The Crafting of Intellectual Property

Implications for Trolls, Litigation, and Innovation

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*It is critically important that the USPTO issues patents that are both **correct** and **clear**. [It] can help **stimulate future innovation** without resorting to **needless high-cost court proceedings**.*

Michelle Lee, USPTO Director

Research Questions

- How much does the patent system affect innovation?
  - –> Patents: a mix of idea and legal construction
  - –> Examiners are involved in construction process
    - An understudied channel
  - –> Lee: examination quality affects both **litigation** and **innovation**
    - If effects are big: USPTO as a policy lever (vs. statutory reform)
- How responsive are non-practicing entities (NPEs) to the legal construction of patents?
  - –> Accusation: purchasers and enforcers of weak patents ("needless court proceedings")
  - –> Do they purchase patents granted by a specific set of examiners?
  - –> If so, do these examiners tend to grant weak patents?

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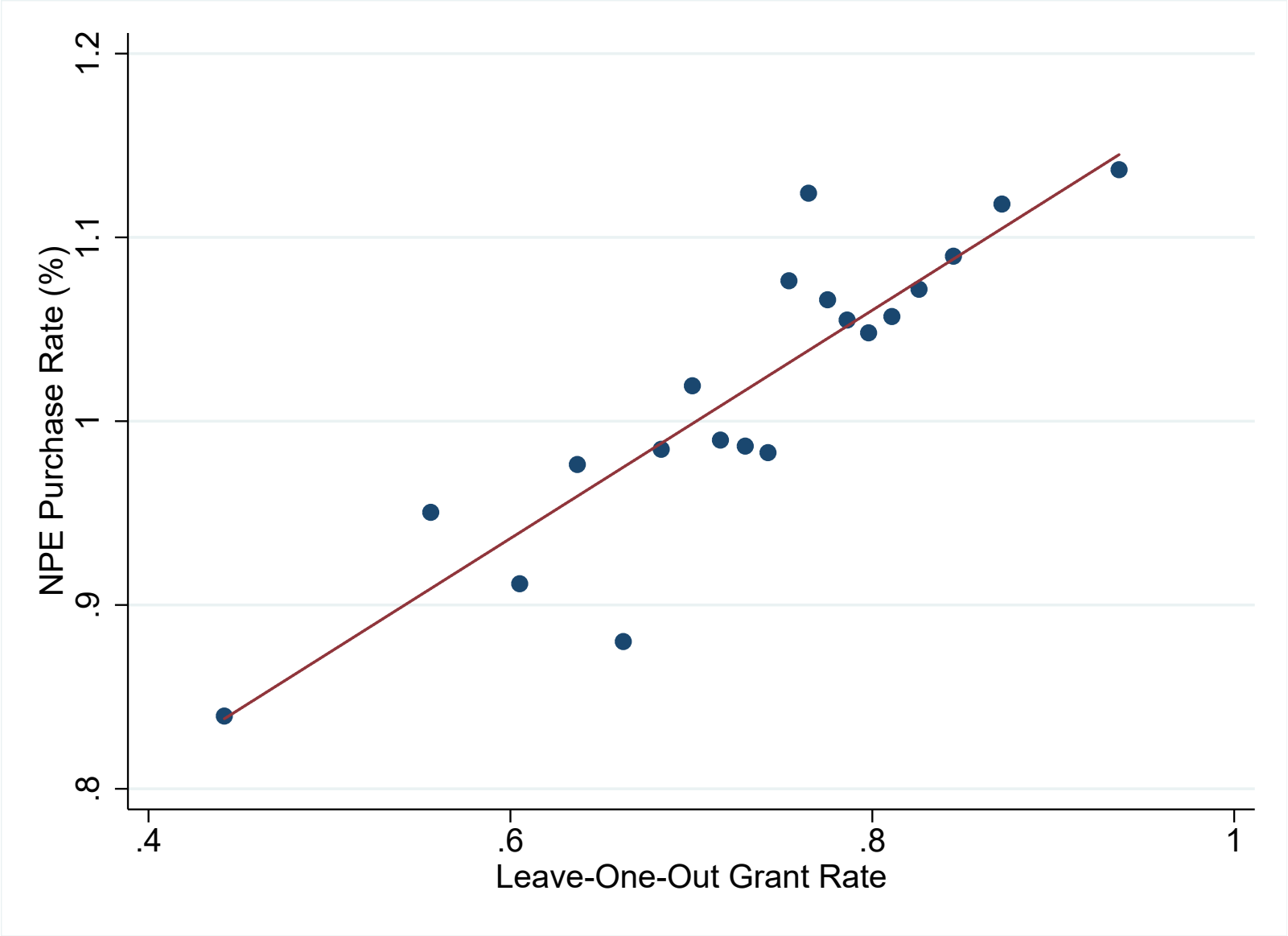
Research Design and Findings

- **Research design**: use variation across examiners in post-grant outcomes to quantify the impact of legal construction
  - –> Leverage quasi-random assignment for causal interpretation
    - Refinements: IT-only, docket instrument, random last digit units
  - –> Focus on pool of granted patents
    - Control for selection on idea quality in order to isolate legal construction variation
  - –> Use shrinkage methodology to deal with rare and noisy outcomes
- Findings
  - –> Examiners have large causal effects on important outcomes
    - NPE purchase, litigation, late-term private value, future patenting
  - –> NPE purchase, litigation very sensitive to legal construction
    - Purchase from lenient examiners who force fewer additions to claims
  - –> Lenient, high-NPE examiners grant more weak patents
    - Patents more likely to be re-issued, instituted in inter-partes review

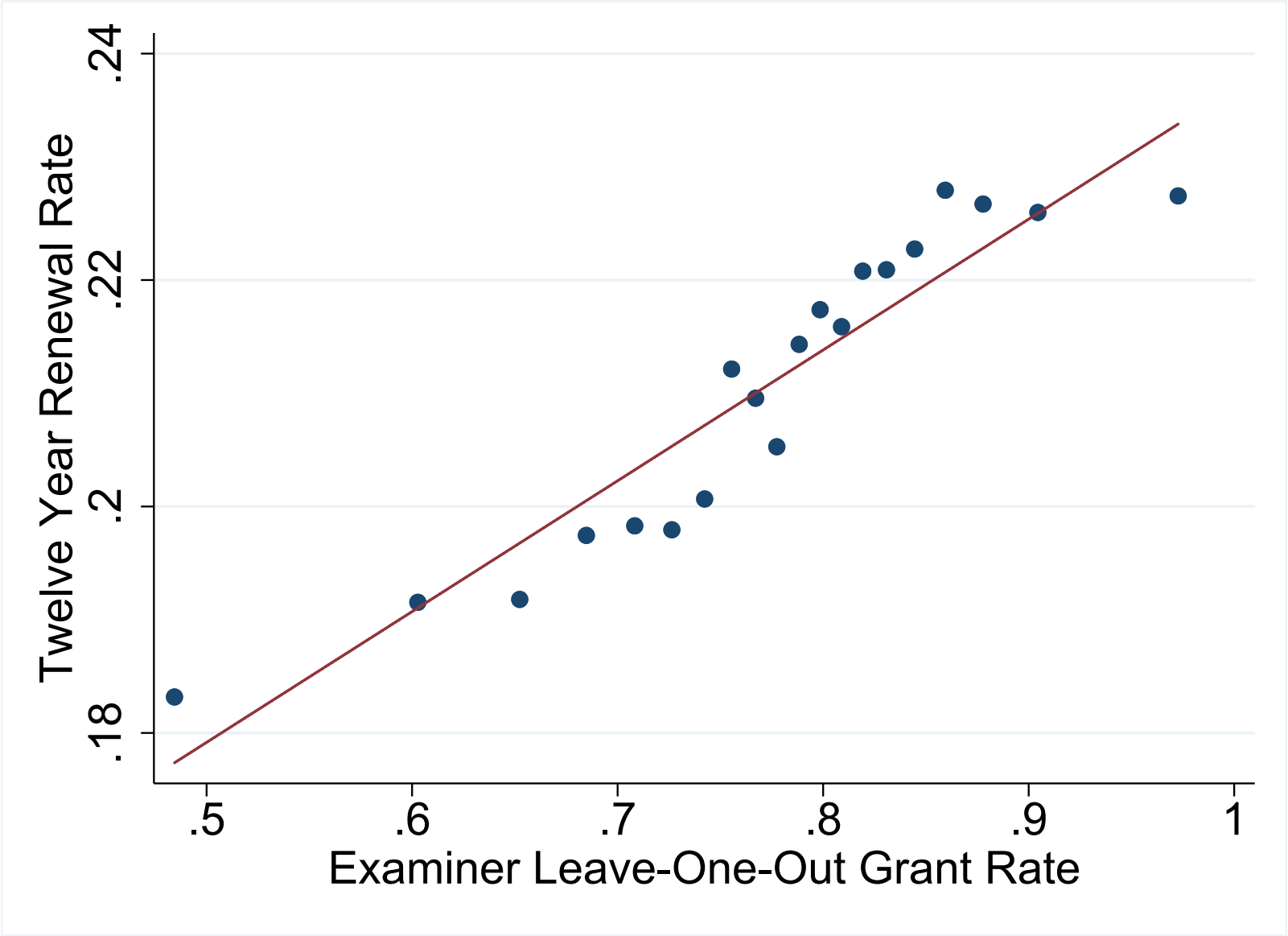
Related Literature

- Effect of patent system on innovation
  - –> Patent laws: Nordhaus (1969); Klemperer (1990); Gilbert and Shapiro (1990); Sakakibara and Branstetter (2001); Moser (2006); Lerner (2009)
  - –> Patent grants: Williams and Sampat (2016); Farre-Mensa, Hegde and Ljungqvist (2017); Righi and Simcoe (2017)
  - –> Patent scope: Kuhn, Roin and Thompson (2016), Kuhn (2016)
  - –> *This paper: effect of patent examination process*
- NPEs and innovation
  - –> Growing literature: Allison, Lemley and Walker (2009); Bessen and Meurer (2014); Tucker (2014); Cohen, Gurun and Kominers (2015)
  - –> *This paper: effect of patent examiners on NPE activities*

Simple Relationships - Examiners and NPEs



Examiners and Renewals



Road Map

1. Data

2. Estimation of Examiner Effects on Post-Grant Outcomes
   - Methodology
   - Results
   - Random Assignment and Selection

3. NPE Behavior
   - Which examiners drive the effect?
   - Weak Patents and Additional NPE Behavior

Data Overview

- Core sample
  - –> USPTO PatEx plus data on claims examiner blocking actions
    - Frakes and Wasserman; Juristat
  - –> 1.27 million non-continuation granted patents from 2001 to 2012
    - 2/3 continuation applications assigned to same examiner
  - –> 11,401 patent examiners in 643 art units
    - Average tenure: 7 years
    - Average applications reviewed per year: 16
- Subsequent outcomes
  - –> 20% of sample is **purchased** by non-NPEs
  - –> 1% of sample is **purchased** by NPEs
  - –> 0.65% of sample is **litigated** by non-NPEs

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Estimating Examiner Effects on Post-Grant Outcomes

- Quasi-random assignment $\rightarrow$ interpret post-grant outcome differences as caused by examiners
  - –> Address potential threats later (Righi and Simcoe 2017)
- Why not compare raw average outcomes across examiners?
  - –> NPE and litigation outcomes are rare
  - –> Simple approach overstates magnitudes
    - e.g. 8 times too large for NPE
- Solution: look for persistent differences across examiners
  1. Bayesian shrinkage methodology
  2. Shrink raw averages by a signal to noise ratio
- End up with estimates of the right magnitude (split sample)

Extracting Residuals

$$T_{ijt} = X_i\beta + a_{ut} + v_{ijt}$$
$$v_{ijt} = \mu_j + \epsilon_{ijt}$$

- i indexes the patent, j the examiner, u the art unit
- Data variables
  - T: outcome (e.g. NPE purchase, litigated, 103 blocking action)
  - a_{ut}: art unit-year fixed effect (**random assignment level**)
  - X_i: observable application characteristics (assignee, applicant history, number of claims at application)
- Other variables
  - μ_j: examiner causal effect
  - ϵ_{ijt}: idiosyncratic noise

Shrinkage Using the Residuals

1. Aggregate residuals at examiner x year level:

$$\bar{v}_{jt} = \frac{1}{n_{jt}} \sum_i v_{ijt} \left(= \mu_j + \frac{1}{n_{jt}} \sum_i \epsilon_{ijt} \right)$$

2. Compute correlation of residuals across years (variance of examiner effect distribution):

$$\hat{\sigma}^2_\mu = cov(\bar{v}_{jt}, \bar{v}_{j(t+1)})$$

3. For each examiner: shrink raw average residual by signal-to-noise ratio to recover estimate with **same scale** as μ_j:

$$ExaminerEffect_j = \bar{v}_j \frac{\hat{\sigma}^2_\mu}{Var(\bar{v}_j)}$$

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Causal Examiner Effects on Post-Grant Outcomes

Outcome	$\hat{\sigma}_\mu$/Baseline Rate
NPE Purchase	50.97% [33.7%, 60.7%]
Non-NPE Litigation	62.1% [42.62%, 71.99%]
Non-NPE Purchase	14.01% [10.70%, 14.47%]

Causal Examiner Effects on Post-Grant Outcomes

Outcome	$\hat{\sigma}_\mu$/Baseline Rate
Payment of 4th-Year Maintenance Fees	3.69%
Payment of 8th-Year Maintenance Fees	6.46%
Payment of 12th-Year Maintenance Fees	9.02%
Log patents by Assignee (within 5 years)	13.03%

Causal Examiner Effects on Post-Grant Outcomes

Outcome	$\hat{\sigma}_\mu$/Baseline Rate
Log Total Citations	24.07%
External Patent Citations (0-3 years)	18.56%
Internal Patent Citations (0-3 years)	21.84%

Results Recap

- Largest examiner causal effects on legal-related outcomes
  - –> NPE purchase, litigation, inter-partes review filing
  - –> Focus of our second research question
- Smaller but sizable effects for innovation outcomes
  - –> Citations, future patenting
  - –> Late-term private value more sensitive than early-term

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Random Assignment Issues

- Previous research: random assignment mechanisms
  - –> Taking from the top of the pile
  - –> Random by last digit
- Worry: specialization even within art units
  - –> New evidence from Righi and Simcoe (2017)
  - –> Specialization of examiners

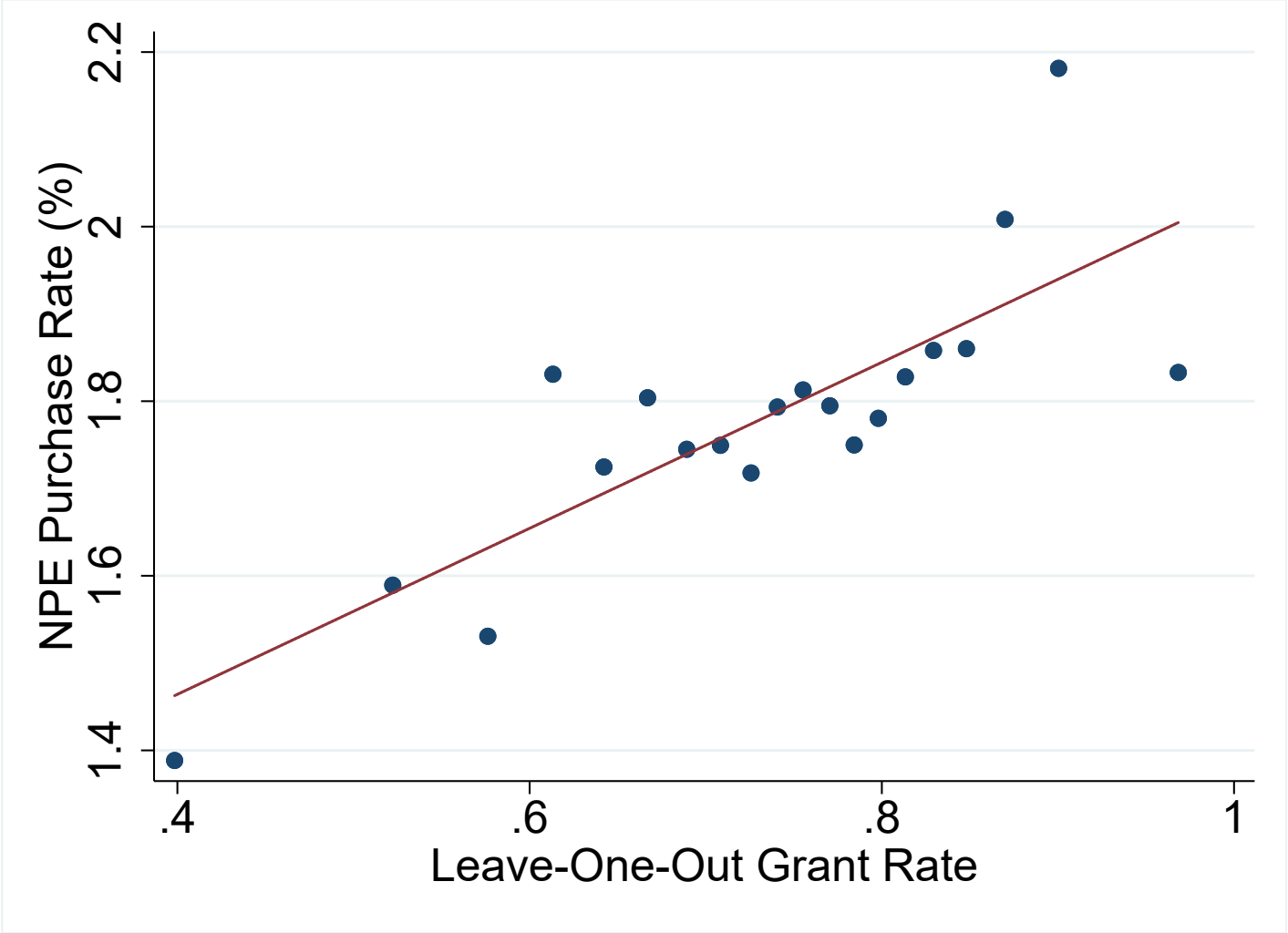
Workarounds

1. **Focus on IT (tech centers 21, 24, 26)**
   - –> **Righi and Simcoe (2017): specialization in other areas**
   - –> **Recover similar results**

2. Busy-ness instrument
   - –> Exploit variation in busy-ness of lenient examiners
   - –> Examiners with recent disposed applications $\rightarrow$ more likely to be assigned docketed application
   - –> Instrument leniency with busy-ness weighted leniency across all examiners
   - –> Recover similar relationships between outcomes and leniency

3. Identify units that randomize by last digit
   - –> Chi-square statistic by examiner and last digit
   - –> About 1/3 of applications in units that have p-value < 0.01

IT Only



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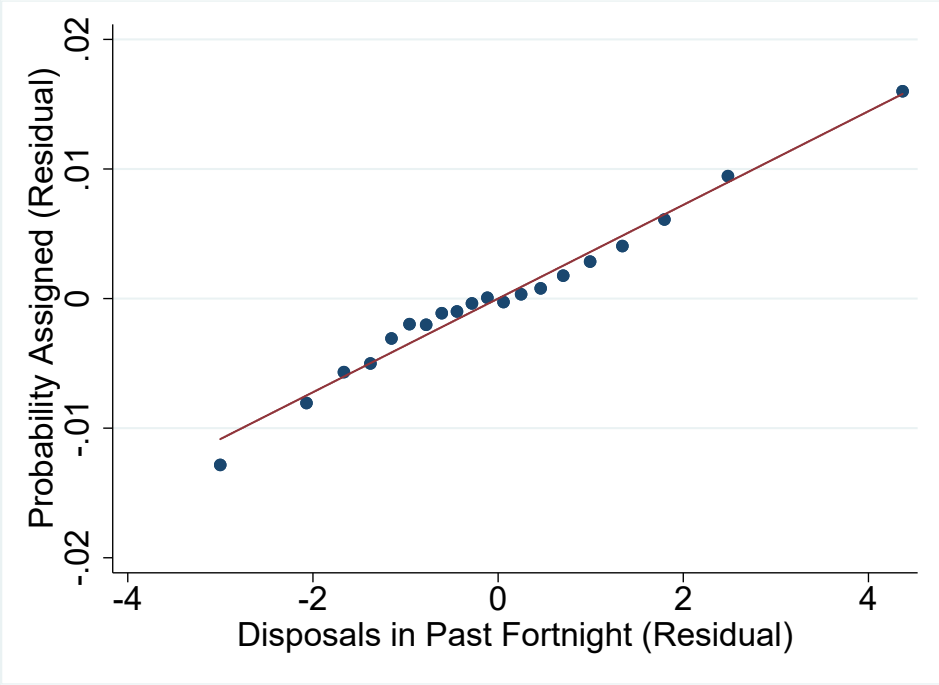
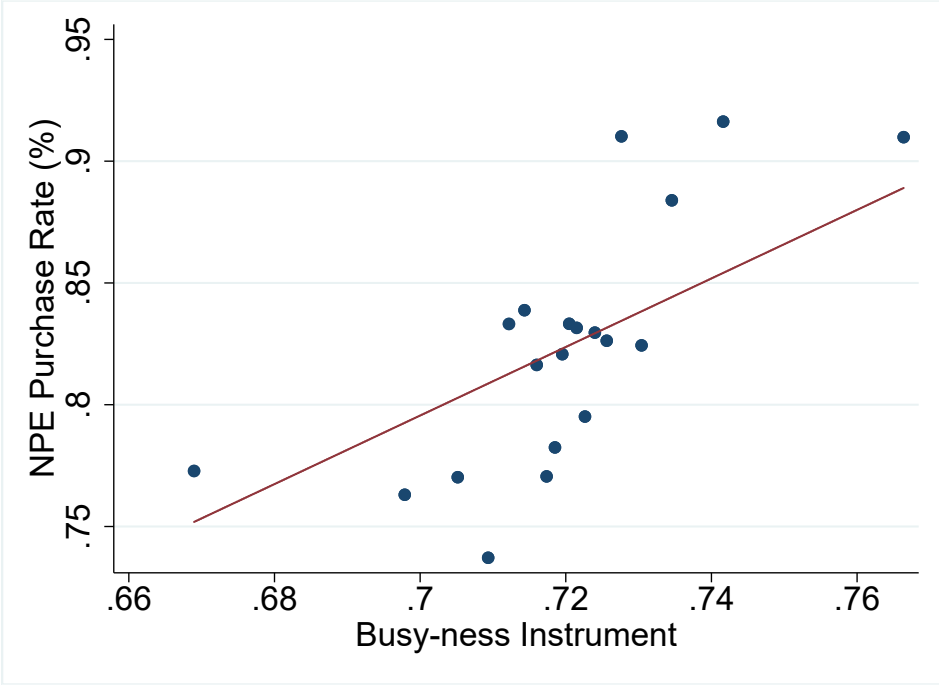
Busy-ness Instrument



(a) Allocation



(b) Reduced Form

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Random Last Digit Unit Analysis

- Examiners' signal SDs are similar in subsample of art units that randomize by last digit

Outcome	$\hat{\sigma}_\mu$/Baseline Rate	Original
NPE Purchase	38.16%	50.97%
Non-NPE Litigation	41.85%	62.10%
Non-NPE Purchase	14.52%	14.01%

Selection

- Additional concern: examiners selecting based on quality of idea
  - –> Variation is not about differences in legal construction
- Workaround
  - –> Control flexibly for grant rate in outcome regression
    - Compare examiners with same grant rate
    - Assumption: idea quality is vertical (grant same ideas)
    - Remaining difference is due to legal construction differences
    - Similarly large differences in examiner effects remain
  - –> Address remaining variation in selection (given grant rate)
    - Add additional controls: similar application, similar examiner
    - Inventor, assignee, and application characteristics at filing
- Alternative: Heckman correction (non-linear)

Addressing Extensive Margin Selection Effects

- Examiners' signal SDs are similar when controlling for (leave-one-out) examiner grant rate

Outcome	$\hat{\sigma}_\mu$/Baseline Rate	Original
NPE Purchase	62.64%	50.97%
Non-NPE Litigation	63.06%	62.10%
Non-NPE Purchase	14.31%	14.01%

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How Do High-NPE Examiners Behave?

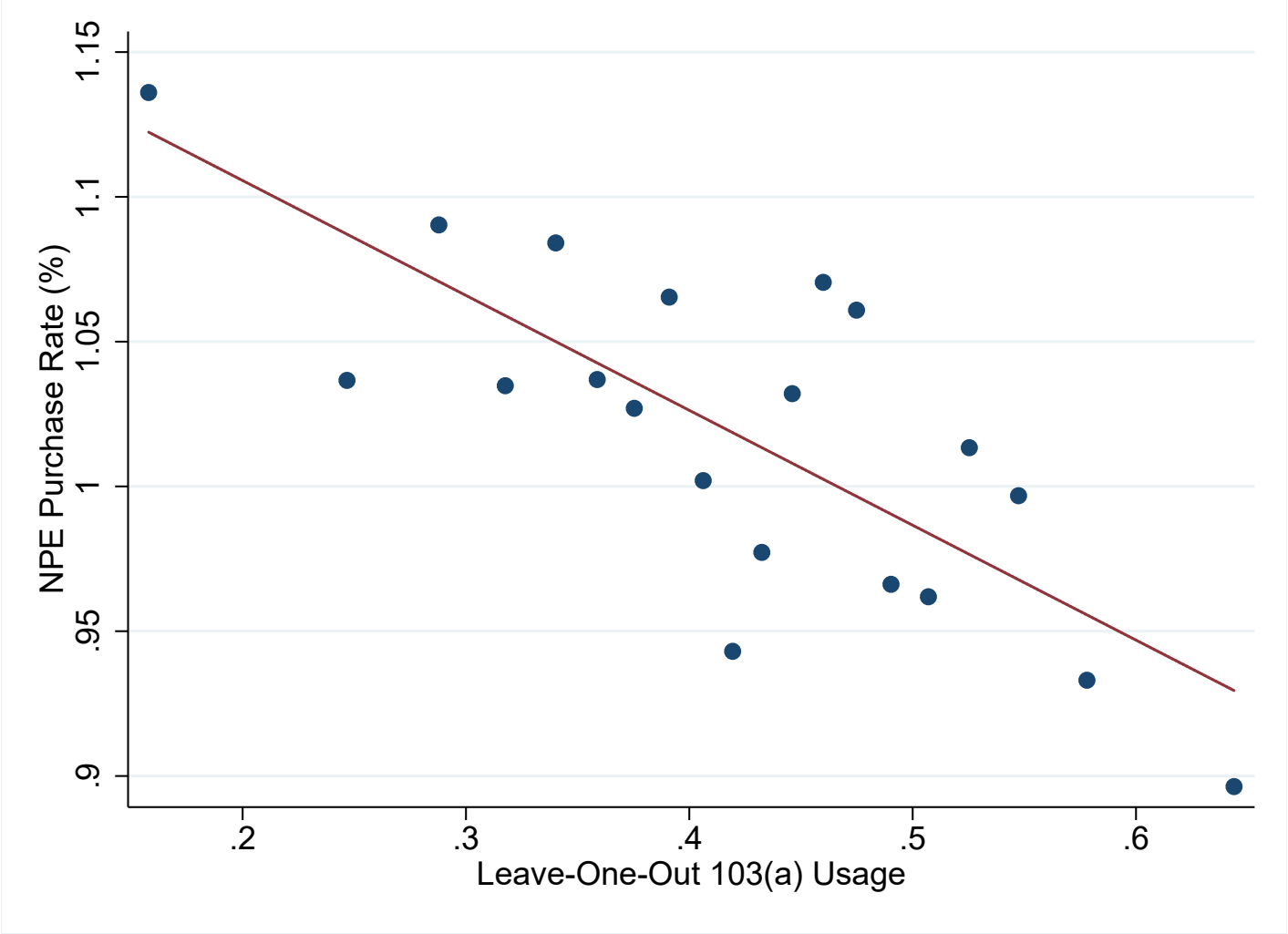
- NPEs buy disproportionately from a specific set of examiners
- Use prosecution behaviors of high NPE effect examiners to understand nature of NPE-purchased patents
  - –> Note: not causal
- Methodology
  - –> Compute leave-one-out examiner effects for various prosecution behaviors
  - –> Predict patent outcomes using these measures ($\hat{E}_j$)

$$NPE_{ijt} = \beta \hat{E}_j + \epsilon_{ijt}$$

Examiner Prosecution Behavior

- Examiner blocking action usage by type:
  - 101: not patentable subject matter, lacking utility
  - 102: not novel
  - 103(a): obvious
  - 112(a): unclear technological disclosure
  - 112(b): unclear claims language
- Claims text changes between application and grant
  - Edits in response to examiner blocking action critiques

NPE Purchase and 103(a) Usage

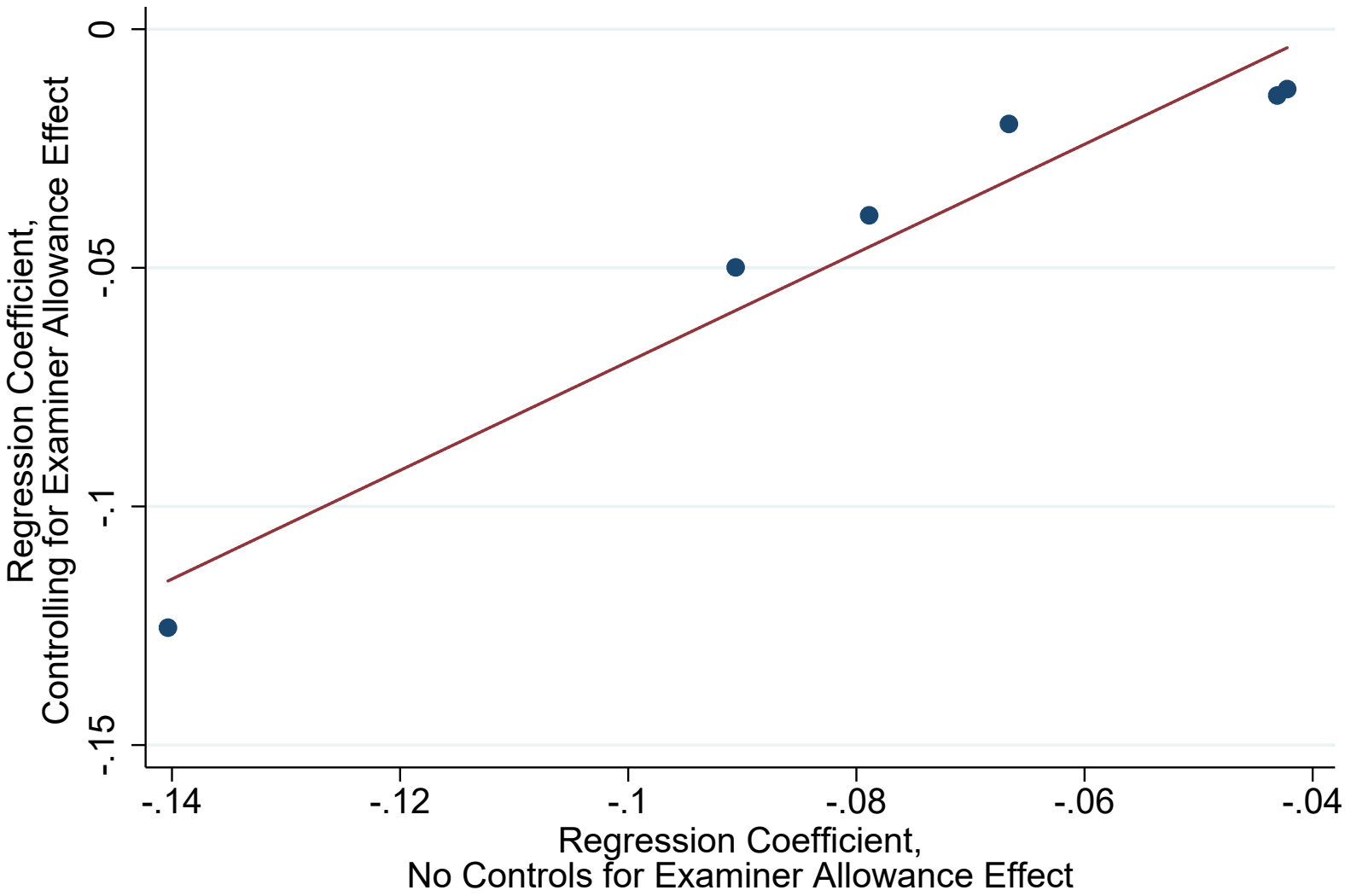


Formal Analysis - Pairwise Correlations

	NPE Purchase	Non-NPE Lit.
103(a) - Obviousness	-0.099***	-0.039**
	(0.023)	(0.017)
112(b) - Unclear claims	-0.047**	-0.040**
	(0.023)	(0.018)
Δ Words/Claim	-0.148***	-0.061***
	(0.021)	(0.016)
N	1,269,623	

** p-value < 0.10, ** p-value < 0.05, *** p-value < 0.01*

Addressing Extensive Margin Selection Effects



Coeff. 1.13*** (s.e. 0.139), R2=0.94

Summary

- Main finding: examiners with high NPE and non-NPE litigation effects are "lenient":
  - Use specific blocking actions less often: 103(a), 112(b)
- Why might these patents be useful to NPEs?
  - –> *Obviousness*: higher likelihood others take this step when developing products
  - –> *Vague claims language*: many possible interpretations which can be used flexibly to read on subsequent technology
- Remaining questions
  - –> Are they buying weak patents?
  - –> Can other NPE purchasing mechanisms explain the data?

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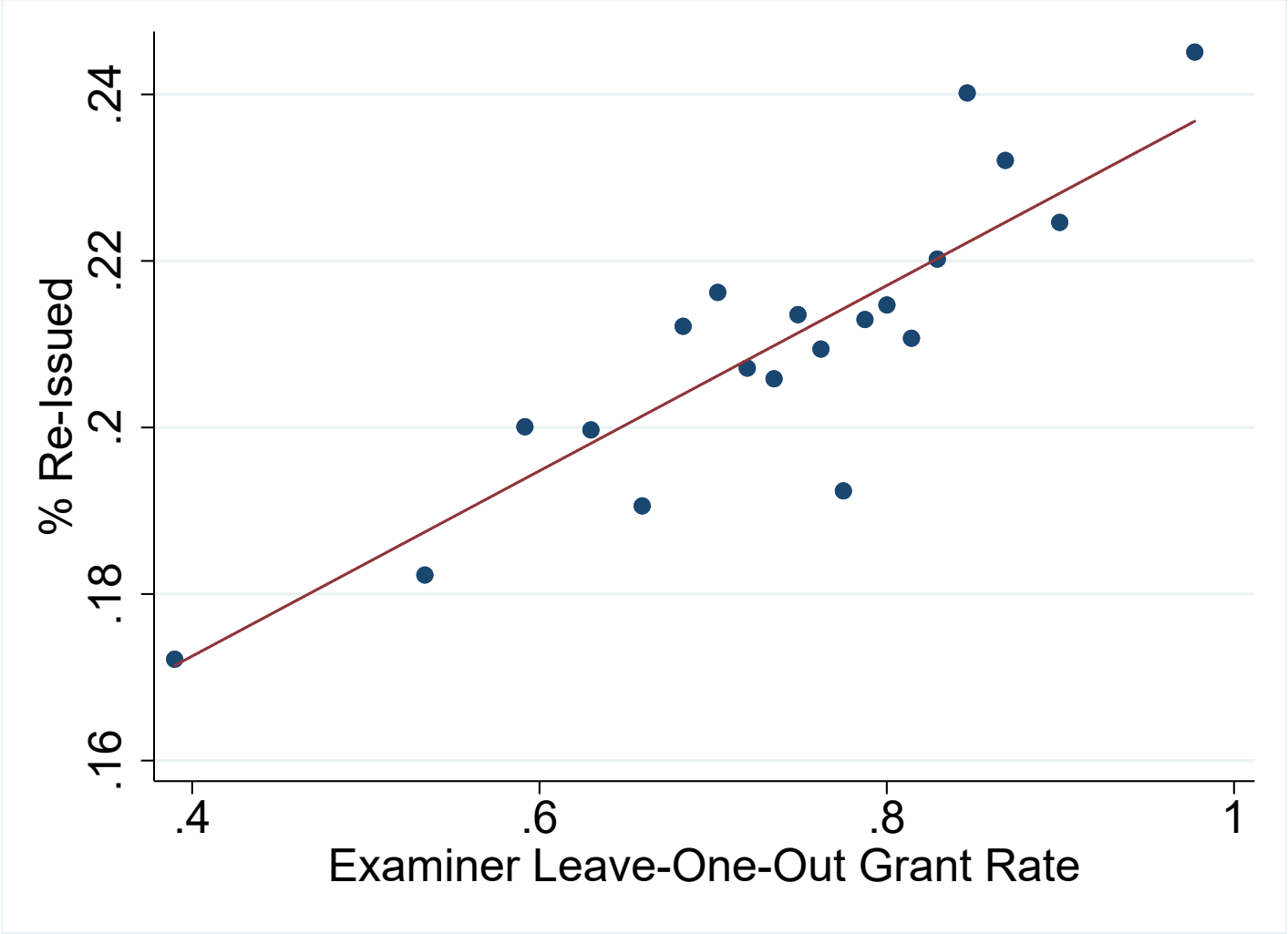
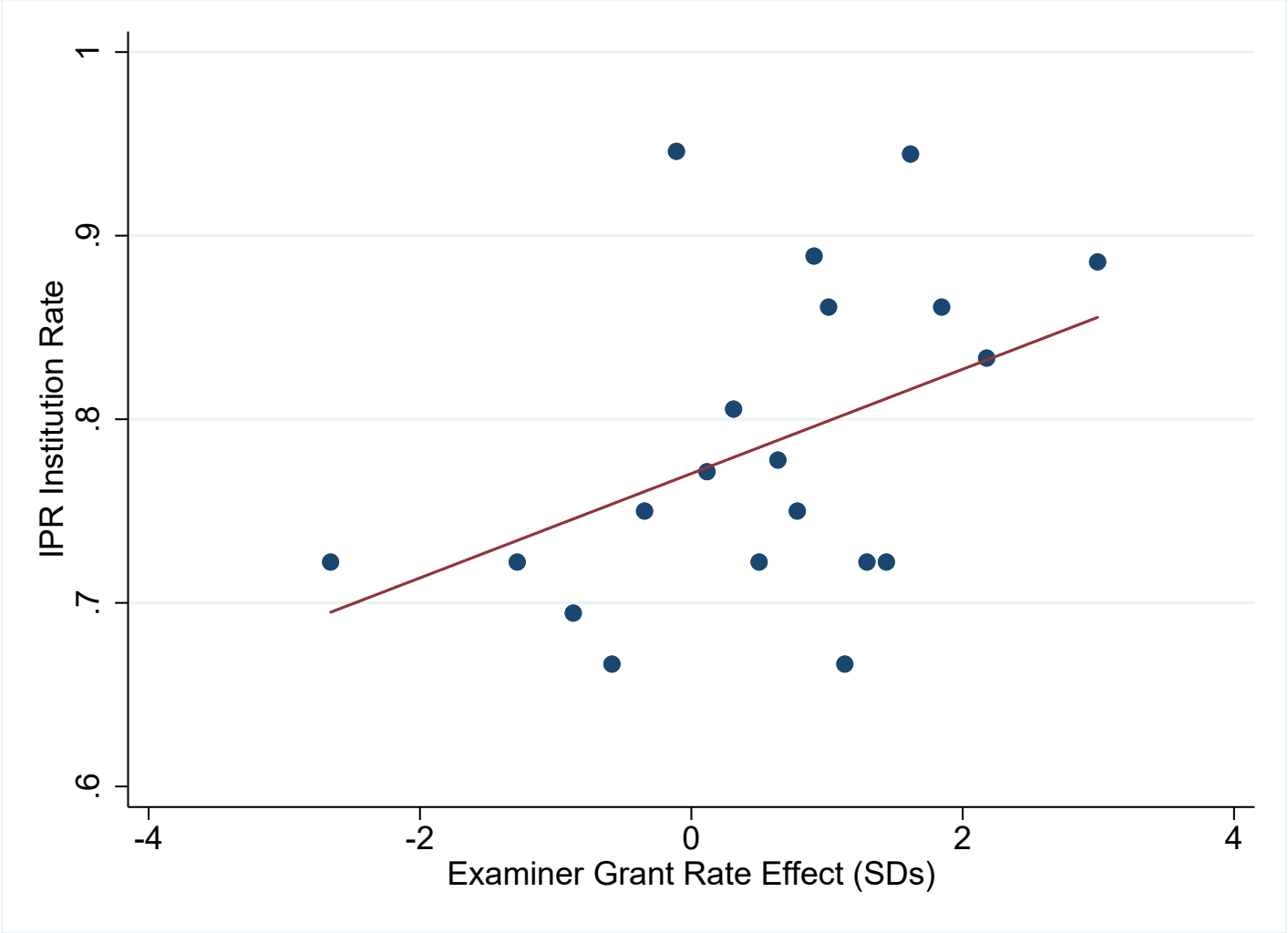
Weak Patents

- **Definition**: patents that may well be invalid, but require conclusive litigation to find out
  - –> NPEs accused of asserting weak patents
- Ideal data
  - –> Have courts rule on all granted patents
- Our evidence
  - –> Examiner errors: re-issuance filings
    - 35 U.S.C. 251: ask for re-issuance if patent deemed wholly or partly inoperative or invalid through error
    - Much higher rate for lenient examiners
  - –> Inter-partes review institution (conditional on filing)
    - Lenient examiners more likely to have patents challenged
    - AND found to be likely invalid conditional on filing

Examiner Errors



Invalidity Rulings



Targeted Purchases

- NPEs also target patents within firm portfolios
  - –> Results hold after controlling for assignee fixed effects
- Rules out purchasing behavior based solely on characteristics of original firm
  - –> Supply-driven: NPEs buy whole portfolios during fire sales
    - Struggling firms hold weaker IP
  - –> NPEs buy based on firm attribute: e.g. small firms or individuals
    - Lenient examiners grant more small entity patents
- Another possible form of targeting: buy patents on the best ideas in the pool of weak patents
  - –> Use an independent signal of idea quality: EPO decisions

EPO Evidence

Table: NPE Purchase vs. EPO Decision

	(1)	(2)	(3)	(4)
EPO Grant	-0.461***	-0.211***	-0.199**	-0.023
	(0.056)	(0.057)	(0.059)	(0.063)
Artunit-Year F.E.	No	Yes	Yes	Yes
Examiner F.E.	No	No	Yes	Yes
Assignee F.E.	No	No	No	Yes
N	218,867	218,867	217,491	197,919

EPO Evidence

	NPE Purchase	Non-NPE Purch.	Non-NPE Lit.
EPO Grant	-0.2144**	0.0037	-0.0831
	(0.1001)	(0.0133)	(0.1074)
Examiner F.E.		Yes	
Assignee F.E.		Yes	
Artunit-Year F.E.		Yes	
N		109,383	

Sample: patents of examiners with above median NPE Effect

Conclusion

- Core results
  - –> Examiners have sizable causal effects on the nature and subsequent usage of patents
  - –> Biggest impacts on legal outcomes, but general effects on private value and follow-on innovation
- NPE behavior
  - –> Highly dependent on examiner behavior
  - –> Likely to be selectively purchasing weaker patents

Addressing Extensive Margin Selection Effects

- Examiners' signal SDs are similar when controlling for (leave-one-out) examiner allowance effect, and inventor's and assignee's past applications, grants and citations

Outcome	$\hat{\sigma}_\mu$/Baseline Rate	Original
NPE Purchase	75.94%	50.97%
Non-NPE Litigation	90.32%	62.10%
Non-NPE Purchase	17.04%	14.01%