DISAGGREGATED ECONOMIC ACCOUNTS

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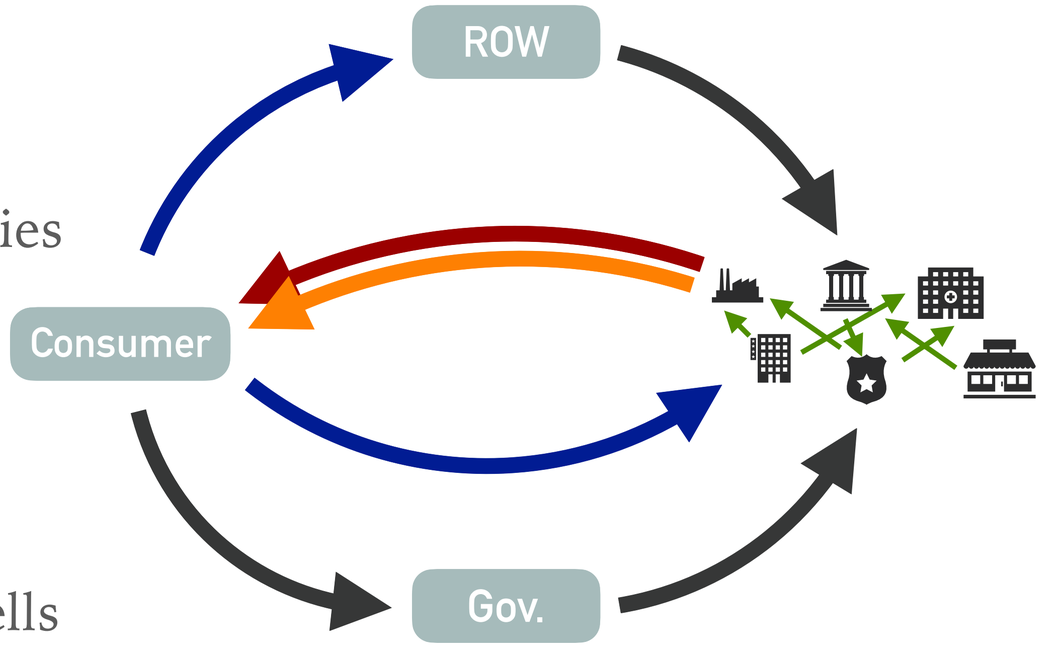
INTRODUCTION: DISAGGREGATING THE CIRCULAR FLOW

- Background: National Accounts as we know it
  - based on work by Kuznets and Stone in 1930s and 40s
  - key idea: The economy as a "**circular flow**"
  - first, single aggregate consumer & producer
  - later, disaggregated trade among producer industries
- Today: "**Disaggregated Economic Accounts**"
  - disaggregates both consumer and producer sides
  - into small, consistently defined units (“cells”)
  - connected by bilateral flows between all pairs of cells
  - that add up to National Accounts aggregates
  - thus breaking down the full circular flow



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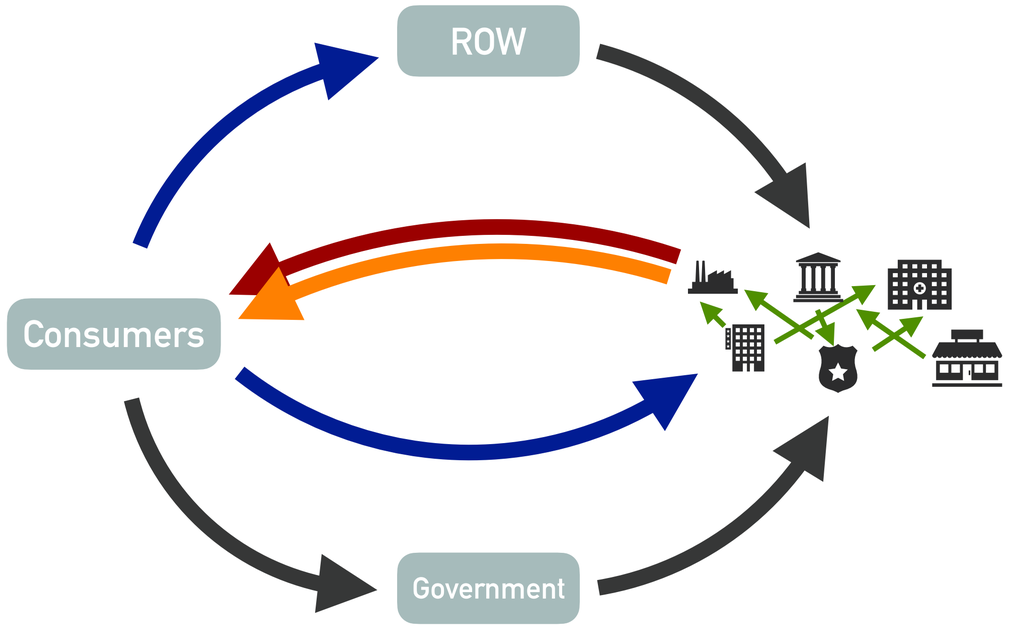
IN TERMS OF CIRCULAR FLOW CHARTS

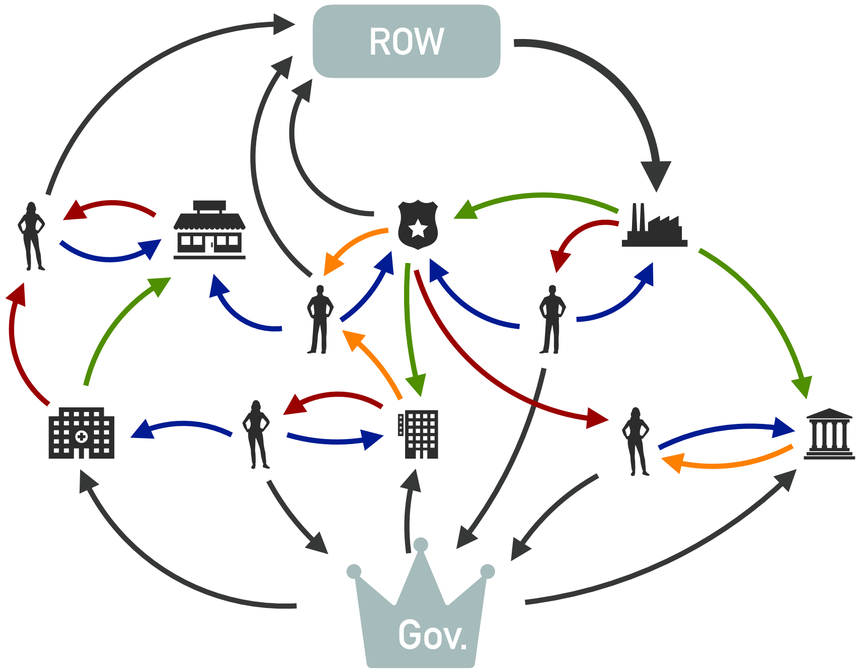
National Accounts in the (Richard) "Stone Age"

- *whole circular flow*
- *capture national aggregates*
- *mostly aggregate flows, except producer trade*

Disaggregated Economic Accounts (DEA)

- *whole circular flow*
- *capture national aggregates*
- *bilateral flows across small cells*





WHAT WE DO IN THIS PAPER

1. **Measurement:** proof of concept in Denmark
   - ➤ 2,700 region-by-industry cells; geocoded spending data
2. **Facts:** spending flows across regions and industries
   - ➤ e.g., “triangular trade” pattern between rural, urban, and foreign regions
3. **Policy relevance**: Fiscal policy in general equilibrium model with many consumers, producers - cell-level fiscal multipliers during demand-driven recessions:
   - ➤ key insight: targeting cells that spend intensely on "slack" cells is very effective
   - ➤ in economy-wide recession, this means targeting old, rural, less-educated cells
   - ➤ also study multipliers during recession triggered by higher U.S. tariff

THREE STEPS TO OUR MEASUREMENT

1) Assemble aggregate circular flow

   36 flows such as consumer spending, labor compensation, intermediate input purchases, exports, imports, taxes, gov. spending, etc.

2) Set unit of disaggregation

   ~2,700 consumer cells: adults by region of residence & industry of main job

   ~2,700 producer cells: establishments by region & main production industry

3) Disaggregate all flows across region-industry cells using micro data

   - "Bottom-up": Measure cell-to-cell flows directly from micro data
   - "Top-down": Distribute aggregate flow using assignment algorithm informed by micro data

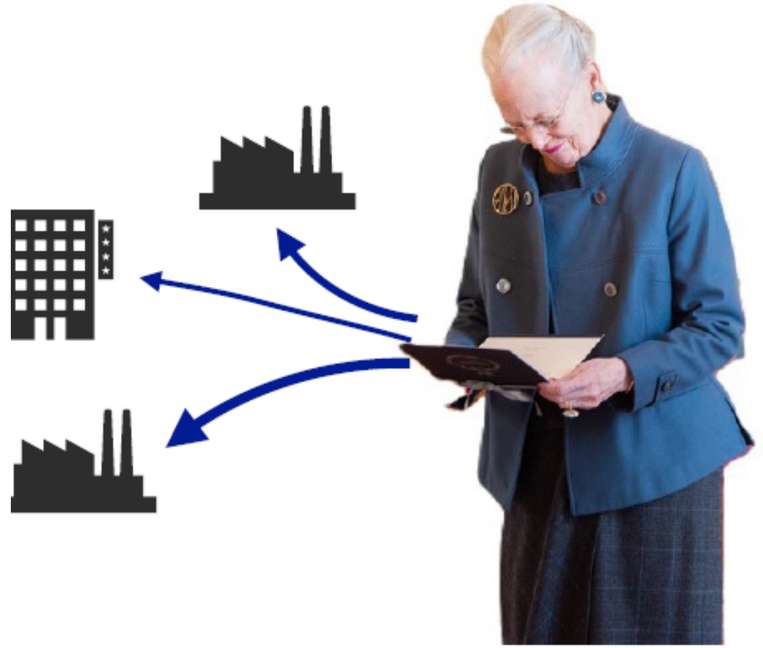
Today: focus on **consumer spending** measured with **bank transaction data** ("bottom up")

DISAGGREGATING CONSUMER SPENDING: DATA SOURCES

- Main data: **consumer-to-store transactions** from Danske Bank
  - 20% of Danish adults have their main bank account at Danske Bank
  - customers representative of population
  - all credit/debit card payments (~45%), bills/direct debits (~45%), mobile payments, cash withdrawals
- Augment with administrative datasets on housing, fin. services, vehicles
  - e.g., rental value of owner-occupied housing, int. rate spreads, vehicle registrations

DISAGGREGATING CONSUMER SPENDING: MAPPING CELL-TO-CELL FLOWS

- Observe **consumer** industry from salary payments, and region of residence from home address
- Observe **shop's** industry and region for payments
  - cross-walk between MCC and industry codes
  - address of terminal for card & mobile payments
  - address of bill recipients
  - also foreign addresses and industries

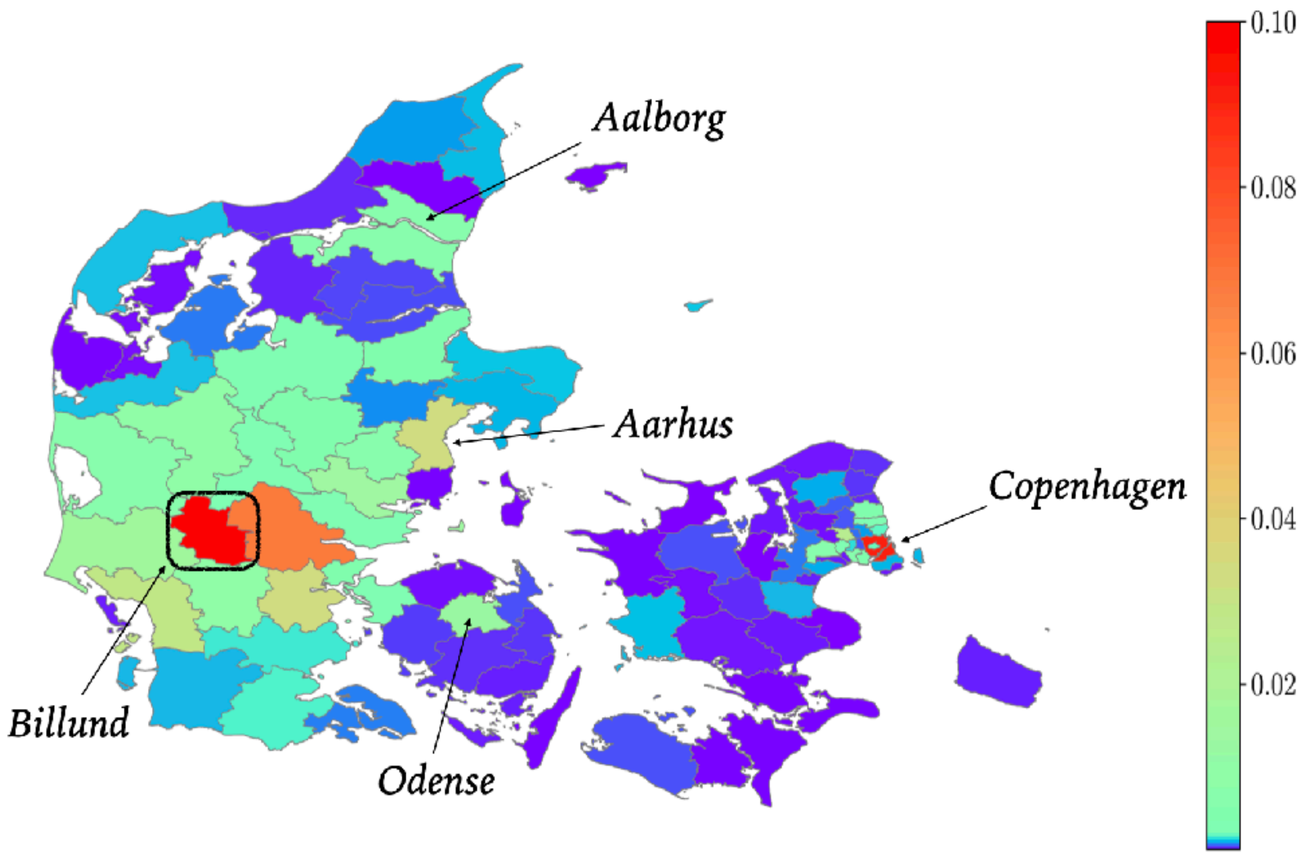


- Aggregate micro-level flows to cell-to-cell values, rescale to cell population

FAQ Graphs

DISAGGREGATED CONSUMER SPENDING FLOWS: AN EXAMPLE

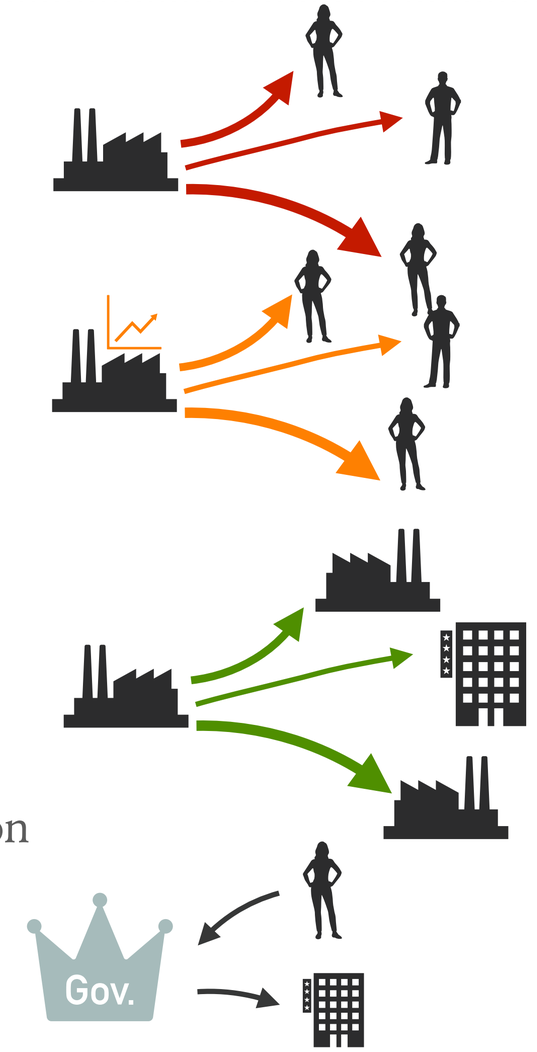
Spending of manufacturing workers in Billund



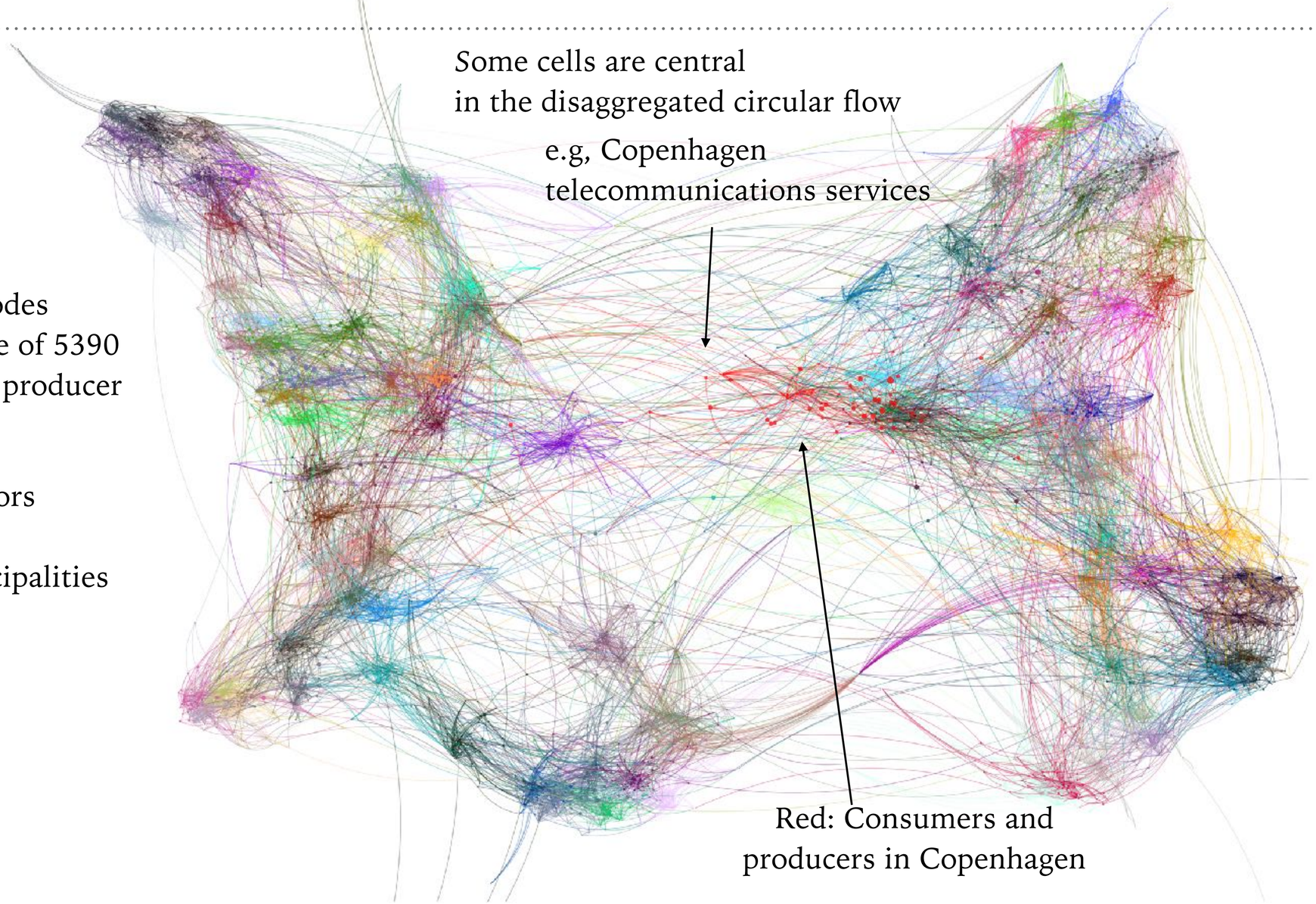
- Spending flows geographically concentrated
- Strong effect of distance, captured by gravity model
- But also notable deviations from gravity (e.g. Copenhagen, malls in neighboring Vejle)

DISAGGREGATING OTHER FLOWS: SOME EXAMPLES

- **Labor compensation**
  - Administrative registers on locations of residence and work
- **Dividend income**
  - Unincorporated businesses: Mixed income from administrative registers
  - Corporations: Assign dividend payments in line with dividend income on tax returns
- **Intermediate inputs trade**
  - Start with finest national IO table in Denmark (117 industries)
  - Add regional dimension using gravity structure estimated from producer-to-producer transaction data, while taking into account regional labor compensation shares within industries
- Government transactions
  - Admin registers on taxes and subsidies



VISUALIZING 43M DISAGGREGATED FLOWS



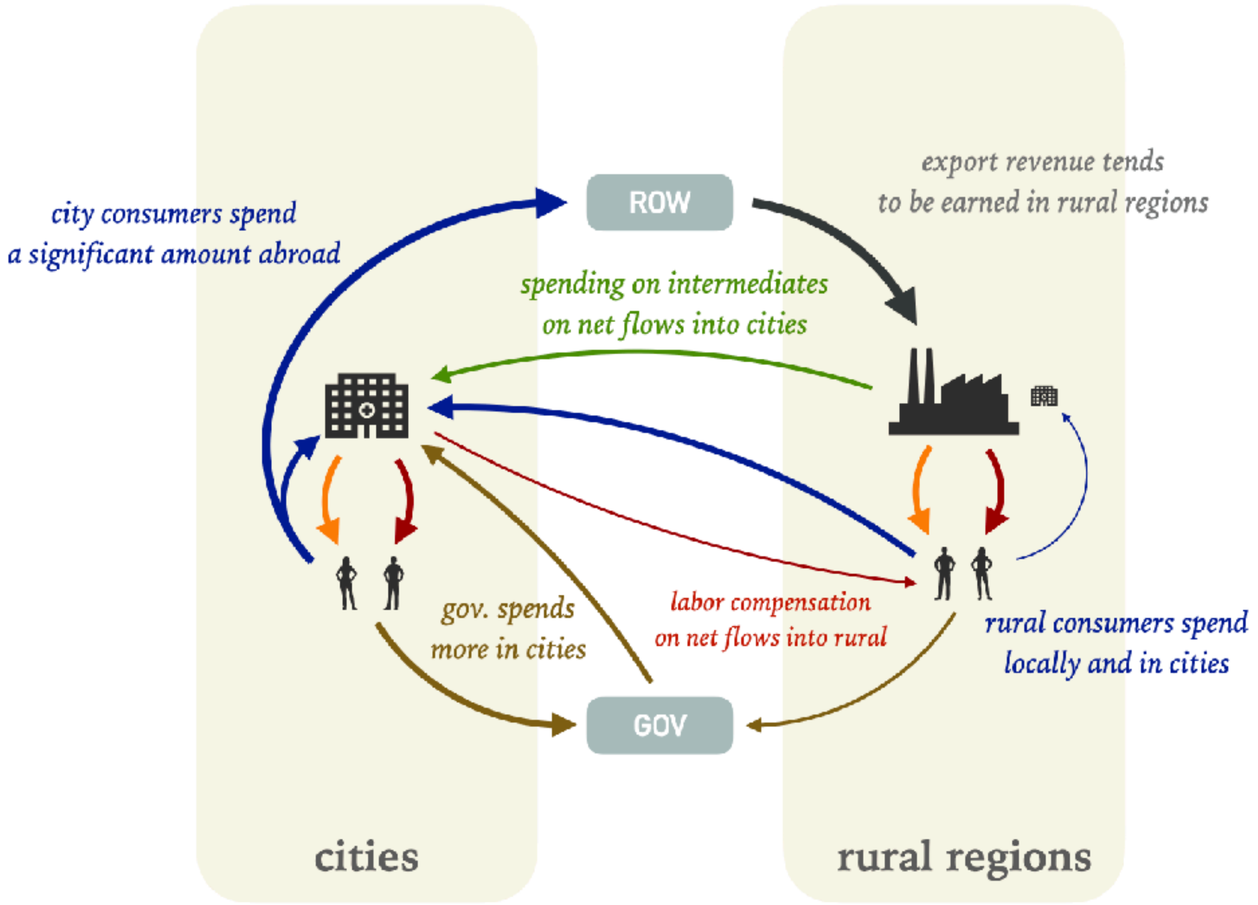
Individual nodes represent one of 5390 consumer or producer cells

Different colors represent the 98 municipalities of Denmark

THREE FACTS FROM THE DISAGGREGATED ACCOUNTS: TRIANGULAR TRADE

- Fact 1: Consumer spending flows from rural areas towards urban areas
- Fact 2: Urban consumers spend more abroad than rural consumers
- Fact 3: Rural areas are net exporters vis-à-vis the rest of the world, urban areas are net exporters vis-à-vis the rest of Denmark

Stylized summary of the facts: Triangular trade



MODEL OVERVIEW

- Static New Keynesian general equilibrium model
  - many consumer cells, producer cells, government, rest of the world (ROW)
  - small relative to rest of the world
  - fixed exchange rate, wages downwardly rigid
- Producers produce differentiated goods, using labor inputs from consumers and intermediate inputs from other producers
- Consumers have homothetic preferences over domestic and foreign goods
- Government taxes, spends on producers, and transfers to consumers.
- Calibrate model to match disaggregated accounts.

APPLICATION: FISCAL MULTIPLIERS DURING RECESSIONS

- Demand-driven recession: Excess capacity in some cells ("slack")
  - Economy-wide recession: All cells become "slack"
  - Heterogeneous recession (e.g., U.S. Tariff shock): Only some cells become "slack"

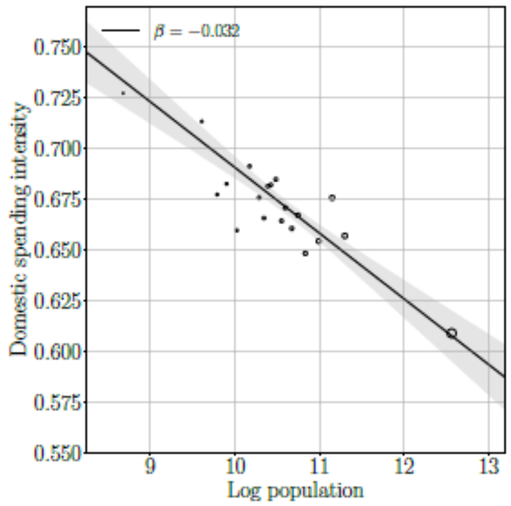
- Fiscal multipliers: What happens to output if government transfers 1 DKK to a given consumer cell?
  - How much variation across cells?
  - Do multipliers vary systematically with cell characteristics?

- For given amount of stimulus (e.g., 5% of GDP), how much can government save by targeting cells with high multipliers?

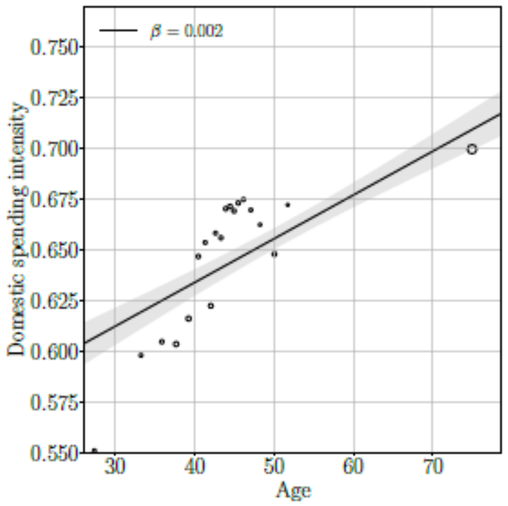
KEY CONCEPT: "DOMESTIC SPENDING INTENSITY "

- For a given consumer cell: To what extent does its spending contribute to income of other domestic consumer cells (as opposed to leaving the country)?
- Takes into account own spending behavior, but also higher-order linkages
- Higher domestic spending intensity in rural regions (due to triangular trade pattern), and for older and less-educated cells

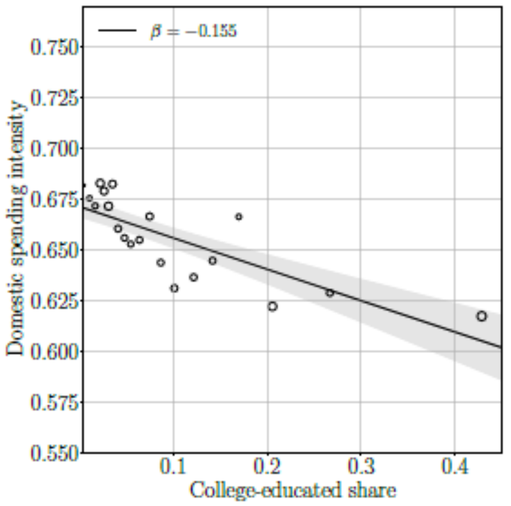
(a) By region size



(b) By age

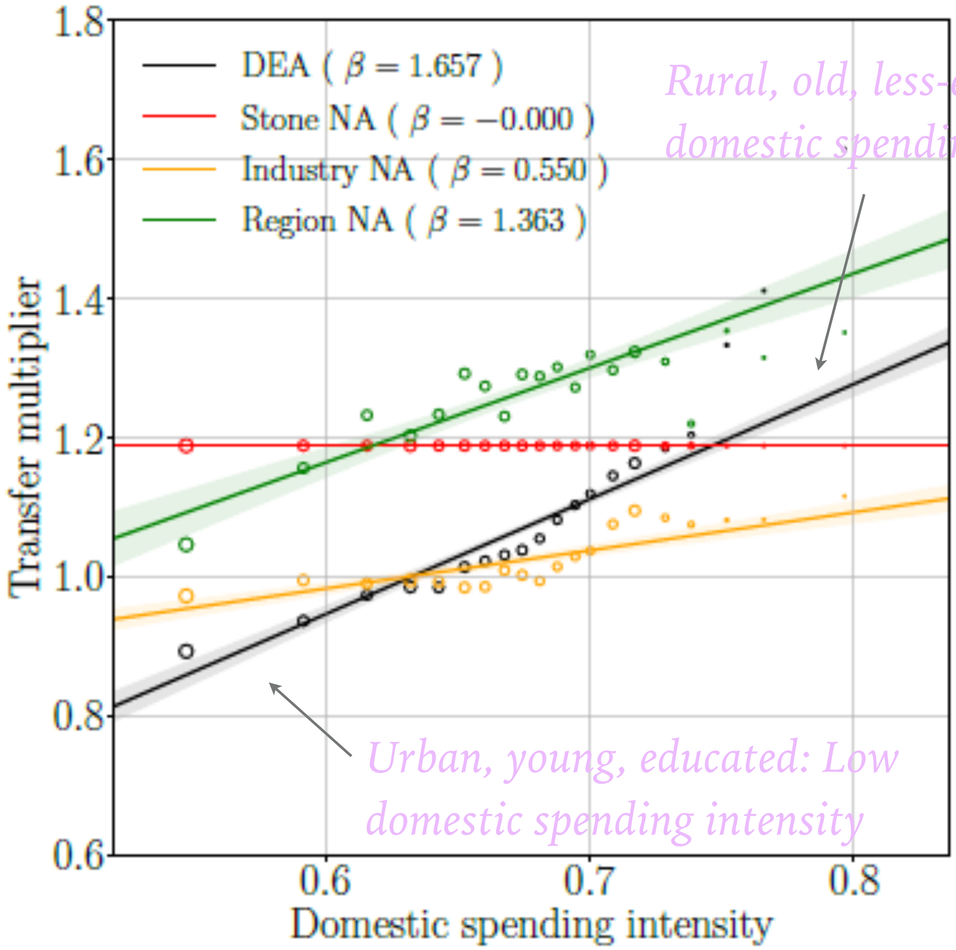


(c) By college education



ECONOMY-WIDE RECESSION: FISCAL MULTIPLIERS AND DOMESTIC SPENDING INTENSITY

(b) Multipliers by domestic spending intensity



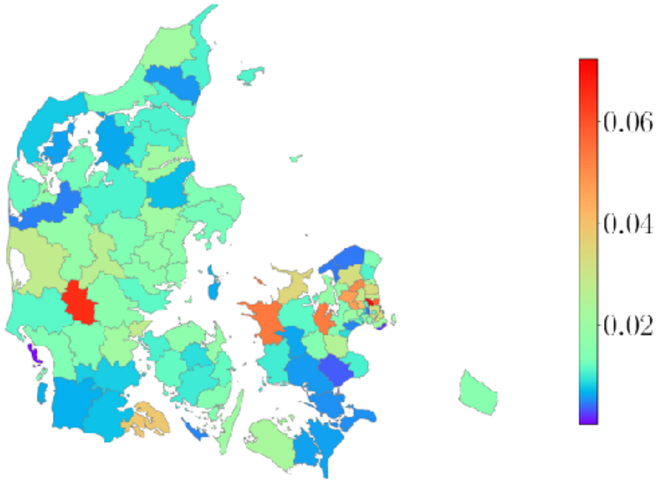
- Transfers to cells with higher domestic spending intensity raise demand for labor in domestic cells more, instead of “leaking abroad.”
- Since the labor market is slack in every cell ("economy-wide recession"), greater labor demand directly raises employment and aggregate GDP

ECONOMY-WIDE RECESSION: EFFECTIVENESS OF HYPOTHETICAL AND ACTUAL POLICIES

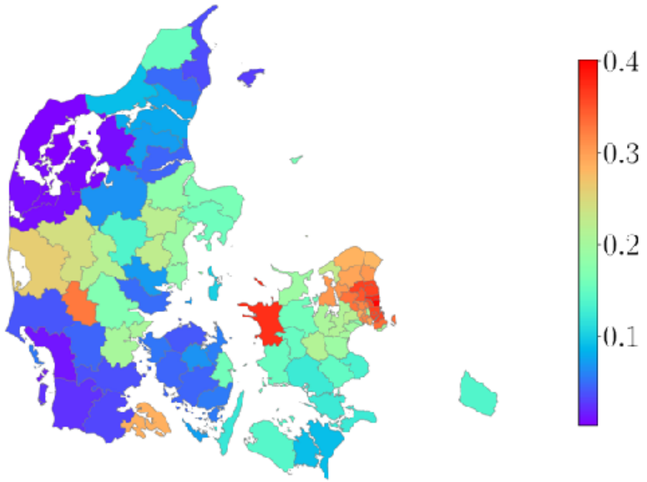
Transfer policy	Multiplier	Cost to raise GDP by 5% (in bn DKK)
Uniform	1.04	96.08
10% highest spending intensity	1.21	81.99
2018 child tax credit	1.02	97.85
2022 inflation relief to elderly	1.13	88.11
2023 housing rent inflation support	1.03	96.45
Construction worker support	1.23	81.16
Consulting / IT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

HYPOTHETICAL (?) U.S. TARIFF SHOCK: ~40% REDUCTION IN EXPORTS TO U.S.

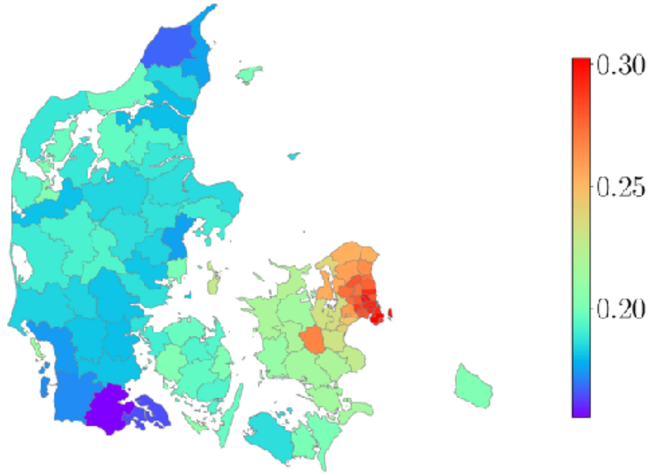
(a) Direct exposure through U.S. exports



(b) Labor market slackness

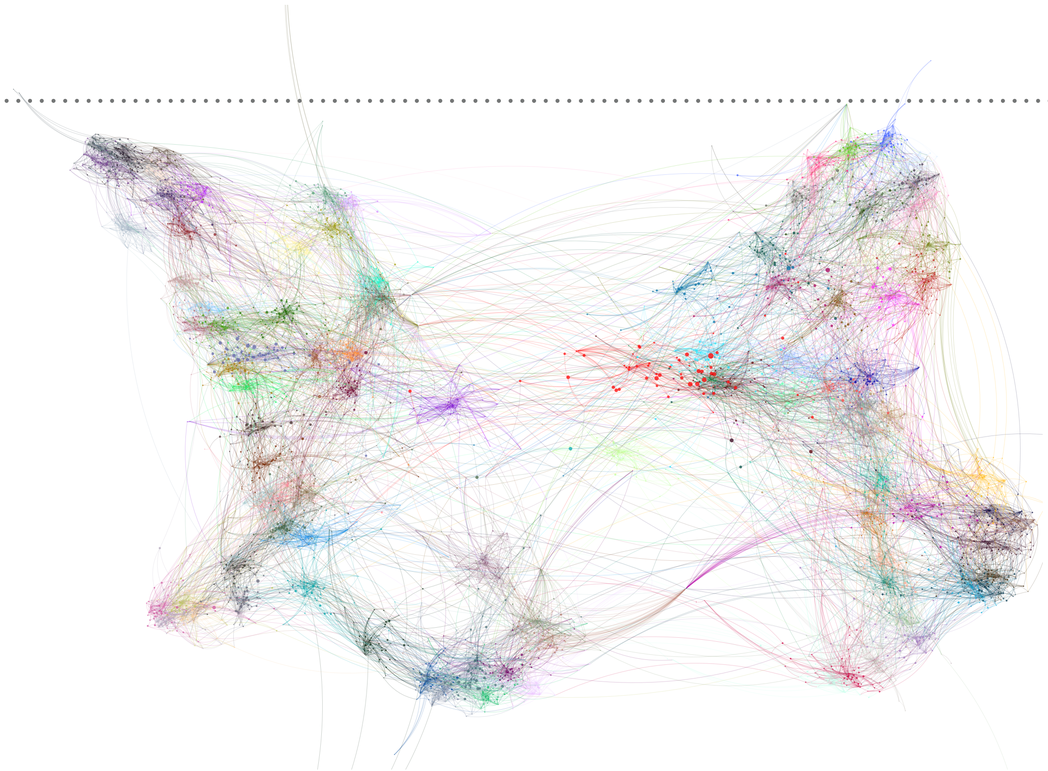


(c) Transfer multipliers



- Direct exposure highly concentrated in regions with major exporters
- Shock propagates through economy and spreads to neighboring regions and cities
- Multipliers are higher in regions with **high spending intensity on slack cells:** Not necessarily those with highest direct exposure

CONCLUSION

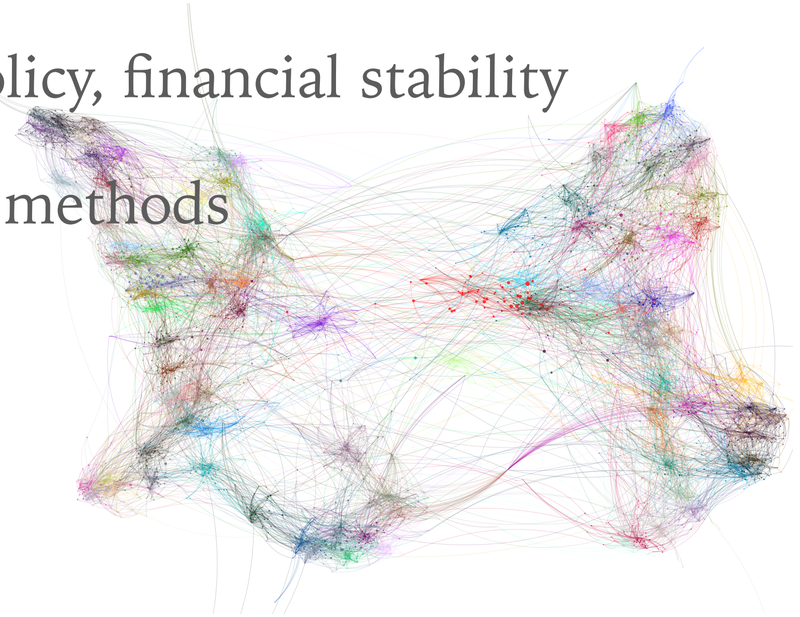


- Measure disaggregated economic accounts for Denmark
- Document facts on the circular flow of spending
- Can inform aggregate and distributional effects of shocks and policies

disaggregatedaccounts.com

WHAT'S NEXT?

- Next step: Disaggregated Financial Accounts
- How are households and producers connected to each other through their balance sheets?
  - Via lending and borrowing through financial intermediaries (loans, deposits, bond holdings)
  - Via direct or indirect firm ownership (e.g. stock holdings, funds)
- Important implications for transmission of monetary policy, financial stability
- Measurement requires additional data sources and new methods



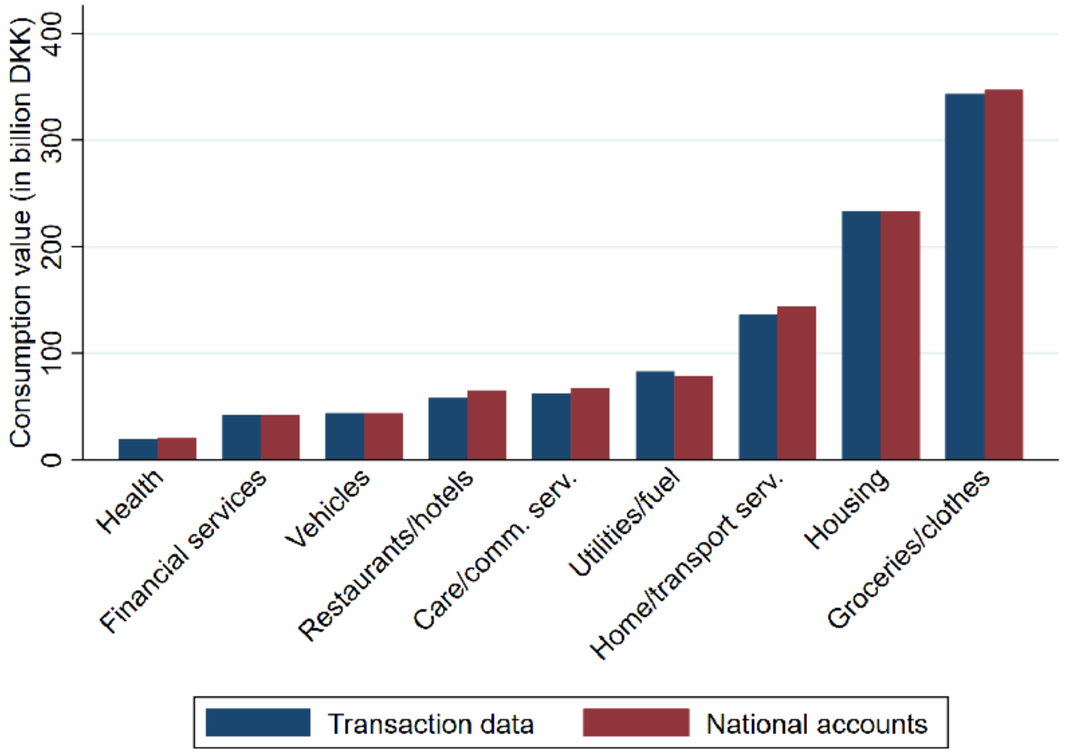
APPENDIX SLIDES

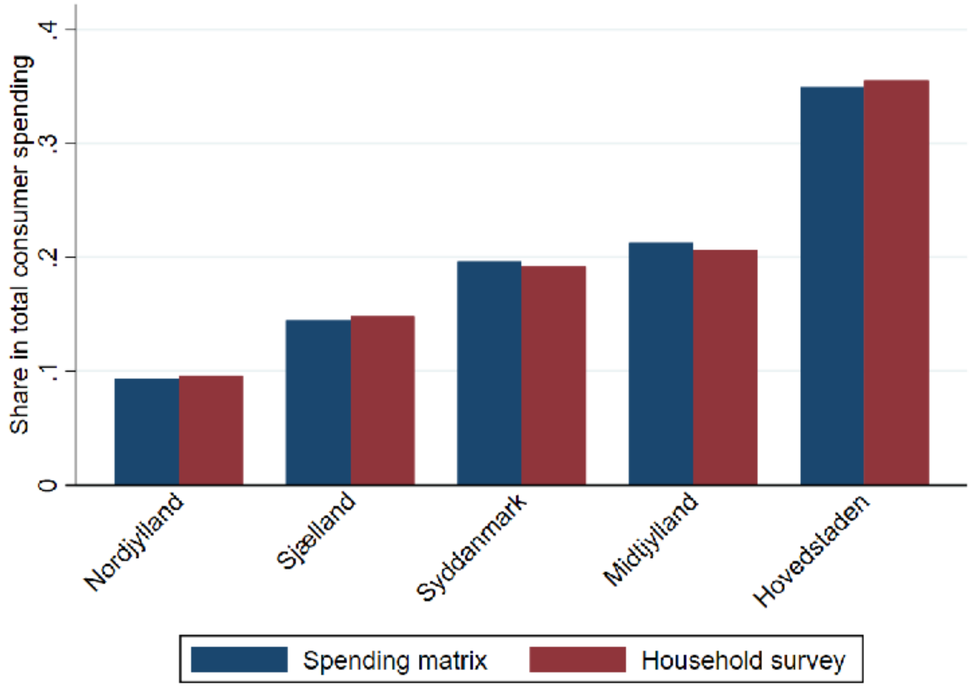
FREQUENTLY ASKED QUESTIONS

- **Cash?** Only 7% of spending. Observe ATM withdrawals, assume spent like other in-person spending.
- **Online spending?**
  - We want the observed producer establishment to be the store providing final good or service
  - Online purchases of **goods**: verified by hand that transactions go to the store/distr. center shipping the good.
  - Online purchases of **services**: corrected online payments for in-person services (e.g. movie theaters, entertainment, etc) to follow the geographical distribution of offline spending in the same category.
  - Confirm that for each industry, the regional distribution of consumer sales is close to that of labor income.
  - Similar facts and model results if we focus on in-store spending.
- **Individuals versus households?**
  - Could in principle identify transfers across individuals (e.g., within same household)
  - Would not affect today's facts on spatial spending patterns.

BACK

COMPARING DEA WITH NATIONAL ACCOUNTS AND HOUSEHOLD SURVEY

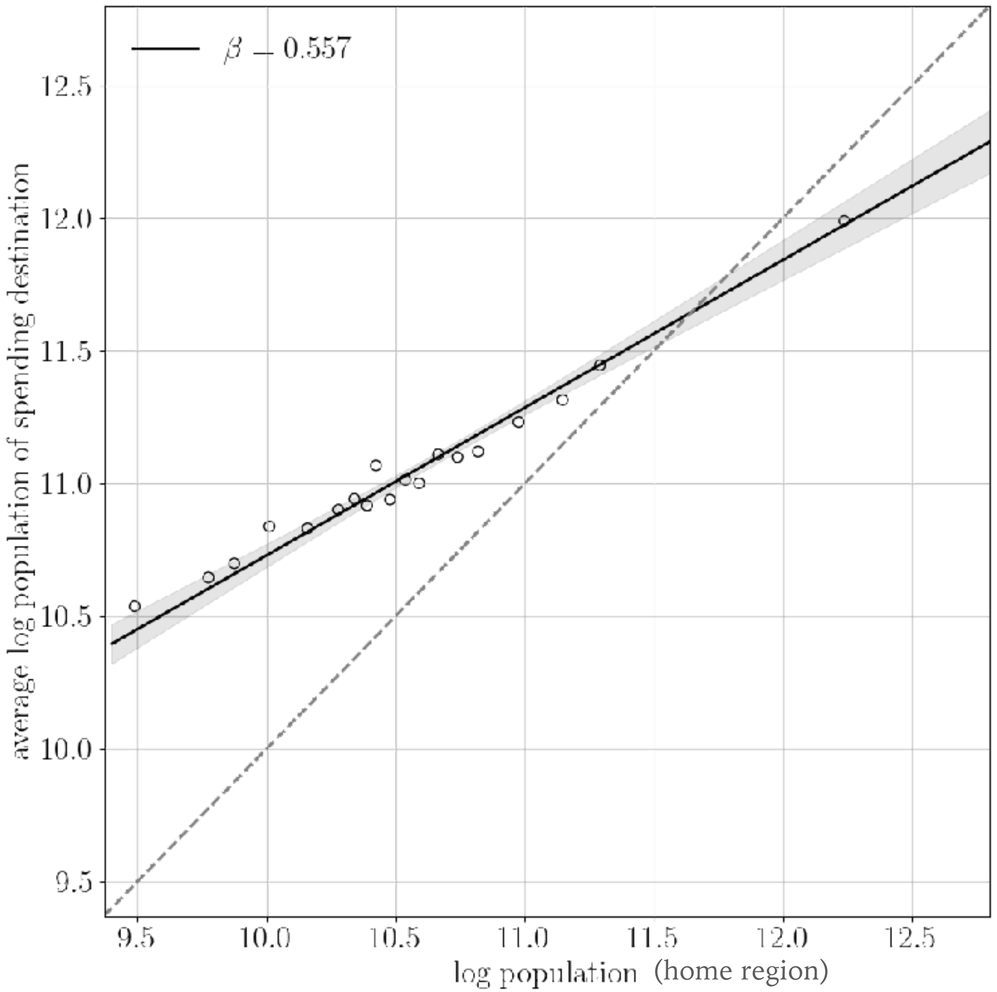




BACK

FACT 1: CONSUMERS SPEND IN MORE URBAN PLACES THAN THEY LIVE

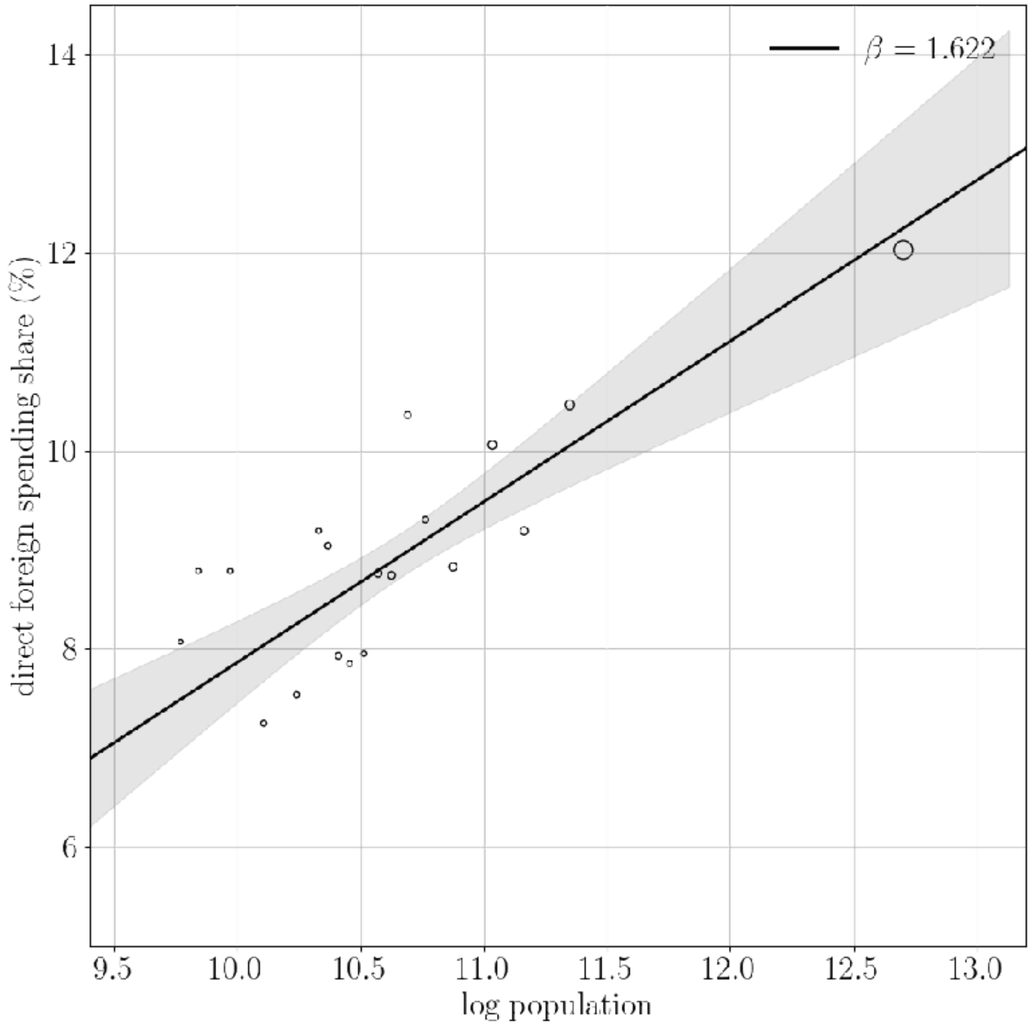
Average log population of recipient region



- Recipient region tends to be more urban than home region: Consumer spending flows into cities.
- Most pronounced in spending on services (e.g., entertainment, telecommunications)
- Same pattern for in-person spending only
- Significant deviation from gravity-based model

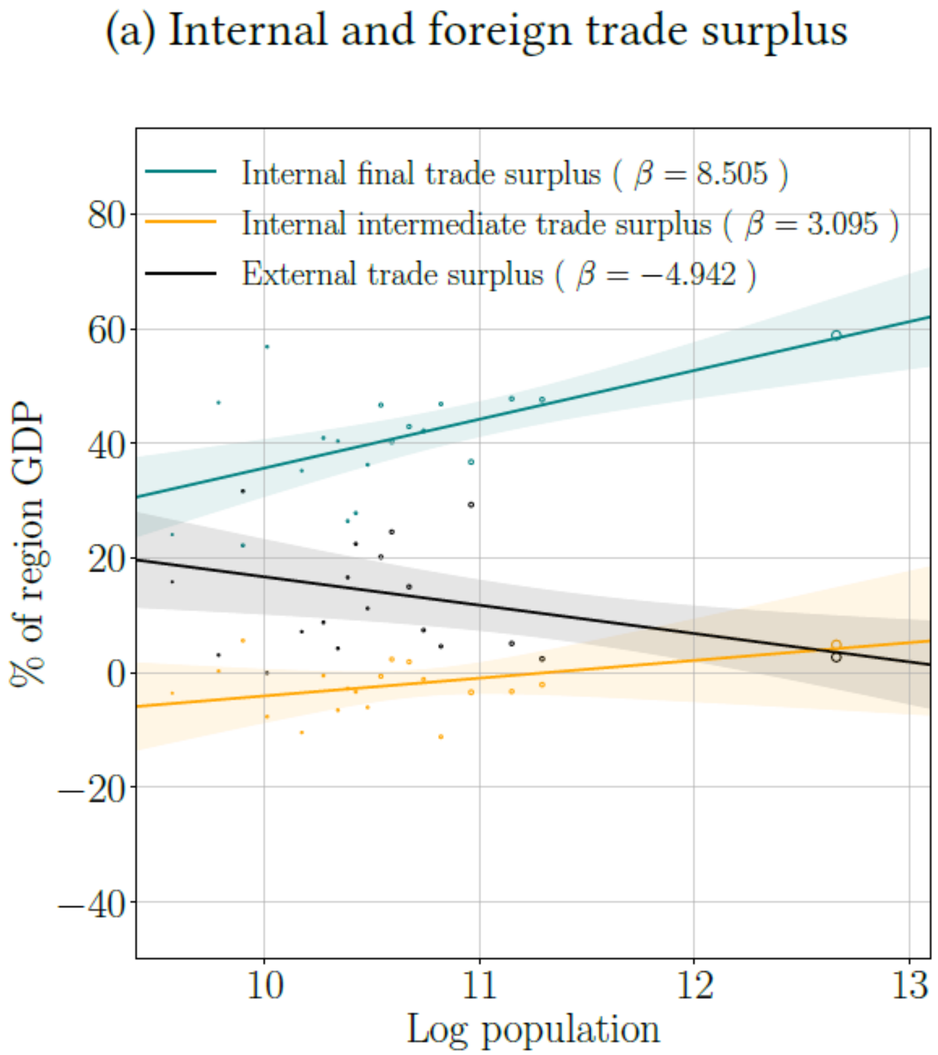
FACT 2: CITY CONSUMERS SPEND MORE ABROAD

Direct foreign spending share by region population



- Urban consumers spend a larger fraction in foreign countries
- Mostly driven by travel related expenses: hotels, rental cars, airfare, retail stores
- Robust to controlling for distance to foreign border

FACT 3: RURAL REGIONS EXPORT EXTERNALLY, URBAN REGIONS DOMESTICALLY

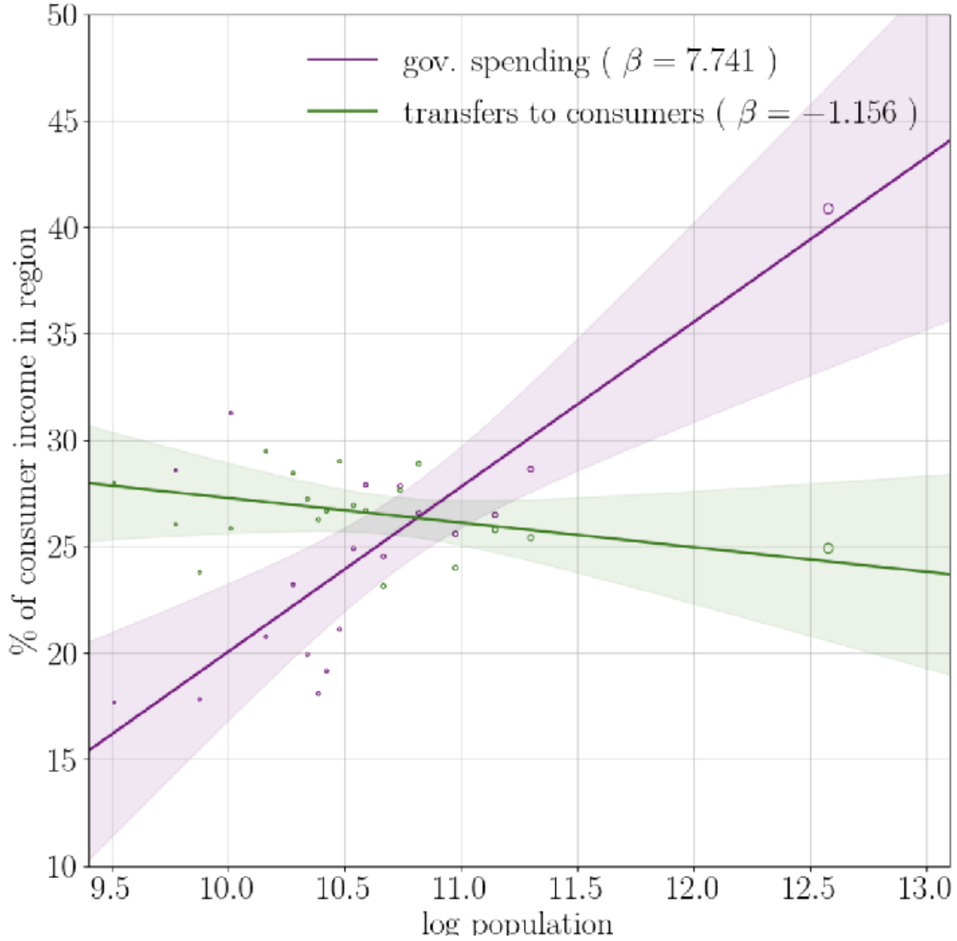


- Use DEA to construct regional balance-of-payments & GDP statistics
  - *Internal trade surplus*: trade surplus vis-à-vis the rest of the Danish economy
  - *External trade surplus*: trade surplus vis-à-vis the rest of the world
- Rural regions export more of their output to the rest of the world
- Urban regions export more to the rest of Denmark
  - Reflects that domestic consumer and producer spending flow towards cities

FACT 4: THE GOVERNMENT'S TWO-WAY REDISTRIBUTION

- Government sends *transfers* towards rural regions… but *spends* in urban ones

Government outlays received (scaled by consumer income)



Net flow from government (scaled by consumer income)