

# **How do Internal and External Contracts Differ? Evidence from the Semiconductor**

## **Industry**

### **Abstract**

Firms often use internal formal contracts between organizational units to govern transactions within firms. However, there is little empirical evidence of what is included in internal contracts and how they differ from contracts used between firms. Using a novel data set of internal and external formal contracts from firms in the semiconductor industry, we empirically investigate their contents using topic modeling. The results indicate that internal contracts focus more than external contracts on enforcement and property rights. In contrast, external contracts place more emphasis on the specification of terms and deliverables, compensation, and contingencies. This study demonstrates how the use of formal contracts in transactional governance differs within and between firms, an understanding of which is critical to managers given the ubiquity of internal transactions and the prevalence of internal formal contracts.

Keywords: intra-firm contracting, internal transactions, formal contracts, governance, property rights, organizational units, topic modeling

**\*Working Paper – Please do not cite without the authors' permission.**

## INTRODUCTION

Organizational economists generally treat the decision to internalize a transaction as a discrete choice that constitutes a distinct governance structure (David and Han, 2004; Tadelis, 2002; Walker and Weber, 1984) and focus on the use of formal contracts for transactions between firms (Elfenbein and Lerner, 2003; Lo, Zanmarone, and Ghosh, 2022; Reuer and Ariño, 2007), ignoring choices for internal transactional governance. However, the conditions that make markets imperfect are likely to persist within the firm, albeit in different ways (Eccles and White, 1988; Jacobides and Winter, 2005; Nickerson and Zenger, 2008). In fact, recent studies provide evidence that firms often use formal contracts to govern transactions between organizational units (Magelssen, 2020; Magelssen, Rich, and Mayer, 2022; Markovits and Rauterberg, 2018; Rauterberg, 2016).<sup>1</sup> These studies have theorized the role of internal formal contracts (Magelssen *et al.*, 2022; Rauterberg, 2016) and provide evidence of their validity (Magelssen, 2020). To date, however, no study has systematically assessed the content of internal (within the firm) formal contracts and how they are similar to or different from external (between firms) formal contracts.<sup>2</sup> This is an important omission as the differences can shed light on the use of formal contracts as a governance mechanism within firms as well as the nature of the firm and how it handles transactions differently than in hybrid or market settings (Williamson, 1991).

The purpose of this study is first to understand the primary issues addressed in internal contracts and second how these issues may differ from those in external contracts.<sup>3</sup> The content of

---

<sup>1</sup> Formal contracts are written agreements between two or more parties that define for the exchange the terms and conditions, rights, compensation, and enforcement mechanisms (Markovits and Rauterberg, 2018). While internal and external formal contracts have these elements, their relative weight to different issues within the contract may be different based on their transactional governance needs.

<sup>2</sup> In this paper, we refer to wholly owned units as “within the firm” or “internal” and partially or fully separately owned (i.e. non-wholly owned) as “between firms” or “external.”

<sup>3</sup> Our focus is not on when firms will use formal contracts, but rather, conditional on having an internal contract for a transaction, we ask what are the central elements focused on in the contract.

contracts is important because it affects transactional performance and the incentives of the parties involved (Mayer and Argyres, 2004; Ryall and Sampson, 2009). We argue that internal contracts can help infuse market-like elements for transactions between organizational units to reduce some of the shortcomings of hierarchy. Common ownership of assets is a distinct aspect of hierarchies that creates ambiguity over property rights for transacting units (Magelssen *et al.*, 2022). This leads to transactional issues within firms associated with coordination and incentives for the effective management of firm resources (Ostrom and Hess, 2000), including weaker internal incentives for efficiency than external transactions, moral hazard issues from liabilities and problems with centralized authority. We expect internal contracts to address these transactional issues by focusing on assigning property rights, the most important of which are intellectual property (IP) rights, and addressing liabilities and enforcement.

We use a novel confidential dataset of 164 internal and 312 external formal contracts and employ topic modeling on the corpus of contracts to systematically assess the qualitative content of the contracts. This approach allows us to leverage the dataset's richness to identify the contracts' central issues rather than impose theory on the data (e.g., Shah, Agarwal, and Echambadi, 2019). We begin by creating a baseline topic modeling analysis on the external contracts and reconciling the results with extant theory on external contracts. We then apply the analysis to internal contracts to ascertain their salient issues and shed light on the use of formal contracts for governing internal exchanges. Finally, we employ the topic modeling on the pooled set of internal and external contracts to help understand the differences between internal and external transactional governance.

The topic modeling analysis of external contracts identifies enforcement, compensation, roles and responsibilities, IP rights, contingencies, communication, and specification of transaction

details as primary contractual topics. These topics align with theories and research on the role of formal contracts in safeguarding the exchange against opportunism (Williamson, 1975), facilitating adaptation and coordination (Bernstein and Peterson, 2020; Carson *et al.*, 2006; Luo, 2002), and clearly defining transaction boundaries (Macneil, 1973).

The results indicate that internal contracts place significant emphasis on property rights, including specific rights, control rights, and IP rights, as well as liabilities, enforcement, and compensation. These results are generally confirmed in the topic modeling analysis of the pooled corpora of internal and external contracts. In comparing the relative weight of topics in the pooled analysis, we find that while liabilities are relatively similar in prevalence for both internal and external contracts, there are significant differences between internal and external contracts in several topics. Internal contracts focus more than external contracts on enforcement and property rights. In contrast, external contracts place more emphasis on the specification of terms and deliverables, compensation, and contingencies.

We contribute to the literature on transactional governance by theorizing the transactional issues that will influence internal contract design. The findings underscore that authority does not address all transactional problems, and the features that make formal contracts useful in governing external exchanges can also do so for internal exchanges. Firms face internal transactional issues from reduced incentives and internal politics (Hölmstrom, 1979; Williamson, 1991). Our study suggests that the enforcement provisions are important features in internal contracts to hold units accountable for non-performance or noncompliance with the transaction, thus increasing the motivation to adhere to internal transactions and reduce subversive behaviors and politics.

We also contribute to the literature on transactional governance by extending our understanding of the differences between internal and external formal contracts. Our work

highlights the adaptable complementarity between formal contracts and the institutional context in which they are situated – the market or hierarchy. In markets, firms have well-developed IP rights laws they can employ for their rights. In firms, the units do not have such rights. The results indicate that assigning IP rights to units is a prominent feature of internal formal contracts. Delineating unit rights can be essential for managing IP and fostering value creation within firms. Additionally, assigning control rights are a primary component of internal contracts, which leaves room for adaptation. As long as it is clear which unit has control, all the specifics for the transaction do not need to be contracted in writing ex-ante. In contrast, separate ownership determines authority for each transacting firm in external contracts. The parties precisely detail the expectations for what and how goods and services will be delivered. The detailed requirements in external contracts set clear transactional expectations and enable the parties to identify better when a party does not adhere to the agreement.

The theory of the firm has focused on the role of authority in driving intra-firm coordination and incentives (Coase, 1937; Williamson, 1975). The results on the contents of internal formal contracts highlight that while very useful, previous studies of the internal organization may be limited in their ability to explain the governance of internal transactions. A theory of internal exchange requires a focus on the means of effecting that exchange. Theories of internal organization have focused on how firms organize their units and their personnel, which, while important, may limit the ability of these theories to fully address the issue of how firms (as sub-economies or even sub-societies, i.e. Gartenberg and Zenger, 2021) manage internal transactions among business units. Understanding how internal and external contracts differ is a vital first step in understanding the key mechanisms and governance of internal exchange, distinct from, but complementary to, examining the structure of organizations.

## **THEORETICAL BACKGROUND**

Coase's (1937) seminal paper asking the fundamental question, "Why do firms exist if markets work perfectly?" spurred a field of research studying the costs of using price in markets to coordinate transactions and when transactions will be brought within firm boundaries to be coordinated by authority (Klein, 1988; Klein, Crawford, and Alchian, 1978; Williamson, 1975, 1991). An extensive line of work in this field examines external formal contracts for structuring the exchange relationship and safeguarding market transactions (Elfenbein and Lerner, 2003; Faems *et al.*, 2008). Formal contracts are tools to ex-ante address transactional problems to facilitate a successful exchange relationship (Williamson, 1975).

Since formal contracts are incomplete, when market transactions face significant hazards arising from uncertainty, observability, and verifiability, the costs of transacting in the market are greater than the costs of internalization (Williamson, 1985). In such cases, transactions are brought within the firm's boundaries to be coordinated by authority, with disputes resolved by fiat (Williamson, 1985). This notion of incomplete contracts causing transactions to be internalized has, in part, led scholars to overlook the use of formal contracts within the firm.<sup>4</sup>

From a theoretical standpoint, scholars have often focused on the firm as a unitary structure and its advantages from common ownership (Segal and Whinston, 2013). Yet, asserting that firms may perform better than markets under certain conditions is not the same as asserting that firms will perform perfectly (Gibbons, 1999). As aptly stated by Gibbons (1999), "Why should firms be oblivious to conditions that wreck markets?" Common ownership can lead to substantial

---

<sup>4</sup> A second reason why internal formal contracts have been overlooked is the idea that the business judgement rule makes them non-enforceable in courts of law (Bolton and Dewatripont, 2013; Williamson, 1991). However, this argument does not consider the role of formal contracts as greater than one of enforcement (e.g. formal contracts are also used to facilitate coordination and adaptation) and that many firms are corporate groups with subsidiaries that have legal rights that can be upheld in courts of law (see Magelssen *et al.*, 2022 for a discussion).

transactional problems within firms (Ostrom and Hess, 2000). Internal transactions are still executed by separate individuals or units, albeit under one organizational umbrella. Different incentives, interests, and understandings of the parties involved and operating under hierarchical authority means that some transactional issues persist within the firm and new ones emerge.

Assuming that authority effectively governs all internal transactions understates the costs of information for efficient resource allocation, aligning interests, and resolving conflict within firms (Coase, 1937; Eccles and White, 1988; Jacobides and Winter, 2005; Nickerson and Zenger, 2008). The emphasis on authority overlooks a variety of possible transactional governance mechanisms that the firm can employ, including internal formal contracts. Similar to the usefulness in addressing transactional problems between firms, formal contracts may also help address transactional problems within firms.

We lack an understanding as a field about the provisions central to internal contracts. Considering the extensive work on the content of external contracts, we first review the literature on external contracts before theorizing about the primary elements of internal contracts.

### **External Contracts**

Existing research highlights several transactional issues that external contracts address. Early work from an economics perspective focused on the hazards from opportunism and bounded rationality in market exchanges and the role of external contracts in enforcement and incentives for the parties to adhere to the exchange (see Macher and Richman, 2008 for a review). More recent research has highlighted the adaptation and coordination problems in market transactions and how external contracts can clarify parties' roles, responsibilities, and control rights (Mayer and Argyres, 2004). We discuss these below.

**Enforcement.** A substantial body of research emphasizes formal contracts as enforcement

tools, safeguarding the parties against ex-post opportunism from hold-up over specific investments, shirking, and misappropriation of value (Klein *et al.*, 1978; Oxley, 1997). Enforcement provisions include non-compete clauses, breaches, claims, and escalation processes to follow before a third party addresses a dispute, adjudication by third parties, and termination (Devarakonda, McCann, and Reuer, 2018; Zanarone, Lo, and Madsen, 2016). These provisions reduce the scope of defection and safeguard parties' interests in the execution of the exchange (Devarakonda *et al.*, 2018).

**Compensation.** Compensation provisions align the interests of parties to adhere to the agreement. Price terms can mitigate opportunism in incomplete contracts, allocate risks, and motivate adaptation (Baumann, Becker, and Horrmann, 2020; Camuffo, Furlan, and Rettore, 2007; Zanarone *et al.*, 2016). These provisions entail incentive terms for goods and services, including general compensation and benefits, as well as penalties and rewards under certain conditions, such as achieving milestones or failure to meet planned schedules.

**Roles and Responsibilities.** A fundamental aspect of contract design is defining the roles and responsibilities of the parties in the relationship (Macneil, 1973). In external exchanges, problems can arise if parties do not fully understand each other's expectations in the exchange (Mayer and Argyres, 2004; Reuer and Ariño, 2007). Roles and responsibilities provisions are informative clauses on contractual obligations, rights to transactional resources, and information to execute a transaction (Argyres and Mayer, 2007). These provisions can determine the transaction boundaries and reduce genuine misunderstandings between the parties.

**Contingencies.** Transactional disturbances are a central source of problems for market transactions because parties may opportunistically take advantage of the changing situation, or they may have fundamental misunderstandings and expectations of how to adapt (Luo, 2002).



Formal contracts help parties navigate challenges that may arise during execution by specifying the details for coordination, adaptation processes, and the information sharing necessary (Bernstein and Peterson, 2020; Carson *et al.*, 2006; Keller *et al.*, 2021; Reuer and Ariño, 2007). Contingency provisions on how to adapt, including what changes will be made and the systems and processes to follow when the need for adaptation arises, provide a bilateral understanding of how each party will respond if contingencies arise (David and Han, 2004; Tadelis and Williamson, 2013).

**Control Rights.** To address transactional problems with coordination, formal contracts often entail provisions that provide a hierarchical structure to the relationship. Clauses assigning control rights establish which party has the right to make decisions that cannot be contractually specified (Lerner and Merges, 1998). For instance, decision rights are assigned, such as when to patent an innovation, what alterations to make to an innovation, or when to stop production (Gambardella, Panico, and Valentini, 2015; Lerner and Merges, 1998). Provisions may also establish shared control rights, as is the case when the contract specifies setting up a steering committee to make decisions that guide the transaction (Devarakonda *et al.*, 2018; Gambardella *et al.*, 2015), cover monitoring (e.g. quality control, auditing, reporting, and inspection systems), and decision rights for modifications to contractual provisions (Gulati and Singh, 1998; Stinchcombe, 1985). These elements imbue markets with authority properties.

In summary, the literature on external contracts indicates that they are used between firms to provide safeguards to enforce the terms of the agreement; incentives for parties to adhere to the agreement, be efficient, and adapt; define each party's role and responsibilities; contingencies for adaptation; and to impose hierarchical property of authority.

We expect that, similar to external contracts, internal contracts will be designed to address transactional issues. Internalized transactions face distinct challenges from market transactions;

therefore, we expect this to lead to different foci of internal contracts.

### **Internal Contracts**

A fundamental distinction between market and internal firm transactions is that once a transaction is embedded within the firm, there is common ownership of the transacting parties (Grossman and Hart, 1986; Hart and Moore, 1990). As a result, the transacting parties no longer have well-defined property rights to their control over, development, use, exploitation, and value appropriation of assets and resources.<sup>5</sup> Property rights define what parties can and cannot do regarding a resource or asset (Ostrom, 2003). Whereas the laws around property rights are well-developed for transactions between firms, there are fewer legally defined property rights for transactions between organizational units.<sup>6</sup> Laws are clearer when a party violates property rights in transactions between firms than within firms. Ambiguity over unit property rights leads to incentive and coordination problems for the development and use of firm assets (Ostrom and Hess, 2000).

When there is a common pool of assets that parties may use, they often over-exploit, underinvest, or otherwise fail to effectively manage the assets to maximize their value (Libecap, 1993). These problems arise because common ownership reduces parties' incentives to mitigate harmful effects on others (Alchian, 1989; Libecap, 1993). Parties have reduced incentive to put the assets to their best use and may engage in strategic activities to exploit them for their personal benefit or to benefit a specific division or unit of the firm in a way that reduces its overall value to the corporation. Individuals and units often prioritize their interests above others in the organization (Roberts, 2007). They may fail to exert sufficient effort or solve problems if it is not in their interest to do so (Roberts, 2007), and they may take actions at other units' expense (Alchian

---

<sup>5</sup> We refer to "assets and resources" more simply herein as "assets."

<sup>6</sup> We use the term "fewer" because there are some property rights laws regarding organizational units in different jurisdictions (e.g., state, province, country, etc.) and the legal entity status of the unit (e.g., subsidiary or branch).

and Demsetz, 1972). This can lead to lower transactional performance from conflict, shirking, moral hazard, and inefficient decisions (Magelssen *et al.*, 2022).

While authority may be used to coordinate internal transactions and resolve disputes, the problems of using authority have long been acknowledged. Coase (1937) suggests that as the number of transactions within the firm increase, the costs of internal organization rise, where the firm is less likely to put the factors of production to their best use. Williamson (1985) considers firms as the organizational form of last resort because of weaker incentives and the opportunity for bureaucratic distortions. Gibbons and Henderson (2012) note that firms frequently face an administrative problem where top management cannot get the organization to do what they want. Managers often engage in strategic information sharing, subversive behaviors, and political activities to access and control resources (Hölmstrom, 1979; Jensen and Meckling, 1979).

Extant research on the role of formal contracts suggests that internal contracts can clearly and credibly assign property rights to units within the firm (Magelssen *et al.*, 2022). Scholars have theorized that formal contracts will be used in firms to reveal information and provide rights to enforcement when there are information asymmetries and problems with internal politics (Rauterberg, 2016) and to secure units' rights in cases where there are issues with liabilities, lack of clarity from unit differences or transactional complexity, or when there is specialized expertise that makes intervention costly (Magelssen *et al.*, 2022). These studies, however, do not empirically examine internal contracts. Internal contracts are a transaction-level governance mechanism that delineates unit rights when the exchanges cross organizational unit boundaries. Below, we focus on these main internal transactional issues and theorize that firms will use provisions in formal contracts to assign property rights, address liabilities, and enforcement to alleviate these issues.

**Assignment of Property Rights.** We expect firms will incorporate provisions to assign

property rights to units in the formal contracts to address coordination and incentive issues associated with having a common pool of assets. Assets have bundles of various rights that can be allocated to different parties (Foss and Foss, 2005). A distinction is often made between “specific rights”—that is, the rights to perform specified activities in return for a set income—and “control rights”—that is, all residual rights (including decision rights and income rights) not specifically assigned to other parties (Grossman and Hart, 1986). For instance, a unit may be assigned the right to distribute a product in a particular region for a set return on sales but not the right to develop the product further, alter it, or change the product’s pricing. The unit assigned control rights will have the right to make decisions over the product’s modifications and future development, pricing changes, and any other decisions that might come up during the transaction execution that are not explicitly granted to the unit with specific rights. By their very nature, specific rights assign roles and responsibilities to the unit. They establish what a unit can and cannot do regarding the firm’s assets and resources in the transaction. As discussed below, we anticipate that both rights will be present in internal contracts. Moreover, we expect that IP is an area where issues associated with ambiguous property rights within firms will be particularly important.

***Roles and responsibilities.*** Specific rights assigned in contracts include rights to perform activities, access and use firm resources, and when the property rights for goods and services transfer between organizational units. These provisions clarify the roles, responsibilities, and incentives of the units in the exchange to pre-emptively reduce potential transactional problems from misaligned expectations. It resolves problems with underinvestment and inefficient resource allocation by delineating parties’ rights to use the resource and their rights to income from it (Aghion and Tirole, 1997). Property rights for the use of assets can incentivize effective management of the asset and its value (Demsetz, 1967; Libecap, 1993). We, therefore, expect firms

to employ such provisions to address issues from the lack of well-defined internal property rights.

***Control rights.*** We expect that firms will assign control rights to units in internal contracts to address transactional issues stemming from centralized control and reduced incentives. Information asymmetries and bounded rationality limit top management's ability to understand all the contingencies and repercussions of decisions for a transaction. Transferring the information necessary for top management to effectively allocate resources can take time and be subject to manipulation or distortions as information is relayed up the chain of command (Aghion, Bloom, and Van Reenen, 2014; Gibbons and Henderson, 2012). Although firms can use organizational structure to delegate broad control rights to units, often transacting units may be at the same organizational level or in separate divisions or may simply need a more nuanced allocation of control rights for a specific transaction than can occur at the unit level.

Contractual provisions for control rights can allocate decision-making authority to the unit best positioned with the information and expertise to manage the assets effectively. When there is ambiguity over control rights, conflict can occur over strategic decisions such as how to respond when contingencies arise, the direction of development, project selection, and the processes for innovating. Units may also take misaligned actions or not propose or execute ideas because they believe their decisions will be overruled. Assigning control rights for the goods, services, activities or assets associated with the transaction clarifies who is in charge when transactional issues or contingencies arise and which unit will operate under the direction of or on behalf of the other unit. Control clauses may also entail rights for monitoring and reporting (Argyres and Mayer, 2007).

Individuals have private benefits from control. Control rights motivate parties to incorporate local information in the decision (Dessein, 2002; Foss, Laursen, and Pedersen, 2011), exert effort (Aghion and Tirole, 1997), and take the initiative (Magelssen, 2020). It induces relationship-

specific investment (Merges, 2005) and can enhance efficiency and responsiveness to contingencies (Lawrence and Lorsch, 1967). It helps to ensure that those with the relevant information and expertise decide how to adapt when disturbances arise. Thus, as a transaction-level governance mechanism, we expect firms to incorporate control rights to address these transaction-level issues.

***Intellectual Property Rights.*** We expect problems with ambiguous property rights will be particularly costly for IP. IP is often a crucial value source that is strategically important to the firm (Zhao, 2006). Transactional issues over what and how units contribute and their relative contribution to IP cause tension between transacting units, especially since contribution to IP value is generally hard to assess. Effective management of IP requires fostering new development, exploiting the IP, and avoiding issues from moral hazard in teams and value misappropriation. Firms may strategically want to exclude units from accessing these critical assets (Zhao, 2006). Contract terms limiting unit rights to access IP can protect it from knowledge leakage or distortions if the unit cannot maintain its quality.

It is important to have clarity over which unit holds IP control rights to incentivize its effective management. Knowledge workers are motivated when they are allocated decision rights over research projects (Aghion and Tirole, 1997). By assigning rights to the IP, the contracts provide an expectation of the units' rights to access, use, control and exploit the value created from the IP.

***Liabilities.*** Common ownership of assets gives rise to problems with externalities where parties' actions can create pecuniary or nonpecuniary costs or benefits for other parties that did not choose to bear it (Demsetz, 1967; Libecap, 1993; Segal and Whinston, 2013). A particularly relevant externality for internal transactions is liabilities, the potential costs from failed products, projects, or service errors (Magelssen *et al.*, 2022). For instance, a manufacturing unit with poor

quality control can have negative externalities on a distribution unit that loses customers because of problems with product quality. Internally, this is meaningful to managers because the performance of their unit is often used to determine bonuses and raises, firings and promotions, and resource allocation. Liabilities can be a source of conflict within firms when one unit bears the consequences of another unit's actions. Managers are frequently motivated to shift liabilities to others, underinvest when liabilities are borne by others, and more generally to respond self-interestedly (Macleod and Malcomson, 1989; Roberts, 2007).

We expect internal contracts to specify units' obligations in the form of liabilities. Provisions for liabilities include warranties, indemnifications, and claims, essentially limiting, restricting, and/or capping each unit's right to certain types of damages upon the other unit's failure to meet the contract's specified obligations. These provisions ensure that the unit whose actions are primarily responsible for problems ex-post bear the costs associated with them (Segal and Whinston 2013). Crucially, it enables the firm to track manager performance and punish or reward managers accordingly. This incentivizes managers to mitigate the problems for which they are responsible and adapt to manage adverse outcomes (Aghion and Tirole, 1995; Demsetz, 1967).

**Enforcement Provisions.** Existing research on the role of internal contracts raises the importance of providing enforcement mechanisms for internal transactions (Magelssen *et al.*, 2022; Rauterberg, 2016). We expect that firms will employ enforcement clauses in internal contracts to motivate individual and team performance to adhere to the agreement and reduce internal politics and the need for escalating issues to top management.

Incentive misalignment problems are larger within than between firms (Williamson, 1985, 1991). GM spun off Delphi, and Ford spun off Visteon due to issues with their inefficiency and charging high prices to their captive internal customers. Internal suppliers may underperform, and

conflict can arise around meeting deadlines, delivering quality goods, performing the promised task, and pricing (Eccles and White, 1988). Compensation systems often do not fully resolve transactional incentive problems.

Work on hierarchy and transactional governance has failed to address the cost to managers of raising disputes with those above them in the organization. While disputes can be and sometimes are raised to higher level managers to adjudicate, the managers raising the issues implicitly signal that they cannot address the issues on their own and have to reach out for help to those in higher authority. Continually asking for such help can make managers appear ineffective and adversely affect their performance reviews and career advancement. Thus unit managers have strong incentives to establish transactional governance to preempt problems and manage dispute resolution without appealing to fiat to address issues arising in an exchange between their units.

Rauterberg (2016) argues that internal contracts temper internal politics by providing alternative adjudication mechanisms that move dispute resolution away from the direct chain of authority (Rauterberg, 2016). Because authority can be subject to political influence activities, it is beneficial to have an alternative enforcement mechanism within firms. Internal contract enforcement provisions include the actions parties can pursue if a breach occurs and how disputes will be arbitrated, which may entail assigning the dispute arbitration to a third-party unit within the firm, a panel of peers, internal court system, a board appointed independent arbitrator, or courts of law (see, e.g., Appendix A comparing internal and external contract court enforcement clauses), etc. (Magelssen *et al.*, 2022; Markovits and Rauterberg, 2018; Rauterberg, 2016).<sup>7</sup>

Enforcement provisions expose units to sanctions, claims and penalties, transactional

---

<sup>7</sup> Williamson (1991) argues that any internal formal contracts will be unenforceable in courts of law. However, this premise overlooks corporate groups where the firm is composed of legal entities (subsidiaries) that have legal rights to contract (Bethel and Liebeskind, 1998). Magelssen *et al.* (2022) provide a discussion of court enforcement.



terminations, and reputation costs if they violate the agreement terms and therefore help safeguard the agreement. These provisions can reduce the likelihood of top management intervening in a way inconsistent with the agreement because it can undermine their reputation (Magelssen *et al.*, 2022). Having a mechanism to enforce the agreement enhances the credibility that the property rights allocated will be respected during the execution of the exchange.

## **METHODS**

An extensive literature theorizes and empirically tests the determinants of transactions governed internally versus externally. Many factors, some endogenous to the firm, are likely to affect the decision to transact inside or outside the firm. This paper aims to understand the content of internal formal contracts, not to identify which activities are internally versus externally transacted. However, we need a baseline understanding of the content of external contracts to more fully understand internal contracts and how the governance of transactions within firms might differ between firms. We, therefore, start with an analysis of external contracts, then employ the same analysis to internal contracts, before conducting a pooled internal and external contract analysis.

### **Data and Sample**

We compiled a unique, confidential dataset of internal formal contracts and publicly available external formal contracts from firms in the semiconductor industry. The internal contract data was collected under a confidentiality agreement, and for that reason, all firm-specific information is redacted, and any data is presented in averages so as not to identify any of the firms in the sample. The semiconductor industry was chosen based on three primary criteria: (1) it has connections to many other industries as it is a competitive industry with multiple players, valuable intellectual property, and an essential role for manufacturing; (2) the ability to obtain the confidential internal contracting data; and (3) it is an industry scholars have previously studied the design of external

contracts (e.g., Cabral and Leiblein, 2001; Gugler and Siebert, 2007; Leiblein and Reuer, 2004).

There are 164 internal contracts from eight semiconductor firms in the dataset. The internal contracts are between wholly owned subsidiaries of the firms. The eight semiconductor firms had an average revenue of \$1.2 billion (USD) over the sample period. The contracts cover the period from 1997-2011. The internal contracts are material transactions to the firm as defined by international transfer pricing regulations (see, e.g. OECD 2017). While the sample contains both main contracts and addendums, our analysis focuses on the main contracts and excludes all subsequent addendums.<sup>8</sup>

For the external contracts, we first searched for all publicly available material contracts for the eight semiconductor firms represented in the internal sample over the sample period via the SEC Edgar database and LawInsider, a subscription-based contract and clause database. During the sample period, the SEC required that public companies report in their entirety, irrespective of the materiality of the information, any contracts made in the ordinary course of business if the contract was entered into within two years before the filing (see 17 CFR §229.601(b)(10)). We also searched LawInsider, which extracts contracts from publicly available SEC filings and other publicly available documents (e.g., exhibits in court cases) and Google, to allow us to capture more contracts. The external contracts reflect all external contracts available through third-party data sources over the sample period on the firms in the sample. Publicly reported contracts are frequently used by scholars studying inter-firm contracts (Berlin, Nini, and Edison, 2020; Nini, Smith, and Sufi, 2009).

We collected from SEC Edgar and LawInsider databases external contracts (between two or more firms) for firm transactions such as research and development (R&D), engineering,

---

<sup>8</sup> Addendums are the subject of future research.

distribution, manufacturing, sales, services, technical services, collaboration/alliance, OEM, license, technology, co-development, buy-sell, vendor, commissionaire, marketing, freight, and transportation. We separated any contracts that were combined into one document (e.g., in the case of amendments that are complete contracts that follow the main contract).

Our search for the eight semiconductor firms' external contracts yielded nine external contracts from four firms. We, therefore, expanded our search to include external contracts on these eight firms' competitors. Using Capital IQ, we collected the names of the competitors of the focal firms. We cleaned the list of competitors to remove those companies not related to the semiconductor industry and those incorporated after the sample period. There were 115 unique competitors listed in Capital IQ that met these criteria. We then searched the SEC Edgar database, LawInsider, and Google for all available external contracts on the transaction types searched for the semiconductor firms as listed above. We found 303 external contracts on these topics from 29 firms listed as competitors of the focal semiconductor firms to add to our sample of external contracts. The other competitor firms were either private, below the size threshold for reporting to the SEC, or did not have material contracts publicly available of the focal contract types in SEC Edgar, LawInsider, or Google search. The resulting set of competitors has an average total revenue, total assets, and R&D intensity over the sample period not significantly different from the eight semiconductor firms (see Appendix B). The final set of external contracts includes 312 contracts on the specified transaction types from 33 firms.

Of note, our final semiconductor industry sample of 164 internal contracts represents the largest and most comprehensive set of internal contracts analyzed to date; combined with the 313 external contracts, we have a total sample of 476 contracts. The sample size is consistent with that used in external formal contract analyses. For example, Ryall and Sampson (2009) compare fifty-

two contracts via a coding scheme they develop to inform the theoretical insights they derive. Similarly, Mayer's work on the contents of contracts in the information technology industry is based on approximately 400 contracts between a single supplier and their customers (e.g. Argyres, Bercovitz, and Mayer, 2007; Kalnins and Mayer, 2004; Mayer and Salomon, 2006; Weber, Mayer, and Macher, 2011). Work by Lerner and Schoar (2005) examines 210 private equity deals, and work by Lerner and Malmendier (2010) examines 584 biotech research agreements between R&D and financing firms.

Existing research hand-codes, to some degree, the contracts (Adegbesan and Higgins, 2011; Ryall and Sampson, 2009; Weber *et al.*, 2011). Larger-scale empirical analysis of contracts has been limited by the difficulties of working with detailed formal contracts. Our systematic analysis of the internal and external contracts provides a framework for analyzing and understanding contracts that can be replicated in future research on different corpora of contract data.

Before analyzing the data, we redacted all contracts of legal entity names and sensitive information to maintain anonymity. Redacting both internal and external contracts is critical to ensure continuity across the topic modeling and that company and product names were not inadvertently attributed meaning in the topic modeling. We replaced legal entity names with party monikers and sensitive information with a broad classification of what the redacted information contained (e.g., “[Product Detail]” refers to details regarding the product). We also redacted identifying product or component information, individual names, contact information, and websites. We then reviewed and cleaned each contract for formatting issues and spelling errors from the optical character recognition (OCR) software processing of contracts.

## **Methodology**

Topic modeling objectively analyzes large bodies of text without asserting preconceptions about

it (Furman and Teodoridis, 2020; Teh *et al.*, 2006). Topic modeling algorithms are used for prediction, not inference, meaning they can reveal the latent structure of a corpus of texts to predict with high accuracy where a new text would fit into that structure (Furman and Teodoridis, 2020).

We use the hierarchical Dirichlet process for our topic modeling (HDP; Teh *et al.*, 2006). The HDP topic modeling algorithm is considered unassisted machine learning because it does not require pre-specification of the number of topics to group the text. HDP is a probabilistic model that employs a hierarchical Bayesian analysis of the text (e.g., Buntine and Jakulin, 2004; Hofmann, 1999; Teh *et al.*, 2006). HDP identifies the optimal number of topics per corpus of text analyzed. The data are assumed to be characterized by a set of observed variables (words in the document or vocabulary) that develop from a set of hidden variables (the topic structure)(Teh *et al.*, 2006). The algorithm generates collections of words (topics) that are found to appear together in the input text with a certain probability. Essentially, the input text is “assigned” to topics with a certain probability. Topic modeling allows us to compare texts for qualitative differences in topics.

Considering the novelty of our dataset, we use HDP first on the 312 external contracts to confirm that the content of the external contracts aligns with previous research and understand the validity of our methodology. Then, we leverage the same topic modeling procedure on the internal contracts. Finally, we combine the internal and external contract corpora to conduct a pooled topic modeling analysis. This pooled analysis uses the word frequency per topic and per contract to examine whether internal or external contracts influence a given topic more. Taken together with the separate HDP analyses of external and internal contracts, the pooled analysis allows us to confirm that the HDP results from the separate corpora likely reflect the topics of the contracts. This multi-step approach allows us to not impose our theory on the data by looking for measures to hand code but rather to reveal the critical content of the internal contracts from the data.

For our HDP analysis, we use *tomotopy*, a Python-based extension of *tomoto* (topic modeling tool), which uses collapsed Gibbs sampling (CGS) to infer the distribution of topics and words. We specified the parameters  $\alpha$ , which indicates to the model how similar the documents are in terms of the topics they contain (low  $\alpha$  signals that the documents vary in topics and topic distributions) to 1.2 and  $\eta$ , which sets the prior distribution over word weights in each topic, to .008. We removed standard stop words and words that appear in the corpus fewer than ten times (e.g., Teh *et al.* (2006)). The same HDP parameters were used on the external, internal, and combined corpora for consistency.

Notably, these analyses are not dynamic; an analysis of the evolution of topics over time will be the subject of future research. However, to address the time variable, we employ a term frequency-inverse document frequency (TF-IDF) similarity where the frequency of words is weighted by the HDP-generated score that captures the relevance of each word for each topic.

For the pooled analysis, we analyze the internal and external contracts together as input into the HDP algorithm and add code to output contract identifiers and weighted word frequency per contract in a given topic, in addition to the words comprising each topic. This allows us to analyze to what extent words in each contract (internal or external) affect topics in the combined corpus.

### **Descriptive Statistics**

Table 1 shows the number of internal and external contracts in the dataset. The average number of external and internal main contracts per firm is 10.1 and 20.5, respectively. Internal contracts have a greater proportion of amendments to total main contracts than external contracts (40.9% compared to 16.6%, respectively). This could indicate more adaptation of the formal contract over time within firms. Whereas five internal contracts assign a transaction to another entity within the firm and four contracts terminate a transaction, there were no such external formal contracts

available for the semiconductor firms. Overall, the assignments and terminations are consistent with organizational changes such as M&As, restructurings, and strategic changes leading to contractual changes within the firms.

-----Insert Table 1 here-----

Table 2 contains the average word count per contract. External contracts have an average of 421 more words than internal contracts, or 19.5 percent more than internal contracts.

-----Insert Table 2 here-----

Next, we examine the kinds of transactions contracted internally and externally. In our sample, internal contracts often covered multiple transactions such as R&D, sales, and services. In contrast, external contracts tend not to bundle transaction types, and instead, firms have separate external contracts for each transaction type. Table 3 contains the number of main contracts based on the transaction type. For contracts that bundle multiple transaction types together, we code it based on the principle transaction type.<sup>9</sup> The table shows that the dataset contains R&D; manufacturing; sales and distribution; marketing; services; licensing; collaboration, and technology purchase contracts in internal and external contexts. There were only internal contracts for management services. Consistent with internalization theories, the proportion of R&D, sales and distribution, and marketing contracts are greater for internal than external contracts. Low-value-added services are a large proportion of externally contracted transactions.<sup>10</sup>

-----Insert Table 3 here-----

## **RESULTS**

### **External Contracts Topic Modeling Results**

---

<sup>9</sup> For instance, if a contract is primarily focused on distribution with some additional post-sale services we code it as primarily a distribution contract.

<sup>10</sup> Of note, one firm in our external contract sample (a competitor firm) had a significant number of licensing external contracts. This firm is an outlier in the dataset with 60 external licensing contracts. Removing this firm reduces the sample by 94 formal contracts but does not materially change the results discussed in the paper.

Table 4 summarizes the HDP topic modeling results for external contracts. The analysis indicates that enforcement, IP rights, roles and responsibilities, compensation, contingencies, specifications, and communication are salient topics in external contracts.

---Insert Table 4 here---

Enforcement and compensation conform to existing theories and research on the role of formal contracts in safeguarding against opportunism in external transactions and aligning incentives to adhere to contract terms (Klein, 1989; Williamson, 1979, 1985). The topics of roles and responsibilities, contingencies, and communication are consistent with research on formal contracts' facilitating coordination and adaptation for the transaction (Bernstein and Peterson, 2020; Carson *et al.*, 2006; Luo, 2002). Specifications align with formal contracts defining and clarifying the transaction (Macneil, 1973). We did not ex-ante theorize the topic of IP rights in external contracts. However, this result is consistent with prior work that has discussed IP rights in terms of allocating control rights for coordination (Gambardella *et al.*, 2015; Lerner and Merages, 1998) and enforcement (Devarakonda *et al.*, 2018). Overall, our results for external contracts conform to existing research.

### **Internal Contract Topic Modeling Results**

Table 5 contains the HDP topic modeling results for internal contracts. Consistent with our theory on formal contracts focusing on transactional issues associated with common ownership of assets, the results indicate that enforcement, IP rights, liabilities, control rights, and roles and responsibilities are prevalent topics in internal contracts. Although we did not directly theorize compensation as a central topic, it is consistent with formal contracts instilling market-like characteristics within firms (negotiated and agreed-upon prices) to address incentive problems.

---Insert Table 5---



To visualize the relative weights of the keywords for each topic, we construct word clouds of the HDP topic modeling output (see Figure 1). The word clouds support our analysis.

---Insert Figure 1 here---

The initial external contracts topic modeling analysis identified contingencies, specifications, and communication as important topics, but these topics were not identified in the internal contract analysis. In contrast, control rights and liabilities were identified as important topics for internal contracts, not external ones. These results imply that applying theories and findings from research on external contracts to internal contracts may miss important aspects of internal transactional governance. Internal formal contracts have distinct elements they emphasize based on the aspects that are needed to address transactional issues in the different institutional contexts. To understand better how the content of internal contracts diverges from external contracts, we now turn to a pooled analysis of internal and external contracts.

### **Pooled Internal and External Contract Topic Modeling Results**

We pool the internal and external contracts for the HDP topic modeling analysis to identify the top topics across all contracts and the relative weight of internal versus external contracts for each topic. In Table 6, the primary topics for the pooled analysis are IP rights, enforcement, roles and responsibilities, specifications, contingencies, compensation, and liabilities.

---Insert Table 6 here---

We then construct bar charts of the word frequencies per contract of each of the pooled analysis topics (see Figure 2). These charts indicate the extent to which internals versus externals had relatively greater weight in the content associated with the topic.

---Insert Figure 2 here---

Figure 2 shows significant differences between internal and external contracts in several

topics. Internal contracts focus more than external contracts on property rights, including IP rights and specific rights assigning roles and responsibilities. They also focus more on enforcement. In contrast, external contracts place more emphasis on the specification of terms and deliverables, contingencies, and compensation. We find that liabilities are relatively similar in prevalence for both internal and external contracts.

The results of enforcement provisions having relatively more weight in internal contracts than external contracts are consistent with firms needing to address weak internal incentives to perform. The enforcement provisions can impose penalties and rewards and hold units accountable for transactional non-performance or noncompliance, thus increase the motivation to adhere to the agreement and reduce subversive behaviors and politics. In an interview, a senior manager of a large firm explained that the enforcement clauses in internal contracts are crucial for motivating employees to adhere to the contract. As the manager explained,

*“The enforcement gives it teeth. Otherwise, if we don’t get the reward when we do all the work, we have no incentive to perform. [With enforcement] everyone will be a bit careful about it because it affects the teams individually, and it will end up affecting the reputation of the project manager and the bonuses by how well you perform compared to what you said you would do.”*<sup>11</sup>

The quote from the manager also demonstrates how internal formal contracts strengthen relational contracts by harming the manager’s reputation if the manager does not adhere to the agreement as specified in the contract. It also suggests that the firm may have more levers to discipline managers in the context of internal transactions than for inter-firm transactions. Another manager echoed this idea: *“formal contracts are more enforceable within firms than between in that the firm has a variety of tools through which it can use to make parties adhere to the contracts.”*<sup>12</sup> It can use contractual violations to not give bonuses, fire employees, allocate

---

<sup>11</sup> Information provided in an interview with a senior manager of engineering firm on February 16, 2022.

<sup>12</sup> Information provided in an interview with a manager from a financial services company on March 19, 2020.

resources, or pass over managers for career promotions. Internal contracts also specify adherence to accounting standards, foreign corrupt practices laws, and international trade and export laws. Enforcement clauses can uphold the agreement terms and hold employees accountable.

The emphasis of internal contracts on property rights, such as control rights and rights to IP, is aligned with our theory that the institutional environment of the firm can lead to transactional issues that the formal contract seeks to address. Formal contracts delineate unit rights with enforcement mechanisms, which alleviate some issues from common ownership of assets.

Qualitatively examining the contract texts, we find that external contracts provide greater detail in specifying what is required in the exchange. To illustrate, it is not uncommon for external contracts to specify components to the millimeter on a design. In contrast, the contract typically states that the party will follow the other party's direction for similar internal contracts.

A representative example from our dataset is a firm with a subsidiary that contracts another subsidiary internally and a third party externally to perform R&D activities to develop products.

The contract between two subsidiaries within the firm specifies:

*[PARTY A] hereby engages Contractor, and Contractor hereby agrees, to devote all of its product design, development, and support efforts exclusively to the design, development and support of Developed Products and Improvements, all in accordance with the terms and conditions of this Agreement. Contractor shall not undertake or perform any similar services for any other person, firm, corporation or other entity without the prior written authorization of [PARTY A] .... Contractor will, in consultation with [PARTY A], determine which Developed Products and Improvements it shall devote its design, development, and support efforts to hereunder. At [PARTY A] 's option, [PARTY A] may from time to time, with the agreement of Contractor (which agreement shall not be unreasonably withheld), define Specifications, performance milestones, and/or schedules for completion of particular Developed Products and Improvements.*

The above redacted excerpt from the internal contract demonstrates the flexibility built into the agreement for deciding what products to develop over time. In comparison, the following is an excerpt from a redacted external contract involving the same firm.

*Subject to the terms of this Agreement, [Party A] will render the services and develop the*

*Deliverables described in Exhibit B (“Development Schedule”), based upon Exhibit A (“Specifications”), which development schedule and/or Specification may be modified by the Parties from time to time in accordance with the procedures described in Section 6.6 (“Modification of Specification”). [Party A] shall dedicate full-time employees of sufficient technical and professional caliber to define, develop, complete and verify the [Product] it develops with [Party B] in accordance with Exhibit B (“Development Schedule”), based on Exhibit A (“Specifications”), and will assist [Party B] in launching and supporting the resulting [Product] in accordance with the terms of Section 7.1 (“Technical Service and Support”). [Party B] has selected [Party A] to perform the services described in this Agreement based upon [Party B] receiving [Party A]’s personal services. [Party A] may not, therefore, subcontract or otherwise assign and delegate its obligations under this Agreement without [Party B]’s prior written consent.*

For this external contract, the Development Schedule, Specifications section, Modification Specification, and Technical Services and Support sections contained lengthy descriptions of precisely what was expected in the exchange. External contracts have greater detail to make up for the absence of hierarchies that complement formal contracts inside firms. In other words, they have to specify product and packaging characteristics to clarify what is expected because there are no administrative controls or authority in place overseeing firm trade in the same way that firms have. These specifications also help safeguard the transaction by documenting what was agreed to in the exchange. Considering that, unlike external transactions, firms can use authority and administrative procedures as complementary tools for governing internal transactions, this sheds light on how such complementary mechanisms affect the firm’s formal contracts.

### **Robustness Analyses**

We test the sensitivity of our results to different samples. First, to alleviate issues with unobserved firm differences affecting our results, we restrict the sample to only the four semiconductor firms with both internal and external contracts available. We have nine external contracts and 123 external contracts for these four semiconductor firms. Although the smaller sample size yields fewer topics from the HDP analysis, the results were similar to our main results, with enforcement, IP rights, control rights, and compensation as salient internal contract topics (Appendix C).

Second, we examine whether the results are sensitive to the industry by examining the internal and external contracts from a firm in the computer equipment industry (SIC 3577).<sup>13</sup> An advantage of the computer equipment firm is that, although there are fewer contracts than in our semiconductor industry sample, the company has internal and external contracts for similar functions (see Appendix D, Table D.I). Therefore, we can also study within-firm differences between internal and external contracts as a sensitivity test. We focus on the main contracts and exclude subsequent addendums. During the sample period, the computer equipment firm had an average revenue of over \$1.5 billion.<sup>14</sup> We used the 32 internal contracts material to the computer equipment firm defined by international transfer pricing regulations (see, e.g. OECD 2017) and the 11 material external contracts available from the company or SEC Edgar and LawInsider during our sample period. The external contracts were collected using the same methods for the semiconductor industry external contract sample. The HDP topic modeling results are consistent with the main analyses, with liabilities, enforcement, control rights and IP rights as salient internal contract topics for the computer equipment firm (see Appendix D).

Next, we examine whether the internal contract topic of IP rights is simply driven by the R&D and licensing contract types in the sample. We exclude R&D and licensing contracts and conduct the HDP topic modeling for the other contracts types (e.g. manufacturing, sales & distribution, services, etc.). The results indicate that IP rights are a central topic for internal contracts across the other contract types (see Appendix E). We also examine whether the results are sensitive to the kind of transaction contracted by performing separate analyses for R&D, service, and sales and distribution contracts. While these smaller samples yielded fewer topics, the results of these

---

<sup>13</sup> Data was collected under confidentiality agreement.

<sup>14</sup> The computer equipment firm operates in the computer equipment industry and is not part of the semiconductor industry sample. To maintain anonymity averages and other statistics are used in describing the data.

analyses are generally consistent with our main results.

As a robustness check to the validity of the HDP topic modeling results, we use latent Dirichlet allocation (LDA) topic modeling on the corpora. Using LDA, the researcher sets the number of topics for a given model to determine the number of probable latent topics. As is standard, we tested coherence values on different LDA models (different numbers of topics) to determine the best fit for the data. Based on these tests, the coherence values were highest with ten topics emerging from the external corpus, eight emerging from the internal corpus, and ten emerging from the combined corpus. We also ran these analyses with 5 through 10 topics and 15 topics. The resulting topics from the LDA analysis generally corresponded to the HDP output for topic modeling analyses on external, internal, and combined corpora.

### **Alternative Explanation**

One potential alternative explanation is that formal contracts are purely for transfer pricing purposes, and therefore, internal contracts will be designed to replicate external contracts to demonstrate that the internal transaction is at “arm’s length” (i.e. is similar to a market transaction). We observe significant systematic differences between internal and external contracts. These differences hold for the analyses restricting the sample to only those semiconductor firms with both internal and external contracts and to the computer equipment within-firm analysis (see Appendices C and D). As such, we do not find support that firms are merely replicating their external contracts when designing internal contracts.

### **DISCUSSION AND CONCLUSION**

One of the most fundamental questions managers face is how to govern transactions. Billions of transactions take place each day within firms and in markets. This study aims to understand the key conceptual topics in internal formal contracts and how these topics differ from those in external

contracts. Understanding the topics contained in internal formal contracts is crucial for shedding light on the theory of the firm and the governance of transactions. To our knowledge, this is the first study to empirically assess the content of formal contracts used within firms. As such, our work extends research on transactional governance from formal contracts between firms to within firms.

Using topic modeling, we uncover several key findings. First, the results, combined with qualitative evidence from interviews, indicate that internal contracts place significant emphasis on enforcement. The fact that internal contracts also use enforcement pushes against prior work asserting that formal contracts are not relevant within firms because they are unenforceable in courts of law (Bolton and Dewatripont, 2013; Williamson, 1991). Our interviews with managers demonstrate that formal contracts can provide credible means to enforce adherence to the contract terms and indicate that these clauses give the firm a mechanism to manage and hold employees accountable. The enforcement clauses credibly reward or punish managers and those in their units for their performance in fulfilling the agreement.

Second, we find that internal contracts assign transactional authority to units. A fundamental premise for the choice between markets and the firm is that the costs of governing transactions by fiat are relatively independent of contractual hazards (Riordan and Williamson, 1985; Williamson, 1991). Fiat is considered a relatively more efficient way of resolving disputes than litigation or haggling (Williamson, 1985). The use of internal formal contracts raises questions over the contractual issues arising from contracts used within firms and how features of hierarchies such as authority, ownership rights, and organization design might interact with formal contracts in such a way as to alter the internal hazards faced by firms.

Much research on formal contracts uses a transaction cost lens to understand contractual

relationships. The prevalence of property rights in internal contracts brings property rights theory to the fore. IP rights are a predominant topic in internal contracts, significantly more so than external contracts. This finding aligns with recent theory on the role of formal contracts in resolving problems associated with common pool resources within the firm by providing clear and credible commitments to unit property rights (Magelssen *et al.*, 2022). The findings imply that transactional governance might play an important role in effectively managing IP for the organizational units within the firm.

Our work underscores the adaptable complementarity between formal contracts and firms versus markets in the transactional context. Allocating authority and responsibilities are primary components of internal contracts, but external contracts focus more on the specificity of what is expected in the transaction. Assigning transactional authority and responsibility can help resolve clarity and credibility problems associated with unit property rights to a transaction (Magelssen *et al.*, 2022). This also delineates a unit's discretion in adapting to changes by clarifying who holds the right to make decisions when disturbances arise. In contrast, external transactions, which have authority separately held by the transacting firms, precisely detail the expectations for external transactions. This enables the parties to identify better when a party does not adhere to the agreement, but it also can be costly to specify in advance and reduce the flexibility for adaptation.

One important implication of this study is that scholars need a better theory of internal exchange. There are vast research streams on the internal organization of firms and how firms structure inter-firm transactions, yet little research (theoretical or empirical) on the structure of internal transactions can account for the prevalence of internal contracts utilized by firms. We suggest that scholars complement the extensive work on internal organization with work on the internal exchange. While the incentives managers have under different organizational structures



and whether to spin off or internalize different units are important strategic decisions, they are notably different from how firms govern internal transactions.

The unit of analysis is key as transaction cost economics focuses effectively on the governance of transactions, but the assumptions made about how internal transactions work need to be modified to understand internal transactions better. It is hard to fully understand the governance of internal transactions with the business unit or firm as the unit of analysis; each transaction has different attributes that need to be understood, as well as how formal contracts are used by firms for internal transactions to ensure enforcement or allocate control rights. The asset is the unit of analysis for property rights theory. However, formal contracts specify the assets' specific and control rights for the transaction. Williamson argued that the transaction is an important unit of analysis, and we wholeheartedly agree. While we disagree with some of his assumptions about the nuances of how transactions are governed within hierarchies, a focus on internal transactions will yield a much richer understanding of internal exchange, an important task practically and theoretically, when considering that much of the world's trade takes place within firms.

There are several limitations to this research. First, theory holds that there will be systematic differences between transactions that are internalized versus those that are externalized. Therefore, any internal transaction will likely have some unobservable characteristic that drove it to be brought within firm boundaries. It is impossible to rule out the endogeneity of differences between internal and external transactions driving the differences between internal and external contract topics. However, we believe that even if such differences exist, they support the idea that the role of formal contracts differs internally from externally because the nature of internalized transactions differs. We view this as an initial first step in understanding differences, and future research might be able to disentangle such causes in contractual differences. Second, although our sample is the

largest sample of internal contracts analyzed to date, it is a relatively small sample. Internal contracting data generally are not publicly available. We hope that changes in regulations on the reporting of intra-firm transactions may make internal contracts more available in the future and that, in the meantime, scholars will undertake the task of collecting from firms larger datasets.

There are many fruitful avenues of research that follow from this work. First, understanding the relationship between internal contracting and organization design can provide theoretical insights into transactional governance within firms. Second, our analysis focuses on topic modeling to analyze the content of contracts. Future research can utilize alternative means of studying content, such as using theoretically driven dictionaries to understand internal contracts' psychological and social aspects and how internal contracts might differ in framing, affect, and property rights from external contracts. Finally, our study raises important questions regarding enforcement and authority within firms. Examining qualitatively and empirically the implications of firms' use of internal contracts can generate important theoretical insight into both performance differences between firms and the boundaries of the firm.

Methodologically, our study provides a systematic way of analyzing contract data. Large-scale empirical analyses of external contracts are scarce. Existing work on formal contracts typically hand-codes variables and topics from the contracts. Accordingly, this study contributes a systematic way to analyze large sets of contracts that can provide actionable insights to scholars and practitioners about transactional governance.

Our study reveals that we should extend theories of formal contracting from focusing on market and hybrid formal contracts to those between units within hierarchies. The results generate insights into how contracting is similar and different within firms from the standard predictions in the literature. This study is the first step. We hope it lays the groundwork for future research.

## REFERENCES

- Adegbesan JA, Higgins MJ. 2011. The intra-alliance division of value created through collaboration. *Strategic Management Journal*. John Wiley & Sons, Ltd **32**(2): 187–211. Available at: <http://doi.wiley.com/10.1002/smj.872>.
- Aghion P, Bloom N, Van Reenen J. 2014. Incomplete contracts and the internal organization of firms. *Journal of Law, Economics, and Organization* **30**(1): 37–63.
- Aghion P, Tirole J. 1995. Some implications of growth for organizational form and ownership structure. *European Economic Review* **39**(3–4): 440–455.
- Aghion P, Tirole J. 1997. Formal and Real Authority in Organizations. *Journal of Political Economy* **105**(1): 1–29.
- Alchian AA. 1989. Property rights. In *The Invisible Hand*. Springer: 232–238.
- Alchian AA, Demsetz H. 1972. Production , Information Costs , and Economic Organization. *The American Economic Review* **62**(5): 777–795. Available at: <https://www.jstor.org/stable/1815199>.
- Argyres N, Mayer KJ. 2007. Contract design as a firm capability: An integration of learning and transaction cost perspectives. *Academy of Management Review*. Academy of Management Briarcliff Manor, NY 10510 **32**(4): 1060–1077.
- Argyres NS, Bercovitz J, Mayer. 2007. Complementarity and evolution of contractual provisions: An empirical study of IT services contracts. *Organization science*. INFORMS **18**(1): 3–19.
- Baumann O, Becker MC, Horrmann I. 2020. Ensuring adaptation while seeking efficiency: Tiered outsourcing and skip-level supplier ties in the Airbus A350 program. *Organization science*. INFORMS **31**(5): 1176–1197.
- Berlin M, Nini G, Edison GY. 2020. Concentration of control rights in leveraged loan syndicates. *Journal of Financial Economics*. Elsevier **137**(1): 249–271.
- Bernstein L, Peterson B. 2020. *Managerial Contracting: A Preliminary Study*. Available at: [https://extranet.sioe.org/uploads/sioe2020/bernstein\\_peterson\\_SIOE2020.pdf](https://extranet.sioe.org/uploads/sioe2020/bernstein_peterson_SIOE2020.pdf).
- Bethel JE, Liebeskind JP. 1998. Diversification and the legal organization of the firm. *Organization Science*. INFORMS **9**(1): 49–67.
- Bolton P, Dewatripont M. 2013. Authority in organizations. *Handbook of organizational Economics*. Princeton University Press Princeton, NJ : 342–372.
- Buntine W, Jakulin A. 2004. Applying Discrete PCA in Data Analysis. In *Proceedings of the Twentieth Conference on Uncertainty in Artificial Intelligence (UAI2004)*: 59–66. Available at: <http://eprints.pascal-network.org/archive/00000143/>.
- Cabral R, Leiblein MJ. 2001. Adoption of a process innovation with Learning-by-Doing: Evidence from the semiconductor industry. *The Journal of Industrial Economics*. Wiley Online Library **49**(3): 269–280.
- Camuffo A, Furlan A, Rettore E. 2007. Risk sharing in supplier relations: an agency model for the Italian air-conditioning industry. *Strategic Management Journal*. Wiley Online Library **28**(12): 1257–1266.
- Carson SJ, Madhok A, Wu T, Carson SJ, Tao W. 2006. Uncertainty, opportunism, and governance: The effects of volatility and ambiguity on formal and relational contracting. *Academy of Management Journal*. Academy of Management Briarcliff Manor, NY 10510 **49**(5): 1058–1077.
- Coase RH. 1937. The nature of the firm. *Economica* **4**(16): 386–405.
- David RJ, Han S. 2004. A systematic assessment of the empirical support for transaction cost economics. *Strategic management journal*. Wiley Online Library **25**(1): 39–58.
- Demsetz H. 1967. Toward a theory of property rights. *American Economic Review*. Springer **57**(2): 347–359.
- Dessein W. 2002. Authority and communication in organizations. *The Review of Economic Studies*. Wiley-Blackwell **69**(4): 811–838.
- Devarakonda S V, McCann BT, Reuer JJ. 2018. Marshallian forces and governance externalities: Location effects on contractual safeguards in Research and Development alliances. *Organization Science*. INFORMS **29**(6): 1112–1129.
- Eccles RG, White HC. 1988. Price and authority in inter-profit center transactions. *American journal of Sociology*. University of Chicago Press **94**: S17–S51.
- Elfenbein DW, Lerner J. 2003. Ownership and control rights in Internet portal alliances. *RAND Journal of Economics* : 356–369.
- Faems D, Janssens M, Madhok A, Looy B Van. 2008. Toward an integrative perspective on alliance governance: Connecting contract design, trust dynamics, and contract application. *Academy of management journal*. Academy of Management Briarcliff Manor, NY **51**(6): 1053–1078.
- Foss K, Foss NJ. 2005. Resources and transaction costs: how property rights economics furthers the resource-based view. *Strategic Management Journal*. Wiley Online Library **26**(6): 541–553.
- Foss NJ, Laursen K, Pedersen T. 2011. Linking customer interaction and innovation: The mediating role of new

- organizational practices. *Organization Science*. Informs **22**(4): 980–999.
- Furman JL, Teodoridis F. 2020. Automation, research technology, and researchers' trajectories: Evidence from computer science and electrical engineering. *Organization Science*. INFORMS **31**(2): 330–354.
- Gambardella A, Panico C, Valentini G. 2015. Strategic incentives to human capital. *Strategic management journal*. Wiley Online Library **36**(1): 37–52.
- Gartenberg CM, Zenger T. 2022. The firm as a subsociety. Available at SSRN 3760643.
- Gibbons R. 1999. Taking coase seriously. *Administrative Science Quarterly*. SAGE Publications **44**(1): 145–157.
- Gibbons R, Henderson R. 2012. Relational contracts and organizational capabilities. *Organization Science* **23**(5): 1350–1364.
- Grossman SJ, Hart OD. 1986. The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration. *Journal of Political Economy*. The University of Chicago Press **94**(4): 691–719. Available at: <http://www.journals.uchicago.edu/t-and-c>.
- Gugler K, Siebert R. 2007. Market power versus efficiency effects of mergers and research joint ventures: evidence from the semiconductor industry. *The Review of Economics and Statistics*. The MIT Press **89**(4): 645–659.
- Gulati R, Singh H. 1998. The architecture of cooperation: Managing coordination costs and appropriation concerns in strategic alliances. *Administrative Science Quarterly*. JSTOR **43**: 781–814.
- Hart O, Moore J. 1990. Property Rights and the Nature of the Firm. *Journal of political economy*. The University of Chicago Press **98**(6): 1119–1158.
- Hofmann T. 1999. Probabilistic Latent Semantic Analysis. In *Proceedings of Uncertainty in Artificial Intelligence*: 289–296.
- Hölmstrom B. 1979. Moral hazard and observability. *The Bell journal of economics*. JSTOR **10**(1): 74–91.
- Jacobides MG, Winter SG. 2005. The co-evolution of capabilities and transaction costs: Explaining the institutional structure of production. *Strategic Management Journal*. Wiley Online Library **26**(5): 395–413.
- Jensen MC, Meckling WH. 1979. Theory of the firm: Managerial behavior, agency costs, and ownership structure. In *Economics social institutions*. Springer: Boston, MA, 3: 305–360.
- Kalnins A, Mayer KJ. 2004. Franchising, ownership, and experience: A study of pizza restaurant survival. *Management Science*. INFORMS **50**(12): 1716–1728.
- Keller A, Lumineau F, Mellewigt T, Ariño A. 2021. Alliance governance mechanisms in the face of disruption. *Organization Science*. INFORMS **32**(6): 1542–1570.
- Klein B. 1988. Vertical integration as organizational ownership: The fisher body-general motors relationship revisited. *Journal of Law, Economics, and Organization* **4**(1): 199–213.
- Klein B, Crawford RG, Alchian AA. 1978. Vertical integration, appropriable rents, and the competitive contracting process. *The journal of Law and Economics*. The University of Chicago Law School **21**(2): 297–326.
- Klein S. 1989. A transaction cost explanation of vertical control in international markets. *Journal of the Academy of Marketing Science*. Springer **17**(3): 253–260.
- Lawrence PR, Lorsch JW. 1967. *Organization and environment. Managing differentiation and integration*. Harvard University Press: Boston, MA.
- Leiblein MJ, Reuer JJ. 2004. Building a foreign sales base: the roles of capabilities and alliances for entrepreneurial firms. *Journal of business venturing*. Elsevier **19**(2): 285–307.
- Lerner J, Malmendier U. 2010. Contractibility and the design of research agreements. *American Economic Review* **100**(1): 214–246.
- Lerner J, Merges RP. 1998. The Control of Technology Alliances: An Empirical Analysis of the Biotechnology Industry. *The Journal of Industrial Economics*. Blackwell Publishing Ltd **46**(2): 125–156. Available at: <http://doi.wiley.com/10.1111/1467-6451.00066>.
- Lerner J, Schoar A. 2005. Does legal enforcement affect financial transactions? The contractual channel in private equity. *The Quarterly Journal of Economics*. MIT Press **120**(1): 223–246.
- Libecap GD. 1993. *Contracting for property rights. Property rights: Cooperation, conflict, and law*. Cambridge University Press.
- Lo D, Zanarone G, Ghosh M. 2022. Contracting to (dis) incentivize? An integrative transaction-cost approach on how contracts govern specific investments. *Strategic Management Journal*. Wiley Online Library.
- Luo Y. 2002. Contract, cooperation, and performance in international joint ventures. *Strategic management journal*. Wiley Online Library **23**(10): 903–919.
- Macher JT, Richman BD. 2008. Transaction cost economics: An assessment of empirical research in the social sciences. *Business and politics*. Cambridge University Press **10**(1): 1–63.
- Macleod WB, Malcomson JM. 1989. Implicit Contracts , Incentive Compatibility, and Involuntary Unemployment. *Econometrica: The Journal of the Economic Society* **57**(2): 447–480.

- Macneil IR. 1973. The many futures of contracts. *S. Cal. l. Rev.* HeinOnline **47**: 691.
- Magelssen C. 2020. Allocation of property rights and technological innovation within firms. *Strategic Management Journal*. Wiley Online Library **41**(4): 758–787.
- Magelssen C, Rich B, Mayer K. 2022. The Contractual Governance of Transactions Within Firms. *Organization Science*. INFORMS.
- Markovits D, Rauterberg G. 2018. *Contracts: Law, Theory, and Practice*. University casebook series. Foundation Press. Available at: <https://books.google.co.uk/books?id=n3FdtwEACAAJ>.
- Mayer KJ, Argyres NS. 2004. Learning to contract: Evidence from the personal computer industry. *Organization Science*. INFORMS **15**(4): 394–410.
- Mayer KJ, Salomon RM. 2006. Capabilities, contractual hazards, and governance: Integrating resource-based and transaction cost perspectives. *Academy of Management journal*. Academy of Management Briarcliff Manor, NY 10510 **49**(5): 942–959.
- Merges RP. 2005. A transactional view of property rights. *Berkeley Tech. LJ*. HeinOnline **20**: 1477.
- Nickerson JA, Zenger TR. 2008. Envy, comparison costs, and the economic theory of the firm. *Strategic Management Journal*. Wiley Online Library **29**(13): 1429–1449.
- Nini G, Smith DC, Sufi A. 2009. Creditor control rights and firm investment policy. *Journal of Financial Economics*. Elsevier **92**(3): 400–420.
- OECD. 2017. *OECD Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations 2017*. OECD Publishing: Paris. Available at: <http://dxdoiorg/101787/tpg-2017-en>.
- Ostrom E. 2003. How types of goods and property rights jointly affect collective action. *Journal of Theoretical Politics*. Sage Publications **15**(3): 239–270.
- Ostrom E, Hess C. 2000. Private and common property rights. In *Encyclopedia of law and economics*. Edward Elgar Publishing Limited, 5: 53.
- Oxley JE. 1997. Appropriability hazards and governance in strategic alliances: A transaction cost approach. *Journal of Law, Economics, and Organization* **13**(2): 387–409.
- Rauterberg G. 2016. Contracting within the firm. *Working Paper*. Available at: [https://web.law.columbia.edu/sites/default/files/microsites/law-economics-studies/20151117\\_gabriel\\_rauterberg\\_contracting\\_within\\_the\\_firm.pdf](https://web.law.columbia.edu/sites/default/files/microsites/law-economics-studies/20151117_gabriel_rauterberg_contracting_within_the_firm.pdf).
- Reuer JJ, Ariño A. 2007. Strategic alliance contracts: Dimensions and determinants of contractual complexity. *Strategic Management Journal*. Wiley Online Library **28**(3): 313–330.
- Riordan MH, Williamson OE. 1985. Asset specificity and economic organization. *International Journal of Industrial Organization*. Elsevier **3**(4): 365–378.
- Roberts J. 2007. *The Modern Firm*. Oxford University Press New York: New York.
- Ryall MD, Sampson R. 2009. Formal contracts in the presence of relational enforcement mechanisms: Evidence from technology development projects. *Management Science*. INFORMS **55**(6): 906–925.
- Segal I, Whinston MD. 2013. Property Rights. In *Handbook of Organizational Economics*. Princeton University Press: 100–158.
- Shah SK, Agarwal R, Echambadi R. 2019. Jewels in the crown: Exploring the motivations and team building processes of employee entrepreneurs. *Strategic Management Journal* **40**(9): 1417–1452.
- Stinchcombe AL. 1985. Contracts as Hierarchical Documents. In *Organization Theory and Project Management*, Stinchcombe AL, Heimer C (eds). Norwegian University Press: Bergen, Norway: 121–171.
- Tadelis S. 2002. Complexity, flexibility, and the make-or-buy decision. *American Economic Review* **92**(2): 433–437.
- Tadelis S, Williamson O. 2013. Transaction cost economics. Gibbons R, Roberts J, eds. *The Handbook of Organizational Economics*, Chap. 4. Princeton University Press, Princeton, NJ.
- Teh YW, Jordan MI, Beal MJ, Blei DM. 2006. Hierarchical Dirichlet processes. *Journal of the American Statistical Association* **101**(476): 1566–1581.
- Walker G, Weber D. 1984. A transaction cost approach to make-or-buy decisions. *Administrative science quarterly*. JSTOR : 373–391.
- Weber L, Mayer KJ, Macher JT. 2011. An analysis of extendibility and early termination provisions: The importance of framing duration safeguards. *Academy of Management Journal*. Academy of Management Briarcliff Manor, NY **54**(1): 182–202.
- Williamson OE. 1975. *Markets and hierarchies: analysis and antitrust implications*. The Free Press, New York.
- Williamson OE. 1979. Transaction-Cost Economics: The Governance of Contractual Relations. *Journal of Law and Economics* **22**(2): 233–261.
- Williamson OE. 1985. *Economic Institutions of Capitalism*. The Free Press: New York.
- Williamson OE. 1991. Comparative Economic Organization: The Analysis of Discrete Structural Alternatives.

*Administrative Science Quarterly*. JSTOR **36**(2): 269.

Zanarone G, Lo D, Madsen TL. 2016. The double-edged effect of knowledge acquisition: How contracts safeguard pre-existing resources. *Strategic Management Journal*. Wiley Online Library **37**(10): 2104–2120.

Zhao M. 2006. Conducting R&D in countries with weak intellectual property rights protection. *Management science*. Informs **52**(8): 1185–1199.

**Table 1: Internal and External Contract Count**

	External	Internal
Main contract	312	164
Amendment	52	67
Assignments	0	5
Terminations	0	4
Other (Loans and stock reimbursements)	0	10
Total	364	251
Number of firms in sample	31	8
Average contracts/firm	11.7	31.4
Average main contracts/firm	10.1	20.5

**Table 2: Word Count of Internal and External Contracts**

	External	Internal
Main contract	2581	2160
Amendments	2034	2928
Total (weighted)	1251	2371

**Table 3: Internal & External Contracts by Transaction Type**

	External	%	Internal	%
R&D	46	14.74	44	26.83
Manufacturing	23	7.37	4	2.44
Sales & Distribution	19	6.09	43	26.22
Marketing	5	1.60	31	18.90
Services	57	18.27	20	12.20
License	148	47.44	9	5.49
Management Services	0	0.00	6	3.66
Collaboration	3	0.96	3	1.83
Technology Purchase	11	3.53	4	2.44
Total	312	100	164	100

**Table 4: Semiconductor Industry - External Contracts Topic Modeling Results**

HDP topic modeling output

External Contracts, n = 312; model coherence score = .5013

Topic #	Topic name	Terms
1	Enforcement	right, business, terminate, material, purchase, schedule, law, employee, cost, claim, reasonable, accordance, work, relate, confidential, payment, price, amount, property, liable
2	IP Rights	license, right, patent, technology, subsidiary, confidential, property, intellectual, terminate, disclose, design, effective, law, claim, sell, royalty, control, developer, process, application
3	Roles and Responsibilities	license, software, right, material, fee, confidential, support, terminate, work, design, technology, code, clause, part, maintenance, accordance, disclose, end, royalty, documentation
4	Compensation	officer, terminate, employment, payment, plan, reason, employ, address, benefit, business, annual_incentive, affiliate, salary, resignation, option, involuntary, accordance, effective, cause, good
5	Contingencies	license, system, method, medium, change, warrant, subsidiary, patent, audio, licensor, stock, control, code, transaction, assignment, character, holder, permit, providing, effective
6	Specifications	software, code, common, avc, source, support, release, version, update, end, technology, execution, anti_virus, royalty, revenue, object, user, available, derivative, acknowledge
7	Contingencies	invention, clause, finding, preferred, item, idea, translation, position, relevant, exempt, course, annual, compensation, scope, executive, negotiation, example, allow, vacation, original
8	Communication	client, paper, billing, file, amend, format, bill, account, read, change, receive, produce, fee, communicate, datum, completion, cycle, representative, manipulate, ability

**Table 5: Semiconductor Industry - Internal Contracts Topic Modeling Results**

HDP topic modeling output

Internal Contracts, n = 164; model coherence score = .4798

Topic #	Topic name	Terms
1	Enforcement	confidential, representative, right, terminate, territory, enforce, cost, support, law, sue, effective, fee, breach, property, business, claim, disclose, action, material, arbitration
2	IP Rights	developer, right, product, license, property, terminate, confidential, cost, intellectual, law, patent, relate, intangible, breach, effective, software, project, design, method, process
3	Liabilities	warranty, product, right, sale, recipient, terminate, indemnify, work, confidential, law, behalf, cost, claim, material, property, change, rule, revoke, extent, claim
4	Control Rights	representative, right, purchase, effective, authority, amendment, behalf, project, agent, amend, credit, new, decision, standard, supply, control, design, test, represent, implementation
5	Roles and Responsibilities	side, cost, engineer, recharge, process, total, monthly, resource, charge, work, mutually, project, management, facility, equipment, manufacture, test, developer, part, comment
6	Compensation	memorandum, price, arm_length, pricing, arrangement, quarter, understand, purchase, confirm, monthly, charge, supplier, successful, sale, payable, cost, payment, fee, reasonable, royalty

**Table 6: Semiconductor Industry – Pooled External and Internal Contracts Topic Modeling Results**

HDP topic modeling output

Combined Internal and External Contracts, n = 476; model coherence score = .4706

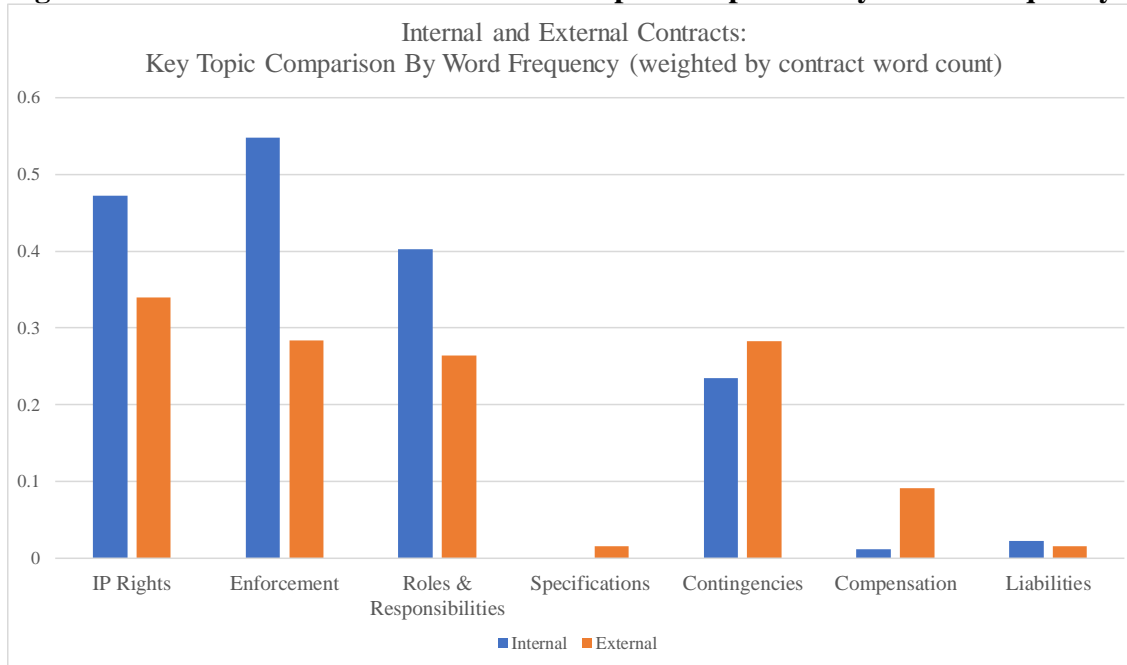
Topic #	Topic name	Terms
1	IP Rights	license, right, technology, patent, software, confidential, terminate, property, subsidiary, intellectual, disclose, design, effective, claim, royalty, law, developer, code, control, schedule
2	Enforcement	right, terminate, representative, business, distributor, law, developer, confidential, cost, property, territory, employee, intellectual, material, effective, breach, disclose, reasonable, claim, accordance
3	Roles and Responsibilities	license, support, schedule, work, accordance, confidential, part, right, fee, design, material, mutually, clause, change, terminate, engineer, reasonable, purchase, software, facility
4	Specifications	package, method, structure, apparatus, manufacturing, circuit, patent, device, leadframe, board, system, type, grid_array, print, mold, chip, application, process, file, mark
5	Contingencies	license, system, method, right, assignment, change, control, subsidiary, licensor, medium, transaction, patent, character, datum, audio, permit, providing, database, content, asset
6	Compensation	executive, group, clause, appointment, terminate, employment, board, relevant, salary, duty, remuneration, insurance, give, invention, hold, entitle, director, benefit, work, take
7	Liabilities	debtor, liable, insurance, policy, engagement, court, signature_line, expense, management, render, insurer, indemnity, counsel, approval, issue, disclose, bankruptcy, database, trial, execution

**Figure 1: Internal Contract Topic Word Clouds**





**Figure 2: Internal and External Contract Topic Comparison by Word Frequency**



**Appendix A**  
**Example Excerpt from Technology License Agreement**

**Internal Contract:**

6.12 Governing Law and Dispute Resolution. The construction, validity and performance of this Agreement shall be governed in all respects by the laws of Switzerland. Any dispute or disagreement arising out of or in connection with, or any breach or alleged breach of, this Agreement shall be submitted for binding arbitration at such time and in such manner as the parties shall agree in writing. The arbitration proceeding shall be conducted in accordance with the Rules of Conciliation and Arbitration of the International Chamber of Commerce in effect on the date of the commencement of the arbitration. The decision of the arbitrator shall be final, binding and incontestable.

**IN WITNESS WHEREOF**, the parties have caused this Agreement to be executed by their duly authorized representatives as of the date first above written.

[Party A]

[Party B]

Name: \_\_\_\_\_

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_

Date: \_\_\_\_\_

**External Contract:**

7.09 This License Agreement shall be construed in accordance with the laws of the State of California.

7.10 Except for injunctive relief relating to breaches of the confidentiality provisions of this License Agreement, any dispute or controversy arising out of or relating to this License Agreement, or any modification or extension thereof, shall be settled by arbitration conducted in the City of San Francisco, California, in accordance with the rules of the American Arbitration Association and judgment upon the award rendered by the arbitrator(s) may be entered in any court having jurisdiction thereof. The parties consent to the jurisdiction of the Supreme Court of the State of California, and of the United States District Court for the Northern District of California, for all purposes in connection with arbitration.

IN WITNESS WHEREOF, the parties have respectively caused this instrument to be executed by duly authorized officers of each of the dates indicated.

PARTY B

PARTY A

Name: \_\_\_\_\_

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_

Date: \_\_\_\_\_

## Appendix B

### Comparing Internal and External Sample Firms

		Mean	Std. Dev.	No. Obs.	Std. Err.	T-Test P-value
Total Assets	Internal	13.82	1.56	57	0.207	0.447
	External	14.17	3.41	336	0.186	
Total Revenue	Internal	12.97	1.75	57	0.231	0.603
	External	13.12	2.05	335	0.112	
R&D Intensity	Internal	0.269	0.283	56	0.039	0.335
	External	0.217	0.386	334	0.021	

## Appendix C

**Table C.I: Sample restricted to Semiconductor firms with both internal and external contracts available – External Contracts Topic Modeling Results**

HDP topic modeling output

Matched firm external contracts, n=9, model coherence score = .4028

Topic #	Topic name	Terms
1	Liabilities/ Enforcement	right, confidential, terminate, purchase, material, reasonable, accordance, schedule, license, cost, liable, support, performance, price, claim, law, warranty, disclose, delivery, change
2	IP Rights	business, license, patent, officer, employee, technology, terminate, intellectual, right, affiliate, law, property, claim, employment, parent, disclose, effect, payment, plan, amount
3	Compensation	work , supplier, charge, employ, salary, dispute, due, payment, change, project, report, rate, partnership, cost, benefit, facility, client, line, provider, employ
4	Specifications	software, license, code, release, right, application, exercise, holder, share, source_code, licensed, multi_point, centerspan, security, documentation, update, new, version, audio, distribute

**Table C.II: Sample restricted to Semiconductor firms with both internal and external contracts available – Internal Contracts Topic Modeling Results**

HDP topic modeling output

Matched firm internal contracts, n=123, model coherence score = .4504

Topic #	Topic name	Terms
1	Enforcement	distributor, breach, right, terminate, license, material, law, confidential, work, property, business, cost, action, intellectual, action, develop, fee, liable, disclose, enforce
2	IP Rights	right, terminate, confidential, territory, cost, principal, law, developer, property, intellectual, product, license, performance, support, patent, business, design, connection, legal, disclose
3	Control rights	representative, right, authority, terminate, territory, agent, standard, subsidiary, behalf, price, control, purchase, law, confidential, accordance, represent, parent, amend, effective, disclose
4	Compensation	representative, spare_part, price, purchase, cost, charge, amend, effective, supplemental_inventory, supply, credit, invoice, standard, payment, memorandum, hundred_percent, royalty, reasonable, paragraph, confirm

## Appendix D

**Table D.I: Internal and External Contracts by Transaction Type for Computer Equipment Firm**

<b>Transaction Type</b>	<b>External Contract</b>	<b>Internal Contract</b>
	<b>% of Total</b>	<b>% of Total</b>
Research and Development	7.1%	24.0%
Manufacturing	7.1%	4.0%
Distribution	35.7%	4.0%
Sales, Marketing, and/or Services	7.1%	56.0%
Vendor	21.4%	0.0%
License	21.4%	12.0%
Total	100.0%	100.0%

**Table D.II: Computer Equipment Firm – External Contracts Topic Modeling Results**

HDP topic modeling output

External Contracts, n = 11; model coherence score = .4933

Topic #	Topic name	Terms
1	Liabilities	right, terminate, payment, provider, liable, sell, effective, business, price, warranty, reasonable, law, credit, deliver, limited, expense, disclose, material, expiration, address
2	IP rights	license, technology, develop, patent, model, terminate, licensor, royalty, software, cost, deliverable, specification, schedule, affiliate, trademark, intellectual_property, claim, design, component
3	Specifications	vendor, ship, freight, receive, invoice, claim, program, charge, package, method, confidential, amount, delivery, purchase, damage, process, contact, complete, utilize, model
5	Communication	meet, cost, file, exception, code, receive, similar, read, market, preferred_status, royalty, complete, cure, approve, settlement, offer, change, quantity, future, fail

**Table D.III: Computer Equipment Firm - Internal Contracts Topic Modeling Results**

HDP topic modeling output

Internal Contracts, n = 32; model coherence score = .48

Topic #	Topic name	Terms
1	Liabilities	terminate, right, territory, interest, cost, condition, expense, support, marketing, warranty, performance, liable, fee, duty, change, law, authority, business, proprietary, disclose
2	Enforcement	right, developer, improvement, confidential, subcontractor, property, terminate, intellectual, breach, specification, documentation, material, disclose, deliver, law, performance, accord, fee, bind, support
3	Control Rights	provider, right, principal, fee, effective, behalf, decision, bind, terminate, delivery, cost, give, send, execute, business, law, exclusive, arbitration, default, accord
4	IP Rights	license, right, property, intangible, royalty, amount, action, connection, intellectual, confidential, process, hold, model, ownership, consideration, developer, sole, define, deliver, cost

## Appendix E

**Table E.I: Semiconductor Firms – Internal Contracts Topic Modeling Results without Licensing and R&D Contracts**

HDP Topic modeling output

Internal Contracts without Licensing and R&D Contracts, n=106; model coherence score = .4235

Topic #	Topic name	Terms
1	Enforcement	developer, representative, right, law, breach, terminate, warranty, business, material, license, cost, territory, property, intangible, amount, payment, disclose, condition, employee, reasonable
2	IP Rights	right, confidential, terminate, cost, developer, law, property, intellectual, license, expense, principal, subsidiary, purpose, effective, business, design, work, liable, marketing, legal
3	Liabilities	distributor, warranty, territory, terminate, right, law, indemnify, liable, sell, business, material, price, distribution, condition, principal, commissionaire, purchase, delivery, deem, consent
4	Roles and Responsibilities	schedule, effective, license, part, support, clarify, business, right, locate, work, principal, certain, purchase, territory, supply, destination, distributor, recital, confidential, execute
5	Control Rights	representation, right, effective, control, work, voting, amendment, ownership, outstanding, credit, validity, performance, charge, resource, design, work, implement, limit, original, purchase