The Economic Foundations of Supply Chain Contracting

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Harish Krishnan

Sauder School of Business
University of British Columbia
Vancouver, British Columbia, V6T 1Z2
Canada
harish.krishnan@sauder.ubc.ca

Ralph A. Winter

Sauder School of Business
University of British Columbia
Vancouver, British Columbia, V6T 1Z2
Canada
ralph.winter@sauder.ubc.ca

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Harish Krishnan[1] and Ralph A. Winter[2]

[1] *Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver, British Columbia, V6T 1Z2, Canada, harish.krishnan@sauder.ubc.ca*
[2] *Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver, British Columbia, V6T 1Z2, Canada, ralph.winter@sauder.ubc.ca*

Abstract

Why do supply chain contracts take the forms that they do? Which contracts should firms adopt to coordinate incentives along a supply chain? This monograph synthesizes the theory of contracts along supply chains. It integrates developments from two largely separate literatures, the management science literature on supply chain coordination and the economic literature on vertical control.

Contents

1

Introduction

1.1 Setting the Stage

A supply chain is the sequence of firms involved in the production of a product or service, from the procurement of raw materials through the production of intermediate inputs to the distribution of the product to ultimate buyers. Supply chain management involves all economic decisions along this chain, including product design, the choice of inputs at each stage, the choice of which suppliers to use, transportation of both inputs and final products, inventory decisions at each point of the chain, and ultimate pricing. No single firm controls all decisions along the supply chain. Many firms, each with their own management and shareholders, make decisions that must be coordinated.

Real-world contracts reflect the need for this coordination. We observe in supply chains an extraordinarily rich array of agreements. Contracts may specify complex nonlinear pricing schedules. Contractual restrictions may be imposed on input suppliers well beyond the obligation to supply at a specified price. Restrictions imposed on downstream firms include restraints on prices or territories, exclusivity requirements of various types, or minimum quantities. We observe inventory risk-sharing arrangements, e.g. buy-back contracts in which

an input supplier agrees to purchase unsold inventory; revenue-sharing and other royalty agreements; loyalty contracts, including market share discounts; and so on.

Why do supply chain contracts take the forms that they do? Which contracts should firms adopt in a given market environment? Existing surveys of the theory underlying these questions approach the area from either the management science perspective (e.g., [33]) or from the perspective developed in the economics literature (e.g., [97]).[1] This separation reflects a division in the community of scholars working in the area, coming largely from either management science or economics. In reference to one of the principal economic approaches to the question, the transactions-cost-economics (TCE) approach, Williamson [200] writes "...some cross-referencing between the TCE and supply chain literatures notwithstanding, these two are mainly disjunct. Arguably, the complementarities and tensions between them should be more fully worked up [and] this could be the beginning of a constructive conversation."

1.2 The Aim of This Monograph

Like other areas in operations management and management science, the theory of supply chain decisions has expanded from its traditional domain of operations optimization by a single decision maker towards the coordination of the incentives and decisions of multiple firms. The theme of this monograph is that as supply chain management moves from a focus on optimization problems to issues of coordination, a closer link to the underlying economic foundations is essential. We offer a synthesis of the economic foundations of supply chain contracts.

A review of all of the relevant economics would require volumes. Accordingly, our treatment is selective, incorporating elements of economic theory that we believe will be of most value to our intended readers, students and scholars of management science and operations management. "Economic foundations" herein refers to the alignment

[1] Our focus is on the theory of supply chain contracts. Lafontaine and Slade [116] offer an excellent review of the empirical evidence on inter-firm contracts.

of incentives by contracts to achieve maximum benefits for firms along supply chains.

1.3 Our Approach

The conceptual starting point for understanding contracts along a supply chain is, ironically, a theoretical benchmark under which there are *no* contracts. Consider a good being produced in a perfectly competitive upstream market, and distributed by a perfectly competitive downstream market. (Let us call the firms "manufacturers" and "retailers" for concreteness.) The only decisions in this ideal market environment are quantity decisions, as prices are outside the control of any single firm. And these quantity decisions are coordinated perfectly along the supply chain by the price system. Indeed, in an economy with perfect markets the price system alone conveys all the information that is needed for individuals to make decisions that are in the best interest of the society as a whole [52, 178]. The efficiency of simple price-mediated exchange along a supply chain under perfect market conditions is Adam Smith's "invisible-hand theorem" writ small. With the price system acting as an invisible hand there is no need for any inter-personal or inter-firm contracts at all. Firms along a supply chain make the same decisions *as if* they costlessly met and decided on each detail of their production plans. Contracts play no role.

The price system in reality, not just in theory, provides the central mechanism for coordination of decisions along a supply chain. Consider, for example, the decisions of all parties who produce inputs into a pencil: the graphite miners, the lumberjacks, the mill operators, the final producers and the retail distributors. These parties are not members of a single, huge multi-party contract or planning committee. They interact anonymously for the most part, each maximizing profit given prevailing prices [159]. In maximizing its own interest given the prices along the supply chain, each party makes more or less efficient decisions.

But not perfectly efficient decisions. If the price system functioned as well in reality as in the abstract theory then we would see no contracts. The invisible hand theorem, in other words, tells us that we must depart from the perfect market benchmark to explain contracts.

Introducing any particular deviation from the perfect market setting gives rise to specific incentive distortions, i.e., specific failures of the price system. The economic theory of supply chain management can be thought of as a mapping from "imperfections" in the economic conditions, to incentive distortions, and then to contracts that optimally resolve the incentive distortions:

$$\text{Market imperfections} \quad \rightarrow \quad \text{Incentive Distortions} \quad \rightarrow \quad \text{Contracts}$$

In the domain of this mapping lie a large number of potential market imperfections. One is the *market power* that firms have in setting prices. Firms rarely take prices as outside their control. A second departure from the ideal world arises from *uncertainty*. Demand and costs are never entirely predictable. This would create no incentive problems with a sufficiently rich set of futures markets and insurance markets, as in the Arrow–Debreu model.[2] In reality, this set of markets is incomplete. The price system fails, and the coordination problem arises, whenever some markets are missing.[3]

One source of missing markets is *asymmetric information*. Downstream firms such as retailers are often better informed about the state of demand in their market than upstream producers. Alternatively, as in the case of innovators with special knowledge of the value of their innovations, information may be superior at the upstream stage. Exchanges cannot be made contingent upon events that are not jointly observed. Consumer information is also limited. Consumers may be influenced in their demand by retailers' actions such as sales effort, or the provision of information. Outlets must attract consumers through advertising and other product promotions because of limited consumer information. These are merely some examples of departures from the ideal of perfect markets.

[2] Specifically, the economic theory of exchange in perfectly competitive markets assumes a complete set of markets for contingent commodities [52] or a complete set of securities markets with ex post markets for goods [11]. A contingent commodity is a good specified not just by its physical characteristics but also by the date and "state of the world" in which it is to be delivered.

[3] The phrase "missing markets" encompasses all imperfections including market power, which is the absence of competitive markets.

Moving from the *domain* of the mapping to its *range* (observed contracts), contractual relations can be thought of as falling along a spectrum representing the degree of centralization. At one end of this spectrum is uniform pricing: a contract in which the seller states a price and the buyer chooses a quantity. At the other end is the vertically integrated or centralized firm.

In the supply chain literature both within the theory of management and traditional neoclassical economics, the concept of vertical integration or a centralized firm owning the entire supply chain has come to mean, usually implicitly, a contract in which *all* decisions are taken in the interest of the integrated firm. For example, the literature often asks when particular contracts can achieve the "first-best" profits that would be earned by a vertically integrated firm coordinating all decisions at zero cost.[4]

Against the benchmark of the centralized firm one can assess the performance of "minimally intrusive" or "minimally sufficient" contracts that restrict a smallest subset of the actions of contractual parties. The search for the simplest contracts that can achieve the centralized solution is an implicit recognition of costs of writing and enforcing complex contracts. Minimal contracts are more easily enforced than contracts dictating *all* the actions of agents involved. For example, in the classic paper by Pasternack [153], a contract providing for the buyback of a retailer's inventory at an agreed upon buyback price will elicit first-best retailer decisions on inventory. Implicit in this theory is the assumption that contracting directly over inventory is infeasible, or problematic for reasons outside the model.

In systematically analyzing contracts in this monograph, we will identify the source of the failure of the simple price contract in terms of the externalities introduced by the market conditions. An externality,

[4] The hypothetical costless, complete contract represented by the centralized firm is a very useful benchmark. In reality, however, incentive distortions arise even *within* the firm. The decision between undertaking a particular set of transactions through a market or within a firm involves a tradeoff between the costs of imperfections in the market — *transactions costs*, in economic terminology — with the transactions costs of allocations within the firm. While the main focus of this monograph is on the set of inter-firm contracts that align incentives along a supply chain, we will synthesize as well key contributions to the Coasian (1937) question of whether to transact in a market or within a firm.

in our context, is a failure of a firm (or individual) to capture the full benefits and costs of its decisions to contract partners along a supply chain. Having identified particular externalities at the heart of the "market failure" of the price system, we then design contracts that resolve the distortions in a minimally intrusive way. Note that while perfectly competitive markets yield the socially efficient outcome, contracts that arise as a response to missing markets will be structured to achieve privately efficient outcomes for the firms with market power. The use of contracts to achieve privately efficient outcomes may or may not increase social surplus. The focus of this monograph is on the private incentives for coordination and not on the appropriate policy towards restrictions on contracting. Iacobucci and Winter [89] offer an overview of the law and economics of placing imposing restrictions on the contracts that market participants may enter.

We organize the synthesis of supply chain contracts according to a single dimension of the market environment: the market structures for which contracts are designed. These are depicted in Figure 1.1.

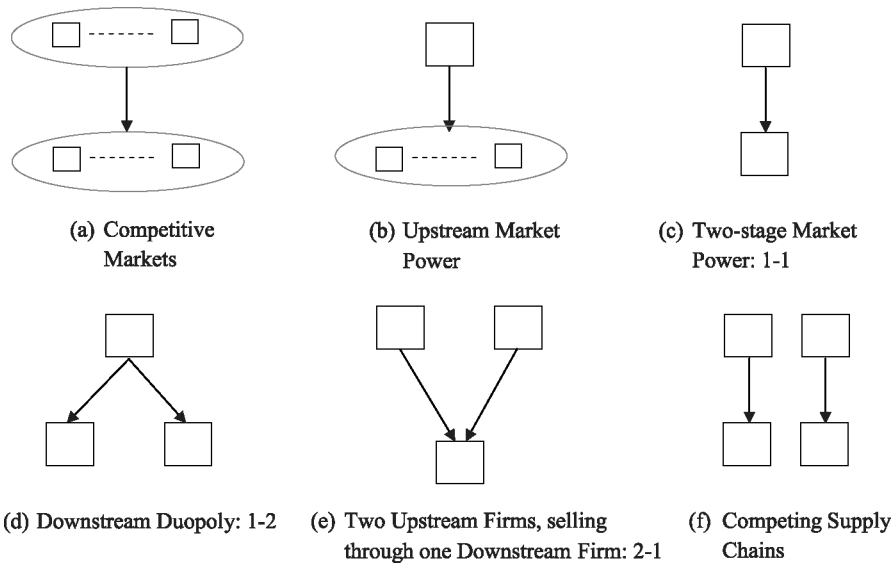

Fig. 1.1 Market structures.

For brevity, we refer to the market structures as 1–1 for the two-stage monopoly; 1–2 for the upstream monopoly facing a downstream duopoly; and 2–1 for the upstream assembly problem and common agency problem in which two upstream firms face a single downstream firm. In our review, we take the market structure as exogenous for the most part.

1.4 Plan

As practical background, we provide in Section 2 an overview of evidence on the nature and frequency of specific supply chain contracts. We then offer in Section 3 some brief remarks on methodology concerning the application of economic theory to supply chain contracting. The basic setting, perfect markets, is reviewed in Section 4 of the monograph. The simplest departure from perfect markets is the introduction of market power, which we examine in Section 5 via the assumption of a single monopolist upstream, facing a competitive downstream market. Section 6 considers contracts in a standard framework: one firm operates at each of two levels of a supply chain. Section 7 adds imperfect competition downstream. Section 8 considers contracts in a setting with a single downstream firm and multiple upstream firms, including the case of a single incumbent firm facing potential entry. Section 9 reviews the role of contracts in competing supply chains (each chain with a single firm at each level). In Sections 10 and 11 we offer overviews of the dynamics of supply chain contracting as well as an explicit asymmetric information approach to contracting. Section 12 reviews the key contributions to the fundamental issues of vertical integration, investment in specific assets, and long run or relational contracting. We consider as well the economic theory on the role of reputational forces in resolving incentive distortions. Section 13 concludes the monograph with an overview of additional issues in the economics of supply chain contracting.

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