Impacts of Taxes on Firm Entry along State Borders

A Pseudo-Regression Discontinuity Approach

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Introduction

Our paper studies the following two problems

- Do changes in tax and regulatory policy impact firm entry?
- Do firms have preferences for government provided amenities?

This is motivated by the following problems:

- States and counties offer tax breaks and infrastructure as promises to bring in larger firms, but do small policy changes have benefits as well?
- Does raising taxes to pay for various government services have distortionary effects?

We utilize both count data models and regression discontinuities around state borders to address this problem

Motivation Cont...

- Existing literature has used count data models, but there might exist unobserved heterogeneity in location choice that is unaccounted for.
- Most papers do not include a full array of marginal tax rates, while tax rates might be part of a comprehensive policy outline. We see this empirically as there is very strong correlations among certain tax rates leading to plausible ommitted variable bias.
- Focus tends to be on agglomeration economies, but we want to identify a pure policy effect.
- As a result, we focus primarily on utilizing a "pseudo-regression discontinuity approach."

Literature Review

- Empirical entry studies of firms (Gabe and Bell (2004), Brulhart et al (2012)) also include government expenditures into models of firm entry.
  - Gabe and Bell show that increasing taxes to pay for education seems to have no adverse effect on firm entry.
  - Brulhart et al shows no significant impact of spending on firm start up rates. But that higher agglomeration will weaken negative impacts of taxes.
- Regression discontinuities around state borders have been used to test the relative growth in employment (Holmes (1998), Dube et al (2010)) as well as firm location (Rohlin (2011)) using minimum wages and right to work status.

Theory Pt I

- Wages and capital costs are adjusted to local tax and location specific measures affecting firm level productivity. If markets are competitive firms will make zero economic profit in the long run, but demand or policy shocks leave short term profits.
- If a regime changes its taxes over time, higher production costs and lower profits exist in that county, and that market will deter a relative amount of firms from entering as firms enter and bid up prices on the other side.
- Firms make decisions based on information from the previous year, as governments might concurrently change policy along with market entry.

Theory Pt II

- Assumption 1: Period specific profit functions are shared across industries and firms, and can be represented by a linear function;

$$\pi_{i,j,t} = Z_{i,t-1}\beta_i + X_{i,t-1}\beta_1 + Z_{j,t-1}\beta_j + X_{j,t-1}\beta_2 + \epsilon_{i,j,t} \qquad (1)$$

- i indexes location, j indexes regime, and t is time period.

Theory Pt III

Let us focus on an interval $[-1, 1]$, where if $i \in [-1, 0)$, i is in regime A, and if $i \in [0, 1]$, i is in regime B. Then, contingent on firms first choosing to move into one of two locations $y \in [-1, 0)$ and $\hat{y} \in [0, 1]$ then the choice of a new entrant to prefer y over $\hat{y}$ is;

$$\begin{aligned} E[\pi_{y,A,t} - \pi_{\hat{y},B,t}] = Z_{y,A,t-1}\beta_y - Z_{\hat{y},B,t-1}\beta_{\hat{y}} + (X_{y,A,t-1} - X_{\hat{y},B,t-1})\beta_1 \\ + Z_{A,t-1}B_A - Z_{B,t-1}\beta_B + (X_{A,t-1} - X_{B,t-1})\beta_2 > 0 \end{aligned}$$

Assumption 2: $Z_{i,t-1}, \beta_i$ is continuous locally around the discontinuity
Assumption 3: $X_{j,t-1} \neq X_{j',t-1}, \quad \forall j' \neq j$
Assumption 4: $\beta_j = 0, \quad \forall j$ Then we see that as $y, \hat{y} \rightarrow 0$ the choice becomes;

$$E[\pi_{y,A,t} - \pi_{\hat{y},B,t}] = (X_{A,t-1} - X_{B,t-1})\beta_2 > 0$$

Empirical Outline

Our empirical framework is developed as follows:

- Discussion of data
- Count data models
- Issues in count data models
- Regression discontinuity technique
- Robustness checks:
  - Fixed effects
  - Test if coefficients are the same on either side of the border
  - Test if coefficients are stable across time

Data

- Total number of firm start ups in every continental US county
- Seven different state top marginal tax rates
  - property, income, capital gains, sales, corporate, workers compensation, unemployment insurance
- State right to work status and minimum wage
- Log state expenditures per capita on education, highways, and welfare
- Scaled county geographic amenities
- Additional (state level) Controls: County level real fuel prices, pct with high school education, population density, pct unionized, pct manufacturing

Count Data Models

Conditional logit estimation for our profit function morphs into Poisson models of the number of firm entry under as long as choice-specific parameters are shared between all firms (Guimaraes, Figueirido, and Woodward (2003)). Therefore, we can estimate a poisson model

$$ln(E[n_{ijt}|X_{j,t-1}]) = X_{j,t-1}\beta \tag{2}$$

$$\implies E[n_{ijt}|X_{j,t-1}] = \exp(X_{j,t-1}\beta)$$

We further estimate both a negative binomial, which allows for variance to extra degrees of freedom.

Count Data Model Results

	Dependent variable:	
	births	
	Poisson	*negative binomial*
	(1)	(2)
ptax	17.938***	−8.138***
	(0.114)	(2.060)
inctax	0.022***	0.059***
	(0.0004)	(0.006)
capgntax	−0.019***	−0.075***
	(0.0003)	(0.005)
salestax	−0.003***	−0.016***
	(0.0003)	(0.006)
corptax	0.025***	0.034***
	(0.0002)	(0.003)
wctaxfixed	−0.102***	−0.147***
	(0.001)	(0.019)
uitaxrate	3.662***	4.308***
	(0.050)	(0.893)
educ_pc_L1	0.0003***	−0.0002***
	(0.00000)	(0.0001)
hwy_pc_L1	−0.001***	−0.001***
	(0.00001)	(0.0001)
welfare_pc_L1	−0.00001***	−0.0004***
	(0.00000)	(0.00004)
Observations	34,166	34,166
Log Likelihood	−7,984,035.000	−202,773.900
θ		0.620*** (0.004)
Akaike Inf. Crit.	15,968,114.000	405,591.800
Note:		*p<0.1; **p<0.05; ***p<0.01

Issues with Count Data Models

- The full model should be

$$ln(E[n_{i,j,t}|X_{i,j,t}]) = Z_{i,t-1}\beta_i + X_{j,t-1}\beta_2 \tag{3}$$

- We only estimated

$$ln(n_{i,j,t}) = X_{j,t-1}\beta_j + v_{i,j,t}$$

$$v_{i,j,t} = X_{i,t}\beta_i + \epsilon_{i,j,t}$$

- For Poisson distribution, we need

$$E[v_{i,j,t}] = 0 \implies E[X_{i,t}\beta_i] = 0$$

- As a result of this our count data models may not be properly identified by either omitted variable bias or unobserved location specific heterogeneity.

Regression Discontinuity Design pt I

By matching county pairs that are close together we are able to properly account for location specific terms

- Proxy distance from the border by matching two counties on either side of a state border, denoting them *sub* and *nbr* arbitrarily.
- From our theory we show how the location effect drops out as we approach the border
- Controls for the unobserved local effect heterogeneity
- We estimate for each pair of matched counties, indexed by j

$$
\begin{aligned}
ln(\ddot{n}_{j,t}) &= \ddot{x}_{j,t-1}\beta_2 + \ddot{\epsilon}_{j,t} \qquad (4)\\
ln(\ddot{n}_{j,t}) &= ln(n_{sub,t}) - ln(n_{nbr,t})\\
\ddot{x}_{j,t-1} &= x_{sub,t-1} - x_{nbr,t-1}\\
\ddot{\epsilon}_{j,t} &= \epsilon_{sub,t} - \epsilon_{nbr,t}
\end{aligned}
$$

Regression Discontinuity Design pt II

- We have G state-pairs, which are borders where two states meet.
- We see each state-pair N_g times each year, once for each matched county-pairs
- and we have T time periods
- Assuming from (4)

$$E[\ddot{X}_j' \ddot{\epsilon}_j] = 0 \tag{5}$$

we get the POLS estimator

$$\hat{\beta} = \left(\frac{1}{TG} \sum_{t=1}^{T} \sum_{g=1}^{G} \ddot{x}_{g,t-1}' \ddot{x}_{g,t-1} \right)^{-1} \left(\frac{1}{N} \sum_{t=1}^{T} \sum_{g=1}^{G} \sum_{i=1}^{N_G} \ddot{x}_{g,t-1}' \ddot{l}n(n_{i,g,t}) \right) \tag{6}$$

$$N = T(\sum_{g=1}^{G} N_G) \tag{7}$$

Regression Discontinuity Design pt III

- For (5) we need that states do not change policy with respect to firm entry. There seems no *a priori* reason to assume that governments care more about one border pair over any other, unless they may be systemically having problems with all of their neighbors at once.
- We might have a border-pair specific effect remaining in $\epsilon_{i,j,t}$, even if (5) holds. Thus we use clustered standard errors.

RD Results

	Dependent variable:	
	births_ratio	
	(1)	(2)
ptax_diff	−0.204	−0.370**
	(0.151)	(0.151)
inctax_diff	−0.092***	−0.083***
	(0.027)	(0.027)
capgntax_diff	0.015	0.007
	(0.024)	(0.024)
salestax_diff	−0.115***	−0.103***
	(0.029)	(0.029)
corptax_diff	0.022	0.017
	(0.020)	(0.020)
wctax_diff	0.004	0.091
	(0.111)	(0.111)
uitax_diff	0.970	1.315
	(4.023)	(4.023)
educ_pc_L1_diff	−0.0002	−0.0003
	(0.0002)	(0.0002)
hwy_pc_L1_diff	0.0004	0.0004
	(0.0004)	(0.0004)
welfare_pc_L1_diff	0.001**	0.001**
	(0.0002)	(0.0002)
amenities	yes	no
Note:	*p<0.1; **p<0.05; ***p<0.01	

Controls drop out besides for real fuel price, which has a positive and strongly significant impact on firm start ups.

Sensitivity Tests Pt I: Fixed Effects

	Dependent variable: births_ratio
	births_ratio
ptax_diff	-0.247^{***}
	(0.088)
inctax_diff	0.107^{***}
	(0.027)
capgntax_diff	0.001
	(0.012)
salestax_diff	-0.024
	(0.017)
corptax_diff	0.054^{***}
	(0.017)
wctax_diff	0.009
	(0.054)
uitax_diff	1.883
	(1.643)
educ_pc_L1_diff	0.0002
	(0.0002)
hwy_pc_L1_diff	0.00002
	(0.0002)
welfare_pc_L1_diff	0.0002
	(0.0001)
Observations	12,071
Log Likelihood	$-21{,}237.570$
Akaike Inf. Crit.	42,505.140
Bayesian Inf. Crit.	42,616.120
Note:	$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Sensitivity Tests Pt II: Stability of Terms over Time

	Dependent variable:			
	births_ratio			
	Year: 1999	Year: 2003	Year: 2006	Year: 2009
ptax_diff	-0.258^{**}	-0.279^{*}	-0.292	-0.500^{***}
	(0.131)	(0.144)	(0.204)	(0.159)
inctax_diff	-0.086^{***}	-0.084^{**}	-0.135^{***}	-0.090^{***}
	(0.025)	(0.034)	(0.046)	(0.027)
capgntax_diff	0.001	-0.038	0.060	0.052^{**}
	(0.023)	(0.032)	(0.041)	(0.023)
salestax_diff	-0.144^{***}	-0.143^{***}	-0.102^{***}	-0.047
	(0.028)	(0.033)	(0.035)	(0.036)
corptax_diff	0.013	0.051^{*}	0.013	-0.007
	(0.018)	(0.028)	(0.019)	(0.020)
wctax_diff	-0.011	-0.240	0.206^{*}	-0.130
	(0.130)	(0.187)	(0.110)	(0.127)
uitax_diff	-1.839	2.320	-4.916	5.352
	(3.989)	(5.196)	(6.032)	(6.249)
educ_pc_L1_diff	0.0002	-0.0005	0.0001	-0.001^{**}
	(0.0003)	(0.0004)	(0.0002)	(0.0004)
hwy_pc_L1_diff	-0.0001	0.0003	0.0004	0.0004
	(0.0005)	(0.001)	(0.001)	(0.0005)
welfare_pc_L1_diff	0.001^{***}	0.001^{***}	0.001^{*}	0.001
	(0.0003)	(0.0002)	(0.0004)	(0.0004)
Note:				*p$<$0.1; **p$<$0.05; ***p$<$0.01

Sensitivity Tests Pt III: Stability of Terms Across Borders

Table : F tests for Coefficient Equality

Test of Coefficient Equal but Opposite	F - test	Significant
property tax sub = - property tax nbr	0.06	
inc tax sub = - inc tax nbr	1.55	
cap gains tax sub = - cap gains tax nbr	0.63	
sales tax sub = - sales tax nbr	3.44	
corp tax sub = - corp tax nbr	0.37	
work comp sub = - work comp nbr	4.23	*
ui tax sub = - ui tax nbr	1.65	
min wage sub = - min wage nbr	2.57	
educ sub = - educ nbr	2.45	
hwy sub = - hwy nbr	0.98	
welfare sub = - welfare nbr	2.08	

Sensitivity Tests Pt IV: Stability across Business Types

Table : Pseudo-RD Base for Ag, Forestry, Fishing, & Hunting

	Dependent variable:	
	(1)	(2)
ptax_diff	−0.202	-0.369^{**}
	(0.150)	(0.150)
inctax_diff	-0.093^{***}	-0.084^{***}
	(0.027)	(0.027)
capgntax_diff	0.018	0.010
	(0.024)	(0.024)
salestax_diff	-0.112^{***}	-0.101^{***}
	(0.028)	(0.028)
corptax_diff	0.024	0.020
	(0.020)	(0.020)
wctax_diff	−0.003	0.085
	(0.109)	(0.109)
uitax_diff	0.814	1.009
	(4.001)	(4.001)
educ_pc_L1_diff	−0.0002	−0.0003
	(0.0002)	(0.0002)
hwy_pc_L1_diff	0.0004	0.0003
	(0.0004)	(0.0004)
welfare_pc_L1_diff	0.001^{**}	0.001^{**}
	(0.0002)	(0.0002)
amenities	yes	no

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table : Pseudo-RD Base for Manufacturing

	Dependent variable:	
	(1)	(2)
ptax_diff	−0.204	−0.368**
	(0.152)	(0.152)
inctax_diff	−0.090***	−0.081***
	(0.027)	(0.027)
capgntax_diff	0.014	0.006
	(0.024)	(0.024)
salestax_diff	−0.111***	−0.100***
	(0.029)	(0.029)
corptax_diff	0.022	0.018
	(0.020)	(0.020)
wctax_diff	0.007	0.094
	(0.110)	(0.110)
uitax_diff	0.864	1.064
	(4.035)	(4.035)
educ_pc_L1_diff	−0.0002	−0.0002
	(0.0002)	(0.0002)
hwy_pc_L1_diff	0.0004	0.0003
	(0.0004)	(0.0004)
welfare_pc_L1_diff	0.001**	0.001**
	(0.0002)	(0.0002)
amenities	yes	no
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table : Pseudo-RD Base for Retail Trade

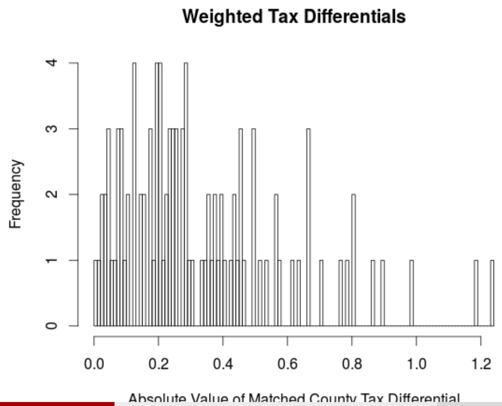
	Dependent variable:	
	(1)	(2)
ptax_diff	−0.191	−0.353**
	(0.152)	(0.152)
inctax_diff	−0.090***	−0.082***
	(0.027)	(0.027)
capgntax_diff	0.014	0.005
	(0.024)	(0.024)
salestax_diff	−0.116***	−0.105***
	(0.029)	(0.029)
corptax_diff	0.023	0.018
	(0.020)	(0.020)
wctax_diff	0.003	0.089
	(0.111)	(0.111)
uitax_diff	1.109	1.438
	(4.004)	(4.004)
educ_pc_L1_diff	−0.0002	−0.0003
	(0.0002)	(0.0002)
hwy_pc_L1_diff	0.0004	0.0003
	(0.0004)	(0.0004)
welfare_pc_L1_diff	0.001**	0.001**
	(0.0002)	(0.0002)
amenities	yes	no
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table : Pseudo-RD Base for Insurance & Finance

	Dependent variable:	
	(1)	(2)
ptax_diff	-0.206	-0.374^{**}
	(0.152)	(0.152)
inctax_diff	-0.093^{***}	-0.085^{***}
	(0.027)	(0.027)
capgntax_diff	0.017	0.009
	(0.024)	(0.024)
salestax_diff	-0.116^{***}	-0.106^{***}
	(0.029)	(0.029)
corptax_diff	0.022	0.017
	(0.020)	(0.020)
wctax_diff	0.004	0.092
	(0.110)	(0.110)
uitax_diff	1.074	1.258
	(4.084)	(4.084)
educ_pc_L1_diff	-0.0002	-0.0002
	(0.0002)	(0.0002)
hwy_pc_L1_diff	0.0004	0.0003
	(0.0004)	(0.0004)
welfare_pc_L1_diff	0.001^{**}	0.001^{**}
	(0.0002)	(0.0002)
amenities	yes	no
Note:	$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$	

Some Comparisons

We calculate the weighted tax differential. This is taken by multiplying our estimates for the impacts of taxes on firm start up rates. We then take the absolute value of this, to get an idea on the distribution of tax differentials imposed on the borders around states.



Some Comparisons Pt II

Finally, we can rank average difference in firm start up rates and tax differential. Surprisingly we see that in the top 10 difference in mean start up rates along a state border, most of them share the same sign as the tax differential. Overall throughout our RD designs though, we find relatively low R^2 values.

Table : Mean Firm Start Ups v Weighted Tax Differential

Mean Firm Starts up	State Pair	Start up Favors	Tax Differential Favors
1.642965	Oklahoma - Texas	Texas	Oklahoma
1.621283	New Mexico - Texas	New Mexico	New Mexico
1.548548	Illinois - Missouri	Missouri	Missouri
1.546172	Alabama - Georgia	Alabama	Alabama
1.435885	California - Nevada	Nevada	Nevada
1.307654	Indiana - Kentucky	Kentucky	Kentucky
1.257129	North Carolina - South Carolina	South Carolina	South Carolina
1.251866	Oregon - Washington	Oregon	Oregon
1.233235	North Carolina - Virginia	Virginia	Virginia
1.208313	North Carolina - West Virginia	North Carolina	West Virginia

Conclusion

Going back to our original two research questions, we see that:

- Property, sales, and income taxes across most specifications besides for our interaction term regressions.
- Property tax rates have a relatively high elasticity, where a 1% increase in relative property tax rates corresponds to a 0.49% decrease in relative firm start up rates.
- This may be due to many firms being small, and so individuals on one side of the border (with preferential government expenditures) can start up a business in the neighboring county. No good explanation for stability across naics subfields.
- Government expenditures on infrastructure, welfare, and education does not seem to impact firm start up rates

Future Work or Extensions

- Can we find ways to proxy or estimate location specific heterogeneity? Calculating agglomeration figures for every county as a first attempt, county level tax rates (very hard to get). Etc.
- Testing coefficients as we get further away from the border (match counties on opposite ends of the state, test for state fixed effects, etc). Currently in the works!
- Run estimator over sub samples of counties of different sizes as a way to better control for "distance."

Thank you for your time!