

Trading and Enforcing Patent Rights

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Motivation (1/2)

Market for innovation (patent licensing/sale) is an important source of *ex ante R&D incentives*, especially for small firms & innovative entrepreneurs and potentially for *ex post* efficiency through reallocation of rights (Arora, Fosfuri & Gambardella, 2001; Gans, Hsu & Stern, 2002)

But growing concern in academic/policy debates that patent transactions deter innovation if they occur to extract rents through litigation, not for technology transfer (FTC Report; Supreme Court)

Disagreement among economists and legal scholars about the scope and severity of this problem (Mann, 2005; Lemley & Shapiro, 2007)

Despite its importance, **there are no large scale empirical studies** of the impact of the market for patents on patent litigation

Motivation (2/2)

Research Question: How does the market for innovation affect patent litigation? What does this teach us about the sources of gains from trade?

Possible countervailing effects:

- ❑ **Commercialization gains:** raise value, thus increase litigation risk
- ❑ **Enforcement gains:** reallocating patents to owners better at settling disputes without courts reduces litigation risk (this hypothesis is novel)

Which effect is empirically stronger? Does it depend on the nature of the patent and the transacting parties?

A third controversial motivation for patent transactions – “trolling”

- ❑ **Patent trolling** increases litigation risk
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Empirical Challenge

- Big challenge is endogeneity of trade
 - + shock to value of technology: trade ↑ and litigation ↑
 - + shock to litigation cost: trade ↑ (enforcement gains), litigation ↓

Identification strategy:

- Exploit a provision in the US tax law: for individuals, profits from patent sales are taxed as *capital gains* while damage awards are taxed as ordinary income
 - State and time variation in capital gain tax rates allow us to identify the causal effect of trade on litigation (not possible for corporations)
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Key Findings

1. Capital gains tax rates strongly affect patent trading
 2. Changes in patent ownership reduce *on average* the probability of litigation for patents originally owned by individuals
 3. But effects are heterogeneous: direction and magnitude of the effect depends on characteristics of the patent and the buyer in the transaction
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Model of Trading and Litigation: Implications

- ❑ Patentee chooses between selling a patent or litigating a probabilistic suit (with settlement). Profit from sale taxed as capital gains, settlement value as personal income, and buyer proceeds as corporate income.
 - ❑ *Likelihood of trade* increases in the person income tax rate, and decreases in corporate and capital gains tax rates
 - ❑ *Likelihood of litigation* does not depend on (capital gains) taxes
 - ❑ If *product market (commercialization) gains* from trade dominate, patent trade increases litigation. If *enforcement gains* dominate, patent trade decreases litigation
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Data (1/3)

Focus on individually-owned patents: either (a) owned by original inventor at grant date or (b) assigned to U.S. individuals

Trade Data: USPTO Patent Assignment Database to identify transfers from re-assignments (Serrano, 2010). Info on buyer, seller and date of private agreement between parties. Data covers period 1983-2001

Strong incentives to record – U.S. Patent Act: *assignment protects owner against previous unrecorded interest*

Conservative approach to identifying re-assignments: drop assignments recorded at grant date, transfers to financial institutions, etc. as in Serrano (2010). Also drop if evidence that seller is inventor working for buyer.

Data (2/3)

Litigation Data: patents litigated 1975-2000 (Lanjouw & Schankerman, 2001, 2004) -- all patent cases in US federal district courts (not appeals)

Tax Data: NBER TAXSIM Data -- Income and Capital Gains tax rates by year and state for a “representative” household

Statutory corporate tax rates manually collected from Significant Features of Fiscal Federalism (1982-1995) and Book of the States (1996+)

For each patent we construct combined (State + Federal) income and capital gains tax rates in state of individual assignee (or primary inventor)

Corporate tax rates linked to patents: (a) weighted average of all states (weights=applications in tech-class) and (b) only assignee state

Data (3/3)

Focus on first trade: subsequent owners are generally not individuals (only 5% of transactions dropped)

Final panel: 299,356 patents and 2,436,649 observations (patent-age), years 1983-2000

Capital Gains Tax Rates			
Period	Mean	Min.	Max.
1982-1986	21.4	20	27
1987-1991	31.6	28	37
1992-1996	32.4	28.9	37
1997-2001	26.9	21.2	40.3

ANOVA: 89% variation is over time and 11% variation across states

Trade and Litigation Rates

	Patents Not Traded	Patents Traded
Patents Not Litigated	284,281	13,038
Patents Litigated	1,468	569

4.55% of sample patents are traded and 0.69% are litigated

4.2% of traded patents are litigated

27.9% of litigated patents are traded

Citations and Trade and Litigation Rates

			Corporate Patents	
		Individually Owned	Small Firms	All Other Firms
Patent Citations Received				
All Patents		5.9	7.3	7.3
Traded Patents		10.3	10.8	9.3
Rate of Trade and Litigation (in percentage)				
Trade rate		4.7	16.1	12.2
Trade rate weighted by cites		32.2	35.4	18.3
Annual Litigation rate		1.2	1.6	0.3
Number of Patents		204,592	236,776	496,284

Econometrics (1/2)

Linear Probability regression model:

$$Litigated_{it} = \alpha NewOwner_{it} + \mu_i + \lambda_\tau + a_t + u_{it}$$

$Litigated_{it} = 1$ if at least one suit is filed involving patent i at age t

$NewOwner_{it} = 1$ if patent i is not owned by original inventor at age t

a_t, λ_τ = age and time-period effects

μ_i = patent fixed effects

α effect of trade on litigation

Econometrics (2/2)

$$Litigated_{it} = \alpha NewOwner_{it} + \mu_i + \lambda_\tau + a_t + u_{it}$$

α = impact of change in (unobserved) ownership characteristics on patent litigation

If we observed all characteristics of the owner that affect litigation, $\alpha = 0$

If (a) unobservable owner characteristics affect litigation and (b) trade reallocates patents to entities with different characteristics, $\alpha \neq 0$

Trade and Litigation: Correlations

Dependent Variable	Litigated	Litigated	Litigated
NewOwner	0.0039*** (0.0003)	-0.0025*** (0.0004)	-0.0019*** (0.0004)
Age Effects	NO	NO	YES
Time Period Effects	NO	NO	YES
Patent Fixed Effects	NO	YES	YES
Obs.	2,436,649	2,436,649	2,436,649

Similar results for smaller sample of traded and litigated patents

Hausman test rejects random effects

Rivers-Vuong rejects the exogeneity of NewOwner

Endogeneity of Trade: Instrumenting

Potential bias if unobservables are correlated both with litigation and new ownership (e.g., positive shock to innovation value increases litigation and trade)

Require an instrument that affects trade but not litigation directly. We use variation in capital gains tax rates across states and over time as IV.

U.S. Internal Revenue Code:

- ❑ **patent transfer** treated as an asset sale, taxed as **capital gains**
- ❑ **patent litigation damages** taxed as **ordinary personal income**

This distinction *does not* apply to patent sales by corporations

Impact of Taxes on Patent Trading

	Probit – Marg. Eff. X 1000	Linear Prob. Model- Coeff. X 1000
DEP VARIABLE	Trade	Trade
Capital Gains Tax Rate	-0.204** (0.09)	-0.313*** (0.121)
Income Tax Rate	0.133** (0.06)	0.196** (0.09)
Corporate Tax Rate	-0.063** (0.03)	-0.147*** (0.05)
Citations Received	0.061*** (0.01)	0.187*** (0.04)
Age, Year, Tech dummies	YES	YES

We drop all observations that follow first change in ownership

Similar results in smaller sample of patents that are both traded and litigated

Findings on Impact on Taxation

- Elasticity of the probability of trade with respect to the capital gains tax rate = -1.62
 - Elasticities for the personal income tax rate and corporate tax rate are 1.22 and -0.77
 - For patents that are litigated and traded, we still find a negative and significant coefficient for capital gains tax rates
 - Similar results with a proportional hazard model to explain timing
 - With patent fixed effects, similar results but only capital gains tax rate is statistically significant
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Taxes and corporate patent transfers

- **Placebo test**: capital gains and personal income tax rates **should not** affect corporate transfers
 - Simple extension of our model: higher corporate income taxes should reduce the transfer of corporate patents
 - We exploit data constructed by Graham (1996) for Compustat firms -- a simulated, firm-specific marginal tax rate that approximates the "true" tax variable managers use in their decisions
 - Tax data cover period 1980-2010, we matched it with sample of large corporate innovators from Serrano (2010)
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Impact of Taxes on Corporate Patent Trading

	1	2	3
Estimation Method	OLS	OLS	OLS
Dependent Variable	Trade	Trade	Trade
	Coefficients x 10 ³	Coefficients x 10 ³	Coefficients x 10 ³
Corporate Tax Rate	-0.882** (0.340)	-0.883** (0.340)	-0.883** (0.344)
Capital Gains Tax Rate		0.107 (1.512)	0.104 (1.514)
Income Tax Rate		-0.565 (1.540)	-0.565 (1.540)
Patent Citations Received			0.019 (0.033)
Patents	150,511	150,511	150,511
Observations	806,366	806,366	806,366

Instrumental Variable Estimation

Construct the probability that a patent is traded at age t as function of capital gains taxes, Z , $\hat{p}_{it} = p(Z_{it})$

The probability that patent i is not owned by the original assignee at age t is

$$\hat{P}_{it} = \hat{P}_{it-1} + (1 - \hat{P}_{it-1})\hat{p}_{it}$$

\hat{P}_{it} is a non-linear estimate of $E[\text{NewOwner} | Z, X]$

2SLS with \hat{P}_{it} as IV identifies the effect of a change in patent ownership on litigation under the constant-effect assumption.

2SLS Estimates

Dependent Variable	Litigated	Litigated
NewOwner (instrumented)	-0.012** (0.005)	-0.011** (0.004)
Age Effects	YES	YES
Time Period Effects	YES	YES
Patent Fixed Effects	YES	YES
Observations	2,436,649	2,436,649
Instrument	\hat{P} from Probit	\hat{P} from OLS

2SLS estimates are 10 times larger than OLS correlations

Endogeneity generates huge downward bias (i.e., negative correlation between u and NewOwner)

Robustness of 2SLS Estimates

- Results robust to inclusion of income and corporate taxes
 - Results robust to controlling for macroeconomic variables (e.g. income per capita at the state level)
 - Similar results in smaller dataset using only patents assigned to individuals at grant date (not subsequently)
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Heterogeneous Effects

Extend econometric model and allow for different effects of trade:

$$Litigated_{it} = \alpha_{it} NewOwner_{it} + \mu_i + \lambda_\tau + a_t + u_{it}$$

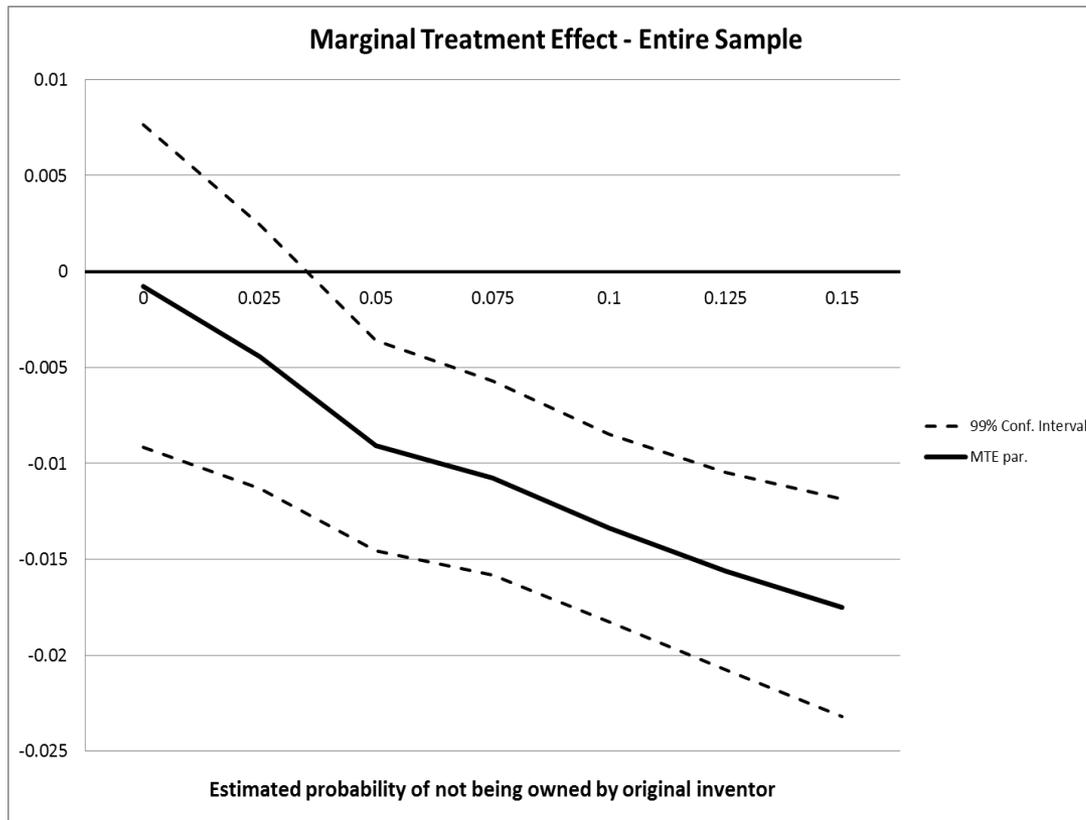
where $\alpha_{it} = \bar{\alpha} + \psi_{it}$ is decomposed into common and random component

Using Carneiro, Heckman & Vytlacil (E'metrica, 2010), we estimate the Marginal Treatment Effect:

$$E(\bar{\alpha} + \psi_{it} | P(X_{it}, Z_{it}))$$

MTE captures the heterogeneous effect of trade on litigation for patents that are traded because of a change in capital gains tax rate

Marginal Treatment Effect



Efficient reallocation: patents with larger enforcement gains have the highest probability of changing ownership

Sorting: patents with low P are more likely to be in transactions where *commercialization gains dominate*, those with high P are transactions with *enforcement gains dominate bite*

Unbundling the MTE

Need transaction characteristics. Buyer names in assignment data are not standardized, manual match is required (traded/litigated patents)

Two new variables:

LargeBuyer =1 if buyer has at least 8 patents (in 20-year window)

Hypothesis: *enforcement gains* are greater when LargeBuyer=1
(Lanjouw & Schankerman, 2004)

TechFit=1 if acquired patent is in technology area in which buyer has more patents

Hypothesis: *product market gains* are larger when patent is a good match for technology profile of the buyer

Role of Portfolio Size and Patent Fit

	Linear Probability Regression
NewOwner	-0.238*** (0.081)
NewOwner x LargeBuyer	-0.365* (0.196)
NewOwner x TechFit	0.461*** (0.137)
Age Dummies	YES
Time Period Dummies	YES
Patent Fixed Effects	YES
Observations	6810

Patents traded to ***small entities with high fit*** experience an ***increase*** in litigation rate

Patents traded to ***large buyers with low fit*** experience a ***reduction*** in litigation rate

Similar results in a variety of robustness checks (see paper for details)

Larger Sample

- Standardize names of patent buyers and USPTO assignees and match two datasets, exploiting algorithm by Thoma et al. (2010)
 - We match buyers to USPTO assignees by constructing a score based on overlap in name strings. The Algorithm classifies buyers as "unmatched" if no USPTO assignee name matches buyer name with score above 0.3 (this is a conservative procedure)
 - We identify assignees for 8,123 out of 13,607 traded patents (about 59 percent)
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Portfolio Size and Patent Fit: Larger Samples

Estimation Method	2SLS	2SLS	2SLS	2SLS
Dependent Variable	Litigation Dummy	Litigation Dummy	Litigation Dummy	Litigation Dummy
NewOwner	-0.040*** (0.013)	-0.021*** (0.008)	-0.012*** (0.005)	-0.009** (0.004)
NewOwner x LargeBuyer	-0.075** (0.036)	-0.079** (0.032)	-0.086*** (0.033)	-0.092*** (0.033)
NewOwner x TechFit	0.024*** (0.006)	0.013*** (0.004)	0.007** (0.003)	0.006** (0.003)
Sample	Matching Score=100%	Matching Score>75%	Matching Score>50 %	Matching Score>30 %
Observations	29161	46333	74457	89585
Patents	2570	4139	6654	8123

Product Market Gains or Patent Trolls?

- Unbundling showed positive association between trade and litigation only for patents traded to small entities with high-fit (consistent with product market gains). An alternative explanation is that the patents in this sub-sample are acquired by small, specialized patent assertion entities

 - We look at industry specialization, serial buyers, and serial litigants
 - No industry specialization in Small-Buyer/High-Fit sub-sample
 - Observed increase in Small-Buyer/High-Fit sub-sample is not driven by serial buyers
 - Observed increase is not driven by a few serial litigants

 - We find no evidence that the increase in litigation is driven by patent trolls in our data, but this may change in more updated sample
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Simulated Tax Effects on Trade and Litigation

We use the parameter estimates to simulate alternative tax scenarios over the lifetime of 1000 patents

	Income Tax Rate	Capital Gains Tax Rate	Sales per 1000 patents	Suits per 1000 patents
Baseline	42.6	29.2	56.9	35.8
Low Tax	42.6	20.0	92.5	23.1
Tax Parity	42.6	42.6	26.4	45.5

Summary of Findings and Conclusions

- ❑ Taxes strongly affect the re-allocation of patent rights. This is an important lesson for encouraging entrepreneurial innovation.
 - ❑ On average, reallocation of individually-owned patents reduces litigation risk. Market looks “efficient”: Estimated likelihood of trade is largest where the gains are largest.
 - ❑ Effects of trade on litigation are heterogeneous: gains (enforcement or commercialization) depend on transaction characteristics.
 - ❑ A well-functioning innovation market generates private and social gains by allocating patent rights efficiently **ex-post**, and taxation affects process. If small innovators appropriate part of these gains, this market also increases their **ex-ante** incentives to innovate.
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Thank you!

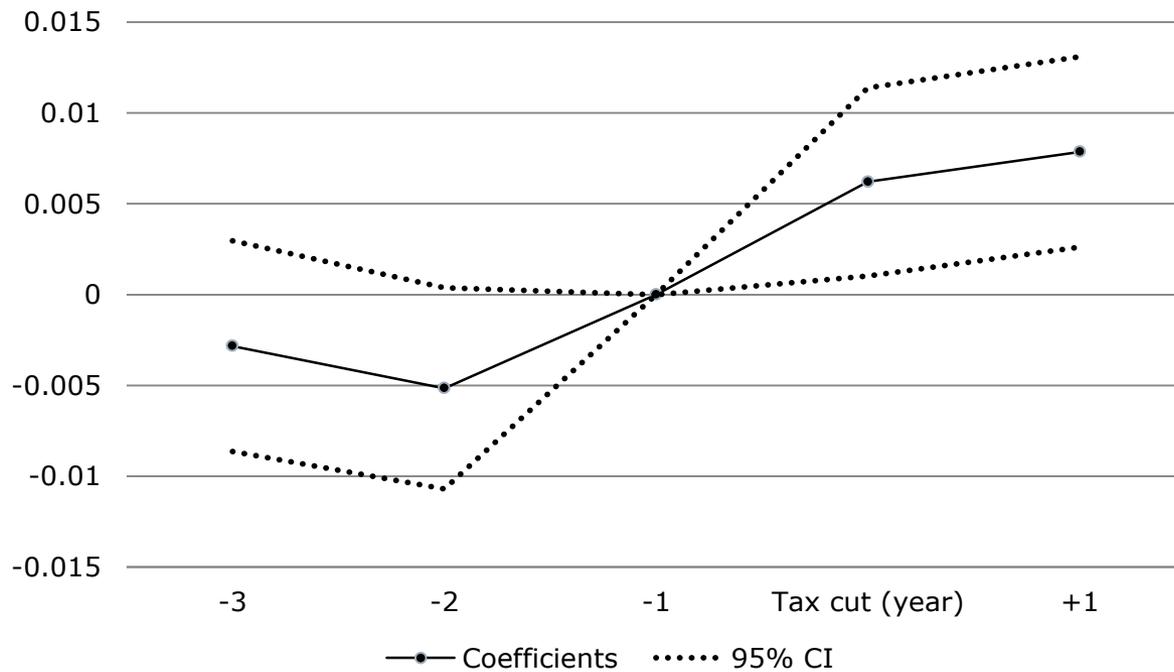
BACK UP SLIDES

Motivating evidence: Diff-in-Diff Analysis

- Over period 1982-2001, we see 268 changes in capital gains tax rates
 - Focus on 8 illustrative tax events (4 cuts/4 hikes) that are both sizeable (top quartile of the distribution) and not confounded by other tax changes within a six-year window
 - Diff-in-Diff: compare changes in trade rates between individually and corporate owned patents before and after the tax change. Done separately for tax cuts and tax hikes (other controls included).
 - Both for tax and hikes, we find a large average effect: the change in trade probability is about 80 percent of mean
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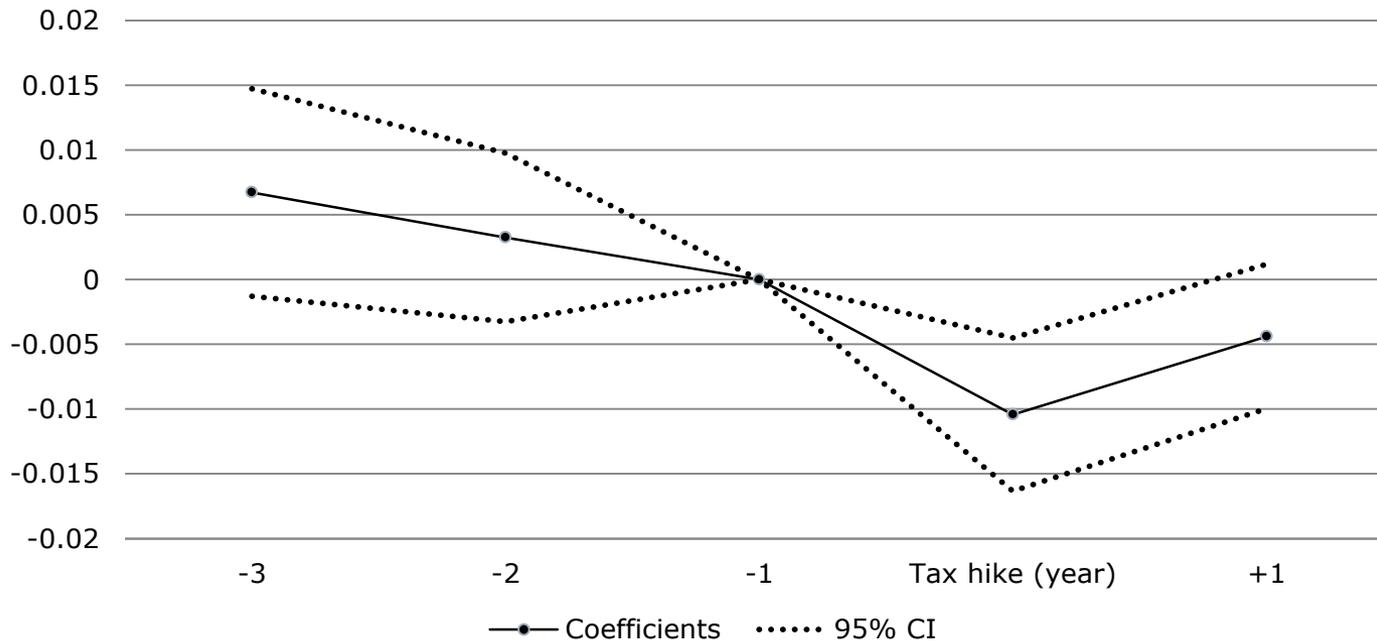
Motivating Evidence (2)

Figure 2.1: Impact of a Capital Gains Tax Cut



Motivating Evidence (3)

Figure 2.2: Impact Capital Gains Tax Hike



Local Average Treatment Effect

Heterogeneous responses likely in our setting since transactions may be related to commercialization and/or enforcement gains.

Thus we estimate the **local average treatment effect**: the average effect of an ownership change for patents trades induced by a change in capital gains taxes

2SLS differs from LATE when there are covariates and/or continuous instruments (Angrist & Imbens, 2005; Lileeva & Trefler, 2010)

We generate alternative IV: **HighDiff** dummy=1 if difference between income rates and capital gain rates is "large". Once dummy=1, it remains equal to 1.

Dummy IV + dummy covariates: procedure in Angrist & Imbens (2005) allow us to estimate LATE

LATE Estimation

Dependent Variable	NewOwner	Litigated	Litigated
HighDiff (19 points cutoff)	0.009*** (0.001)	-	-
<i>NewOwner</i> (instrumented)	-	-0.033*** (0.011)	-0.037*** (0.010)
Age Effects	YES	YES	YES
Time Period Effects	YES	YES	YES
Patent Fixed Effects	YES	YES	YES
Instrument	-	HighDiff (19 points)	HighDiff (15 points)

Findings

- LATE point estimates are about three times larger than 2SLS estimates, but not statistically different
 - LATE estimates imply a **reduction** in annual litigation rate of about **32%** for patents at “risk” of trading
 - Similar results for smaller sample of patents traded and litigated
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