Unraveling the Internal Complexity of a Metropolitan Economy

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Motivation and Collaboration

- In the last four decades, exploration of **horizontal spatial interdependence** has moved from estimation of spillover/feedback effects from interregional input-output models to embrace the more extensive tools of spatial econometrics
- The **vertical dimension** has remained relatively unexplored; recent work by Chung (2014) suggests that at a broad regional scale ignoring the vertical dimension may generate overestimates of the horizontal interactions (spatial spillovers)
- Current presentation part of a broader inquiry into how multiple levels of an economy interact in both a vertical and horizontal fashion

How do Regional Economies Grow?

- To answer this fundamental question that is at the core of regional economics, scholars looked at analyses of national economies for inspiration
- Borrowed from Harold Innes' (Canadian) notion of a staple theory of economic growth in which export activity generated, through the foreign trade multiplier, a stimulus for the creation and development of the local (domestic) economy
- If this worked at the national (international) level, could a similar formulation be considered at the sub-national or regional level?
- Innovation – division of local economy into endogenous and exogenous
- Started with economic base model (basic/export and non basic local)
- Extended with IO and CGE models

How do Regional Economies Grow (2)?

- The main innovation – division of local economy into **exogenous** and **endogenous**
- **Exogenous** **activities that were dependent on external markets**
- **Endogenous** **activities that sold good and services to the local market**
- Exogenous also referred to as the export or basic activity; endogenous as local or non-basic
- Geographers had a similar idea but never developed it beyond basic/nonbasic ratios
- Economists developed a formal model

How do Regional Economies Grow (3)?

- The Economic Base Model assumed that:
  - Nonbasic = f(basic)

- **Hoyt's Model**

$\frac{L_n}{L_T} = \alpha \rightarrow$ a share of total employment

$0 < \alpha < 1$

Total Employment $L_T = L_b + L_n$

Employment (base sector) (exogenous)

Employment (non-base sector)

$$\Rightarrow \quad L_T = \frac{1}{1-\alpha} L_b$$

> 1 : the multiplier

i.e. basic employment has the capacity to generate additional employment in the region

How do Regional Economies Grow (4)?

The Multi-Sectors Model

Input-Output **Multiplier** vs Economic Base **Multiplier**

- Economic Base Model
  - Single multiplier: $L_T = \frac{1}{1-\alpha}\bar{L}_b$
- Input-Output Model
  - Matrix of multipliers: $\mathbf{x} = (\mathbf{I}-\mathbf{A})^{-1}\mathbf{f}$
  - Ripple Effect: $(\mathbf{I}-\mathbf{A})^{-1} = \mathbf{I} + \mathbf{A} + \mathbf{A}^2 + \mathbf{A}^3 + \mathbf{A}^4 + \cdots$

How do Regional Economies Grow (5)?

- What is missing is these models?
  - Focus on the demand side – little is said about supply side (e.g. labor force participation rates, migration, supply of other factors of production)
  - Open models – income is earned but the impact of spending is not considered – the circular flow of income is incomplete
  - Assumes region is homogenous – change in one part of the region will generate the same impact as in another part e.g. a R$1 billion change in Ribeirão Preto is assumed to generate the same impact as a similar change in São Paulo city on the state of São Paulo
  - Use a Representative Household assumption – no differences in income receipt or expenditures based on location on household income levels

What is happening Inside Metro Regions?

- Krugman has argued that patterns and impacts of trade have similar impacts
  - Between countries
  - Between regions inside countries
- What about interaction **within** large metropolitan regions?
- Detailed analysis of the Chicago economy provides some insights into the nature and strength of trading relationships
  - Goods and services
  - Flows of people (commuting)
  - Flows of expenditures by households
- Important to understand how economies work prior to enacting policy or evaluating it – analyses here provide contribution to this dialog

Extended Demo-Economic Modeling

- Most important contribution of Miyazawa (1976) was his analysis of the structure of income.
- Parallel development to the demo-economic models of Batey and Madden
- Example of an "onion-skin" approach to demographic-economic (hereafter, demo-economic) impact analysis
- Link the demographic and economic parts of an economy, revealing the effects of:
  - changes in economic actions on income distribution, status in the labor force or migration behavior on the one hand and
  - the effects of changes in consumption spending, employment status and so forth on economic activities.

Extended Demo-Economic Modeling (2)

- Miyazawa considered the following block matrix:

$$M = \left(\begin{array}{c|c} A & C \\ \hline V & 0 \end{array} \right)$$

where $\boldsymbol{A}$ is a block matrix of direct input coefficients, $\boldsymbol{V}$ is a matrix of value-added ratios for some r-fold division of labor and non-labor categories and $\boldsymbol{C}$ is a corresponding matrix of consumption coefficients for the r-types of households.

In the open IO model only focus on $\boldsymbol{A}$

Extended Demo-Economic Modeling (3)

- Decomposing the Miyazawa matrix, *M*, yields:

$$(I - M)^{-1} = \left(\begin{array}{c|c} I & BC \\ \hline 0 & I \end{array}\right)\left(\begin{array}{c|c} I & 0 \\ \hline 0 & K \end{array}\right)\left(\begin{array}{c|c} B & 0 \\ \hline VB & I \end{array}\right) =$$

$$= \left(\begin{array}{c|c} B(I + CKVB) & BCK \\ \hline KVB & K \end{array}\right)$$

Where $B = (I - A)^{-1}$ is the Leontief inverse matrix

BC is a matrix of production induced by **endogenous** consumption

VB is a matrix of **endogenous** income earned from production

L=VBC is a matrix of expenditures from endogenous income

Extended Demo-Economic Modeling (4)

- The most important component:

$$K = (I - L)^{-1} = (I - VBC)^{-1}$$

is the **Miyazawa interrelational income multiplier** or the generalized Keynesian multiplier

- Traces how income earned in one region or by one group generates income to other regions or groups
- Is it symmetrical or asymmetrical – impact of income generated by region *R* on region *S* may be larger/smaller than the impact of *S* on *R*?

Application to Chicago

- In many metropolitan regions, conflicts between central cities and suburbs have been waged on the premise that neither area needs the other
- These assertions have gone unchallenged with little if any sound economic analysis to provide a foundation for their support or reputation.
- In this climate, inner city development is often seen as a zero-sum game, providing little demonstrable benefit to parts of the metropolitan region outside the targeted areas and commanding public resources with high opportunity costs that might be more effectively directed to other parts of the region.

Application to Chicago (2)

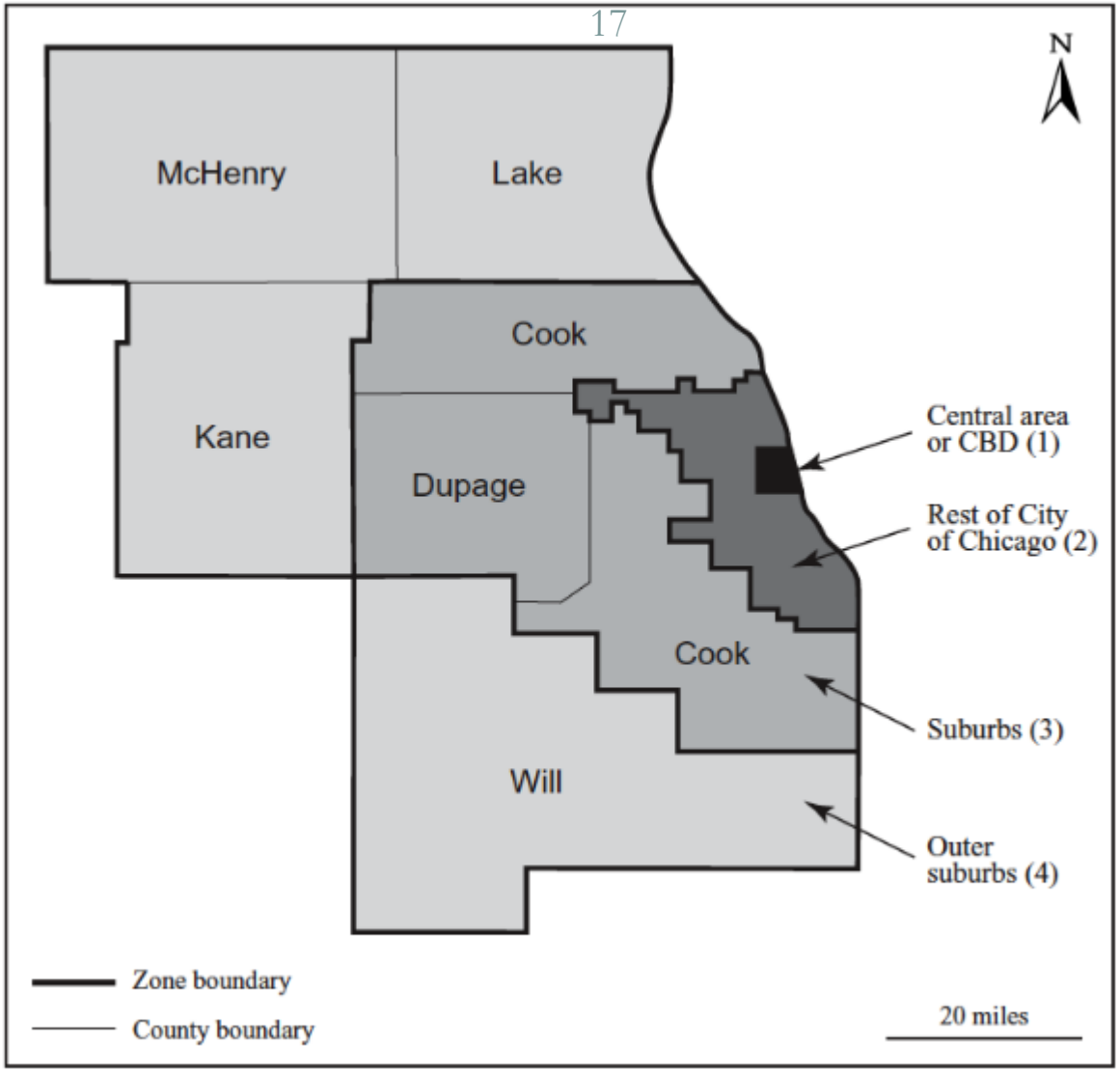
- Little formal analysis has been conducted to examine the nature, strength and type of any economic spillover and thus challenge the veracity of these assertions.
- **Yet, if there are gains from trade and interdependence in general between nations or between regions within a nation, should there not be some expectation of similar findings within a metropolitan region?**
- Chicago analysis attempted to develop an understanding and appreciation of the magnitudes of the economic relationships and economic interdependence between inner-city communities and the rest of the metropolitan area

Application to Chicago (3)

- Unlike trade between nations, this interdependence depends not only on:
  - the **movement of goods and services** but also on the
  - **movement of labor**, i.e., commuting and the
  - associated **income flows** (income earned in one part of the city is taken home to another part) and the
  - movement of consumers in the **spending of this income**
- In order to illustrate the complex interdependencies within a metropolitan area a 4-region multiregional input-output model was constructed using Miyazawa's (1976) extended framework.


Lake Michigan
MICHIGAN
INDIANA
IOWA
MISSOURI
KENTUCKY
INDIANA
ILLINOIS
Charles Mound
1235 feet
Freeport
Rockford
Waukegan
North Chicago
Palatine
Arlington Heights
Elgin
Skokie
Evanston
Chicago
De Kalb
Dixon
Sterling
Naperville
Aurora
Joliet
Rock Island
Moline
Chicago Heights
Peru
Ottawa
La Salle
Kewanee
Streator
Kankakee
Galesburg
Monmouth
Pontiac
Peoria
Canton
Macomb
Pekin
Normal
Bloomington
Rantoul
Havana
Lincoln
Champaign
Danville
Urbana
Beardstown
Quincy
Springfield
Decatur
Jacksonville
Pittsfield
Charleston
Mattoon
Pana
Jerseyville
Effingham
Alton
Vandalia
Carlyle Lake
Olney
Granite City
East St Louis
Salem
Centralia
Belleville
Mount Vernon
Rend Lake
Carmi
West Frankfort
Marion
Harrisburg
Carbondale
Cairo
Mississippi River
Illinois River
Kaskaskia River
Wabash River
Ohio River
State capital
Interstate Highway
Highway
Railroad
Miles
0
25
50
75
100

Spatial Division of Chicago



Chicago Intra Metropolitan Flows

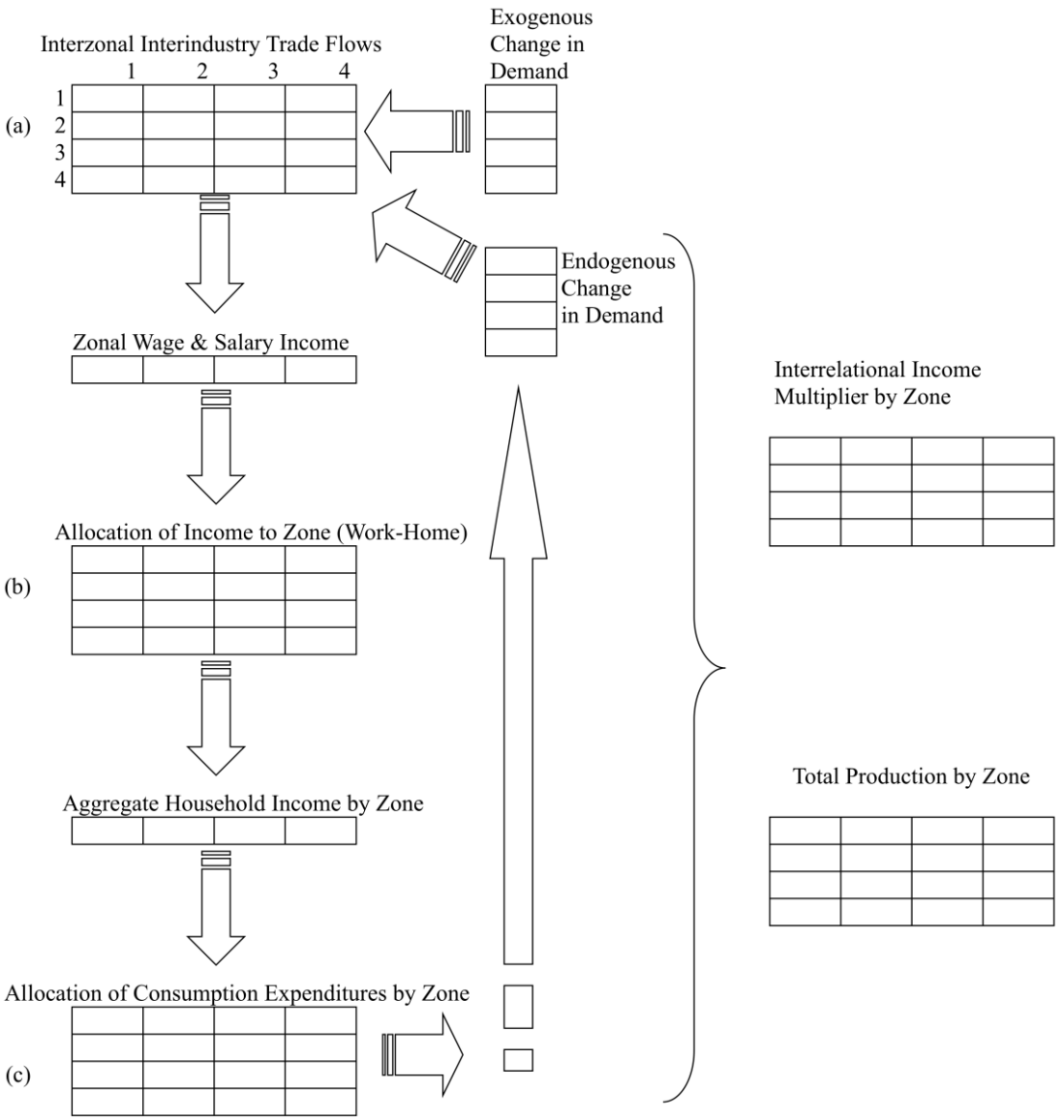
Goods and Services Flows

Wages and salaries

Flows of commuters and their incomes by zone

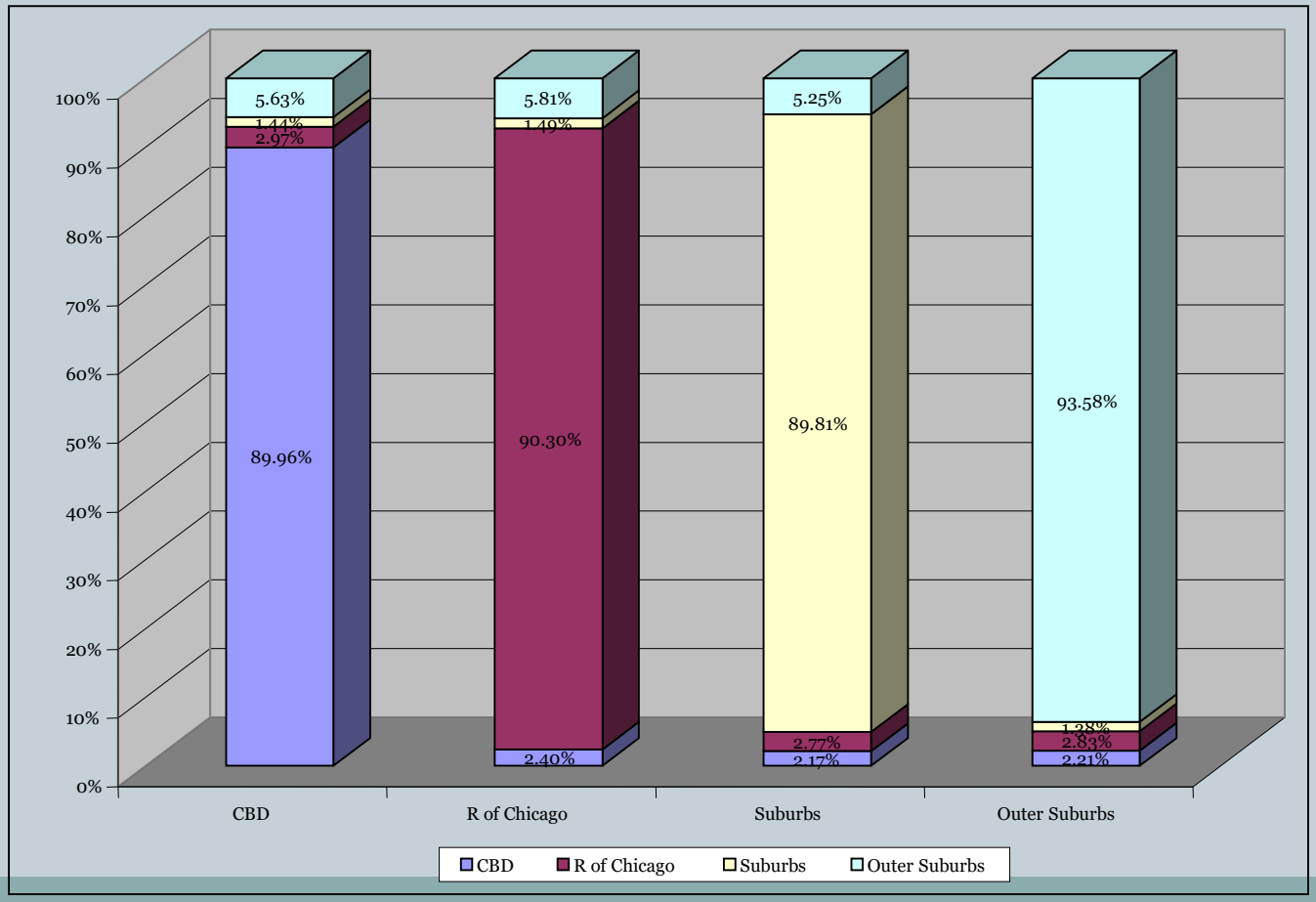
Household expenditures

Flows of total expenditures by zone



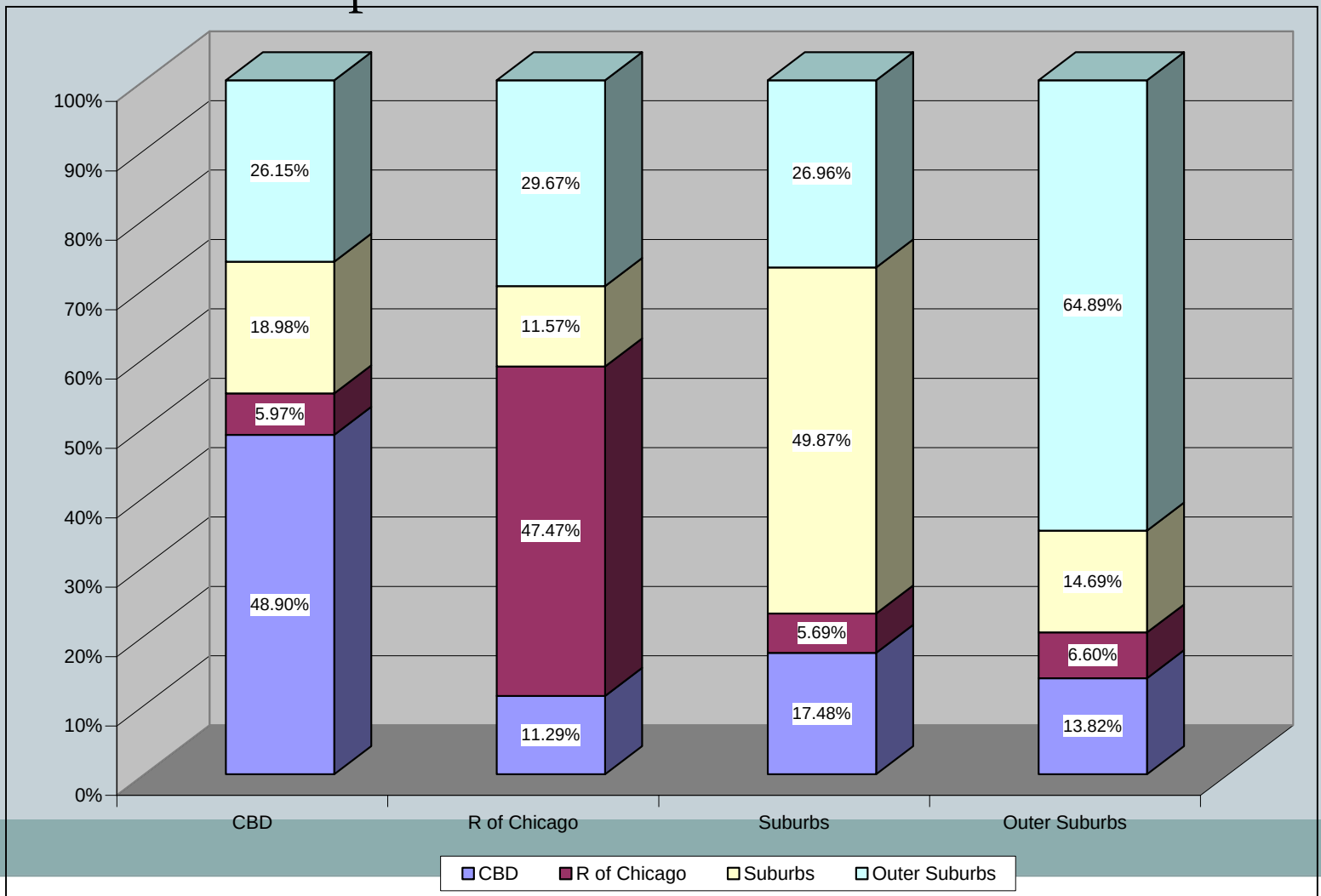
Interindustry Interdependence

- Limited connections across regions

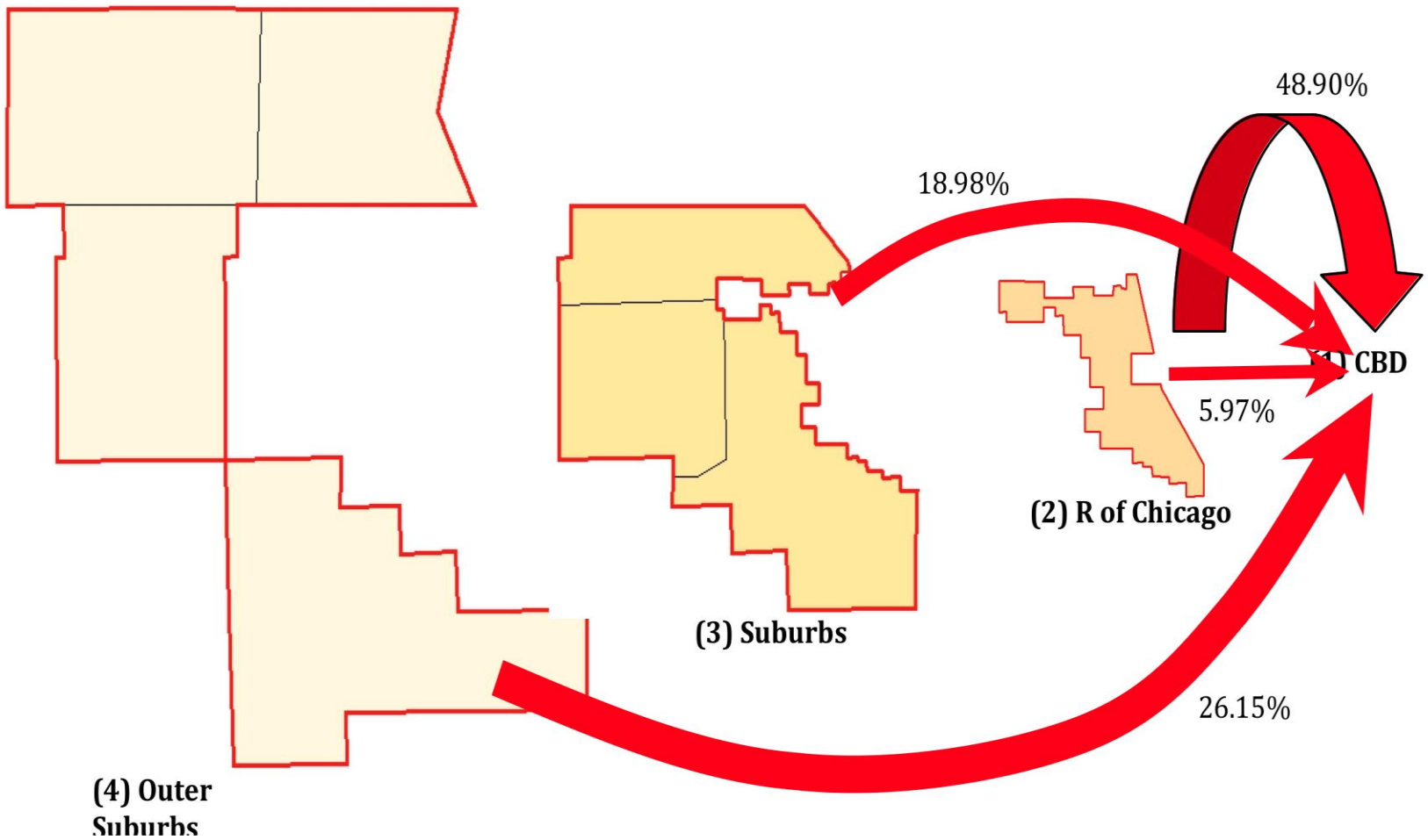


Total Spatial Interdependence

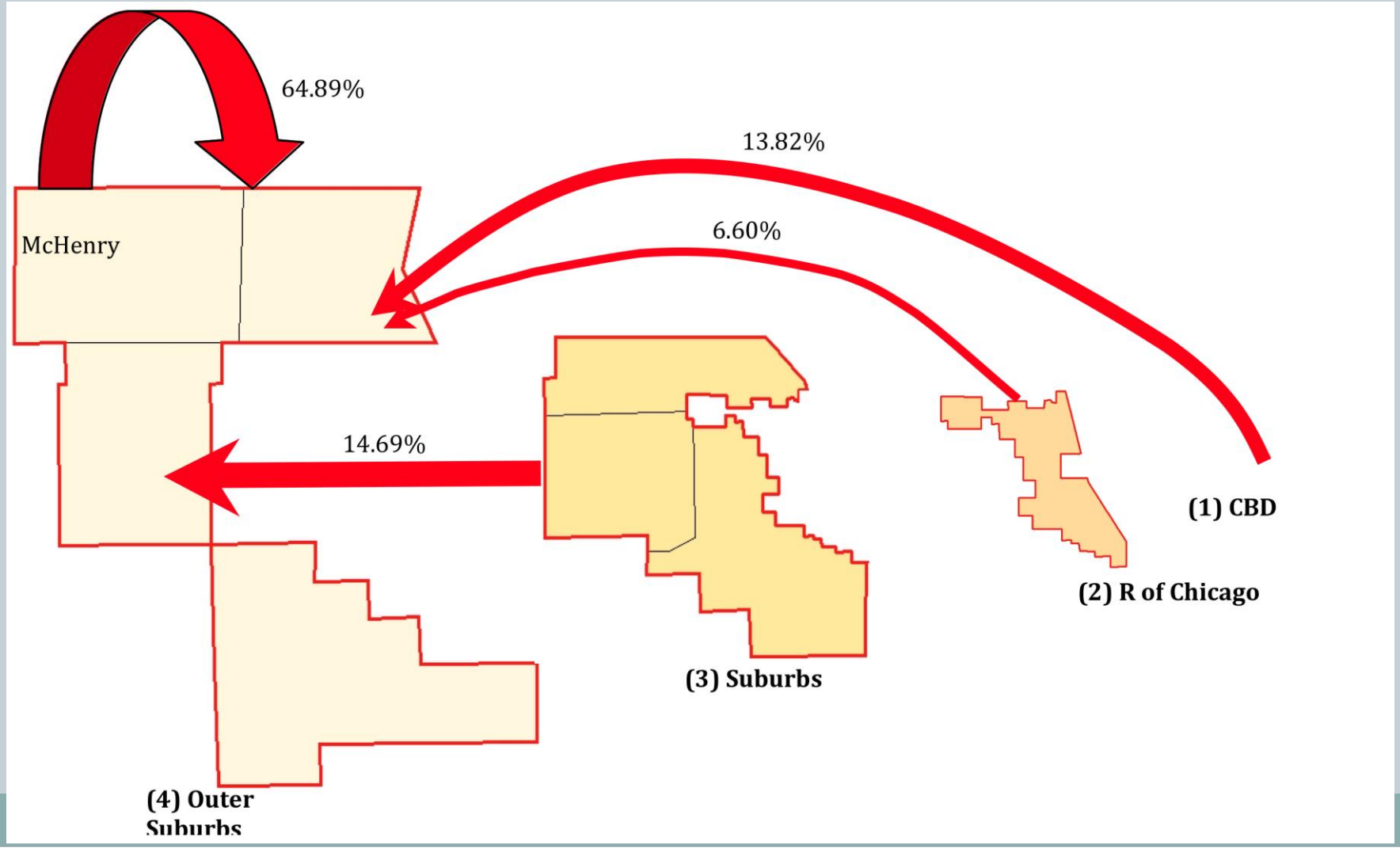
- Substantial interdependence when all interactions considered



Interzonal Impacts as Percentage of Total Impacts: CBD



Interzonal Impacts as Percentage of Total Impacts: Outer Suburbs



Changes in the Nature of Dependence as Complication Increases

- **Layer 1**
  - Intrazonal flows dominate the production relationships in the assembly of $479 billion worth of goods and services.
  - Somewhere between 90% and 94% of the direct and indirect effects of trade remain within the zone
- **Layer 4**
  - With the exception of zone 4, less than 50% of the total production impacts can be traced, directly and indirectly, to activity that is generated within the zone
  - Almost 14% of the impact in zone 4 (outer suburbs) can be traced to zone 1 (the central area or CBD) with a further 6% traced to zone 2 (rest of the City of Chicago)
- About 45-48% of the total impacts derived from income-consumption impacts

Unexpected Result: The Miyazawa Interrelational Income Multiplier

Miyazawa's Interrelational Income Multipliers				
	region of income origin			
	Region 1	Region 2	Region 3	Region 4
Region 1	1.23	**0.12**	0.16	0.07
Region 2	0.11	**1.28**	0.13	0.05
Region 3	0.03	**0.03**	1.06	0.01
Region 4	0.44	**0.56**	0.50	1.77
Total	1.81	**1.99**	1.85	1.90

- Region 2 – **least prosperous but generated largest income multiplier (theory suggests that *apc* higher for lower income households)**
- Significant asymmetric spillovers – **suburbs benefit more from income growth in other regions than vice versa**

References

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