# Lecture 6
# Trade Secrets

## E5104 – Economics of Innovation

**Bernhard Ganglmair**

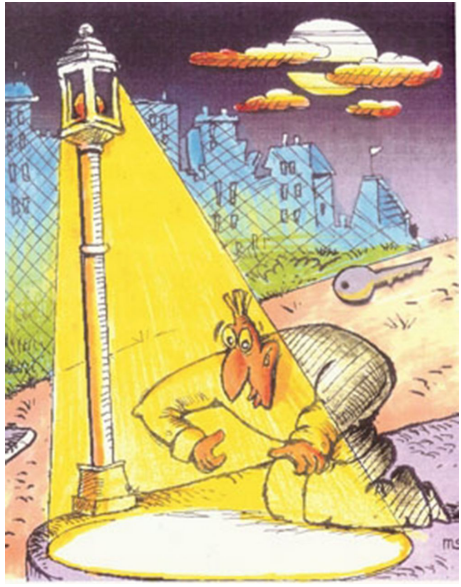
UNIVERSITY OF MANNHEIM
Leibniz Gemeinschaft
ZEW

- Risch (2007): trade secrets are “most important and most heavily litigated intellectual property right”
- Jorda (2007): trade secrets are the “crown jewels” of a firm’s intellectual capitcal
- Technology managers report secrecy to be more effective than patents as a way to appropriate the returns from R&D
- In surveys, secrecy comes in at the top, whereas patents are listed 3rd/4th choice (Levin et al. 1987, Cohen et al. 2002, Arundel 2001)

# Important Ingredient in the IP Mix

From the FTC's 2013 innovation report:

- "Computer hardware manufacturers noted that they often use trade secrets, rather than patents, to protect their inventions, because it is difficult to discover whether a rival firm has infringed a patented manufacturing invention"
- "Because manufacturing processes cannot easily be observed by rivals, trade secrecy is particularly important for foundries and the manufacturing facilities of integrated firms"
- Trade secrets are of particular importance in the high-tech industries.



# Today

- What are trade secrets?
- How are they protected?
- Recent empirical literature on trade secrets/secrecy and the effect on
  - R&D (by firms and individuals)
  - knowledge diffusion (in patents and products)
  - firm value
- Most articles study secrecy (≅ not patenting) using patents as their main data source

# What are Trade Secrets?

Information that is

- valuable in that it confers some sort of competitive advantage
- which derives its value from not being publicly known
- and with respect to which the holder took reasonable steps to keep it secret

# U.S.: Restatement (First) of Torts (1939)

- First codification
- Definition:

  *Any formula, pattern, device or compilation of information which is used in one's business, and which gives him an opportunity to obtain an advantage over competitors who do not know or use it. It may be a formula for a chemical compound, a process of manufacturing, treating or preserving materials, a pattern for a machine or other devide, or a list of customers.*

- Continuous use requirement, but need not be novel or patentable

# U.S.: Restatement (First) of Torts (1939)

- Novelty and non-obviousness (inventive step):

*A trade secret may be a device or process which is patentable; but it need not be that. It may be a device or a process which is clearly anticipated in the prior art of one which is merely a mechanical improvement that a good mechanic can make. Novelty and invention are not requisite for a trade secret as they are for patentability.*

# U.S.: Uniform Trade Secrets Act (1979/1985)

- To clarify and harmonize the standards of trade secrets protection
- Definition:

  *Information including a formula, pattern, compilation, program device, method, technique, or process, that:*

  (i) *derives independent economic value, actual or potential, from not being generally known to, and not being readily ascertainable by proper means by, other persons who can obtain economic value from its disclosure or use, and*

  (ii) *is the subject of efforts that are reasonable under the circumstances to maintain its secrecy.*

- No continuous-use requirement (“potential value”), now includes, e.g., results of research proving that a certain process will not work

# U.S.: Restatement (Third) of Unfair Competition (1995)

- Definition:

  *any information that can be used in the operation of business or other enterprise and that is sufficiently valuable and secret to afford an actual or potential economic advantage over others.*

# U.S.: Economic Espionage Act (1996) | Defend Trade Secrets Act (2016)

- EEA introduces criminal sanctions; DTSA introduces access to federal courts (civil actions)
- Definition (EEA):

*All forms and types of [. . .] information, including [. . .] if*

(A) *The owner thereof has taken reasonable steps to keep such information secret; and*

(B) *The information derives independent economic value, actual or potential, from not being generally known to, and not being readily ascertainable by proper means by the public.*

# Trade Secret Laws in the U.S.

*. . .evolved out of a series of related common law torts: breach of confidence, breach of confidential relationship, common law misappropriation, unfair competition, unjust enrichment, and torts related to trespass or unauthorized access to a plaintiff's property. It also evolved out of a series of legal rules – contract and common law – governing the employment relationship.*

*Lemley (2008)*

# Trade Secret Laws in Europe

- In the past: fragmented
- France: key provision in Article L. 152-7 of the Labor Code (employee divulging a manufacturing secret of his employer may be subject to criminal sanctions)
- Germany: trade secrets laws embodied in the law of unfair competition (Article 17)
- UK: breach of confidence actions are the major tool for trade secret protection

# Europe: EU Trade Secrets Directive (2016/943)

*Trade secret-based competitive advantages are at risk (reduced competitiveness): the fragmented legal protection within the EU does not guarantee a comparable scope of protection and level of redress within the Internal Market, thus putting trade secret-based competitive advantages, whether innovation-related or not, at risk and undermining trade secret owners' competitiveness.*

*European Commission (2013)*

# Europe: EU Trade Secrets Directive (2016/943)

- Harmonization of trade secret laws across member states
- Adopted on June 8, 2016
- To be implemented by June 9, 2018
- Evaluation by June 9, 2026: **What should we expect?**

# What Does Trade Secrets Law Buy You?

- Only right is right to prevent others from misappropriating the secret
  - acquisition through improper means (theft, fraud, misrepresentation, espionage)
  - unauthorized disclosure or use by third persons (under obligation to maintain secrecy or limit use)

- What it does not buy you:
  - No exclusive right to possession or use
  - No protection against independent discovery or reverse engineering
  - No rights against good faith purchasers
  - No market power

# Empirical Literature

- Mainly survey evidence
- Observational-data studies are limited because of the obvious data limitations
- Small and growing literature on indirect effects of trade secrets (or secrecy in more general).
  - Legal protection of trade secrets
  - Secrecy in the patent system
    - American Inventors Protection Act (1999)
    - Patent secrecy programs during WW2
    - Invention Secrecy Act (1951)
- Effects on
  - innovation incentives
  - knowledge diffusion
  - firm value

# Legal Protection of Trade Secrets

- Inevitable disclosure doctrine
  - Contigiani, Hsu, and Barankay (2018 *SMJ*)
- Uniform Trade Secrets Act (1979/1985)
  - Png (2017 *REStat*, 2017 *Strategy Science*)
  - Angenendt (2018 *WP*)
  - Castellaneta, Conti, and Kacperczyk (forthcoming *SMJ*)
  - Ganglmair and Reimers (2019 *WP*)
- *Not today:* Enforceabiliy of covenants not to compete and non-disclosure agreements
  - number of articles by Evan Starr (U Maryland)
  - Garmaise (2011 *JLEO*)

# Inevitable Disclosure Doctrine

- Idea is that a departing employee will "inevitably" disclose trade secrets, even without the intent to disclose
- *Peerless Pattern and Pictorial Review* (1911): "Equity has no power to compel a man who changes employers to wipe clean the slate of his memory."
- *PepsiCo v. Redmond* (1995):
  - Broadened the scope of IDD beyond technical trade secrets
  - Redmond (manager at PepsiCo) in 1990s, accepted job at competitor Quaker in 1994
  - PepsiCo sued, argueing Redmond had access to strategic and operating plans; would not be able to perform his job at Quaker without disclosing PepsiCo's trade secrets
  - In December 1994, court prohibited Redmond from taking the new position through 1995

# IDD and Innovation

- IDD is an employer-friendly trade secrets law, increasing employees' costs of departure
- Innovation expected to *increase*:
  - Without labor market frictions, difficult for firms to appropriate returns of *general* employee human capital
  - IDD introduces frictions, effectively turning general human capital in specific human capital
- Innovation expected to *decrease*:
  - IDD reduces potential of idea recombination and diminishes employees' incentives to innovate
  - *Recombination:* IDD raises the costs of circulating in the labor market, diminishing potential for idea recombination
  - *Employee incentives:* frictions lower employee incentives to obtain skill because diminished ability to use the secondary labor market to bargain for better terms – diminished incentives to signal ability to labor market

# Data and Methodology

- Rulings in favor of IDD:
  - Illinois (1995), New York (1997), Washington (1997), Utah (1998), Iowa (2002), Delaware (2006), and Pennsylvania (2010)
- U.S. patent data to construct inventor-level innovation, location, and affiliation
  - 353,889 distinct inventors from all 50 U.S. states, observed up to 28 years
- Main outcome variable: log of count of granted patents weighted by forward citations
- DiD design, exploiting the state-level rulings at various points in time
- Inventor-year panel data set

# Results

- Positive IDD ruling negatively associated with log citation-weighted patent counts – 4-6% decrease in inventor-level innovation (patents) following the shift to employer-friendly trade secrecy regime
- At the state-year level of analysis: 25% decrease in innovation

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- At the state-year level of analysis: 25% decrease in innovation
- Mechanism:
  - Substitution away from patents to trade secrets?
    - **No** [subsample of discrete technologies for which substitution is expected to be weak]
  - Effect through decreased recombination?
    - **No** [using measure of combinatorial novelty (Fleming and Sorensen 2001)]
  - Individual incentives?
    - **Yes** [arguing that inventors "signal" their skills and quality to noncompeting domains through more general purpose patents]

# Uniform Trade Secrets Act

- Variation in **trade secrets protection**/individual value of trade secrets through **Uniform Trade Secrets Act (1979/1985)**

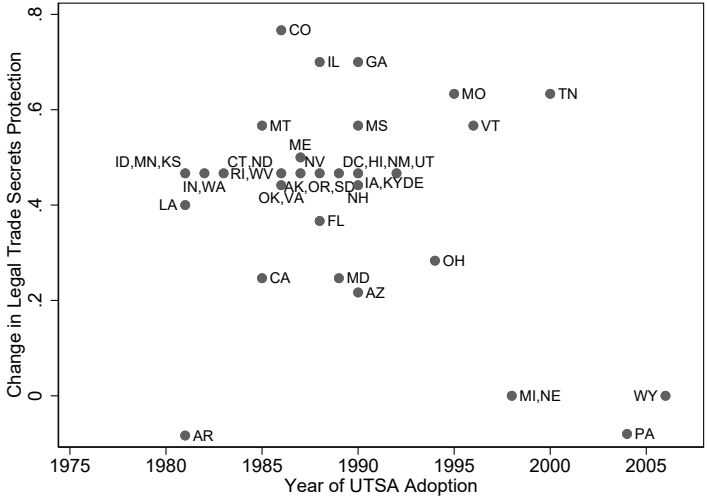
- Published by Nat'l Conference of Commissions on Uniform State Laws
- States voluntarily adopt *template* to change from common law to UTSA
- Between 1981 and 2013, 47 states plus D.C., Puerto Rico, and the U.S. Virgin Islands have adopted

- Harmonize and clarify state trade secrets laws: definition, misappropriation, remedies
- **Png (2017) constructs an index that captures the strength of trade secrets protection in a state before and after adoption of the UTSA**

# Construction of the UTSA Index

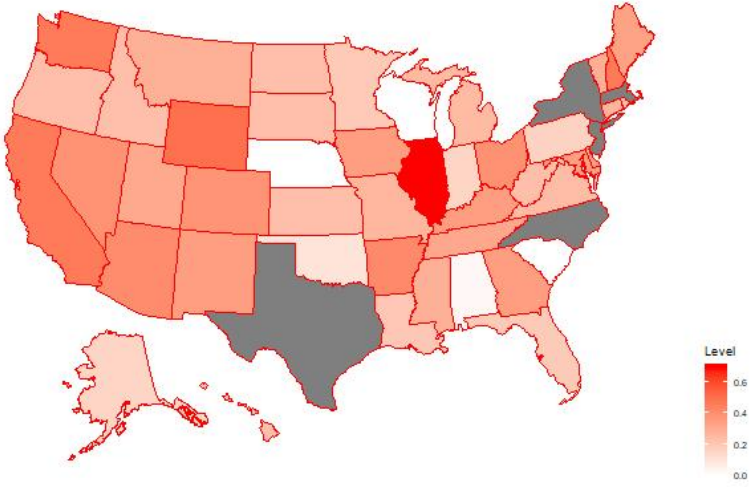
1. Continuous use requirement
2. Requirement to take reasonable effort to protect trade secrets
3. Mere acquisition as misappropriation
4. Limitations on time for the owner to take legal action
5. Availability of punitive damages multiplier
6. Limitations on injunctions (to eliminate advantage from misappropriation)

# Common Law vs. UTSA




Source: Png (2017)

# UTSA: Trade Secrets Protection Index




Source: Png (2017)

# Png (2017 *REStat*)

- Does stronger trade secrets protection boost R&D incentives?
- Dependent variable: R&D expenditures
- DiD design, exploiting the staggered introduction (at different intensities) of the UTSA
- Challenge: What is the location of R&D
  - R.R. Bowker directories of R&D to extract number of professionals at each of a firm's location (1976 through 1998)
  - Firm's total R&D expenditure is apportioned to each state according to the fraction of professionals in that state (in the year before UTSA took effect)
  - Q: effect of stronger trade secrets protection in state *s* on a firm *i*'s R&D expenditures in that state *s*

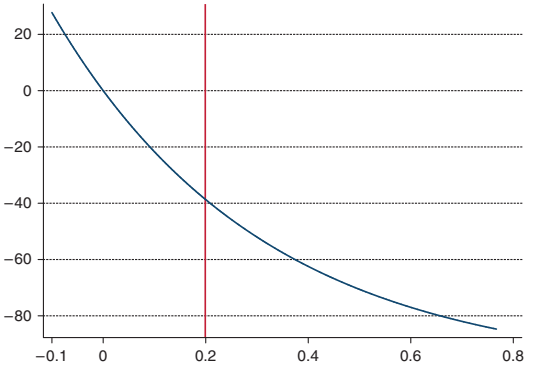
# Results

- UTSA/stronger trade secrets protection is associated with more R&D
- Effect is stronger in larger companies
- Effect is stronger in high-tech industries
- More than 88% of effect is due to change of R&D, conditional on professional staff; 12% is due to change in professional staff
- Note: this result is somewhat at odds with the results (or interpretation) in Contigiani et al. (2018)
  - Contigiani et al. (2018): Stronger trade secrets protection (more employer friendly trade secrets) associated with weaker innovation (less patenting)
  - Png (2017): Stronger trade secrets protection (UTSA) associated with more R&D (more innovation)

# Png (2017 *Strategy Science*): Effect on Patenting

- What is the effect of stronger trade secrets protection on firm's patenting?
- Result: Average increase of trade secrets protection index is associated with 38.6% fewer patents
- Explanation: Substitution from patents to trade secrets

Predicted percent change in patents as function of UTSA index change




Source: Png (2017)

# Angenendt (2018 *WP*): Changes at the Intensive Margin

- In complex product industries, patent content (i.e., patent claims) is a choice variable – determining the extent of an invention to be protected by a patent
- Analysis similer to Png (2017), but with number of patent claims as dependent variable
- Result: negative effect of secrecy on the number of claims (less disclosure)
  - Effect does not run parallel to effect on patents
  - Effect of secrecy on claims is considerably more robust than on patents

# What About Firm Market Value?

- Castellanata, Conti, and Kacperczyk (forthcoming *SMJ*) ask how stronger trade secrets protection (UTSA) affects the market value of firms.
- Data from private equity transactions.
  - Idea: companies are sold at least twice (over relatively short period). PE firm buys a target and sells it.
  - Assess effect of UTSA: treatment group are target firms located in states that adopted UTSA during PE firm holding period; control group are target firms located in states that did not
  - Sample of 1890 U.S. firms managed by 132 private equity firms
  - Main dependent variable is the internal rate of return (IRR) from acquiring a target (standard measure of performance in the context of such buyouts)

# Theory

- Positive effect on target market value when risk of worker mobility is higher:
  - Recall the theoretical motivation for IDD
  - Implicit assumption: UTSA adoption is employer-friendly

- Negative effect when target's industry displays more resource value uncertainty or simply highe risk of poor investments
  - Trade secrecy increases information asymmetry about value of IP between target and investor

# Results

- Positive effect of UTSA on target firm value
  - UTSA adoption increases target firm value by about 4.5%
- Inter-firm mobility of knowledge workers?
  - Increase in worker mobility by one standard deviation, increases market value of targets by 18%
- Resource-value uncertainty?
  - Increase in resource-value uncertainty by one standard deviation, reduces market value of targets by 29%
- Industry-level risk of poor investments?
  - Increase in risk by one standard deviation, reduces market value of targets by 16%

# Is too much trade secrecy bad for welfare?

# “Visibility of Technology and Cumulative Innovation: Evidence from Trade Secrets Laws”

with Imke Reimers (Northeastern University)

# Inventor's Trade-Off

- Patents
  - temporary monopoly rights
  - but: must disclose information

*Grand bargain of the patent system*

- Trade Secrets
  - no exclusive rights – law does provide for (some) legal protection of trade secrets!
  - but: no disclosure, indefinite

# Society's Trade-Off

- Patents
  - Information disclosed for others to access
  - but: temporary monopoly rights as barrier to access (DWL)

- Trade Secrets
  - No disclosure of information

# Society's Trade-Off: Initial and Follow-On Innovation

- Both: **ex ante** incentives
  - Trade secrets for non-patentable inventions *or*
  - patentable inventions where patents are not attractive: low-*visibility* inventions
    - Visibility (of use) is essential for enforceability of a patent
    - The less visible an invention, the more attractive is trade secrecy
- Trade secrecy (lack of disclosure) slows down **follow-on innovation**: Standing on proverbial shoulders depends on
  - Institutions (Scotchmer 1991, Boldrin & Levine 2004/2008, Reimers 2018, . . .)
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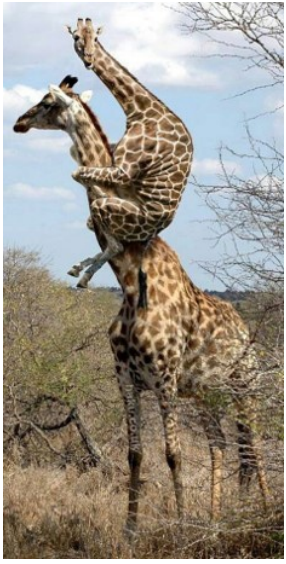

*Do you see?*

Product (visible)?

Process (not visible)?

# Does Patenting Change the Visibility of the Invention?

- Inherently visible (e.g., *product* invention): **No**

- Inherently non-visible (e.g., *process* invention): **Yes**

# Are Trade Secrets Bad for Welfare? Our Main Results

1. stronger TS protection: disproportionately less disclosure of inventions with lower visibility (processes)

2. stronger TS protection: negative **welfare** effects for technologies with relatively high R&D profitability

3. UTSA had negative average **welfare** effects for technologies/industries with high R&D profitability and positive effects for low R&D profitability

# Theoretical Framework:
# The share of process patents is decreasing as trade secrets protection increases.

- Inventor's choice: patent or trade secret
- Model:
  - Processes on average less visible than products
  - Visibility: value of patent ↗; value of trade secret ↘
  - Value of trade secret increases in legal protection of trade secrets
- Stronger trade secrets protection makes patents less attractive, and that effect is stronger for processes

# What is a Trade Secret?

- Any information a firm produces or collects and keeps to itself
  - Secret sauce
  - Customer list
  - Production process (e.g., peanut butter into Peanut Butter M&Ms)
  - Edison's "10,000 ways that won't work"
- In *this paper*: patentable inventions
  - **one third** of patentable inventions kept secret (Mansfield 1986)

# Data Sample

Sample: ~1.5 million single-state U.S. utility **patents** with priority dates between 1976 and 2008 (granted b/w 1976 and 2014)

- *single-state patents:* all U.S. inventors and U.S. assignees are from the same state
- *priority dates:* relevant date, closest to the disclosure decision (priority date of parent application to account for divisionals and continuations)
- **Process** vs. **product patent** indicator to proxy for visibility
- UTSA index by Png (2017)

| | Before UTSA | | After UTSA | |
|---|---|---|---|---|
| | Mean | SD | Mean | SD |
| Process patent | 0.428 | | 0.521 | |
| Number of process claims | 0.759 | 1.300 | 0.964 | 1.470 |
| Number of product claims | 1.812 | 1.810 | 1.951 | 1.920 |
| Observations | 680,766 | | 836,139 | |

- Process patent if at least one claim is a process claim – “aggressive" indicator
- Lower process shares for more conservative indicators – robust results

## Testing the Theoretical Prediction

The share of process patents is decreasing as trade secrets protection increases.

# Empirical Strategy

- Staggered introduction:
  - different states adopt the UTSA at different points in time
- Change in variable of interest:
  - effect of adoption of UTSA plus *something else*
- Comparing states that adopt at some time *t* with states that do not adopt at that *t*
  - allows us to account for that *something else*

- What remains: effect of stronger trade secrets protection on our variable of interest

# Baseline Estimation Results

| Dep. variable: =1 if process patent | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Trade Secrets Protection | -0.018** | -0.021** | -0.026*** | -0.026*** |
| Patent complexity controls | N | Y | N | Y |
| Patent value controls | N | N | Y | Y |
| State, year, USPC class FE | Y | Y | Y | Y |
| Observations | 1,475,058 | 1,465,095 | 907,867 | 899,932 |
| $R^2$ | 0.300 | 0.345 | 0.289 | 0.337 |

At mean increase in TS protection (0.36) and baseline share of process patents (0.428):

- UTSA leads to mean decrease of 2.2% of the probability that a patent is process patent

# Heterogeneity

- Size
  - Individuals, small firms, large firms
  - Effect driven by individuals and small firms

- Technology classes
  - NBER technology classes
  - Effect driven by chemicals, electronics, and mechanics

# Identification and Too Many Robustness Checks

- Identification
  - Instrument for UTSA using other uniform acts
  - Placebo test (enactment two years earlier)
  - State-specific time trends
  - Propensity score matching across states
- Alternative definitions for disclosure timing and location
- Alternative definitions of process patents
- Drop software patents

# Structural Estimation and Welfare Results

# Three-Stage R&D Model

## Stage 1: Initial R&D

- Inventor observes potential invention (an idea)
- forms expectations about commercial
- incurs R&D cost if decides to develop the idea

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## Stage 3: Follow-on Innovation

- For any initial invention *i*: one potential follow-on invention
- Probability of follow-on innovation with trade-off:
  - effective visibility of initial invention (**function of disclosure**)
  - barriers to access (**patents' "anticommons effect"**)

*Do you see shoulders to stand on? Can you stand on them?*

# Modeling Follow-On Innovation

1. Other firms engage in follow-on innovation
   - Sampat and Williams (2018)
2. Disclosure has a positive effect on follow-on innovation
   - Williams (2013) and Gross (2019)
3. Anticommons: patents on early ideas raise costs of creating future ones
   - Galasso and Schankerman (2015); Gaessler, Harhoff, and Sorg (2018)
4. Disclosure in patents is perfect
   - Roin (2005) and Fromer (2009) vs. Furman et al. (2018)

# Societal Trade-off

Stronger trade secrets protection results in

1. higher **ex ante R&D incentives**
2. more potential for follow-on innovation (more shoulders!)

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Stronger trade secrets protection results in

1. higher **ex ante R&D incentives**
2. more potential for follow-on innovation (more shoulders!)

. . .but also . . .

3. **less disclosure** of non-self disclosing inventions (processes)
   - retards knowledge diffusion and follow-on innovation
4. more exclusivity and increased market power for the secret holder
   - larger **deadweight loss**

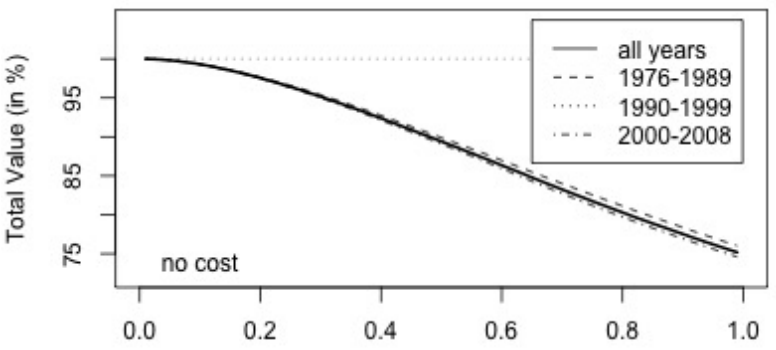
# Estimation Challenge and Approach

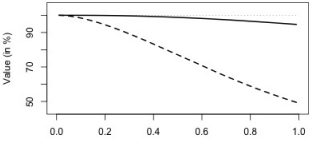
- Find:
  - Ex ante distribution of visibilities for processes and products
  - Ex ante distribution of invention types (processes or products)
- Data:
  - Patents: process or product (the Stage-2 decision)
  - Strength of trade secrets protection
- Estimate:
  - Step 1: Conditional on stage-1 R&D, estimate *conditional distributions* for visibilities and invention types.
  - Step 2: For a given R&D cost, using SMM, estimate *unconditional distributions*.
- Simulate all three stages

# Welfare Results

1. What is the effect of trade secrets protection on welfare?
2. How did the UTSA work out?

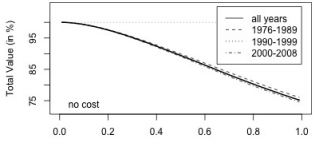
# (1) No R&D Costs: Negative Effect of TS Protection

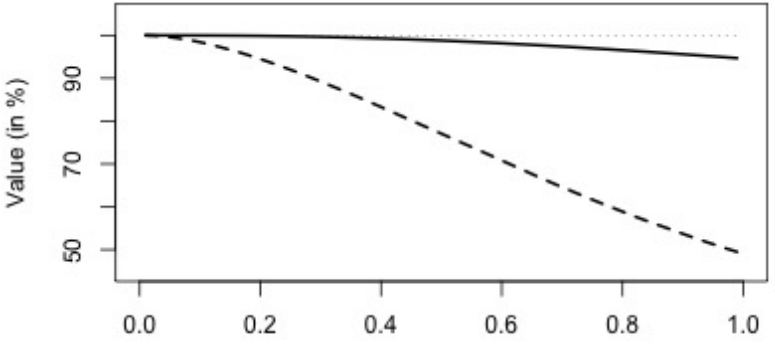



- For no R&D costs, stronger trade secrets protection has an unambiguously negative effect on welfare

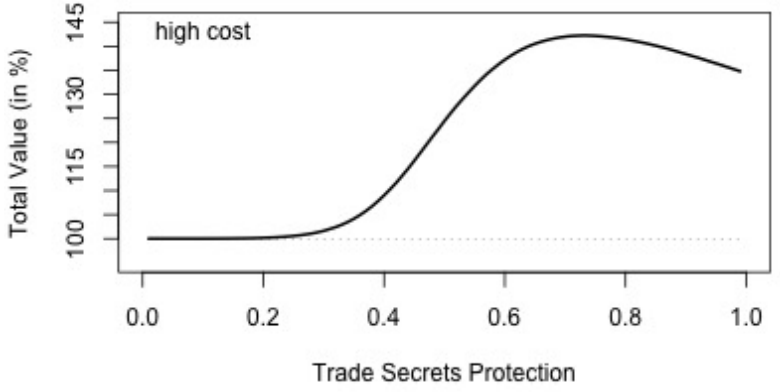
# (1) No R&D Costs: Negative Effect of TS Protection




- Stronger trade secrets lead to less disclosure of low-visibility inventions $\rightarrow$ detrimental for follow-on innovation (dashed)
- Ex ante incentives are ineffective for no R&D costs; only a negative DWL-effect (solid)

# (1) High R&D Costs: Maybe Positive Effect of TS Protection





- For high R&D costs, stronger trade secrets protection can have a positive overall welfare effect

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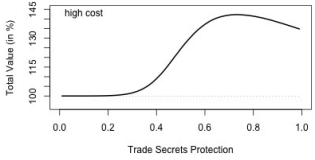
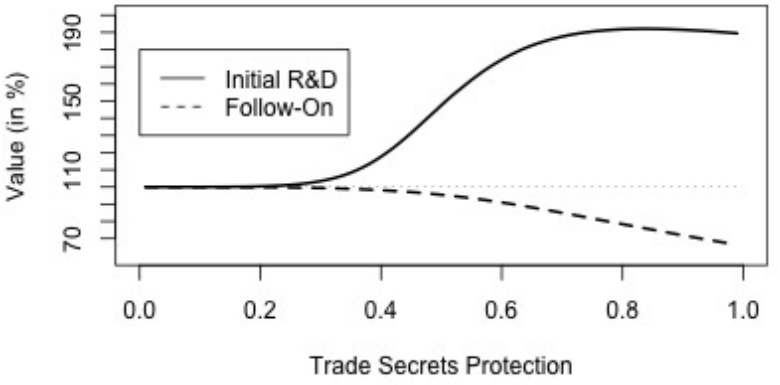


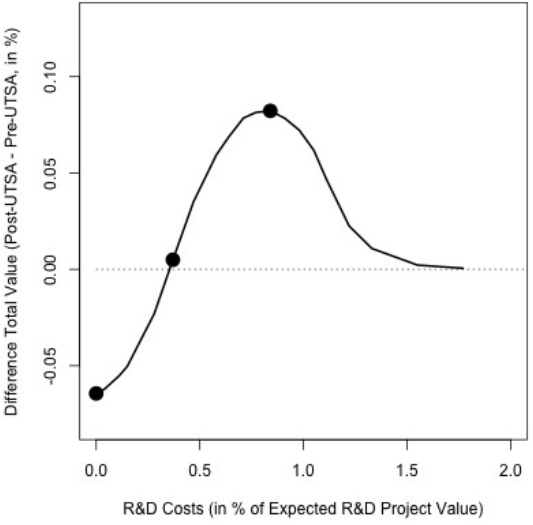



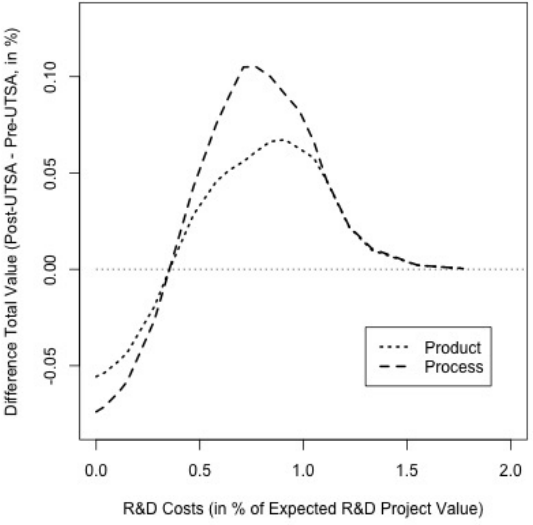

- Negative effect of stronger trade secrets on follow-on innovation prevails (dashed)
- With high R&D costs, the ex ante incentive effect is effective and more than offsets the negative DWL effects (solid)

# (2) Negative Average Effect for High Profitability R&D

$$\Delta W = \frac{W(\tau^{\text{post}}) - W(\tau^{\text{pre}})}{W(\tau^{\text{pre}})}$$

# (2) Negative Average Effect for High Profitability R&D



# Summary of Results

- Patent vs. trade secret: a function of invention's "visibility" and strength of trade secrets protection
- Stronger protection has disproportionately negative effect on disclosure of processes (= less visible inventions)
- From the structural model:
  - TS protection with negative effect on welfare for relatively profitable R&D
  - negative average effect of UTSA for industries with relatively profitable R&D and positive for less profitable R&D

# Quo Vadis?

Directions for future research:

- Movement of workers/inventors and contractors
- Patent vs. trade secrecy trade-off
  - So far only indirect evidence – and valuable survey results.
  - We hardly observe raw inventions
- Entrepreneurship
  - Does entrepreneurship in California thrive despite or because of more stringent trade secrets protection laws (but no CNC enforcement)
- Collaboration between businesses