Competitive Prices and Organizational Choices

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Abstract

We construct a price-theoretic model of integration decisions and show that these choices may adversely affect consumers, even in the absence of monopoly power in supply and product markets. A key observation is that the price of output helps to determine the organizational form chosen. At low prices, managers may be resistant to integration, even if it efficiently coordinates decisions, because it imposes high private costs on them. At higher prices, they may choose integration even if nonintegration would produce more output, because nonintegration leads to an undesired distribution of private costs. Moreover, organizational choices affect output and therefore prices. Since shocks to industries affect product prices, reorganizations are likely to take place in coordinated fashion and be industry specific, consistent with the evidence. We show that there are instances in which entry of suppliers can hurt consumers by changing the terms of trade in the supplier market, thereby inducing harmful reorganizations. When firms are publicly held, we identify conditions under which hostile (shareholder initiated) versus friendly (manager initiated) takeovers are more likely.
1 Introduction

Do consumers have an interest in the internal organization of the firms that make the products they buy? Conventional economic wisdom says no, at least if product markets are characterized by a reasonable degree of competition: firms that fail to deliver the goods at the lowest feasible cost, whatever the reason, including inappropriate organization, will be supplanted by their more efficient competitors.¹

There are, of course, potential interest conflicts between the firm and the consumer: this is a central concern of the industrial organization literature and of competition policy. But the predominant view of the firm there is the classical one of the unitary profit maximizer; as a consequence, the effects of organizational design on market performance are generally absent from the analysis, and both the economic literature and policy practice have focused instead on the adverse effects of market power. In this context, mergers or other major reorganizations are worthy of concern only insofar as they increase the firm’s market power. In particular, it would be hard from this point of view to see how firms might be characterized by too little integration, something for which there is at least some evidence (Bertrand and Mullainathan, 2003).

The question is still open whether and how organizational decisions can affect consumer welfare in ways that do not involve market power. The key insight is provided by the recent literature on the firm (Grossman and Hart 1986; Hart and Moore 1990; Hart and Holmström 2002), which views organizational decisions as the purview of managers who trade off the usual pecuniary costs and benefits, such as profits, with non contractable ones such as managerial effort, working conditions, corporate culture, or leadership vision.

The thrust of this literature is that in environments with imperfect or incomplete contracting, managerial firms may make organizational decisions that have little to do with profit maximization and/or the interests of shareholders. In this paper we will show that organizational decisions are influ-

¹For instance, as Fama and Jensen (1983) aver, “the form of organization that survives... is the one that delivers the product demanded by customers at the lowest price while covering costs.”
enced by product prices, and that these decisions in turn determine product market outcomes. Even in a competitive world, inefficiencies are likely to be significant: both too much and too little integration are possible outcomes from the consumer point of view.

To make this point as simply as possible, we rule out market foreclosure effects altogether by assuming competitive product and supplier markets. In the model we consider, production of consumer goods requires the combination of exactly two complementary suppliers, each consisting of a manager and his collections of assets.\(^2\) When the suppliers form a joint enterprise (or “firm”), the managers operate the assets by taking noncontractable decisions.

As in some recent models of firms, in particular Hart and Holmström (2002), the production technology essentially involves the adoption of standards. While there is no objectively “right” decision, output is higher on average the more decisions are in the same direction. The problem is that managers disagree about which direction they ought to go. Each party will find it costly to accommodate the other’s approach, but if they don’t agree on something, the market will be poorly served.

Under nonintegration, managers make their decisions separately, and this may lead to inefficient production. Integration solves this problem by bringing in an additional party, called HQ, which is motivated by monetary compensation to maximize the enterprise’s output.\(^3\) HQ accomplishes this by enforcing a common standard. But delegating decision rights to HQ does not come for free, and generates two types of losses. First this solution to the coordination problem may lead to high private costs for the initial managers. Second, using HQ to enforce coordination may have direct costs in terms of foregone output. For instance, HQ may not be specialized in all the tasks carried out by the suppliers, (e.g., Hart and Moore 1999), there may be additional communication and delay costs (e.g., Radner 1993, Bolton and Dewatripont 1994), or HQ may have its own moral hazard problems.

Whether to integrate is decided by managers when the firms form; this

\(^2\)The model is inspired by earlier work (Legros and Newman 1996, forthcoming) that shows how competitive market conditions determine organizational design such as the degree of monitoring or the allocation of control. Those papers do not consider the interaction of organization with the product market or consumer welfare, however.

\(^3\)Other models that take this view of integration include Alchian and Demsetz (1972), Hart and Holmström (2002), Mailath et al. (2002).
takes place in a competitive supplier market in which the two types of suppliers “match”. The firms’ output is sold in a competitive product market, wherein all firms and consumers are price-takers.

At low prices, managers do not value the increase in output brought by integration since they are not compensated sufficiently for the high costs they have to bear. At very high prices, managers value output so much that they are willing to concede in order to achieve coordination. Therefore integration only emerges for intermediate levels of price. In other words, there is an inverted U-shaped relationship between product price and the degree of integration.

One feature of our model is that the derivation of equilibrium organizational choices and product prices reduces to a standard supply-and-demand analysis, where the industry supply curve embodies the price dependent organizational decisions described above. We apply this framework to show how internal organization, as well as prices and quantities, respond to shocks such as changes in product demand, entry of additional suppliers. Incorporating organizational design into this otherwise standard analysis can lead to surprising results: for instance we identify regimes where product prices increase and consumer welfare decreases following positive shocks, such as the entry of low-cost suppliers.

The price mechanism also provides a natural explanation for the tendency for organizational restructuring to be widespread. There is considerable evidence that firms integrate (or divest) in “waves” and that reorganizations of this sort are most pronounced at the industry level. Since product price is common to a whole industry, anything that changes it will not only have the classical price-theoretic quantity and consumer welfare effects, but will have organizational effects as well. And as we have suggested, these organizational effects will in turn feed back to quantity and welfare.

For most of the paper, we are silent about whether the initial units are publicly owned. If they are, outside shareholders have – in our competitive world – nearly the same interests as consumers. In particular, at (moderately) low prices, they would also like integration, since from their point of view there would be an increase in revenue. Thus, the model identifies situations in which firms are ripe for “takeover”. This begs the question of whether outside shareholders can discipline managers into taking the profit
maximizing organizational decision. Short of imposing such decision directly, we show that instruments such as variable profit shares or free cash flow will not eliminate the inefficiencies – and in some cases make things worse.

2 Model

There are two types of supplier, denoted $A$ and $B$. Production of marketable output requires the coordinated input of exactly one $A$ and one $B$ provider, and we call their union a firm. Examples of $A$ and $B$ might include game consoles and game software, upstream and downstream enterprises, or manufacturing and customer support. For each provider, a decision is rendered indicating the way in which production is to be carried out. For instance, software can be elegant or user friendly, or a product line and its associated marketing campaign can be mass- or niche-market oriented. Denote the decision in an $A$ provider by $a \in [0, 1]$, and a $B$ decision by $b \in [0, 1]$. Overseeing each provider is a manager, who bears a private cost of the decision made in his unit. We assume that the $A$ manager’s preferences are increasing in $a$, while the $B$ manager’s preferences are decreasing in $b$: formally, $C_A(a) = \frac{1}{2}(1 - a)^2$ for the manager $A$ and $C_B(b) = \frac{1}{2}b^2$ for manager $B$.\footnote{Although we model the managers disagreement as differences in preferences, we expect very similar results could be generated by a model in which they differ in “vision” as in van den Steen (2005).}

It is important that decisions made in each part of the firm do not conflict, else there is loss of output. More precisely, the enterprise will succeed with a probability equal to $1 - \frac{1}{2}(a - b)^2$, in which case it generates a unit of output; otherwise it fails, yielding 0. For instance, if $A$ finds Macintosh aesthetically pleasing while $B$ finds PCs practical, and each adopt large quantities of their preferred machines, the resulting incompatibilities will reduce expected output.

Decisions are not contractible, but the right to make them can be reassigned by contract. In addition, the output generated by the firm is contractible, which allows monetary incentives to be created. Managers bear the cost of decisions even if they don’t make them because their primary function is to implement decisions and to convince their workforces to agree.

Managers can integrate by engaging the service of a headquarters (HQ).
HQ can aid in coordinating decisions, but the cost of ceding control from the managerial point of view is a loss of “quiet life,” that is to say, a higher private cost. From the consumer point of view, the benefit of integration is to improve coordination and therefore increase output and decrease prices; but since they don’t choose organization, they may not enjoy these benefits.

The divergence between consumer and managerial interests is governed by the efficacy of HQ. Typically, employing an HQ comes at a cost in terms of foregone output that we model as reduction $\sigma \geq 0$ in the success probability. As discussed in the Introduction, HQ may reduce potential output through the direct costs of communication, additional management personnel, or losses from delegating decisions from $A$ and $B$ to staff who are not experts. In this case, HQ could take a share of the (reduced) revenue, leaving the residual for the managers to share.\(^5\)

Other costs could be linked to a moral hazard problem: since HQ has control over both suppliers resources, it also may have opportunities to divert those resources into other activities (including private benefits, other divisions, or pet projects).\(^6\)

To summarize, expected output is

$$Q(a, b) = \begin{cases} 
1 - \frac{1}{2}(a - b)^2 & \text{if there is nonintegration} \\
\frac{1}{2}(a - b)^2(1 - \sigma) & \text{if there is integration.}
\end{cases}$$

Before production, $B$ managers match with $A$ managers in order to benefit from the synergies; at the time of matching, they sign contracts indicating

- the share $s$ of managerial revenue accruing to manager $A$, with $1 - s$ going to $B$ (in case of failure each receives zero); and

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\(^5\)There is an alternative form of integration which does without HQ, instead delegating full control to one of the managers, who will subsequently perfectly coordinate the decisions in his preferred direction. It is straightforward to show (section 2.2) that this form of integration is dominated by nonintegration.

\(^6\)For instance, suppose that after output is realized, there is a probability $\sigma$ that HQ has a chance to divert whatever output there is to an alternative use valued at $\nu$ times its market value, where $\sigma < \nu < 1$. If output is diverted, it doesn’t reach the market, and the verifiable information is the same as if the firm had failed. Managers could prevent diversion by offering a share $\nu$ to HQ, leaving $(1 - \nu)$ of the revenue to be shared between the managers, but since $\nu > \sigma$, it is actually better for them to give HQ a zero share of market revenue and let him divert when he is able, so that successfully produced output reaches consumers only $(1 - \sigma)$ of the time.
• the ownership structure of the relationship.

For now we take the total managerial revenue in case of success to be the product market price \( P \).

There are only two relevant structures to consider here: nonintegration (\( N \)), where each manager takes the decision on his activity, and integration (\( I \)), where the headquarters HQ takes decisions on each activity. Once a contract is given, managers (or HQ) make their decisions, output is realized and shares are distributed.

The demand side of the product market is modelled as a decreasing demand function \( D(P) \), and the market price \( P \) is taken as given by all firms when they make decisions.

In the supplier market, there is a continuum of both types of suppliers. The \( A \)'s are on the long side of the market: their measure is \( n > 1 \), while the \( B \)'s have unit measure. All unmatched \( A \) managers receive a payoff of zero (the outside option of \( B \)-managers will play little role here and can be taken to be 0).\(^7\)

### 2.1 Integration

With integration, HQ receives an expected surplus proportional to \( (1 - \frac{1}{2}(a - b)^2)P \) and therefore makes decisions for both activities in order to maximize profits of the integrated firm, that is chooses \( a = b \). When \( a = b \), total cost is lowest when \( a = 1/2 \) and we assume that HQ will choose these decisions (indeed this is exactly what \( A \) and \( B \) would want her to do: since it maximizes the joint payoff, which is perfectly transferable via the sharing rule \( s \), it Pareto dominates any other choice). The cost to each manager is then \( \frac{1}{8} \), and the payoffs to the \( A \) and \( B \) managers are

\[
\begin{align*}
  u^I_A(s, P) &= (1 - \sigma)sP - \frac{1}{8} \\
  u^I_B(s, P) &= (1 - \sigma)(1 - s)P - \frac{1}{8}.
\end{align*}
\]

Total managerial welfare under integration is \( W^I(P) = (1 - \sigma)P - \frac{1}{4} \) and is fully transferable.

\(^7\)In fact it is a simple matter to generalize the model to the case of non zero and even heterogenous outside options, see Section 3.2 and the Appendix.
2.2 nonintegration

Since each manager keeps control of his activity, $A$ chooses $a \in [0, 1]$, $B$ chooses $b \in [0, 1]$ in Cournot-Nash fashion. Using the expression for output under nonintegration yields payoffs

$$u_A^N = (1 - \frac{1}{2}(a - b)^2)sP - \frac{1}{2}(1 - a)^2$$
$$u_B^N = (1 - \frac{1}{2}(a - b)^2)(1 - s)P - \frac{1}{2}b^2.$$

The best responses in the (unique) Nash equilibrium are:

$$a^N = \frac{1 + (1 - s)P}{1 + P}$$
$$b^N = \frac{(1 - s)P}{1 + P}.$$ (1)

Note that $a^N > b^N$ and that the coordination loss is

$$a^N - b^N = \frac{1}{1 + P},$$ (3)

which is independent of $s$. This loss is decreasing in the price $P$: as $P$ becomes larger, the revenue motive becomes more important for managers and this pushes them to better coordinate.

The Nash equilibrium output is

$$Q^N(P) = 1 - \frac{1}{2(1 + P)^2},$$ (4)

and the equilibrium payoffs are

$$u_A^N(s, P) = Q^N(P)sP - \frac{1}{2}s^2\left(\frac{P}{1 + P}\right)^2,$$
$$u_B^N(s, P) = Q^N(P)(1 - s)P - \frac{1}{2}(1 - s)^2\left(\frac{P}{1 + P}\right)^2.$$

Varying $s$, one obtains the Pareto frontier in the case of nonintegration. We have $\partial u_A^N/\partial s = Q^N(P)P - s\left(\frac{P}{1 + P}\right)^2$, $\partial u_B^N/\partial s = -Q^N(P)P + (1 - s)\left(\frac{P}{1 + P}\right)^2$ and simple computations show that the Pareto frontier is decreasing and concave.
Total welfare is

\[ W^N(s, P) = Q^N(P)P - \frac{1}{2}(s^2 + (1-s)^2) \left( \frac{P}{1+P} \right)^2 \]  

(6)

The maximum surplus is obtained at \( s = 1/2 \) and the minimum surplus is obtained at \( s = 0 \) (or \( s = 1 \)). Note that when \( s = 0, a = 1 \): the A manager makes no concession, and only the B bears a positive private cost.\(^8\)

### 2.3 Choice of Organizational Form

The frontier under integration is a straight line, while the frontier under nonintegration is concave. The relative positions of these frontiers depend on the price. Figure 1 below represents a situation where neither integration nor nonintegration dominates globally, but one form may dominate for some levels of payoffs. If the frontiers are as in the figure, the organization that managers choose depend on where they locate along the frontiers, i.e., on the terms of trade on the supplier market.

As the following proposition establishes, nonintegration may dominate integration when product price is low or high, but integration never dominates nonintegration. There is a range of prices where integration is preferred to nonintegration when B’s share of surplus is large enough. Thus, organizational form is determined only in the full general equilibrium of the supplier and product markets.

Contrary to managers, consumers are indifferent between all values of \( s \) given the organization. Hence, conditions in the supplier market affect consumers only insofar as they affect the choice of organizations.

**Proposition 1** When \( \sigma \) is positive, managerial welfare with integration

(i) is smaller than the minimum total welfare with nonintegration if and only if \( P \) does not belong to the interval \([\pi(\sigma), \pi(\sigma)]\), where \( \pi(\sigma) \) and \( \pi(\sigma) \) are the two solutions of the equation \( \sigma = \frac{P^1 - P}{4P(1+P)} \).

(ii) is smaller than the maximum welfare with nonintegration.

\(^8\)Using \( W^N(0, P) = P \left( 1 - \frac{1}{\pi(1+P)} \right) - \frac{1}{2} \left( \frac{P}{1+P} \right)^2 \), it is now straightforward to show that giving B full control will be dominated by nonintegration. For under B control, \( a = b = 0 \) and even assuming no additional integration cost, the total surplus is \( P - \frac{1}{2} \) which is everywhere less than \( W^N(0, P) \).
It is straightforward to see that \([\pi(\sigma), \pi(\sigma)]\) is nonempty when \(\sigma\) is smaller than some upper bound \(\bar{\sigma}\), and that \(\pi(\sigma)\) is increasing and \(\pi(\sigma)\) is decreasing in \(\sigma\).

2.4 Industry Equilibrium and the “Organizationally Augmented” Supply

Industry equilibrium comprises a general equilibrium of the supplier market and product market. In the supplier market, an equilibrium consists of matches of one upstream firm and one downstream firm, along with a surplus allocation among all the managers. Such an allocation must be stable in the sense that no \((A,B)\) pair can form an enterprise that generates payoffs to each manager that exceed their equilibrium levels. In the product market, the large number of firms implies that the industry supply is almost surely equal to its expected value of output given the product price; equilibrium requires that the price adjust so that the demand equal the supply.

Since the \(A\) agents are in excess supply and would earn zero if unmatched, their competitive payoff must be equal to zero. Then if frontiers are as in Fig-
ure 1, integration would be chosen since it maximizes $B$’s payoff given that $A$ gets zero. At other product prices, the maximum payoff to $B$ may be generated through nonintegration. The maximum payoff to $B$ under integration is equal to the total welfare $(1 - \sigma)P - \frac{1}{4}$ and the maximum payoff to $B$ under nonintegration obtains when $s = 0$ in (6), that is $(1 - \frac{1}{2(1+P^2)})P - \frac{1}{2}(\frac{P}{1+P})^2$.

From Proposition 1, there are three cases of interest, depending on the size of $\sigma$. When $\sigma = 0$, managers (strictly) prefer nonintegration if and only if $P < \bar{\pi}(0) = 1$. When $\sigma \in (0, \bar{\sigma})$, managers prefer nonintegration if and only if $P \notin [\underline{\pi}(\sigma), \bar{\pi}(\sigma)]$. And when $\sigma > \bar{\sigma}$, managers never integrate. Integration will be chosen by managers in equilibrium only when $P \in [\underline{\pi}(\sigma), \bar{\pi}(\sigma)]$.

We note that output supplied to the product market under integration $(1 - \sigma)$ is smaller than output under nonintegration $(1 - \frac{1}{2(1+P^2)})$ if and only if

$$\sigma > \frac{1}{2(1+P)^2},$$

that is when

$$P > \pi^*(\sigma) = \sqrt{\frac{1}{2\sigma}} - 1.$$  

It is straightforward to see that $\pi^*(\sigma) \in (\underline{\pi}(\sigma), \bar{\pi}(\sigma))$ whenever $\sigma < \bar{\sigma}$.

The reason nonintegration generates higher output as price increases is simple enough: the higher is $P$, the more revenue figures in managers’ payoffs. This leads one to “concede” to the other’s decision in order to reduce output losses.

The nonmonotonicity of managers’ organizational preference in price when $\sigma \in (0, \bar{\sigma})$ is more subtle. At low prices, despite integration’s better output performance, revenue is still small enough that the managers (in particular the manager of $B$) are more concerned with their private benefits, i.e., they like the quiet life. At high prices, nonintegration performs well enough in the output dimension that they do not want to incur the cost $\sigma$ of HQ. Only for intermediate prices do managers prefer integration. In this range, the $B$ manager knows that revenue is large enough that he will be induced to bear a large private cost to match the perfectly self indulgent $A$ manager, who generates little income from the firm ($s = 0$) and therefore chooses $a = 1$. $B$ prefers the relatively high output and moderate private cost that he incurs
under integration.\footnote{For this outcome, it is crucial that the supplier market be "unbalanced," i.e., that $A$ or $B$ be accruing the preponderence of the surplus. For as we already noted, the total surplus under nonintegration when it is equally shared ($s = \frac{1}{2}$) always exceeds that generated by integration. Thus if surplus is (nearly) equally shared by $A$ and $B$, (for instance, if one side has a nonzero outside option), they never integrate. On the other hand, our specific functional forms are not critical to this kind of outcome: similar results obtain if the managers have a standard partnership problem, where total net revenue is $Pf(a,b)$ and the non-contractible cost functions $C_A(a)$ and $C_B(b)$ are increasing in $a$ and $b$. Details are in the Appendix.}

As discussed above, the demand side of the product market is represented by the demand function $D(P)$. To derive industry supply, suppose that a fraction $\alpha$ of firms are integrated and a fraction $1 - \alpha$ are nonintegrated. Total supply at price $P$ is then

$$S(P, \alpha) = \alpha(1 - \sigma) + (1 - \alpha) \left( 1 - \frac{1}{2} \left( \frac{1}{1 + P} \right)^2 \right).$$

(9)

For $\sigma < \bar{\sigma}$, when $P < \pi(\sigma)$, $\alpha = 0$ and total supply is just the output when all firms choose nonintegration. At $P = \pi(\sigma)$, $\alpha$ can vary between 0 and 1 since managers are indifferent between the two forms of organization; however because $\pi(\sigma) < \pi^*(\sigma)$, output is greater with integration and as $\alpha$ increases total supply increases. When $\alpha = 1$ output is $1 - \sigma$ and stays at this level for all $P \in (\pi(\sigma), \pi(\sigma))$. At $P = \pi(\sigma)$, managers are again indifferent between the two ownership structures and $\alpha$ can decrease from 1 to 0 continuously; because $\pi^*(\sigma) < \pi(\sigma)$, output is greater the smaller is $\alpha$. Finally for $P > \pi(\sigma)$ all firms remain nonintegrated and output increases with $P$.

When $\sigma \geq \bar{\sigma}$, managers always choose nonintegration and $\alpha = 0$ for all prices.

We therefore write $S(P, \alpha(P))$ to represent the supply correspondence, where $\alpha(P)$ is described in the previous paragraph. The supply curve for the case $\sigma \in (0, \bar{\sigma})$ is represented in Figure 2. The dotted curve corresponds to the industry supply when no firms are integrated.

An equilibrium in the product market is a price and a quantity that equate supply and demand: $D(P) \in S(P, \alpha(P))$. There are three distinct types of industry equilibria, depending on where along the supply curve the equilibrium price occurs: those in which firms integrate (I), the mixed equilibria in
which some firms integrate and others do not (M), and a pure nonintegration equilibrium (N).

The product market supply embodies organization choices by managers. The model suggests that industries in which product prices are high or low will be predominately composed of nonintegrated firms, while those with intermediate prices will tend to be integrated. The model is also useful for illuminating sources of changes in organization.
3 Comparative Statics

The fact that all firms face the same price means that anything that affects that price – a demand shift or foreign competition – can lead to widespread and simultaneous reorganization, e.g., a merger wave or mass divestiture. An additional channel of coordinated reorganization is the supplier market: changes in the relative scarcities of the two sides, or to outside opportunities on one side, will change the way surplus is divided between managers, and this too will lead to reorganization. In some cases these changes in the supplier market terms of trade will have surprising effects on product market outcomes.

3.1 Demand and Balanced Supply Shocks

Assume that both sides of the supplier market expand so as to keep the ratio of $A$’s to $B$’s the same, or alternatively assume that the measure of $B$ firms increases while remaining less than that of $A$ firms. This increase in the number of $A$ and $B$ firms could come from “globalization”, i.e., a lowering of barriers to international trade and factor movements. See Figure 3. If demand is high, following the increase in supply, the industry moves from a nonintegration equilibrium to an integration equilibrium. Hence, in industries when demand is high and firms are nonintegrated, balanced positive supply shocks yield merger activity. Hence, globalization can be a force for the generation of merger activity without further assumption about changes to technology or regulation. If demand is low however, the opposite is true and globalization can be a force for divestiture.

Notice that in both cases, though prices fall following entry, they do not fall as far as they might if somehow the managers were prevented from integrating when demand is high or forced to stay integrated when demand is low.

A number of authors have emphasized the empirical regularities surrounding “clustering” of takeovers and divestitures. For instance, Mitchell and Mulherin (1996) argue that for the US at least, merger waves are best explained empirically by the joint effects of macroeconomic and industry-level

\[10\text{See Legros and Newman (forthcoming) for a detailed analysis of this mechanism.}\]
variables. In particular, Powell and Yawson (forthcoming), looking at data from the UK, emphasize growth in sales and foreign competition as important explainors of takeovers, while divestitures are associated with negative demand shocks.

### 3.2 Hetereogeneity and Unbalanced Supply Shocks

Many market-induced reorganizations, such as outsourcing due to the opening of international factor markets, are thought to be motivated by the search for lower costs of production. Here we modify the basic model to take account of this possibility. Suppose that it costs the $A$ a fixed amount $\omega$ to participate in joint production with $B$, who continues to have zero costs.

It turns out that the effect of entry by lower cost $A$’s (e.g. assume at least a unit measure of $A$ with low costs become available to match with the $B$’s) depends crucially on whether the cost $\omega$ can be paid contingently on the firm’s output or must be paid lump sum. Examples of the first kind would be an outside option of the $A$ or a “brownfield” investment. Examples of the second kind would be a wage bill that must be paid upfront or “greenfield” investment in relation specific new factory.

#### 3.2.1 Brownfield Investments
Think of contracting with an A manager with a plant that could fetch a profit of \( \omega \) in some other use. The contracting problem is very similar to what we have done before with the caveat that A must now be assured of an expected payoff of \( \omega \).

As is apparent from Figure 1, as the minimum payoff to A decreases, it becomes possible (and optimal for the B) to choose integration. Formally, fix the price \( P \) and suppose that B’s maximum payoff when A’s cost is \( \omega \) is obtained for a sharing rule \( s \), and therefore that the indirect payoffs are

\[
    u_A^N(s, P) = \omega, \quad u_B^N(s, P) = W^N(s, P) - \omega.
\]

Consider now a lower value \( \omega' < \omega \). We know that \( W^N(s, P) \) and that \( u_A^N(s, P) \) are decreasing in \( s \) for \( s < 1/2 \). Hence, for \( s' < s \) such that \( u_A^N(s', P) = \omega' \), we have \( W^N(s', P) < W^N(s, \omega) \). Supposing that B is indifferent between nonintegration and integration under \( \omega \), we have \( W^N(s, P) = (1 - \sigma)P - 1/4 \), implying that

\[
    W^N(s', P) - \omega' < W^N(s, P) - \omega' = W^I(P) - \omega'
\]

and B strictly prefers integration to nonintegration. Hence, whenever \( P \) is such that integration is preferred under \( \omega \), it will be also under \( \omega' \); because the preference is strict with \( \omega' \) when there is indifference with \( \omega \), there are more prices for which integration is preferred under \( \omega' \). Thus, for brownfield investments, reduced costs are a force toward integration. This is represented in the Figure 4.

It is then immediate that if the industry demand is high, offshoring brownfield investments will lead to a lower quantity and higher price with \( \omega' \) than with \( \omega \). When demand is low, though, entry of low-cost A’s yields the the usual comparative static of lower prices and higher quantities.

Note that the payoff of A is adjusted by using the sharing rule only. Even if the two managers are liquidity constrained, it is possible for them to borrow \( \omega \), transfer \( \omega \) to A in order to meet the cost of participation and then commit to repay a debt when output is high. It can be shown, however, that the payoffs obtained under such debt contracts are Pareto dominated.
Figure 4: Entry of lower cost suppliers: Brownfield investments

by contracts without debt, and will therefore never be used for brownfield investments (Legros and Newman forthcoming.)

For greenfield investments however, liquidity constrained managers are forced to borrow $\omega$, since $\omega$ must be paid before production takes place. What is perhaps surprising is that conditional on debt in order to finance the cost $\omega$, the comparative statics of a lowering of this cost are opposite to the case of brownfield investment: lower costs are a force toward nonintegration.

### 3.2.2 Greenfield Investments

If $\omega$ must be paid up front, and if the firm has not enough cash for this, the firm will need to borrow $\omega$ from the financial market in exchange for a state contingent debt repayment $D$ in case of success and 0 in case of failure. The market for loans is competitive. Under integration, the level of price does not affect the probability of success and the probability of repayment is one; the $B$ manager’s surplus is therefore $u_B^I(P, \omega) = (1 - \sigma)P - 1/4 - \omega$, as in the brownfield case.

Under nonintegration however, debt distorts incentives to concede and therefore, if $B$ was indifferent between integration and nonintegration, he will
favor nonintegration after a decrease in $\omega$. This is shown in the Appendix.

With greenfield investments, a lower cost faced by the A managers is a force away from integration. Alternatively the interval $[\pi(\sigma), \pi(\sigma)]$ over which integration is preferred to nonintegration is decreasing in $\omega$ (that is the lower bound increases and the upper bound decreases). This leads to a shift of the industry supply as in Figure 5.

As is apparent, it is now in low demand regimes that offshoring of greenfield investments may decrease output and increase price, while decreased prices and increased quantities occur in high demand regimes. Note that the debt has the effect of lowering the price perceived by the managers. For this reason it may be tempting to view the effect of debt as that of a tax: for a given price $P$ and a level of debt $D$ the organizational choice should be the same under price $P - D$ and no debt. This reasoning would imply that both the lower bound $\pi$ and the upper bound $\pi$ increase. As we have seen this intuition is incorrect because it does not take into account the different incentive effects that debt on different organizations.
Proposition 2 Following a decrease in $\omega$, the region of integration expands with brownfield investment while it shrinks with greenfield investment.

Finally, the results in Section 3.2 indicate that the availability of low cost suppliers does not necessarily benefit consumers in the presence of the distortions entailed by organizational design. In the brownfield case, for instance, the shift in surplus division toward the short side of the supplier market is accomplished by integrating more, and when prices are already high enough, this may lead to a reduction in the quantity supplied and an increase in price, hurting consumers. The effects on consumer welfare of switching to low-cost suppliers in the various cases is summarized in the matrix below.

<table>
<thead>
<tr>
<th>type</th>
<th>demand</th>
<th>high</th>
<th>low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenfield</td>
<td>+</td>
<td>−</td>
<td></td>
</tr>
<tr>
<td>Brownfield</td>
<td>−</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

4 Welfare

Until now we have assumed that the managerial revenue in case of success is equal to $P$. This will be the case if the managers fully own the firms. For publicly held firm, managerial revenue will be a portion of the price.

For a given demand function, we compare the equilibrium welfare to the welfare that would be generated if the equilibrium form of organization is not allowed. Hence an equilibrium with integration is second-best efficient if welfare is greater than in the equilibrium where firms are forced to choose nonintegration.

If one uses a consumer welfare criterion, second-best inefficiencies arise whenever the equilibrium output level is not maximal at the equilibrium price. Hence, in the case of privately held firms, integration with $P \in (\pi^*, \pi)$ and nonintegration with $P < \pi$ are second-best inefficient. For publicly held firms, if $\pi(P)$, the price contingent managerial share, is non-decreasing in $P$, then integration with $P \in (\pi^{-1}(\pi^*), \pi^{-1}(\pi))$ and nonintegration with $P < \pi^{-1}(\pi)$ are second-best inefficient.

However, a consumer welfare criterion puts no emphasis on managerial costs and this begs the question of whether integration decisions can be
second-best inefficient when managerial costs are taken into consideration. Below, we use a total welfare measure, that is the sum of consumer and firm (shareholders and managers) welfares.

4.1 Privately Held Firms

Consider nonintegration. Suppose that the firm is fully owned by the managers (that is $\pi(P) = P$), and that the share going to manager $A$ is $s$. We know that the output is independent of $s$:

$$Q(P) = 1 - \frac{1}{2(1 + P)^2}$$

therefore we have

$$P = 1 - \frac{1}{\sqrt{2(1 - Q)}}.$$

Using the values for $a, b$ at the Nash equilibrium (1), we derive the total managerial cost:

$$C(Q, s) = (s^2 + (1 - s)^2)c(Q)$$

where

$$c(Q) = \frac{1}{2} \left( \frac{3 - 4Q - \sqrt{2(1 - Q)}}{7 - 8Q} \right)^2.$$

At a given price $P$ an organization is output maximizing if it leads a larger level of output than with the other type of organization. Clearly, if an organization maximizes managerial welfare and is output maximizing, it is also second-best efficient. Hence, at prices $P > \pi$ and prices $P \in (P, P^*)$ equilibria are second-best efficient.

For the other cases, it is convenient to consider first the case of zero outside option of $A$; we will refer below to Figure 6.

If $u = 0$, it is optimal for $B$ to choose $s = 0$. When $B$ decides on how much to produce given price $P$, it solves $\max PQ - C_B(Q; 0)$ and the supply curve under nonintegration corresponds to marginal cost pricing $P = c'(Q)$.

\[11\]While this seems efficient from the point of view of competition, it is not. Indeed, the cost minimizing way would be achieved at $s(Q) = 1/2$ and the supply function would then satisfy $P = c'(Q)/2$. 

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Figure 6: Welfare, Privately Held Firms

It follows that total managerial cost (when $s = 0$) is the area under the supply curve with nonintegration. At $\pi$, welfare under integration is the same as under nonintegration. It follows that the managerial cost $1/4$ under integration is the shaded area $a - a' - b' - b$.

Consider first the case $P < \pi$ and a typical demand function $d'$. Industry equilibrium is at $x'$ and total welfare is the area $d' - x' - a$. If integration is “forced”, equilibrium will be at point $y'$: consumer surplus is larger but since the managerial costs are the same for all prices in this region, the total welfare is the area $d' - x' - a$ minus the area $x' - a' - b' - y'$. Hence the equilibrium is second-best efficient. It is simple to verify that this is true for any demand function for which the equilibrium is at $P < \pi$.

Consider now an equilibrium price $P \in (\pi^*, \bar{\pi})$, as in point $x$ in the figure. Total welfare is the area $d - x - b' - a' - a$. If integration is prevented, the equilibrium would be at point $y$ and nonintegration will result. Contrary to
the previous case, managerial cost is now larger with nonintegration than with integration. Total welfare is the area $d - y - a$. The difference in total welfare between nonintegration and integration is therefore the difference between the area $x - y - c$ and the area $a' - c - b'$. If this difference is positive, the equilibrium is second-best inefficient. Since the relative positions of $x$ and $y$ depend on the elasticity of demand, for inelastic demand functions, the area $x - y - c$ is small and the equilibrium is second-best efficient. For elastic demand functions, a necessary and sufficient condition for the existence of an equilibrium that is second-best inefficient with $P \in (\pi^*, \pi)$ is that the area $a'' - b'' - c$ is larger than the area $a' - c - b'$. In fact, we can show that these two areas are equal, and therefore that all equilibria are second-best efficient.

**Proposition 3** *For privately held firms, equilibria are second-best efficient.*

This result does not depend on the fact that managers have a zero outside option. Details are in the Appendix.

This welfare result should be taken with a grain of salt because we have used a rather weak concept of efficiency. Indeed, we assume that the outside options of the managers are kept constant. However, as we have seen, the managerial cost with nonintegration is a function of the share going to manager $A$: it is maximum when $s = 0$, that is when manager $A$ has a zero outside option, and is decreasing in $s \leq 1/2$, that is when the outside option of $A$ increases.

In particular, the minimum cost of production with nonintegration is attained at $s = 1/2$ and from Proposition 1, nonintegration dominates integration (for any value of $\sigma$). Therefore, integration necessarily leads to a lower total welfare than nonintegration with equal sharing.

Hence while consumers are not concerned about the way the profit is shared within an organization once it is created, they are indirectly affected by this distribution: the way profit is shared between the managers determines which organizations are chosen in equilibrium, and therefore affects the equilibrium product market price.

While privately held firms are of interest, most of the M&A activity, divestitures, restructuring are made by firms with large capitalization and characterized by a separation of ownership and control. In these firms, managers get only a fraction of the firm’s revenues but because they still bear
the same non-contractible costs, the supply of a firm will be a function of the revenue share of the managers, and the price will not reflect the “marginal cost” of production. As we will see, this will make equilibria second-best inefficient (in our weak sense, that is ignoring distributional considerations between the managers).

4.2 Publicly Held Firms

To simplify the exposition, we focus on the case of a fixed share $\lambda$ of the price going to the managers, and the inability of existing shareholders to impose an organizational choice. We also focus on the case of a zero outside option of $A$. We have represented in Figure 7 a typical case, where $\lambda < \pi/\pi^*$. The supply curve under nonintegration is now $Q^N(P) = 1 - 1/[2(1 + \lambda P)]^2$. Hence, in the supply-demand diagram, the total cost is no longer the area under the supply curve $(Q^N(\lambda P), P)$ with nonintegration but is the area under the curve $(Q^N(\lambda P, \lambda P)$.

Since the managerial cost under integration is the area $a - z' - b$, moving from integration to nonintegration will generate a social gain when $P \in (\pi^*/\lambda, \pi/\lambda)$ and as long as the demand is sufficiently elastic the equilibrium will be second-best inefficient. Intuitively, the gain in output is first order now while the increase in managerial costs is second order.

By the same argument however, an industry equilibrium at $P \in [0, P/\lambda]$ can now be second-best inefficient. Indeed, in this range of prices, since managerial costs are a smaller part of total welfare than in the case of privately held firms, the large gain in welfare obtained by consumers and shareholders when moving from nonintegration to integration in the case $P < \pi/\lambda$ may now dominate the managerial loss. The equilibrium may therefore also be second-best inefficient for low levels of output. Figure 7 illustrates such a case.

Point $c$ represents the quantity-price pair $(Q^N(\pi), \pi)$. Since at $\pi$ managers are indifferent between nonintegration and integration, the cost under

\footnote{Nothing depends on these assumptions. As we will show in section 5.1, with nonlinear compensation rules, there exist cutoffs $P_0$ instead of $\pi/\lambda$ and $P_1$ instead of $\pi/\lambda$ defining the integration and nonintegration regimes. As long as $\pi^{-1}(\pi)$ is greater than $\pi^*$, the industry supply curve lies above the marginal managerial cost, and our qualitative results apply. The case of positive outside options is treated in a way parallel as that of Proposition 3.}
integration is the area $a - c - e' - b$.

For the demand $d$, equilibrium is at $x$ and welfare is the area $d - x - e' - a$ since the managerial cost is the triangle $a - e' - e$. If integration is forced, the industry equilibrium would be at $x'$ with welfare equal to $d - x' - c' - c - a$. There is therefore a deadweight loss equal to the area $x - x' - c - e'$. Note that if the demand is more inelastic, the deadweight loss is lower. Under weak conditions, it is possible to characterize the region of inefficient nonintegration.

A family of demand functions $\{Q = d(P; t), t \in \mathbb{R}_+\}$ is regular if for each $P$ and $t$, $d(P, t)$ is strictly increasing in $t$, strictly decreasing in $P$, $\lim_{P \to 0} d(P, t) = \infty$, and for each $Q$ and $t$ there exists $P$ such that $d(P, t) = Q$. Hence, in a regular family, demand functions do not intersect the horizontal axis, two demand functions do not intersect and demand functions are onto $\mathbb{R}_+$.

**Proposition 4** Suppose $\lambda < \pi/\pi^*$. There exists a regular family of demand
functions such that the following holds. There exist $P_m \in (0, \overline{p}/\lambda]$ and $P_M \in (\overline{p}^*/\lambda, \overline{p}/\lambda)$ such that

(i) an equilibrium with integration is second-best efficient only if $P \leq P_M$, and

(ii) an equilibrium with nonintegration is second-best efficient if and only if $P \leq P_m$.

This proposition shows that publicly held firms are characterized by too little and too much integration. Shareholders like consumers would like to have organizations that increase output (for a given competitive price $P$); it is therefore reasonable to conjecture if shareholders had more control on managers they would be able to implement organizations that maximize output. We show that this conjecture is incorrect in the next section. In particular, while it would be easy for the shareholders to implement the output maximizing solution, they will not always do this because this would imply too large a share flowing to the managers. The key feature is the non-contractibility of decisions $a, b$ under nonintegration.

5 Publicly Held Firms and Manager Control

In publicly held firms, the ability of shareholders to mitigate their loss of control is a function of the quality of the corporate governance and the contractual instruments at their disposal. We will consider in turn two instruments: price contingent shares of $P$ going to the managers (with or without the ability to also impose a price contingent organization on the managers), and the transfer of cash to managers in order to ease their contracting under nonintegration.

5.1 Price contingent shares

We assume here that shareholders can choose managerial shares that are not linear in the market price $P$. The derivations in the text assume that $\sigma$ is small, precisely, that $\sigma < \overline{\sigma}$. In this case, there exist two share levels $\overline{\pi}, \overline{\pi}$ such that managers prefer integration only if $\pi \in [\overline{\pi}, \overline{\pi}]$. In addition, there exists a unique $\pi^*, \overline{\pi} < \pi^* < \overline{\pi}$, at which integration and nonintegration
expected output are equal. We will focus on this case.  

Suppose that shareholders want the managers to choose integration: the cheapest way for them to do so is to give a fixed compensation in case of success of $\bar{\pi}$ (or $\epsilon$ greater than this to avoid indifference). Hence, the maximum payoff to shareholders when they want to implement integration is

$$v^I(P) = (1 - \sigma)(P - \bar{\pi})$$

Suppose now that the shareholders want to implement nonintegration. They are constrained in their choice since they need to choose $\pi$ that is not in the interval $[\underline{\pi}, \bar{\pi}]$. Let us, however, ignore the constraint for the moment. The value under nonintegration is given by the function $v_N(P)$,

$$v^N(P) = \max_{\pi \geq 0} \left(1 - \frac{1}{2(1 + \pi)^2}\right)(P - \pi) \quad (10)$$

The objective is strictly concave in $\pi$ and strictly supermodular in $(\pi, P)$, so that the (unique) optimum $\pi(P)$ is increasing in $P$. Consequently, $Q^N(\pi(P))$ is also increasing, and there exist unique values of prices $P, P^*$, and $\bar{P}$ such that $\underline{\pi} = \pi(P)$, $\pi^* = \pi(P^*)$, and $\bar{\pi} = \pi(\bar{P})$. Since by the envelope theorem $v^N(P) = Q^N(P)$, $v^N(P)$ is (strictly) convex.

Note that $v^N(0) = 0 > v^I(0)$. On the other hand, $v^N(P^*) < v^I(P^*)$: by definition, $v^N(P^*) = \left(1 - \frac{1}{2(1 + \pi^*)}\right)(P^* - \pi^*) = (1 - \sigma)(P^* - \pi^*) < (1 - \sigma)(P^* - \bar{\pi})$, since $\bar{\pi} < \pi^*$. Moreover, $v^N(P^*) = v^I(P^*) = 1 - \sigma$; thus for $P > P^*$, $v^N(P) > v^I(P)$, and for $P < P^*$, $v^N(P) < v^I(P)$ and we conclude that $v^N(\cdot) = v^I(\cdot)$ at two prices $P_0$ and $P_1$, with $0 < P_0 < P^* < P_1$. Since $Q_N(\bar{\pi}) < 1 - \sigma$, $v^N(P) < v^I(P)$. Therefore, $P_0 < P^* < P_1$.

Finally, taking into account the constraint that $\pi \notin [\underline{\pi}, \bar{\pi}]$ if the shareholders are implementing nonintegration, they will put $\pi = \bar{\pi}$ for $P \in [P, \hat{P}]$ and $\pi = \underline{\pi}$ for $P \in (\hat{P}, \bar{P})$ for some $\hat{P} \in (P, \bar{P})$. The value $\hat{v}_N(P)$ of this

\[\text{\footnotesize{\textsuperscript{13}If } \sigma > \underline{\sigma} \text{ managers always prefer nonintegration, so that a nonlinear sharing rule cannot be used to implement integration any more than a linear one can. Shareholders will still solve problem (10). Integration would produce more output than nonintegration for all } P < P^*, \text{ where } \pi(P^*) = \sqrt{1 - 2\sigma} - 1, \text{ so as long as } \sigma < \frac{1}{2}, \text{ there is a range of prices in which integration would have lead to higher output.}}\]

\[\text{\footnotesize{\textsuperscript{14}In particular, } \pi(P) = 0 \text{ when } P < 1/2: \text{ shareholders implement a probability of success of } 1/2 \text{ while the probability of success would be larger – equal to } Q^N(P) – \text{ if the firms were privately held.}}\]
constrained problem is convex (it is piecewise linear on \([\mathcal{P}, \mathcal{P}]\)) and bounded above by \(v^N(P)\), coinciding with it outside \([\mathcal{P}, \mathcal{P}]\). Thus \(\hat{v}_N(\cdot) = v^I(\cdot)\) at two prices \(P_0\) and \(\hat{P}_1\) with \(\hat{P}_1 \geq P_1\), where the inequality is strict if and only if \(P_1 < \mathcal{P}\), in which case \(\hat{P}_1 < \mathcal{P}\) as well.\(^{15}\)

The analysis therefore shows that when shareholder optimize, they will decide to keep the organizational form that is not output maximizing because it is too costly to provide incentives when \(P < P_0\) and when \(P \in [P^*, \hat{P}_1]\). Note that the industry supply curve is similar to the case dealt with in section 5 (with \(\pi/\lambda\) replaced by \(P_0\) and \(\bar{\pi}/\lambda\) replaced by \(\hat{P}_1\)) and that ranges of both inefficient nonintegration and inefficient integration persist.

**Proposition 5** Suppose \(\sigma < \bar{\sigma}\). There exist a range of prices \([P_0, P_1]\), \(P_0 < P_1\) such that shareholders give a fixed compensation to managers equal to \(\pi\) in order to implement integration. For other prices, they prefer to implement nonintegration.

**Remark 6** Because \(P_0\) is likely to be larger than \(\pi\) when a firm has a large capitalization, integration arises at higher product market prices than when there is no separation of ownership and control.

Providing more instruments to the shareholders will not modify the qualitative result. For instance, if shareholders can also choose the organization as a function of the price, they can dissociate the choice of compensation from the organization choice. Hence, assuming a zero outside option for the managers, if shareholders choose integration, they have to compensate the managers for their costs of \(1/4\) and their total profit is

\[
\hat{v}^I(P) = (1 - \sigma)P - 1/4, \tag{11}
\]

with \(\hat{v}^I(P) > v^I(P)\) for all \(P\). If the shareholders impose nonintegration, they can control the probability of success by choosing a compensation \(\pi\), and their profit is given by the \(v^N(P)\) in (10). We still have \(\hat{v}^I(0) < v^N(0)\), and therefore shareholders prefer to choose integration when \(P\) is in an \(\hat{P}_0, \hat{P}_1\), where \(\hat{P}_0 < P_0\) and \(\hat{P}_1 > P_1\).

\(^{15}\)The necessary and sufficient condition for having \(\hat{P}_1 < \mathcal{P}\) is \(\mathcal{P} < O^N(\pi) - (1 - \sigma)\pi\) since under this condition, shareholders would strictly prefer to implement nonintegration with a share of \(\pi\) than to implement integration with a share of \(\pi\).
**Corollary 7** Suppose $\sigma < \bar{\sigma}$ and that shareholders can impose the organization. Integration is chosen if, and only if, $P$ belongs to the interval $[\hat{P}_0, \hat{P}_1]$, $\hat{P}_0 < P_0$, $\hat{P}_1 > P_1$.

Note that when $P \in (\hat{P}_0, P_0)$, managers will choose nonintegration by Proposition 5 while shareholders prefer integration. If corporate governance does not allow existing shareholders to impose organizational changes, a price in this interval may trigger an hostile takeover whereby the ridder puts in place an integrated structure. For other prices however, nonintegration decisions are immune to takeovers, even if they are second-best inefficient.

Bertrand and Mullainathan (2003) provide evidence that managers prefer a “quiet life” at the possible expense of productivity-enhancing integration. The corollary shows that even if shareholders can make organizational decisions, managers may enjoy a quiet life – with a second-best inefficient organization – because it is too costly for shareholders to implement integration.

### 5.2 Free Cash Flow

One important difference between integration and nonintegration is the degree of transferability in managerial surplus: while managerial welfare can be transferred 1 to 1 with integration (that is one more unit of surplus given to $B$ costs one unit of surplus to $A$), this is no longer true with nonintegration. This explains why the organizational choice will not necessarily coincide with that maximizes the total managerial welfare. This is no longer true if the managers have access to cash, or other free cash flow,\(^{16}\) that can be transferred without loss to the $B$ manager before production takes place.

Cash is a more efficient instrument for surplus allocation than the sharing rule $s$ only when firms do not integrate. Indeed, under nonintegration, a change of $s$ affects total costs. By contrast, when firms are integrated, a change in $s$ has no effect on output or on costs and therefore surplus is perfectly transferable by using $s$. Hence, the introduction of cash favors

\(^{16}\text{Jensen (1986) showed how free cash flow can lead managers to choose projects with a low rate of return, in particular how they will value firm growth beyond the “optimal” size. Interestingly, here we point out a distortion in the other direction, that managers are willing to use their cash to avoid growth, and how this is detrimental to shareholders when price is low. Legros and Newman (1996) and (forthcoming) discuss the role of cash in equilibrium models of organizations.}\)
nonintegration and we should observe in equilibrium a smaller number of firms that are integrated.

To simplify, assume that the shareholders are forced to use linear compensation rules with managers, that is that for each price \( P \), the managers receive \( \lambda P \), where \( \lambda < 1 \). The range of market prices for which managers choose integration is therefore \([\overline{\pi}/\lambda, \overline{\pi}/\lambda]\)

Consider a distribution of cash \( F(l) \) among the \( A \) managers, where \( \int dF(l) = n > 1 \), and let \( l_F \) be the marginal cash, that is there is a measure \( n \) of \( A \) managers with cash greater than \( l_F \)

\[
F(l_F) = n - 1.
\]

There is no loss of generality in assuming that only \( A \) firms with cash greater than \( l_F \) will be active on the matching market.

Since there is a measure \( n - 1 \) of \( A \) units that will not be matched, \( A \) managers will try to offer the maximum payoff consistent with being matched with a \( B \) unit while getting a nonnegative payoff. Fix the product price at \( P \). The maximum surplus that a \( B \) manager can obtain via integration is \( (1 - \sigma)P - 1/4 \). The maximum he can obtain when the sharing rule is \( s \) is \( W^N(s, P) \); however this can be achieved only if the \( A \) manager has cash at least equal to \( \pi_A^N(s, P) \) that can be transferred ex ante to \( B \).

We have three regimes. First, when \( \lambda P \leq \overline{\pi} \), or when \( \lambda P \geq \overline{\pi} \), integration is dominated by nonintegration (Lemma 1) and therefore cash has no effect on the supply curve: each firm produces \( Q^N(\lambda P) = 1 - \frac{1}{2(1+\lambda P)} \) and the role of cash is to increase managerial surplus since the transfer of cash enables firms to choose \( s \) closer to 1/2.

When \( \lambda P \in (\overline{\pi}, \overline{\pi}) \), as in Figure 1, there exists a sharing rule \( s_0 \) for which

\[
W^N(s_0(\lambda P), \lambda P) = W^I(\lambda P).
\]

Then, assuming that the \( A \) managers have a zero outside option, manager \( B \) is indifferent between using integration with a share of \( s = 0 \) to \( A \) or using nonintegration with a share \( s_0(P) \) to \( A \) and getting an ex ante transfer of

\[
L(P) = \pi_A^N(s_0(\lambda P), \lambda P).
\]
If \( l < L(P) \), the maximum payoff to a \( B \) manager is less with nonintegration and an ex ante transfer of \( l \) than with integration. Hence, all \( A \) firms with \( l \leq L(P) \) will still offer integration contracts in order to be matched; however, firms with \( l > L \) will offer nonintegration contracts.

The measure of firms that integrate is the measure of \( A \) managers with cash greater than \( L(P) \). Hence, there is a measure \( F(L(P)) - F(l) = F(L(P)) - n + 1 \) of firms that integrate and a measure of \( n - F(L(P)) \) of firms that do not integrate. With cash there is a smaller measure of firms that integrate, and because the output with integration is larger than with nonintegration when \( P < \pi^*/\lambda \) we conclude that the supply curve rotates at \( \pi^*/\lambda \), as illustrated in Figure 8 and the next proposition.

![Figure 8: The effect of cash](image)

**Proposition 8** With cash, the supply curve coincides with the no cash case when \( P \notin (\pi/\lambda, \pi*/\lambda) \). When \( P \in (\pi/\lambda, \pi*/\lambda) \) the supply curve is shifting in and when \( P \in (\pi*/\lambda, \pi/\lambda) \) the supply curve is shifting up.

Going back to the characterization of the conflict between managers and the other stakeholders we note two opposite effects of cash. First, there is less often inefficient integration in the region \( P \in (\pi*/\lambda, \pi/\lambda) \) and therefore output is larger and prices lower. Second, there is more inefficient nonintegration since firms stay non integrated in the price region \( (\pi/\lambda, \pi*/\lambda) \) while they
were integrated before; since integration is output maximizing in this region, inefficiencies increase from the point of view of consumers and shareholders. This result is squarely in the second-best tradition: giving the managers an instrument of allocation that is more efficient for them may induce them to minimize their costs of transacting, but this may exacerbate the inefficiency of the equilibrium contract. Here while cash reduces the over-internalization of the benefits of coordination, it increases the over-internalization of the benefits of specialization. This role of cash seems new to the literature.

6 Conclusion

In many models of organization, managers trade off pecuniary benefits derived from firm revenue against private costs of implementing decisions. In our model, two key variables affect the terms of this trade-off: product prices, over which managers have no control, and the choice whether to integrate, over which they do. In particular, nonintegration performs well from the managerial point of view under both high and low prices, while integration is chosen at middling prices.

At the same time, organizational choices also affect production: nonintegration produces relatively little output compared to integration at low prices, as managers prefer a “quiet life”; at certain higher prices, integration can be less productive than nonintegration, despite being preferred by managers. Thus, organizational decisions rendered by managers acting in their own interests can lead to lower output levels and higher prices than would occur if they were forced to act in consumers’ interests. This result is obtained even with a competitive product market, i.e., firms or managers do not take into account the effect of reorganization or vertical integration on product prices.

We believe that these effects can be identified in practice. For instance, the model can identify conditions under which “waves” of integration are likely to occur – e.g., growing demand in an initially nonintegrated industry – or when opening borders to low cost suppliers might lead to increased product prices. More generally, as prices, quantities, and integration decisions are easily measured, we are hopeful that models such as the present
one will encourage empirical investigations that will quantify the real-world significance of the effects of prices on organization and vice versa.

Our analysis raises the issue of what policy remedies might be indicated to improve consumer welfare. It is likely that these policies may be unconventional. For instance, in the case of inefficient integration (where output would be higher under nonintegration), standard merger policy implemented by an antitrust authority that blocks a potentially harmful merger may be effective in increasing output and lowering market prices. But the policy is surely unconventional, in the sense that it does nothing to enhance competition, which by assumption is perfect both before and after a proposed merger – thus it is unlikely that the antitrust authority would be called upon to act. In the range of prices in which managers inefficiently opt not to integrate, conventional merger policy is rather ineffective – there is no merger to prevent.

Instead, the model suggests a novel benefit of corporate governance regulation: in competitive markets, strengthening shareholders’ ability to force appropriate integration decisions may improve consumer welfare as well as shareholder interests. In our competitive world, shareholder and consumer interests are (nearly) aligned since they both would value higher levels of output. However, as we have shown, even if shareholders control organizational choice, their interests will typically diverge somewhat from those of consumers, particulary at higher product prices, where they will tend to favor integration more than consumers would.

Notice in particular that governance matters at low prices (and profitability levels) in this model, when there is inefficiently little integration, as well as at medium-high ones, where there is inefficient integration. This is in contrast to much literature on corporate governance, which emphasizes high profit regimes as most conducive to managerial cheating. Presumably, this is because high profit regimes are most conducive to “profit taking”, diversion of revenues to private managerial benefits or investments in pet projects. Our analysis underscores that governance also matters for “profit making”: proper organizational design affects managers’ production decisions, and is particularly important when low profitability provides weak incentives for them to invest in an profit or output maximizing way.

Though the effects we have identified can occur absent market power,
this is not to say that market power is irrelevant to the effects of – or its
effects on – major organizational decisions. When firms have market power,
incentives to integrate may be also linked to efficiency enhancements, such
as the desire to eliminate double markups. However firms may also recognize
that by reducing output they will raise prices, and some of the effects we
describe happen all the more strongly.

Moreover, the impact of “effective” corporate governance may be quite
different in this case. In a noncompetitive world, shareholders and consumers
interests are no longer aligned, and as we have already noted, managerial dis-
cretion may be a way for shareholders to commit to low output and therefore
high profits. The relative effects of corporate governance regulation and com-
petition policy may therefore depend non trivially on the intensity of product
market competition.\textsuperscript{17} These points warrant further investigation.

\textsuperscript{17}Indeed, one can show that in the monopoly case, the welfare loss due to inefficient
organization leads to what can be dubbed a “Leibenstein trapezoid,” loss that can dwarf
the usual “Harberger triangle” welfare loss (Legros and Newman 2006). In this case,
strengthening shareholder control may be counterproductive.
7 Appendix

7.1 Proof of the Claim in Footnote 9

Consider a specification Pf(a, b) and increasing costs CA(a), CB(b). Assume that CB(0) = 0 and that f(a, b) is strictly increasing in a, b and has an upper bound of y. We prove the claim that there is nonintegration at low and high prices and that if integration is used, it must be for intermediate values of price.

Assume that the long side managers have a zero outside option and therefore that the payoff to the short side managers (B) is the total welfare.

We show that either nonintegration is always preferred to integration for low values of P and for large values of P.

With integration, HQ chooses a, b to maximize f(a, b). Assume that HQ chooses the cost mimizing solution (aI, bI) if there is more than one optimum solution. Payoff to the B manager is uI_B(P) = Py(1 − σ) − CA(aI) − CB(bI), where y is the maximum output.

With nonintegration, the short side chooses s to maximize (1 − s)Pf(a, b) − CB(b) where (a, b) is a Nash equilibrium of the game induced by s. Let uN_B(P) be the optimal value for B. If uN_B(P) > uI_B(P) for all P, there is nothing to prove. If however there exists P such that integration is preferred to nonintegration we show that necessarily nonintegration is preferred to integration for large values of P.

As P = 0, the Nash equilibrium is a = b = 0 and B has a zero payoff; therefore for low prices nonintegration is preferred to integration. For P > 0, the payoff uN_B(P) is greater than what B can achieve with s = 0. If s = 0, for any P a Nash equilibrium requires a = 0. Let b(P) be the solution of maxa Pf(0, b) − CB(b). The payoff to B when s = 0 is then vB(P) = Pf(0, b(P)) − CB(0, b(P)) and by the envelop theorem, v′B(P) = f(0, b(P)). Note that b(P) is strictly increasing in P, and therefore that v′′(P) = b′(P)f2(0, b(P)) > 0. Hence vB(P) is convex increasing in P. Because dvI_B(P)/dP = y(1 − σ), there exists b* such that f(0, b*) = y, and therefore there exists P* such that b(P*) = b* and v′B(P) > y(1 − σ), for all P > P*. This shows that for P large enough uN_B(P) ≥ vB(P) > uI_B(P), as claimed.
7.2 Proof of Proposition 1

(i) Managerial welfare under integration is smaller than the minimum managerial welfare under nonintegration when

\[(1 - \sigma)P - \frac{1}{4} < \left(1 - \frac{1}{2(1 + P)^2}\right)P - \frac{1}{2}\left(\frac{P}{1 + P}\right)^2,\]

\[\iff \sigma > \frac{P - 1}{4P(1 + P)},\]

\[\iff 4\sigma P^2 + (4\sigma - 1)P + 1 > 0,\]

which holds whenever \(P\) is outside the interval \([\pi(\sigma), \pi(\sigma)]\), where \(\pi(\sigma)\) and \(\pi(\sigma)\) are the two solutions of the equation \(\sigma = \frac{P - 1}{4P(1 + P)}\).

(ii) Managerial welfare under integration is always smaller than the maximum nonintegration welfare. From (6), maximum welfare under nonintegration is obtained at \(s = 1/2\), and welfare with integration is smaller than this maximum welfare when

\[(1 - \sigma)P - \frac{1}{4} < \left(1 - \frac{1}{2(1 + P)^2}\right)P - \frac{1}{2}\left(\frac{P}{1 + P}\right)^2\]

which simplifies to

\[\sigma > -\frac{1}{4P(1 + P)^2},\]

which is true for all nonnegative \(\sigma\).

7.3 Proof of Proposition 2

Under nonintegration, \(A\) gets an ex-ante payment of \(\omega\) and the two managers commit to pay \(D\) if there is success. The payoffs to the two managers given a sharing rule \(s\) are then,

\[\pi_A^N(s, P, D) = s(P - D)(1 - (a - b)^2) - \frac{1}{2}(1 - a)^2 + \omega\]
\[\pi_B^N(s, P, D) = (1 - s)(P - D)(1 - (a - b)^2) - \frac{1}{2}b^2.\]

Formally, from (4), the equilibrium under nonintegration is \(Q^{no} = 1 - 1/(2(1 + P - D)^2)\). Since the creditor makes zero profits when \(QD = \omega\), the level of debt \(D(\omega)\) when the cost is \(\omega\) is obtained by solving the equation
\[
\frac{\omega}{D} = 1 - \frac{1}{2(1 + P - D)^2}.
\] (14)

There can be multiple solutions but the lowest repayment is also the preferred equilibrium by the managers and is increasing in \(\omega\).

Since \(u_A = \omega\), we can choose \(s = 0\) and \(\pi_A^N(0, P - D(\omega)) = 0\) and \(\pi_B = W^N(0, P - D(\omega))\). If \(B\) is indifferent between integration and nonintegration, we have

\[
W^N(0, P - D(\omega)) = W^I(P) - \omega
\] (15)

Observe that

\[
W^N(0, P - D(\omega)) + \omega = PQ^N(P - D(\omega)) - C(P - D(\omega))
\]

where \(C(P) = \frac{1}{2}P^2/(1 + P)^2\). For \(P' < P\), the function \(PQ^N(P') - C(P')\) is increasing in \(P'\).\(^{18}\) Hence, for \(\omega' < \omega\), \(P - D(\omega') > P - D(\omega)\), and

\[
W^N(0, P - D(\omega')) + \omega' > W^N(0, P - D(\omega)) + \omega
\]

\[
= W^I(P)
\]

Thus \(B\) manager strictly prefers nonintegration to integration when the cost is \(\omega'\).\(^{19}\)

### 7.4 Proof of Proposition 3

We show here that the area \(a'' - b'' - c\) is equal to the area \(a' - c - b'\) and that the result is still true for positive outside options.

Let \(G\) be the area \(a'' - b'' - c\) and \(L\) the area \(a' - c - b'\). We have

\[
G = \int_{\pi^*}^{\pi} [Q^N(P) - (1 - \sigma)]dP
\]

\[
L = \int_{\pi}^{\pi^*} [(1 - \sigma) - Q^N(P)]dP
\]

\(^{18}\)Derivation with respect to \(P'\) yields the expression \((P - P')(1 + P')^3\) which is positive because \(P' < P\).

\(^{19}\)The same reasoning holds for any initial share \(s \in (0, 1/2)\). Because \(u_A(s, \omega', P) = \pi_A^N(s, P - D(\omega')) + \omega'\) and \(\pi_A^N\) is increasing in \(P - D(\omega)\), we have \(u_A(s, \omega', P) < \omega'\). The optimal value of \(s\) under \(\omega'\) will therefore be \(s' < s\), which will further increase the payoff to \(B\) under nonintegration while the payoff under integration is the same.
Hence,
\[ G - L = \int_{\pi}^{\bar{\pi}} Q^N(P) dP - (1 - \sigma)(\bar{\pi} - \pi) \]

By definition of \( \bar{\pi}, \pi \), we have
\[ Q^N(\pi)\bar{\pi} - C(Q^N(\pi)) = (1 - \sigma)\bar{\pi} - \frac{1}{4} \]
\[ Q^N(\pi)\pi - C(Q^N(\pi)) = (1 - \sigma)\pi - \frac{1}{4} \]

Note that for any \( \pi \), we have \( C(Q^N(\pi)) = Q^N(\pi)\pi - \int_0^{\pi} Q^N(x) dx \). Operating this substitution in the two left hand sides of the previous equalities and subtracting the second inequality from the first we obtain
\[ \int_{\pi}^{\bar{\pi}} Q^N(\pi) d\pi = (1 - \sigma)(\bar{\pi} - \pi) \]
proving that \( G - L = 0 \).

Note that the reasoning has been made for any cost \( C(Q) \), that is allows for positive \( s \). Consider now the case of a positive outside option of \( A \).

First, note that the departure of the rule \( P \) equal marginal cost is even more apparent if \( A \) has a nonzero outside option \( u > 0 \), \( B \) chooses for each output \( Q \) the share \( s \) such that \( PQs - C_A(Q; s) = u \). Contrary to the previous situation this share will typically vary with \( Q \). Let \( s(Q, u) \) be the share schedule when \( A \) gets her outside option.\(^{20}\) \( B \) wants to maximize \( PQ(1 - s(Q, u)) - C_B(Q; s(Q, u)) \), or – using the fact that \( PQs - C_A(Q; s) = u \),
\[ PQ - u - (s(Q, u)^2 + (1 - s(Q, u))^2)c(Q) \]
and the first order condition is
\[ P = 2s'(Q)(2s(Q, u) - 1)c(Q) + (s(Q, u)^2 + (1 - s(Q, u))^2)c'(Q) \]

Note that contrary to the zero outside option case, the area under the supply curve with nonintegration is not anymore the total managerial cost.

\(^{20}\)This value solves the quadratic \( s^2c(Q) - PQs + u = 0 \); this has two solutions but \( B \) prefers the smallest value; precisely, \( s(Q, u) = \left( PQ - \sqrt{(PQ)^2 - 4uc(Q)} \right) / 2c(Q) \)
Nevertheless, consider points on the supply curve with nonintegration, for instance point $x'$ in Figure 6. The share accruing to $A$ is $s^* = s(Q^A(P), u)$. Keeping this share constant, and ignoring the fact that the level of utility of $A$ will change when $Q$ changes, the equilibrium solves indeed $\max_Q PQ - (s^*2 + (1-s^*)^2)c(Q)$, and the area under the supply curve up to $x'$ is equal to the managerial cost given the share $s^*$. With integration, since total welfare is transferable, the managerial cost of $1/4$ is still the area $a - a' - b' - b$. We can therefore proceed as in the case of zero outside option.

### 7.5 Proof of Proposition 4

**Proof.** For (i) assume that the demand function going through It is enough to consider equilibrium prices less than $\frac{\pi}{\lambda}$ since we know that nonintegration equilibria with $P > \frac{\pi}{\lambda}$ are second-best efficient. Because the family of demand functions is regular, if one starts from an equilibrium such as $x$ in Figure 7 which is not second-best efficient, any other equilibrium with nonintegration above $x$ will also be second-best inefficient. By going down the supply curve, the welfare loss continuously decrease: by regularity, if $x$ goes down the demand curve, $y$ will go down the vertical line corresponding to the integration supply. Therefore there exists at most one $P_m$ such that the welfare loss is zero, proving the result. □

### 7.6 Outside Options

Let $F(u_A)$ and $G(u_B)$ be the distributions of outside options for $A$ and $B$ respectively, with supports $[0, \infty)$. We assume that $F$ and $G$ have continuous and positive densities.

Let $u$ be a payoff to $A$ and $\phi^{no}(u; P)$ and $\phi^{int}(u; P)$ be the frontiers of the nonintegration and integration cases when the price is $P$. The overall frontier is $\phi(u; P) = \max\{\phi^{no}(u; P), \phi^{int}(u; P)\}$.

**Lemma 9** Fix a price $P$. There exists a unique value $\alpha(P)$ such that $F(\alpha) = G(\beta)$ and $\beta = \phi(\alpha; P)$. Moreover, this solution is increasing in $P$.

**Proof.** The function $h(\alpha) = G^{-1}(F(\alpha))$ is well defined since the densities are positive. Moreover, as $\alpha$ increases, $h(\alpha)$ strictly increases. Now $\phi(\alpha; P)$
is strictly decreasing in \( \alpha \). It follows that there exists a unique value solving 
\( h(\alpha) = \phi(\alpha; P) \); this solution is increasing in \( P \) because \( \phi(\alpha; P) \) is increasing in \( P \). ■

We will write that a firm improves on outside options whenever \( u_B \leq \phi(u_A; P) \).

**Proposition 10** In a supplier market equilibrium, firms that can improve on outside options consist of \( A \)-managers with outside options \( u_A \leq \alpha(P) \) and \( B \)-managers with outside options \( u_B \leq h(\alpha(P)) \). All \( A \) managers have payoff \( \alpha(P) \) and all \( B \)-managers have payoff \( h(\alpha(P)) \).

**Proof.** Consider an equilibrium in the supplier market with sets \( I_A \) and \( I_B \) of managers, where we identify (wlog) a manager with an outside option. Consider a firm \((u_A, u_B)\) that improves on outside options and let \((\pi_A, \pi_B)\) be the equilibrium payoffs. Suppose that manager \( u'_A < u_A \) is not in a firm. Then this manager gets her outside option. Because the frontiers are strictly decreasing and firms improve on outside options, \( \pi_B = \phi(\pi_A; P) \leq \phi(u_A; P) \). Hence, there exist \( \pi'_B > \pi_B \) and \( \pi'_A > u'_A \) satisfying \( \pi'_B = \phi(\pi'_A; P) \), contradicting stability. A similar argument shows that all managers with outside options \( u'_B < u_B \) must be in equilibrium firms.

Let \([0, \alpha)\) be the set \( A \)-managers in firms. By measure consistency, the set of \( B \)-managers is \([0, h(\alpha)]\). We claim that all \( A \)-managers get the same payoff and all the \( B \)-managers get the same payoff. If, for instance, there are two \( A \)-managers have different payoffs \( \pi_i < \pi_j \), consider the \( B \)-manager \( k \) who is in a firm with \( j \). Since firms improve on outside options, \( k \) gets her outside option by matching with \( j \); hence \( k \) will obtain a strictly higher payoff by matching with the \( A \)-manager \( i \) and offering a payoff in the interval \((\pi_i, \pi_j)\). Hence all \( A \)-managers get the same payoff \( \pi_A \). A similar argument shows that all \( B \)-managers get the same payoff \( \pi_B \). Because firms improve on outside options, it must be the case that \( \pi_A \geq \alpha \) and that \( \pi_B \geq h(\alpha) \).

If \( \alpha < \alpha(P) \), then \( \pi_A + \pi_B > \alpha + h(\alpha) \). Without loss of generality, assume that \( \pi_B > h(\alpha) \), then there exists \( \epsilon > 0 \) such that \( \pi_B > h(\alpha) + \epsilon \). But then there exists \( \delta > 0 \) such that a \( B \)-manager with outside option \( h(\alpha) + \epsilon \) can offer a \( A \)-manager \( \pi_A + \delta \) while getting for herself strictly more than her outside option, contradicting the assumption that this manager is not in a
firm. Hence $\alpha = \alpha(P)$ as claimed, proving the proposition.

This proposition is useful because it suggests that the way the surplus is shared in equilibrium depends on the slope of the curve $h(\alpha)$. In particular we have the following.

**Corollary 11** Suppose that $F = G$, then for any price $P$ and any $\sigma$ nonintegration is chosen.

Indeed, if the two sides have the same distributions of outside options, $h(\alpha) = \alpha$ and in equilibrium, the payoffs are $\pi_A = \pi_B = \alpha(P)$. Because nonintegration dominates integration when A and B get the same payoff, nonintegration will be the equilibrium organization for any value of $P$, even if $\sigma = 0$.

We illustrate below this corollary construction for a price $P$ in the interval $[P, \overline{P}]$. The steeper curve $h(\pi_A)$ corresponds, to a situation where the outside option of the B-managers ‘raises faster’ than that of the A-managers (e.g., if $G(m\alpha) = F(\alpha)$ with $m$ being “large”.)

![Figure 9: Equilibrium for different $F$ and $G$](image)

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References


