Recent Developments in Transaction Cost Economics

Sophia Ruester

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Abstract

This working paper provides a summary on transaction cost economics (TCE) and recent developments thereof. After an introductory discussion of TCE's role within the field of New Institutional Economics, a critical analysis of the contribution of the existing body of empirical literature is conducted. In recent years, researchers have continued to develop and extend TCE. Williamson (1991b) introduces the *shift parameter framework* which investigates how the optimal choice of governance changes in response to dynamics in the institutional environment. Nickerson (1997) develops the *positioning-economizing perspective* arguing that decisions regarding market position, resource investments, and governance mode are interdependent and determined simultaneously. A number of authors came up with an increasing interest in *relational institutional arrangements* arguing that TCE may overstate the desirability of complex long-term contracts and vertical integration in exchange settings where a substantial hold-up potential is present.

[1] Dresden University of Technology, Department of Business and Economics, Chair of Energy Economics and Public Sector Management, D-01062 Dresden. The usual disclaimer applies.
Corresponding author: contact@sophia-ruester.de, URL: http://www.sophia-ruester.de.

1 Transaction Cost Economics in the Framework of New Institutional Economics

1.1 Introduction to New Institutional Economics

New Institutional Economics[2] is still a young theory. Having its origins in the seminal article of Ronald Coase (1937) on 'The Nature of the Firm', it developed not before the 1970s and 1980s. Major works have been contributed by Ronald Coase, Douglass North, and Oliver Williamson amongst others (see e.g., Ménard and Shirley, 2005). NIE is an interdisciplinary approach combining research from the fields of economics, law, social and political sciences, organization theory, and strategic management; it "is all but an isolated and closed paradigm" (Ménard, 2004, p. xv). The literature focuses on institutions and on how institutions interact with organizational arrangements.

Traditional neoclassical economics differs from NIE in various respects. Firms typically are treated as production functions transforming inputs into outputs, taking the available technologies as given. Market prices contain all relevant information. Individuals are assumed to have perfect information and to be super-rational (i.e., do not have any problems with memory usage and can formulate and solve problems of high complexity). Transactions are realized instantaneously and without any transaction costs. Disputes are disregarded because of the presumed efficacy of court adjudication. Given technology, input prices and the demand function, the firm is able to maximize its profits. A firm's size and product range are explained in terms of production costs. Economies of scale imply larger firms; economies of scope support multi-product corporations.

However, "[w]hat economists usually mean by 'the theory of the firm' is the theory of production, not the theory of the firm as a legal entity" (Klein, 1999, p. 463). Neoclassical economics provides little insight into the boundaries of the firm and alternative organizational forms cannot be explained. Cost subadditivity implies that a certain output can be produced more efficiently when it is produced within one single production plant. Absent any transaction costs, two independent firms could agree for sharing the same facility and jointly produce the efficient level of output. However, whether the firms will integrate depends on the cost of writing and enforcing contracts, i.e., ex-ante and ex-post transaction costs, not only on the production technology.

NIE assumes that individuals suffer from bounded rationality and that the environment may be characterized by uncertainty about the future state of nature. The firm is understood as an institution created by economic actors in order to reduce risk and transaction costs. Firms are not regarded as black boxes but as possessing an internal structure. NIE went beyond the "conception of the firm-as-production function (which is a technological construction) to consider the firm as a governance

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[2] The term 'New Institutional Economics' has been introduced by Williamson (1975, p. 1). Like the 'old' institutional economics, NIE is interested in social, economic, and political institutions, but social phenomena such as corporate culture "[are taken] as explananda, not the explanans" (Klein, 1999, p. 457). Furthermore, NIE does not abandon neoclassical economics. Rather it investigates new questions such as why economic institutions emerge in the way they do.

structure (which is an organizational construction) in which internal structure has economic purpose and effect" (Williamson, 2000, p. 602) Thus, "organizational variety is not disregarded but located centrally on the research agenda [of NIE]" (Williamson, 1986, p. 172).

Davis and North (1971, pp. 6 f.) define the institutional environment as "the set of fundamental political, social, and legal ground rules that establishes the basis for production, exchange and distribution." These rules guide individuals' behavior and can be both formal, explicit rules (such as property rights or laws) and informal, implicit rules (such as norms, customs or social and religious conventions). They further define an institutional arrangement as "an arrangement between economic units that governs the ways in which these units can cooperate and/or compete".[3] It may be formal or informal, temporary or long-lived.

Williamson (2000) proposes to consider four levels of social analysis, corresponding to different time perspectives (see Figure 1): The first level represents *social embeddedness* (i.e., customs, traditions, religion, norms, etc.). These institutions tend to change very slowly and are taken as given by most institutional economists. Nevertheless, they contribute to shaping the institutional environment in defining rules and supporting the organization of transactions. The second level describes the *institutional environment* containing formal rules. Level three is referred to as the *institutional arrangements* (i.e., governance modes) embedded in the existing institutional environment as well as in traditions and norms shaping the behavior of transactors. These institutions may be changed periodically in order to reorganize transactions in a production and transaction cost economizing way. Finally, the last level focuses on *short-term resource allocation and employment* (i.e., neoclassical economics' object of investigation) with the firm typically being described as a production function. Adjustments concerning prices, supply and demand levels occur continuously. Within this framework, first levels impose constraints on the levels immediately following; lower levels in turn give feedback to the higher ones. NIE in general is concerned with levels two and three.
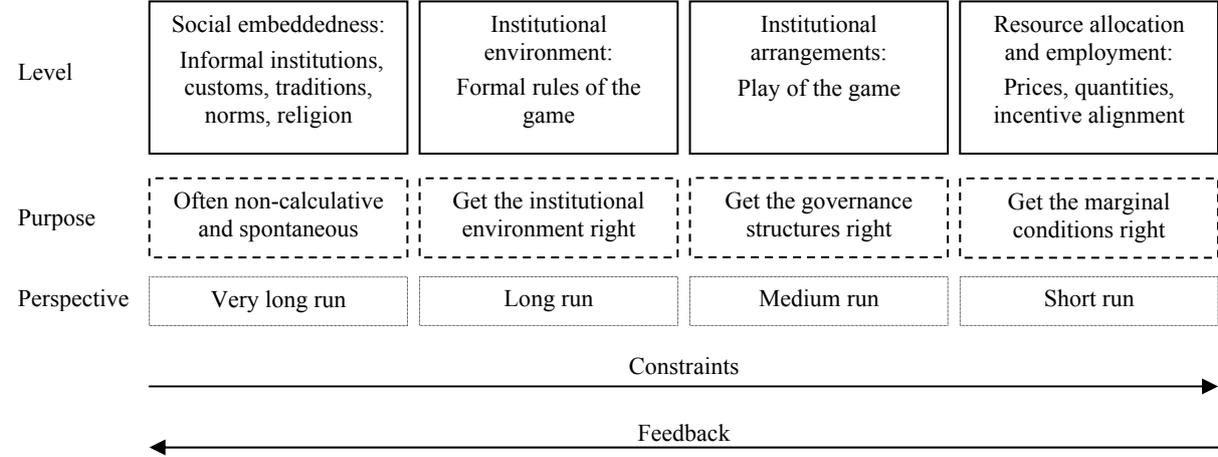
One can summarize that NIE investigates how institutions emerge and operate, how they shape the arrangements that support exchange relationships and production processes, as well as how these arrangements act in turn to change the institutional environment. Klein (1999, pp. 461 ff.) concludes that "development is seen as a response to the evolution of institutions that support social and commercial relationships. Economic growth thus depends on the degree to which the potential hazards of trade (shirking, opportunism and the like) can be controlled by institutions, which reduce information costs, encourage capital formation and capital mobility, allow risks to be priced and

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[3] Institutional arrangements "must … be designed to accomplish at least one of the following goals: to provide a structure within which its members can cooperate to obtain some added income that is not available outside that structure; or to provide a mechanism that can effect a change in laws or property rights designed to alter the permissible ways that individuals (or groups) can legally compete" (Davis and North, 1971, p. 7).
Ménard (1995) builds on these definitions and further delineates and defines the fundamental concepts of 'institutions' and 'governance structures' (i.e., markets and organizations) with the last being embedded in the institutional environment.

shared and otherwise facilitate cooperation. […] Economic development, then, is institutional development."

Figure 1: Williamson's four levels of social analysis

Level	Social embeddedness: Informal institutions, customs, traditions, norms, religion	Institutional environment: Formal rules of the game	Institutional arrangements: Play of the game	Resource allocation and employment: Prices, quantities, incentive alignment
Purpose	Often non-calculative and spontaneous	Get the institutional environment right	Get the governance structures right	Get the marginal conditions right
Perspective	Very long run	Long run	Medium run	Short run

Constraints →

← Feedback

Source: Own depiction based on Williamson (2000) and Ménard (2004)

1.2 Alternative theories of the firm

Two alternative streams of research are distinguished within the field of NIE. One stream focuses on institutional arrangements ('micro level'), the other deals with the institutional environment in which institutions are embedded ('macro level'). Whereas the former is especially interested in the trade-off among governance modes and provides some insights on the internal structure of institutions such as firms or contractual agreements, the latter investigates the role of laws and formal rules on economic development and growth as well as on transaction costs of exchange relationships. The next section provides an overview on alternative theories investigating firms' boundary choices which have developed during the last decades under the umbrella of NIE.

The starting point of a theory explaining vertical integration goes back to Adam Smith, who argued in the 18th century that the division of labor is limited by the extent of the market. According to Stigler's (1951) life cycle theory of the firm, emerging industries are characterized by a small size with the market not being able to supply input, technologies or specialized skills. With the expansion of the industry, tasks can be turned over to specialists. Declining industries in contrast, will again favor vertical integration with the surviving firm re-appropriating functions. However, this approach is incomplete as only one cost component (the cost of production) is considered. Competing theoretical frameworks within the field of NIE – despite their differing underlying assumptions – are all based on a common starting point: in the absence of any transaction costs, contractual choices, organizations, and institutions are of no interest and the way property rights are distributed in an economy does not impact the way this economy uses scarce resources (Coase Theorem). In contrast, the below introduced approaches explicitly allow for non-zero transaction costs.

(1) <u>Transaction cost economics</u> (TCE) (see e.g. Williamson, 1975, 1985, 1993; Klein et al., 1978) hypothesizes that the optimal choice of governance depends on the relative costs of alternative institutional arrangements which in turn depend on the characteristics of the transaction at stake. Economic actors are assumed to be characterized by bounded rationality and may behave opportunistically. In a world in which uncertainty about the future state of nature is present, contracts will remain incomplete and do not account for all possible contingencies. As long as there is functioning competition among trading partners, incomplete contracts are unproblematic. However, ex-post bilateral dependencies, as do result from investments in relationship-specific assets, will generate ex-post exchange hazards (e.g., maladaptation, opportunistic renegotiations).

(2) The <u>property rights theory</u> developed at a time when transaction cost economics had already been confirmed empirically (see e.g., Grossman and Hart, 1986; Hart and Moore, 1990). The reason why ownership and property rights become important is the incompleteness of contracts. Grossman and Hart (1986, p. 691) describe two types of contractual rights: Contractible specific rights and non-contractible residual rights of control which are not verifiable by any third party. A firm is limited by the assets over which is has control.[4] The central proposition of the property rights approach argues that it is optimal to allow one party to purchase the asset when it is too costly to list all specific rights in a contract and that the party which is mainly responsible for the return of the asset should own it in order to be endued with the residual control rights. Implications for the real world following Grossman and Hart (1986), Hart and Moore (1990), Hart (1995), and Salanié (1997) can be summarized as follows: i) highly complementary assets should be under joint ownership whereas independent assets should be separately owned; ii) employees doing simple routine jobs will not have control rights since their ownership of residual rights would not increase the firm's revenue; iii) control over non-human assets leads to control over human assets.

Even though both approaches have a similar point of interest (i.e., the make-or-buy decision), the property rights theory differs from TCE in its underlying assumptions. It assumes that economic actors are rational without any cognitive limitations, that the environment is characterized by risk about the future state of nature and that there is symmetric information between contracting partners but asymmetric information with third parties. Hence, actions and investments of the parties are observable, but not verifiable. Whereas TCE understands ex-post haggling over quasi-rents as the principal source of inefficiency, the property rights theory assumes efficient bargaining ex-post but non-contractible specific investments and investment distortions ex-ante. Furthermore, property rights models typically distinguish between upstream and downstream integration whereas TCE investigates only whether successive stages of a value chain should be unified.

Whinston (2001) discusses whether empirical literature confirming TCE does deliver any evidence for the property rights theory. Predictions of the two approaches differ substantially. To formulate testable

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[4] Grossman and Hart (1986) do not distinguish between ownership and control. Employees are treated in the same way as outside contractors if the firm provides all tools and other assets used by the contractor.

hypothesis for the second, numerous information about the trading environment, in general not documented in transaction cost analysis, are necessary. Therefore, existing empirical studies in general do not provide evidence for both approaches due to the lack of information, mainly on the extent of non-contractible investments.

(3) On the roots of <u>incentive theory</u> a third stream of literature has established, based on the assumption of asymmetric information between the contracting parties (see e.g., Laffont and Martimort, 2002). Within this approach, the firm itself is not the unit of analysis, but rather the collection of contracts between owners and managers, managers and employees, the firm and its customers and suppliers, or a regulator and the firm. The firm is understood as "nexus of a set of contracting relationships" (Klein, 1999, p. 466) with the central question being the optimal design of ex-ante incentive compatible contracts suited to mitigate agency costs in the face of potential adverse selection and moral hazard. The boundary of the firm here is not the focal subject of attention. This is criticized by Williamson (1991b, p. 274), who argues that "to regard the corporation only as a nexus of contracts misses much of what is truly distinctive about this mode of governance."

(4) From an alternative perspective, numerous articles discuss the boundaries of the firm with respect to its resources and capabilities. The <u>resource-based view</u> (see e.g., Barney, 1991) has especially contributed to the field of strategic management. Competitive advantage is supposed to stem from the possession of unique factors of production and valuable, difficult-to-imitate, difficult-to-transfer resources. A firm's specific resources may include organizational capabilities and routines, managerial skills, technological and reputational capital. A value chain of production can be broken down into various activities. Some activities may be similar in that they draw on the same firm capabilities; others may be complementary in that they are connected within the value chain. Richardson (1972, p. 895) argues in an early paper that "[w]here activities are both similar and complementary they could be coordinated by direction within an individual business." Dissimilarity of activities is supposed to make integration costly. Asset specificity is primarily regarded as a form of human assets embedded in firm-specific routines. Accordingly, the resource-based view hypothesizes that increased asset specificity enhances the governance efficiency of internal organization rather than decreasing the efficiency of market exchange.

(5) Other theoretical approaches have concluded that market imperfections such as the existence of market power, barriers to entry, or price discrimination favor vertical integration. See Joskow (2005) for a detailed summary.

2 Transaction Cost Economics: A Static Concept

TCE is a comparative analysis studying governance structures under the target of economizing economic exchanges with respect to the sum of both production and transaction costs. Organizational forms are never examined separately but always in relation to alternatives. The transaction, defined as "occur[ing] when a good or service is traded across a technologically separable interface", is the basic

unit of analysis of TCE (Williamson, 1993, p. 16). The following paragraphs provide an overview on the theory's underlying assumptions, the relevance of transaction costs in exchange relationships and the optimal alignment of transactions which differ in their attributes to governance modes that differ in their costs and competencies.

2.1 The concept of transaction costs: From Coase (1937) to Williamson (1975, 1985)

 "There was nothing inevitable about my writing The Nature of the Firm. It came about as a series of accidents" Ronald Coase stated in 1988, three years before he was awarded the Nobel Prize in Economics. In fact, Coase, who chose to study economics only because of little interest in mathematics and a lack of knowledge in Latin, made one of the most important contributions to New Institutional Economics.

Coase (1937) criticizes the simplified view of an economy assumed by most researchers until the first half of the 20th century. The economic system was understood to work by itself without any central control and supply and demand being coordinated by a price mechanism, i.e., an automatic, totally elastic and immediately adaptive process. In traditional price theory there were no costs but production and transportation costs. So when Coase asked "his brilliant naive question" (Langlois et al., 2002, p. xii) why there are firms, he could not find an answer in price theory. He was the first economist, thinking about costs that accompany exchange relationships on markets arguing that the neoclassical picture would be incomplete and not able to explain two basic questions, namely the existence of firms and the determinants of firm size.

The first central statement of his article is that the "main reason why it is profitable to establish a firm would seem to be that there is a cost of using the price mechanism" (Coase, 1937, p. 389). These include the costs of discovering relevant prices and negotiating and concluding contracts. Hence, firms are likely to emerge when contracting becomes too expensive. Coase defines the firm based on the concept of authority as a coordinating device. Whereas on a market agents decide on their exchange relationships based on relative prices, in a firm the employer decides on the employees' activities.

But what determines the optimal size of the firm with size defined as the number of transactions organized internally? Coase (1937, p. 393) asks: "Why, if by organizing one can eliminate certain costs and in fact reduce the cost of production, are there any market transactions at all? Why is not all production carried by one big firm?" He specifies two reasons. First, additional internal costs arise with every transaction organized within a firm; second, the entrepreneur's capability of making the best use of production factors decreases. All innovations improving management efficiency tend to increase firm size since internal organization and coordination costs are reduced. A firm will tend to expand until the cost of organizing an extra transaction within the own hierarchy equals the cost of carrying out the same transaction on the market or the cost of organizing it within another firm.

About 30 years Coase's work attracted little attention, but with the development of NIE during the 1970s it became one of the most cited articles. However, Coase (1937) does not discuss the sources of

transaction costs and contractual difficulties. Williamson (1975, 1985) operationalized TCE focusing on the economic actors' behavioral characteristics on the one hand and on transaction attributes on the other. Ménard (2004, xxi) points out that "[Williamson] opens the door to a systematic analysis of alternative modes of governance" in establishing the relationship between the sources of contractual hazards and their impact on the choice of institutional arrangements. His work has been widely cited during the last three decades and has a substantial impact on recent theoretical developments based on TCE as well as on a huge body of empirical literature.

Williamson (1975, pp. 20 ff.) develops a framework of organizational failure in market exchanges softening step by step neoclassical economics' assumptions on behavioral and environmental characteristics (see Figure 2):

Behavioral assumptions: Economic individuals are characterized by <u>bounded rationality</u>; they are "intendedly rational, but only limited so" (Simon, 1961, xxiv).[5] Bounded rationality involves limited cognitive competences such as neurophysiologic limits (impossibility to receive, store, retrieve, and process all information without any error) and language limits (individuals are not able to articulate their knowledge and information clearly to be perfectly understood by others).

Second, economic actors may <u>behave opportunistically</u> guided by considerations of self-interest and making strategic decisions in a way to achieve an individual advantage (e.g., by lying, cheating, or calculated distorted disclosure of information). Two types of opportunistic behavior are distinguished: i) deviations from joint-surplus maximizing within the terms of an existing agreement and ii) enforcement of renegotiations and modification of contractual terms in the case unexpected changes in market conditions evolve (hold-up). Woolthuis et al. (2005, p. 814) distinguish between a passive form of opportunism (lack of dedication in performing to the best of one's own competences) and an active form (self-interest seeking with guile as referred to within TCE).

Transaction attributes: There are several exchange hazards that necessitate contractual safeguards. The institutional environment may be characterized by <u>uncertainty</u> about the future state of nature including amongst others price and demand levels, technological innovations, or legal instabilities. An increase in uncertainty can originate from two sources: more disturbances occur and/or disturbances become more consequential (Williamson, 1991b, p. 291). Within exchange relationships, the most relevant form of uncertainty is behavioral uncertainty which arises from the difficulty in predicting actions of the counterparty considering the potential for opportunistic behavior.

The presence of <u>relationship-specific assets</u> transforms an exchange relationship from ex-ante competition where the identity of the trading partners is irrelevant to an ex-post bilateral dependency where the identity of the exchange partner is of critical importance. Williamson (1986, pp. 184 ff.) calls this 'fundamental transformation'. The frequency of transactions will have an impact on the

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[5] Williamson (1986, pp. 173 f.) later distinguishes between three levels of rationality: i) strong rationality (i.e., postulated in neoclassical economics with firms being reduced to production functions, consumers being characterized by utility functions, institutions taken as given), ii) semistrong rationality (i.e., bounded rationality), and iii) weak rationality (i.e., organic rationality relevant within evolutionary approaches).

recovery of investments in relationship-specific assets (Williamson, 1985, pp. 60 f.). Asset specificity thereby refers to "durable investments that are undertaken in support of particular transactions, the opportunity cost […] is much lower in best alternative uses or by alternative users should the original transaction be prematurely terminated" (Williamson, 1985, p. 55). The excess value of an asset over its salvage value is termed 'quasi-rent'. Six types of specific assets are distinguished:

- Site specificity: Immobile assets are placed in close proximity in order to minimize transportation or time costs or to benefit from complementarity advantages (e.g., a natural gas liquefaction plant has to be close to natural gas fields whereas crude oil economically can be transported to refineries in downstream countries);
- Physical asset specificity: Assets involving design characteristics specific to the transaction having a lower value in alternative uses (e.g., liquefied natural gas import facilities of the first generation were designed to receive natural gas from a specific supplier characterized by a certain quality);
- Dedicated assets: Investments in assets dedicated to a certain trading partner that otherwise would not be made; they are not redeployable due to a limited size of the market for these assets (e.g., liquefied natural gas vessels in the early years of the industry were ordered once a long-term sales and purchase contract was signed and were dedicated to specific trade routes between an export and an import project);
- Human asset specificity: Human capital evolving due to learning of individuals and team building (e.g., only a small number of engineering firms is capable of constructing liquefied natural gas terminals);
- Intangible assets: Intangible capital such as a brand name (e.g., McDonald's); and
- Temporal specificity (added to the discussion by Klein et al., 1978, p. 301): The threat of a delay in production or delivery may be an effective bargaining device (e.g., newspaper publishers generally own presses whereas book publishers in general do not).

In a static market, free of any uncertainty, bounded rationality is irrelevant and an analysis of transaction costs uninteresting. All contingencies can be specified ex-ante in a complete contingent claims contract. Bounded rationality will become relevant under environmental uncertainty and complexity which makes periodical contract adaptations necessary. Writing a complete long-term contract is too costly or not feasible anymore since it is not possible to specify all contingencies ex-ante. However, the presence of incomplete contracts per se would be unproblematic as long as economic individuals are benevolent. Since this cannot be presumed for the 'homo oeconomicus', the hazard of ex-post opportunistic behavior persists. As long as the exchange can be carried out on a functioning competitive market, economic agents will have no incentive to deviate from joint-surplus maximizing behavior. However, in situations where only a small number of potential trading partners

are available on the market – which is the case once specific investments are realized – contracting on the market will result in high ex-post transaction costs.

Figure 2: Organizational failure framework
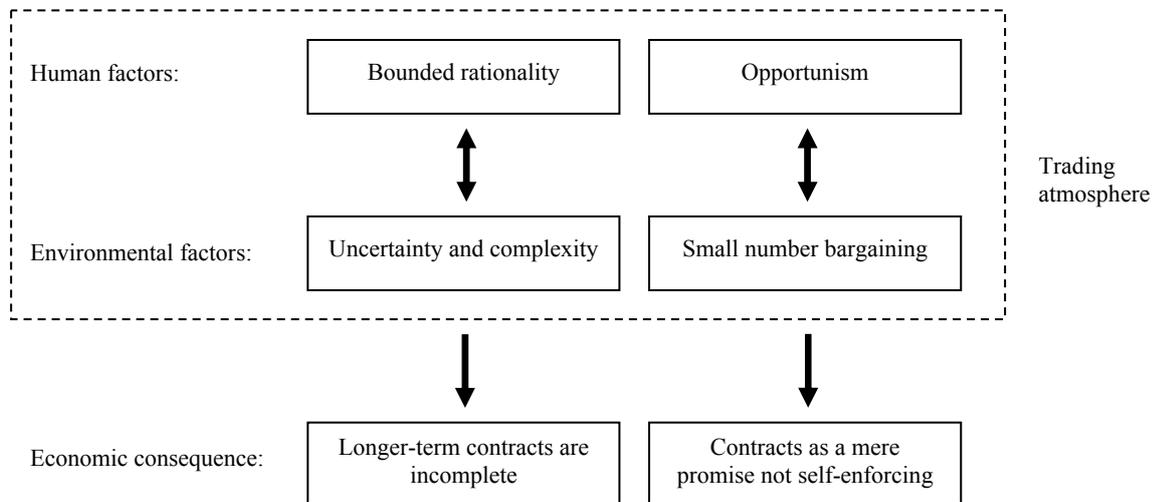
Source: Own depiction

Transaction costs have been described as the "costs of running the economic system" (Arrow, 1969, p. 48) or the "equivalent of friction in physical systems" (Williamson, 1985, p. 19). One distinguishes ex-ante costs (e.g., discovering potential trading partners and relevant prices, negotiating and writing contracts) from ex-post costs (e.g., costs from maladaptation, renegotiation, monitoring, and breach of contract). The focus of TCE typically is on ex-post transaction costs which become especially relevant under long-term contracting and might exceed ex-ante costs by far.

Summarizing, economic individuals within the framework of TCE are cognitively less competent due to bounded rationality but motivationally more complex due to opportunism in the sense of self-interest seeking with guile than are those presumed within neoclassical economics. Therefore, it is essential to "[o]rganize transactions so as to economize on bounded rationality while simultaneously safeguarding them against the hazards of opportunism" (Williamson, 1986, p. 177). Williamson (1971, p. 112) picks up Coase's (1937) discussion asking: "if the costs of operating in competitive markets are zero […] why integrate?" TCE understands the firm as being more than a simple efficiency instrument in the sense of economies of scale and/or scope or technical complementarities. The firm possesses coordinating potential. Substituting market exchange by internal organization is efficient in the presence of market failures (see also Williamson, 1975, pp. 20-40). TCE tries to explain how trading partners choose, from a set of feasible institutional arrangements, the governance form that protects relationship-specific investments at least costs.

2.2 Discriminating alignment

Given that long-term contracts are unavoidably incomplete due to bounded rationality and that contracts as mere promise are not self-enforcing due to opportunism, the question is, which

transactions should be organized under which governance modes. NIE focuses on a comparative institutional analysis. Thereby, the difference between rather than the absolute magnitude of transaction costs matters.

Two pole governance structures, market and hierarchy with a continuum of hybrid forms in between, are distinguished.[6] Anonymous spot markets have an advantage over central planning in situations where the price reflects all relevant information. Firms get to specialize in doing what they do best and innovation is generated by numerous sources. The opposite pole of governance is vertical integration in the form of backward integration into the supply of inputs or forward integration into marketing and distribution. Internal organization of successive stages of the value chain is the optimal governance choice where relationship-specific investments under uncertainty are required. Between the two poles hybrid forms of governance (e.g., long-term contracts, joint ventures, or partial ownership arrangements) are settled. Since an economically enforceable long-term contract is the primary alternative to vertical integration in order to avoid opportunistic behavior, some economists regard these two organizational structures with indifference. However, Klein et al. (1978, p. 302), as other transaction cost economists, criticize this simplified view as having "defined [the] extremely difficult question [of optimal governance choice] away by calling a long-term contract a form of vertical integration."

As already revealed by Hayek (1945, p. 523), "economic problems arise always and only in consequence of change." Williamson (1991b) understands adaptation to unexpected circumstances as the central economic problem. Thereby, he distinguishes between inconsequential disturbances (adjustment costs would exceed the efficiency gain), consequential disturbances to which contractual agreements are adaptable (for example via price adaptation provisions), and highly consequential disturbances (providing incentives for ex-post opportunism departing from the original spirit of the contract).

Governance structures differ in their capacity to respond to exogenous disturbances. Whereas Hayek (1945) proposes that the price system is a more efficient mechanism for communicating information and inducing change as compared to central planning, Barnard (1938) highlights adaptation within the organization. Williamson (1991b) picks up both opinions arguing that the two authors refer to adaptations of different kinds. There is autonomous adaptation (i.e., the neoclassical economics' ideal) on the one hand and coordinated adaptation (i.e., required within long-term bilateral exchange relationships) on the other.

The central hypotheses of TCE originate from the discriminating alignment hypothesis according to which "transactions that differ in their attributes, are aligned with governance structures, which differ in their costs and competencies, in a discriminating (mainly transaction cost economizing) way" (Williamson, 1991b, p. 277). The level of investments in relationship-specific assets thereby is the most important dimension.

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[6] Other authors use alternative terms such as buy, ally, and make.

Governance costs for market organization (M) or internal organization (H) increase with the level of investments in specific assets (s). Since internal organization involves higher bureaucratic costs as well as lower internal incentives (changes in an agent's effort have little or no immediate effect on his compensation assuming a fixed-wage schedule), the intercept of a hierarchy's governance cost curve is higher than that of market organization with $M(0) < H(0)$. Whereas the market supports autonomous adaptation to unpredictable events, internal organization supports coordinated adaptation which becomes relevant in the presence of bilateral dependency (i.e., relationship-specific investments). Hence, the slopes of the cost curves are characterized by $dM(s)/ds > dH(s)/ds > 0$. Hybrid governance forms (L) are located between market and hierarchy with respect to incentives, adaptability, and bureaucratic costs with $M(0) < L(0) < H(0)$ and $dM(s)/ds > dL(s)/ds > dH(s)/ds$. The choice of the optimal (i.e., transaction cost economizing) governance form implies operating on the envelope and using the market for $s < s^1$, hybrid governance modes for $s^1 < s < s^2$ and internal organization otherwise (see Figure 3).

Figure 3: Discriminating alignment
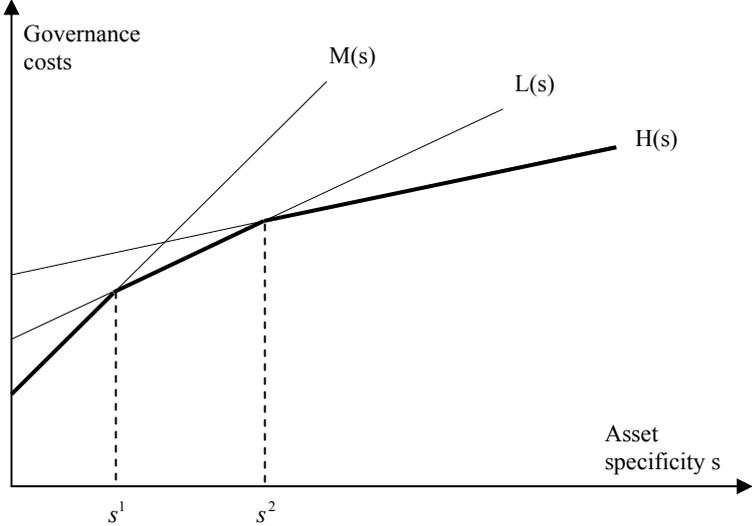
Source: Own depiction

A variety of alternative governance modes for similar transactions is most likely to be observed where the governance form matters least, i.e., for levels of asset specificity near the threshold values. In contrast, where one governance form has large cost advantages over the others, the superior alternative will tend to dominate. In the short run, misalignment may occur, though in the long run, a firm's governance choice given transaction attributes converges to equilibrium.

Table 1 summarizes the attributes of alternative governance modes with respect to incentive intensity, administrative controls and adaptation. The gains from coordinated adaptation for internal organization in the presence of bilateral dependency relationships come at a cost. Decreased incentives and an increase in agency costs (i.e., inter-organizational opportunism) with an increasing size of the firm are accompanied by increased bureaucratic costs. Therefore, "[v]ertical and lateral integration are

usefully thought of as organization forms of last resort, to be employed when all else fails"
(Williamson, 1991, p. 279). Internal organization will be the efficient mode of organization only in the
presence of both substantial relationship-specific investments and environmental uncertainty where the
hazard of post-contractual opportunistic behavior by the counterparty would otherwise result in ex-
ante under-investment and decreasing overall efficiency. Asset specificity without uncertainty allows
for the conclusion of complete contingent claim contracts; uncertainty without asset specificity can be
dealt with in exchanges on competitive markets.

Table 1: Attributes of alternative governance modes

| Attribute	Market	Hybrid	Hierarchy
Incentive intensity	Strong	Semi-strong	Weak
Administrative controls	Weak	Semi-strong	Strong
Autonomous adaptation	Strong	Semi-strong	Weak
Coordinated adaptation	Weak	Semi-strong	Strong

Source: Own depiction based on Williamson (1991b, p. 281)

It has to be pointed out again that the objective of firms is to economize on the sum of both transaction
and production costs as is illustrated in Figure 4. Assuming a constant output level, the difference in
governance costs between internal organization and market exchange depending on the level of
specific investments s is defined as $\Delta GC(s) = GC_H(s) - GC_M(s)$. If economies of scale and scope are
assumed to be negligible, the decision to integrate successive stages of the value chain will depend
solely on the difference in governance costs. Internal organization will be the preferred governance
form when asset specificity is high, i.e., when ex-post bilateral dependency arises and coordinated
adaptations become necessary.

However, markets are often able to realize economies of scale and/or scope by aggregating the
demands of various customers. Hence, production cost differences have to be taken into account. The
production cost difference between internal and market procurement of a given output is defined as
$\Delta PC(s) = PC_H(s) - PC_M(s)$. This difference will always be positive and decreases with s. For generic
transactions, the penalty of internal procurement is large due to forgone scale economies and higher
internal organization costs. With an increasing level of investments in specific assets, the potential of
economies of outside supply in aggregating demands decreases and $\Delta PC(s)$ converges to zero.

The minimization of $\Delta GC(s) + \Delta PC(s)$ reveals a threshold value of the level of specific investments
s^*. Economies of aggregation favor market procurement over a wider range of asset specificity than
would be observed if production cost economies were absent. Since the market always has an
advantage over the firm in production cost respects, vertical integration will never be economically
reasonable for production cost reasons alone.

Figure 4: Comparative production and governance costs
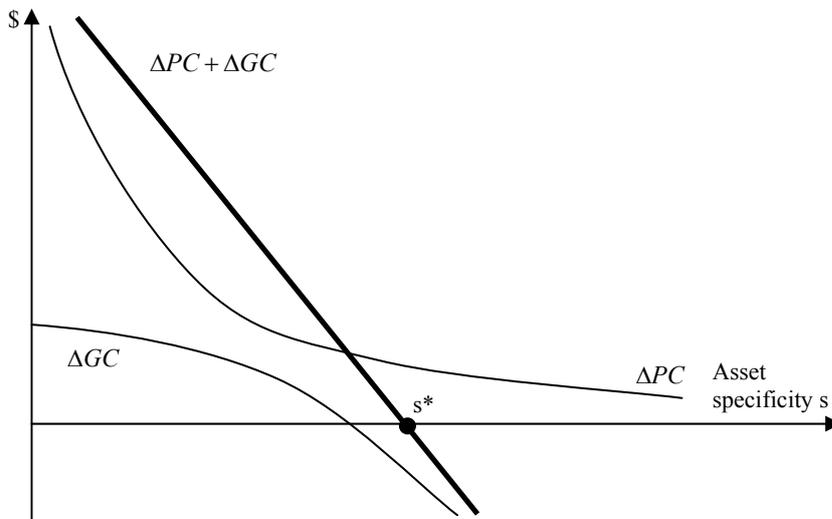
Source: Own depiction following Williamson (1985, p. 93)

The investment in specific assets and the additional costs of hierarchical governance forms will be easier to recover for transactions of a recurrent kind (Williamson, 1985, p. 60). Therefore, the frequency of transactions is understood as the third critical dimension determining investment behavior and governance choice. A firm will be better able to realize economies of scale as its own requirements of the respective product or service become larger. For a higher transaction frequency $\Delta PC(s)$ will fall with $\Delta GC(s)$ remaining unchanged. The critical value of s^* will move to the left. Hence, larger firms are predicted to be more integrated than smaller firms.

3 Transaction Cost Economics: An Empirical Success Story?

"[T]heory without evidence is, in the end, just speculation" (Masten, 2002, p. 428). TCE often has been referred to as an "empirical success story" (e.g., Williamson, 2002, p. 182). Several literature reviews highlight the increasing number of corroborative empirical papers. About 900 studies, including published articles, working papers and book chapters, test propositions derived from TCE. Most of them seem to be consistent with the theory's predictions; investments in relationship-specific assets are identified as the main driver of more hierarchical governance structures. The following section summarizes the historical development of empirical contributions related to the optimal governance choice and discusses critically, whether the existing body of literature provides conclusive support for TCE.

3.1 Review on empirical literature

Empirical studies investigating a firm's motivation to choose among alternative governance modes have a long-standing history. One can distinguish between quantitative analyses (i.e., based on econometrics) and qualitative studies (i.e., case studies), cross-sectional and panel data, papers investigating the make-or-buy decision and papers interested in the choice of contractual provisions.

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This review cannot present all existing empirical work in the TCE tradition, but rather summarizes the development of alternative classes of empirical contributions during the last three decades and introduces some seminal papers.

The first generation of empirical tests based on a transaction cost framework appeared already during the early 1980s. At this time, the authors focused on backward integration in manufacturing sectors with most studies using data on US-based companies. Monteverde and Teece (1982a) describe the phenomenon of 'quasi vertical integration', where a downstream firm owns specialized tools that are used in the upstream production stage. Motivations for integration are flexibility on the one hand (if the supplier's production is interrupted, tools can be moved to another supplier) and avoiding post-contractual opportunistic behavior on the other. Estimation results from a linear probability model using data on 28 input components of a US car company show that the likelihood of integration increases with the level of quasi-rents at stake. Masten (1984) analyzes input procurement in the US aerospace industry using a dataset of 1,887 components. He shows that the probability of backward integration is higher for complex and highly specialized inputs and that the hazards from incomplete contracting in complex environments increase in the presence of component design specificity. Further contributions include amongst others Klein et al. (1978), Monteverde and Teece (1982b), Walker and Weber (1984), and Klein (1988).

The second generation of studies investigates forward integration into marketing and distribution of products from the manufacturing sector. Anderson and Schmittlein (1984), focusing on vertical structures in the US electronic component industry, analyze the corporate choice between employing a sales person (corresponding to market exchange) and direct employee sales people (corresponding to integration). Estimation results from a logit model show that the presence of asset specificity, the difficulty in evaluating performance, and company size have a positive influence on the likelihood of integration. John and Weitz (1988) analyze forward integration into the distribution stage of industrial good manufacturers. Distribution channels are classified into direct channels (company employees) and indirect channels (independent resellers). The authors show that the likelihood of integration increases with the level of specific assets and environmental uncertainty. Further contributions include Klein (1989).

Whereas this early literature mainly focused on the manufacturing sector, later studies also analyze vertical integration in other industries. These are for example studies on the make-or-buy decision in the rail freight sector (Palay, 1984), in the Canadian forest industry (Globerman and Schwindt, 1986), in the aluminum and tin industries (Hennart, 1988), in naval shipbuilding (Masten et al., 1991), in the chemical sector (Lieberman, 1991), in bulk shipping markets (Pirrong, 1993), in the pulp and paper industry (Ohanian, 1994), in the poultry, egg, and broiler industries (Martinez 1999, 2002), in information services (Poppo and Zenger, 1998; 2002; Aubert et al., 2004), in the Spanish cotton industry (Rosés, 2005), in sugar production (Sartorius and Kirsten, 2005), or in the global natural gas market (Ruester and Neumann, 2009).

Another group of empirical studies is interested in the choice of contractual provisions. This literature started with qualitative discussions of contracting structures in the mid-1980s. Mulherin (1986) shows that specific investments in the US natural gas industry historically have been protected by the use of complex forms of organization. Whereas prior to the 1930s vertical integration from production over transportation to distribution has been common, governmental regulation led to long-term contracts being the predominant governance form with pipeline companies buying from producers and reselling to distributors. Exclusive dealing and take-or-pay provisions served as a mean to protect quasi-rents at stake and prevent opportunistic behavior by the non-investing parties. Hubbard and Weiner (1986) analyze long-term natural gas supply contracts between producers and pipelines following the phased deregulation of wellhead prices in the US and derive a theoretical model on the determination of take-or-pay provisions. They show that wellhead price ceilings favor long-term contracts which include non-price contract provisions which increase the producers' total compensation.

A quite substantive body of empirical literature aims to explain the determinants of contract duration. Joskow's (1987) seminal work investigating the relationship between specific investments and contract duration in the US coal industry shows that contracting parties make longer commitments when site specific, physical asset specific or dedicated investments occur. Saussier (1999) provides an empirical study based on the European coal industry discussing the trade-off between both the costs and benefits of contracting. Using a dataset containing 70 contracts for the transportation and unloading of coal to Electricité de France's power plants, he confirms that contract duration reflects the desire to minimize transaction costs. Whereas duration increases with the level of appropriable quasi-rents at stake in the transaction, it decreases with the level of uncertainty. Further contributions include Crocker and Masten (1988), Kerkvliet and Shrogren (2001), Hirschhausen and Neumann (2008), and Ruester (2009).

Other studies explore the optimal determination of alternative contractual provisions. Masten and Crocker (1991) investigate the choice of alternative price adaptation clauses in US natural gas supply contracts. Whereas the presence of uncertainty should favor renegotiation, the presence of high quasi-rents at stake should support redetermination clauses based on pricing formulas which reduce the frequency of negotiations and therewith the hazard of opportunistic haggling. Saussier (2000) adds a new dimension to the discussion, testing the influence of transaction parameters on the level of completeness of French coal supply contracts, accounting for the endogeneity of asset specificity. Analyzing a sample of 29 contracts he shows that the completeness of contracts increases with the level of physical-, site-, dedicated-, and human asset specificity and decreases with the level of uncertainty.

Recent papers pick up the aspect of relational governance in the form of implicit, unwritten contractual agreements. Using data on outsourcing relationships in information services, Poppo and Zenger (2002) show empirically that formal contracts and relational governance function as complements and both have a positive impact on exchange performance. The complementarity of contractual and relational

governance is also confirmed by Zheng et al. (2008). Further contributions include Liu et al. (2008), Nagaoka et al. (2008), and Desrieux et al. (2009).

Other literature – which is not discussed in detail here – also focuses on other hybrid governance forms such as inter-firm alliances (e.g., Oxley, 1999), franchise contracts (e.g., Bercovitz, 2004), or joint ventures (e.g., Richards and Yang, 2007). However, as Gulati and Nickerson (2008, p. 690) point out, there are only few empirical studies addressing this expanded set of governance modes. Table 2 illustrates the historical development of different generations of empirical literature as discussed above. Table 3 and 4 in the Appendix provide a summary on selected empirical papers testing TCE's propositions. Literature reviews are also provided by Klein (2004) and Macher and Richman (2006).

Table 2: Development of empirical literature

Period	> 1975	> 1980	> 1985	> 1990	> 1995	> 2000	> 2005
Make-or-buy decision	Backward integration in manufacturing sector *(e.g., Klein et al, 1978; Monteverde and Teece, 1982a and b; Masten 1984)*						
		Forward integration in manufacturing sector *(e.g., Anderson and Schmittlein, 1984; John and Weitz, 1988)*					
			Back-/forward integration in non-manufacturing industries *(e.g., Globerman et al., 1986; Lieberman, 1991; Ohanian, 1994)*				
Contractual provisions			Qualitative discussion of contracting structure *(e.g., Mulherin, 1986; Hubbert and Weiner, 1986)*				
			Econometric analyses (EA) explaining contract duration *(e.g., Joskow, 1987; Crocker and Masten, 1988; Lyons, 1994)*				
				EA explaining other contractual provisions *(e.g., Masten and Crocker, 1991)*			
						EA explaining contractual completeness *(e.g., Saussier, 2000)*	
						EA investigating relational governance *(e.g., Poppo/Zenger, 2002)*	

Source: Own depiction

3.2   Limitations of existing empirical literature

At first glance, TCE in fact seems to be an empirical success story. However, the existing body of empirical literature suffers from a number of shortcomings: i) a part of the studies is not fully consistent with propositions developed within transaction cost theory; ii) in some cases, imperfect proxies for key variables are employed; iii) the endogeneity of right-hand side variables often is ignored; and iv) most analyses are based on reduced form models and therefore cannot test for the theory's propositions directly.

3.2.1 Inconsistency with hypotheses derived from transaction cost theory

As is also highlighted in Carter and Hodgson (2006), only few empirical studies provide unambiguous support for the hypotheses derived from transaction cost theory. Most of the studies do not test for all three transaction attributes, i.e., relationship-specific investments, uncertainty, and frequency of transactions. This is also mirrored by the above presented sample of empirical papers; most of those focus on asset specificity and uncertainty, ignoring the frequency of transactions within the exchange relationship. Furthermore, few studies explore the interaction effects among transaction cost variables and other potentially relevant factors (e.g., specific investments in the presence of uncertainty). Also contractual provisions such as contracted volume, contract duration, and price adaptation clauses are chosen simultaneously and can be expected to interact with one another.

Whereas empirical findings generally provide broad support for the positive relationship between specific investments and the likelihood of more hierarchical governance forms, this is not always the case for other transaction attributes. Anderson and Schmittlein (1984), for example, testing the impact of transaction frequency on forward integration do not find any support for the predicted positive impact. Macher and Richman (2008, p. 7) justifiably claim that a "greater theoretical and empirical treatment of frequency is […] required."

In addition, numerous empirical studies investigating the effect of environmental uncertainty on governance choice present non-significant and even ambiguous results (e.g., Crocker and Masten, 1988; Heide and John, 1990; Masten and Crocker, 1991). Klein et al. (1990, p. 206) argue that their study "raises more questions than it answers" finding a positive impact of uncertainty in the form of volatility in environmental conditions and a negative impact of uncertainty in the form of diversity in uncertainty sources on vertical integration. Klein (1989) argues that the effect of uncertainty depends on its dimension. He shows that whereas unpredictability has a negative impact on vertical control, complexity has a positive impact. Therefore, future empirical studies should split external uncertainty into its components, investigate the opposing effects and determine which dimensions of uncertainty are relevant for the respective transaction.

3.2.2 Measurement difficulties

Of the transaction attributes that have been examined empirically, the level of relationship-specific investments is argued to be the most important determinant of governance choice (see e.g., Klein, 1999; Macher and Richman, 2008). However, this variable at the same time is argued to be the most difficult to measure. Proxy variables in general are constructed using secondary data sources and, therefore, are often only very rough approximations of the respective theoretical construct. Typical proxies include the level of investment costs (physical asset specificity, e.g., Lieberman 1991), worker-specific knowledge (human asset specificity, e.g., Monteverde and Teece, 1982b), the complexity of components (physical asset specificity, e.g., Masten, 1984), locational proximity of exchange partners (site specificity, e.g., Joskow 1987), quantities dedicated to the trading partner (dedicated asset specificity, e.g., Saussier, 1999), the percentage of input capacity satisfied by the

counterpart (dedicated asset specificity, e.g., Kerkvliet and Shrogren, 2001), or a ranking of the importance of having an input on schedule (temporal specificity, e.g., Masten et al., 1991). Often, these right-hand-side variables are constructed based on ordinal – and even binary – rankings which limit the comparability of the variables across studies.

Environmental uncertainty is generally referred to unanticipated changes in circumstances surrounding an exchange. Among the proxy variables employed are the volatility of prices indicating price uncertainty (e.g., Masten and Crocker, 1991), time dummies indicating more or less uncertain periods (e.g., Saussier, 1999), rankings of uncertainty concerning future demand (e.g., Athias and Saussier, 2007), rankings of general environmental uncertainty (e.g., John and Weitz, 1988), rankings of technological requirements' unpredictability (e.g., Heide and John, 1990), or rankings evaluating the exchange partner's performance indicating behavioral uncertainty (e.g., Anderson and Schmittlein, 1984). As discussed above, empirical evidence for the impact of different dimensions of uncertainty on optimal governance choice is mixed.

Furthermore, a number of studies obtain data from the contracting parties themselves using surveys and interviews with key informants.[7] On the one hand, this has the advantage that the researchers can specify survey questions in a way measuring the variables of interest for their analyses which otherwise generally are not publicly available (e.g., specificity of an investment, exchange performance, reliability of the exchange partner, etc.). On the other hand, however, this has the disadvantage that the received information may be based on the respondents' subjective beliefs rather than on objective valuations. In addition, the quality of survey data may suffer from the respondents' difficulties in understanding the question: Masten (1996, pp. 48 f.), for example, argues that the difference between asset specificity (i.e., non-redeployability) and specialized assets (e.g., equipment that only can produce a single product) often is not clear and underline this presumption reporting very low correlations between two respondents' evaluations of the level of asset specificity of input component in naval shipbuilding.

3.2.3   Endogeneity of right-hand-side variables

Variables affecting governance choice and contractual design often are themselves endogenous variables. This applies amongst others for the level of specific investments, the contracted volume in long-term supply agreements, or contractual completeness. These variables are chosen simultaneously with and dependent on the governance form. However, "[t]he binding constraint here is not technique but data availability" (Masten and Saussier, 2000, p. 232). Instrumental variables are difficult to identify and researchers often lack access to written contracts so that they have no information on contractual provisions such as price adaptation or renegotiation clauses.

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[7] Among empirical studies using survey data are Anderson and Schmittlein (1984), Walker and Weber (1984), John and Weitz (1988), Klein (1989), Masten et al. (1991), Lyons (1994, 1995), Zaheer and Venkatraman (1995), Zaheer et al. (1998), Saussier (1999), Poppo and Zenger (2002), Gulati and Nickerson (2008), and Gulati and Sytch (2008).

Therefore, endeneity is a serious problem in econometric studies testing theories of the firm.[8] Even though some authors account for this issue (e.g., Saussier 1999, 2000), there is a huge body of empirical literature ignoring the endogeneity of right-hand-side variables. Hamilton and Nickerson (2003, p. 53) found that "of the 421 empirical papers published in the Strategic Management Journal (out of 601) between January, 1990, and December, 2001, […] only 27 papers […] explicitly econometrically correct for potential endogeneity concerns."

3.2.4 Tests based on reduced form models

Since an efficient outcome would be achieved under any governance form in the absence of any transaction costs, an explanation of the existence of alternative institutional arrangements must turn on a comparison of the costs of governing the transaction under alternative modes of organization. One can formalize Coase's (1937) discussion as

$$G* = \begin{cases} G^{\mathrm{A}} & \text{if } C^A < C^B \\ G^B & \text{if } C^A \geq C^B \end{cases} \tag{1}$$

where $G*$ represents the chosen governance form; G^A and G^B indicate alternative modes of organization (such as spot market versus internal organization) and C^A and C^B are the costs of governing the transaction under the corresponding organizational alternatives. However, it is very difficult or even impossible to measure (ex-post) transaction costs. Furthermore, transaction costs only can be observed for actually chosen governance forms but not for the alternative. Williamson's (1975, 1985) major contribution to the theoretical discussion was the identification of transaction attributes that influence the transaction costs of alternative organizational arrangements, which can be formalized as $C^A = f(X, e^A)$ and $C^B = f(X, e^B)$ with

$$\begin{aligned} C^A &= \alpha X + e^A \\ C^B &= \beta X + e^B \end{aligned} \tag{2}$$

assuming linear relationships. X represents a vector of observable transaction attributes, α and β are vectors of parameters, and e^A and e^B capture unobserved factors such as omitted variables, decision maker misperceptions about the true values of transaction costs, and measurement errors. Even though transaction costs themselves are not observable, testable propositions can be derived by analyzing how

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[8] Endogeneity of a right-hand-side variable occurs when the respective regressor is not orthogonal to the error term, i.e., $Cov(x, u) \neq 0$. Simple one-stage estimation procedures such as ordinary least squares will lead to biased estimates; two-stage instrumental variables estimation is required.

transaction attributes affect the relative costs of institutional alternatives. The probability of observing governance mode G^A equals

$$\Pr\left(G* = G^A\right) = \Pr\left(C^A < C^B\right) = \Pr\left(e^A - e^B < (\beta - \alpha)X\right) \qquad (3)$$

The impact of exogenous variables X on optimal governance choice then depends on the sign of $(\beta - \alpha)$. According to TCE, the likelihood of more hierarchical governance modes will increase with the quasi-rents at stake (i.e., the level of relationship-specific investments), with the level of uncertainty and complexity of the transaction, and with transaction frequency.

First generation empirical tests predict exactly this differential effect by applying discrete choice models such as probit or logit specifications with the chosen governance form (typically make versus buy) defined as a binary dependent variable (e.g., Monteverde and Teece, 1982b; Masten, 1984; Lieberman, 1991) and transaction attributes as well as a number of control variables as explanatory variables. Later studies also extend these models to multinomial settings (e.g., Masten and Crocker, 1991) or parameterize the governance form as a continuous variable, such as the degree of vertical integration (e.g., Ohanian, 1994; Rosés, 2005). However, estimation results of such reduced form models cannot say anything about the respective signs of the single coefficients but calculate coefficients in the form of $(\beta - \alpha)/\sigma$ with σ being the standard deviation of the difference of the error terms e^A and e^B. This variance negatively correlates with the quality of the decision maker's perceptions. The less precise the manager's evaluation of the performance of alternative governance modes, the higher will be σ and the lower will be the estimated effect of an exogenous attribute on the probability of choosing a particular governance mode.

The estimation of differential effects implies that a significant number of studies can be reinterpreted in terms of other theories of the firm. However, alternative approaches not always predict complementary but in some cases also rival propositions on the impact of exogenous factors on governance choice. This shall be illustrated comparing theoretical discussions coming from TCE with those deduced from the resource-based view of the firm. Whereas both approaches predict increasing transaction costs on the market under increasing asset specificity TCE hypothesizes that transaction costs within the firm increase, too, even though to a lower extend – whereas the resource-based view argues that transaction costs of internal organization decrease with specific human assets (see Figure 5).

According to the resource-based view, increased human asset specificity may generate shared language, knowledge, and routines that enhance the efficiency of coordination (see Poppo and Zenger, 1998, pp. 853 f.). Alternatively, skilled workers may require less monitoring (Masten et al. 2001, p. 19). Hence, we should test for $(\beta - \alpha) > 0$ with $(\beta > \alpha > 0)$ to test for TCE and for $(\beta - \alpha) > 0$ with $(\beta > 0)$ and $(\alpha < 0)$ to test for the resource-based view. Estimating only the differential effect does not allow for differentiating between these rival hypotheses.

Figure 5: Rival propositions on the impact of asset specificity on transaction costs
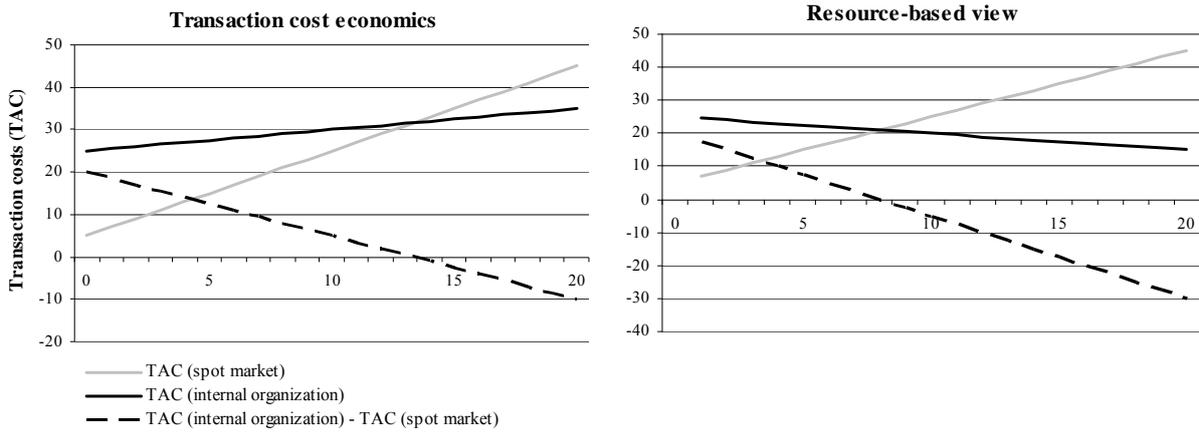
Source: Own depiction

Similar reduced form tests are conducted in order to investigate the optimal duration of long-term agreements. Starting with the discrete choice problem developed above, exchange partners will choose to contract if the expected gains from doing so exceed the expected gains from organizing the transaction in another way: $G^* = G^C$ if $V^C > V^0$ with V^C and V^0 measuring the net gains from contracting and not contracting respectively. The choice of optimal contract duration can be understood as a series of discrete choices in which the exchange partners decide whether or not to contract for an additional period. This can be formalized as

$$\max_{\tau} V^C(\tau) + V^0(T - \tau) \tag{4}$$

with τ indicating contract duration, T indicating the potential duration of the exchange relationship, $V^C(\tau)$ representing the cumulative value of exchange under the contract, and $V^0(T - \tau)$ being the value of trade in periods not covered by the contract. The first order condition yields optimal contract duration τ^* with $V^{C\prime}(\tau^*) = V^{0\prime}(\tau^*)$. Since the costs (i.e., the hazard of being bound in an agreement not reflecting market realities) and benefits (i.e., avoiding repeated negotiations) of contracting for an additional period are not observable, the value of exchange under contracting and respectively not contracting are related to observable transaction attributes X with $V^{C\prime} = f(\tau, X, e^C)$ and $V^{0\prime} = f(\tau, X, e^0)$. Assuming linear relationships:

$$\begin{aligned} V^{C\prime} &= \alpha_0 + \alpha_1\tau + \alpha_2 X + e^C \\ V^{0\prime} &= \beta_0 + \beta_1\tau + \beta_2 X + e^0 \end{aligned} \tag{5}$$

with the error terms capturing unobserved factors. From Equation (5) one can derive the optimal contract duration being determined by

$$\tau^* = \gamma_0 + \gamma_1 X + v \tag{6}$$

with $\gamma_0 = (\beta_0 - \alpha_0)/(\alpha_1 - \beta_1)$, $\gamma_1 = (\beta_2 - \alpha_2)/(\alpha_1 - \beta_1)$, and $v = (e^0 - e^C)/(\alpha_1 - \beta_1)$

Existing empirical literature generally predicts these differential effects instead of testing for the structural form propositions derived from theory.

4 Recent Trends in Transaction Cost Economics

Even though "there is considerable support for many of the central tenets of [TCE]" (Macher and Richman, 2008, p. i), researchers have continued to develop and improve the theory. The following paragraphs introduce recent trends in the theoretical discussion as well as in empirical testing.

4.1 From a static to a dynamic concept

TCE in its basic form is a static concept taking the institutional environment as given. This has been a major point of criticism in the New Institutional Economics literature. In 1991, Oliver Williamson therefore introduced the so called shift parameter framework, an extension of the TCE model investigating how the optimal choice of governance changes in response to dynamics in the institutional environment. Changes in exogenous parameters will shift the relative costs of alternative governance structures and therefore, will have an impact on the optimal alignment of transactions to institutional arrangements. Shift parameters shall be used to indicate institutional differences between alternative market settings (such as developed versus developing countries) and will influence the predictions about transaction costs and governance choice in each environment. Hence, the influences of both transaction characteristics and the institutional environment on governance choice are analyzed (Williamson, 1991b).

Empirical literature testing the shift parameter framework is rather scarce. The first application is Oxley (1999) who investigates the impact of intellectual property protection on the structure of inter-firm technology transfer alliances linking US and non-US firms. Finding support for TCE's hypotheses she shows that more hierarchical alliances (i.e., equity joint venture instead of a contractual alliance) are more likely in the presence of weak intellectual property protection. A strong protection of intellectual property is achieved only when property rights are easy to establish, interpreted broadly and strictly enforced. Weak protection will result in an increased appropriability hazard and support the choice of more hierarchical governance modes. Oxley concludes that a "complete understanding of the structure of inter-firm alliances thus requires a combined focus on the institutional environment and mechanisms of governance" (p. 285).

Henisz and Williamson (1999) discuss the concept of shift parameters for national and multinational firms focusing on the impact of weak (respectively strong) property rights and on the stability of contract law on governance choice (e.g., partnership between the foreign and a host-country firm). They argue that within a single country, the choice is mainly determined by the attributes of the

transaction. Comparing corporate behavior over time or across countries, a higher credibility of the institutional environment (i.e., secure property rights, stable contract law) will support complex transactions and governance forms. High political hazards should support partnering of multinational firms with host-country entities.

Gulati and Nickerson (2008) analyze the impact of inter-organizational trust as a shift parameter on governance choice and the performance of exchange relationships in the US auto industry using a survey of component buyers at Ford Motor Company and Chrysler Corporation. Estimation results of a three-stage switching regression model[9] support transaction cost theory's predictions. Further, the authors' hypotheses of exogenous trust enhancing performance both directly and indirectly are confirmed. On the one hand, an increase in inter-organizational trust directly enhances firm performance; on the other hand, it shifts the likelihood of organizational choice from hierarchy to the market (i.e., a more expensive mode of governance is substituted by a less expensive one) and hence indirectly enhances firm performance.

4.2   Linking alternative theories of the firm

As early as in the mid-1980s, Williamson (1986, p. 200) argued that "[t]ransaction cost economics is […] in need of refinement. […] it needs to be joined with other approaches to the study of economic process. I am confident that developments of both kinds will be forthcoming and that the evolving theory of economic organization will be deepened as a consequence." In recent years, several authors have started to develop theoretical approaches combining alternative theories of the firm. The general consensus is that "managers are well advised to adopt a multidisciplinary approach to strategy to ensure their firms' survival" (Silverman et al., 1997, p. 31).

To link TCE with the field of strategic management has first been proposed by Day and Klein (1987) who discuss the determinants of inter-firm cooperations along value chains from both a market failure and a strategic management approach. Rumelt et al. (1991, p. 14) highlight "[transaction cost economics'] affinity with strategic management." Both approaches are interested in organizational structures and institutional details such as particular contract provisions.

The so called positioning-economizing perspective finally has been introduced by Nickerson (1997). He develops an extension of the basic transaction cost model transforming Williamson's theory from an 'economizing theory of organization' that focuses on the discriminative alignment of transactions to institutional arrangements into an 'economizing theory of strategy'. Nickerson argues that decisions regarding market position, resource investments, and governance mode are interdependent and are determined simultaneously. A target market position is supported by a resource profile that in turn

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[9] In the first stage regression, inter-organizational trust is explained as a function of exchange attributes and a number of antecedents of pre-existing trust; the second stage explains governance choice (i.e., buy, ally, and make) as a function of transaction attributes and the predicted level of trust; the third stage switching regression explains exchange performance as a function of governance choice, transaction attributes, and the predicted level of trust.

determines the organizational choice of a firm (see Figure 6). Ghosh and John (1999) develop a similar model starting with traditional TCE linking transaction attributes to governance modes and then add positioning (i.e., the target market position) as well as resources (i.e., scarce and imperfectly mobile skills, assets, or capabilities). According to this approach, two firms in the same market may choose varying governance forms in order to align these to the respective external and internal conditions depending on their strategy.

Figure 6: Positioning-economizing perspective
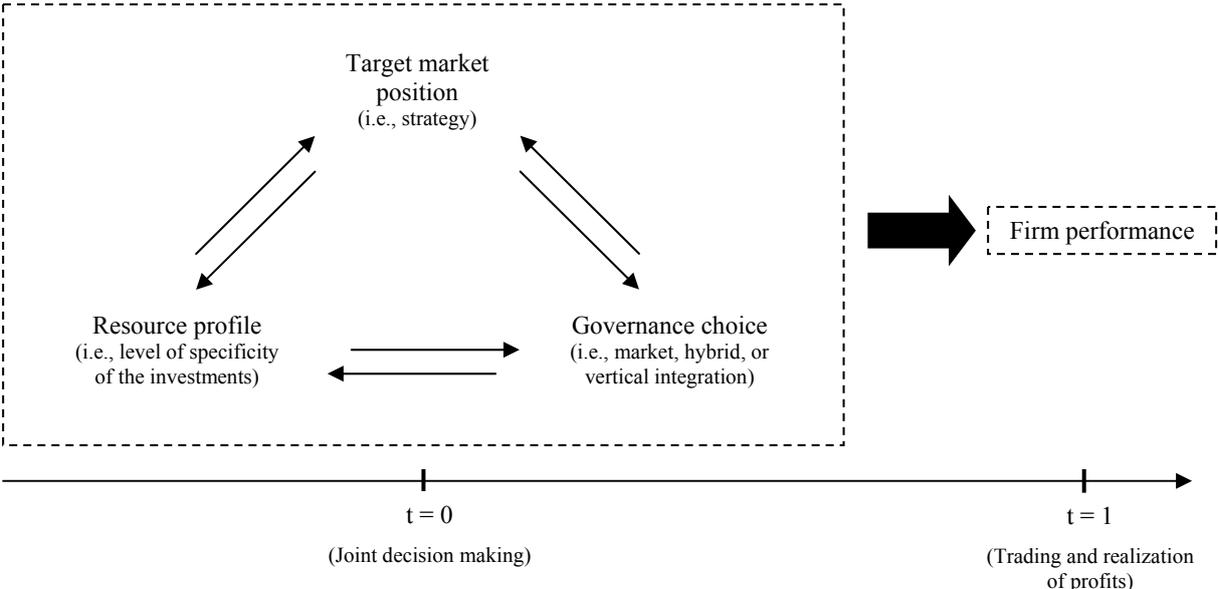
Source: Own depiction

Empirical literature testing for alternative theories or their combination is still rare. Building on Nickerson (1997) and Ghosh and John (1999), Nickerson et al. (2001) link Porter's strategic positioning framework and the transaction cost approach with an application to the international courier and small package service in Japan in order to overcome the weaknesses of both approaches, since "Porter (1996) fails to call upon Williamson's insights to inform whether activities should be organized internally or outsourced, and Williamson (1991[a]) claims that managers are well advised to concentrate on economizing instead of on positioning" (p. 252). Using a dataset 995 parcels shipped from Japan to 160 destination cities in 42 countries they test industry-specific predictions relating market position to resource investments, the resource profile to organizational form and the resource profile/organization pairings to firm performance (i.e., delivery speed). Estimation results of the three-stage, reduced form, endogenous self-selection model provide broad support for all propositions and confirm that decisions on a firm's market position, resource profile and organizational choice are interrelated in ways predicted by the positioning-economizing perspective. The authors conclude that the heterogeneity in corporate strategies reflects the reality of firms being endowed with different feasible resource profile/organization pairings.

4.3   Structural form tests: The two-stage Heckman model

The majority of empirical tests is based on reduced-form models where the probability of observing a certain governance form depends on transaction attributes (i.e., asset specificity, uncertainty, transaction frequency). Such studies, however, "establish correlations, not causal relations" (Klein, 2004, p. 25); they provide no basis to test for structural relations derived from alternative theories of the firm and leave open the question what the costs of misalignment are. Since in some cases rival explanations for certain correlations between exogenous variables and the governance form would be viable (e.g., TCE versus resource-based view), there is an obvious need for tests that can discriminate between alternative interpretations. In order to conduct stronger tests of transaction cost propositions, measures of transaction costs or other performance indicators are needed.

There is an extensive literature finding mixed results for the relationship between measures of firm performance and governance choice. However, these studies simply regress a performance measure π on an indicator of the governance form G and a vector of exogenous variables X with $\pi_i = \alpha G_i + \beta X_i + e_i$ and interpret the estimated parameter α as the contribution of governance choice to performance (Masten, 2002). But they fail to account for the fact that managers make strategic decisions, such as the organizational structure, not randomly but rather decide based on the expectations on how their choices affect future performance and self-select into the strategy where they expect a competitive advantage. Therefore, this literature ends up answering the question: 'What is the difference in the performance of firms that adopt a certain governance form and of those adopting an alternative institutional arrangement?' In contrast, from a transaction cost perspective, the crucial question that should be addressed is: 'What *would have been* the performance level if the transactor had chosen the alternative governance form?'

The Heckman model is a two-stage estimation in which results from a first regression explaining the selection decision (e.g., governance choice) are used to control for selection bias in the structural form performance equations. Suppose a simple model with a set of strategies (e.g., make versus buy) $G = (G^0, G^1)$ and the corresponding performance outcomes $\pi = (\pi^0, \pi^1)$. TCE is interested in the difference between the performance under the chosen governance form and the performance under the alternative, namely what Hamilton and Nickerson (2003, p. 60) call the 'strategy effect' $\pi_i^1 - \pi_i^0$. The question is, what would have been the performance outcome under the alternative, not chosen, governance form, $E(\pi^0 \mid S^1)$ and $E(\pi^1 \mid S^0)$, respectively.

Governance choice is modeled as a continuous latent variable G^* and depends on the expected performance difference $\pi_i^1 - \pi_i^0$, on exogenous variables Z affecting governance choice but not the performance outcome, and on some unobserved factors v:

$$G_i^* = \gamma\left(\pi_i^1 - \pi_i^0\right) + \delta Z_i + v_i \quad \text{with } G_i = 1 \text{ if } G_i^* > 0 \text{ and zero otherwise.} \qquad (7)$$

The parameter γ measures the extent to which the impact of strategy on performance itself affects strategy choice. Since we only observe the performance outcome under the chosen alternative, we have to substitute the performance levels using $\pi_i^1 = \beta^1 X_i + e_i^1$ and $\pi_i^0 = \beta^0 X_i + e_i^0$ and get the reduced form model

$$G_i^* = \beta X_i + \delta Z_i + w_i \quad \text{with } w_i = \gamma\left(e_i^1 - e_i^0\right) + v_i \text{ and } \beta = \gamma\left(\beta^1 - \beta^0\right). \qquad (8)$$

Heckman (1979) showed that under the assumptions that e^1, e^0 and v are jointly normally distributed and that unobservables for π_i^1 are uncorrelated with unobservables for π_i^0 that

$$
\begin{aligned}
E\left(e_i^1 \middle| G^1\right) &= E\left(e_i^1 \middle| G^* > 0\right) = -\sigma_u^1 \phi[X_i\beta + Z_i\delta] / \Phi[X_i\beta + Z_i\delta] = -\sigma_u^1 \lambda_i^1 \\
E\left(e_i^0 \middle| G^0\right) &= E\left(e_i^0 \middle| G^* \le 0\right) = \sigma_u^0 \phi[X_i\beta + Z_i\delta] / \Phi[X_i\beta + Z_i\delta] = \sigma_u^0 \lambda_i^0
\end{aligned}
\qquad (9)
$$

with ϕ being the normal density function, Φ being the cumulative normal distribution, λ being referred to as the inverse Mills ratios, and the parameter values β and δ estimated from Equation (8). The sample-selection corrected performance equations then can be estimated using ordinary least squares (OLS), including the inverse Mills ratios as an additional regressor. The inclusion of the inverse Mills ratios leads to expected values of the error terms equaling zero by construction; OLS estimation will deliver unbiased estimates for the parameters of

$$
\begin{aligned}
\pi_i^1 &= \beta^1 X_i - \sigma_u^1 \phi\left[X_i\hat{\beta} + Z_i\hat{\delta}\right] / \Phi\left[X_i\hat{\beta} + Z_i\hat{\delta}\right] + e_i^1 \\
\pi_i^0 &= \beta^0 X_i + \sigma_u^0 \phi\left[X_i\hat{\beta} + Z_i\hat{\delta}\right] / \left(1 - \Phi\left[X_i\hat{\beta} + Z_i\hat{\delta}\right]\right) + e_i^0
\end{aligned}
\qquad (10)
$$

As discussed in Hamilton and Nickerson (2003, pp. 64 ff.), the parameter estimates of the inverse Mills ratios in fact have an interesting interpretation. The expected performance outcome for firms having adopted G^1 is given by $E\left(\pi_i^1 \middle| G^1\right) = \beta^1 X_i - \sigma_u^1 \lambda_i^1$. Since the inverse Mills ratio always has a positive value, $\sigma_u^1 < 0$ implies that $E\left(\pi_i^1 \middle| G^1\right) > \beta^1 X_i$ and that a positive selection into the strategy occurs; i.e., firms having chosen G^1 actually have performance outcomes above average under this strategy selection. Similarly, $\sigma_u^0 > 0$ implies that $E\left(\pi_i^0 \middle| G^0\right) > \beta^0 X_i$ and indicates a positive selection of firms into G^0. Summarizing, if we observe both $\sigma_u^1 < 0$ and $\sigma_u^0 > 0$, we have a situation of competitive advantage. Each firm has chosen the strategy where it maximizes its expected performance. When $\sigma_u^1 = \sigma_u^0 = 0$ strategy choice is exogenous.

The estimated parameters from Equation (10) furthermore can be used to construct the strategy effects and calculate the gain in performance realized by having chosen a certain governance form (G^1 for the first equation or G^0 for the second equation) instead of the alternative (G^0 or G^1, respectively):

$$
\begin{aligned}
E\left(\pi^1 - \pi^0 \middle| G^1, X_i\right) &= X_i\left(\beta^1 - \beta^0\right) + \left(-\sigma_u^1 + \sigma_u^0\right)\lambda^1 \\
E\left(\pi^1 - \pi^0 \middle| G^0, X_i\right) &= X_i\left(\beta^1 - \beta^0\right) + \left(\sigma_u^1 - \sigma_u^0\right)\lambda^0
\end{aligned}
\tag{11}
$$

For an extension of the two-stage Heckman model to situations in which numerous alternative strategies (e.g., make versus long-term contract versus buy) are possible, see Hamilton and Nickerson (2003, pp. 68 ff.).

There is only a small number of studies that test TCE's predictions based on structural form equations and that therefore can explicate the costs associated with failing to align transactions and governance forms in a transaction cost economizing way and test for hypotheses derived from rival theories of the firm, but "[w]e would like to know how much we lose by going from the best to the next best" (Joskow, 1991, p. 81).

Masten et al. (1991) investigate organizational choice in the US naval shipbuilding industry. Using survey data, they are able to construct a measure of the governance costs of internal organization (i.e., the number of hours devoted by the management to planning, directing, and supervising a particular component or process times the average hourly wage rate). The authors provide dollar estimates of transaction costs based on a two-stage Heckman model and show that organizational misalignment would lead to substantial cost increases of 175% if the internally made items in the sample would have been subcontracted and of 72% if subcontracted items would have been produced within the respective firm. This implicates that changes in legal rules that favor one governance form can have significant efficiency implications. For the first-stage estimation Masten et al. confirm transaction cost theory's predictions showing that internal organization is more likely the higher temporal and human asset specificity are. They find a non-monotonic effect of complexity on the probability of vertical integration; the deficiencies of contracting seem to exceed the administrative costs of internal organization only for very complex components. Labor intensity has a positive and engineering intensity a negative effect on the integration decision. For the second-stage estimation, they furthermore show that contrary to TCE's predictions, an increase in human asset specificity will *decrease* the costs of internal organization suggesting that it is less costly to manage employees with more specific skills.

Developing a model of comparative institutional performance, Poppo and Zenger (1998) examine the make-or-buy decision in information services and test alternative theories of the firm (e.g., transaction cost theory, resource-based view, agency theory). Using survey data, they measure overall exchange performance (considering production and transaction costs) via proxy variables that rank the satisfaction with overall costs, the quality of the output, and the responsiveness to problems or

inquiries. The first-stage estimation results show that the presence of firm-specific assets encourages internal procurement whereas outsourcing of a service is more likely if extensive technological skills are required. The second-stage equations indicate that asset specificity has a negative effect on firm performance under outsourcing but no significant effect on performance of internal organization. Measurement difficulty has a negative impact on the overall costs. Furthermore, uncertainty seems to have no effect on boundary choice in the information services industry. Summarizing, this paper provides broad support for TCE and refutes rival hypotheses concerning the impact of asset specificity on the performance under integration derived from the resource-based view of the firm.

Leiblein et al. (2002) analyze firms' decision to outsource production in the global semiconductor industry and quantify the impact of governance choice on technological performance (measured as a function of transistor density). In the first step, they show that firms tend to internalize production when ex-ante small number bargaining with potential suppliers is severe. Furthermore, confirming TCE, they find that outsourcing is less likely when firms have to invest in specific assets under high demand uncertainty. Estimation results of the second stage support the assumption that firms self-select into the strategy where they expect a higher performance. Deviation from the optimal governance mode with respect to the attributes of the transaction will have a negative impact on performance. Average expected performance would decrease by about 45% if firms that internalized production would rely on outsourcing; expected performance for observations showing outsourcing would decrease by about 30% if those would be integrated.

Sampson (2004) examines the costs of misaligned governance in the context of R&D alliances in the telecommunications equipment industry. Thereby, she distinguishes between excessive contracting hazards in an alliance not safeguarding ex-post opportunism and excessive bureaucracy in an alliance providing too much hierarchical structures. She shows that firms choose a more hierarchical governance mode when alliance activities are more complex (specification and monitoring are expected to be difficult) and when only weak external protections for intellectual property are available. Furthermore, she finds support for TCE's structural form hypotheses. If the alliance form is selected according to the theory's propositions, firm performance (measured via firm patents for a specified period after the alliance) improves substantially. Misalignment will decrease performance by more than 60%. Interestingly, misalignment costs occur inhomogenously; governance misalignments imposing excessive bureaucracy reduce performance more than misalignments imposing excessive contracting hazards.

Ruester and Zschille (2009) investigate the impact of governance structure on firm performance using a database of German water supply companies. Based on a first OLS model, they find that private sector participation as opposed to pure public service provision is accompanied with higher retail prices. Controlling for scale economies as well as technical and structural characteristics, a representative household on average pays 18.40 € per year more if water is supplied under private sector participation. Estimation results of a two-stage Heckman model indicate, however, that

governance choice seems to be an exogenous variable from the supplier's perspective. In fact, outsourcing decisions are taken by local public authorities and need not always be driven by economical but also by political considerations.

4.4 Relational contracting

During the past decade, researchers came up with an increasing interest in relational institutional arrangements since traditional TCE may overstate the desirability of complex long-term contracts and vertical integration in exchange settings where a substantial hold-up potential is present. Close relationships between exchange partners allow to enact relational contracts and to obtain first best outcomes that would not be achievable through explicit contracts alone.

Relational (or implicit) contracts are informal agreements between two parties – within the firm (between employer and employee) or between firms (vertically or horizontally) – which are not enforceable by any third party such as a court. They circumvent the limitations of formal contracting in helping to respond to unforeseen contingencies or inducing a supplier to provide informally agreed optimal product or service quality when transaction attributes are not verifiable ex-post. Exchange partners may choose to rely on a less complete contract in order to avoid contractual rigidities, leaving out certain elements of intended performance unspecified and enforcing these terms instead by a private enforcement mechanism.

Since relational contracts are not verifiable ex-post, they have to be self-enforcing; the value of the future relationship must be sufficiently large that neither party wishes to renege. Mechanisms through which relational governance attenuates exchange hazards can be both economic (monetary cost-benefit calculus) and sociological (based on social norms and developed social ties). Exchange partners compare the short-term gain with the long-term disadvantages of breaching the contract, including the future loss due to the termination of the relationship plus the potential damage in reputation. The self-enforcing range measures the extent to which market conditions can change without providing one of the parties an incentive to hold-up the other, but where the parties will perform in a way consistent with the mutually understood contractual intent (Klein, 1996). Relational contracting increasingly is becoming the subject of study in theoretical and applied literature. The following paragraphs introduce a number of selected exemplary contributions.

Focusing on a setting where actions are unobservable (moral hazard) and outcomes are observable but not verifiable (non-contractibility), Baker et al. (2002) develop repeated-game models investigating why and how relational contracts within firms differ from those between firms. Amongst others, they formally show that vertical integration is an efficient response to widely varying supply prices since integration reduces the incentives to renegotiate contract terms in such settings.

Poppo and Zenger (2002) focus on relational governance in the form of relational norms such as trust between the exchange partners and point out that contractual enforcement within relational contracts occurs through social processes that promote norms of flexibility (facilitating adaptation to unforeseen

events), solidarity (facilitating problem solving), and information sharing (facilitating both problem solving and adaptation). Using survey data on outsourcing relationships in information services, they find that formal contracts and relational governance function as complements. Well-specified contracts may support more cooperative exchange relationships at the same time that relational governance may help to overcome the limitations of incomplete contracts in the sense that there exists a bilateral commitment to 'keep-on-with-it' also for situations where market conditions change unexpectedly. Second, the authors show that both relational governance and contractual complexity deliver higher levels of satisfaction with exchange performance. The complementarity of contractual and relational governance is also confirmed by Zheng et al. (2008) discussing two case studies of long-term arrangements in the form of public-private partnerships.

Liu et al. (2008) study the role of contractual and relational mechanisms in manufacturer-distributor relationships in the Chinese household appliance industry. Estimation results of a multivariate regression show that written contracts and relational governance in the form of mutual norms and trust are complements in that opportunism is restrained more effectively and exchange performance is improved when both mechanisms operate simultaneously. However, they do not account for the impact of relational norms on the *degree* of contractual complexity but only regard whether any contract is used to govern the relationship. Chapter 4 of this thesis adds to this discussion an empirical study investigating the impact of inter-organizational trust on the choice of more or less hierarchical governance modes.

Nagaoka et al. (2008) assess the determinants of governance choice extending the traditional decision between make and buy introducing as a third choice the procurement from an affiliated supplier. This typically Japanese type of strategic alliance, also called keiretsu, is a form of relational contracting. Using survey data on Japanese car manufacturers and their component supply, the authors find that an increasing level of design specificity of a component makes keiretsu sourcing preferred to market procurement, but does not significantly affect the probability of vertical integration over keiretsu. This result suggests that relational contracting can effectively mitigate the hold-up risk associated with specific investments.

Gil and Marion (2009) examine the impact of relationships between contractors and subcontractors in the Californian highway construction market on bidding, auction participation, and subcontractor choice. Amongst others, they show that a bigger stock of past relationships between the same exchange partners results in lower bids (i.e., indicating lower coordination costs) and that a higher number of potential future interactions results in lower bids, too (i.e., indicating a higher value of continuing the exchange relationship). Furthermore, past relationships seem to have only a negligible impact in the absence of any self-enforcement mechanism of future business.

5   Summary and Conclusions

Under the assumption that economic individuals are characterized by bounded rationality and might behave opportunistically, once relationship-specific investments have been realized, transaction cost economics aims to align transactions that differ in their attributes to governance modes that differ in their costs and competencies in an optimal way. Even though TCE often is referred to be an empirical success story with about 900 empirical contributions providing considerable support for its central propositions, "the field continues to offer many opportunities to plant, grow, and harvest new and value-creating research" (Nickerson and Bigelow, 2008, p. 208). In recent years, TCE has become more interdisciplinary. Researchers increasingly combine predictions derived from TCE with those from other theoretical perspectives such as strategic management or the resource-based view of the firm.

Several theoretical advancements have been proposed in recent years. Williamson (1991b) introduces the shift parameter framework investigating how the optimal choice of governance changes in response to dynamics in the institutional environment. Nickerson (1997) develops the positioning-economizing perspective linking TCE with the strategic management literature. Structural form tests employing two-stage Heckman models account for the self-selection of managers into a certain strategy (i.e., organizational form) and succeed in testing for rival propositions on the relationship between exogenous variables and exchange performance derived from alternative theories of the firm (e.g., Poppo and Zenger, 1998). Furthermore, researchers increasingly are interested in relational institutional arrangements (e.g., Gil and Marion, 2009).

Future empirical work should address several issues: i) more precise proxies for theoretical constructs such as transaction costs, asset specificity, uncertainty, or transaction frequency will improve empirical testing. If researchers succeed in measuring governance costs, structural form models can be estimated allowing for the confrontation of propositions derived from rival theories of the firm and to evaluate the costs associated with failing to align transactions and governance forms; ii) the concept of uncertainty should be considered with respect to a variety of dimensions and a more intensive theoretical and empirical treatment of transaction frequency is required; iii) more empirical tests investigating governance choice in a more comprehensive way are desirable (e.g., studies analyzing the trichotomous choice between market, hybrids, and hierarchy, or studies investigating a set of alternative hybrid governance forms such as different forms of joint ventures and inter-firm alliances); iv) analyses going beyond the single transaction as the unit of analysis but instead regarding constellations of interdependent transactions would improve the understanding of overall firm strategy; and finally, v) accounting for the simultaneous choice of contract provisions such as contract duration and the level of completeness would provide important insights on their interactions. For this purpose, case studies are a suitable tool. Even though often criticized because of a lack of generality, case studies are able to focus on institutional and transactional details and provide, as a complement to econometric tests, a richer perspective.

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Appendix

Table 3: Selected empirical studies testing TCE: Make or buy

Authors/Year	Sector/Unit of analysis	Method	Dependent variables	Main independent variables	Main findings
Klein et al. (1978)	US auto sector (Fisher Body and GM), petroleum industry	Qualitative discussion	Vertical integration along successive stages of the value chain	Hold-up potential by exchange partner	Vertical integration is more likely when hold-up potential (i.e., quasi-rents from firm-specific investments) is large.
Globerman (1980)	Technology-intensive industries (focus on telecommunication, defense, IT)	Qualitative discussion	Backward integration into research and development	Uncertainty, complexity, transaction-specific investments	The more complex, uncertain, and specialized the innovation, the more complex will be the governance structure. Competitive bidding only feasible when technology transfer is amenable to fairly precise performance and feature specifications.
Monteverde and Teece (1982a)	US auto sector	Linear probability model	Vertical quasi integration (downstream firm owns specialized tools used in upstream production)	Asset specificity	Positive relationship between appropriable quasi-rents and the occurrence of quasi integration.
Monteverde and Teece (1982b)	US auto sector	Probit model	Backward integration into component supply	Human assets	Engineering effort is positively related to appropriable quasi-rent. The higher the appropriable quasi-rent, the greater the likelihood of vertical integration.
Masten (1984)	US aerospace industry	Probit model	Internal versus external procurement of supplies	Design and site specificity, complexity of item	Probability of internal procurement is higher for complex and highly specialized inputs. Hazard of incomplete contract in complex environments is greater when specific designs are involved.
Walker and Weber (1984)[*]	US auto sector	Multiple-indicator structural equation model (unweighted least squares)	Backward integration into supply of simple components	Volume and technological uncertainty, specificity, supplier production cost advantage	The higher the supplier production cost advantage the more likely is external procurement; the competitiveness of supplier market increases production cost advantage of suppliers over buyers. Volume uncertainty increases the likelihood of integration.
Palay (1984)*	Rail freight industry	Qualitative discussion and some statistics	Vertical structures between rail freight carriers and their shippers	Asset specificity	As investment characteristics become more transaction-specific, the associated institutional structure becomes increasingly unique to the parties and transactions it supports.

Authors/Year	Sector/Unit of analysis	Method	Dependent variables	Main independent variables	Main findings
Anderson and Schmittlein (1984)*	US electronic component industry	Logit model	Forward integration into marketing	Specificity, uncertainty (environmental unpre-dictability, difficulty of evaluating performance)	Asset specificity, the difficulty in evaluating performance, and company size all have a positive influence on the likelihood of forward integration.
Joskow (1985)	US coal-burning power plants	Qualitative discussion	Vertical structure between coal supplier and power plant (i.e., spot market, vertical integration, or long-term contract)	Specificity (site, physical asset, dedicated), uncertainty and complexity	Empirical results consistent with TCE; e.g. vertical integration or very long and complex long-term contracts are used for mine-mouth plants.
Globerman and Schwindt (1986)	Canadian forest products	Qualitative discussion	Backward integration of forest product companies into ownership of timber rights	Dedicated asset specificity	Transactional considerations, particularly asset specificity, prove to be robust empirical determinants of governance structures.
Klein (1988)	US auto sector (Fisher Body and GM)	Qualitative discussion	Backward integration of General Motors into the supply of car bodies	Hold-up potential by exchange partner	Vertical integration will be used when hold-up potential (i.e., quasi-rents from firm-specific investments) is large.
Hennart (1988)	Aluminum and tin industries	Qualitative discussion	Upstream vertical integration	Number of actual or potential parties at each stage, level of quasi-rents, uncertainty	Scale economies, barriers to entry, higher transportation costs, and greater asset specificity explain a higher degree of upstream integration.
John and Weitz (1988)*	Industrial good manufacturers	Multiple regression and multinomial logit models	Forward integration into distribution	Specificity, environmental and behavioral uncertainty	The higher the level of specific assets and the higher the level of uncertainty, the higher the likelihood of forward integration.
Klein (1989)*	Canadian exporting firms	Multiple regression	Degree of vertical control exerted by a firm in its export channel	Specificity, uncertainty (complexity/dynamism), transaction frequency	The higher asset specificity, frequency, and uncertainty (i.e., complexity) the higher will be the degree of vertical control. Uncertainty (i.e., dynamism) has a negative effect.
Masten, Meehan, Snyder (1991)*	Naval shipbuilding sector	Two-stage self selection model	Backward integration into input component supply	Specificity (physical, human, temporal), complexity, similarity of the transactions	Temporal and human asset specificity have a positive impact on the likelihood of vertical integration. Non-monotonic effect of complexity (for simple components increases in complexity make it less likely that production is internalized; for more complex components positive impact). Integration is more likely for more labor-intensive and less engineering-intensive activities. Contrary to expectations, human asset specificity has a negative impact on transaction costs suggesting that workers with more specific skills are less costly to manage.

Authors/Year	Sector/Unit of analysis	Method	Dependent variables	Main independent variables	Main findings
Lieberman (1991)	US chemical sector	Logit model	Backward integration	Specificity, supplier concentration, demand variability measures	The likelihood of integration increases with asset specificity. Backward integration to avoid variability in the input market that is independent of fluctuations in own downstream market (assuring stable supplies).
Pirrong (1993)	Bulk shipping markets	Qualitative discussion	Contracting practices and vertical integration	Differences in exogenous factors (e.g., market structure, vessel specialization)	Whereas spot contracts are chosen in the absence of any bilateral dependency relationship, forward contracts are employed when significant temporal specificity is observed. In a specialized shipping market where both temporal and contractual specificities are present, long-term contracts or vertical integration are observed.
Ohanian (1994)	US pulp and paper industry 1900-1940	Logit and tobit models	Likelihood and degree of vertical integration of pulp and paper production	Market concentration, controls such as firm size	With rising small number bargaining problem and higher investments in specific assets the likelihood for as well as the level of vertical integration increase.
Lyons (1995)*	UK mechanical engineering, motor vehicle, electronics, and metal processing industries	Logit models	Backward integration into input procurement	Specificity (specialized equipment necessary for input production), economies of scale and scope	The probability of buying-in specialised inputs is higher if the production technology is non-specific, but only if there are economies of scale or scope. The effect of economies of scale and scope is much reduced in the presence of specific assets.
Poppo and Zenger (1998)*	Information services	Two-stage Heckman model	Outsourcing (dummy, percentage)	Asset specificity, measurement difficulty, technological uncertainty, economies of scale	1st stage probit: The presence of firm-specific assets encourages internalization whereas outsourcing more likely if extensive skills are required. 2nd stage: Asset specificity has a negative effect on market performance and no clear effect on firm performance; measurement difficulty has a negative impact on overall costs.
Martinez (1999)	US pork and broiler industry	Qualitative discussion	Contracting practices and vertical integration	Transaction cost variables	Observed vertical structures in the pork and broiler industry are consistent with TCE's predictions.
Gonzalez et al. (1999)	Spanish construction industry	OLS, fixed effects panel data approach	Subcontracting	Specificity, uncertainty, geographical dispersion, output variety, technological specialization	As specificity is higher, firms tend to subcontract less. The opposite happens when output heterogeneity and the use of intangible assets and capabilities increase. Neither temporary shortage of capacity nor geographical dispersion of activities seem to affect the extent of subcontracting. Proxies for uncertainty do not show any clear effect.
Simoens and Scott (1999)	UK primary care sector	Qualitative discussion and literature review	Vertical and horizontal integration	Transaction cost variables	Economic and non-economic theories of integration are relevant and applicable to explain integration in primary care.

Authors/Year	Sector/Unit of analysis	Method	Dependent variables	Main independent variables	Main findings
Fan (2000)	Petrochemical industry	Multivariate regression	Vertical integration (input self-sufficiency ratio)	Specificity, price uncertainty	Input price uncertainty in the 1970s positively affected the extent of backward integration. This positive reaction of vertical integration to price uncertainty mainly occurs in transactions subject to asset specificity.
Vernimmen et al. (2000)	Belgian agriculture sector	Probit model	Outsourcing of administration	Complexity, uncertainty, transaction frequency	The complexity of the task and uncertainty regarding the outcome have a high impact on the decision to outsource. Larger firms tend to outsource more administration.
Martinez (2002)	US poultry, egg, and pork industries	Qualitative discussion	Contracting practices and vertical integration	Transaction cost variables	Observed vertical structures are consistent with TCE's predictions.
Leiblein et al. (2002)	Global semiconductor industry	Two-stage Heckman models	Outsourcing of production, technological performance	Ex-ante number of suppliers, asset specificity, uncertainty of product demand	1st stage: Firms tend to internalize production when ex-ante small number bargaining with potential suppliers is severe. Outsourcing is less likely when the firms have to invest in specific assets under high demand uncertainty. 2nd stage: Firms self-select into the strategy where they expect a higher performance.
Aubert et al. (2004)*	IT outsourcing	Partial least squares	Level of outsourcing	Asset specificity, uncertainty, required business and technical skills	Uncertainty is the major deterrent to outsourcing, while the level of technical skills is the most important reason to outsource. Business skills do not seem to play a significant role; asset specificity showed inconsistent effects.
Rosés (2005)	Spanish cotton industry 1720-1860	Logit and tobit models	Likelihood and degree of vertical integration of cotton spinning and weaving production	Market concentration, asset specificity, firm size	The likelihood as well as the level of vertical integration increase with higher specificity and a higher small numbers bargaining problem.
Acemoglu et al. (2005)	Numerous industries worldwide	OLS	Degree of vertical integration	Contracting costs, credit market development, barriers to entry	Firms are more integrated in countries with greater contracting costs, greater credit market imperfections, and greater barriers to entry. Countries with worse contracting institutions and greater credit market imperfections are more concentrated in industries that are typically characterized by strong vertical integration.
Sampson (2004)	R&D alliances in the international telecommunications equipment industry	Two-stage Heckman model	Alliance type (pooling contract vs. equity joint venture), firm innovative performance	Contracting difficulties, alliance characteristics, strength of intellectual property regime	Misaligned governance dampens firm performance.

Authors/Year	Sector/Unit of analysis	Method	Dependent variables	Main independent variables	Main findings
Sartorius and Kirsten (2005)*	Southern African sugar production	Case study	Outsourcing of sugarcane production to small-scale farmers	Transaction frequency, asset specificity, uncertainty	Sugarcane production should not be outsourced but rather co-ordinated by a more relational structure such as a strategic alliance.
Makholm (2006)	US natural gas industry	Qualitative discussion	Vertical integration between pipelines, production, and distribution	Asset specificity, regulatory actions	Until 1935, no federal regulation and a high degree of vertical integration – consistent with TCE due to the high level of asset specificity. After 1935, vertical separation of pipelines and long-term take-or-pay contracts between producers and pipelines with pipelines re-selling the gas to distributors. Since 1985, functioning market for pipeline capacity with well defined property rights and transparency over prices.
Spekle et al. (2007)	Auditing activities in Dutch companies	OLS	Proportion of outsourcing of auditing activities	Specificity, frequency, environmental and behavioral uncertainty	Firm-specific knowledge and frequency (influenced e.g. by firm size) positively influence internal auditing. Uncertainty has no impact on the outsourcing decision.
Gil (2007)	Spanish movie industry	OLS, two-stage least squares	Share of vertically integrated companies	Renegotiation frequency, movie release in the US, Spanish origin of the movie	Movies renegotiated ex-post more often are more likely to be distributed by integrated distributors. Hence, integrated distributors specialize in movies that are contractually more complex and use their own theaters more often for those of their movies that are contractually more complex.
Bigelow and Argyres (2008)	US auto industry 1917-1933	Probit models	Make or buy of the engine for each of its models	Specificity, number of suppliers, firm's industry experience	Asset specificity associated with an engine was associated with a greater likelihood that the engine would be produced internally.
Nagaoka et al. (2008)*	Japanese automobile manufacturers	Multinomial logit	Choice between vertical integration, relational contracting (keiretsu) or market sourcing	Design specificity, interdependency in design of this and other components, testability of quality	An increasing level of design specificity of a component makes keiretsu sourcing preferred to market procurement, but does significantly affect the probability of vertical integration over keiretsu. The interdependency of components has a positive impact on the likelihood that more hierarchical governance forms are chosen.
Fernández-Olmos et al. (2008)	Spanish wine industry	Ordered logit models	Market versus hybrid versus hierarchy	Physical and dedicated asset specificity, behavioral and environ-mental uncertainty, firm size, product quality	The probability of vertical integration increases with asset specificity and uncertainty. Wineries that produce high-quality wines are more likely to vertically integrate.

*… based on survey data

Table 4: Selected empirical studies testing TCE: Contractual provisions

Authors/Year	Sector/Unit of analysis	Method	Dependent variables	Main independent variables	Main findings
Mulherin (1986)	US natural gas industry	Qualitative discussion	Development of vertical structures 1920s to mid-20th century	Vulnerability to opportunistic behavior	Potential for opportunistic behavior created by specialized assets has induced the use of complex, long-term contracts.
Hubbert and Weiner (1986)	US natural gas industry	Qualitative discussion with some descriptive statistics	Contractual structure	Phased deregulation of wellhead prices in the US	Derive a theoretical model on the determination of take-or-pay provisions. Wellhead price ceilings favor long-term contracts which include non-price contract provisions such as take-or-pay clauses increasing the producers' total compensation.
Joskow (1987)	US coal industry	OLS and maximum-likelihood models	Contract duration	Site, physical asset, and dedicated specificity	Contracting parties make longer commitments when specific, investments occur.
Crocker and Masten (1988)	US natural gas sector	Tobit model, OLS, two-stage least squares	Take-or-pay percentage, contract duration	Uncertainty, number of potential traders to capture quasi-rent, regulatory actions	Confirm the trade-off between the costs of repeated bargaining in the presence of relationship-specific investments and the hazard of being bound to an inflexible long-term agreement. Show theoretically and empirically that distortions in performance incentives raise the costs of long-term agreements and therefore shorten contract duration.
Masten and Crocker (1991)	US natural gas sector	Probit and multinomial probit models	Processes by which parties adjust prices in long-term contracts (renegotiation vs. redetermination)	Specificity, price uncertainty	No significant results for transaction cost variables. With increasing contract duration, the probability of adopting renegotiations increases as expected; negative relationship between price and quantity flexibility as expected.
Lyons (1994)*	UK engineering firm	Probit model	Formal contract	Vulnerability to opportunistic behavior, complexity	The probability of using formal contracts increases with the vulnerability to opportunistic behavior whereas it decreases with the complexity of the transaction.
Saussier (1999)**	Electricité de France's coal supply	OLS, two-stage least squares	Contract duration	Specificity (physical, site, dedicated, human assets), uncertainty	Whereas contract duration increases with the level of appropriable quasi-rents at stake, it decreases with the level of uncertainty.
Saussier (2000)**	Electricité de France's coal supply	OLS, ordered probit, and two-stage models	Contractual completeness	Specificity (physical, site, dedicated, human assets), uncertainty	Whereas contractual completeness increases with the level of appropriable quasi-rents at stake, it decreases with the level of uncertainty.
Kerkvliet and Shrogren (2001)	US coal supply contracts to power plants in Powder River Basin	OLS	Contract duration	Specificity (physical, site, dedicated assets), trading and market experience	Positive relationship between physically specific investment and contract duration but counterintuitive result for impact o dedicated asset specificity. Duration decreases with rising trading and market experience.

Authors/Year	Sector/Unit of analysis	Method	Dependent variables	Main independent variables	Main findings
Poppo and Zenger (2002)*	Information services	Three-stage least squares model correcting for self-selection into outsourcing	Contractual complexity and relational governance, exchange performance	Exchange performance , relational governance index, contractual complexity, asset specificity, measurement difficulty, technological change	Increases in the level of relational governance are associated with greater levels of contractual complexity. Both relational governance and contractual complexity deliver higher levels of satisfaction with exchange performance.
López-Bayon and González-Diaz (2004)*	Spanish electronics industry	Logit and multinomial logit models	Contract duration of subcontracting agreements	Product specificity, technological and demand uncertainty	Probability of signing an indefinite duration contract is related positively to the specificity of the activity and negatively to the uncertainty regarding future demand and to the degree of formalization of the contract. Indefinite duration contracts (working as relational contracts) improve flexibility for adjusting the relationship to the changing environment.
Zylbersztajn and Lazzarini (2005)	Technology licensing contracts between seed companies and a governmental R&D organization in Brazil	Hazard rate models	Contract survival	Quasi-rents, monitoring costs, past performance, environmental stability	Rates of contract termination decrease with the level of quasi-rents at stake, decrease as a function of past satisfactory outcomes, increase with the extent of disturbances affecting the technology's demand, and increase over time.
Brickley et al (2006)	Franchise contracts	OLS and ordered probit models	Contract duration, change in contract duration	Total investments, training requirements, contract renewal restrictions	Contract duration increases with the franchisee's physical and human capital investments, recontracting costs, and the franchisor's experience in franchising (argued to be negatively related to uncertainty about optimal contract provisions).
Athias and Saussier (2007)**	International infrastructure concession contracts	Ordered logit and two-stage ordered logit models	Contractual rigidity	Uncertainty (future demand, costs, difficult to predict future), reputation	Develop a model combining property rights theory and TCE. The higher demand uncertainty, the more flexible the toll adjustment provisions will be. Reputation has a negative effect on the level of rigidity.
Liu et al. (2008)*	Chinese household appliance industry	Multivariate regression	Relationship between formal and relational contracts	Specific investments, relational norms, trust, exchange performance	Contracts are more effective in restraining opportunism while relational mechanisms are more powerful in improving performance. Written contracts and relational governance in the form of mutual norms and trust are complements.
Hirschhausen and Neumann (2008)	World natural gas market	OLS	Contract duration	Specificity, market restructuring	Contract duration decreases as the market structure evolves to more competitive regimes. Investments linked to specific infrastructures increase contract duration by an average of three years.

Authors/Year	Sector/Unit of analysis	Method	Dependent variables	Main independent variables	Main findings
Ruester (2009)	World liquefied natural gas market	Two-stage least squares, GMM	Contract duration, annual contracted volume	Specificity, uncertainty, transaction frequency	The higher asset the longer is contract duration. On the contrary, the need for flexibility in today's 'second generation' LNG market supports shorter-term agreements. When firms have experience in bilateral trading, contract duration decreases. Countries with a greater dependence on imports in the form of LNG tend to negotiate longer agreements. Deliveries to competitive downstream markets are realized via contracts with about 2.5 to three years shorter duration.
Kozhevnikova and Lange (2009)	US coal industry	Tobit model	Contract duration	Asset specificity, contractual complete-ness, regulatory reforms	Larger quantities and spatial closeness of plants and mines lead to longer contracts. Contract completeness has no impact on the duration once it is controlled for endogeneity. The railroad reform, which decreased transportation costs, had a negative effect on contract duration.

[*] …   based on survey data
[**] …   authors had access to complete contract