Taxation, Migration, and Innovation: The Effect of Taxes on the Location of Star Scientists?

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Preliminary

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*The views expressed in this paper are those of the authors should not be attributed to the Federal Reserve Bank of San Francisco or the Federal Reserve System.

Introduction

- How sensitive are people and businesses to taxes?
- When jurisdictions raise tax rates, do they push taxpayers to move away?
- By cutting taxes, can jurisdictions pull in "economically valuable" taxpayers – those who generate either fiscal or social rents

Introduction

- Much debate about tax-induced migration

Gérard Depardieu in Russian costume last year, after receiving his new passport.

- For example, Gerard Depardieu moves to Russia after France enacts 75% income tax rate on high-wealth residents

Introduction

- Recent literature on tax-induced migration has focused on particular segments of population:
  - Young & Varner (2011) and Varner & Young (2012) look at "millionaires taxes" and high-income migration (in California and New Jersey)
    - Found little evidence of tax-induced migration
  - Kleven, Landais, & Saez (2013) look at within-E.U. mobility of star football players in response to tax changes
    - Found strong evidence of tax-induced migration
- Large literature on non-tax determinants of migration
  - Kennan & Walker's (2011) estimate dynamic structural location choice model
  - Gabriel, Shack-Marquez, and Wascher (1993) estimate state-pair level cross-sectional model of pairwise migration as function of pairwise unemployment rate differentials.

Introduction

- Surprisingly little research on tax-induced mobility of "economically valuable" individuals
  - Jurisdictions have strong interest in attracting individuals and businesses who generate positive economic spillovers (fiscal or social)

Introduction

- This paper estimates tax-induced mobility of star scientists…
  - Surprisingly little research on tax-induced mobility of "economically valuable" individuals
  - Star scientists thought to have large positive local spillovers (Jaffe, Henderson, and Trajtenberg 2005)

- …in context of U.S. states
  - Using data on state-to-state migration of (<u>all</u>) star scientists in U.S.
  - Compute bilateral migration rates for every pair of states (50x50)
  - Identify tax effects on migration rates from within state-pair, over-time variation in pairwise tax rate differentials

Outline

- Introduction
- Data
- Some Stylized Facts
- Theoretical Framework
  - Model of Location Choice
- Estimation Results
- Conclusion

Data

We address these questions with rich compilation of data

1. Universe of U.S. patents from 1977-2010
   - Identify prolific ("star") patenters
   - Identify state of residence and state-to-state moves
   - Identify important characteristics of scientists such as corporate status of employer
   - Compute annual bilateral migration flows between pairs of states

2. Individual Income Tax Rates by Income Level, by State
   - NBER ***TaxSim***
   - ***World Top Income Database*** (Alvaredo, Atkinson, Piketty, & Saez, 2013)

3. Corporate Income Tax Rates, R&D Credit Rates, and Investment Credit Rates, by State
   - Chirinko & Wilson (2008), Wilson (2009)

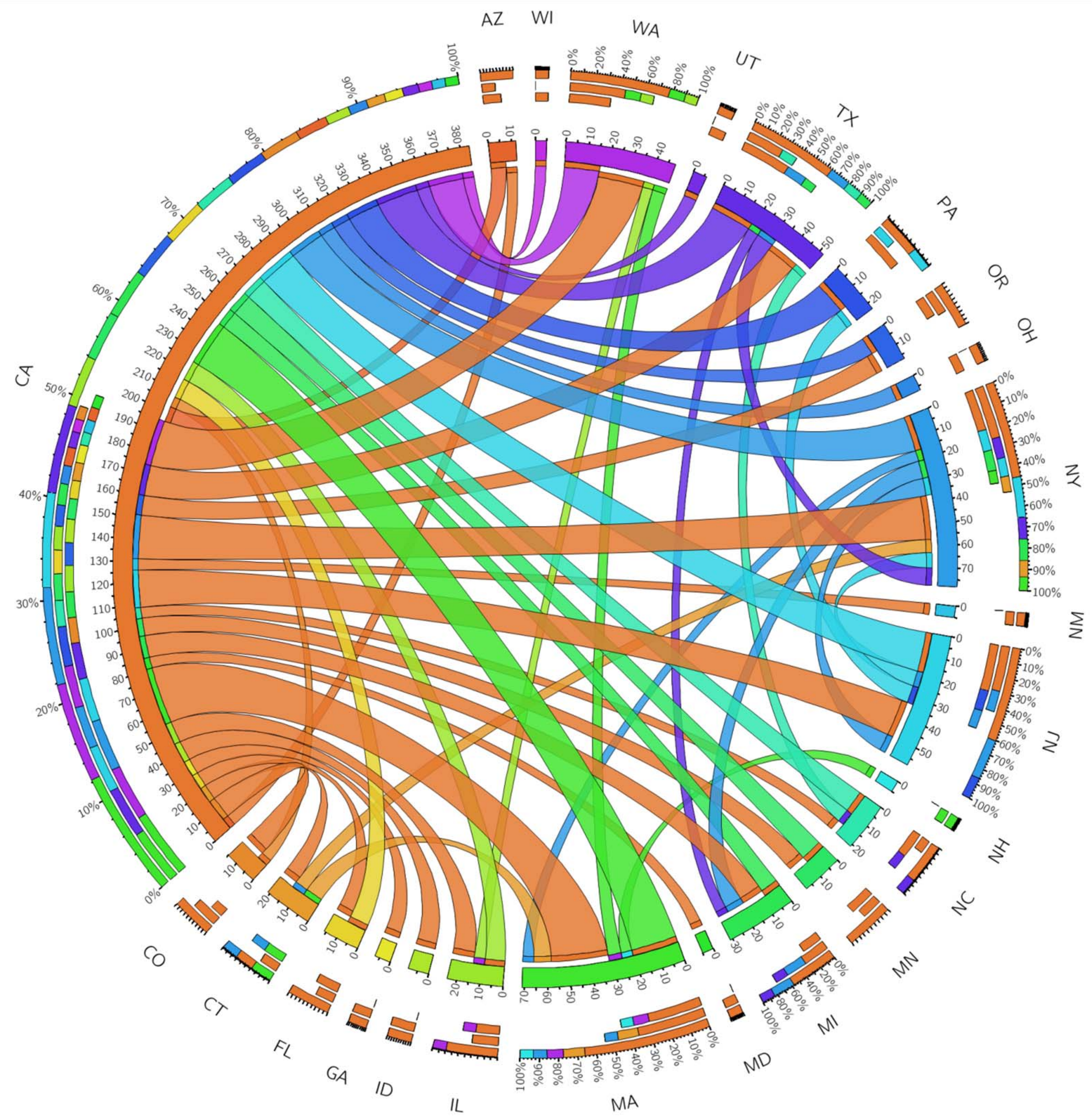
Some Stylized Facts

Basic Facts about Star Scientists

1. Define stars as scientists in top 5% of patent count over prior 10 years
   - **290,000 observations over 83,000 scientists**
     (conditional on observing *state* in both year *t* and *t+1*)

2. Mobility
   - About 4% of (top 5^{th}) star-scientist*year observations exhibit a move
   - About 6% of stars move at least once
   - Average moves per star: 0.33
   - Average moves per star, conditional on moving at least once: 2.6
   - *Not a lot of movers, but movers move a lot*

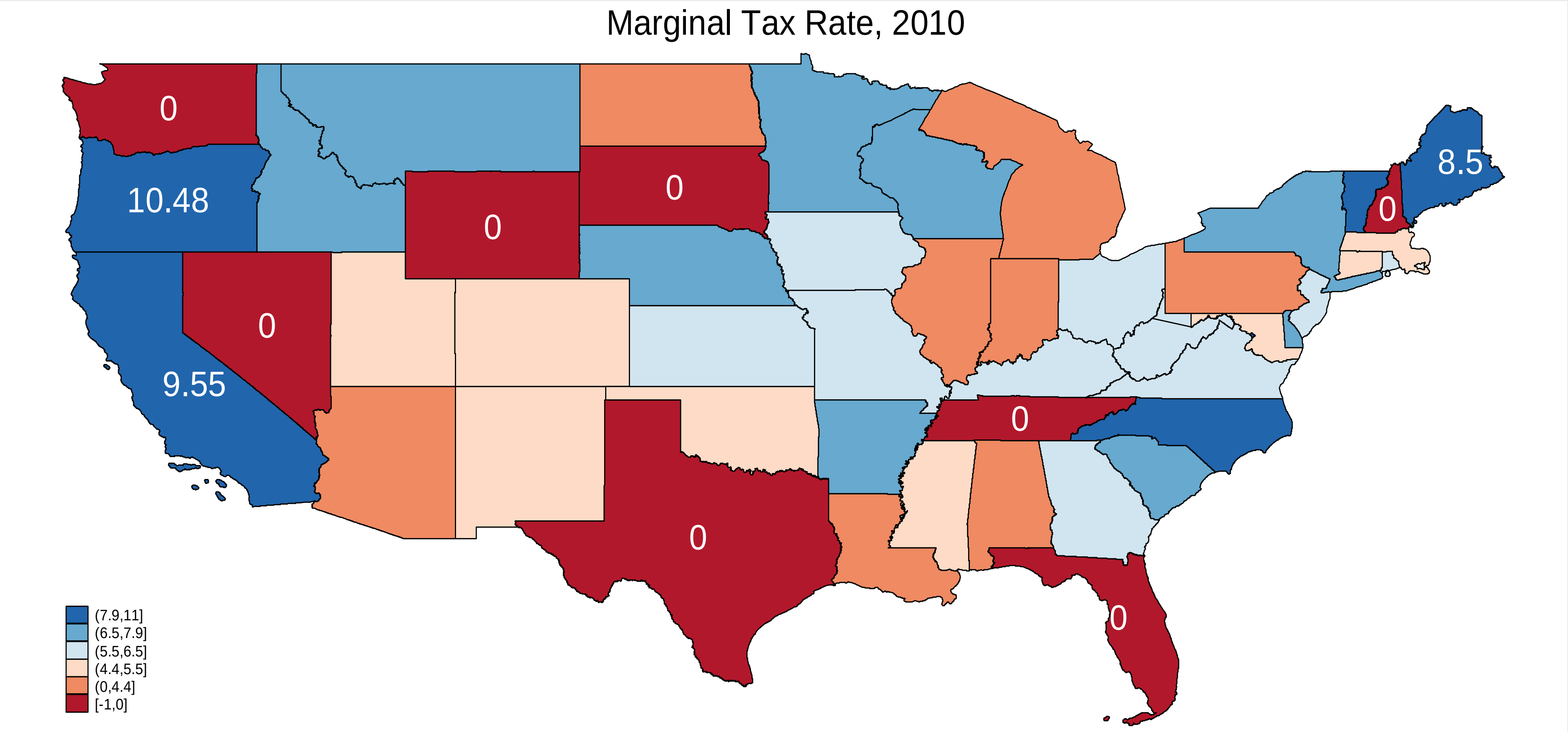
Bilateral Flows of Stars (2006)

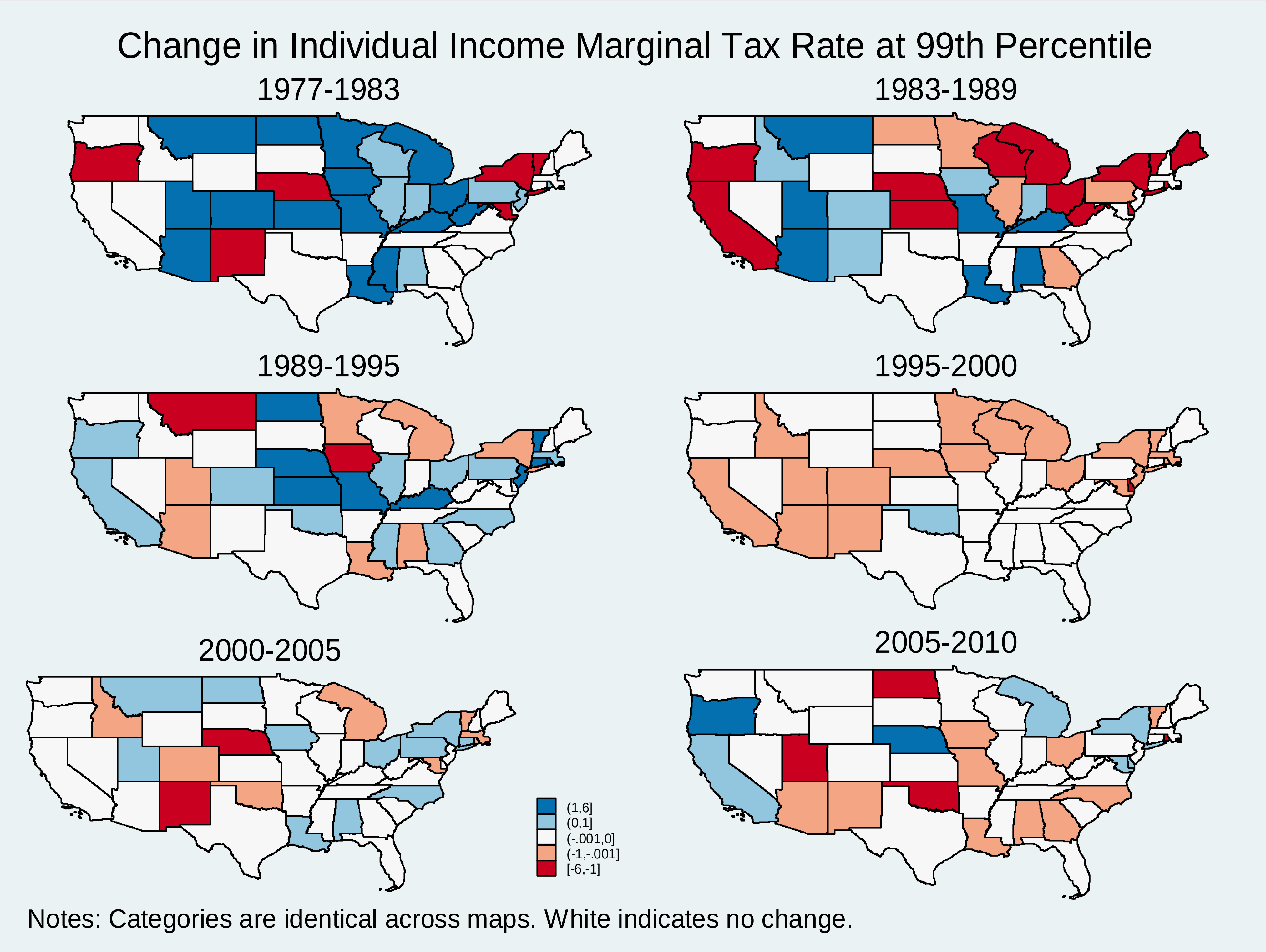


- CA accounts 1/3 of bilateral flows over 4 (or 20% of all flows)
- High-tax CA is net exporter to low-tax WA. Yet CA is net importer from low-tax TX

Cross-State Variation in Taxes

Individual Income Tax Rate for household making $365,026 (99th percentile) in 2010




Change in Individual Income Marginal Tax Rate at 99th Percentile
1977-1983
1983-1989
1989-1995
1995-2000
2000-2005
2005-2010
(1,6]
(0,1]
(-.001,0]
(-1,-.001]
[-6,-1]
Notes: Categories are identical across maps. White indicates no change.

Theoretical Framework

- Objective: Derive regression eqn at state-pair*year level
- Random Utility Model:

$$\begin{aligned} U^d_{iot} &= u[(1-\tau^d_t)w^d_{it}, \mu^d_{iot}] \\ &= \alpha s^d_o \log(1-\tau^d_t) + \alpha \log w^d_{it} + \gamma^d_o + \gamma_t + \epsilon^d_{iot} \end{aligned}$$

where s^d_o captures salience of policy in *d* relative to *o* $(s^o_o = 1)$

- Define Probability of Moving from state *o* to state *d*:

$$P^d_{iot} = \Pr(U^d_{iot} > U^x_{iot} \text{ for } x = 1 \text{ to } 50)$$

- Assuming *Independence of Irrelevant Alternatives* (McFadden 1978):

$$P^d_{iot} = exp(U^d_{iot}) / \sum_k exp(U^k_{iot})$$

Theoretical Framework

Aggregate over i to state-pair*year level (level of tax variation), measuring P_{ot}^{d} by observed bilateral migration rate.

$$P_{ot}^{d} = exp(U_{ot}^{d}) / \sum_{k} exp(U_{ot}^{k}) \ ; \ P_{ot}^{o} = exp(U_{ot}^{o}) / \sum_{k} exp(U_{ot}^{k})$$

implies ***odds-ratio***:

$$\frac{P_{ot}^{d}}{P_{ot}^{o}} = \frac{exp(U_{ot}^{d})}{exp(U_{ot}^{o})}$$

and ***log odds-ratio***:

$$\begin{aligned} \log P_{ot}^{d} / P_{ot}^{o} &= U_{ot}^{d} - U_{ot}^{o} \\ &= \alpha s \log\left(1 - \tau_{t}^{d}\right) - \alpha \log\left(1 - \tau_{t}^{o}\right) + \tilde{\gamma}_{o}^{d} + \gamma_{t} + \nu_{ot}^{d} \end{aligned}$$

Estimating Equation

$$\log P^d_{ot}/P^o_{ot} = \alpha s \log\left(1-\tau^d_t\right) - \alpha \log\left(1-\tau^o_t\right) + \tilde{\gamma}^d_o + \gamma_t + \nu^d_{ot}$$

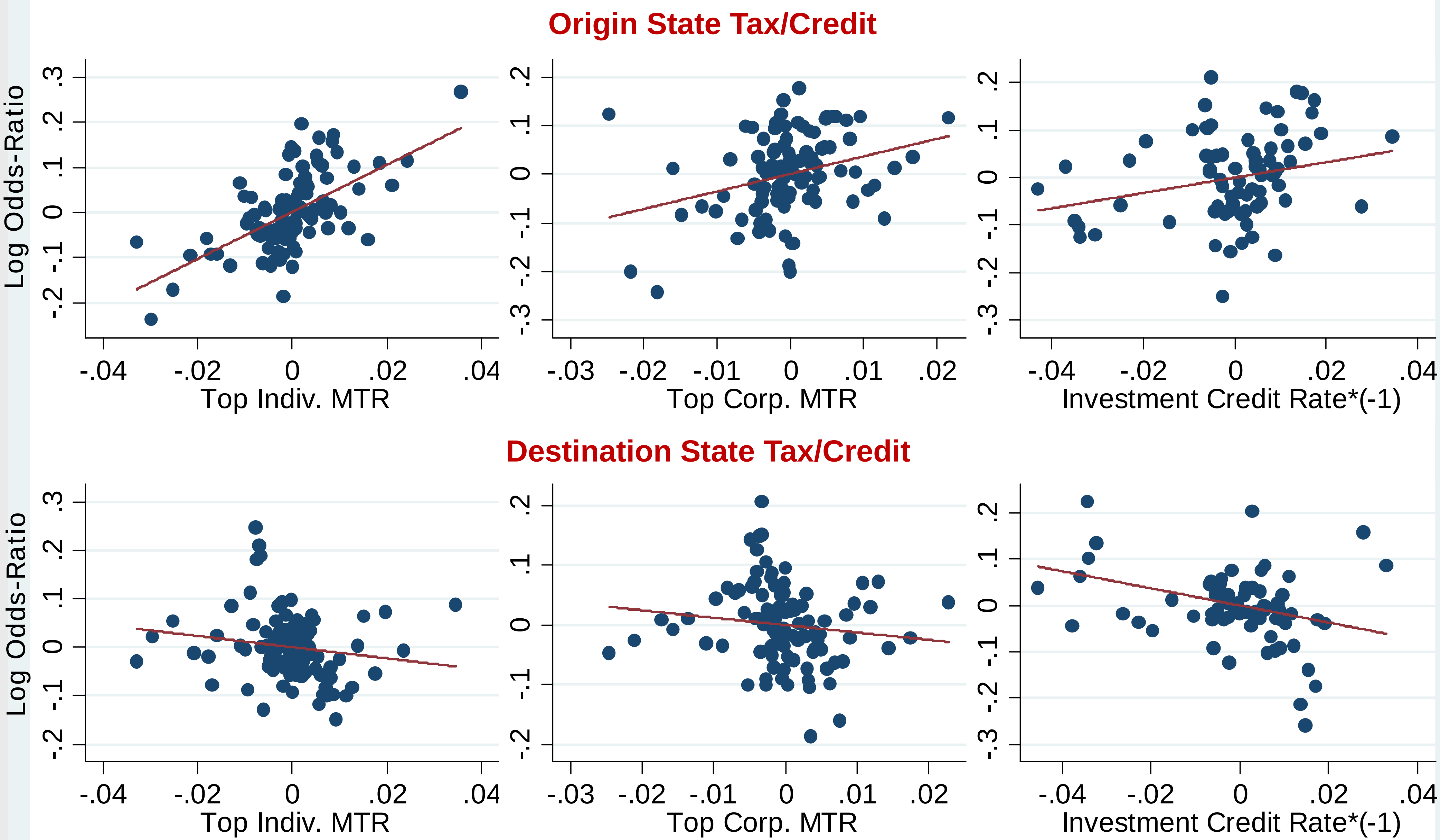
- Under perfect information/salience, $s = 1$, and equation reduces to single regressor :

  destination – origin net-of-tax rate differential

- For tax credits, $-\tau = c$
- Regression accounts for state "pair" and year fixed effects
  - Controls for amenities/characteristics of different states
- Cluster by state-pair
- Coefficients are reduced-form functions of (unobserved) labor supply and labor demand elasticities

Graphical Evidence

Out-migration Vs. Tax Rates (Net of State-Pair & Year Fixed Effects)



Notes: Points represent averages of x and y within quantile bins.
All variables demeaned of their state-pair and year means.

Baseline Regression Results

$$\log P^d_{ot}/P^o_{ot} = \alpha(k) \sum_k \boxed{\left[\log\left(1-\tau^d_t(k)\right) - \log\left(1-\tau^o_t(k)\right)\right]} + \tilde{\gamma}^d_o + \gamma_t + \nu^d_{ot}$$

	Log Odds Ratio (1)	Log Odds Ratio (2)	Log Odds Ratio (3) Origin Region*Year	Log Odds Ratio (4) Origin State	Log Odds Ratio (5) Dest. State	Log Odds Ratio (6) Region Pair*Year
MTR, 99th Perc.	2.5309***	2.4254***	1.7347***	1.6689**	3.1461***	1.6711***
	(0.4691)	(0.5005)	(0.3696)	(0.7044)	(0.8865)	(0.3464)
State CIT Rate	2.1846***	2.1828***	2.3906***	2.2003***	2.7070**	1.3492**
	(0.6716)	(0.7269)	(0.6698)	(0.7382)	(1.3045)	(0.6737)
State ITC	1.9634***	2.0270***	1.5197***	2.5678***	1.6930**	1.5256***
	(0.3989)	(0.4311)	(0.3689)	(0.5691)	(0.6880)	(0.3829)
R&D Credit	0.4250**	0.4385**	0.0502	1.2742***	-0.6182*	-0.3180*
	(0.1855)	(0.2036)	(0.1783)	(0.2914)	(0.3439)	(0.1744)
No. Observations	11475	11475	11475	11475	11475	11475
Origin & Destination State Fixed Effects	Yes	No	No	No	No	No
Origin*Destination Pair Fixed Effects	No	Yes	Yes	Yes	Yes	Yes
State*Year Fixed Effects	No	No	No	Yes	Yes	No

- Higher Destination-Origin Net-of-Tax Differential $\longrightarrow$ Higher Origin-to-Destination Migration

Individual Income MTR, Top-End vs. Median

	Log Odds Ratio (1)	Log Odds Ratio (2)	Log Odds Ratio (3)	Log Odds Ratio (4) Origin Region*Year	Log Odds Ratio (5) Origin State	Log Odds Ratio (6) Dest. State
MTR, 50th Perc.	-0.0594	-0.2133	0.4130	-1.2976*	0.9662	0.5833
	(0.6786)	(0.7327)	(0.5410)	(0.7439)	(1.1303)	(0.5539)
MTR, 99th Perc.	3.6206***	3.5246***	2.0880***	2.7213**	4.4479***	1.7832***
	(0.7066)	(0.7579)	(0.5770)	(1.1080)	(1.1718)	(0.5528)
No. Observations						
Origin & Destination State Fixed Effects	Yes	No	No	No	No	No
Origin*Destination Pair Fixed Effects	No	Yes	Yes	Yes	Yes	Yes
State*Year Fixed Effects	No	No	No	Yes	Yes	No

- Only High-Income Net-of-Tax Rate Matters for Star Scientists

Corporate Income MTR, Corp vs. Non-corp

	Log Odds Ratio (1) Full Sample	Log Odds Ratio (2) Excluding Firm-Based Stars
MTR, 99.9th Perc.	2.8785***	1.3415**
	(0.5027)	(0.5957)
MTR, 99th Perc.	2.6980***	1.3902**
	(0.5170)	(0.6025)
MTR, 95th Perc.	2.6811***	1.0515*
	(0.5212)	(0.6033)
MTR, 50th Perc.	1.6461***	-0.0409
	(0.6357)	(0.5616)
State CIT Rate	2.4772***	1.0283
	(0.6899)	(0.8982)
State ITC	2.1736***	1.8271***
	(0.4564)	(0.4994)
R&D Credit	0.5382**	0.6502***
	(0.2247)	(0.2476)

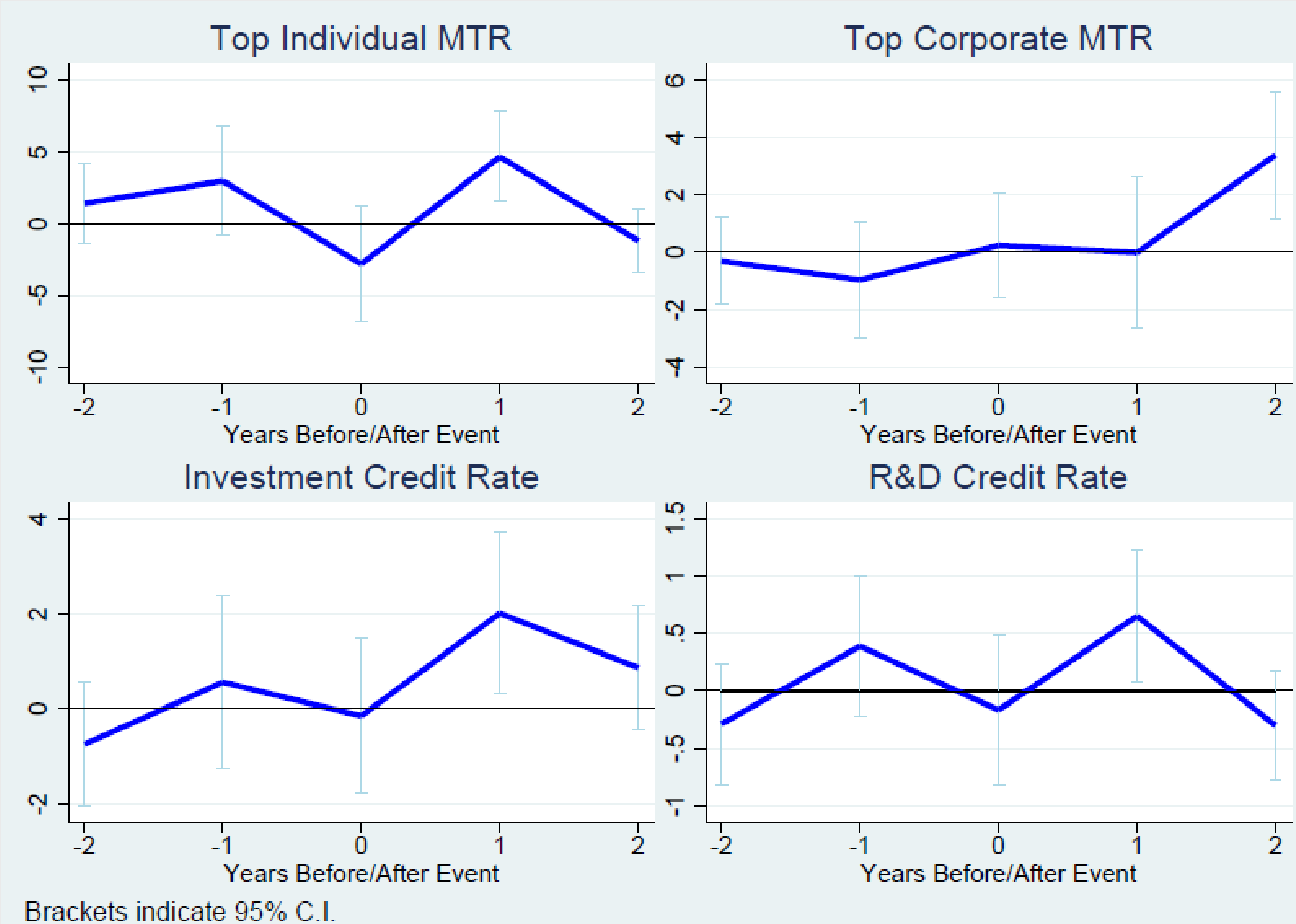
- Corporate Tax Matters for corporate stars, but not for non-corporate stars

Dynamic Specifications: Effect seen at t+1 or t+2

$$\log P^d_{ot}/P^o_{ot} = \sum_{j=-2 \text{ to } 2} \alpha^j [\log(1-\tau^d_{t-j}) - \log(1-\tau^o_{t-j})] + \tilde{\gamma}^d_o + \gamma_t + \nu^d_{ot}$$

Dynamic Specifications: Effect seen at t+1 or t+2

$$\log P_{ot}^{d}/P_{ot}^{o} = \sum_{j=-2 \text{ to } 2} \alpha^{j}[\log(1-\tau_{t-j}^{d}) - \log(1-\tau_{t-j}^{o})] + \tilde{\gamma}_{o}^{d} + \gamma_{t} + \nu_{ot}^{d}$$



Dynamic Specifications: Effect seen at t+1 or t+2

$$\log P^d_{ot}/P^o_{ot} = \sum_{j=-2 \text{ to } 2} \alpha^j [\log(1-\tau^d_{t-j}) - \log(1-\tau^o_{t-j})] + \tilde{\gamma}^d_o + \gamma_t + \nu^d_{ot}$$

Brackets indicate 95% C.I.

Asymmetric Effects of Origin vs. Destination

$$\log P_{ot}^{d}/P_{ot}^{o} = \sum_{k}[\alpha(k)s\log(1-\tau_t^d(k)) - \alpha(k)\log(1-\tau_t^o(k))] + \tilde{\gamma}_o^d + \gamma_t + \nu_{ot}^d$$

	Log Odds Ratio (1)	Log Odds Ratio (2)	Log Odds Ratio (3) Origin Region*Year	Log Odds Ratio (4) Region Pair*Year
MTR, 99th Perc. Origin	-3.9020***	-3.4439***	-1.8819**	-2.0127***
	(0.8124)	(0.8817)	(0.7711)	(0.7500)
MTR, 99th Perc. Destination	1.1168	1.3441	1.6581**	1.3062*
	(0.7317)	(0.8347)	(0.7641)	(0.7847)
State CIT Rate - Origin	-3.2780***	-3.1000**	-2.8234**	-2.8975**
	(1.1481)	(1.2740)	(1.2278)	(1.1847)
State CIT Rate - Destination	0.9722	1.1568	1.6806*	-0.2979
	(0.9456)	(1.0443)	(0.9506)	(1.0914)
State ITC - Origin	-2.2237***	-1.9177***	-0.6896	-0.7092
	(0.6067)	(0.6530)	(0.7141)	(0.7334)
State ITC - Destination	1.7227***	2.1188***	2.1617***	2.2989***
	(0.6179)	(0.7042)	(0.5975)	(0.5997)
R&D Credit - Origin	0.1225	0.4216	1.3737***	1.3112***
	(0.3010)	(0.3360)	(0.3224)	(0.3084)
R&D Credit - Destination	0.9593***	1.2880***	1.2239***	0.6531**
	(0.3010)	(0.3474)	(0.3261)	(0.3184)

- For taxes (Indiv. and corp.), origin more salient; for credits, destination more salient

Robustness

Baseline results robust to:

- Alternative Definitions of Stars: Top 10%, Top 1%
- Alternative Patent Database applying disambiguation algorithm to scientist names (Li, et al. 2014)
- Weighting observations by (origin) state population
- Cluster by destination*year & origin*year
- Dropping post-2006 observations

Conclusion

- Taxes (& Credits) Matter
  - Both Personal Taxes and Business Taxes
  - Both Taxes and Credits: Investment Credits and R&D Credits
- Tax Progressivity Matters
  - Star scientists very sensitive to marginal tax rate on high income, insensitive to marginal tax rate on median income.
- Corporate Taxes Only Matter for Corporations
  - Migration of star scientists who work for corporations is sensitive to corporate income tax
  - migration of non-corporate scientists insensitive to corporate income tax
- Push vs Pull
  - For taxes, push (origin tax) effect is bigger than pull (destination tax) effect
  - For credits, pull effect is bigger

Still To Come

- Estimate tax elasticity separately for stars who:
  - Switch employers vs. stay with same employer (between *t* and *t+1*)
  - Multi- vs. single-state firms
- Full Logit estimation of destination choice
  - Interact taxes with individual characteristics (scientific field, productivity/patent-count, distance, etc.)

Extra Slides

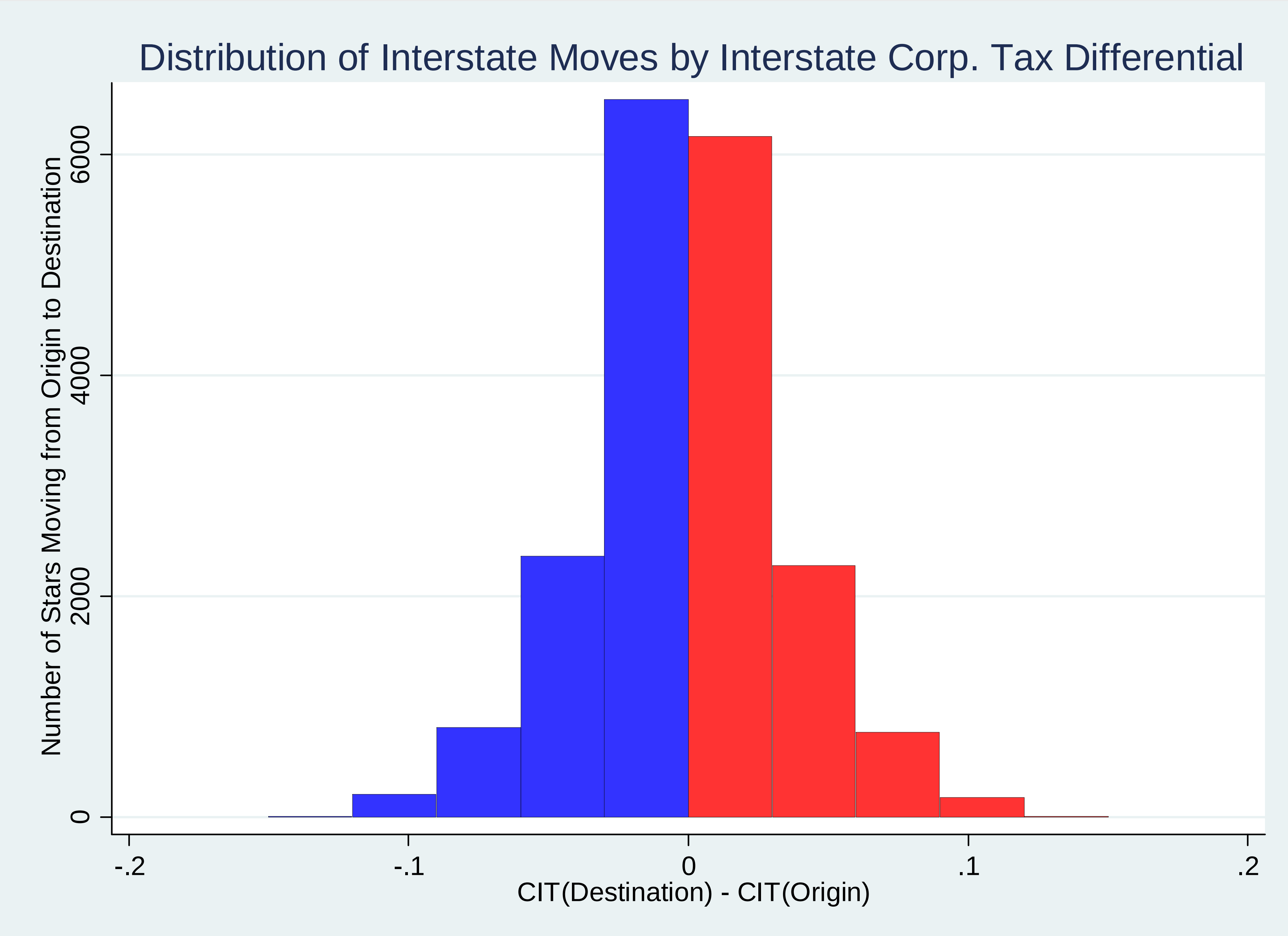
Robustness

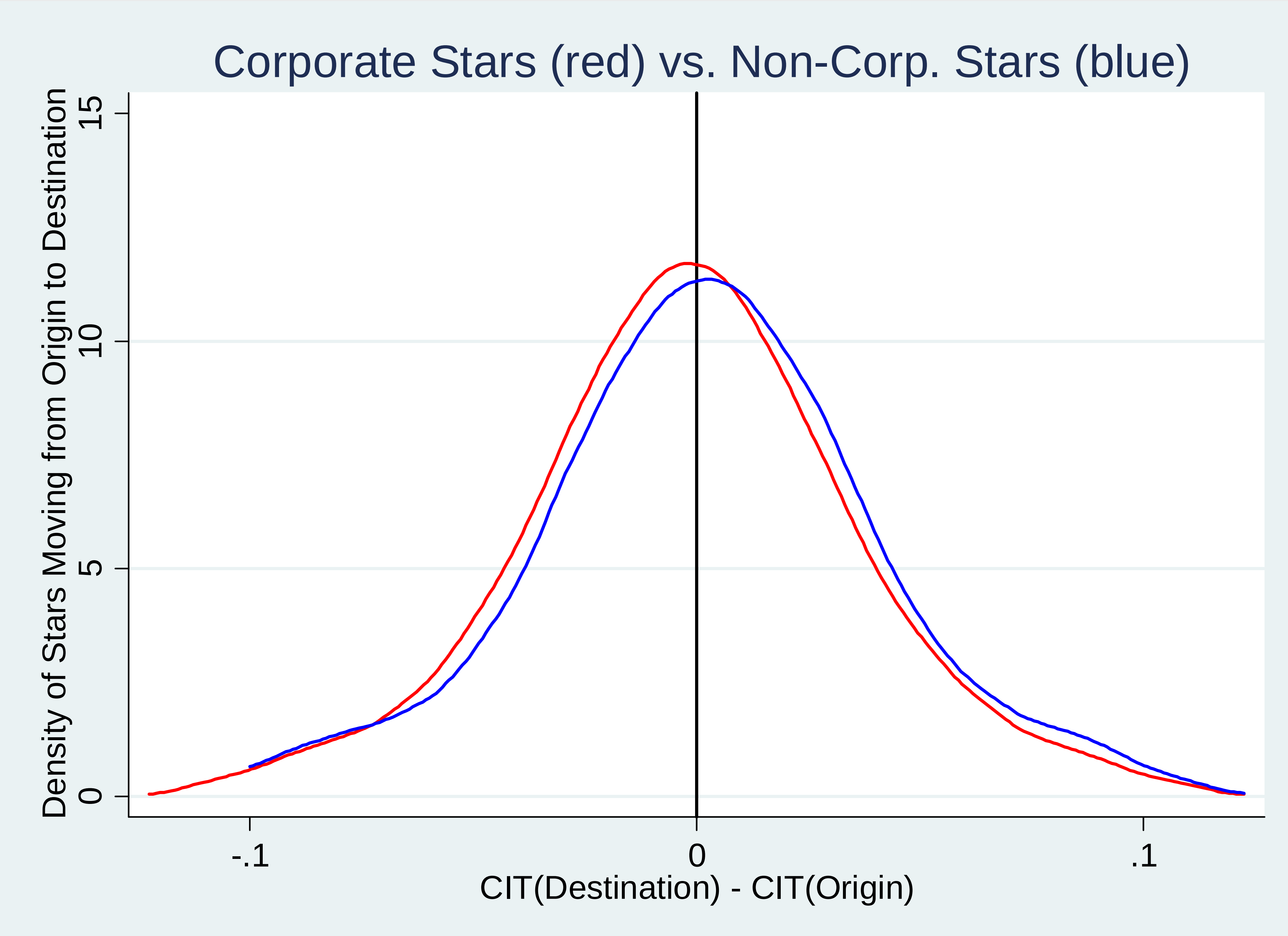
	Log Odds Ratio (1) 95 perc. Stars	Log Odds Ratio (2) 99 perc. Stars	Log Odds Ratio (3) 90 perc. Stars	Log Odds Ratio (4) Weighted by 1977 State Pop.	Log Odds Ratio (5) Through 2006 Only	Log Odds Ratio (6) Disambiguation Data Set
MTR, 99.9th Perc.	2.8785***	4.4607***	2.6193***	2.5356***	2.7483***	3.9293***
	(0.5027)	(0.7576)	(0.4622)	(0.5952)	(0.5031)	(0.6144)
MTR, 99th Perc.	2.6980***	4.3100***	2.4893***	2.2988***	2.5453***	3.8580***
	(0.5170)	(0.8004)	(0.4762)	(0.6154)	(0.5152)	(0.6648)
MTR, 95th Perc.	2.6811***	4.3279***	2.4498***	2.2964***	2.5765***	3.6919***
	(0.5212)	(0.8028)	(0.4881)	(0.6321)	(0.5207)	(0.6865)
MTR, 50th Perc.	1.6461***	2.7011***	1.4589**	0.2052	1.5121***	1.8600**
	(0.6357)	(0.9080)	(0.5795)	(0.6488)	(0.6465)	(0.7611)
State CIT Rate	2.4772***	3.3926***	1.9292***	3.0445***	2.8030***	1.8203**
	(0.6899)	(1.0925)	(0.6650)	(0.7572)	(0.7575)	(0.8501)
State ITC	2.1736***	2.0801***	2.0479***	2.6135***	2.1736***	1.6139***
	(0.4564)	(0.6379)	(0.3998)	(0.6105)	(0.4564)	(0.4989)
R&D Credit	0.5382**	0.6412*	0.3980**	0.8541***	0.5264**	0.3571
	(0.2247)	(0.3827)	(0.1995)	(0.2962)	(0.2246)	(0.2633)
No. Observations	11933	6255	14157	11933	11545	7916

Alternative Tax Variables

	Log Odds Ratio (1)	Log Odds Ratio (2)	Log Odds Ratio (3) Origin Region*Year	Log Odds Ratio (4) Origin State	Log Odds Ratio (5) Dest. State	Log Odds Ratio (6) Region Pair*Year
User Cost of Capital	6.6428***	6.6837***	4.0240***	7.8452***	6.5524***	3.0406***
	(0.8363)	(0.9171)	(0.7773)	(1.3894)	(1.4697)	(0.7932)
R&D User Cost	0.2793	0.2671	0.2704*	1.3469***	-1.0850***	-0.0102
	(0.1737)	(0.1892)	(0.1548)	(0.2488)	(0.2693)	(0.1482)
ASTR, 99.9th Perc.	3.0656***	3.0702***	2.6381***	2.0468***	3.7360***	2.4819***
	(0.5326)	(0.5645)	(0.4050)	(0.7546)	(1.0012)	(0.3963)
ASTR, 99th Perc.	3.6885***	3.5917***	2.8378***	2.4522***	4.6565***	2.5853***
	(0.6071)	(0.6547)	(0.4576)	(0.8986)	(1.1277)	(0.4372)
ASTR, 95th Perc.	5.0984***	4.9491***	3.6310***	3.6187***	6.4582***	3.1667***
	(0.6977)	(0.7652)	(0.5468)	(1.0288)	(1.2912)	(0.5257)
ASTR, 50th Perc.	6.9121***	6.5517***	6.0718***	2.5100**	10.8234***	5.5426***
	(1.1430)	(1.2441)	(0.9445)	(1.0906)	(1.9156)	(0.9994)
No. Observations	11511	11511	11511	11511	11511	11511
Origin & Destination State Fixed Effects	Yes	No	No	No	No	No
Origin*Destination Pair Fixed Effects	No	Yes	Yes	Yes	Yes	Yes
State*Year Fixed Effects	No	No	No	Yes	Yes	No

More Moves from High-Tax to Low-Tax States than Vice-Versa




Corporate Stars (red) vs. Non-Corp. Stars (blue)
Density of Stars Moving from Origin to Destination
0
5
10
15
-.1
0
.1
CIT(Destination) - CIT(Origin)

But for Individual Income MTR, distribution is symmetric