postal codes as bill payments with observed postal codes from the same consumer region to the same industry. For the remaining industries (covering 20% of bill transaction value), we assume that bill payments flow to the same postal codes as card payments from the same consumer region to the same industry.

We generally do not observe how cash withdrawals are spent, but we assign them to merchants in proportion to observed card spending in Denmark if the withdrawal was in Denmark and to observed card spending abroad otherwise. In a few cases, country information is missing, so we assume that withdrawals without decimal points (e.g., 100.00 DKK) are withdrawn and spent in Denmark and that other withdrawals (e.g., 100.76 DKK) are spent abroad.

Appendix E.D Identifying the Merchant Industry

We observe the merchant category code (MCC), a classification for the type of goods sold by a merchant, in the bank transaction data. To create disaggregated economic accounts with consistently defined producer cells, we need to map MCCs to the industry codes used in the employment and trade data. However, no such mapping exists so far. We therefore create a new cross-walk between MCCs and NACE industries.

First, we observe each merchant's Danish business identification number (CVR) and MCC in the bank's system. We link the CVR to the Danish Central Business Register where we can retrieve the merchant's industry (at the level of 741 NACE codes). Second, we manually assign MCCs to our 31 industries (only 14 of which are consumer-facing and are assigned MCCs). We then identify which of our industries appear most frequently among merchants in each of the 741 NACE codes. In very few cases, two industries appear equally often and we manually research the largest firms to identify the best match.

We create an alternative mapping between a merchant classification system called PCAT and our industries. The PCAT usually appears as part of the electronic transaction information for bill payments and can easily be mapped to our industries. MCC and PCAT are missing for some bill payments, amounting to 8% of total transaction value through bills. We assume that these payments go proportionally to the same industries as other bill payments by the same consumer cell.

We censor information for cell-to-cell flows based on fewer than 10 transactions in total, which overall is relevant for less than 0.1% of national spending. We instead impute these flows, setting them equal to the average per capita spending flows of all other cells in the same region.

Appendix E.E Online Spending

We identify whether card transactions took place in a physical store or online. Dankort transactions include a straightforward binary indicator for online transactions. MasterCard and Visa transactions contain ISO 8583 information, an internationally standardized message sent by a sales terminal in a transaction. If the POS7 code (input method) equals 1, 6, K, or L or if the POS5 (cardholder) code equals 5, the transaction is online. We treat payments using mobile applications (e.g., MobilePay) and online services (e.g., PayPal) that do not report a physical merchant ID and address as online transactions. For digital payment services, such as PayPal and DoorDash, we typically see the correct MCC of the establishment receiving the final sales.

In constructing the disaggregated spending flows, we generally treat online spending identically to spending in a physical store. That means that we identify the region-industry cell of the merchant and assign the incoming spending to this cell. However, we adjust the regional (but not the industrial) distribution of online spending for industries where we know that consumption of the final good takes place entirely in a physical location. In these cases, we assign all online spending using the regional distribution of spending on physical merchants. The online spending on these industries often goes to the central payment terminal of a parent company before being assigned to the physical merchant. For instance, online purchases of cinema tickets are often booked through a central company terminal in Copenhagen, even though consumption happens in local movie theaters. The full list of industries where we adjust the regional distribution is: food away from home; entertainment; medical and other specialized merchants; commuting; vehicle repair; hotels; rental cars; home improvement services. (These industries are sub-categories of our 31 final industries.)

We verify that the distribution of merchants receiving spending is in line with the distribution of where workers are employed in Figure A.III, which validates the disaggregated spending data. We make one final adjustment to the disaggregated spending flows: we adjust spending on airlines flowing into Copenhagen because we know that the airline establishments receiving the spending are actually located in the neighboring Tårnby region, which also contains the airport. Specifically, we reassign a share of each consumer cell's spending on airlines flowing into Copenhagen to airlines in Tårnby, so that Copenhagen's share in airline spending received equals its share in airline employment.

Appendix E.F Improving the Spending Flows with Government Data

Consumer spending on four types of goods is not captured comprehensively in bank transaction data: housing, financial services, vehicles, and water and waste services. We replace the transaction-based values from the bank data with adjusted values derived from combining Danske Bank data with government registers.

Appendix E.F.1 Consumption of Housing

We use separate methods to assign spending on owner-occupied housing and rented housing. First, owner-occupied rents are notoriously difficult to measure because they involve no financial transaction. However, the administrative income register (IND) contains the imputed rental value of owner-occupied housing for every individual. We thus allocate the national consumption of owner-occupied housing to consumer cells in proportion to the imputed rental value of their owner-occupied housing. Expenditure on owner-occupied housing flows to the producer cell for owner-occupied housing (our industry number 30) located in the same region as the home owners. The operating surplus of an owner-occupied housing producer cell in a region (SNA B.2G) then goes back to the consumer cells owning homes in that same region.

Second, we do not observe all rental payments in the bank transaction data. We instead distribute the national consumption of rented housing across consumer cells in proportion to their estimated rental costs. We observe some rental payments in the bank data, which we use to estimate

$$rental\ payment_p = \alpha + \vartheta\, region_p + \phi\, industry_p + \psi_1\, age_p + \psi_2\, age_p^2 + \varepsilon_p, \tag{A.1}$$

where p is an individual renter. Using the estimated fixed effects ϑ and ϕ, we predict the average rental cost in each consumer cell. We observe ownership of real estate in the administrative income register (IND) and assume that all consumers who do not own real estate are renters, which allows us to calculate the number of renters by consumer cell. Combining estimated rental payments with the number of renters allows us to estimate total rental costs by consumer cell, which we use to allocate national consumption of rented housing across cells.

Finally, we use aggregate statistics to assign rental payments to producer cells. In the National Housing Statistics (Table BOL101), we observe the number of rental housing units in each region owned by different owner types: individuals, non-profit building societies, limited liability companies, housing societies, and public authorities. The surplus of individual owners accrues to the "private landlord" industry (our industry number 29) and the surplus of corporate owners accrues to the "finance, real estate" industry (our industry number 17). As there is no information about the geographical location of the owners, we assume that the geographical distribution of individual owners of rental units in a given region follows the geographical distribution of mixed income in the region and that the geographical distribution of the individuals behind corporate owners of rental units in a given region follows the geographical distribution of dividend payments. The remaining owner types are public or non-profit organization. The surplus of these owners goes to the "government-owned housing" industry (our industry number 31) in the same region where the housing is located.

Appendix E.F.2 Consumption of Financial Services

Consumption of financial services in the national accounts is composed of the value of financial advice provided by financial firms and the interest rate spreads accruing to financial firms. While we observe payments for financial advice in the bank transaction data, it is difficult to disentangle the interest rate spreads from the raw value of interest payments in transaction data. Instead, we allocate the national consumption of financial services across consumer cells in proportion to their interest expenses. The tax register (IND) contains interest expenses for every individual. We aggregate interest expenses at the level of each consumer cell.

Producer cells in our "finance, real estate" industry (number 17) receive consumers' expenditures on financial services. To identify which regional producer cells receive expenditures from which consumer cells, we use loan-level data from the administrative credit register (URTE). Specifically, for each bank loan and each interest payment, the credit register contains an identifier for the bank branch that has recorded the loan and the interest payment. There are around 3,000 bank branches in Denmark. We do not observe the region of branches directly, so we define the region of each branch as the most common region of consumers holding loans recorded at the branch. We then compute how the interest payments of each consumer cell are distributed across bank branches in different regions. Finally, we assume that a consumer cell's spending on financial services is distributed across producer cells in proportion to its distribution of interest payments.

Appendix E.F.3 Vehicle Purchases

We do not observe all vehicle purchases in the bank transaction data because many purchases do not flow directly to the vehicle producer but rather flow through financial firms. We therefore use a top-down approach to assign national vehicle purchases to consumer cells in proportion to each consumer cell's share of total spending on new cars. We estimate each consumer cell's total spending on new cars by combining bank transaction data on annual spending at vehicle dealers with information on vehicle registrations from the administrative auto register (DMR). We use data over the period 2014–2016, as this is the most recent period where we can combine transaction data from Danske Bank and administrative data from the auto register. We therefore assume that relative levels of vehicle spending are unchanged between 2014–2016 and 2018.

We first estimate the average price of purchased vehicles for each consumer cell. We use a sample of individuals where we observe just one new car registration in a given year and spending at vehicle dealers of at least 50,000 DKK in the bank transaction data in the same year. We then regress individual-level spending at vehicle merchants on industry-by-year and region-by-year fixed effects,

$$spending_{p,y}^{vehicle\_merchants} = \theta_{i(p),y} + \eta_{r(p),y} + \epsilon_p,$$

where p is an individual in industry $i(p)$ and region $r(p)$ and year is y. We predict the average price of new cars in each consumer cell using the estimated fixed effects. We can directly calculate the number of newly registered vehicles in the government vehicle registers. Combining the estimated price with the number gives an estimate of total spending on new cars by consumer cell for each year in 2014–2016. We compute each cell's share of total spending on new cars in each year and then average across years. We use these shares to allocate national vehicle purchases in 2018 across consumer cells.

Producer cells in our "cars, fuel, car repair, public transport" industry (number 5) receive consumers' expenditures on vehicles. To identify which regional producer cells receive spending from which consumer cells, we use Danske Bank data on vehicles purchased via cards, assuming that all consumers within the same region distribute their vehicle spending across regions in the same proportion.[A2]

[A2]If there are less than 50 vehicle car purchases in a region, we group that region with a neighboring region. This

Appendix E.F.4 Water and Waste Services

Rental payments often include consumption of water and waste services in Denmark, which implies that we cannot separately identify spending on water and waste in the transaction data. We therefore allocate the national consumption of water and waste services to consumer cells in proportion to their spending on other utilities. We assume that water and waste is produced locally, setting the region of the producer cell receiving the payments equal to region of the consumer cell.

Appendix F Measuring Disaggregated Product and Production-Related Taxes

Product taxes (SNA D.21) are paid by buyers upon the purchase of a good to the government. The most important product taxes are import taxes, product-specific taxes (e.g., on fuel, energy, cigarette, and alcohol), and value added taxes (VAT).

We first describe how we measure import and product-specific taxes paid by consumers. (We turn to VAT later.) We observe the aggregate of import and product-specific taxes in the Danish national accounts table NIO3. The table reports aggregate import and product-specific taxes paid by consumers on the products of 117 distinct industries. These 117 industries do not map directly into our 31 industries. We therefore break down the 117 industries into the most granular grouping in the Danish national accounts (741 industries), by assuming that taxes paid on each industry's products are proportional to industry employment shares, and subsequently aggregate to our 31 industries. We then calculate the implied product-specific tax rate and the implied import tax rate for each of our industries by combining information on total tax-inclusive consumer spending on each industry from the disaggregated consumer spending flows with the tax data. The implied import and product-specific tax rates range from 0% in exempt industries (e.g., personal services, pharmacies and cultural and social organizations) to 50% in utilities (due to Denmark's very high energy tax rates).

We next describe how we measure VAT paid by consumers. The standard VAT rate in Denmark is 25%. We set this tax rate for consumer spending on all industries except a few industries whose products are VAT-exempt: airlines, finance, health, education, public administration, and all housing. In addition, spending on two of our industries is partially exempt: insurance (part of our industry 8, telecommunication and insurance) and culture (part of our industry 18, cultural and social organizations). We use data from NIO3 on total VAT paid by consumers on products of each industry, following the method used for product-specific and import taxes described above, and calculate that the average VAT rate is 7% (for industry 8) and 5% (for industry 18).

We disaggregate product taxes paid by Danish producers, the government, and the capital accumulation cell using the Danish input-output table, as described in Appendix N. Note that

leads us to group Læsø with Frederikshavn; Langeland and Ærø with Svendborg; Fanø with Esbjerg; Ringkøbing-Skjern with Herning; Lemvig with Holstebro; Morsø with Thisted; and Samsø with Odder.

producers are reimbursed for VAT paid on intermediates.

We observe the net of production-related taxes (SNA D.29) and subsidies (SNA D.39) in the industry-level national accounts (summing positions in the national accounts of the financial, non-financial, and unincorporated household production sectors). Examples of such positions are a special payroll tax on firms in the financial industry, which compensates for the industry's VAT exemption; subsidies to agricultural producers; and housing property taxes. We take a top-down approach to allocating these industry-level flows to producer cells. For all industries except owner-occupied housing, we allocate the industry's net production-related taxes in proportion to labor compensation, which we compute from the employment register (BFL). For owner-occupied housing, we allocate net production-related taxes in proportion to their total rental value, which we compute from the income register (IND).

Appendix G Measuring Disaggregated Non-Product Taxes

Consumer non-product taxes are flows from consumer cells to the government. There are two types: current taxes on income, wealth, etc. (SNA D.5) and social contributions (SNA D.61).

First, current taxes on income, wealth, etc. include income taxes paid directly by consumers as well as a tax on pension wealth returns paid by pension funds on consumers' behalf. We disaggregate each part separately. In the income register (IND), we observe total annual income taxes paid, excluding pension returns taxes, for each individual in the population. We scale this measure by a factor of 1.09 to match the national accounts aggregate when summing the values at the level of consumer cells. For the pension returns taxes paid by pension funds, we have no direct individual-level measure. We therefore apply a top-down approach assuming that DKK pension wealth returns, and hence also returns taxes, are proportional to total accumulated pension contributions since 1995, which is the first year for which we have microdata on pension contributions in the pension contribution register (INPI).

Second, we use a bottom-up approach to disaggregate social contributions. In the income register (IND) and the pension contributions register (INPI), we observe total annual pension contributions, including contributions to a mandatory retirement savings program (ATP), as well as on membership fee payments to unemployment insurance funds. We aggregate these variables to the cell level and scale the cell totals by a factor of 1.2 to make the national total match the national accounts aggregate.

Producer non-product taxes (SNA D.5) are paid on income and flow from producer cells to the government. Since income taxes in Denmark are a fixed fraction of producer profits, we allocate the national aggregate in proportion to the accounting income of each producer cell (sales minus intermediates minus labor compensation).

Appendix H Measuring Disaggregated Consumer Interest and Transfers Paid

We disaggregate interest payments (SNA D.41) using a bottom-up approach. In the administrative income register (IND), we observe each individual's interest payments on all financial liabilities. The sum of these interest payments exceeds the value of position D.41 in the national accounts because the individual-level measure includes the full nominal amounts paid by consumers to lenders, whereas the national accounts value is net of Financial Services Indirectly Measured (FISIM). We therefore scale the individual-level variable so that its aggregate matches the national accounts. The implicit assumption is that the ratio of FISIM to total nominal interest payment is the same across consumer cells.

Since we have no individual-level data on payments related to renting of land and subsoil resources (SNA D.45), we use a top-down approach to disaggregate this flow. Each consumer cell is assigned a share of the aggregate value corresponding to its population share in the population register (BEF).

Other current transfers (SNA D.7) include non-life-insurance premium payments and miscellaneous current transfers. We also disaggregate these transfers top-down, assigning each cell a share of the national total equal to its population share.

Appendix I Measuring Disaggregated Labor Compensation

We use the income register (IND) and the pension contributions register (INPI) to measure total annual labor compensation, including employer contributions to pension schemes, paid to each individual consumer. We then aggregate these payments at the level of consumer and domestic producer cells. The aggregate of the raw disaggregated flows is slightly lower than in the national accounts, mostly because our sample contains only adults. We scale each value by a factor of 1.01 to match the national accounts flow compensation of employees, receivable (SNA D.1).

We also observe labor compensation received from foreign producers in the income register (IND). The aggregated value in the income register is below the aggregate in the national accounts, likely because our consumer cell definition implies that we do not capture individuals moving to Denmark during the year and because we do not observe foreign pension income perfectly in the income register. As a result, we scale each value by a factor of 1.47 to match the national accounts aggregate.

Finally, we record labor compensation paid by Danish producers to foreign employees. The employment register (BFL) contains all labor compensation payments by Danish producers and the unique personal identifier of the employee receiving the payment. We consider recipients not listed in the population register (BEF) as foreign employees. We scale the value of payments to foreign employees for each producer cell by a common factor of 1.14 to match the national accounts aggregate.

Appendix J Measuring Disaggregated Mixed Income, Dividends, and Surplus

We measure mixed income, dividends, and surplus flowing from each producer cell to each consumer cell.

Non-corporate firms pay mixed income to their owners. We determine how mixed income is distributed across consumer cells following the methodology for labor compensation discussed above. We link information about establishments operated by sole proprietorships from the employment register (IDAN), including the municipality where the establishments are located, to the mixed income of the individuals owning the establishment.

Corporate firms pay surplus to their owners in the form of dividends. To distribute dividend payouts across consumer cells, we rely on individual-level data on stock dividend income from the income register (IND). We disaggregate aggregate distributed income of corporations, receivable (SNA D.42) in proportion to the total dividend income of each consumer cell. We thereby implicitly assume that all consumer cells hold a diversified portfolio of Danish corporations. We measure dividends paid by each producer cell by distributing the aggregate dividends paid to Danish consumers in proportion to the accounting income of each producer cell, which are measured in the disaggregated accounts as: total sales − intermediates − labor compensation − mixed income − surplus − dividends and surplus paid to government − net taxes − imports.

Finally, the national accounting flow operating surplus, gross (SNA B.2G) corresponds to operating surplus from owner-occupied housing. We aggregate individual-level imputed rental values of owner-occupied housing as reported in the income register (IND), which produces the industry's total output. We scale this output by a factor 0.67 to match the national value for B.2G. The implicit assumption is that the ratio between gross operating surplus and output in the owner-occupied dwellings industry is constant across consumer cells.

Appendix K Measuring Disaggregated Government Benefits to Consumers

National accounts describe three types of transfers to consumers. First, we aggregate all government income transfers and private pension savings payouts from the income register (IND) to calculate the cell-level measure of social benefits other than social transfers in kind (SNA D.62). We scale by a factor of 1.03 to match the national accounts value. Second, other current transfers (SNA D.7) consist of miscellaneous current transfers, for example, disaster and accident relief. We disaggregate this position top-down using cell population shares obtained from the administrative population register (BEF). Third, adjustment for the change in pension entitlements (SNA D.8) represents an accounting adjustment in the national accounts to avoid double-counting changes in pension entitlements.[A3] We disaggregate it by combining data from the income register and the pension

[A3] In our system, all pension-related flows (SNA D.61, D.62, and D.8) originate and go to the government cell, which has the advantage that all double-counting of pension flows naturally nets out in the government cell. Aggregate contributions register (INPI) to construct an individual-level measure of pension contributions net of payouts. We then scale this measure to match the national accounts aggregate value.

Appendix L Measuring Disaggregated Consumer Interest and Transfers Received

First, we disaggregate interest, receivable (SNA D.41) bottom-up by using individual-level information on interest income from the income register (IND) and scaling so that the total across consumer cells matches the national accounts aggregate. Second, other investment income, receivable (SNA D.44) includes investment income from insurance policies and pension entitlements. We disaggregate this using a top-down approach where each consumer cell is assigned a share of the national accounts value proportional to its pension contributions accumulated since 1995. Third, rent, receivable (SNA D.45) consists of income from renting land and subsoil resources. We disaggregate it top-down using population shares.

Appendix M Measuring Consumer Characteristics

We use information from several government registers at the individual level for the full population. From the education register (UDDA), we extract each individual's highest level of education and use it to compute the share of individuals in each cell who have completed a university degree. Occupation codes are from the labor market register (AKM). We define an individual as doing manual labor if their main occupation is in manual trades work, operator and assembly work, transportation, other manual labor, or military service.

From the wealth register (FORMGELD), we obtain information about individual balance sheets. We compute cell-level averages of their: total debt, which includes both unsecured debt (e.g., consumer credit) and secured debt (e.g., mortgages and car loans); liquid financial assets, which consists of bank deposits and financial securities like stocks, bonds and investment fund shares; and illiquid assets like housing, cars, and retirement savings in tax-preferred pension saving accounts.

Appendix N Measuring Disaggregated Intermediates Trade

Disaggregated intermediates trade flows describe how producers in one cell are connected to producers in other cells through trade in intermediates. We start from the Danish input-output table at the most disaggregated level with 117 industries (Tables NIO1, NIO2, and NIO3 at statbank.dk). The input-output table illustrates how the output produced by one industry is used as intermediate input in other industries or in final use categories, such as government spending and capital

national accounts in different countries deal with pensions in different ways. In the Danish national accounts, pensions flow between consumers and government as well as between consumers and the financial corporation sector, which creates the double-counting issue.

formation. It also shows how output from a given industry is produced from intermediate inputs acquired from other industries.

To convert the standard input-output table to a format suitable for our purposes, we need to address three challenges. First, the 117 industries do not map directly onto the industry classification used in the disaggregated economic accounts (DEA). Second, the input-output table has no geographical dimension: it describes flows from firms in industry s to firms in industry t at the national level, but not from firms in industry s and region i to firms in region j and industry t. Third, the national accounting convention of measuring output of retail industries in the form of net trade margins is not compatible with the disaggregated consumer spending flows (which reports actual money flows). The following subsections describe how we overcome these challenges.

Appendix N.A Adapting the IO table to DEA Industry Classification

To address the first challenge, we disaggregate the input-output table based on the national accounts (NA) industry classification to a more granular subindustry grouping. Formally, let lower-case letters $\{a, b, c...\}$ denote the NA industries in the standard input-output table and let upper-case letters $\{A, B, C...\}$ denote the 27 output-producing DEA industries shown in Table A.I. Let j denote a granular industry at the level used in the microdata. Consider a particular NA industry $x \in \{a, b, c...\}$ and a particular DEA industry $Y \in \{A, B, C...\}$: we define subindustry x_Y as the set of granular-level industries that are subindustries of both x and Y, $x_Y = \{j | j \subset x, j \subset Y\}$. This approach produces 173 non-empty subindustries, which represent the highest level of industry aggregation compatible with both the NA classification and the DEA classification.

To carry out the disaggregation into subindustries, we compute a measure of output for each establishment by distributing the output of each firm across the establishments of the firm, using the within-firm labor compensation share of each establishment as weight. We then aggregate output to the level of each subindustry x_Y, compute the subindustry's output share within NA industry x, and disaggregate the flows for industry x reported in the original input-output table using these shares. For example, the original input-output table reports the value of flows from NA industry a to NA industry b. We assume that the flow stemming from subindustry a_Y is proportional to the share of output produced by NA industry a. Similarly, we assume that the flow to subindustry b_Z is proportional to its share of output in NA industry b. Concretely, we compute the flow from a_Y to b_Z as the total flow from a to b multiplied by the output shares of a_Y and b_Z within their respective NA industries.

The input-output table also reports flows from domestic final use categories (government spending, capital accumulation) to domestic producers and from domestic producers to the government in the form of VAT and product tax payments. We disaggregate these flows to the subindustry level on the producer side using subindustry output shares.

In sum, these steps produce a national table of trade flows at the level of 173 subindustries.

We will later re-aggregate the 173 subindustries to the 27 output-producing industries in the DEA. However, before doing so, we add a regional dimension, as described next.

Appendix N.B Estimating the Role of Distance

We incorporate the effect of distance on intermediates trade using transaction-level data on producer-to-producer sales. The dataset is from the business service provider CrediWire and covers more than 4,300 firms over the period 2018-2022. The dataset includes information about industry and region of supplying firms retrieved from CrediWire's records. This allows us to assign each of the selling firms to a producer cell. When the buying firm is an identifiable domestic firm, the dataset also includes information about the industry and the region of the buying firm retrieved from the national business register. This allows us to assign each of these buying firms to a producer cell.

The CrediWire data include around 5 million producer-to-producer transactions where both supplier and buyer can be assigned to producer cells, covering around 1% of aggregate domestic intermediates transactions. To compare the distribution of industry-to-industry sales in the CrediWire data to the national accounts, we construct a matrix of total industry-to-industry transactions by aggregating the raw transactions in CrediWire. We then plot a binned scatter plot of entries in the matrix using CrediWire data against the corresponding entries in the national accounts input-output table for intermediates trade. The high correlation in Figure A.IV suggests that the Crediwire data are broadly representative in terms of the distribution across supplier and buyer industries.

To construct our disaggregated matrix, we aggregate the transactions in CrediWire to the cell-level and estimate a gravity model, with the aim of estimating how producer-to-producer trade varies with distance. The dependent variable is sales from the selling (supplier) producer cell to the buying (user) producer cell and the key explanatory variable is geographical distance. The model also includes two sets of fixed effects. First, there are fixed effects for every producer cell, both on the supplier side and the user side, which control non-parametrically for the economic size of producer cells. Second, there are fixed effects for every pair of supplier industry and user industry, which ensures that identification comes exclusively from variation in geographical distance within industry pairs. We estimate the gravity model in its multiplicative form with the Poisson pseudo-maximum likelihood estimator (Silva and Tenreyro 2006).

The baseline model yields a statistically significant distance coefficient of around -0.74. This coefficient captures the average elasticity of domestic trade with respect to distance.[A4] Incidentally, it is close to analogous estimates for international trade (e.g., Silva and Tenreyro 2006 report an estimate of -0.78 in their Table 3, column 6). We next allow for heterogeneity in the distance

[A4] This average coefficient differs from the one reported in Figure V because there we use a more traditional log-log specification without the pairwise supplier-by-user fixed effects, without zero flow and zero distance observations in the dataset, and without relying on the Poisson estimator.

coefficient by interacting distance with indicators for supply industries and use industries. This allows us to obtain an estimated distance coefficient for every combination of supply industries and use industries (576 estimates) by adding the coefficients on the relevant supply industry interaction and the relevant use industry interaction. Figure A.V illustrates the results with two sets of box plots: Panels a and b show the distribution of distance coefficients (i.e., median, quartiles, and adjacent values) for each supply industry and for each use industry, respectively. The distance coefficients vary substantially across supply industries (and much less within) and within use industries (and much less across). This pattern is consistent with the notion that the structural elasticity is product-specific and that firms tend to use a large number of inputs to produce a small number of outputs.

Appendix N.C Combining Regional and Industry Variation

We determine the level of trade in each region-by-industry cell by assuming that regions send and receive intermediates in proportion to their shares of total labor compensation paid in each subindustry (except in the three zero-employment housing industries where we use regional spending shares from the disaggregated consumer spending flows, see Appendix E).

Combining this assumption on trade levels with the estimated distance coefficients, we can now disaggregate the flows between subindustries to a region-by-subindustry table. Formally, let a_Y and b_Z denote subindustries and let i and j denote regions. We assume that the flow from subindustry a_Y, region i to firms in subindustry b_Z, region j is

$$flow_{a_Y,b_Z,i,j} = flow_{a_Y,b_Z} * \theta_{a_Y,b_Z,i} * \eta_{a_Y,b_Z,j} * distance_{ij}^{-\beta^{IND(i)} - \beta^{IND(j)}}, \tag{A.2}$$

where $flow_{a_Y,b_Z}$ is the intermediates flow from subindustry a_Y to subindustry b_Z at the national level and $distance_{ij}$ is the distance between region i and region j. The parameters $\theta_{a_Y,b_Z,i}$ and $\eta_{a_Y,b_Z,j}$ are origin and destination region fixed effects within the a_Y-b_Z subindustry pair. These are set so that 1) region i's total share of national a_Y-b_Z flows (i.e., $\sum_j flow_{a_Y,b_Z,i,j}/flow_{a_Y,b_Z}$) matches its share of labor compensation payouts in subindustry a_Z, and 2) region j's total share of industry a_Y-b_Z flows (i.e., $\sum_i flow_{a_Y,b_Z,i,j}/flow_{a_Y,b_Z}$) matches its share of total labor compensation payouts in subindustry b_Z.

We implement this assumption through an iterative numerical procedure. Starting from initial guesses for $\theta_{a_Y,b_Z,i}$ and $\eta_{a_Y,b_Z,j}$, we compute the implied value of each $flow_{a_Y,b_Z,i,j}$. We then adjust the guesses by a multiplicative constant that ensures that the flows add up to their national counterpart, $flow_{a_Y,b_Z}$. Next, we update the guesses by multiplying them with the ratios of the regions' labor compensation shares to the implied shares of national a_Y-b_Z flows. We repeat this procedure until the implied share of national a_Y-b_Z flows converges toward the relevant labor compensation share for each origin and destination region.

For flows from final use categories (non-profits, government spending, capital formation) to domestic subindustries, we add a geographic dimension on the destination side only. Here, we assign each region a share of the total national flow equal to its share in subindustry labor compensation. Conversely, for VAT and product taxes going from domestic subindustries to the government, we add a geographic dimension on the origin side only: each region is assigned a share of the national flow equal to its labor compensation share within the subindustry.

After disaggregating to the subindustry-region level, we aggregate to the industry-region cell level described in Appendix D by summing over subindustries belonging to the same DEA industry within each region.

Appendix N.D Redirecting Flows From Consumers Through Retailers

National accounts measure output in retail industries as trade margins (i.e., sales net of acquisition costs). Thus, if a retailer buys a product from a non-retail producer at price p_1 and sells it to a consumer at price p_2, the national accounts input-output table will display two flows: 1) a flow of $p_2 - p_1$ from consumers to retail, and 2) a flow of p_1 from consumers to the non-retail producer's industry. This makes the standard input-output table inconsistent with our disaggregate spending flows because the disaggregated spending flows show total sales values going from consumers to producers. A consistent system of disaggregated economic accounts therefore necessitates an adjustment to make the different disaggregated datasets compatible.

Since the disaggregated economic accounts are measured in total sales units, we leave the disaggregated consumer spending flows untouched and instead adjust the disaggregated intermediates trade flows. Specifically, we identify flows in the national accounts input-output table that go directly from consumers to producer industries that, in fact, do not sell directly to consumers (see Table A.I). We set the original flow equal to zero and instead add it in two places: first, to the flow going from consumers to the retail industry that sells the relevant goods; and second, to the flow going from the relevant retail industry to the industry producing the good. With that adjustment, the producing industry still receives the same amount of inflows, while consumers still spend the same amount. The only difference is that the relevant retail industry now has higher inflows (from consumers) and outflows (to the producing industry). We identify the relevant industry by manually assigning the 72 consumption categories reported in the input-output tables to the retail industry most likely to sell that category.[A5]

Note that this adjustment increases the total sum of flows in the input-output table. For retail

[A5] An example illustrates how the adjustment affects the final intermediates trade table. If the input-output table reports a flow of 1,000 from private consumers to manufacturers in region X as payment for cheese, the disaggregated intermediates trade flows replace this flow of 1,000 with 1) flows from grocery retailers in each of the 98 regions to manufacturers in region X, where the size of each flow is 1,000 multiplied by the origin region's share in total existing flows from grocery retailers to manufacturers in region X; and 2) flows from private consumers to grocery retailers in each of the 98 regions, where the size of each flow matches the corresponding retailer-to-manufacturer flow.

industries, the total sum of inflows thus no longer corresponds to the total value of output as defined in national accounts. The output of retailers is now defined as the full value of sales (excluding VAT and product taxes), while the retailer's acquisition cost is treated as an intermediate input from the non-retail producer of the traded product.

Appendix O Measuring Disaggregated Foreign Exports and Imports

Appendix O.A Foreign Exports and Imports of Manufacturing Firms

We follow different methods for manufacturing and non-manufacturing firms. For manufacturing firms, we observe imports and exports at the level of individual firms (CVR level) in two databases. Trade in goods is in the foreign trade registry (UHDI), while trade in services is in the firm sales and purchases registry (FIKS). We calculate each firm's total exports and imports as the sum of the values in the two registries.[A6] In some industries, the firm-level data and national accounts do not follow the same reporting guidelines for exports and imports. For instance, Danish national accounts report exports and imports of electricity traders by netting out short-run off-setting trades, while firm data report gross values. To ensure that we report values in line with national accounting guidelines, we scale total exports and imports in the firm-level data to match the industry aggregates in the national input-output table, at the level of 117 industries.

The vast majority of firms have only one establishment. We therefore assign these firms' exports and imports to their unique region-industry cell. For multi-establishment firms, we use information on the occupations of workers in each establishment to distribute firm exports and imports. We allocate exports of manufacturing firms to an establishment in proportion to the share of manufacturing workers' labor compensation paid by that establishment (relative to the firm's other establishments). We define manufacturing workers as those with occupation codes 13, 21, 31, 60--62, 70–75, 80–83, and 90–97. For instance, if a manufacturing firm has three establishments but one employs no manufacturing workers and two pay the same total labor compensation to manufacturing workers, we would assume that the exports of that firm come in even measure from the two establishments employing manufacturing workers. For imports, we allocate imports to an establishment in proportion to the share of firm-level non-retail store workers' labor compensation paid by that establishment.

Once we have allocated imports and exports of manufacturing firms to establishments, we assign each establishment to an industry-region cell, as described in Appendix D, and aggregate to the cell level.[A7]

[A6]For exports to non-EU countries, the FIKS registry shows only the sum of goods and services exports. We calculate services exports separately by assuming that the ratio of services to goods exports is the same for EU and non-EU exports at each firm.

[A7]To conform with anonymity guidelines, we censor exports and imports for cells with less than five firms and for cells where two firms represent more than 85% of total firm turnover. Within each industry, we compute total exports and imports associated with the censored cells and distribute it across the censored cells in proportion to their

Appendix O.B Foreign Exports and Imports of Non-Manufacturing Firms

We disaggregate exports and imports of non-manufacturing firms using labor compensation shares of regions within fine industries (based on the finest Danish classification at the level of 173 industries).

One industry (owner-occupied housing) has no firms, yet still has a small amount of imports according to the national accounts. We disaggregate this amount to the industry-region level using the geographic distribution of the imputed rental value of owner-occupied housing from the income register (IND).

Following the method applied to the disaggregated intermediates trade flows, we adjust the imports of retail industries to ensure consistency with the disaggregated consumer spending flows (see Appendix N.D).

Appendix O.C Exports to Foreign Visitors in Denmark

Firms can also export by selling goods to foreign consumers while they are in Denmark (e.g., sales to foreign tourists in Denmark). The national input-output table reports the total amount of consumer spending by foreign residents on Danish producers. We disaggregate this amount across Danish producer cells using two data sources.

First, we use the industry distribution of Danish residents' spending abroad from the disaggregated consumer spending flows to compute a proxy for each industry's share of foreign tourist spending, thus assuming that Danish tourists' spending behavior in foreign countries is indicative of foreign tourists' spending in Denmark. Second, to distribute across regions, we use data from visitdenmark.dk on foreigners' overnight stays at hotels to compute a proxy for each region's share of foreign tourist spending.

Appendix O.D Foreign Exports and Imports by Trading Partner

We measure foreign exports and imports by trading partner country using a combination of firm-level trade data from administrative registers, survey data, national accounts, and balance of payments (BoP) statistics. Total imports and exports, as measured above, are allocated across countries using cell-specific shares derived from micro data and aggregate BoP statistics. We conduct all steps separately for imports and exports.

For goods trade, we use detailed firm-by-product level data from the foreign trade register (UHDI) and use it to compute the share of goods trade relative to total trade for each cell, as well as individual country shares of total cell goods trade. As for total imports and exports, we disaggregate firm-level variables to the establishment level using labor compensation shares before aggregating to cell level. If information about the trading partner country is missing in a given firm-product

within-industry labor compensation shares.

entry, we impute it using the country distribution in uncensored entries for either (in order or priority) other products sold by the same firm, other firms selling the same product, or other firms belonging to the same cell.

For services trade, we rely on firm-level data from a survey conducted by Statistics Denmark. The survey covers the largest services trade firms in Denmark and a random sample of smaller firms. It is a key input in the compilation of BoP statistics. Since the number of firms in the survey is limited, inferring cell-level country distributions would introduce too much noise. Instead, we construct country distributions at the industry level and assume that these apply uniformly across all cells belonging to the same industry. In industries with limited survey coverage and in non-firm industries, we use the national-level country distributions for trade in services from aggregate BoP statistics.

Exports in the form of sales to foreigners visiting Denmark are treated separately. We use municipality-level data on the nationalities of overnight visitors to break down foreigners' spending in Denmark by visitor home country. For municipalities with missing data, we use the corresponding shares for the larger geographical unit ("landsdel") to which they belong. We apply the same country distribution across all industries, implicitly assuming that visitors from different countries visiting the same municipality spend their money on roughly the same products and services.

Finally, we compute overall country shares for total imports and exports in each cell as the value-weighted average of the corresponding shares for goods, services, and sales to foreign visitors. Due to anonymity requirements, we must censor all values in cells that contain only a few establishments or are dominated by one or two large firms. In those cases, we assume that the cell-level country shares correspond to the value-weighted average shares in the relevant industry.

Appendix P Measuring Disaggregated Government Dividend and Surplus Income

The government receives income from each producer cell that contains some government-owned establishments. We start with a list of firms that sell to consumers and producers at market prices and are (full or partly) owned by the government.[A8] We manually collect annual turnover for every firm from annual reports. We also collect information on establishment-level employment from the Danish business register (CVR). We combine these two datasets and split annual turnover regionally using each firm's distribution of employment across regions. We finally aggregate across industries (using the industry code of the parent firm) and regions to get to our level of producer cells. We assume that the share of surplus received by the government is equal to the share of turnover by government-owned establishments in each producer cell.

[A8] See fm.dk/arbejdsomraader/statens-selskaber/organisering.

Appendix Q Measuring Disaggregated Producer and Government Net Interest, Transfers, and Saving

The analog to producer net interest, transfers, and saving in the aggregate national accounts is the sum of the following SNA positions in the financial and non-financial corporate accounts: interest paid − received (net of D.41) + reinvested earnings on direct foreign investments other current transfers paid − received (net of D.43) + other investment income paid − received (net of D.44) + other current transfers paid − received (net of D.7) + natural resource rents paid (D.45) + gross saving (B.8g) + distributed income of corporations paid to rest of world (part of D.42) − distributed income of corporations received (D.42). This sum, based on the aggregate national accounts, differs slightly from "producer net interest, transfers, and saving" in our disaggregated accounts because the disaggregated spending flows imply a slightly higher value for consumer spending on foreign producers and thus slightly lower sales of domestic producers. An advantage of our approach is that we can directly observe foreign spending by Danish consumers in the Danske Bank data. In contrast, national accounts rely on balance of payments statistics, retail turnover, and consumer surveys to determine foreign spending (see also Footnote 15).

The analog to government net interest, transfers, and saving in the aggregate national accounts is the sum of the following government SNA positions: interest paid − received (net of D.41) + other current transfers paid − received (net of D.7) + gross saving (B.8g) − other investment income (D.44) − natural resource rents received (D.45). However, this sum based on the aggregate national accounts does not equal "net interest, transfers, and saving" in our disaggregated accounts because we do not disaggregate taxes, benefits, and subsidies received by institutional sectors other than producers and consumers (see Section III.B).

Appendix R Measuring Producer Balance Sheets

We use information on producer balance sheets from the firm financial accounts register (FIRE). The information in this register comes mainly from firms' financial statements, as reported to government agencies. It is collected by Statistics Denmark for economic analysis purposes and serves as key input into national accounts. The register covers private firms in most industries, except agriculture, fishing, finance, and government administration. Firms in FIRE make up around 93% of aggregate sales of Danish firms.

The data in the register are reported at the level of individual firms. For firms with establishments in multiple producer cells (e.g., in different regions), we assign a value to each establishment in proportion to its share of the firm's total labor compensation. We then compute average values at the cell level. Due to anonymity protection requirements, we censor values in cells that have only a few firms or are strongly dominated by one or two large firms.

On the assets side, we measure total, current, intangible non-current, tangible noncurrent, and financial noncurent assets. On the liabilities side, we measure total debt, provisions for future obligations, short-term accounts payable, long-term accounts payable, other short-term debt, other long-term debt, and equity. Finally, from the firms' income statements, we measure the average turnover for the establishments in the cell.

Appendix S Measuring Disaggregated Consumption of Government and NPISH Output

We measure which consumer cells consume different types of government services. In the system of disaggregated economic accounts, the government purchases these services from government-operated establishments in each producer cell and provides them to consumers free of charge. We assume that the per capita consumption of collective public goods is uniform across the Danish population (including police, national defense, and public administration). We use individual-level data on actual uses of public services to allocate individual public consumption (including education, healthcare, and social protection), as detailed below.

Appendix S.A Education

We assign the aggregate consumption of education services observed in the national accounts to consumer cells according to the number of students in primary, secondary, and tertiary education in a cell. The education register (UDD) contains information about the education program in which each individual is currently enrolled (if any) as well as each individual's highest completed education. We categorize individuals as primary school students if they are currently enrolled in a program and have no completed education; as secondary school students if they are currently enrolled in a program and their highest completed education is primary school (10 years); as tertiary education students if they are currently enrolled in a program and their highest completed education is secondary school (13 years); and as non-students if they are currently not enrolled in a program.

We aggregate the number of students in primary, secondary, and tertiary education to the level of consumer cells. As the cells only include the adult population, we assign the education consumption of minors to adults in the same household before aggregating, drawing on the intra-household links in the population register (BEF). For instance, two parents with three children, two of whom are in primary school and one of whom is in secondary school, would each consume the equivalent of one year of primary education and half a year of secondary education.

Finally, we allocate aggregate government spending on education to cells in proportion to their share of students in primary, secondary, and tertiary education and total government expenditure on education at each of these levels. Specifically, the estimated consumption of education services in cell i is

$$C_i^{edu} = \sum_{q=p,s,t} \frac{\#students_{i,q}}{\#students_q} \times expenditure_q,$$

where q is the level of education (with p, s, and t indicating primary, secondary, and tertiary, respectively) and expenditure is government spending on education of level q.

Appendix S.B Healthcare

Government spending on healthcare falls into six categories: outpatient services; hospital services; medical products, appliances and equipment; public health services; research and development; and other. We allocate government healthcare consumption summed over all six categories, as reported in national accounts, to consumer cells using publicly available statistics for the first two categories, which make up around 85% of the total.

Outpatient services capture government spending flowing to primary healthcare providers, like general practitioners, specialist doctors, psychiatrists, and dentists. We obtain average primary healthcare expenditures by age, gender, and municipality (Table SYGU1 in the Public Expenditure Statistics). Based on a regression of average primary healthcare expenditure on a set of indicators for age, gender, and municipality, we predict primary healthcare expenses for each individual in the population. We then aggregate the predicted expenditures to the level of consumer cells. Since children account for a non-negligible part of healthcare spending, we include the full population by assigning minors to the same consumer cells as the adults cohabiting with the child. If parents live together but work in different industries, we split the child's predicted healthcare expenditure equally between the two cells.

Hospital services capture government expenditure related to hospital treatments, including emergency room and outpatient hospital treatments. Again, we obtain information on the average number of days spent in hospital by age, gender, and municipality (Table INDAMP01 in the Health Statistics). Regressing average hospital days on a set of indicators for age, gender, and municipality, we predict the number of hospital days for each individual in the population. We then aggregate the predicted hospital days to the consumer cell level, again allocating the hospital days of minors to their parents' cells.

Finally, we combine the two indicators of healthcare usage to disaggregate total consumption of healthcare services of consumer cell i as

$$C_i^{health} = \sum_{q=o,h} \left(\frac{usage_{i,q}}{\sum_i usage_{i,q}} \times \frac{exp_q}{exp_o + exp_h} \right) \times exp, \tag{A.3}$$

where q indexes the type of healthcare (with o and h indicating outpatient and hospital services, respectively), $usage_{i,q}$ denotes cell i's usage of type q (expenditure on primary care and the number of hospital days), exp_q is national government spending on healthcare of type q, and exp is national government spending on healthcare summed over all six categories.

Appendix S.C Social Protection

Government spending on social protection falls into five categories: sickness and disability; old age; family and children; unemployment; and other. We allocate social protection services to consumer cells based on government microdata. Specifically, we allocate the category “sickness and disability” to cells in proportion to the number of individuals on sick leave or disability pension as observed in the income register (IND); the category “old age” in proportion to the number of individuals aged 80 or older as observed in the population register (BEF); the category “family and children” in proportion to the number of preschool children as observed in the population register (BEF); the category “unemployment” in proportion to the number of long-term unemployed; and the category “other” by population shares. The estimated consumption of social protection services in consumer cell i is thus

$$C_i^{social} \quad = \sum_{q=s,o,d,u,z} \frac{usage_{i,q}}{\sum_i usage_{i,q}} \times exp_q, \tag{A.4}$$

where q indexes the type of social protection (with s, o, d, u, and z denoting sickness/disability, old age, family/children, unemployment, and other, respectively), $usage_{i,q}$ denotes the relevant indicator for cell i's usage of type q (see above), and exp_q is national government spending on social protection services of type q.

Appendix S.D Measuring Disaggregated Consumption of NPISH Output

We measure the consumption of output provided by non-profit organizations (NPISH) for different consumer cells. NPISH output falls into five categories: education; social work activities; libraries; museums and other cultural activities; sports activities (non-market); and activities of membership organizations.

We first disaggregate usage of the first four categories by consumer region. For education, we use regional data on the share of children attending private schools (Table “UDDAKT20” in the Education Statistics). For social work, we use regional data on the share of privately owned (as opposed to government-operated) daycare institutions (Table “BOERN4” in the Child Care Statistics). For libraries, we use regional data on library usage per capita (Table “BIB1” in the Culture and Leisure Statistics). For museums and other cultural activities, we use regional data on members of sports associations per capita.

To infer usage by industry of work, we rely on the Danske Bank data. For education, we proxy use of NPISH education with payments to private schools. For social work, we calculate payments to private child-care institutions. For libraries, we use payments to libraries. For sports activities, we use membership payments to sports associations. For all categories, we count the number of transactions relative to the number of bank customers in each industry. We thereby estimate how likely consumers in each industry are to consume a given type of NPISH output.

We combine the information on consumption shares of NPISH by consumer region and industry to calculate consumption of NPISH output by consumer cell:

$$npish_{r,i}^{q} = \sum_{q} \frac{npish_{q,r} \times npish_{q,i} \times pop_{r,i}}{\sum_{r,s} npish_{q,r} \times npish_{q,i} \times pop_{r,i}} \times expenditure_{q},$$

where q is the NPISH category, r is region, i is industry, $pop_{r,i}$ is the cell's population, and expenditure is national NPISH output of type q.

For the final type of NPISH consumption, activities of membership organizations, we rely on Danske Bank data. This category consists mostly of trade unions and a small component of political or religious organizations. We disaggregate national consumption using as weights the share of individuals making payments to trade unions in each cell multiplied by the cell's population.

Appendix T Measuring Exposure to Fiscal Policy Transfer Programs

We measure the exposure of consumer cells to three transfer programs: the child tax credit as of 2018, the inflation relief to elderly in 2022, and the housing rent inflation support in 2023.

Appendix T.A Child Tax Credit as of 2018

The child tax credit is a refundable tax credit given to parents as a function of child age and parent income. In 2018, the highest annual rate of child tax credit amounted to around DKK 18,000 for children up to age 2, around DKK 14,000 for children age 3-6, and around DKK 11,000 for children age 7-17, with phase-out starting at a gross income around DKK 760,000. The total fiscal cost of the program was around DKK 12 billion in 2018.

Using detailed information about birth dates and parent-child links from the Population Register (BEF) combined with information about income from the Income Register (IND) and the parameters of the program, we determine the child tax credit received by each individual parent. We then aggregate across individuals to measure the exposure to the program of each consumer cell.

Appendix T.B Inflation Relief to Elderly in 2022

Following the surge in inflation in 2022, the Danish government decided to stimulate the economy and abate the living cost crisis by providing tax-free cash transfers to elderly individuals with low income and low liquidity (in addition to existing transfer programs). The inflation relief was targeted at around 290,000 individuals who were above the statutory retirement age (65 years), whose income was below DKK 91,000, and whose liquid assets were below DKK 95,000. There were three cash transfers: DKK 2,500 in September 2022, DKK 2,500 in January 2023, and DKK 5,000 in May 2023. The total fiscal cost was around DKK 3 billion.

Using detailed information from the Income Register (INC) about income and liquid assets in 2018 combined with the parameters of the program, we determine how much each individual would have received if an equivalent program had been in place in that year (deflating income and liquidity thresholds). We then aggregate across individuals to measure the exposure of each consumer cell.

Appendix T.C Housing Rent Inflation Support in 2023

To abate higher living cost due to the surge in inflation, the government decided in 2023 to pay a one-off cash transfer equal to one month's housing rent to people in social housing (in addition to other existing social programs). The transfer was targeted at individuals in social housing sections with special needs, including those with low median gross income, low median disposable income, receiving other social transfers, and single parents. The cash transfers were made in July 2024. In aggregate, the program transferred DKK 350 million.

We do not observe the payouts directly in the administrative registers and cannot measure all the specific criteria for special needs, so we allocate the aggregate transfers to consumer cells in proportion to the number of individuals living in social housing in 2018.

Appendix U Measuring Marginal Propensities to Consume (MPCs)

Appendix U.A MPCs Based on the Danish Release of Mandatory Savings in 2009

We estimate heterogeneous marginal propensities to consume using a Danish stimulus policy from 2009. The policy allowed individuals to convert savings held in an illiquid Special Pension (SP) account into immediately accessible funds (Kreiner et al. 2019). The SP funds stemmed from a government-mandated retirement saving program that was in place from 1998 to 2003. Originally, they were meant to be paid out in regular rates only after individuals turned 65. However, on March 1, 2009, the Danish government unexpectedly announced that all SP account holders would have free access to their SP funds from June 1, 2009. More than three million people—about three quarters of the adult population—were eligible. Of those, 94% chose to have their SP funds paid out, nearly all within the first two months.

Using individual-level monthly data on spending from Danske Bank matched with data on income, wealth, SP pay-outs and age from government administrative registers, we estimate the following equation for the period January 2009 to May 2010:

$$spend_{it} = \alpha_i + \delta \cdot post_t + \beta \cdot SP_i \cdot post_t + \boldsymbol{\gamma}' \boldsymbol{X}_i \cdot post_t + \epsilon_{it} \tag{A.5}$$

where $spend_{it}$ is individual i's spending in month t, α_i is an individual fixed effect, $post_t$ is an indicator taking the value one from June 2009 onward, and SP_i is the amount that individual i held in their SP account when it was released. $\boldsymbol{X}_i$ is a vector of categorical control variables, all measured at the beginning of 2009, capturing the individual's age, ex ante income, liquid assets, debt, DEA industry, and home region. Under the assumption that similar individuals with different SP funds would have remained on parallel spending trajectories in the absence of the policy, β identifies the effect of the stimulus program on spending, measured relative to the amount released and averaged over the first 12 months following this release. Because we annualize the monthly spending variable by multiplying it with 12, it can be interpreted as the one-year MPC for the average person in our sample.

To estimate heterogeneous MPCs, we extend the model by interacting $SP_i \cdot post_t$ with categorical variables representing key ex-ante characteristics: income, liquid assets, debt, and age. We find an average MPC of 0.43; lower MPCs for young adults and people with liquid assets; and no clear MPC heterogeneity by income and debt.

In a final step, we combine the coefficient estimates with individual-level data on age, income, liquid assets, and debt to compute predicted MPCs for each adult member of the population in 2018. We then average across individuals in each consumer cell to obtain cell-level MPC estimates.

Appendix U.B MPCs Based on Lewis et al. (2025)

The U.S. Economic Stimulus Act (ESA) of 2008 led to baseline transfers ranging from 300 USD to 600 USD per individual, with higher payments to individuals with children. The 2008 stimulus was originally studied by Parker et al. (2013) and re-analyzed with a focus on heterogeneity by Lewis et al. (2025). The average MPC reported in Section 4.1 of Lewis et al. (2025) is 0.42. Home-ownership, terciles of labor income, terciles of non-labor income, and the linear ratio of consumption to income are significantly associated with MPCs, as reported in their Table 3, column 5.

We predict the MPC of Danish consumer cells implied by the estimates in Lewis et al. (2025). We measure characteristics of Danish consumer cells that correspond to the characteristics in Table 3, column 5 of Lewis et al. (2025) that are statistically significantly associated with MPCs. Specifically, we measure: the share of homeowners in each cell; terciles of average labor income; terciles of non-labor income; and the ratio of total consumer spending to total income. The predicted MPC of a Danish consumer cell is given by a linear model of the cell-level characteristics multiplied with the relevant point estimates from Lewis et al. (2025). Finally, we ensure that the average predicted MPC matches the 0.42 average estimated by Lewis et al. (2025).

Appendix U.C MPCs Based on Boehm et al. (2025)

The French government paid a subset of households a one-off fiscal transfer of 300 Euro in May 2022. Boehm et al. (2025) in their Figure 2 report that the average household had spent 200 Euro by February 2023, implying a 9-month MPC of 0.67. Their results are consistent with an MPC of 1 after a few years. In their Figure 7, key dimensions of heterogeneity identified by a Lasso procedure include liquid wealth, age, and rural versus urban residence.

We predict the MPC of Danish consumer cells implied by the estimates in Boehm et al. (2025). Their Lasso specification uses quartiles of relevant consumer characteristics to analyze heterogeneity. We analogously calculate quartiles of characteristics for the Danish consumer cells. We then use the point estimates of heterogeneous MPCs according to the Lasso procedure at the 5-fold cross validation choice, as reported in their Figure 7. The predicted MPC of a Danish consumer cell is given by a linear model of the point estimates interacted with indicators for the bins with non-zero MPC heterogeneity. These bins with non-zero heterogeneity are: age Q3, age Q4, population size Q1 (for the most rural regions), population size Q4 (for the most urban regions), and liquidity rate Q3 (liquid assets over income). Finally, we ensure that the average predicted MPC matches the 0.67 average estimated by Boehm et al. (2025).

Appendix V Details on Model Derivations

Appendix V.A Proof of Proposition 1

To prove Proposition 1, we start from (20),

$$dGDP = \sum_{j \in \mathcal{J}} P_j dQ_j - \sum_{j \in \mathcal{J}} \sum_{j' \in \mathcal{J} \cup \{\mathcal{R}\}} P_{j'} dX_{j'j}. \tag{A.6}$$

Applying a total derivative to (10), we can express $P_j dQ_j$

$$P_j dQ_j = \sum_{i \in \mathcal{I}} Z_j P_j \frac{\partial F_j}{\partial N_{ji}} dN_{ji} + \sum_{j \in \mathcal{J} \cup \{\mathcal{R}\}} Z_j P_j \frac{\partial F_j}{\partial X_{jj'}} dX_{jj'}. \tag{A.7}$$

Next, observe that the first order condition for N_{ji} in the producer cell j's profit maximization problem is

$$Z_j P_j \frac{\partial F_j}{\partial N_{ji}} = W_i.$$

Similar, the first order condition for $X_{jj'}$ reads

$$Z_j P_j \frac{\partial F_j}{\partial X_{jj'}} = P_{j'}.$$

Substituting this into (A.7), we express $P_j dQ_j$ as

$$P_j dQ_j = \sum_{i \in \mathcal{I}} W_i dN_{ji} + \sum_{j \in \mathcal{J} \cup \{\mathcal{R}\}} P_{j'} dX_{jj'}. \tag{A.8}$$

This equation holds even if F_j is not using labor from some consumer cells i, that is, $\frac{\partial F_j}{\partial N_{ji}} = 0$ even if $N_{ji} = 0$, because in that case, $dN_{ji} = 0$, and similarly for the case where F_j is not using intermediates from some producer cell j'. Summing (A.8) across j and substituting into (A.6), this shows that the change in real GDP, $dGDP$, can be computed as the change in real labor payments,

$$dGDP = \sum_{j\in\mathcal{J}}\sum_{i\in\mathcal{I}} W_i dN_{ji}. \tag{A.9}$$

With all consumer cells having a fixed wage, as the economy is in a general recession, we have that $dGDP$ also equals the change in nominal labor payments, $\sum_{j\in\mathcal{J}}\sum_{i\in\mathcal{I}} d\left(W_i N_{ji}\right)$.

To compute how nominal labor payments change, we collect nominal equations from all consumer and producer cells.

Consumer cells. Due to their Cobb-Douglas preferences, nominal consumer spending across producer cells is simply a fraction of nominal income. Thus, in changes after a shock,

$$d\left(P_j c_{ij}\right) = \alpha_{ji} dY_i = \alpha_{ji}\left(1-\tau_i\right)\left(\sum_{j\in\mathcal{J}} d\left(W_i N_{ji}\right) + \sum_{j\in\mathcal{J}} \kappa_{ij}\left(1-\tau_j\right) d\Pi_j + dT_i\right) \tag{A.10}$$

for all $i \in \mathcal{I}$ and $j \in \mathcal{J} \cup \{\mathcal{R}\}$.

Producer cells. For firms, given their Cobb-Douglas production functions, nominal profits are simply a fraction of total nominal revenue,

$$d\Pi_j = \gamma_j d\left(P_j Q_j\right). \tag{A.11}$$

Similarly, labor demand is also a fixed fraction of total nominal revenue,

$$d\left(W_i N_{ji}\right) = \Lambda_{ij} \cdot d\left(P_j Q_j\right) \tag{A.12}$$

and so is the demand for intermediates,

$$d\left(P_{j'} X_{jj'}\right) = \Omega_{j'j} \cdot d\left(P_j Q_j\right). \tag{A.13}$$

Finally, from goods market clearing (17) we have that

$$d\left(P_j Q_j\right) = \sum_{j'\in\mathcal{J}} d\left(P_j X_{j'j}\right) + \sum_{i\in\mathcal{I}} P_j c_{ij}. \tag{A.14}$$

Putting things together. We define the vector $d\mathbf{v}$ as the change in *factor income* in the economy: the change in labor income received in the economy stacked with total profit income,

$$d\mathbf{v} \equiv \begin{pmatrix} \left\{\sum_{j\in\mathcal{J}} d\left(W_i N_{ji}\right)\right\}_{i\in\mathcal{I}} \\ \left\{d\Pi_j\right\}_{j\in\mathcal{J}} \end{pmatrix}.$$

Stacked pre-tax consumer income $d\mathbf{Y} = \{dY_i\}_{i\in\mathcal{I}}$ is then

$$d\mathbf{Y} = \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} \cdot d\mathbf{v} + d\mathbf{T}, \tag{A.15}$$

which follows directly from (A.10). $d\mathbf{T} = \{dT_i\}_{i\in\mathcal{I}}$ is the vector of transfer shocks across consumer cells.

Next, stacked consumer spending $d\mathbf{c} \equiv \left\{\sum_{i\in\mathcal{I}} d\left(P_j c_{ij}\right)\right\}_{j\in\mathcal{J}}$ is

$$d\mathbf{c} = \mathbf{A} d\mathbf{Y}, \tag{A.16}$$

which is simply the matrix version of the first equality in (A.10). Combining (A.13) with (A.14), we have

$$d\left(P_j Q_j\right) = \sum_{j'\in\mathcal{J}} \Omega_{jj'} \cdot d\left(P_{j'} Q_{j'}\right) + \sum_{i\in\mathcal{I}} P_j c_{ij}.$$

Thus, denoting the change in nominal revenue by $d\mathbf{q}$, we have

$$d\mathbf{q} = \Omega d\mathbf{q} + d\mathbf{c}$$

or in other words,

$$d\mathbf{q} = \left(\mathbf{I} - \Omega\right)^{-1} d\mathbf{c}. \tag{A.17}$$

Finally, observe that from (A.11) and (A.12) it directly follows that the change in factor income $d\mathbf{v}$ is

$$d\mathbf{v} = \begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} d\mathbf{q}. \tag{A.18}$$

Recall that $D(z_j)$ is our notation for a diagonal matrix with elements z_j along the diagonal, for any z_j. Putting together (A.15)–(A.18), we find that $d\mathbf{v}$ is determined as the solution to the fixed point

$$d\mathbf{v} = \begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} \left(\mathbf{I} - \Omega\right)^{-1} \mathbf{A} \left(\begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} d\mathbf{v} + d\mathbf{T}\right).$$

Using the definition of $\mathbf{M}$ in (18), we rewrite this as

$$d\mathbf{v} = \mathbf{M} d\mathbf{v} + \mathbf{M} \begin{pmatrix} d\mathbf{T} \\ 0 \end{pmatrix}, \tag{A.19}$$

where $\begin{pmatrix} d\mathbf{T} \\ 0 \end{pmatrix}$ is a vector with $|\mathcal{I}|$ entries dT_i at the top and otherwise zeros.

Unique solution $d\mathbf{v}$. Next, we show that there is a unique solution $d\mathbf{v}$ to (A.19). To do so, observe that, because $\alpha_{\mathcal{R}i} > 0$ for all consumer cells and spending shares sum to 1, $\sum_{j\in\mathcal{J}\cup\{\mathcal{R}\}} \alpha_{ji} = 1$, $\mathbf{A}$ has column sums strictly below 1. Moreover, the matrices $\mathbf{A}$, $\begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix}$ have non-negative entries and column sums at least weakly below 1. Thus, their product

$$\mathbf{A}\begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix}$$

has non-negative entries and columns sums strictly below 1.

Next, observe that

$$\begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} (\mathbf{I} - \Omega)^{-1}$$

also has non-negative entries and column sums at least weakly below 1.

To prove this, note first that, rearranging (11), we have

$$d\Pi_j + \sum_{i\in\mathcal{I}} d\left(W_i N_{ji}\right) + \sum_{j'\in\mathcal{J}} d\left(P_{j'} X_{jj'}\right) = d\left(P_j Q_j\right) - \sum_{j'\in\mathcal{J}\cup\{\mathcal{R}\}} d\left(P_{\mathcal{R}} X_{j\mathcal{R}}\right).$$

Combining this with (A.11)–(A.13) and noting that $\sum_{j'\in\mathcal{J}\cup\{\mathcal{R}\}} d\left(P_{\mathcal{R}} X_{j\mathcal{R}}\right) \geq 0$, we find

$$\mathbf{1}'D(\gamma_j) + \mathbf{1}'\Lambda + \mathbf{1}'\Omega \leq \mathbf{1}'. \tag{A.20}$$

Since Λ, $D(\gamma_j)$, Ω have non-negative entries, and, by assumption, either Λ or $D(\gamma_j)$ have at least one entry in each column that is positive, Ω must have column sums strictly below 1. Therefore, Ω has a maximum eigenvalue below 1 and

$$(\mathbf{I} - \Omega)^{-1} = \mathbf{I} + \Omega + \Omega^2 + \ldots$$

exists and has non-negative entries. Moreover, the column sums of $\begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} (\mathbf{I} - \Omega)^{-1}$ are

$$\mathbf{1}'\begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} (\mathbf{I} - \Omega)^{-1} = \mathbf{1}'\Lambda\left(\mathbf{I} - \Omega\right)^{-1} + \mathbf{1}'D(\gamma_j)\left(\mathbf{I} - \Omega\right)^{-1}. \tag{A.21}$$

From (A.20), we see that

$$\mathbf{1}'D(\gamma_j) + \mathbf{1}'\Lambda \leq \mathbf{1}' - \mathbf{1}'\Omega$$

and so that

$$\mathbf{1}'D(\gamma_j) + \mathbf{1}'\Lambda \leq \mathbf{1}'\left(\mathbf{I} - \Omega\right). \tag{A.22}$$

Using (A.22) we can bound (A.21) above,

$$\mathbf{1}' \begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} (\mathbf{I} - \Omega)^{-1} \leq \mathbf{1}'.$$

Thus, to sum up, $\mathbf{M}$, as defined in (18), consists of the product of two matrices

$$\begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} (\mathbf{I} - \Omega)^{-1} \qquad \text{and} \qquad \mathbf{A} \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix}$$

with non-negative entries and column sums strictly below 1. $\mathbf{M}$ therefore has all eigenvalues strictly inside the unit circle and $\mathbf{I} - \mathbf{M}$ is invertible. The unique solution to factor income $d\mathbf{v}$ in (A.19) is

$$d\mathbf{v} = (\mathbf{I} - \mathbf{M})^{-1} \mathbf{M} \begin{pmatrix} d\mathbf{T} \\ 0 \end{pmatrix}. \tag{A.23}$$

With the expression in (A.9), we can write $dGDP$ as

$$dGDP = \begin{pmatrix} \mathbf{1}' & 0 \end{pmatrix} d\mathbf{v} = \begin{pmatrix} \mathbf{1}' & 0 \end{pmatrix} (\mathbf{I} - \mathbf{M})^{-1} \mathbf{M} \begin{pmatrix} d\mathbf{T} \\ 0 \end{pmatrix}.$$

This proves (21) once the multiplier μ_i on a transfer to consumer cell i is defined as in (19) with fiscal externality $\overline{\tau}_i$.

Fiscal externality. Next, we derive the equation for the fiscal externalities $\overline{\tau}_i$ in (22). To do so, we totally differentiate the right hand side of the government budget constraint (14) to obtain the increase in tax revenue due to greater economic activity. Defining

$$\text{tax} \equiv \sum_{i \in \mathcal{I}} \tau_i Y_i + \sum_{j \in \mathcal{J}} \tau_j \Pi_j,$$

we have

$$d\text{tax} = \sum_{i \in \mathcal{I}} \tau_i dY_i + \sum_{j \in \mathcal{J}} \tau_j d\Pi_j.$$

We rewrite this in vector form as

$$d\text{tax} = \mathbf{1}' D(\tau_i) d\mathbf{Y} + \mathbf{1}' D(\tau_j) d\Pi.$$

Substituting in $d\mathbf{v}$, this becomes

$$d\text{tax} = \mathbf{1}' D(\tau_i) \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} \cdot d\mathbf{v} + \mathbf{1}' D(\tau_i) d\mathbf{T} + \mathbf{1}' D(\tau_j) \begin{pmatrix} 0 & \mathbf{I} \end{pmatrix} d\mathbf{v}. \tag{A.24}$$

Next, define effective tax rates $\boldsymbol{\mathcal{T}}$ as $\mathcal{T}_i \equiv \tau_i$ and $\mathcal{T}_j \equiv \tau_j + \sum_i \tau_i \kappa_{ij} (1 - \tau_j)$. Then:

$$d\text{tax} = \boldsymbol{\mathcal{T}}' \cdot (\mathbf{I} - \mathbf{M})^{-1} \mathbf{M} \begin{pmatrix} d\mathbf{T} \\ 0 \end{pmatrix} + (\tau_i)' \, d\mathbf{T},$$

which simplifies to

$$d\text{tax} = \boldsymbol{\mathcal{T}}' \cdot (\mathbf{I} - \mathbf{M})^{-1} \begin{pmatrix} d\mathbf{T} \\ 0 \end{pmatrix}.$$

Thus, the fiscal externalities are given by

$$\overline{\boldsymbol{\tau}} = \boldsymbol{\mathcal{T}}' \cdot (\mathbf{I} - \mathbf{M})^{-1} \begin{pmatrix} \mathbf{I} \\ 0 \end{pmatrix},$$

which is (22).

Price normalizations. Note that this entire proof of Proposition Appendix V.A does not rely on any of the price normalizations that we made for convenience in the calibration section.

Appendix V.B Formula for Domestic Spending Intensity

We define domestic spending intensity in (5) and (6). Denoting the intensity by z_i for consumer cells and z_j for producer cells, these equations are

$$z_i = \sum_{j \in \mathcal{J}} \alpha_{ji} z_j$$

and

$$z_j = \sum_{i \in \mathcal{I}} \Lambda_{ij} \left(1 + z_i (1 - \tau_i)\right) + \sum_{i \in \mathcal{I}} \gamma_j \kappa_{ij} (1 - \tau_j) \left(1 + z_i (1 - \tau_i)\right) + \sum_{j' \in \mathcal{J}} \omega_{j'j} z_{j'}.$$

To simplify the notation, we define $\tilde{z}_i \equiv (1 - \tau_i) z_i$. We summarize these equations in vector notation,

$$(\tilde{z}_i)' = (z_j)' \, \mathbf{A} \tag{A.25}$$

and

$$(z_j)' = \mathbf{1}'\Lambda + (\tilde{z}_i)' \Lambda + \left(\mathbf{1}' + (\tilde{z}_i)'\right) \mathbf{K} D(\gamma_j) + (z_j)' \, \Omega \tag{A.26}$$

where $(\tilde{z}_i)$ and (z_j) are vectors of that stack the intensities of consumer cells and producer cells, respectively. Rearranging (A.26), we express (z_j) as

$$(z_j)' = \left(\mathbf{1}' + (\tilde{z}_i)'\right) \Lambda \left(\mathbf{I} - \Omega\right)^{-1} + \left(\mathbf{1}' + (\tilde{z}_i)'\right) \mathbf{K} D(\gamma_j) \left(\mathbf{I} - \Omega\right)^{-1}.$$

We further rewrite this as

$$(z_j)' = \left(\mathbf{1}' + (\tilde{z}_i)'\right) \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} \begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} (\mathbf{I} - \Omega)^{-1}$$

and

$$(z_j)' = (\tilde{z}_i)' \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} \begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} (\mathbf{I} - \Omega)^{-1} + \mathbf{1}' \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} \begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} (\mathbf{I} - \Omega)^{-1}.$$

Combining this with (A.25), we have

$$(\tilde{z}_i)' = (\tilde{z}_i)' \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} \begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} (\mathbf{I} - \Omega)^{-1} \mathbf{A} + \mathbf{1}' \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} \begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} (\mathbf{I} - \Omega)^{-1} \mathbf{A}.$$

Multiplying from the left with $\begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix}$, we have

$$(\tilde{z}_i)' \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} = (\tilde{z}_i)' \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} \mathbf{M} + \mathbf{1}' \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} \mathbf{M}$$

and thus

$$(\tilde{z}_i)' \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} = \mathbf{1}' \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} (\mathbf{I} - \mathbf{M})^{-1} \mathbf{M}.$$

Multiplying from the left with $\begin{pmatrix} \mathbf{I} \\ 0 \end{pmatrix}$ we then obtain

$$(\tilde{z}_i)' = \mathbf{1}' \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} (\mathbf{I} - \mathbf{M})^{-1} \mathbf{M} \begin{pmatrix} \mathbf{I} \\ 0 \end{pmatrix}.$$

In terms of z_i, this means

$$(z_i)' = \mathbf{1}' \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} (\mathbf{I} - \mathbf{M})^{-1} \mathbf{M} \begin{pmatrix} D\left((1-\tau_i)^{-1}\right) \\ 0 \end{pmatrix}.$$

Appendix V.C Proof of Proposition 2

To prove Proposition 2, we start from our expression for GDP in (A.9) from the proof of Proposition 1,

$$dGDP = \sum_{j \in \mathcal{J}} \sum_{i \in \mathcal{I}} W_i dN_{ji}.$$

Denoting by ϕ_i an indicator variable whether consumer cell i's labor supply is slack ($\phi_i = 1$) or not ($\phi_i = 0$), we can write the GDP response as

$$dGDP = \sum_{j \in \mathcal{J}} \sum_{i \in \mathcal{I}} \phi_i d\left(W_i N_{ji}\right). \tag{A.27}$$

For all slack consumer cells, the wage is rigid, as it is up against a binding lower bound. Thus, for those i, $W_i dN_{ji} = d\left(W_i N_{ji}\right)$. For all other cells i, $dN_{ji} = 0$, as the wage is free to adjust. This explains (A.27). Following the exact footsteps of the proof of Proposition 1, we see that the same equation for $d\mathbf{v}$ holds, (A.23). Combining (A.23) with (A.27) immediately implies

$$dGDP = \begin{pmatrix} \boldsymbol{\phi}' & 0 \end{pmatrix} \left(\mathbf{I} - \mathbf{M}\right)^{-1} \mathbf{M} \begin{pmatrix} d\mathbf{T} \\ 0 \end{pmatrix}.$$

The fiscal externality is identical to that in Proposition 1. This proves Proposition 2.

Appendix V.D Dynamic Model Setup

Time is discrete and we interpret each period as a year. Each consumer cell i consists of a continuum of consumers with overlapping generations. Consumers are born young without any assets. They earn labor income in the first period, enjoy log utility from consumption, and save for the future by holding assets. When saving, they earn an annuity premium, as in Blanchard (1985). Thus, they do not leave behind any bequests. For simplicity, we assume unitary elasticities, that is, Cobb-Douglas preferences and production functions.

Consumer cells. Consumer $\ell \in [0, 1]$ in consumer cell i born at time t_0 maximizes

$$\max_{\{C_{it}(\ell), A_{it}(\ell)\}} \sum_{t=t_0}^{\infty} \left(\beta \phi_i\right)^{t-t_0} \log C_{it}(\ell), \tag{A.28}$$

subject to

$$P_{it} C_{it}(\ell) + A_{it}(\ell) = \phi_i^{-1} \left(1 + r^*\right) A_{it-1}(\ell) + 1_{\{t=t_0\}} \frac{\left(1 - \tau_i\right) Y_{it}}{1 - \phi_i}. \tag{A.29}$$

Within each period, we that all consumers ℓ within cell i have exactly the same preferences, given by (7), that are Cobb-Douglas across goods with expenditure shares α_{ji}. ϕ_i is a cell-specific survival probability. We do not interpret it literally as physical survival probability, but instead, in the spirit of Farhi and Werning (2019), as analogous to the probability of avoiding a borrowing constraint in a richer model. A low ϕ_i therefore serves to effectively restrict the planning horizon of the consumers. We later calibrate ϕ_i to match MPC estimates across consumers.

$A_{it}(\ell)$ is the consumer's end-of-period t asset position. The consumer is earning the world interest rate $1 + r^*$ on the asset position, multiplied by the inverse of the survival probability ϕ_i^{-1} to capture the annuity premium.

A mass $1 - \phi_i$ of consumers is born each period t. These consumers all earn the income of the cell, giving an income of $\frac{(1-\tau_i)Y_{it}}{1-\phi_i}$ per newborn. Here, τ_i is the same tax rate as that introduced in Section V. Y_{it} is pre-tax income of cell i,

$$Y_{it} = N_{it}W_{it} + \sum_{j \in \mathcal{J}} \kappa_{ij} \left(1 - \tau_j\right) \Pi_{jt} + T_{it}, \tag{A.30}$$

where all objects are simply the time-varying counterparts of those in (8). The assumption that all income is earned in the first period of a perpetual youth model follows Caballero et al. (2008), and helps to keep the dynamics tractable. It avoids consumers changing consumption plans in anticipation of future income changes, for which there is only limited evidence in the data (see, e.g., Broda and Parker 2014, Auclert et al. 2020).

Aggregating across consumers within a consumer cell, overall cell consumption and cell asset accumulation

$$C_{it} = \int_0^1 C_{it}(\ell) d\ell \qquad \text{and} \qquad A_{it} = \int_0^1 A_{it}(\ell) d\ell$$

follow the following system of equations

$$P_{it}C_{it} = \left(1 - \phi_i\beta\right) \left(\left(1 + r^*\right) A_{it-1} + \left(1 - \tau_i\right) Y_{it}\right) \tag{A.31}$$

and

$$P_{it}C_{it} + A_{it} = \left(1 + r^*\right) A_{it-1} + \left(1 - \tau_i\right) Y_{it}. \tag{A.32}$$

This is a direct application of Proposition 5 in Appendix B.7 of Aggarwal et al. (2023).

Producer cells. Producer cells are an exact replica of the producer cells in the static model. Each cell j is occupied by a representative firm producing a quantity Q_{jt} of good j with technology

$$Q_{jt} = Z_j F_j \left(\{N_{jit}\}_{i \in \mathcal{I}}, \{X_{jj't}\}_{j' \in \mathcal{J} \cup \{\mathcal{R}\}}\right),$$

where F_j and Z_j are as before. N_{jit} and $X_{jj't}$ are now time-varying. Pre-tax profits are time-varying, too,

$$\Pi_{jt} = P_{jt}Q_{jt} - \sum_{i \in \mathcal{I}} W_{it}N_{jit} - \sum_{j' \in \mathcal{J} \cup \{\mathcal{R}\}} P_{j't}X_{jj't}. \tag{A.33}$$

Wage rigidity. We keep the assumption that wages are downwardly rigid,

$$W_{it} \geq \left(1 - \delta\right) W_{it-1}, \tag{A.34}$$

though for our analysis of cumulative multipliers below, we study the impact of fiscal stimulus during a recession which pushes wages down against the constraint (A.34) until some period H capturing the horizon of the recession.

Rest of the world. The economy still operates a fixed nominal exchange rate, $\mathcal{E}_t = 1$, with an exogenous constant foreign price $P_{\mathcal{R}}$ and stable export demand

$$x_{jt} = \tilde{x}_j \cdot (P_{jt}/P_{\mathcal{R}})^{-\tilde{\sigma}}\,. \tag{A.35}$$

Government. The government budget constraint is given by

$$\sum_{j\in\mathcal{J}\cup\{\mathcal{R}\}} P_{jt}G_j + \sum_{i\in\mathcal{I}} T_{it} + (1+r^*)\,B_t = B_{t-1} + \sum_{i\in\mathcal{I}} \tau_i Y_{it} + \sum_{j\in\mathcal{J}} \tau_j \Pi_{jt} + \Delta_t, \tag{A.36}$$

where now transfers T_{it}, pre-tax income Y_{it}, profits Π_{jt} and transfers from abroad Δ_t are time-varying. B_t is government debt issued at the end of period t.

Balance of payments. The balance of payments for our small open economy is now given by

$$\sum_{j\in\mathcal{J}} P_{jt}x_{jt} \;+\; \Delta_t \;+\; (1+r^*)\,\mathrm{nfa}_{t-1} \;=\; \mathrm{nfa}_t \;+\; \sum_{i\in\mathcal{I}} P_{\mathcal{R}}c_{i\mathcal{R}t} \;+\; P_{\mathcal{R}}G_{\mathcal{R}} \;+\; \sum_{j\in\mathcal{J}} P_{\mathcal{R}}X_{j\mathcal{R}t}, \tag{A.37}$$

where the net foreign asset position is

$$\mathrm{nfa}_t = \sum_{i\in\mathcal{I}} A_{it} - B_t.$$

Equilibrium. A *competitive equilibrium* in the dynamic economy consists of paths for prices and wages $\{P_{jt}, W_{it}\}$ and a dynamic allocation $\{Q_{jt}, N_{jit}, X_{jj't}, \Pi_{jt}, T_{it}, G_j, Y_{it}, C_{ijt}, x_{jt}, B_t, A_{it}\}$ such that (a) income is given by (A.30); (b) all consumer cells maximize utility (A.28) subject to (A.29); (c) all producer cells maximize profits (A.33); (d) the downward nominal wage rigidity (A.34) holds; (e) the government's budget constraint (A.36) is balanced with bounded B_t; (f) exports are given by (A.35); (g) labor markets clear for each consumer cell,

$$N_{it} = \sum_{j\in\mathcal{J}} N_{jit}; \tag{A.38}$$

(h) the goods market clears for each producer cell,

$$Q_{jt} = \sum_{j'\in\mathcal{J}} X_{j'jt} + x_{jt} + \sum_{i\in\mathcal{I}} C_{ijt} + G_j; \tag{A.39}$$

and (i) the balance of payments hold in (A.37).

Calibration. We calibrate the model exactly as we calibrated the static model in Section V.C. The only parameters we have to determine in addition are the survival probability ϕ_i for each consumer cell i, the discount factor β, and the world interest rate r^*. Since consumer cell i's consumption and saving behavior is summarized by equations (A.31) and (A.32), and only the product $\phi_i\beta$ appears there, we only have to choose $\phi_i\beta$ for each cell i. Independently, β does not matter for the behavior of the dynamic model. Furthermore, $1-\phi_i\beta$ is exactly consumer cell i's marginal propensity to consume (MPC) out of post-tax income. In our baseline, we calibrate this object using the MPC evidence from Denmark described in Appendix U.A. Finally, we set $r^*=0$ as in Aggarwal et al. (2023). In an economy that explicitly modeled growth, this would correspond to the common "$r=g$" assumption, which has not been far from the truth for Denmark. This assumption ensures that the flows in any steady state of the dynamic model are identical to those in the static model of Section V.

Appendix V.E Dynamic Model Analysis

We now analyze the response of the dynamic economy to a surprise transfer shock (dT_{it}), raising transfers to consumer cell i at date t by dT_{it}, all financed by transfers Δ_t from abroad, $\Delta_t = \sum_{i\in\mathcal{I}} dT_{it}$. We denote the change in assets by consumer cell i by dA_{it}. We convert all asset changes to be pre-tax, $d\tilde{A}_{it} \equiv \frac{dA_{it}}{1-\tau_i}$, which turns out to be convenient further down, and collect them in vector $d\tilde{\mathbf{A}}_t$. The law of motion of $d\tilde{A}_{it}$ is then obtained by linearizing (A.32)

$$\frac{1}{1-\tau_i} d\left(P_{it}C_{it}\right) + d\tilde{A}_{it} = \left(1+r^*\right) d\tilde{A}_{it-1} + dY_{it}. \tag{A.40}$$

Here, the change in nominal consumption across consumer cells $d\left(P_{it}C_{it}\right)$ is then

$$\frac{1}{1-\tau_i} d\left(P_{it}C_{it}\right) = m_i\left(1+r^*\right) d\tilde{A}_{it-1} + m_i dY_{it}, \tag{A.41}$$

where we abbreviate the MPC by $m_i \equiv 1-\phi_i\beta$ to simplify the notation. Nominal income dY_{it} changes according to

$$dY_{it} = \underbrace{\sum_{j\in\mathcal{J}} \lambda_{ij} d\left(P_{jt}Q_{jt}\right)}_{\equiv dv_{it}} + \sum_{j\in\mathcal{J}} \kappa_{ij}\left(1-\tau_j\right) \underbrace{\gamma_j d\left(P_{jt}Q_{jt}\right)}_{\equiv dv_{jt}} + dT_{it}. \tag{A.42}$$

In words, consumer i spends a fraction m_i of the additional assets $(1+r)\, dA_{it-1}$ with which it entered period t, as well as a fraction m_i out of income dY_{it}, including any transfers received dT_{it}. As before, dv_{it} is the factor income of consumer cell i's labor, dv_{jt} is the factor income of producer cell j's fixed factor. We stack transfers and factor income into $|\mathcal{I}| + |\mathcal{J}|$-dimensional vectors $d\mathbf{T}_t = ((dT_{it})_i, \mathbf{0})'$ and $d\mathbf{v}_t$. Equation (A.42) then becomes

$$d\mathbf{Y}_t = \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} d\mathbf{v}_t + d\mathbf{T}_t.$$

A crucial object in the dynamic model is the *dynamic factor demand matrix* $\mathbf{M}^{dyn}$, defined as

$$\mathbf{M}^{dyn} = \begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} (\mathbf{I} - \Omega)^{-1} \mathbf{A} D(m_i) \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix}, \tag{A.43}$$

which includes a diagonal matrix of MPCs, $D(m_i)$. This matrix will guide the Keynesian amplification happening within each period. The full dynamics of our model are then described by two equations.

Proposition 3. *The response of the dynamic model to a transfer shock* $(d\mathbf{T}_t)$ *is governed by two equations. First, the vector of pre-tax asset positions* $d\tilde{\mathbf{A}}_t = (d\tilde{A}_{it})$ *evolves according to*

$$d\tilde{\mathbf{A}}_t = D(1 - m_i)(1 + r^*)\, d\tilde{\mathbf{A}}_{t-1} + D(1 - m_i) \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} (d\mathbf{T}_t + d\mathbf{v}_t), \tag{A.44}$$

where factor income $d\mathbf{v}_t$ *is determined by*

$$d\mathbf{v}_t = \mathbf{M}^{dyn} (d\mathbf{T}_t + d\mathbf{v}_t) + \begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} (\mathbf{I} - \Omega)^{-1} \mathbf{A} D(m_i)(1 + r^*)\, d\tilde{\mathbf{A}}_{t-1}. \tag{A.45}$$

GDP is given by

$$dGDP_t = \begin{pmatrix} \mathbf{1}' & 0 \end{pmatrix} d\mathbf{v}_t \tag{A.46}$$

and tax revenue is given by

$$dtax_t = \boldsymbol{\mathcal{T}}' (d\mathbf{T}_t + d\mathbf{v}_t). \tag{A.47}$$

Proof. Equation (A.44) is a simple combination of (A.40) and (A.41). To derive (A.45), we follow the steps in Appendix V.A, but instead of (A.10), we use

$$d(P_{it} c_{ijt}) = \alpha_{ji} m_i (1 - \tau_i) \left((1 + r^*)\, d\tilde{A}_{it-1} + dY_{it} \right).$$

Stacked consumer spending (A.16) is now given by

$$d\mathbf{c}_t = \mathbf{A} D(m_i) d\mathbf{Y}_t + \mathbf{A} D(m_i)(1 + r^*)\, d\tilde{\mathbf{A}}_{t-1},$$

giving us the within period fixed point

$$d\mathbf{v}_t = \begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} (\mathbf{I}-\Omega)^{-1} \mathbf{A} D(m_i) \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} (d\mathbf{v}_t + d\mathbf{T}_t) + \begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} (\mathbf{I}-\Omega)^{-1} \mathbf{A} D(m_i) (1+r^*) \, d\tilde{\mathbf{A}}_{t-1}.$$

With the definition of $\mathbf{M}^{dyn}$ in (A.43), this simplifies to

$$d\mathbf{v}_t = \mathbf{M}^{dyn} (d\mathbf{v}_t + d\mathbf{T}_t) + \begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix} (\mathbf{I}-\Omega)^{-1} \mathbf{A} D(m_i) (1+r^*) \, d\tilde{\mathbf{A}}_{t-1},$$

which is identical to (A.45). The GDP equation (A.46) follows from (A.9).

To solve for the response of tax revenue, we start with the dynamic analog of (A.24),

$$d\text{tax}_t = \mathbf{1}' D(\tau_i) \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} \cdot d\mathbf{v}_t + \mathbf{1}' D(\tau_i) \begin{pmatrix} \mathbf{I} & 0 \end{pmatrix} d\mathbf{T}_t + \mathbf{1}' D(\tau_j) \begin{pmatrix} 0 & \mathbf{I} \end{pmatrix} d\mathbf{v}_t.$$

Using effective tax rates $\boldsymbol{\mathcal{T}}$ as before, this becomes

$$d\text{tax}_t = \boldsymbol{\mathcal{T}}' \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} \cdot (d\mathbf{T}_t + d\mathbf{v}_t),$$

which is identical to (A.47). $\square$

Appendix V.F Dynamic vs. Static Multipliers

We define the H-horizon cumulative multiplier of the dynamic model as

$$\mu_i^{pv}(H) = \frac{\sum_{t=0}^{H} (1+r^*)^{-t} \frac{dGDP_t}{dT_{i0}}}{1 - \sum_{t=0}^{H} (1+r^*)^{-t} \frac{d\text{tax}_t}{dT_{i0}}}$$

for a small transfer to consumer cell i. Stacking them into a vector, we denote them by $\boldsymbol{\mu}^{pv}(H)$. We next prove that the ∞-horizon cumulative multiplier equals the static multiplier.

Proposition 4. *The ∞-horizon cumulative multipliers in the dynamic model, $\boldsymbol{\mu}^{pv}(\infty)$, defined in (25), are equal to the multipliers in the static model, defined in (21).*

Proof. To prove this result, we take present values of the equations in Proposition 3. To simplify the math, we define $q \equiv \frac{1}{1+r^*}$. We begin with (A.44),

$$\sum_{t=0}^{\infty} q^t d\tilde{\mathbf{A}}_t = D(1-m_i) \sum_{t=1}^{\infty} q^{t-1} d\tilde{\mathbf{A}}_{t-1} + D(1-m_i) \begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix} \left(\sum_{t=0}^{\infty} q^t d\mathbf{T}_t + \sum_{t=0}^{\infty} q^t d\mathbf{v}_t \right),$$

which simplifies to

$$D(m_i)\sum_{t=0}^{\infty} q^t d\tilde{\mathbf{A}}_t = D(1-m_i)\begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix}\left(\sum_{t=0}^{\infty} q^t d\mathbf{T}_t + \sum_{t=0}^{\infty} q^t d\mathbf{v}_t\right).$$

Multiplying this on the left with $\begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix}(\mathbf{I}-\Omega)^{-1}\mathbf{A}$, we get

$$\begin{aligned}\begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix}&(\mathbf{I}-\Omega)^{-1}\mathbf{A}D(m_i)\sum_{t=0}^{\infty} q^t d\tilde{\mathbf{A}}_t \\ &= \begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix}(\mathbf{I}-\Omega)^{-1}\mathbf{A}D(1-m_i)\begin{pmatrix} \mathbf{I} & \mathbf{K} \end{pmatrix}\left(\sum_{t=0}^{\infty} q^t d\mathbf{T}_t + \sum_{t=0}^{\infty} q^t d\mathbf{v}_t\right)\end{aligned}$$

where the big matrix on the left is simply $\mathbf{M}-\mathbf{M}^{dyn}$. Therefore,

$$\begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix}(\mathbf{I}-\Omega)^{-1}\mathbf{A}D(m_i)\sum_{t=0}^{\infty} q^t d\tilde{\mathbf{A}}_t = \left(\mathbf{M}-\mathbf{M}^{dyn}\right)\left(\sum_{t=0}^{\infty} q^t d\mathbf{T}_t + \sum_{t=0}^{\infty} q^t d\mathbf{v}_t\right). \quad \text{(A.48)}$$

Next, taking present values of (A.45), we find

$$\sum_{t=0}^{\infty} q^t d\mathbf{v}_t = \mathbf{M}^{dyn}\left(\sum_{t=0}^{\infty} q^t d\mathbf{T}_t + \sum_{t=0}^{\infty} q^t d\mathbf{v}_t\right) + \begin{pmatrix} \Lambda \\ D(\gamma_j) \end{pmatrix}(\mathbf{I}-\Omega)^{-1}\mathbf{A}D(m_i)\sum_{t=0}^{\infty} q^t d\tilde{\mathbf{A}}_t.$$

Substituting (A.48) on the right hand side, this becomes

$$\sum_{t=0}^{\infty} q^t d\mathbf{v}_t = \mathbf{M}\left(\sum_{t=0}^{\infty} q^t d\mathbf{T}_t + \sum_{t=0}^{\infty} q^t d\mathbf{v}_t\right).$$

Thus, the present value of factor income $\sum_{t=0}^{\infty} q^t d\mathbf{v}_t$ responds “as if” we had a static economy with $\mathbf{M}$ (instead of $\mathbf{M}^{dyn}$) and a static transfer shock of $\sum_{t=0}^{\infty} q^t d\mathbf{T}_t$. Solving the fixed point,

$$\sum_{t=0}^{\infty} q^t d\mathbf{v}_t = (\mathbf{I}-\mathbf{M})^{-1}\mathbf{M}\sum_{t=0}^{\infty} q^t d\mathbf{T}_t.$$

The present value of GDP (A.46) therefore moves according to

$$\sum_{t=0}^{\infty} q^t dGDP_t = \begin{pmatrix} \mathbf{1}' & 0 \end{pmatrix}(\mathbf{I}-\mathbf{M})^{-1}\mathbf{M}\sum_{t=0}^{\infty} q^t d\mathbf{T}_t.$$

Comparing this to (21), we see that

$$\sum_{t=0}^{\infty} q^t \frac{dGDP_t}{dT_{i0}} = \mu_i \cdot (1 - \overline{\tau}_i), \tag{A.49}$$

where μ_i is the static multiplier.

The present value of tax revenue changes (A.47) is

$$\sum_{t=0}^{\infty} q^t d\text{tax}_t = \boldsymbol{\mathcal{T}}' \left(\sum_{t=0}^{\infty} q^t d\mathbf{T}_t + \sum_{t=0}^{\infty} q^t d\mathbf{v}_t \right) = \boldsymbol{\mathcal{T}}' (\mathbf{I} - \mathbf{M})^{-1} \left(\sum_{t=0}^{\infty} q^t d\mathbf{T}_t \right).$$

Thus,

$$\sum_{t=0}^{\infty} q^t \frac{d\text{tax}_t}{dT_{i0}} = \overline{\tau}_i, \tag{A.50}$$

with the fiscal externality $\overline{\tau}_i$ exactly as defined in Proposition 22.

Putting together (A.49) and (A.50) we confirm that the infinite-horizon cumulative multiplier equals the static multiplier,

$$\mu_i^{pv}(\infty) = \frac{\sum_{t=0}^{\infty} (1+r^*)^{-t} \frac{dGDP_t}{dT_{i0}}}{1 - \sum_{t=0}^{\infty} (1+r^*)^{-t} \frac{d\text{tax}_t}{dT_{i0}}} = \frac{\mu_i \cdot (1 - \overline{\tau}_i)}{1 - \overline{\tau}_i} = \mu_i.$$

□

Appendix W Detailed Discussion of Alternative Accounts and Elasticities

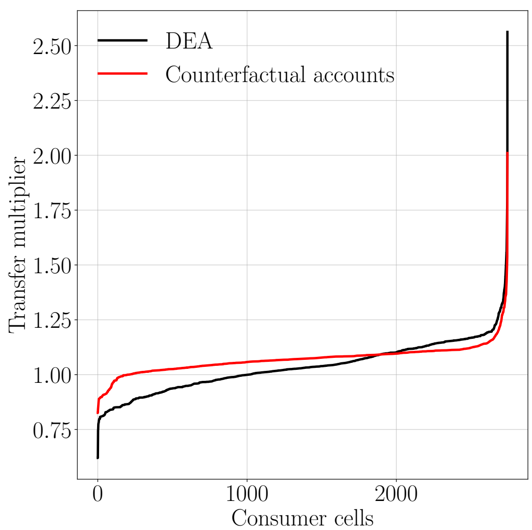
We present a more elaborate analysis of the points summarized in Section IX.

Appendix W.A Multipliers Under Counterfactual Accounts

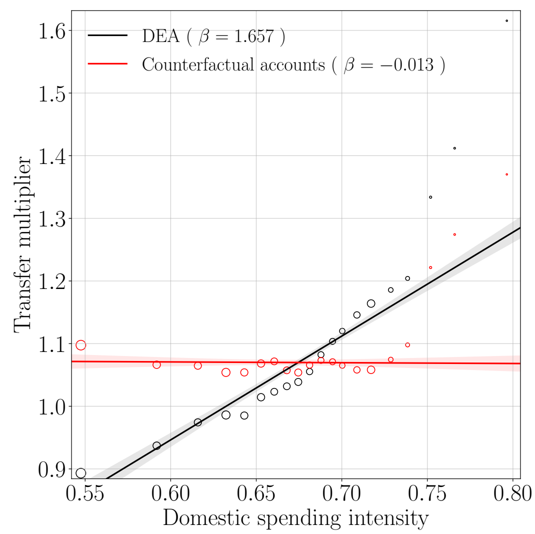
We show that the multipliers depend on the specific patterns observed in the disaggregated economic accounts (DEA), as opposed to being generic outcomes of a disaggregated model. We construct alternative, counterfactual accounts that differ from the true DEA in three ways. First, the domestic spending shares of rural consumer cells are low and those of urban cells are high in the counterfactual accounts, exactly opposite to the true pattern documented in Section IV.B. Second, urban consumer cells disproportionately spend in rural regions, so there is "rural bias" in consumption, contrasting the true urban bias established in Section IV.E. Finally, foreign exports of rural manufacturing firms are low and those of urban service firms are high in the counterfactual accounts. The three changes ensure that all accounting identities remain satisfied.

Using the counterfactual accounts, we re-calibrate the model of Section V and re-estimate the

Figure A.XVIII: Multipliers under counterfactual accounts



(a) Multipliers under counterfactual accounts and DEA



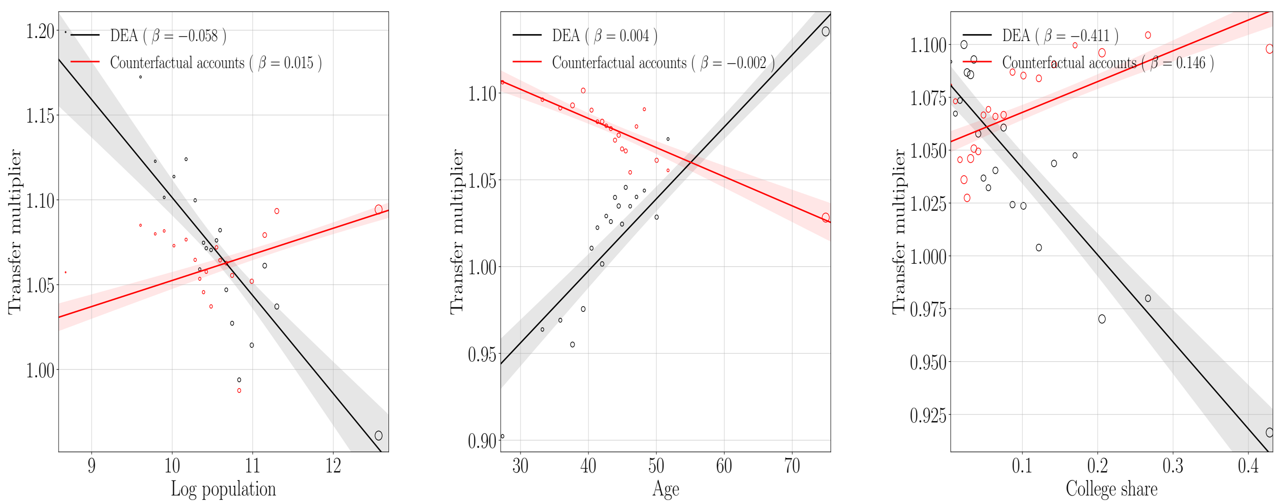
(b) Multipliers and domestic spending intensity

Panel a shows a binned scatter plot of the multiplier under alternative, counterfactual accounts described in Appendix W.A against the multiplier in the true disaggregated economic accounts (DEA). Panel b shows a binned scatter plot of the two multipliers against the DEA domestic spending intensity (calculated using the true DEA data). The solid lines are the lines of best fit, estimated using the cell-level data. Each circle contains the same number of cells. The size of a circle is proportional to the population size of cells in the circle. The regressions are weighted by population in the consumer cell. Standard errors are clustered by consumer cell. The error bands are 95% confidence intervals.

multipliers. The resulting multipliers differ from the baseline DEA multipliers, as shown in Figure A.XVIIIa, and are weakly associated with the domestic spending intensity calculated under the true DEA data, as shown in Figure A.XVIIIb. Moreover, rural, old, and less college-educated cells have lower multipliers under the counterfactual accounts, in contrast to the conclusions based on the true data, as shown in Figure A.XIX.

Figure A.XIX: Multipliers under counterfactual accounts and consumer characteristics

(a) By region size (b) By age (c) By college share



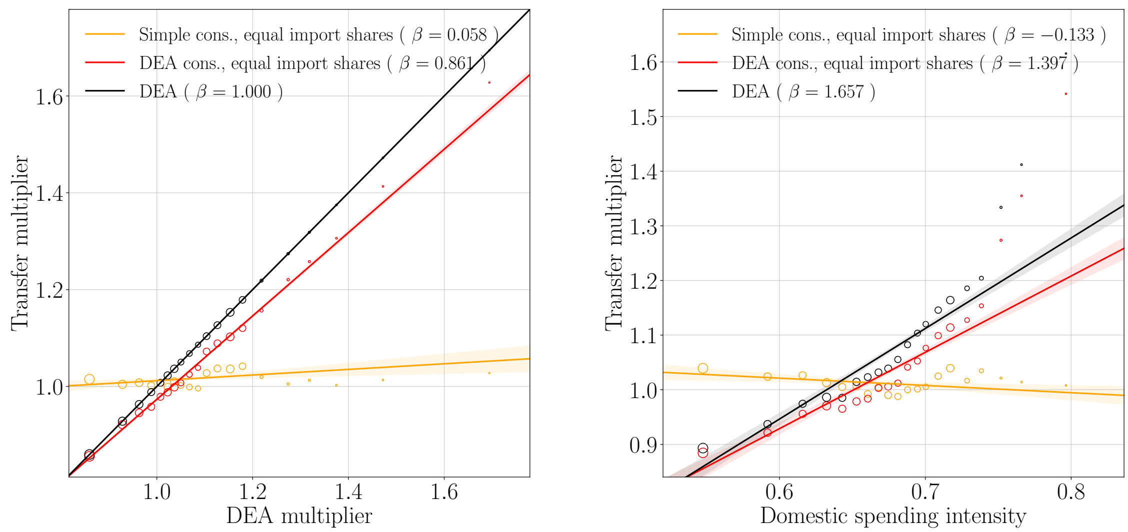
Panel a shows a binned scatter plot of the multiplier under alternative, counterfactual accounts against log population of the home region. Panel b shows a binned scatter plot of the multiplier under alternative, counterfactual accounts against the average age in the cell. Panel c shows a binned scatter plot of the multiplier under alternative, counterfactual accounts against the share of college-educated consumers in the cell. The solid lines are the lines of best fit, estimated using the cell-level data. Each circle contains the same number of cells. The size of a circle is proportional to the population size of cells in the circle. The regressions are weighted by population in the consumer cell. Standard errors are clustered by consumer cell. The error bands are 95% confidence intervals.

The analysis shows that changing the patterns in the disaggregated accounts changes the distribution of multipliers. Policymakers in economies with different structures may therefore benefit from measuring the disaggregated accounts in their specific context.

Appendix W.B Multipliers Under Simplified Accounts

Disaggregated data on foreign imports and consumer spending are not always available at the industry-by-region level. Some previous measurement systems have made simplifying assumptions to analyze the propagation of shocks in multi-region and multi-industry economies. While these assumptions are useful for some questions, they may lead to different conclusions about cell-level variation in transfer multipliers compared to the full DEA. We analyze to what extent the conclusions on multipliers change when we impose commonly used simplifying assumptions about foreign imports and consumer spending.

Figure A.XX: Multipliers under simplified accounts



(a) Multipliers under simplified accounts and DEA (b) Multipliers and domestic spending intensity

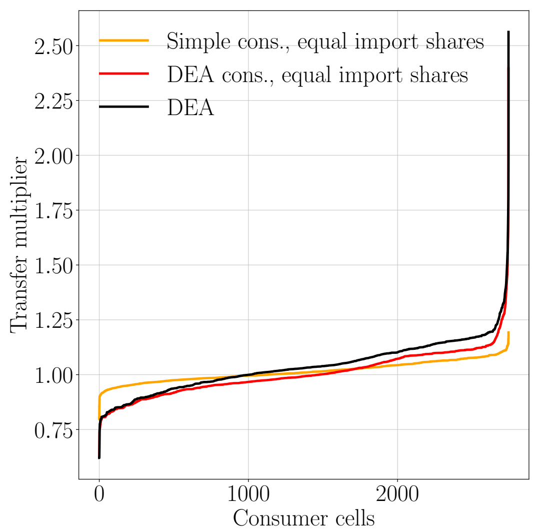
Panel a shows a binned scatter plot of the multiplier under two simplified accounts described in Appendix W.B against the multiplier in the true disaggregated economic accounts (DEA). Panel b shows a binned scatter plot of the multipliers against the DEA domestic spending intensity (calculated using the true data). The solid lines are the lines of best fit, estimated using the cell-level data. Each circle contains the same number of cells. The size of a circle is proportional to the population size of cells in the circle. The regressions are weighted by population in the consumer cell. Standard errors are clustered by consumer cell. The error bands are 95% confidence intervals.

In the absence of cell-level foreign trade data, a typical assumption is that every producer cell within an industry imports the same share of its intermediates from abroad. We adopt this simplified import pattern, but keep all other parts of the DEA unchanged. The resulting multiplier in the simplified accounts is positively associated with the multiplier based on the true data, but the slope is below 1, as shown in Figure A.XXa. In the same vein, the association between the multiplier and domestic spending intensity (calculated under the true data) is slightly lower in the simplified accounts, as shown in Figure A.XXb. Overall, the multipliers change somewhat but not strongly when we assume identical within-industry import shares.

In the absence of disaggregated consumer spending data, a common assumption is that consumers spend only on local producers and that local producers purchase final consumer goods from other regions in proportion to their purchases of intermediates from other regions. This approach is equivalent to assuming that the share of final goods purchased by region i consumers from region-by-industry producer cell j (out of the total consumer spending of region i consumers) equals the share of intermediates purchased by region i producers from producer cell j (out of the total intermediates spending of region i producers). In practice, this assumption is often implemented using expenditure shares calculated from cross-region shipments (e.g., the U.S. Commodity Flow Survey).

When we impose this simplified consumer spending matrix, the conclusions on multipliers change strongly, as shown by the low slopes in Figure A.XX. The distribution of multipliers is also more compressed than in the true data, as shown in Figure A.XXI, suggesting that simplifying assumptions would lead us to underestimate the potential gains from targeting high-multiplier groups.

Figure A.XXI: Distribution of multipliers under simplified accounts



The figure shows the distribution of multipliers under two simplified accounts described in Appendix W.B.

Another common simplifying assumption about consumer spending is that the share of consumer cell i's spending going to producer cell j (out of cell i's total spending) is identical across consumer cells. This assumption mirrors the representative consumer structure of Stone's SNA. Since there is no heterogeneity in consumer spending, the transfer multiplier is identical across cells, as shown in Figure XI.

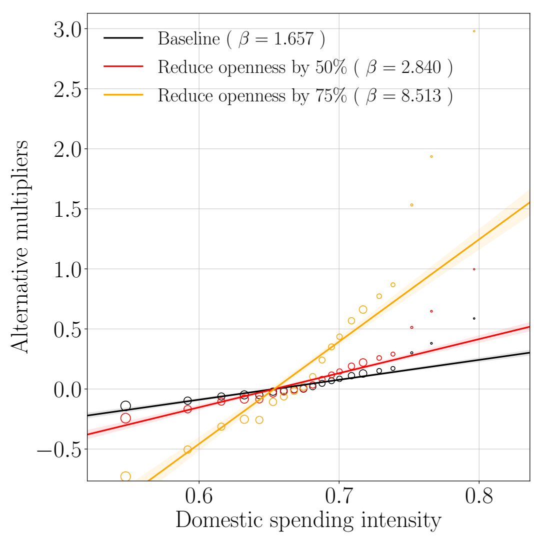
Taken together, the findings show that the variation in transfer multipliers cannot be replicated under simplifying assumptions in the absence of disaggregated data.

Appendix W.C Multipliers in Less Open Economies

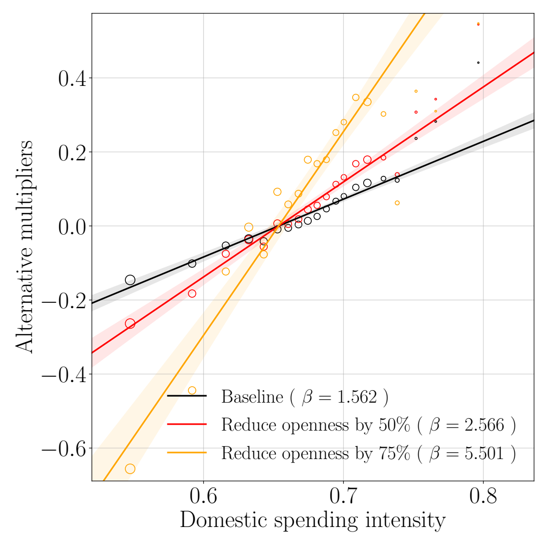
We show that a cell's domestic spending intensity is associated with the relative size of its multiplier in economies less open to foreign trade than Denmark. The ratio of aggregate imports to GDP in Denmark was roughly 52% in 2018, slightly below the median European Union country. In contrast, the ratio was around three-quarters lower in the United States, which at 15% was the least open OECD country in the world.

We analyze two less open versions of the Danish economy by proportionally scaling down every cell's imports and exports by 50% and 75%, respectively. In the less open economies, domestic cells that import from abroad in the true data now purchase more from other domestic cells that export in the true data. As a result, each cell's foreign imports and exports are lower in the less open economies, relative to the true DEA, but each cell's total outflows and inflows remain unchanged.

Figure A.XXII: Multipliers in less open economies



(a) Static multipliers



(b) Dynamic multipliers after year 4

The panels show binned scatter plots of the multiplier in two less open economies against the DEA domestic spending intensity (calculated using the true data). The multipliers are de-meaned relative to other cells in the economy, which eases visual comparisons. Panel a shows multipliers from the static model. Panel b shows multipliers from the dynamic model after year 4. The solid lines are the lines of best fit, estimated using the cell-level data. Each circle contains the same number of cells. The size of a circle is proportional to the population size of cells in the circle. The regressions are weighted by population in the consumer cell. Standard errors are clustered by consumer cell. The error bands are 95% confidence intervals.

Using the less open economies, we re-calibrate the model of Section V and re-estimate the multipliers in an economy-wide recession in the static model. For each version of openness, we report de-meaned multipliers, since this eases visual comparisons and we do not want to focus on the well-known finding (going back to the textbook Mundell-Fleming model) that average multipliers are higher in less open economies. The de-meaned multipliers are equal to the multipliers of transfers that are funded internally through equal taxes on each consumer cell.

We plot the de-meaned multipliers for economies with different openness against the domestic spending intensity measured in the true DEA data in Figure A.XXIIa. Two findings stand out. First, domestic spending intensity continues to be strongly associated with the multiplier in less open economies. As before, the intuition is that cells with high domestic spending intensity contribute more to domestic incomes, implying that their spending leads to greater GDP gains. Second, the higher slopes in the less open economies reveal that the relation between domestic spending intensity and the multiplier is stronger in less open economies. Intuitively, each dollar spent in a less open economy reaches a multiple more domestic cells, so that an initial difference in domestic spending intensity is disproportionately amplified in a less open economy.

We repeat the analysis of less open economies using the dynamic model of Section VIII. Figure A.XXIIb plots multipliers from the dynamic model after year 4 against domestic spending intensity measured in the true data. The difference between the true DEA and the less open economies is less pronounced in the dynamic model relative to the static model. The reason is that in the dynamic model after finite horizons, consumers have not spent the initial transfer in full, so that the multiplicatively greater impact of domestic spending intensity has not yet fully played out.

Taken together, our key point is not to analyze whether spending intensities matter more or less in less open economies. Instead, we wish to emphasize that knowledge of the full DEA can provide policy-relevant insights in less open economies.

Appendix W.D Alternative Elasticities of Substitution

The baseline analysis assumes Cobb-Douglas elasticities equal to 1 because they may be appropriate for the analysis over a 4-year horizon and because of their analytical tractability, as explained in Section V.C. We explore variation in transfer multipliers using alternative elasticities.

Throughout this section, we assume that, for each consumer cell i, $C_i(\cdot)$ is of the form

$$C_i(\cdot) = c_{i\mathcal{R}}^{\alpha_{i\mathcal{R}}} \mathcal{C}_i(\{c_{ij}\}_{j\in\mathcal{J}})^{1-\alpha_{i\mathcal{R}}}.$$

$\mathcal{C}_i$ is a nested CES utility function with an outer elasticity of substitution between industries, $\overline{\sigma}$, and an inner elasticity of substitution σ between producer cells within an industry. We write the production function $F_j(\cdot)$ as

$$Q_j = Z_j F_j\left(K_j, \{N_{ji}\}_{i\in\mathcal{I}}, \{X_{jj'}\}_{j'\in\mathcal{J}}, X_{j\mathcal{R}}\right). \tag{A.51}$$

Here, we explicitly model the fixed factor K_j, and we separate the domestic labor bundle $\{N_{ji}\}_{i\in\mathcal{I}}$, domestic intermediates $\{X_{jj'}\}_{j'\in\mathcal{J}}$ and imported intermediates $X_{j\mathcal{R}}$. Given that we explicitly model the fixed factor K_j, F_j is constant returns to scale.[A9]

We assume F_j is nested CES, too, with an outer elasticity of substitution ϑ across the four types of inputs in (A.51), as well as an inner elasticity of substitution between domestic consumer cells (within industry) of ζ, and for domestic intermediates an outer cross-industry elasticity of

[A9] This formulation nests (10) by normalizing $K_j = 1$, as it is in fixed supply, and assuming that F_j is Cobb-Douglas over K_j and all the other inputs.

substitution of $\overline{\upsilon}$ as well as a within-industry elasticity of substitution υ. Irrespective of the choice of elasticities, our pre-shock economy is always calibrated to match the same flows as those described in Section V.C. Different elasticities only govern the response of the economy to shocks, such as transfers to consumer cells.

We study the robustness of our results on transfers multipliers with respect to two alternative calibrations of elasticities, one designed to capture short-run elasticities, and one designed to capture long-run elasticities. We summarize these calibrations in Table A.XVI.

Elasticity	**Symbol**	**Our baseline**	**Short-run**	**Long-run**
Consumption, across industries	$\overline{\sigma}$	1	0.9	1
Consumption, within industries	σ	1	1	2.11
Exports	$\tilde{\sigma}$	1	4	4
Production, across value added and inputs	ϑ	1	0.5	1
Intermediates, across industries	$\overline{\upsilon}$	1	0.2	1
Intermediates, within industries	υ	1	4	4
Labor, within industries	ζ	1	1	2.10

Table A.XVI: Alternative elasticities

Short-run elasticities. Here, we follow the calibrations suggested in Atalay (2017) and Baqaee and Farhi (2024). As in these papers, we let the elasticity of substitution in consumption across industries be $\overline{\sigma} = 0.9$, while the elasticity within industries is still $\sigma = 1$. The elasticity in the production function between value added and other types of inputs is $\vartheta = 0.5$. The elasticity of substitution between intermediate inputs from different industries is $\overline{\upsilon} = 0.2$, while it is $\upsilon = 4$ within industries, consistent with the within-industry estimates from Caliendo and Parro (2015). We assume that the export demand elasticity is also equal to $\tilde{\sigma} = 4$ following Simonovska and Waugh (2014) and Head and Mayer (2014). Labor demand within industries keeps a unit elasticity, $\zeta = 1$.[A10]

Long-run elasticities. To analyze the higher elasticities employed in trade, which are more relevant for long-run analyses, we set the consumption elasticity of substitution within domestic industries to $\sigma = 2.11$ as in Adão et al. (2022). We keep the export demand elasticity at $\tilde{\sigma} = 4$, as

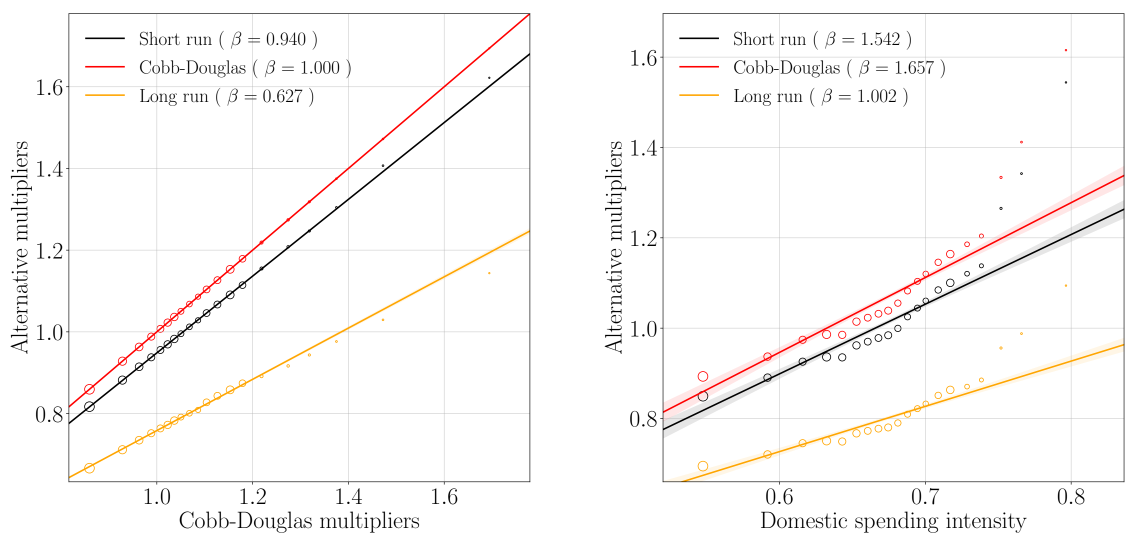
[A10]Note that there is almost no labor demand across industries given that we index consumer cells by their main work industry.

well as the elasticity between domestic intermediates within the same industry, $\upsilon = 4$. Finally, we assume that labor demand has an elasticity of 2.10 as in Adão et al. (2022) and close to Monte et al. (2018).

Results. We repeat the analysis of Section VI to calculate transfer multipliers during an economy-wide recession. Figure A.XXIII shows that the multipliers based on the lower elasticities are higher on average. However, the focus of our paper lies not on the level of multipliers, but on the variation in multipliers and the relative effectiveness of targeted policies. The multipliers with lower elasticities are positively and linearly related to those from the baseline calibration. This finding implies that the conclusions related to variation in multipliers are similar with lower elasticities.

Figure A.XXIII also shows that the multipliers based on the long-run elasticities are lower, but positively correlated with the baseline multipliers, with little deviation from the linear line of best fit. This implies that the conclusions related to variation in multipliers, the focus of our analysis, are similar using long-run elasticities.

Figure A.XXIII: Multipliers using alternative elasticities



(a) Multipliers using alternative elasticities (b) Multipliers and domestic spending intensity

Panel a shows a binned scatter plot of the multiplier under alternative elasticities described in Appendix W.D against the multiplier using the baseline Cobb-Douglas elasticities. Panel b shows a binned scatter plot of the multipliers against the DEA domestic spending intensity. The solid lines are the lines of best fit, estimated using the cell-level data. Each circle contains the same number of cells. The size of a circle is proportional to the population size of cells in the circle. The regressions are weighted by population in the consumer cell. Standard errors are clustered by consumer cell. The error bands are 95% confidence intervals.