KU LEUVEN

10th Annual Summer School on Data and Algorithms for Science, Technology & Innovation (ST&I) Studies

The Dark Side of Licensing: How Contract Design Influences Inventor Mobility

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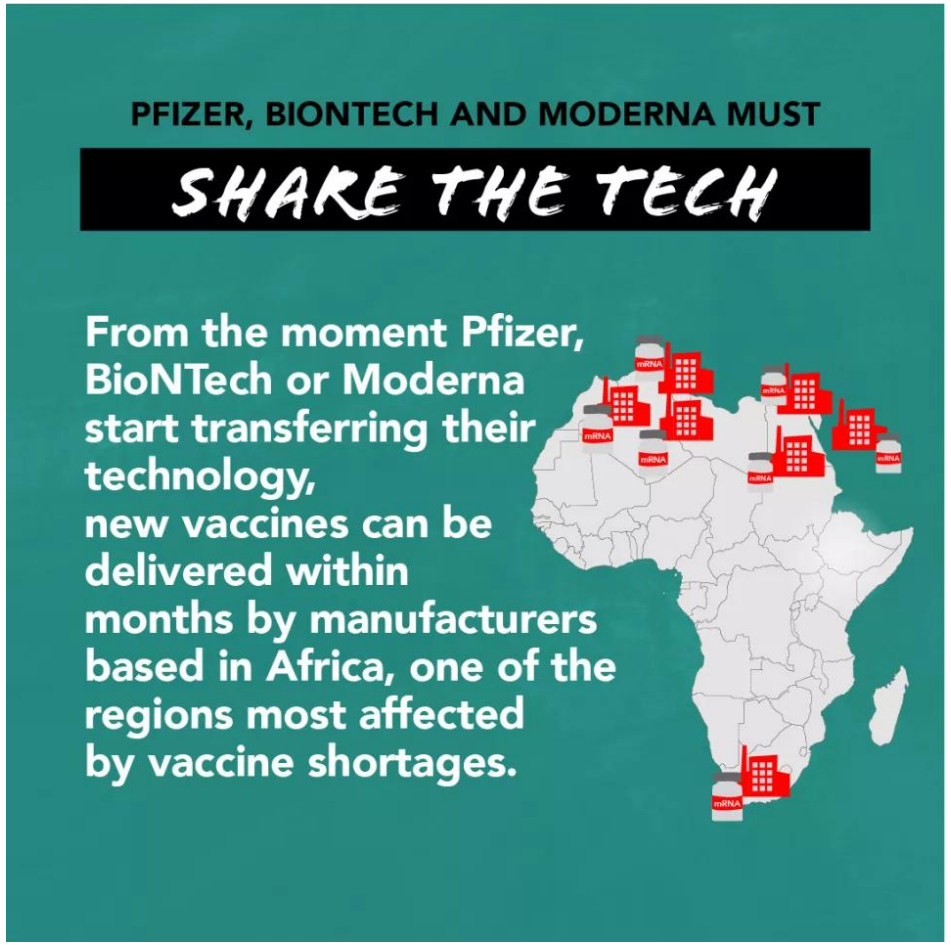
Pfizer BioNTech mRNA licensing deal COVID vaccine



BioNTech's licensing partnership with Pfizer generated €18.9bn in revenues in 2021 (vs €482.3mn in 2020) - nearly a 40x increase

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But licensing may have an unexplored a negative (dark) side...

- Traditional licensing literature focuses on the trade-off between revenue generation and profit dissipation through increased competition (Arora, Gambardella & Fosfuri, 1999)
- **However, there's a potential third dimension: inventor mobility**
- When firms license technology, they may inadvertently trigger the movement of key inventors to licensees
- This could undermine the licensor’s long-term ability to capture value from their own innovations

Research questions

- **RQ1:** How does outlicensing affect the mobility of inventors associated with the licensed patented technologies?

- **RQ2:** Do specific contract design elements (i.e., relational contract clauses) moderate the relationship between outlicensing and inventor mobility?

Licensing contract design

- **Technology licensing contracts are typically formal, detailed, and enforceable** (Hagedoorn & Hesen, 2007), **yet they may include relational elements** like technical support and joint committees that foster sustained interactions between parties

- **Biopharma contracts** tend to include relational clauses (Hagedoorn et al., 2009)
  - ~60% of biopharma deals embedded in broader partnerships

- **Managerial contract literature** (Hanisch et al., 2024; Weber & Mayer, 2011) suggests relational elements may moderate mobility effects, but this hasn't been tested systematically in licensing contexts

H1: Outlicensing and inventor mobility

- **Outlicensing increases inventor visibility** by exposing licensed inventions and creating awareness of inventor expertise among licensees and other industry participants who become aware through the licensing event (Agarwal et al., 2009; Marx et al., 2009)
- **Tacit knowledge complementarity drives hiring incentives** as firms seek access to tacit knowledge that complements codified patent knowledge for successful technology commercialization (Agrawal, 2006)

Then access through licensing interactions allows:

➢ Licensees gain insider knowledge of inventor capabilities

➢ Natural targeting for poaching by licensees or others aware of the expertise

H1: *Inventors whose patented technologies are included in outlicensing agreements exhibit higher mobility rates compared to similar inventors whose technologies are not licensed*

H2: Moderating effect of contract design

Competing hypotheses on moderating effect of contract design (transactional vs. relational) on the relationship between licensing and inventor mobility

- **Knowledge transfer mechanism (weakens H1)**
  - Relational contracts stimulate tacit knowledge transfer through frequent interactions between licensors and licensees (via joint committees, technology transfer, etc.), reducing the need to poach inventors of licensed technology
- **Exposure mechanism (strengthens H1)**
  - Relational contracts increase inventor visibility by involving them in interactions between licensors and licensees (via joint committees, technology transfer, etc.), which allows licensees to better assess their unique inventor capabilities

H2: Moderating effect of contract design

Competing Predictions:

H2a ("Knowledge transfer effect"): *Relational elements in licensing contracts* ***reduce*** *inventor mobility following outlicensing*

H2b ("Exposure effect"): *Relational elements in licensing contracts* ***increase*** *inventor mobility following outlicensing*

Note: Transactional contracts may include explicit non-poaching clauses

Data & methodology

We use a novel dataset consisting of **3,558 technology licensing contracts** from the BioSciDB licensing deals database

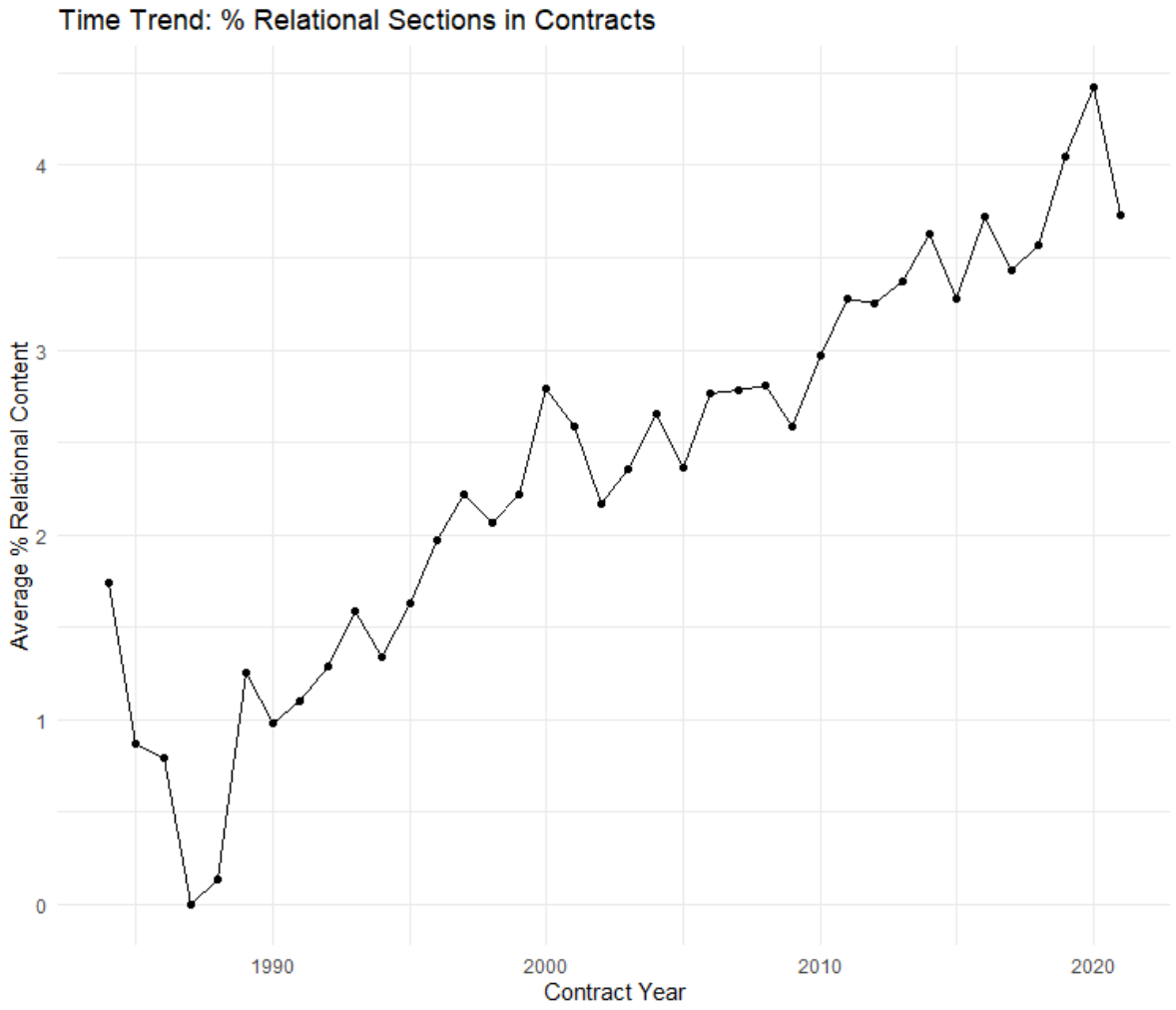
- Obtained all contracts as PDF of which we extracted and pre-processed the text
- Partitioned pdf files into sections representing clauses, resulting in *340,111 contractual clauses*
- We draw on prior work to identify instances of relational contracting in the clauses (e.g., Hanisch et al., 2024; K, Lumineau, Mellewigt & Ariño, 2021; Samant & Kim, 2023)
- Complement dataset with patent information (PATSTAT), firm consolidation (ORBIS – Bureau van Dijk), and inventor-level data (USPTO PatentsView)

Custom pipeline

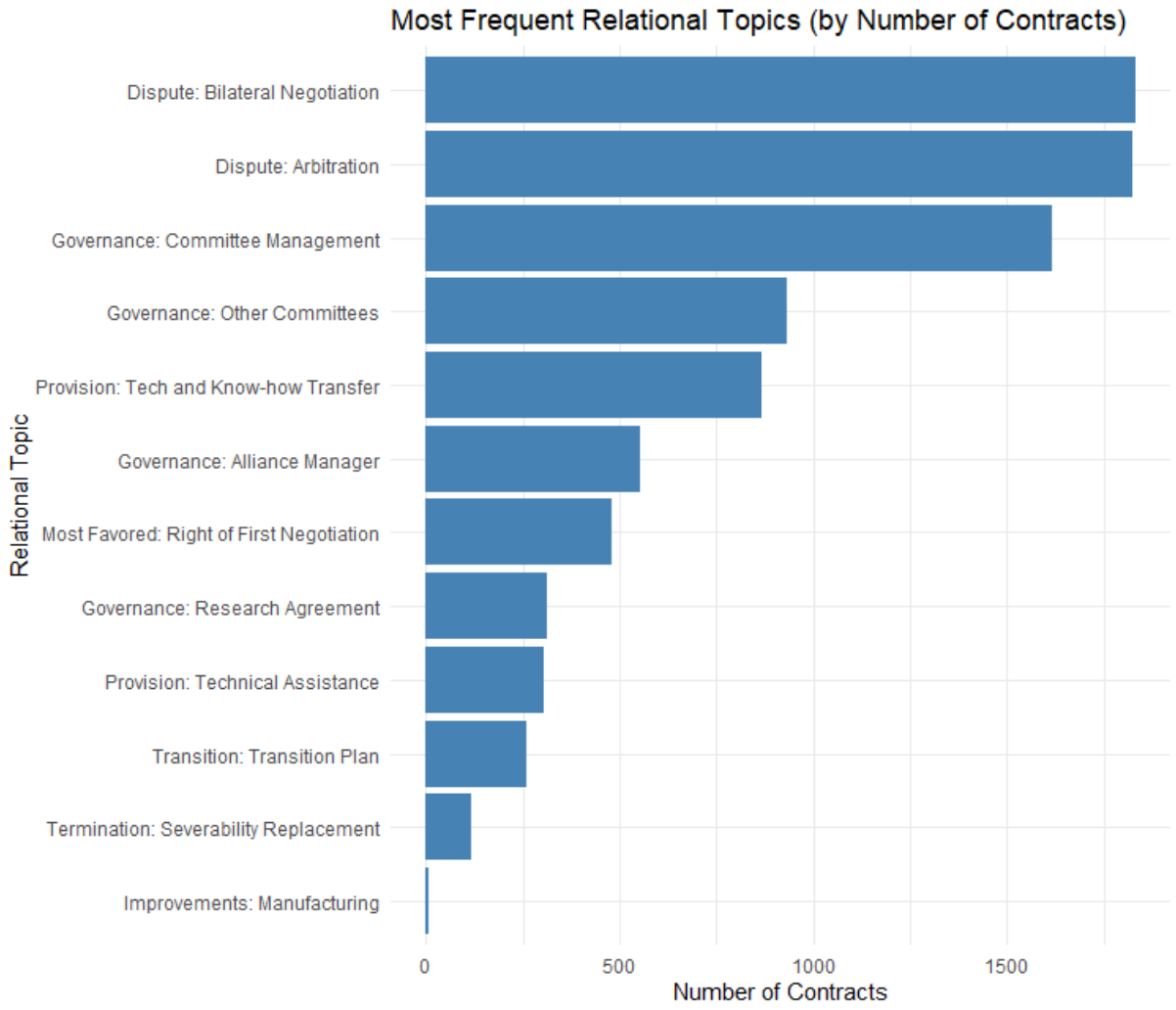
For the contracts we developed a custom pipeline to classify 340K clauses combining NLP techniques, with vector embeddings and automated classification

- **Contract clause taxonomy:**
  - Cluster analysis of word embeddings of the contract clauses
  - Consensus review procedure to label 107 clause types into 19 primary categories, identifying 13 as relational clusters (out of 107)
    - Eg. Joint committees, know-how transfer, bilateral negotiation, …
- **Validation:** Montecarlo simulation and LLM generated clauses
- **Scale and coverage:** Relational clusters account for 23,000 clauses and 84.8% of all contracts contain at least one relational cluster
  - 6.8% of all clauses are relational (7.5% of contract text)

Relational contracting: Time trend



Relational contracting: Most frequent clauses



Identification strategy

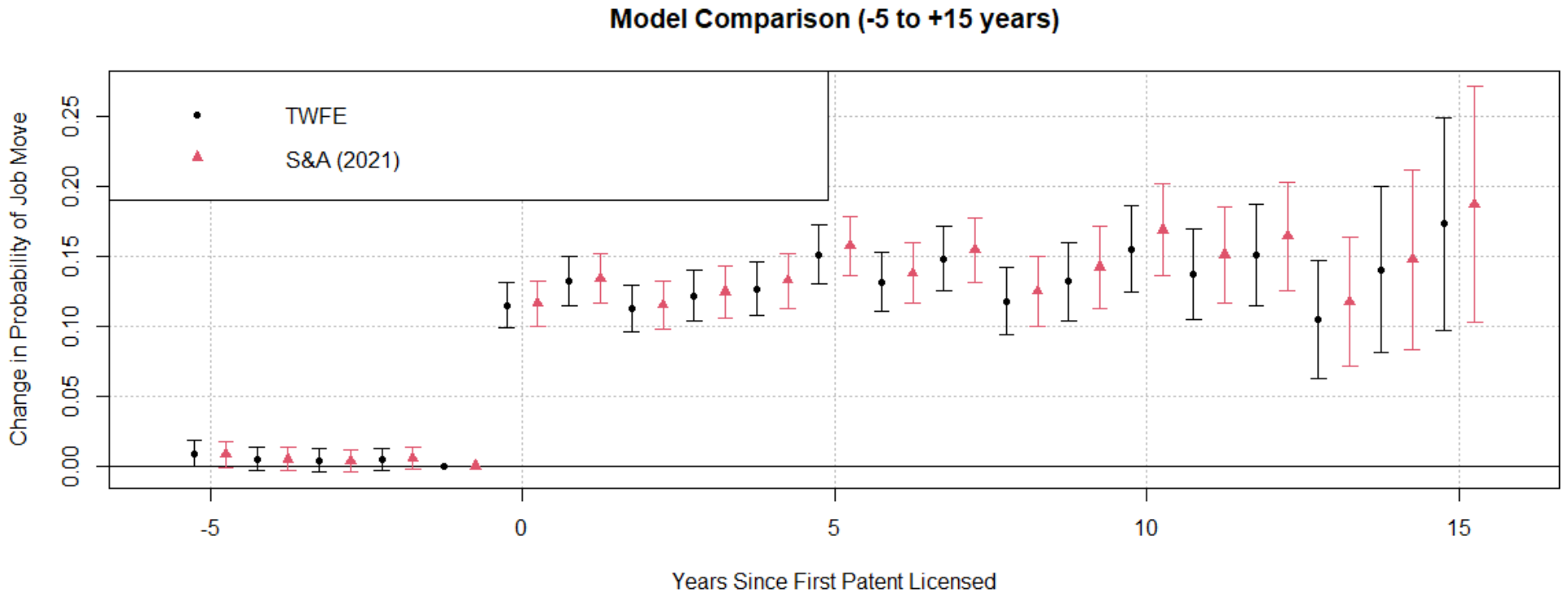
✓**Empirical Approach - Staggered DiD** (Sun & Abraham, 2021) **and TWFE**: We exploit temporal variation in licensing events with inventor, assignee, and year fixed effects to absorb time-invariant unobservables

Treatment definition:

- Focal company inventors whose patents were outlicensed vs. those inventors whose patents have not been outlicensed
- **Inventor mobility tracking**: via patent records (Melero et al., 2020)
- Patent data consolidated yearly to account for structural changes over time

Preliminary findings

- Licensing events increase inventor mobility by **13-20 p.p.** in the post-licensing period
- Effects persist and mildly strengthen over 10+ year window
- Consistent across Sun & Abraham (2021) and a baseline TWFE specification



Next steps

- **Licensee Specific Mobility Analysis:** Examine moves specifically to the licensee firm versus other firms to test our theoretical mechanism that licensing creates privileged access and targeted hiring incentives
- **Analyze heterogeneity in contract design:** Test whether specific relational clauses (technical support, joint committees, collaborative arrangements) moderate the licensing-mobility relationship
- **Matching:** Ensure comparability between treated and control inventors by matching on inventor, firm, or region/country characteristics.

Additional Robustness Checks:

- Two-step control function approach to address endogeneity of licensing decisions
- Practitioner interviews for validation of theoretical mechanisms

Potential contributions

- Empirically examine inventor mobility as an under-explored consequence of outlicensing

- Bridge managerial contract design literature (Hagedoorn & Hesen, 2007; Weber & Mayer, 2011; Hanisch et al., 2024) with inventor mobility research (Hoisl, 2007; Marx et al., 2009; Melero et al., 2020; Palomeras & Melero, 2010)

- Theoretically extend the licensing trade-off framework beyond revenue vs. competition (Arora & Fosfuri, 1999) to include human capital retention

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