

What is a Firm?

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Introduction¹

An understanding of the firm is surely basic to any cogent analysis of markets. However, in conventional Neo-Classical theory, the firm is viewed simply as a "rhetorical device adopted to facilitate discussion of the price system" (Demsetz, 1987). The question of what determines which activities a firm chooses to do for itself, and which it procures from others, is glossed over within a 'firm-as-production function' tradition.

It is contended in this paper that a better understanding of the economic system can be obtained by pursuing in more detail the question of what a firm actually is. The central message of Coase (1937), that the firm and market are alternative institutions for organizing the same transactions, is argued to represent a basic and fruitful insight into the nature of the firm. The discussion is divided into three sections. The first canvasses the shortcomings of the firm-as-production function approach. The second section elaborates upon this, illustrating the problems which plague comprehensive contracting. Finally, the third section identifies vertical integration in the shape of the firm as the second-best

solution in the presence of transactions costs.

The competitive equilibrium firm

Within the competitive equilibrium framework, the basic economic actors are firms and households. Both treat prices parametrically, and engage in optimizing behaviour. Given perfect knowledge and the absence of external effects, weak assumptions concerning preferences and technological possibilities suffice to yield general welfare results, notably the first and second welfare theorems.

Couched in the vernacular of this general equilibrium framework, the firm emerges as an entity whose essence is ill-defined. Rosen (1987) furnishes a useful benchmark. He argues that "If there were no scale economies, transport costs or economies of joint production, it is difficult to imagine why complete decentralization of

¹ This paper draws extensively on the proceedings of a 1987 conference organised to celebrate the fiftieth anniversary of the publication of Coase's (1937) seminal article "The Nature of the Firm". The award of the 1991 Nobel Prize in Economics to Ronald Coase makes this article all the more timely.

[factor] markets would fail to achieve efficient allocations. This echoes the seminal questions posed by Coase (1937): "Why is there any internal organization?"; and "Why is not all production carried on by one big firm?" The orthodox response is that "the natural boundaries of the firm are defined by technology - economies of scale, technological non-separabilities, and the like" (Winter and Williamson, 1991). Hence the firm is perceived as a cost-minimising conglomeration of productive resources, its shifting boundaries contingent on productive efficiency. However, this perception is arguably glib. As Tirole (1988) adduces, it is not immediately obvious why economies of scale should necessarily be exploited within the firm: "They could, *a priori*, also be obtained through contracting between legally separate entities" (1988). Williamson concedes that there are circumstances, interpretable in applied price theory terms, under which firms will internalise transactions. However, such explanations, together with technological determinism, "...explain only a small number of the total activities in which firms engage" (Winter and Williamson, 1991).

Clearly, a more satisfactory theory of the firm is requisite. It is here that the work of Coase (1937), and subsequently Williamson (1975), becomes relevant. Coase asserts that the firm and the market are alternative modes for organizing the same transactions: "[when] a workman moves from department Y to department X, he does so not because

of a change in relative prices, but because he is ordered to do so" (1937). What distinguishes the firm is the supersession of the price mechanism. Hence there are two separate mechanisms that can be used to ensure that productive resources act in concert - comprehensive contracting (price-based), and hierarchy (quantity-based). The choice of which to employ is contingent on comparative costs of utilisation. This comparative institutional perspective generates a more worthwhile theory of the firm. The next step is to examine the efficacy of the market mechanism in performing its coordination role. This is the purpose of the next section.

Coordination of productive resources: the market

Rosen (1987) endeavours to formalise the coordination role played by the market.² His point of departure is a specification of labour. Workers own or rent a place in the assembly line, the economic value of which resides in the 'residual rights of control' it confers. This is the profit accruing from purchasing intermediate products from adjacent upstream sellers and selling the value-added units to contiguous downstream buyers. Joint production entails complementarities of time spent with co-workers.

² Rosen notes that, while Coase is adept at formulating his arguments in terms of lucid elegant prose, the theory of the firm lends itself to mathematical treatment. This is not to say that Coase always eschewed such formalism.

Denoting the output of worker i by x_i and the time that i spends with j by t_{ij} :

$$x_i = F_i(t_{i1}, t_{i2}, \dots, t_{in}), \text{ for } i = 1, 2, \dots, n, \quad (1)$$

for a total of n workers. If the total amount of time spent producing by i is normalized to 1, then summing across $j = 1, 2, \dots, n$, $\sum_j t_{ij} = 1$, for all i . Given that the total time that i desires to spend with j must equal the time that j wants to spend with i , the firm's problem is:

$$\text{problem: } \max \sum_i x_i \quad (2)$$

$$\text{s.t. } \sum_j t_{ij} = 1 \text{ for all } i = 1, 2, \dots, n$$

$$t_{ij} = t_{ji} \text{ for all } i, j = 1, 2, \dots, n$$

where $\{t_{ij}\}$ is an allocation sequence of n^2 elements.

From the Kuhn-Tucker theorem, first-order conditions take the following form. For t_{ii} :

$$F_i'(t_{ii}, t_{i2}, \dots, t_{in}) \leq \phi_i, \quad i = 1, 2, \dots, n \quad (3)$$

where ϕ_i is the multiplier on constraint i in the first n constraints. If $t_{ii} > 0$, the constraint is binding, and ϕ_i represents the shadow price of i 's time. On the other hand, for t_{ij} and t_{ji} :

$$F_j'(t_{ij}, t_{i2}, \dots, t_{in}) \leq \phi_j + \beta_{ij}, \quad j = 1, 2, \dots, n \quad (4)$$

$$F_i'(t_{ij}, t_{i2}, \dots, t_{in}) \leq \phi_i + \beta_{ji}, \quad i = 1, 2, \dots, n \quad (5)$$

where $\beta_{ij} = -\beta_{ji}$ is a multiplier associated with the last $(n^2 - n)/2$ constraints. Once again, (4) and (5) are equalities for $t_{ij} > 0$. Together with (3) they yield:

$$\frac{\delta F_i}{\delta t_{ii}} + \frac{\delta F_i}{\delta t_{ij}} = \frac{\delta F_j}{\delta t_{ij}} + \frac{\delta F_j}{\delta t_{ji}}, \quad i, j = 1, 2, \dots, n. \quad (6)$$

Intuitively, if it is efficient for i and j to work together (i.e. if $t_{ij} > 0$), the marginal product of joint production must equal the incremental output of their working separately.

It is immediately apparent that the decentralized price system that implements this condition is very complex. (4) and (5) refer only to *pairs* of workers, and hence since $\beta_{ij} = \beta_{ji}$ in general, the marginal product of a *given* worker's time is not equated across all workers. The implication is that different time-prices must obtain for each possible pairing. Since the number of independent pairings $(n^2 - n)/2$ is an increasing function of order 2, the number of prices requisite for efficiency increases with the square of the number of workers. In these circumstances, not only does the calculation of the efficiency price vector require full knowledge of the underlying technology and productivity of workers, but also an inordinate amount of calculation.

This complexity imputes large transaction costs, the consequences of which can be severe. Contracts are formulated based on the *ex ante* incentive alignment, but as long as they are complete (i.e. fully contingent), the *ex post* division of surplus reflects *ex ante* investment decisions, and returns to capital are undistorted. However.

"...in a real world characterized by uncertainty, changing input prices, changing technology, multiple products, and long-lived investments specific to a particular buyer/seller relationship, there are significant costs associated with writing, monitoring and enforcing...different types of contract"

(Williamson, 1976; quoted in Joskow, 1987)

When such transactions costs impinge, the parties to a relationship cannot write a contract that anticipates all contingencies. Rationality is therefore bounded, with the result that, "...all complex contracts are unavoidably incomplete" (Winter and Williamson, 1991). In terms of Rosen's (1987) model, it is impossible to ascertain the efficiency price vector when the number of workers is substantial, and agents engage in satisficing behaviour. Incentives exist for parties to an agreement to *ex post* dispute the meaning of its clauses, or to seek to change them. Such opportunism results in a distorted distribution of returns, propagating dynamic inefficiency. In these circumstances, provision for *ex post* governance is needed.³

An alternative coordinator: the firm

It is in this context that a rationale for the firm can be discerned. In the presence of transaction-costs-induced incompleteness, Tirole (1988) identifies a number of courses of action. The first, *ex post* bargaining, is rejected since it will, in general, distort investment *ex ante*. Alternatively, parties engaged in the production process can engage in one of two forms of intermediate contracting. The first of these, arbitration, imposes a considerable information burden and moreover is vulnerable to prejudice on the part of the arbitrator. The remaining alternative is integration.

This was Coase's (1937) original insight. He highlighted the nature of the employment relation: one contract is substituted for many and employees "...agree to obey the direction of an entrepreneur..." (1937). According to Williamson (1976), such a shift from the market to hierarchy sacrifices incentive intensity in favour of greater bilateral adaptability. As Rosen asserts, errors in price can be more costly than errors in quantity (1987). The second-best result of recourse to authority is the least-cost governance structure.

Williamson (1975, 1979, 1986) and Klein, Crawford and Alchian (1978) refine this analysis by isolating specific investments as a critical factor causing "simple spot market transactions to be plagued by transactional difficulties" (Joskow, 1987). Asset-specificity is present when the investments that parties make have a much greater use within the relationship than outside it. Under such circumstances, the incentive to engage in opportunism is larger, and the need for *ex post* governance concomitantly greater. Williamson (1979) asserts that as investments become more specific to the buyer/seller relationship, cost-minimisation will involve moving from simple (anonymous) spot-market contracting to more complex long-term contractual arrangements with protective provisions, and ultimately to vertical integration (Joskow, 1987).

³ This discussion pays scant attention to reputation effect penalties. It is merely noted that, while they do deter opportunism, Klein does not find them dispositive.

This reasoning is complemented by the work of Grossman and Hart (1986), who also focus on asset-specificity, but in addition, quasi-rents and hold-up problems, in explaining incomplete contracts. They canvass the idea of residual rights of control identified with asset-ownership, and establish that the distribution of authority exerts a significant influence on *ex ante* investment decisions. From this result they demonstrate that integration, or the reallocation of rights of control, constitutes a second-best solution.

In sum, the presence of transaction costs leads to incomplete contracts which distort pre-investment. This gives rise to inefficiency, the extent of which is contingent on the level of transaction costs, but also on the degree of asset specificity. The second-best solution is a redistribution of authority, and the firm provides the nexus for such a redistribution.

Conclusion

This paper has canvassed the transaction costs approach to the theory of the firm. The first section examined the chimerical nature of the firm within the Arrow-Debreu framework. The second section illustrated how in theory a conglomeration of productive resources could be mediated through a system of comprehensive contracting. However, complexity and transaction costs are likely to cause the failure of such a system. This provides the motive for integration. Clearly, Coase's insight ranks among the most fruitful of economic theories.

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