Taxes and Commuting

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Nürnberg Research Seminar

Research Question

- How do tax differentials within a common labor market alter commuting patterns and times?
  - Do the tax differentials distort the urban spatial structure of cities?
- Taxes may change residential locations as well as the place of work.
  - Commuting captures bot these changes. Under what conditions are commute times a sufficient statistic to measure the spatial distortion of income taxes?

Taxes and Commuting

- Limited Research examining the relationship between tax policy, city size, and commuting.
  - Transportation costs and commuting are central to determining the city's urban spatial structure.
  - Many empirical urban economic models also rely on tax differentials at geographic borders but cross-border commuting is understudied.
- Urban sprawl is often thought of as resulting from increases in income, population, and transportation.
  - But tax competition within a MSA may result in tax differentials that yield distorted city shapes and commutes.
  - Fiscal competition for mobile workers and residents may be intense in interstate MSAs.
- Commuting and location responses to taxation are distortionary, but are not captured in the elasticity of taxable income.

Taxes and the City

- Wildasin (1985) examines the impact of income taxes on density and commuting.
  - By lowering the opportunity cost of time, income tax increases commuting time (expands city limits).
- Brueckner and Kim (2003) examines the impact of the property tax on density and commute time.
  - Via capitalization, by reducing land prices relative to capital costs, the property tax increases the land/capital ratio in housing thereby reducing density and increasing city size.
- In both cases *uniform tax increases* act to change the size of the city.

Taxes and Commuting in Theory: Our Focus

- Prior literature focuses on how *uniform* tax increases change the city size (theoretically).
  - Our interest is how *tax differences* within the city (MSA) resulting from a border *distort* its shape (of employment and residences) and thereby result in wasteful commuting.
- Our focus is on commuting as a sufficient welfare statistic for spatial distortion, which results from movements of firms and people.
- Thus, we focus on approximately 50 Metropolitan Statistical Areas (MSAs) that cross state lines.
  - Approximately 75 million people live in one of these MSAs.
  - Approximately 7% have an interstate commute.
  - Average tax differentials is approximately 1.6 percentage points.

USA Institutions

- Individual income taxes set by state governments (and some localities).
- Decentralized tax system results in substantial tax differentials in metropolitan areas that cross state borders.
  - For example, New York City (NY-NJ), Chicago (IL-IN), Texarkana (TX-AR), etc.
- Substantial autonomy to the states: ability to set tax rates, tax brackets, credits and deductions.
- The rules governing the place of taxation for interstate commuters are determined by tax treaties discussed on the next slide.

Reciprocity / No Reciprocity

- The issue of taxation of income in multi-state MSAs is complicated by reciprocity agreements.
  - Reciprocity states: taxes depending on the location of residence
  - No reciprocity states: taxes depend (partially) on the location of employment
    - The system of tax credits (attempt to avoid double taxation) can move no reciprocity states closer to the effects of residence based taxation.
- Reciprocity agreements are historically determined. Very few treaties signed or changed following 1980.

Link To European Context: Frontaliers

- In 2007, approximately 800,000 people engaged in cross-country commuting in the European Union – up from 500,000 in 2000.
- Cross-border commuters are especially important in small countries such as Luxembourg where they represent over 40% of domestic employment.
- Germany: in-commuting represents 1.11% and out-commuting represents 1.51% of domestic employment.
- 260,000 individuals commute into Switzerland. Current policy debate: Should Italians working in Switzerland pay Swiss tax rates or possibly within 20 km of the border?
- In Europe, tax treaties – similar to reciprocity agreements – determine place of taxation. Some variation exists.

Summary of Results (for High-Income HH)

Taxes are resident-based:

1. capitalization in land rents
2. interstate commuters from low to high increase
3. decrease commute times in high-tax state and increase in low-tax state (confirmed empirically)

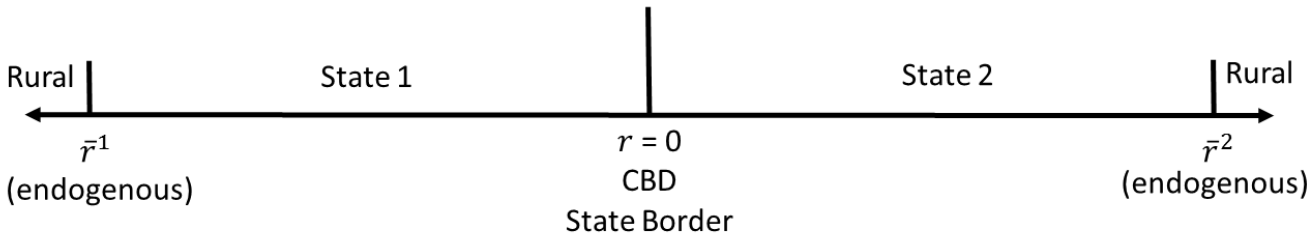
Taxes are not resident-based:

1. capitalization in wages
2. interstate commuters from low to high decrease
3. increase commute times in high-tax state and decrease commute times in low-tax state (confirmed empirically)

Theory

Geography and Firms

- Monocentric city model with a state border through the central business district (CBD).



- Firms
  - Production in state i is given by the general function $f_i(e_i^k, E_i, E_j)$ where e_i^k is employment in firm k in state i, E_i is the employment in state i and E_j is the employment in the other state in the MSA.
  - Agglomeration: total employment in the state in which the firm is located is greater than the impacts of increases in employment in the other state.

Households

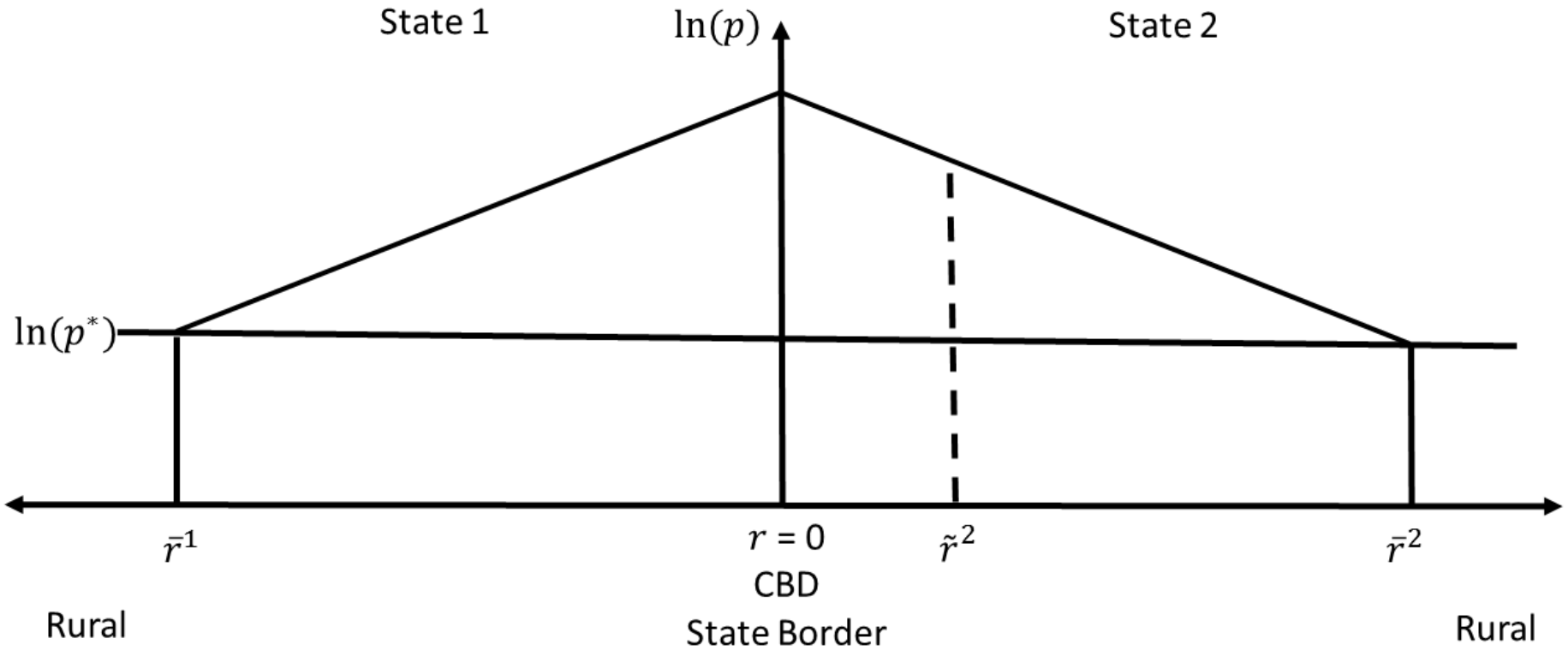
- Households
  - N residents live in either state 1 or 2 and earn wages w^i; can costlessly move between the two states.
  - Commuting cost to CBD is given by $\gamma r + \sigma$ where r is the distance from the CBD and where $\sigma = 0$ for a within state commute and $\sigma > 0$ for an interstate commute.
    - ★ Individuals living between the CBD and $\tilde{r}^2$ have an interstate commute.
    - ★ For this talk only: Everyone in state 1, works in state 1.
  - Utility is defined by the utility function $U = U(x, g, l)$ where utility is received over private good (x), a public service (g), and land (l) .
  - $V\left(w^i - \gamma r - \sigma - T^i, g(T^i), p^i(r)\right)$ is indirect utility where $p^i(r)$ is rent on a unit of land in state i at distance r

Governments and Taxes

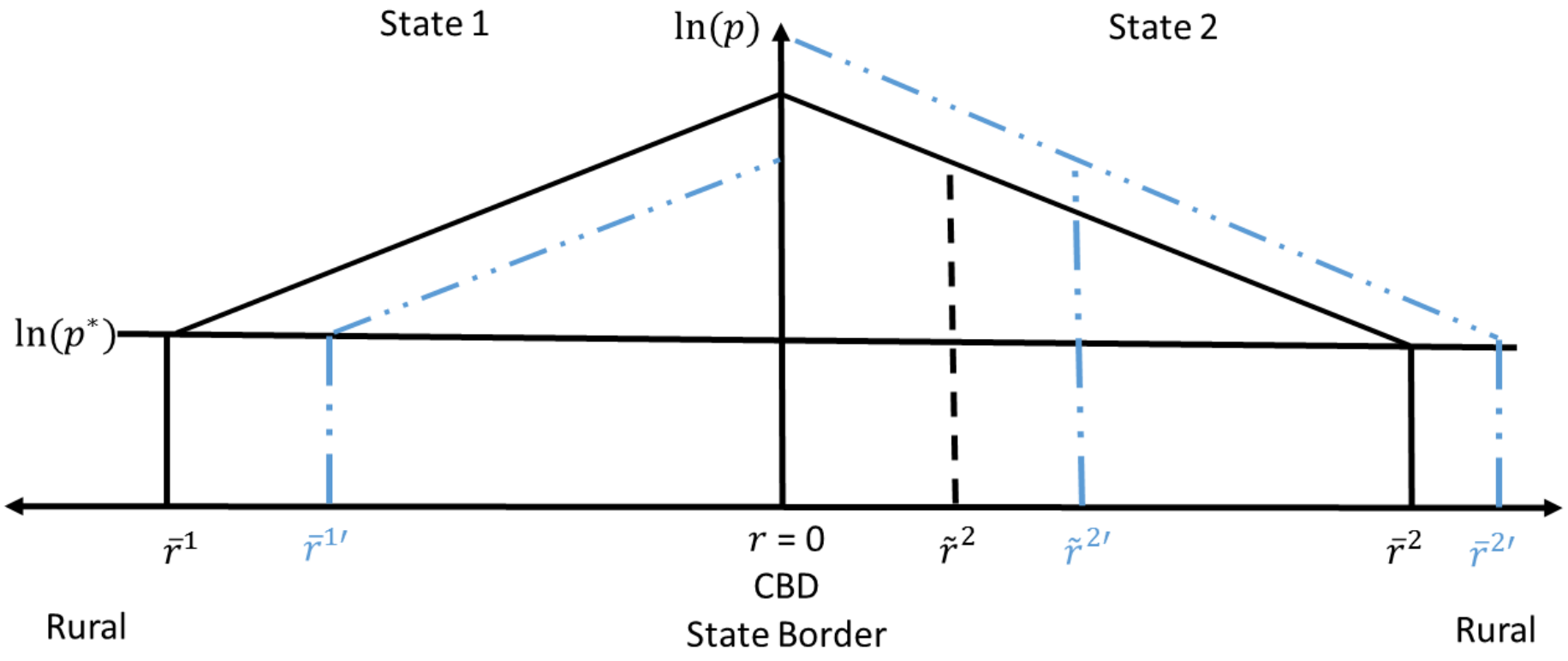
- Governments
  - Tax income at T depending on whether have reciprocity agreement or not.
  - Residents of a state receive a tax credit on their income taxes for taxes paid in their state of employment. Some fraction of taxes paid eligible for the credit.
  - In the presentation, we assume the tax cost of increase in public services is $\geq$ the sum of the marginal benefits (think high-income).
- Reciprocity corresponds to a tax T^i applying based on residence only.
- No Reciprocity:
  - For talk [credits for taxes paid in state 1 exceed the tax liability of a resident in state 2] implies an increase in T^1 increases total tax liability for an interstate commuter from state 2 by dT^1.

Equilibrium (Graphical)

[Eq. Eqns]



Impact of an Increase in T^1: Reciprocity (Residence)



Responses to an Increase in T^1: Reciprocity (Residence)

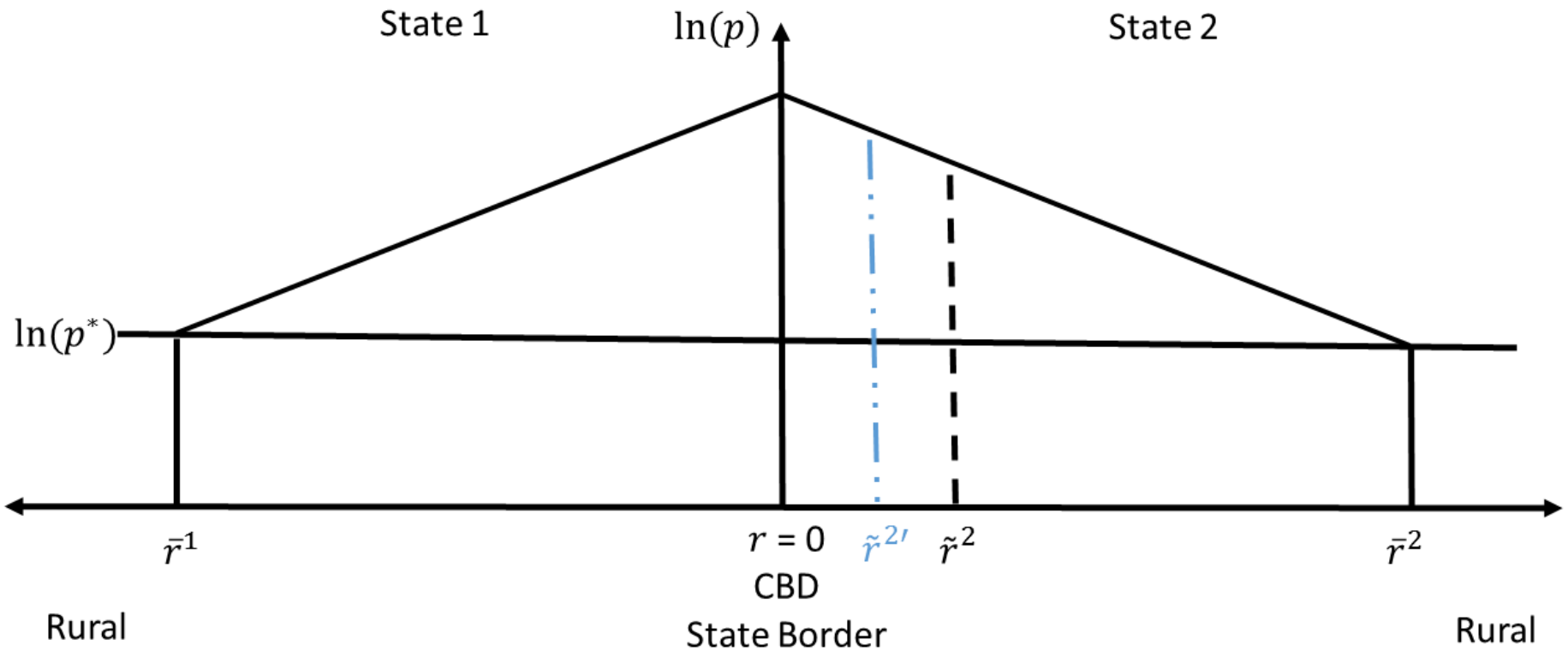
Proposition

An increase in taxes in state 1 will:

(a) The size of state 1 will contract and state 2 will increase;
(b) The number of commuters from state 2 to state 1 increases;
(c) Commute times in state 1 decrease and increase in state 2.

- Intuition: People move. If the change in land prices does not significantly affect the distribution of population within the state, perhaps resulting in an approximately proportional increase or decrease in population density at all r, the factor that determines whether commuting times increase or decrease will be whether the state's share of the MSA expands or contracts.

Increase in T^1: No Reciprocity (Not Residence)



Responses: No Reciprocity (Not Residence)

Proposition

If states 1 and 2 do not have reciprocity agreements, an increase in taxes in state 1 will:

(a) The size of state 1 and state 2 are unaffected;
(b) The number of interstate commuters decreases;
(c) Commuting times decrease in state 2.

- Intuition: Employment moves to the low-tax state, which changes commuting patterns. However, if credits are partial, then we are in a system where some of the reciprocity channels arise.

Welfare Analysis

- Estimates of the elasticity of taxable income (ETI) are traditionally assumed to be a sufficient statistic for DWL, however, in the context of this model the spatial distortion of taxation is missing.
- If marginal differences in agglomeration are small:

$$\frac{dW}{dT^1} \approx -N^1 \frac{dAC^1}{dT^1} - N^2 \frac{dAC^2}{dT^1}. \tag{1}$$

Not This Talk, But in Paper

[Full Model]

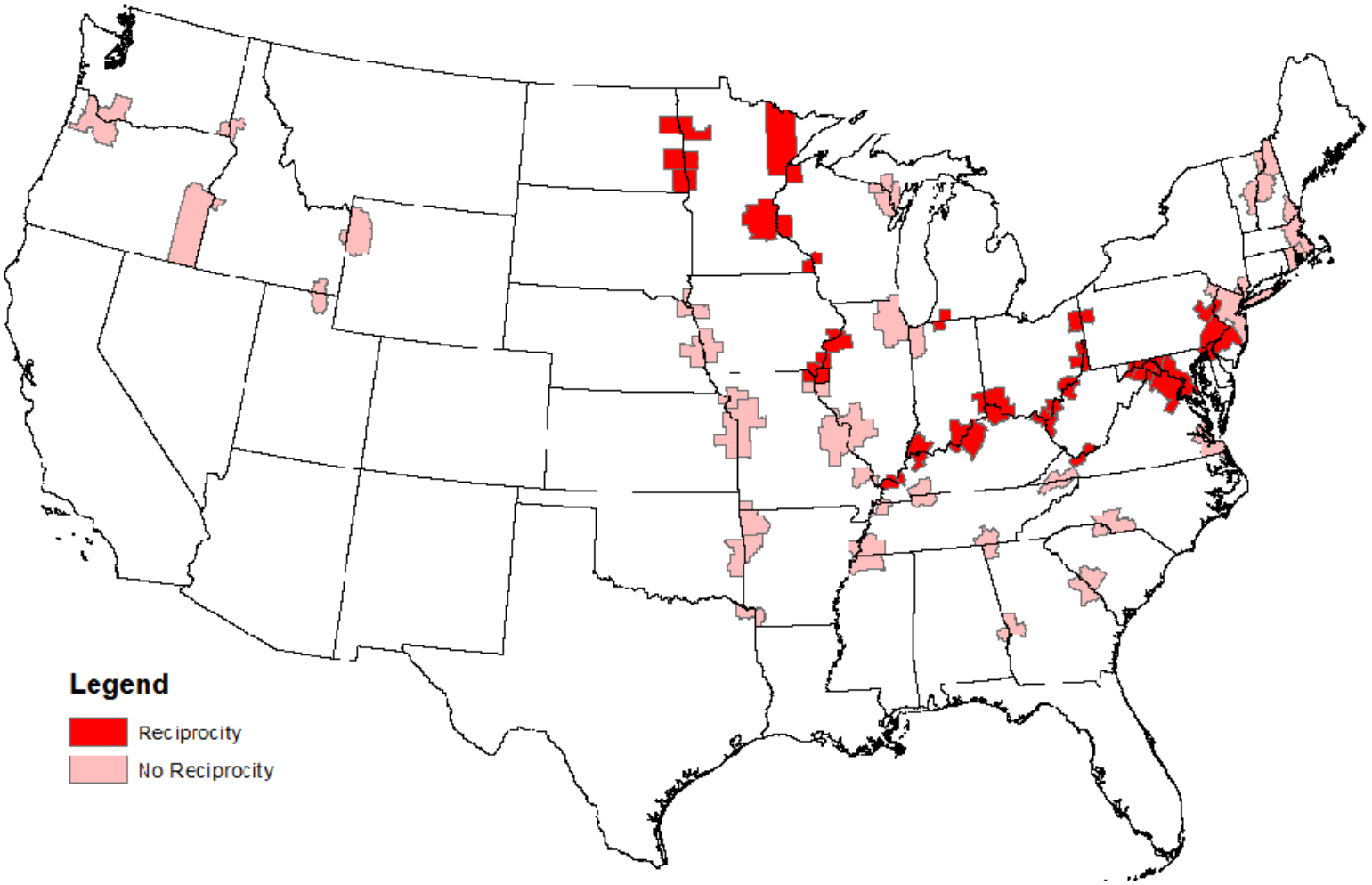
- Two types of workers with different consumption amenity valuations and thus multiple towns within each state.
  - Generates interstate commuting in both directions.
- Comprehensive discussion of net benefits from the public services.

Key Result / Lessons for Empirics

- The effect on commute times depends on reciprocity status and is opposite signed.
  - It is the differential that matters.
  - This asymmetry helps strengthen identification.
- The effects are largest for individuals with the highest tax costs relative to benefits (high-income households).
- Partial tax credits such that "no reciprocity" states may have an employment based and residence based component.

Empirical Analysis

CBSAs in Sample: Cross-Border



Data

- We use data from the 2005 though 2011 ACS.
  - IPUMS sample of households.
- We calculate the average tax payment and the marginal tax rate (federal and state) conditional on being in either state of the cross-border CBSA using the NBER's TAXSIM program.
- Rich data on other policies that vary across the state borders (such as gas taxes, sales taxes, spending, etc.) and demographic variables from the ACS.
- Data on reciprocity agreements from Rork and Wagner (2012).
  - Key is that reciprocity agreements are historically determined (1 changes in our sample).

The Counterfactual

- We calculate the average tax rate in the state of residence.
  - This is the household's own-state tax rate.
- Our goal is to construct a counterfactual tax rate for each household in the sample.
  - We do this by calculating what the average tax rate for each household would be in the other state assuming that none of the income characteristics of the household change.
  - Reasonable assumption in the local labor market.
- Thus we can define the resident as living in the high-tax state and low-tax state based off of

$$\triangle atr_{i,m,s} = atr_{i,m,s} - atr_{i,m,-s}$$

Marginal Tax Rates

- Wildasin (1985) suggests that marginal tax rates are important because they change the opportunity cost of time.
  - Thus, we also calculate a variable for marginal taxes paid.

$$mtr_{i,m,s} = \begin{cases} mtr_{i,m,live} & \text{if } R_m = 1 \\ mtr_{i,m,work} & \text{if } R_m = 0 \end{cases}$$

- Will not focus on these results in talk.

Estimating Equation

$$C_{i,m,s,t} = \beta_1 \triangle atr_{i,m,s,t} + \beta_2 \triangle atr_{i,m,s,t} \times R_m + \gamma_1 mtr_{i,m,s,t} + \gamma_2 mtr_{i,m,s,t} \times R_m + \rho X_{i,m,s,t} + \zeta_{m,t} + \theta_{s,t} + \varepsilon_{i,m,s,t},$$

- We allow marginal and average tax rates to have different effects.
- We allow for an asymmetric effect in reciprocity and non-reciprocity metro areas (R_m)
- We include CBSA by year and and state by year dummies. In addition we include dummy variables for the occupation that the individual works in.
- Standard errors are clustered at the state-CBSA level

Identification

- Identification comes from within a particular CBSA and within a particular occupation type in a given year.
- The creation of the counterfactual tax rates provides the researcher with person specific measures of incentives.
- We control for a battery of controls such as other policy differentials across state lines (gas, corporate, etc.) and spending differentials. In addition, we observe household specific control variables from the ACS.
  - Also control for state-CBSA and state time varying characteristics.
- Threat to identification: omitted variables or selection from sorting.
  - Addressed with a panel data approach.

Income Percentiles

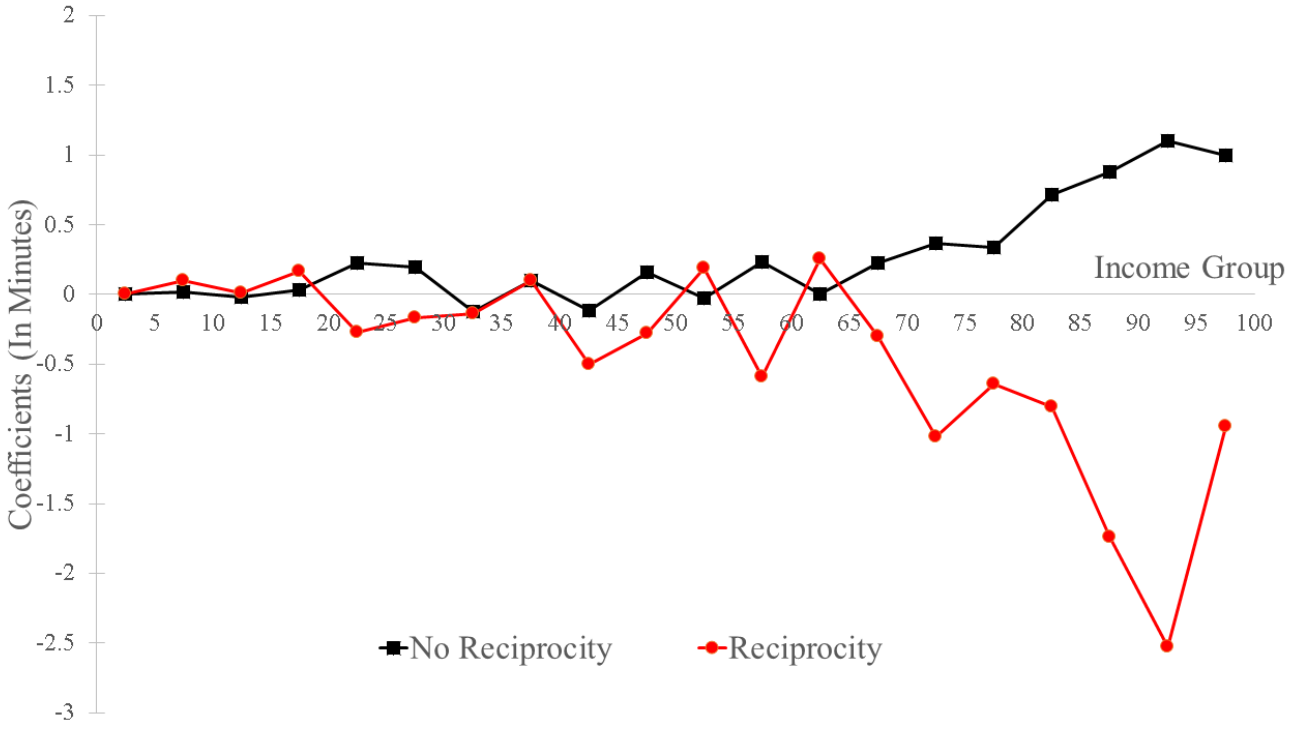
	(1) Minimum Income	(2) Average Income
$>$ 50th	\$55,001	\$122,931
$>$ 75th	\$92,804	\$175,864
$>$ 80th	\$104,510	\$195,552
$>$ 85th	\$122,001	\$224,117
$>$ 90th	\$150,001	\$269,375
$>$ 95th	\$214,004	\$361,744
$>$ 99th	\$479,001	\$589,926

The Effect on Commute Times: Baseline

	(1) >85th and ≤90th	(2) >90th and ≤95th	(3) >95th
$\triangle atr$	0.779**	1.202**	0.987***
[theory: +]	(0.351)	(0.603)	(0.191)
$\triangle atr * R$	-1.880**	-3.911***	-2.209**
[theory: -]	(0.781)	(1.084)	(0.974)

Visualization Via Triple Interaction

$$\beta_1 \triangle atr_{i,m,s,t} + \sum_{y=2}^{20} \eta_y \triangle atr_{i,m,s,t} 1(g=y) + \beta_2 \triangle atr_{i,m,s,t} R_{m,t} + \sum_{y=2}^{20} \lambda_y \triangle atr_{i,m,s,t} R_{m,t} 1(g=y)$$



Mobile Households: Top 25%

	(1) No Restriction	(2) Single, No Children	(3) Recent Movers	(4) Moved Longer Ago
$\triangle atr$	0.826***	0.551*	0.649*	0.362
[theory: +]	(0.278)	(0.323)	(0.391)	(0.294)
$\triangle atr * R$	-1.004**	-1.432**	-2.201***	-0.702
[theory: -]	(0.434)	(0.614)	(0.625)	(0.638)

Model Specification: Top 10%

	(1) Only Dummies	(2) Full Model
$\triangle atr$	1.503***	1.236***
	(0.486)	(0.310)
$\triangle atr * R$	-1.684**	-2.063***
	(0.765)	(0.544)
R^2	0.047	.277

IV for Reciprocity

- Although we have argued that reciprocity agreements were historically decided, it is possible that unobserved location fundamentals that determine reciprocity status could persistent and may be related to commuting times today.
- We instrument for reciprocity status with participation in interstate compact agreements prior to 1999 [alternatively: prior to 1970] in the areas of water safety, child welfare, lottery, pest control, insurance and planning.
  - Participation in these agreements signals cooperation between the states.

	(1) > 75th	(2) > 90th
$\triangle atr$	0.968***	1.320***
	(0.286)	(0.311)
$\triangle atr * R$	-1.774*	-2.643***
	(0.992)	(0.973)

Other Empirical Estimates

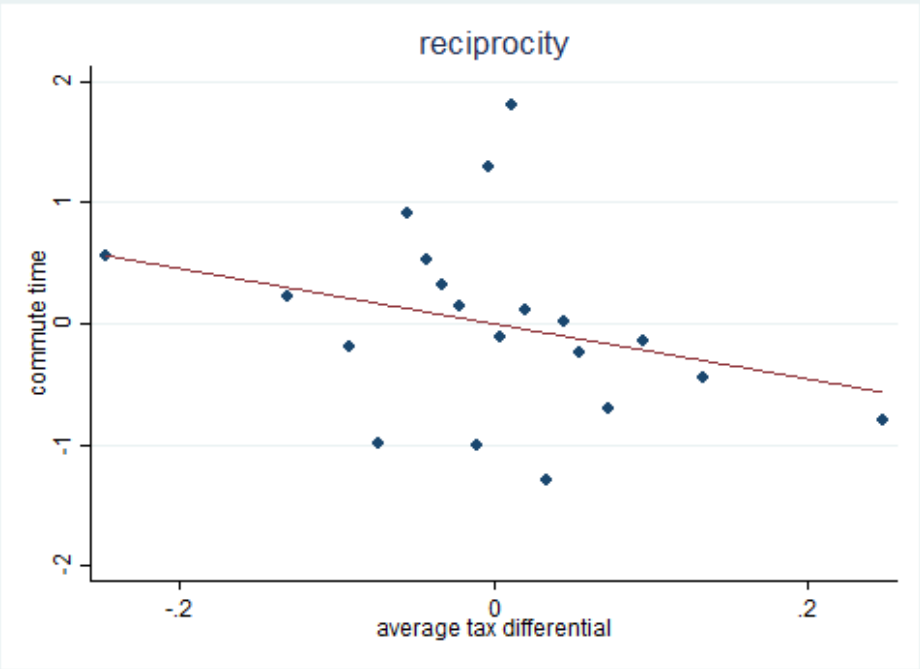
- We can also test for push vs. pull effects by allowing the own- and other-state tax rate to enter the regression separately.
  - In general, coefficients are not statistically different from each other and match the theoretically predicted signs in reciprocity and no reciprocity states. [MW Table]
- We can allow different effect on the high-tax and the low-tax side of the border.
- Multi-state MSAs and conditioning based on principal city.

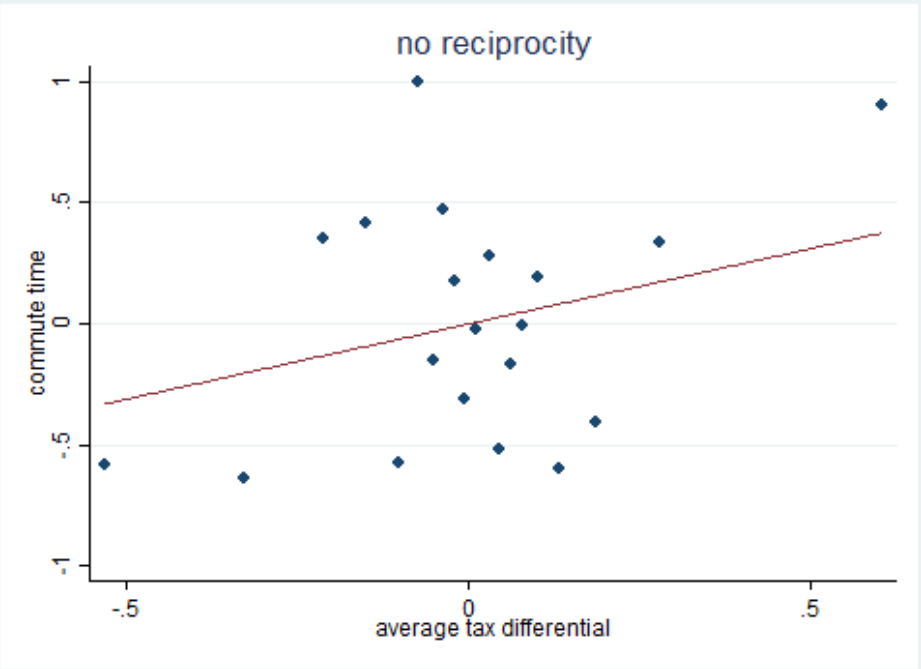
Panel Data Regressions

- Aggregate by percentile-MSA-state-year.
- We divide our sample into 100 percentiles indexed by p using the *national* averages for each percentile of the income distribution.
- To identify purely statutory changes that are independent of changes in income, we construct tax rates for each percentile by holding *fixed* income and all other characteristics at the fixed averages for each percentile but changing the tax year and state in TAXSIM.

$$C_{p,m,s,t} = \begin{array}{c} \beta_1 \triangle atr_{p,m,s,t} + \beta_2 \triangle atr_{p,m,s,t} \times R_{m,t} + \gamma_1 mtr_{p,m,s,t} + \gamma_2 mtr_{p,m,s,t} \times R_{m,t} \\ + \vartheta R_{m,t} + \rho X_{p,m,s,t} + \delta_t + \omega_{p,m,s} + \varepsilon_{p,m,s,t}, \end{array}$$

Panel Data Results





Panel Data Results

	(1)	(2)	(3)
	>85	> 90	>95
$\triangle atr$	0.867**	1.008***	0.899**
	(0.428)	(0.374)	(0.407)
$\triangle atr * R$	-0.884	-1.861**	-2.353
	(0.718)	(0.773)	(1.664)

Welfare Estimates

Welfare Analysis

- Recall that if population density is log-linear in distance and if the opportunity cost of land at the termini is small, to a first order approximation:

$$\frac{dW}{dT^1} \approx -N^1 \frac{dAC^1}{dT^1} - N^2 \frac{dAC^2}{dT^1} - \left[\gamma\left(\bar{r}^1 - \bar{r}^2\right) - \left(AC^1 - AC^2\right)\right] \frac{dN^1}{dT^1} - p^* \left(\frac{\bar{r}^2 - \bar{r}^1}{\bar{r}^1 + \bar{r}^2}\right) \quad (2)$$

$$\approx -N^1 \frac{dAC^1}{dT^1} - N^2 \frac{dAC^2}{dT^1}. \quad (3)$$

Welfare Estimates

	No Reciprocity (employment $\approx$ 23.69 m.)			Reciprocity (employment $\approx$ 10.31 m.)		
	Minutes	Hourly Wages	\$30/hour	Minutes	Hourly Wages	\$30/hour
All Incomes	0.16	0.07	0.08	-5.0	-2.2	-2.5
$\triangle atr \approx$ \$530 per person						
HH Income $>$ 75th	47.8	54.6	23.9	-43.8	-43.6	-21.9
$\triangle atr \approx$ \$1150 per person						
HH Income $>$ 90th	84.0	150.4	42.0	-338.5	-498.5	-169.2
$\triangle atr \approx$ \$1700 per person						

- HH Income $>$ 90: For these households, that change in taxes correspond to commutes that are 604 minutes longer on the low-tax side and 498 minutes shorter on the high-tax side (per person, per year).
- If valuing time at an hourly wage, this corresponds to a welfare loss of \$890 (52% of a one percentage point tax change) and welfare gain of \$723 (43% of the tax change), respectively.

Conclusion

- We have shown robust evidence that average tax rate differentials change commute times either by expanding the spatial reach of the city or by altering interstate commutes.
  - The mechanism by which average tax rates have such an effect is through the mobility of people or jobs.
  - Largest for people who are net payers into the system or are highly mobile.
- The distortion to commutes has important welfare implications because of the spatial distortion of the city.

Push vs. Pull

[Back]

	(1)	(2)	(3)	(4)
	No Reciprocity		Reciprocity	
	$[\beta_1 > 0 \ \& \ \beta_2 < 0]$		$[\beta_1 < 0 \ \& \ \beta_2 > 0]$	
	Income> 75th	Income> 90th	Income> 75th	Income> 90th
$\beta_1 : atr_{i,m,s}$	0.849***	0.903***	-0.191	-0.957**
	(0.236)	(0.212)	(0.338)	(0.434)
$\beta_2 : atr_{i,m,-s}$	-0.706***	-0.936***	0.347	0.999**
	(0.250)	(0.286)	(0.286)	(0.379)

Equilibrium Conditions

[Back]

- Equal Utility across states (Termini Condition): $V\left(w^1 - \gamma\bar{r}^1 - T^1, g(T^1), p^*\right) = V\left(w^2 - \gamma\bar{r}^2 - T^2, g(T^2), p^*\right)$ where $\bar{r}^i$ is the terminus (boundary) of state i
- Equal utility within state: $V\left(w^1 - \gamma\bar{r}^1 - T^1, g(T^1), p^*\right) = V\left(w^1 - \gamma r - T^1, g(T^1), p(r)\right)$ and similarly for residents with interstate commutes
- When states have reciprocity agreements: $V\left(w^2 - \gamma\tilde{r}^2 - T^2, g(T^2), p^2\left(\tilde{r}^2\right)\right) =$ $V\left(w^1 - \gamma\tilde{r}^2 - \sigma - T^2, g(T^2), p^2\left(\tilde{r}^2\right)\right)$
- Without reciprocity: $V\left(w^2 - \gamma\tilde{r}^2 - T^2, g(T^2), p^2\left(\tilde{r}^2\right)\right) =$ $V\left(w^1 - \gamma\tilde{r}^2 - \sigma - T^1, g(T^2), p^2\left(\tilde{r}^2\right)\right)$
- In a market equilibrium the wage in each state must equal the marginal product of labor in that state given the level of employment there.

Full Model

[Back]

- Each state is composed of two areas, a central city and suburbs denoted by C and S, respectively.
- While the boundary of the MSA is endogenous, the boundary of the central cities are fixed, consistent with historical invariance.
- There are two types denoted by C and S; Individuals of type C receive utility from an amenity that only exists in the cities.

Full Model

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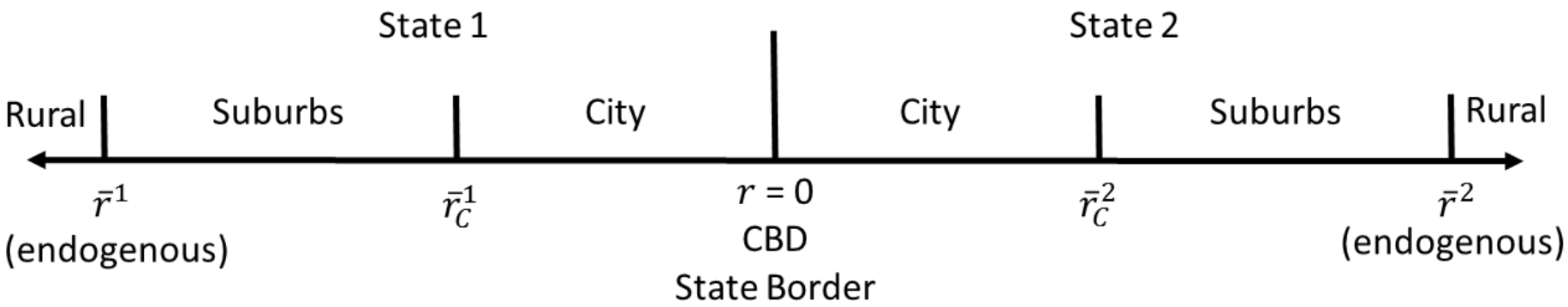

Full Model: Conditions

[Back]

- Equal utility between the two states for type S requires
  $V\left(w_S^1 - \gamma\bar{r}^1 - T^1, g(T^1), p^*\right) = V\left(w_S^2 - \gamma\bar{r}^2 - T^2, g(T^2), p^*\right)$
- Equal utility condition for type C at their municipal border is
  $V\left(w_C^1 - \gamma\bar{r}_C^1 - T^1, g(T^1), p^1\left(\bar{r}_C^1\right)\right) + \phi =$
  $V\left(w_C^2 - \gamma\bar{r}_C^2 - T^2, g(T^2), p^2\left(\bar{r}_C^2\right)\right) + \phi.$
- Equal utility condition for type S interstate commuters is
  $V\left(w_S^2 - \gamma r - T^2, g(T^2), p^2(r)\right) =$
  $V\left(w_S^1 - \gamma r - \sigma - \left((1 - I_S)T^2 + I_S T^1\right), g(T^2), p^2(r)\right), r \in (\bar{r}_C^2, \tilde{r}_S^2]$
  where the indicator $I_s = 1$ with no reciprocity and $T^1 \geq T^2$; $I_S = 0$ with reciprocity or with no reciprocity if $T^2 > T^1$.
- Equal utility condition for type C interstate commuters is
  $V\left(w_C^1 - \gamma r - T^1, g(T^1), p^1(r)\right) + \phi =$
  $V\left(w_C^2 - \gamma r - \sigma - \left((1 - I_C)T^1 + I_C T^2\right), g(T^1), p^1(r)\right) + \phi,\ r \in (0, \tilde{r}_C^1]$
  where where the indicator $I_C = 1$ with no reciprocity and $T^2 \geq T^1$; $I_C = 0$ with reciprocity or with no reciprocity if $T^1 > T^2$.

Full Model: Equilibrium

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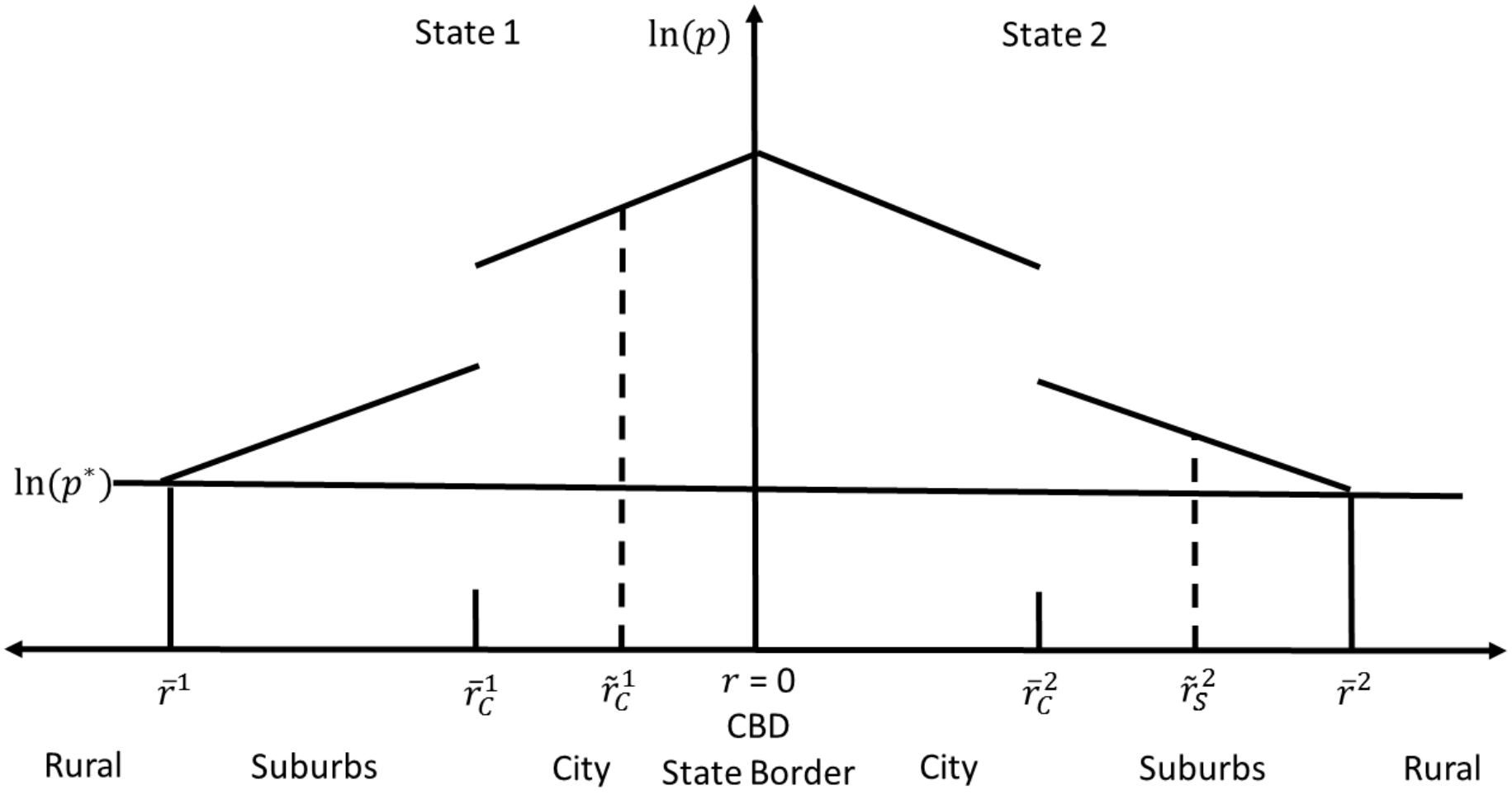

Full Model: Reciprocity

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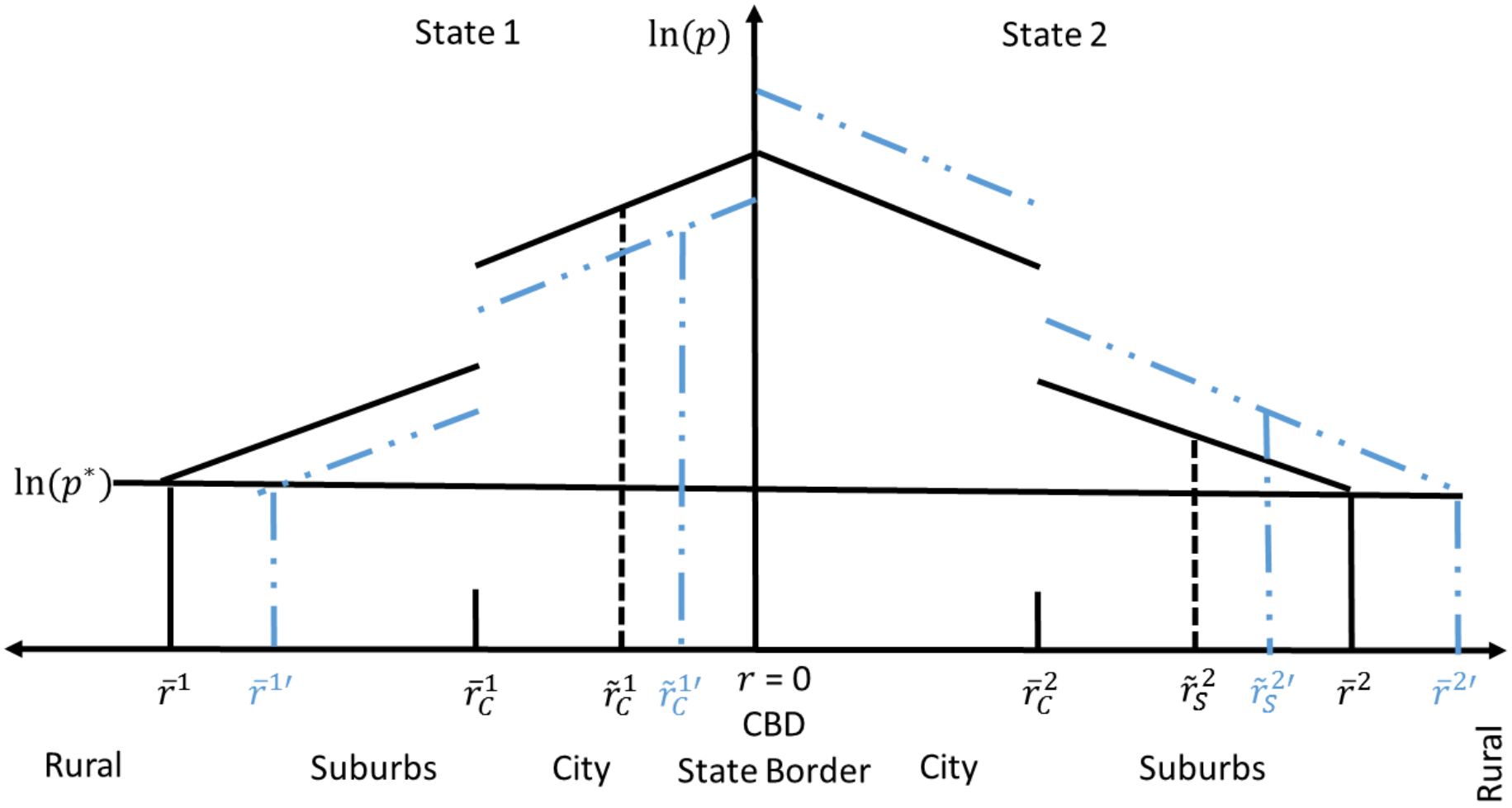

Full Model: No Reciprocity

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