# The Role of Exclusive Licensing in Follow-on Research of Academic Patented Inventions

Kyriakos Drivas*, Zhen Lei** and Brian D. Wright*

*ARE, UC Berkeley

** Pennsylvania State University

Patent Statistics for Decision Makers

November 15-17, 2011

# Overview of University Technology Management

- Relations between academia and industry have been the focus of recent economics research:
  - Interest by scholars
  - Interest by policy makers
- Rapid transformation of technology management. Translated into:
  - Total **invention disclosures** ↑
  - US university **patents** ↑
  - **License income** of US universities ↑

# Bayh-Dole Act – 1980

- Bayh-Dole Act of 1980 allowed universities to retain ownership of federally funded inventions and in addition to file for patents for these inventions
  - Also encouraged use of exclusive licensing if needed

- Given that federal support constitutes 60-70% of funding to academia this can have a great impact

- Rationale behind Bayh-Dole: federally funded inventions could not pass to the marketplace (Harbridge House Study 1968)

- Relevance of BD extends beyond US borders. Countries are considering or have already adopted similar policies (Mowery and Sampat 2005)

# Concerns for University Technology Management

- Less basic research in favor of applied research (corporate sponsorship, royalty revenues) (Cohen et al 1998, Henderson et al 1998)

- Patenting may retard scientific advances (Heller and Eisenberg 1998)

- **Exclusive licensing may discourage follow-on research (Nelson 2003)**

# Exclusive Licensing: Negative Effects

- Exclusive licensing is the most frequent tool of university technology transfer (Henry 2002)

- Exclusive license may impede follow-on research to **non-licensees** (Nelson 2003):
  - Exclusively licensing a research tool that is widely applicable (e.g. Oncomouse, Murray 2006)

- Give exclusive rights to a **licensee** that may shelve the invention
  - Intentionally (Thursby et al 2005)
  - Unintentionally (Colyvas et al 2002, Nelson 2004)

# So, Why an Exclusive License?

- University inventions are embryonic (Jensen and Thursby 2001)
- Follow-on R&D investment: costly and risky
- Exclusive license needed to provide incentives

# Objective – Key Results

- ***Question I:*** *Does exclusive licensing affect <u>licensee</u> follow-on research?*
  - **Result:** Licensee performs follow-on research due to the exclusive license

- ***Question II:*** *Does exclusive licensing affect <u>non-licensee</u> follow-on research?*
  - **Result:** Non-licensees are encouraged to do follow-on research due to the exclusive license

# Methodology

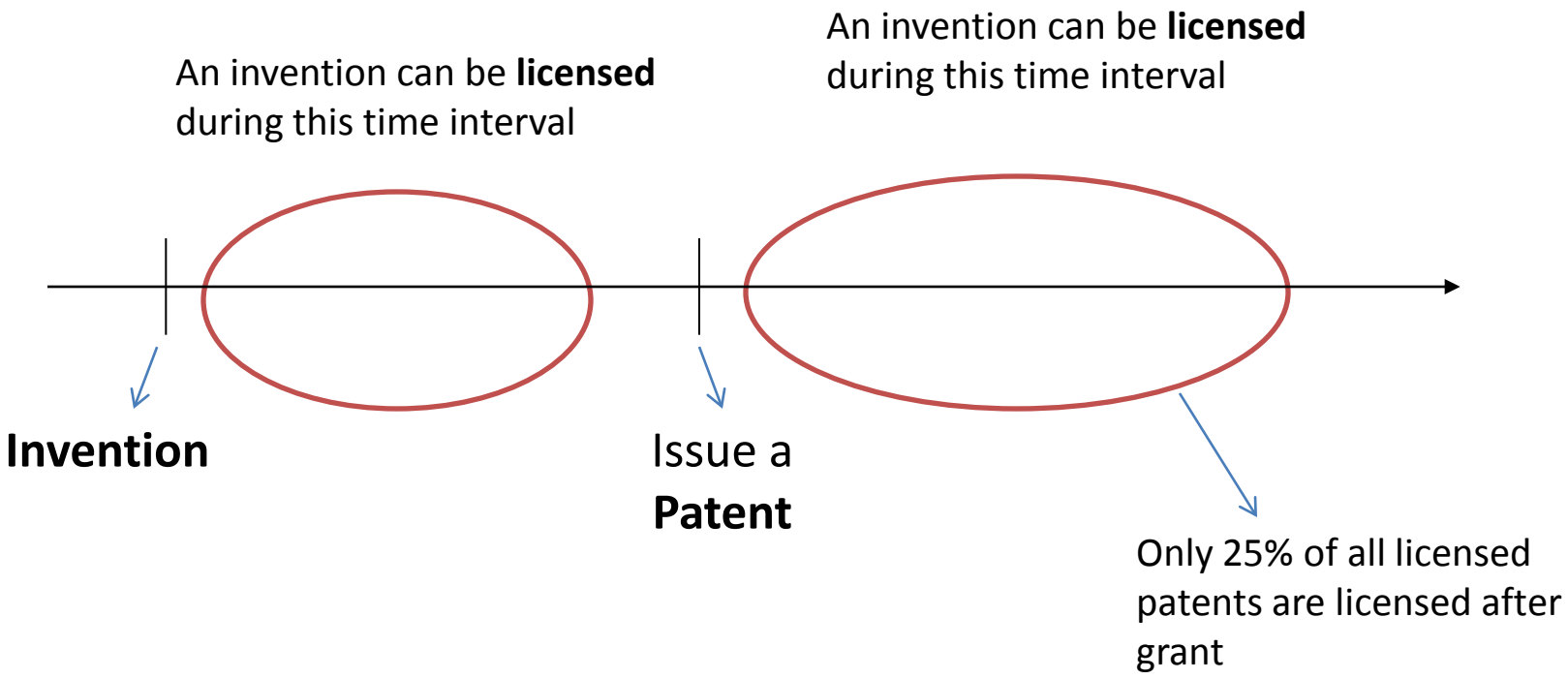
# Methodology – Proxy for Follow-on Research

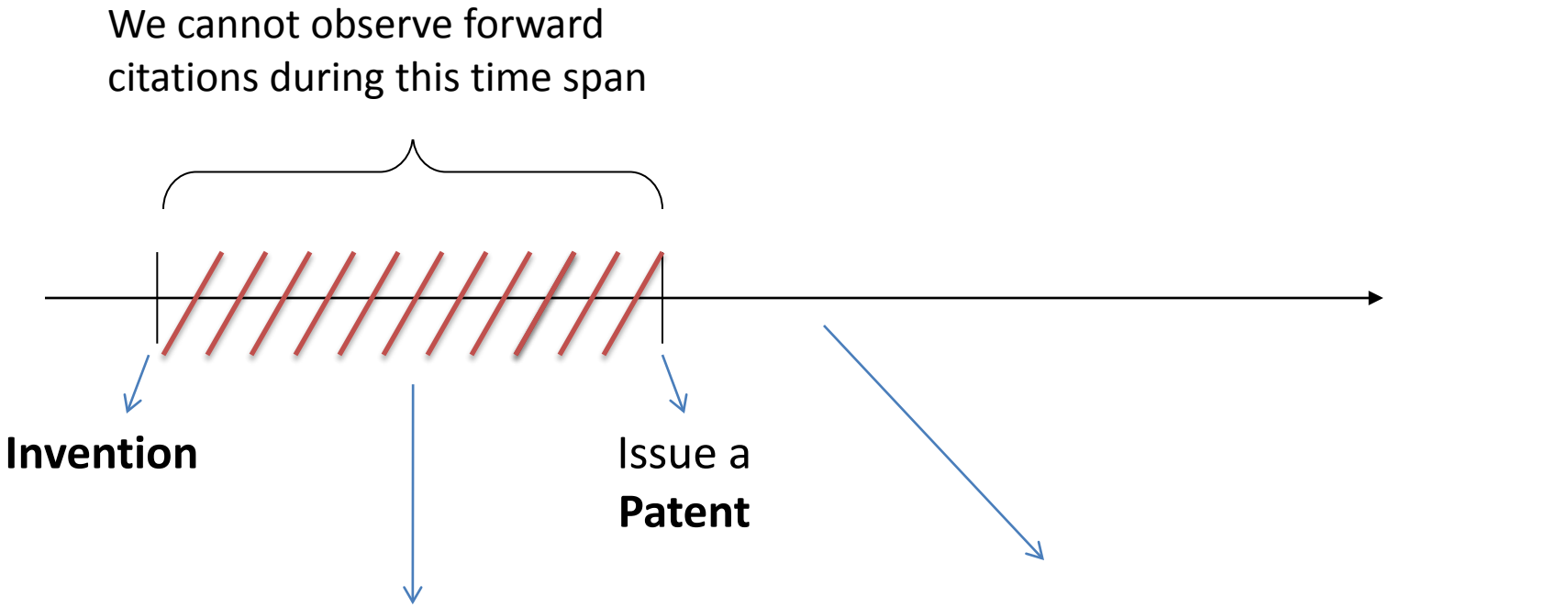
- Count of patents that cite the patent of interest (forward citations)

- Extensive use of this metric for patent quality (Trajtenberg 1990)
  - Evidence shows that it is a good but rather noisy proxy (Harhoff 1999, Bessen 2008)

- **Extensive use of this metric for knowledge spillovers** (Jaffe et al 1993)

# Invention – Patent – License






My observation unit: **The Patent**

# Our Empirical Study

- 3,232 University of California (UC) patents (grant years: 1977-2009)
- Difference-in-Differences estimation:
  - Examine the change in citations after the patent becomes exclusively licensed
- Group of interest:
  - Patents that have been exclusively licensed after grant
  - Exploit time variation of licensing
  - Also, use patents licensed before grant as comparison group
- Metric for follow-on research → Forward Citations:
  - Distinguish citations by licensee and all others (non-licensees)

# Key Results

- Licensee citations increase significantly after exclusive licensing

- Non-licensee citations increase significantly after exclusive licensing

# Econometric Specification

Standard Difference-in-Differences Estimation:

$$Y_{i,t,s} = g_0 + g_1 * Exclusive_{i,t} + g_2 * ExclusiveExpire_{i,t} + Patent_i + Period_t + Year_s + \varepsilon_{i,s,t}$$

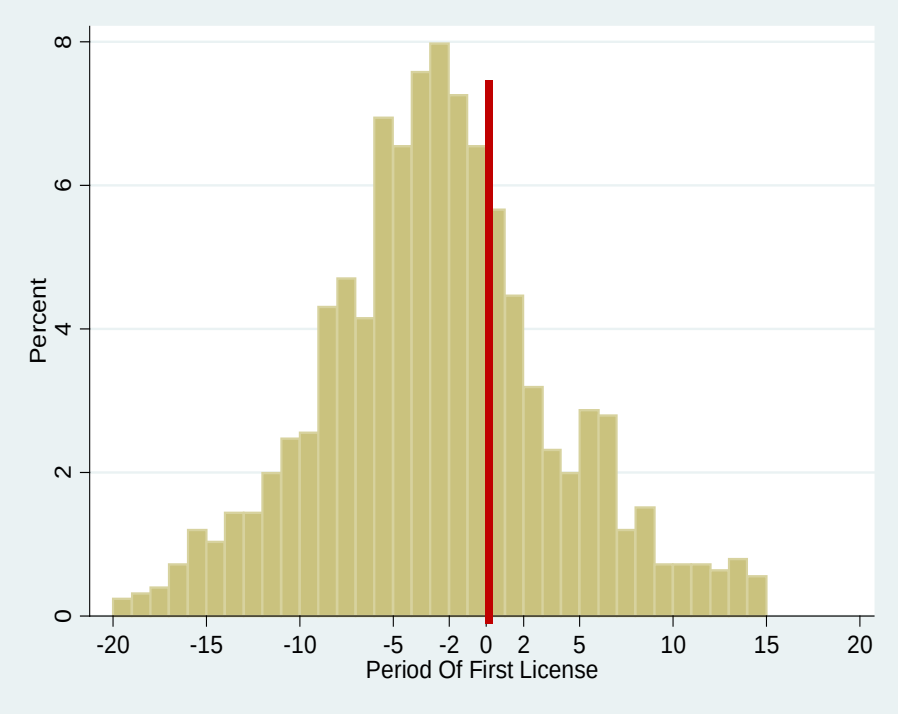
$Y_{i,t,s}$ :

Licensee citations or Non-licensee citations to patent *i*, at period *t* and in year *s*

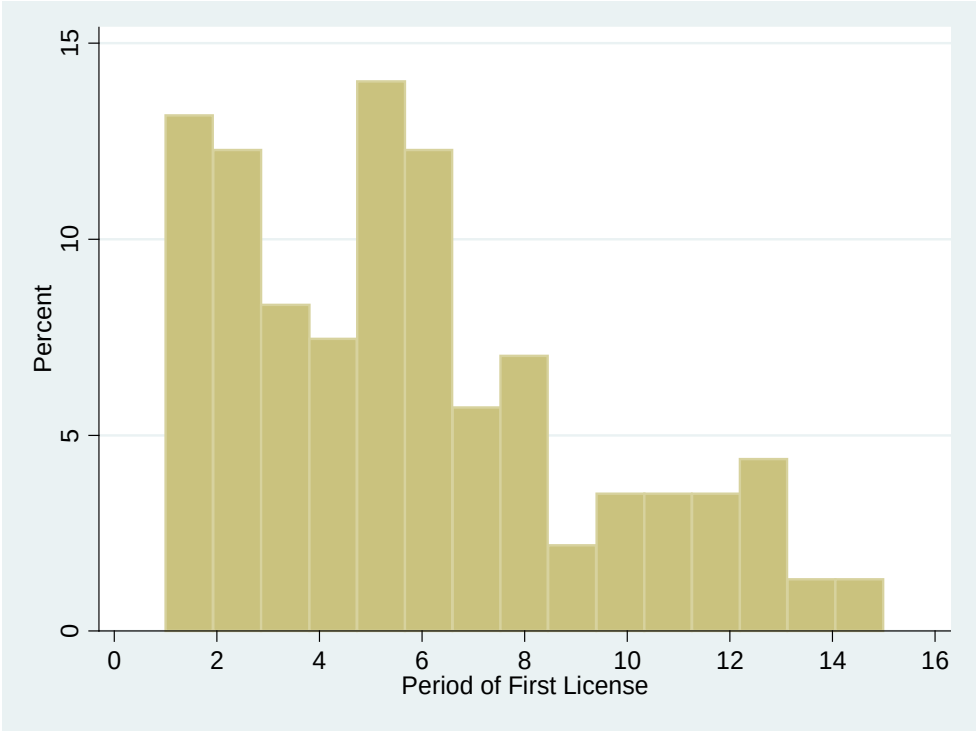
# Data

- 2,033 utility inventions associated with 3,232 utility patents (grant years: 1977-2009)
  - And their associated **licensing** activity

**All Exclusively Licensed Patents – Revoked Included**

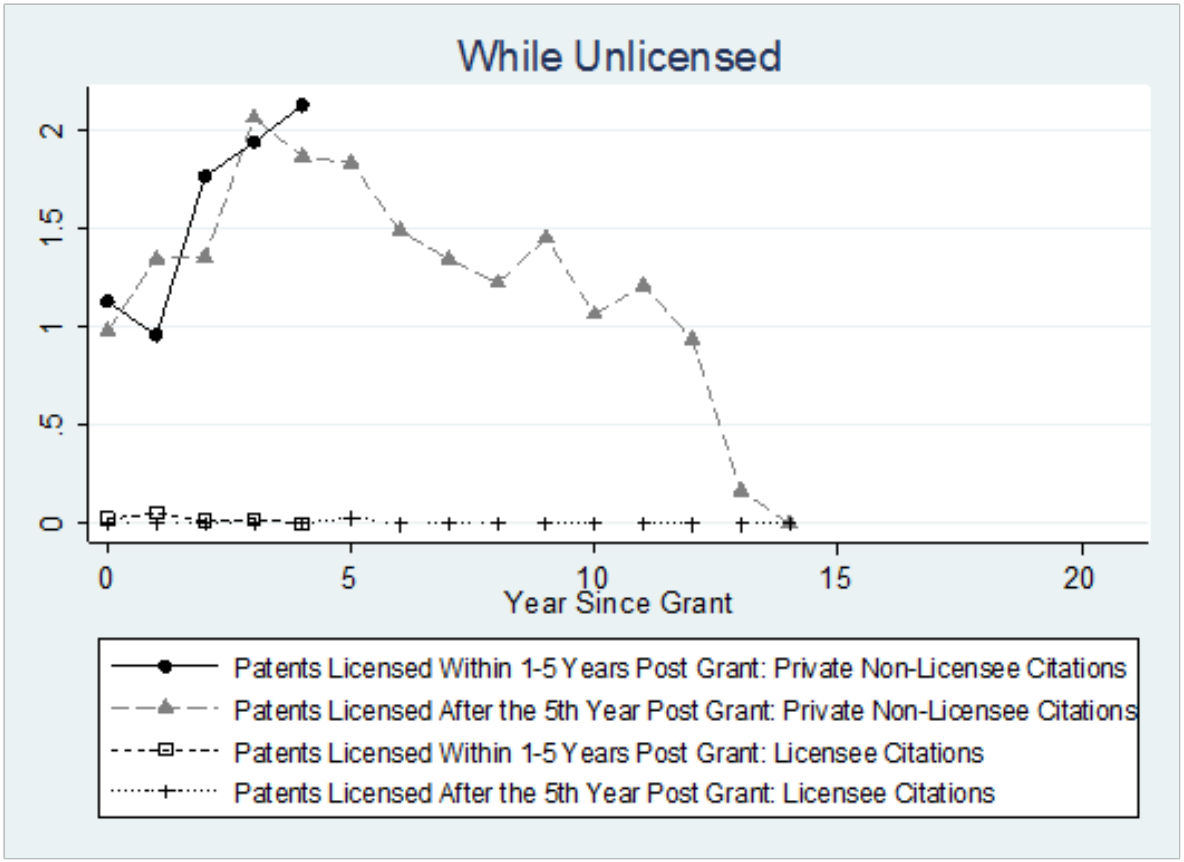



**Patents Licensed After Grant – Non-Revoked Licenses**



# Endogeneity Issues
# Group of Interest: Early Licensed vs. Late Licensed

- Non-licensee citations: When unlicensed, both groups receive similar number of citations
- Licensee citations: When unlicensed, there are virtually no citations



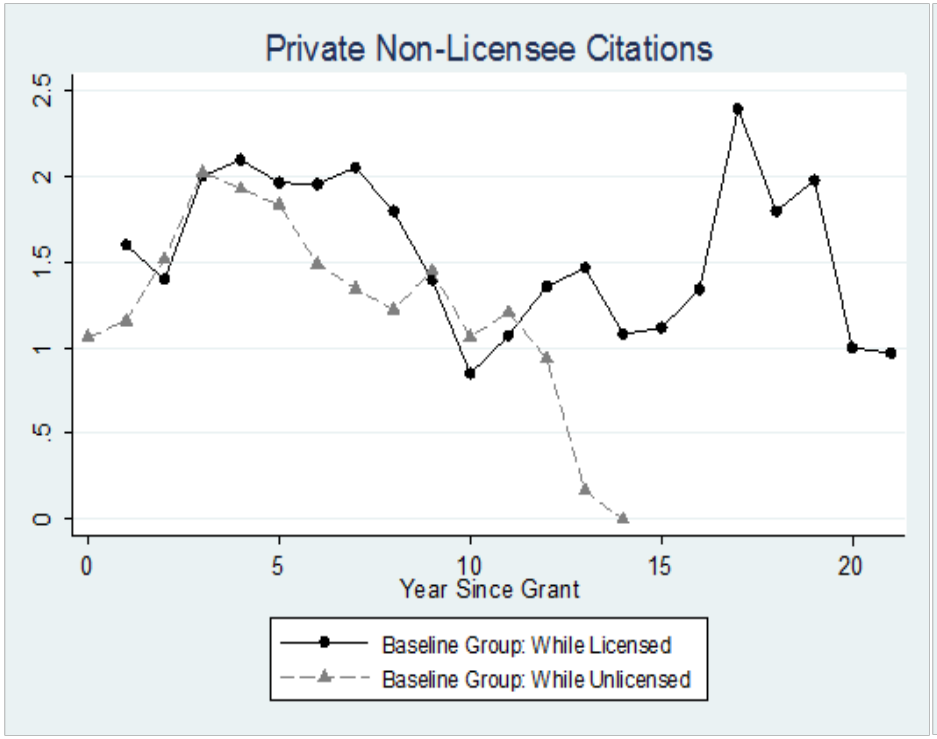
# Endogeneity Issues
# Do Early Licensed Patents Differ from Late Licensed Patents?

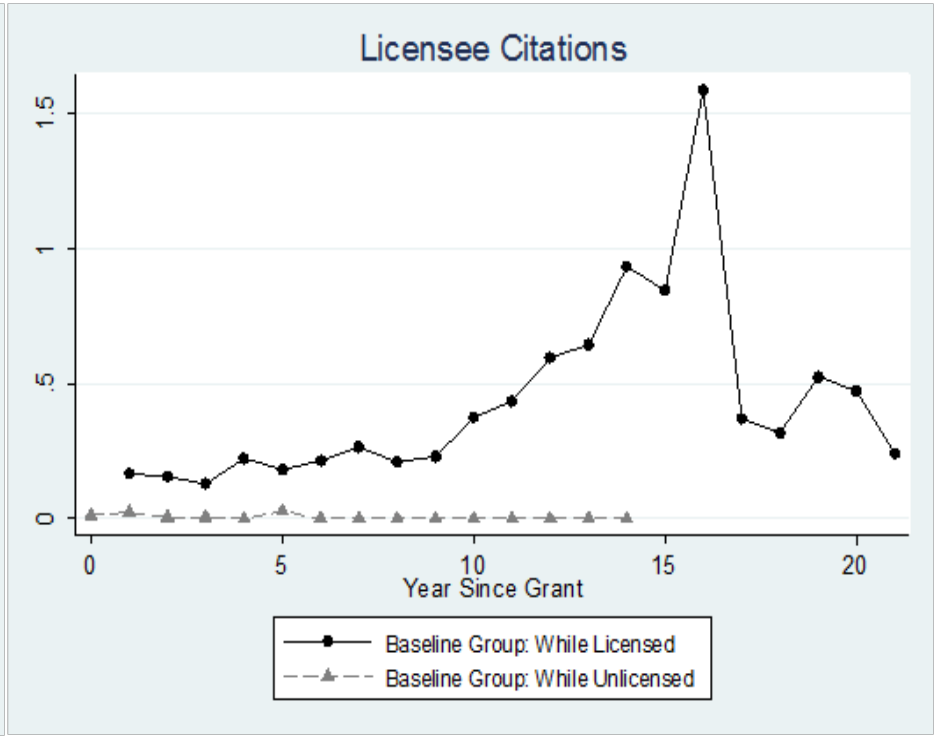
| | Patents Licensed Exclusively Between 1 and 5 Years After Grant | | Patents Licensed Exclusively on or the 6th Year After Grant | | |
|---|---|---|---|---|---|
| | Obs | Mean | Obs | Mean | P-Value |
| Claims | 126 | 18.71 | 102 | 16.7 | 0.29 |
| | | -14.78 | | -13.64 | |
| NumberOfUSClass | 126 | 5.45 | 102 | 5.07 | 0.44 |
| | | -4.15 | | -3.04 | |
| NumberOfIPC | 126 | 7.41 | 102 | 5.59 | 0.03 |
| | | -7.44 | | -4.41 | |
| BackCites | 126 | 8.4 | 102 | 11.64 | 0.07 |
| | | -12.17 | | -14.89 | |
| BackCitesJournals | 126 | 10.42 | 102 | 9.36 | 0.56 |
| | | -12.26 | | -14.98 | |
| IssueYear | 126 | 1995.73 | 102 | 1994.49 | 0.09 |
| | | -5.51 | | -5.29 | |
| AppLength | 126 | 2.62 | 102 | 2.26 | 0.02 |
| | | -1.32 | | -0.8 | |
| NumberOfSecrecies | 126 | 1.98 | 102 | 1.36 | 0.18 |
| | | -4.17 | | -2.26 | |
| NumberOfLetters | 126 | 0.35 | 102 | 0.5 | 0.09 |
| | | -0.6 | | -0.73 | |

# Results

# Graphical Results

- When licensed, patents receive higher non-licensee and licensee citations



# Baseline Specification

| | Only the Group of Interest | | Include Patents Licensed Within Two Years Before Grant | |
|---|---|---|---|---|
| VARIABLES | LicenseeCites | NonLicenseeCites | LicenseeCites | NonLicenseeCites |
| **Exclusive** | 0.144** | 0.679** | 0.137** | 0.649** |
| | (0.0588) | (0.340) | (0.0622) | (0.269) |
| **Observations** | 3,380 | 3,380 | 5,047 | 5,047 |
| **R-squared** | 0.094 | 0.187 | 0.077 | 0.162 |
| **# of Patents** | 228 | 228 | 356 | 356 |

# Result Robust to:

- Considering only patented inventions funded by the federal government
- Excluding patents that have been licensed by the sponsor
- Taking only into account patents that have not been licensed in a bundle (coefficient not significant but same magnitude)

# "Reverse Causality" Explanation

- With no expressed prior interest, that is when non-licensee citations increase

| | **Baseline patents (Patents Exclusively Licensed After Grant)** | | | |
|---|---|---|---|---|
| | **Patents with no secrecy agreements** | | **Patents with at least one secrecy agreement** | |
| | Licensee Citations | Non-Licensee Citations | Licensee Citations | Non-Licensee Citations |
| **Exclusive** | 0.0910** | 1.276*** | 0.0479 | -0.0136 |
| | (0.0354) | (0.449) | (0.105) | (0.478) |
| **Observations** | 1,889 | 1,889 | 1,491 | 1,491 |
| **# of Patents** | 119 | 119 | 109 | 109 |

# “Signal Effect” of Exclusive Licensing

# Field of Citing Patents:
## Licensees vs. Non-Licensees

- Narrow vs. Broad Fields:

  **480** US Classifications/NARROW

  **vs.**

  **36** Technology fields (Hall et al 2001)/BROAD

- We find:
  - Licensees do most of subsequent patenting on the same narrow field
  - Non-licensees don't do the patenting on the same narrow field but on the same broad field

# Differences By Technology Fields

# Distinguish by Technology Fields of Patents

- Patent strength different across these technology fields

| | **Baseline patents (Patents Exclusively Licensed After Grant)** | | | |
|---|---|---|---|---|
| | **Patents in Chemical, Drug and Medical fields** | | **Patents in Computers, Communications, Electrical, Electronic and Mechanical fields** | |
| | Licensee Citations | Non-Licensee Citations | Licensee Citations | Non-Licensee Citations |
| **Exclusive** | 0.195** | 0.207 | 0.108 | 1.384** |
| | (0.0927) | (0.381) | (0.0707) | (0.526) |
| **Observations** | 2,098 | 2,098 | 1,165 | 1,165 |
| **# of Patents** | 142 | 142 | 80 | 80 |

# Conclusion

→ Licensees do follow-on research due to exclusive license

- The increase stems mainly from patenting in the same narrow field
- Adding to the policy debate that argues exclusive licensing is to promote development

→ Non-licensees: “Signal Effect” in addition to a “Discouragement Effect”:

- Citing behavior (narrow vs. broad fields)
- Compare between technology fields
- The former appears to dominate the latter