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# IS TOKYO TOO LARGE?

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## Questions

Metropolitan Areas in Japan

City Size: Conceptual Foundation

Agglomeration and Deglomeration Economies

Estimation of Agglomeration Economies

Estimation of Total Land Values

Conclusion

# Questions

- ## Is Tokyo too large?
  - ### Population of more than 30 million
    - Congestion, High land prices
    - Agglomeration economies: business interactions, variety in consumption
- ## What is the optimal city size?
  - ### The Henry George Theorem
- ## Can we empirically test it?
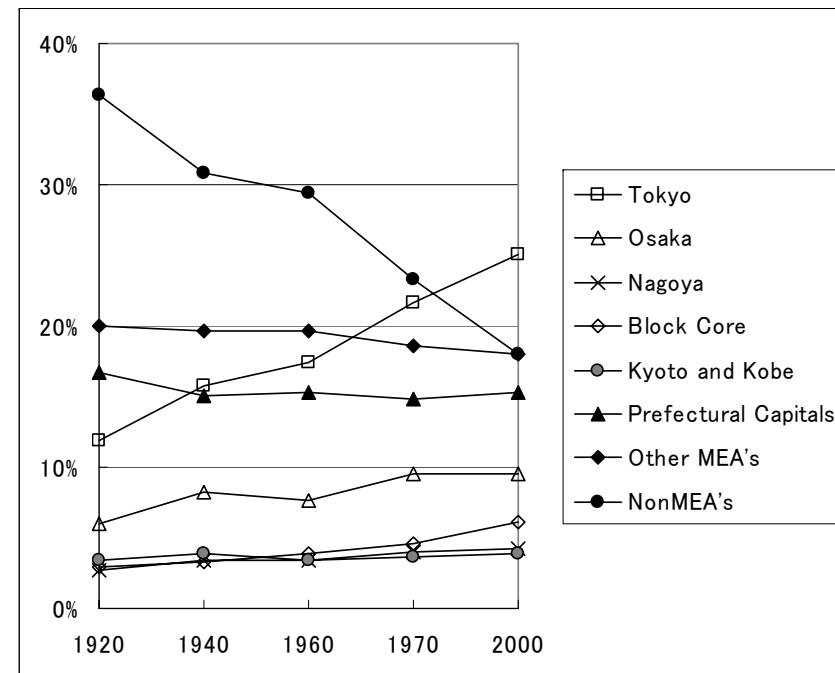
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# Metropolitan Employment Areas

- Need to define cities

- No official metropolitan area definition in Japan

- Metropolitan Employment Area by Tokuoka and Kanemoto

http://www.urban.e.u-tokyo.ac.jp/UEA/index.htm
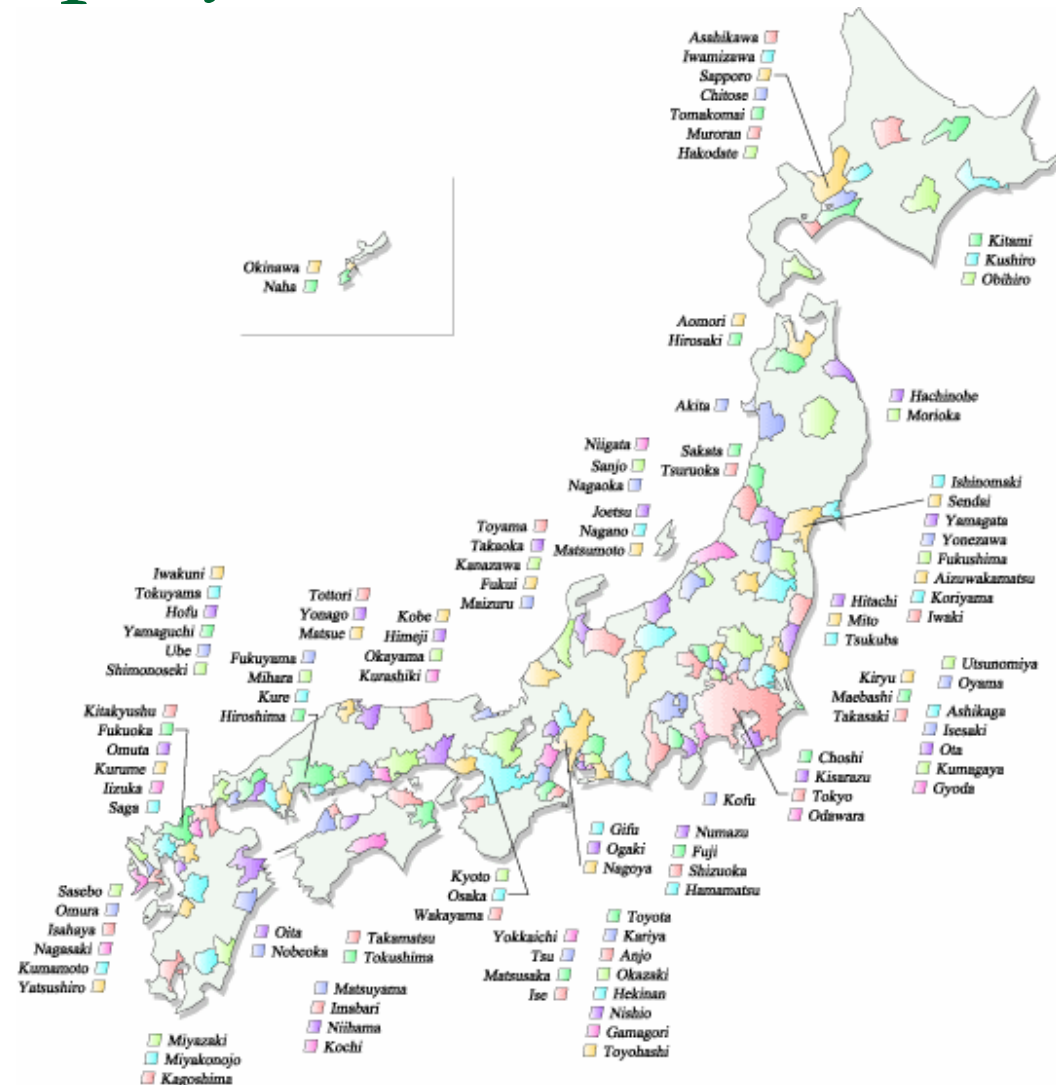
# Long-term trends in Japanese metropolitan areas

- Tokyo's population share has more than doubled from 12% in 1929 to 25% in 2000.

# Japanese and U.S. Metropolitan Areas

| MEA | Population 2000 | MSA | Population 2000 |
|---|---|---|---|
| Tokyo | 31,874 | New York | 18,323 |
| Osaka | 12,139 | Los Angeles | 12,366 |
| Nagoya | 5,344 | Chicago | 9,098 |
| Kyoto | 2,598 | Philadelphia | 5,687 |
| Fukuoka | 2,336 | Dallas | 5,162 |
| Kobe | 2,298 | Miami | 5,008 |
| Sapporo | 2,243 | Washington | 4,796 |
| Hiroshima | 1,588 | Houston | 4,715 |
| Sendai | 1,550 | Detroit | 4,453 |
| Kitakyushu | 1,417 | Boston | 4,391 |
| Kumamoto | 1,007 | Atlanta | 4,248 |
| Shizuoka | 1,000 | San Francisco | 4,124 |
| Niigata | 950 | Riverside | 3,255 |
| Okayama | 949 | Phoenix | 3,252 |
| Hamamatsu | 939 | Seattle | 3,044 |
| Utsunomiya | 876 | Minneapolis | 2,969 |
| Gifu | 821 | San Diego | 2,814 |
| Naha | 754 | St. Louis | 2,699 |
| Himeji | 745 | Baltimore | 2,553 |
| Kanazawa | 738 | Pittsburgh | 2,431 |

# Rank Size Rule in Japan and the U.S.
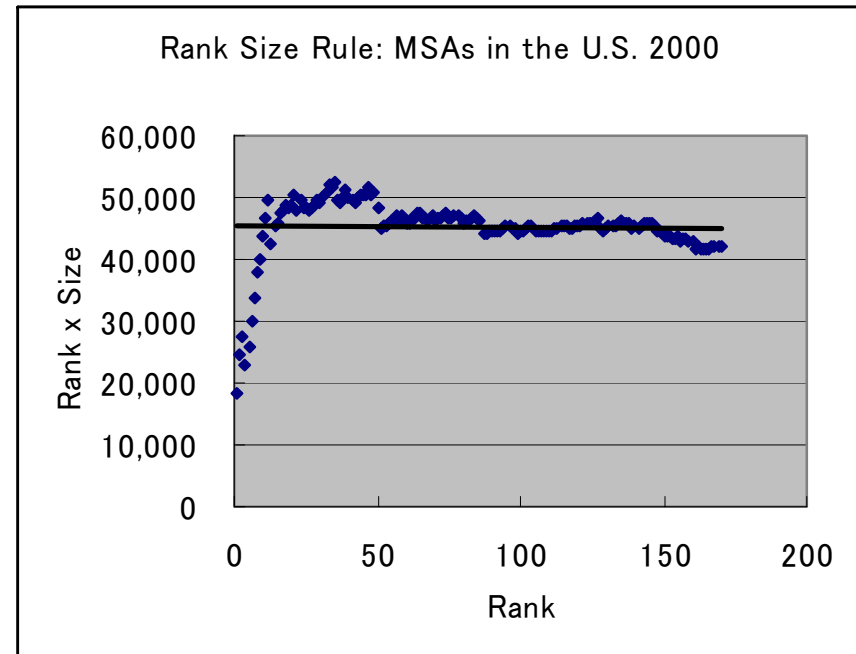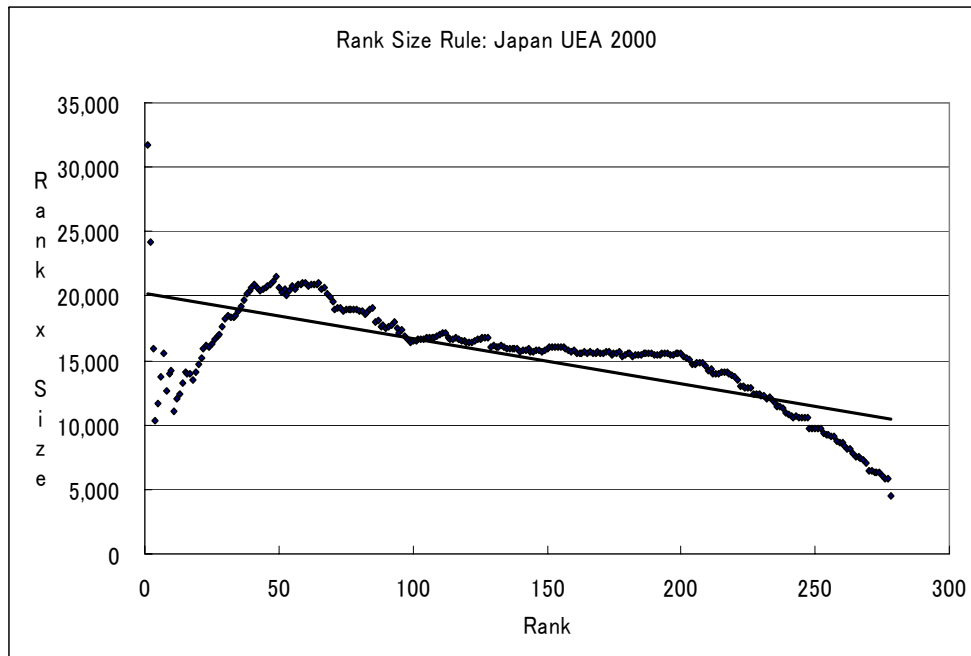


Rank Size Rule: Japan UEA 2000



Rank Size Rule: MSAs in the U.S. 2000

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# Why cities?: Agglomeration and Deglomeration Forces

- **Agglomeration Forces**
  - Interaction among firms
  - Urban amenity: Variety in consumption
  - Public goods

- **Deglomeration Forces**
  - Transportation costs (commuting, etc.)⇔Housing Costs
  - Congestion externality

- **The balance between agglomeration and deglomeration forces detemines the city size**

# A Hierarchy of Cities

- **Cities with different product mixes have different city sizes**

- **A hierarchy of cities**
  - National Core: Tokyo
  - West and Mid Japan Cores: Osaka and Nagoya
  - Regional Cores: Sapporo, Sendai, Hiroshima, Fukuoka
  - Prefectural Cores

# Sources of Market Failure

- **Externalities and public goods**
  - External benefits from agglomeration
    - Technological externalities: innovative ideas created by interactions
    - "Marshallian" externality in a spatial economy with non-convex technology: **Works like technological externality in a spatial economy**
  - External costs of agglomeration: Congestion costs
    - **Transport costs (the most important deglomeration force) are not externalities**
  - Public goods
- **Difficulty in new city formation**
  - Creating a new city large enough to compete with existing cities is difficult

# Optimal City Size: Two Margins

- **Optimal size of a city with a fixed number of cities**
  - MSB=MSC of adding a person to a city
  - MSB-MSC>0 ⇒ Pigouvian subsidy to city residents
    - Commuting costs are not external costs ⇒ MSB tends to be larger than MSC

- **Optimal number of cities**
  - Net social benefit of adding a city = 0
  - The Henry George Theorem:
    - Total Rent =Total Pigouvian Subsidy + ...
  - The optimal number for each level of hierarchy
    - National Core, Regional Core, Prefectural Core

# Too Small Cities With a Fixed Number of Cities

- ## MSB tends to be larger than MSC.

  - ❑ The difference is determined by the size of commuting costs.

  - ❑ The tendency to become too small is larger for larger cities.

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$U'$
$U$

$U(P)$

$P$     $P'$
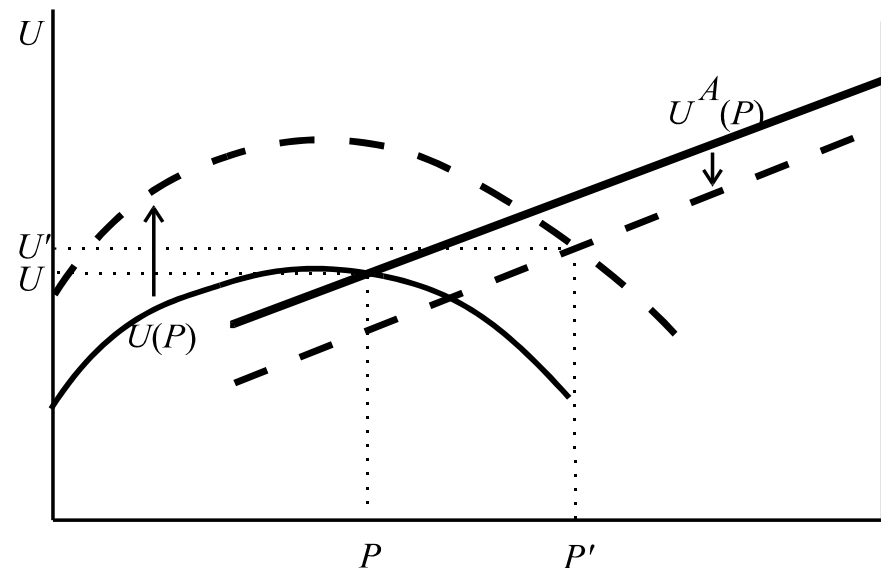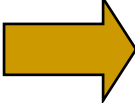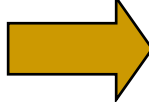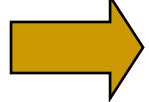
# Too Large Cities: Too Few Cities

- The number of cities can be increased only by creating a new city: Not easy.

- Cities in the highest hierarchy have greater tendency to become too big.
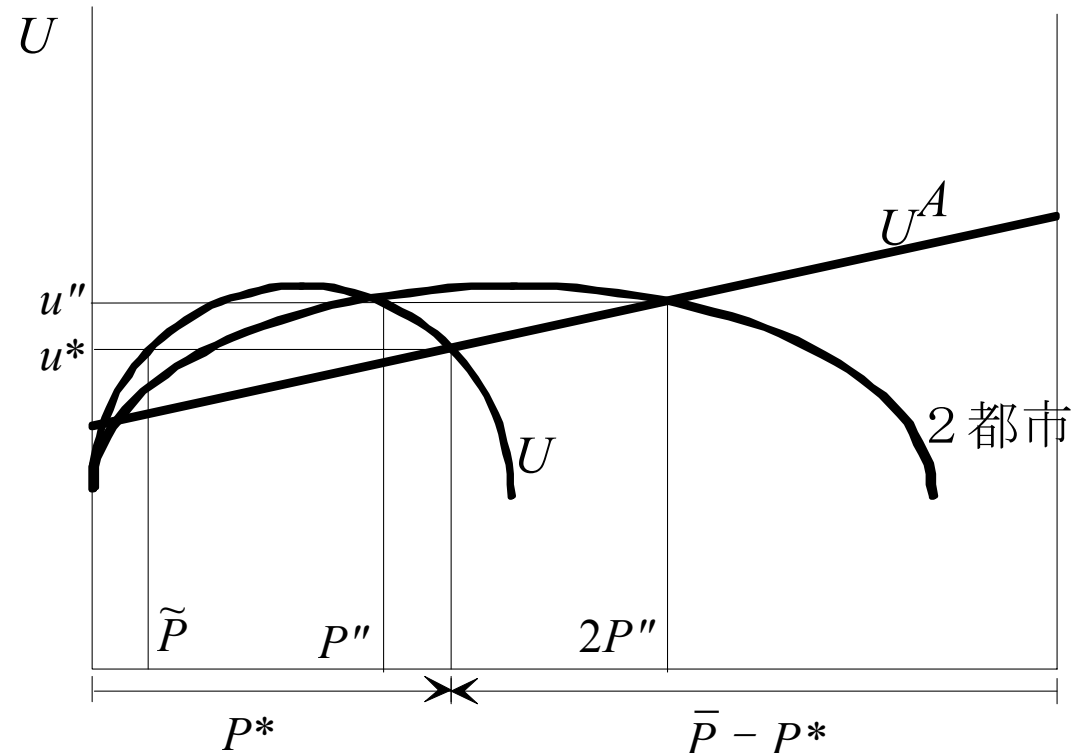
# City sizes tend to be too big

- Fixed number of cities ⟹ too small cities with positive net agglomeration economies
- Difficulty to create a new city ⟹ too big cities
    - The difficulty is more serious for higher levels of hierarchy
- Hypothesis: Tokyo is too big ⟹ Tokyo has much higher land value/Pigouvian subsidy ratio than other MEAs

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# Externalities

- **Agglomeration economies**
  - **<span style="color:red">_production side_</span>**
  - consumption side

- **Congestion externalities**
  - Commuting costs per se & Urban differential land rent are not externalities

- **Public goods**
  - **<span style="color:red">_social overhead capital_</span>**
  - local public services

# Previous estimates of agglomeration economies

- Nakamura (1985)
  - manufacturing industries only, Jurisdictional data
  - augments a translog production function with a cost-share equations
  - Production side agglomeration economies: Large variation between industries
- Kanemoto-Okawara-Suzuki JJIE 1996
  - IMAs by S. Takeuchi, 1985 Data
  - Production side: 7% for IMAs with over 1 million population
- Kanemoto-Saito (住宅土地経済1998)
  - 119SMEAs, 1985 Data
  - Production side: 4.5%
- Tabuchi and Yoshida (2000)
  - SMEA data
  - Dual
  - Instrument variables
  - Production-side: 10%
  - Consumption-side: 7 to 12%

# Production Functions

- Firm-level production function

$$f(n, k, G, N)$$

- Metropolitan production function

$$Y = AK^{\alpha} N^{\beta} G^{\gamma}$$

$$\ln(Y / N) = A_0 + a_1 \ln(K / N) + a_2 \ln N + a_3 \ln(G / N)$$

# Lack of land rent data

- **Land value data only**
  - Enormous variation in value-rent ratio: 600 trillion yen (1980) ⇒ 1,800 trillion yen (1990) ⇒ 1,000 trillion yen (2000)
- **Cross-sectional variation in TDV/TPS (or (TDV-SOC)/TPS)**
  - TDV: Total Differential Land Value
  - Cities at a higher level hierarchy have greater tendency to be too big
    - More difficulty in creating a new city at the top of the hierarchy
  - Does Tokyo have a higher TDV/TPS ratio than other cities?

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# How to test the optimality of city size?

- Private good case

$$\frac{TDV}{TPS} \qquad TPS = a_2 Y$$

- Local public good case

$$\frac{TDV - SOC}{TPS} \qquad TPS = (a_2 - a_3)Y$$

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# Estimation Results: Cross-Section

- ## All MEA's

| Parameter | 1980 | 1985 | 1990 | 1995 |
|---|---|---|---|---|
| $A_0$ | $0.422^{**}$ | $0.440^{**}$ | $0.632^{***}$ | $0.718^{***}$ |
| | (0.153) | (0.18) | (0.201) | (0.182) |
| $a_1$ | $0.404^{***}$ | $0.469^{***}$ | $0.528^{***}$ | $0.449^{***}$ |
| | (0.031) | (0.039) | (0.043) | (0.037) |
| $a_2$ | $0.031^{***}$ | $0.026^{***}$ | $0.021^{**}$ | $0.020^{**}$ |
| | (0.009) | (0.009) | (0.009) | (0.007) |
| $a_3$ | 0.015 | -0..031 | $-0.124^{***}$ | $-0.086^{**}$ |
| | (0.045) | (0.041) | (0.040) | (0.032) |
| $\overline{R}^2$ | 0.608 | 0.568 | 0.644 | 0.653 |

Note: Numbers in parentheses are standard errors. *** significant at 1% level. ** significant at 1% level. * significant at 10% level.

# Panel Estimates

| | ALL MEAs | | Small MEAs | | Medium MEAs | | Large MEAs | |
|---|---|---|---|---|---|---|---|---|
| | FE | RE | FE | RE | FE | RE | FE | RE |
| $a_1$ | 0.279*** | 0.310*** | 0.354*** | 0.376*** | 0.281*** | 0.325*** | 0.170*** | 0.194*** |
| | (0.015) | (0.014) | (0.030) | (0.027) | (0.021) | (0.020) | (0.029) | (0.026) |
| $a_2$ | 0.101*** | 0.031*** | -0.016 | -0.044 | 0.416*** | 0.096*** | -0.044 | 0.059*** |
| | (0.023) | (0.007) | (0.037) | (0.030) | (0.040) | (0.026) | (0.058) | (0.010) |
| $a_3$ | -0.084*** | -0.108*** | -0.147*** | -0.132*** | 0.145*** | -0.061* | -0.151*** | -0.113*** |
| | (0.020) | (0.017) | (0.034) | (0.029) | (0.040) | (0.031) | (0.030) | (0.026) |
| $R^2$ | 0.623 | 0.770 | 0.741 | 0.761 | 0.311 | 0.721 | 0.502 | 0.862 |
| Hausman | 39.6 | | 11.3 | | 132.5 | | 21.3 | |
| chi (5%) | 28.9 | | 28.9 | | 28.9 | | 28.9 | |
| Sample size | 1888 | | 528 | | 896 | | 464 | |

Note: Numbers in parentheses are standard errors. *** significant at 1% level. * significant at 10% level.

# GMM 3SLS estimates

|  | All MEAs | Small MEAs | Medium MEAs | Large MEAs |
|---|---|---|---|---|
| $a_1$ | $0.518^{***}$ | $0.601^{***}$ | $0.479^{***}$ | $0.344^{***}$ |
|  | (0.030) | (0.066) | (0.047) | (0.048) |
| $a_2$ | $0.044^{***}$ | 0.027 | $0.053^{***}$ | $0.068^{***}$ |
|  | (0.005) | (0.018) | (0.013) | (0.007) |
| $a_3$ | 0.047 | 0.077 | 0.023 | 0.056 |
|  | (0.033) | (0.081) | (0.069) | (0.045) |
| $J$-statistics (D.F.) | 16.28 (4) | 5.73 (4) | 24.57 (4) | 3.78 (4) |
| chi (5%) | 9.49 | 9.49 | 9.49 | 9.49 |
| 1st stage $F$-statistics | 216.85 | 81.10 | 105.19 | 91.73 |
| Sample size | 1888 | 528 | 896 | 464 |

Note: *** significant at 1% level.

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# Construction of Total Land Value Data for MEAs

- ## Land Value data

  - ### Prefecture data in Annual Report on National Accounts

- ## Allocation to MEAs

  - ### Allocate prefecture aggregates to MEAs according to employment shares

  - ### Adjustment to account for higher average land prices in larger cities

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# The Land Value and the Pigouvian Subsidy

| MEA | Population | Land Value (a) | Pigouvian Subsidy 1 (b) | (a)(b) | Social overhead capital (c) | Pigouvian Subsidy 2 (d) | (a)-(c) (d) |
|---|---|---|---|---|---|---|---|
| Tokyo | 30,938,445 | 518,810 | 9,493 | 55 | 133,310 | 1,613 | 239 |
| Osaka | 12,007,663 | 176,168 | 3,216 | 55 | 53,654 | 546 | 224 |
| Nagoya | 5,213,519 | 62,517 | 1,594 | 39 | 20,774 | 271 | 154 |
| Kyoto | 2,539,639 | 27,851 | 637 | 44 | 10.075 | 108 | 164 |
| Kobe | 2,218,986 | 21,913 | 575 | 38 | 12,345 | 98 | 98 |
| Fukuoka | 2,208,245 | 19,810 | 532 | 37 | 8,890 | 90 | 121 |
| Sapporo | 2,162,000 | 12,645 | 508 | 25 | 14,670 | 86 | -23 |
| Hiroshima | 1,562,695 | 14,708 | 421 | 35 | 8,481 | 72 | 87 |
| Sendai | 1,492,610 | 12,529 | 377 | 33 | 7,604 | 64 | 77 |
| Kitakyushu | 1,428,266 | 11,059 | 311 | 36 | 6,719 | 53 | 82 |
| Shizuoka | 1,002,032 | 12,740 | 258 | 49 | 3,715 | 44 | 206 |
| Kumamoto | 982,326 | 6,505 | 206 | 32 | 4,892 | 35 | 46 |
| Okayama | 940,208 | 7,637 | 230 | 33 | 5,370 | 39 | 58 |
| Niigata | 936,750 | 7,519 | 231 | 33 | 5,698 | 39 | 46 |
| Hamamatsu | 912,642 | 11,489 | 242 | 47 | 3,707 | 41 | 189 |
| Utsunomiya | 859,178 | 8,021 | 223 | 36 | 3,551 | 38 | 118 |
| Gifu | 818,302 | 6,709 | 187 | 36 | 3,800 | 32 | 92 |
| Himeji | 741,089 | 6,143 | 205 | 30 | 4,640 | 35 | 43 |
| Fukuyama | 729,472 | 5,367 | 174 | 31 | 4,433 | 29 | 32 |
| Kanazawa | 723,866 | 7,412 | 182 | 41 | 3,957 | 31 | 112 |
| Average |  | 47,878 | 990 | 38 | 16,014 | 168 | 108 |

Note: Land value, Pigouvian subsidy, and social overhead capital are in billion yen.

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# Conclusion

- **Estimation of MEA production function**
  - Simple OLS: Serious simultaneity bias.  Negative productivity of SOC.
  - Panel Estimation: Does not solve the problem.
  - GMM 3SLS with instrumental variables: Positive but insignificant productivity of SOC.

- **The magnitudes of agglomeration economies**
  - 7.0% for Large MEAs, 5.3% for Medium, 2.7% for Small

- **Tokyo and Osaka have significantly higher land value/Pigouvian subsidy ratios than other MEAs**
  - 53 for the two, 37 for the average for 20 MEAs

# Extensions

- Land value estimates

- Better instruments and better estimation techniques

- Agglomeration economies on the consumption side and congestion externalities

- The Henry George Theorem in a second best situation.

- Other private inputs than capital and labor

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