Organizing for Synergies

Wouter Dessein, Luis Garicano, and Robert Gertner*

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Abstract

Large companies are usually organized into business units, yet some activities are almost always centralized in a company-wide functional unit. We first show that organizations endogenously create an incentive conflict between functional managers (who desire excessive standardization) and business-unit managers (who desire excessive local adaptation). We then study how the allocation of authority and tasks to functional and business-unit managers interacts with this endogenous incentive conflict. Our analysis generates testable implications for the likely success of mergers and for the organizational structure and incentives inside multidivisional firms.

Keywords: coordination, incentives, task allocation, incomplete contracts, merger implementation, scope of the firm, organizational design, multidivisional firms.

JEL Classifications: D2, D8, L2.

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1 Introduction

Large companies are generally organized into business units, yet some activities are almost always consolidated in company-wide functional units. These organizations are neither pure M-form business-unit organizations nor pure U-form functional organizations; they are "hybrid" organizations. The typical organization design problem is to choose which activities should be integrated and which should remain at the business-unit level. For example, Procter and Gamble centralizes product development, accounting, and finance, but regional business units are responsible for sales, distribution, manufacturing, and procurement while GE centralizes sourcing at a global level, but keeps sales, distribution and manufacturing at product-level business units.[1]

Hybrid structures require business-unit managers and functional managers to coordinate their activities. Functional managers attempt to create value by standardizing activities that impact many business units, while business-unit managers benefit from tailoring activities to increase profits in their units. Coordinated decision-making about which activities to standardize is difficult when mangers have divergent interests arising from narrow incentives. A key organizational design problem is then to provide incentives for managers and determine the authority structure so that synergies from standardization can be captured.

Failure to implement organizational strategies to achieve synergies while ensuring local adaptation is the cause of the most spectacular merger disasters.[2] For example, a claimed source of increased value in the merger between AOL and Time Warner was to be synergies from selling advertising packages that included all media encompassed by the merged company's divisions. But centralized ad-selling was thwarted by divisional advertising executives who felt they could get better deals than the shared revenue from centralized sales. An outside advertising executive was quoted by the Wall Street Journal, stating, "[t]he individual operations at AOL Time Warner have no interest in working with each other and no one in management has the power to make them work with each other."[3] Or, as a recent analysis of the failure of the merger between Citbank

[1] Note that we study when to centralize activities, rather than decisions. While centralized decisions can be made by the principal (e.g. see Aghion and Tirole, 1997), centralized activities must be carried by an agent who needs to be motivated. For example, even though GE centralizes sourcing globally, the GE CEO does not make the individual sourcing decisions; these are delegated to a functional manager. See Simons (2005), Chapter 3, for these and many other examples of centralized functions along these lines.

[2] The anecdotal evidence of failed synergy implementation is also consistent with the broader empirical literature on merger performance in corporate finance. See Andrade, Mitchell, and Stafford (2001).

[3] See Rose, Matthew, Julia Angwin and Martin Peers. "Bad Connection: Failed Effort to Coordi-

and Travelers that created Citigroup put it,[4] "it failed because internal compensation incentives mainly stressed units, not the whole, the downside of all behemoths." The problem is that achieving synergies is not without costs: it requires reducing the sensitivity of decisions to local information, reducing the coordination among the different activities of a business unit, and blunting incentives; when organizations choose not to incur those costs, the synergies are not captured.

We study the design and use of hybrid structures to achieve synergies. We model a firm organized around two product units – one can think of two distinct products or locations, although we will refer to the them as products. Each product requires two activities such as manufacturing and marketing. We assume that the optimal organizational structure requires that one activity, say marketing, be organized by products because business-unit managers must make decisions based on local information. But there may be benefits from standardizing the second activity, say manufacturing, across products. Synergies can only be realized if the manufacturing activities for each product are integrated (e.g. in a single manufacturing plant), and a functional manager specialized in that activity is put in charge. Once the organizational structure and incentives are set, managers obtain information that determines whether or not standardization is efficient. In an integrated structure, the functional manager obtains information about the cost savings that may be attained through standardization and business-unit level managers learn about the cost of standardization to their business units – the lost value of local adaptation to the needs of the individual market.

Furthermore, managers need to be motivated to carry out their activities, so compensation must be linked to performance.[5] Since managers are risk-averse, this is best achieved by making incentives narrowly targeted to the performance of their (functional or business) unit. However, and this is key, motivating managers in this way makes them care about their own output, thereby biasing decision-making away from joint objectives and making communication strategic. A functional manager who is given a stake in low-cost production will be biased in favor of standardization, while business-unit managers will be biased in favor of adaptation to local market conditions.

Integrating two business units and putting the manufacturing activities under the control of a functional manager then results in a trade-off between motivation and co-

nate Ads Signals Deeper Woes at AOL – Infighting Among Divisions Derails Key Merger Goal; Board Considers Shake-Up – Moment of Truth for Pittman." Wall Street Journal (July 18, 2002): A1.

[4] "The End of Citi's Financial Supermarket," Andy Kessler, Wall Street Journal, January 18, 2009

[5] We assume that only the task allocation is contractible. In contrast, the way the task is carried out (which includes the effort provided, and whether or not to limit local adaptation) can only be indirectly influenced through output incentives.

ordination. The benefit of integration is the ability to identify and realize synergies.[6] The costs of integration arise from the fact that, in addition to cost-reducing effort, the functional manager needs to be motivated to make value-increasing standardization decisions. First, to improve decision-making, the incentives of the functional manager must be broadened, so that the functional manager is also accountable for business-unit performance. This increases incentive costs by increasing risk-exposure for a given level of effort. Second, to economize on risk compensation, the organization mutes effort incentives. The optimal compensation structure then balances the cost of biased standardization decisions (worse coordination) and suboptimal effort (worse motivation), leading to an endogenous incentive conflict. At the optimum, the functional manager is biased towards his functional performance (cost minimization), and effort provision and decision-making alignment move in opposite directions as a response to changes in external variables. Variable pay may be higher relative to non-integration, even though effort provision is always lower.

In Section 3 we show that integration may be suboptimal if motivating managers is important. Intuitively, muting and broadening effort incentives becomes too costly and an integrated organization engages in excessive standardization. In contrast, integrating and centralizing an activity becomes more attractive when the performance measures of that activity are noisier (and even non-integrated organizations provide low-powered effort incentives) or the expected value of synergies increases (and standardization is likely to be optimal).

In Section 4, we enrich the analysis by introducing private information which creates scope for strategic communication. The need to induce credible communication sharpens the trade-off between coordination and incentives – when incentives are more narrowly targeted, credible communication becomes more difficult, as a business-unit manager may choose to misrepresent local market information to limit standardization. Thus providing effort incentives under integration has two costs – distorted decision-making and distorted (not credible) communication. Making communication possible requires softening business-unit manager effort incentives and giving him a stake in the

[6] For example, in order to take advantage of economies of scope, Daimler-Chysler's Commercial Vehicles Division created the Truck Product Creation organization in 2004, a unit responsible for centralized product development and purchasing across the various divisions while other functions remained at a local level. "The second cornerstone of [our strategy for Commercial Vehicles] consists of deriving appropriate cost advantages from the large volumes that DaimlerChrysler realizes as the world's leading producer of commercial vehicles. The core of this strategy is to use as many identical parts and shared components as possible, and to use existing vehicle concepts for the maximum possible production volumes while protecting the identity of our brands and products." 2004 Management Report:, http://www.daimlerchrysler.com/Projects/c2c/channel/documents/629779_management_report.pdf

standardization decision. This implies that non-integration becomes more attractive than when communication is non-strategic.

Section 5 explores when a decentralized structure may be optimal, in which business-unit managers – rather than the functional manager – control standardization decisions, effectively giving each of them veto power over standardization. On the one hand, business-unit control is a safe-guard against excessive standardization, and thus removes the need to mute and broaden the incentives of the functional manager. On the other hand, business-unit control is ineffective at realizing win-lose synergies where standardization is value-increasing, but reduces the revenues of one of the business units. It is only effective at implementing win-win synergies, where both business-units face low adaptation costs.

The resulting trade-off between business-unit control and functional control is qualitatively similar to the one between non-integration and integration (with functional control). When effort incentives are not too important or business-unit performance measures are not too noisy, the organization prefers to make standardization decisions which fully reflect the associated cost savings and revenue losses. This is done most efficiently by having functional control over standardization, and providing the functional manager with broad but low-powered incentives. In contrast, if incentive alignment is costly, for example because motivation is important, business-unit control may be optimal. Managers are then provided with high-powered, narrow incentives, and standardization only occurs if both business-units face low adaptation costs, regardless of the associated cost savings. We further show that business-unit control is more attractive if either the correlation or the variance in adaptation costs is higher, as win-lose synergies then matter less.

Our paper is the first to model the endogenous conflict between functional and business-unit managers which arises as organizations try to capture synergies. Previous models of organizational decision-making generally treat managerial biases as exogenous (Hart and Moore (2005), Hart and Holmstrom (forthcoming), Alonso, Dessein, Matouschek (2008), Rantakari (2008)); our model allows decision-making biases to be the outcome of a trade-off between effort incentives, coordination or decision making incentives, and risk.[7] Athey and Roberts (2001) are the only precedent to

[7] A related strand of literature, under the broad heading of team theory (Marshack and Radner, 1972), studies coordination problems absent incentive issues. For example, Cremer (1980), Genakoplos and Milgrom (1991) and Vayanos (2002) study the optimal grouping of subunits into units in the presence of interdependencies; Harris and Raviv (2002) study the organizational structure that best appropriates synergies when managers are expensive; Qian, Roland and Xu (2006) study how the grouping of units (M-form versus U-form) affects how organizations coordinate changes; Dessein and Santos (2006) study the trade-off between ex ante coordination, through rules, and ex post coordina-

our work in this respect, as they also focus on the conflict between high-powered incentives to induce effort and biased decision-making.[8] However, task allocation and decision-making authority are endogenous in our framework and exogenous in theirs. These features, together with the more tractable framework we develop, distinguish our paper from theirs and also allow us to generate new empirical implications.[9]

Specifically, we obtain new testable implications concerning centralization and mergers and the design of incentives in multidivisional organizations. For example, consider a company that is undertaking a merger. Which activities should it centralize? Trivially, it is optimal to centralize activities with high synergy potential. Less obviously, it should centralize activities whose output is hard to measure or for which it is difficult to provide high-powered incentives for, such as R&D or HR. In activities such as these, the loss from lower-powered incentives will be less important. For the same reasons, we expect a merger to be more likely to fail if the two firms had high-powered incentives pre-merger and if the desired synergies come from many small distinct decisions, rather than one big source. When synergies come from many separate decisions, contingent decision-making is more important, so incentives must be more muted. In multidivisional organizations, we expect functional managers to be motivated with broad, but lower-powered incentives and business-unit managers with targeted but higher-powered incentives. Section 6, which sums up our paper, provides more discussion on the testable predictions of our model.

tion, through communication; Cremer, Garicano and Prat (2007) study the limits to firm scope due to the loss of specificity in organizational languages as firm scope grows. A polar approach is taken by Maskin, Qian and Xu (2000) who abstract from any coordination problems, and study the optimal grouping of tasks (M-form versus U-form) purely based on incentive and measurability considerations. Outside of economics an old literature (e.g. Chandler's 1962 and and Lawrence and Lorsch's 1967) studies coordination and integration mechanisms in organizations.

[8] If incentives are endogenous one may expect that low-powered incentives may be optimal, as the multitasking literature (Holmstrom and Milgrom (1991, 1994), Holmstrom (1999)) has shown in a reduced-form setting. This literature however is not explicit about the coordination issue underlying the multiple tasks, and thus cannot illuminate how the allocation of authority and of tasks to (functional and business-unit) managers interact with the need to provide low-powered incentives. Endogenizing the trade-off between capturing synergies and preserving adaptation, we give specific content to the broad multitasking intuition on the motivation-coordination trade-off and show that the power of incentives vary with integration decisions and the allocation of authority over standardization decisions.

[9] Note also Friebel and Raith (forthcoming), written after we concluded a first draft of this paper, who studies the interaction between incentives for effort and the incentives to accurately communicate information needed for coordination. Also Van den Steen (2006) analyzes a trade-off between effort and coordination, but in a set-up where agents are exogenously biased because of differing priors.

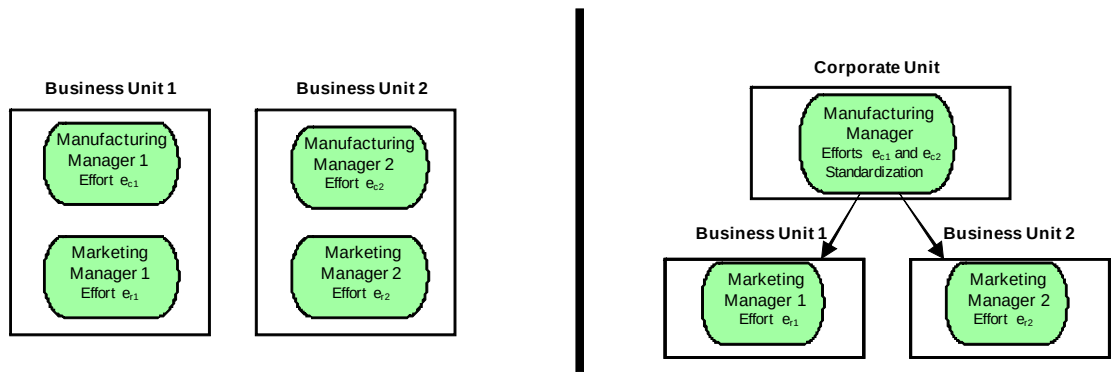

Figure 1: Non-Integrated structure Integrated structure

2 Model and Expected Profits

2.1 The model

Tasks and Organizational Structure: We model a company or organization that produces two goods; each one requires two tasks or activities. Potential benefits from standardization exist in one of the activities – say manufacturing; the other activity, say marketing, requires adaptation to local conditions, so standardization of these activities is never profitable. We consider two task allocations or organizational structures. Under *non-integration*, each of these four tasks are allocated to a different manager: there are two marketing managers and two manfucturing managers. Under *integration*, there are only three managers as the manufacturing activities are integrated and allocated to a single company-wide functional manager. In any organizational structure, the marketing activity requires a dedicated business-unit level manager, say, because of the need for specialized market knowledge. All managers are risk-averse with CARA utility and have a reservation wage of 0.

Costs, Revenues and Standardization. Production generates four value streams: two cost streams (generated by the manufacturing activities) and two revenue streams (generated by the marketing activities). The costs to produce each product $i = 1, 2$ depend on the effort e_{ci} of the manager who is allocated the manufacturing activity of good i. The privately-incurred cost of effort level e equals $e^2/2$. In addition, under an integrated structure, the manager in charge of both manufacturing activities may standardize his activities in order to further reduce costs. Under standardization, the organization saves costs k on these activities, where k is a random variable drawn from a uniform distribution $k \backsim U[0, K]$. No cost savings can be achieved if the two

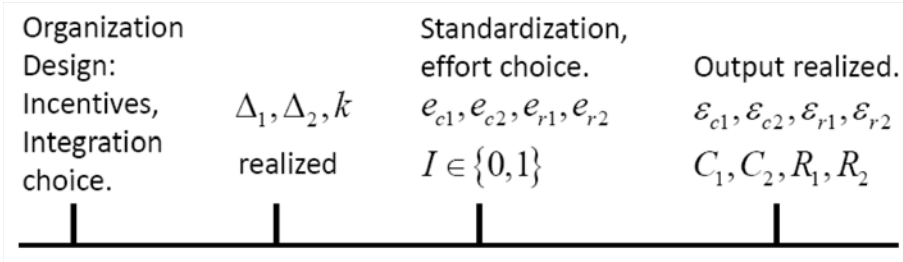

Figure 2: Timeline

manufacturing efforts are undertaken by different managers. The total costs of product i are

$$C_i = \mathbb{C} - ve_{ci} - \frac{k}{2}I + \varepsilon_{ci}, \tag{1}$$

where ε_{ci} is an i.i.d. shock to the costs, $\varepsilon_{ci} \sim N(0, \sigma_c^2)$, v is the marginal product of effort and

$$I = \begin{cases} 0 & \text{under non-integration;} \\ 0 & \text{under integration and no standardization;} \\ 1 & \text{under integration and standardization.} \end{cases}$$

The revenues of each product i depend on the effort e_{ri} of the manager who is allocated the marketing activity of good i. As in manufacturing, the marginal (and average) product of effort is v, the privately-incurred cost of effort e equals $e^2/2$. Standardization not only reduces costs, it also results in revenue losses. These revenue losses are the costs of not being adapted to the local environment, that is of producing a good that is not ideal for local market conditions. Adaptation costs are high, $\Delta_i = \Delta_H$ with probability p and low $\Delta_i = \Delta_L \in [0, \Delta_H]$ with probability $(1-p)$, where Δ_1 and Δ_2 are drawn independently.[10] Total revenues of product i are

$$R_i = ve_{ri} - \Delta_i I + \varepsilon_{ri}, \tag{2}$$

for $i = 1, 2$, where ε_{ri} is an i.i.d. shock to the revenues, $\varepsilon_{ri} \backsim N(0, \sigma_r^2)$.

Synergies are positive whenever $k - (\Delta_1 + \Delta_2) > 0$. We assume that $2\Delta_H < K$ so that it is sometimes optimal to standardize ex post regardless of realization of Δ_1 and Δ_2. This assumption reduces the number of cases to consider, thereby simplifying the analysis without affecting the results. While the first-best standardization decision

[10] The binary distribution for Δ_i makes the analysis of strategic communication, in section 4, and of business-unit control, in section 5, tractable. But our results in section 3, the core of the paper, do not depend on it.

is contingent on the realization of Δ_1, Δ_2 and k, we assume that managers learn this information only after the organization is set-up and the integration decision is made. In section 3 and 5, Δ_1, Δ_2 and k are observable to all managers. Section 4 analyzes private information and strategic communication.

Contracts: Whether or not an activity generates a positive or negative value stream is not important for our analysis. The key feature is that output from each activity is observable and contractible, while effort choices, standardization choices and output shocks are not.[11] Unverifiable effort leads the firm to tie wages to output. As is common in this literature, we restrict incentive contracts to be linear in costs and revenues.[12] We also ignore the impact that uncertainty over k and Δ_i has on the risk-averse manager's utility.[13] As shown in Appendix B, this assumption not only simplifies the analysis but can be endogenized by assuming that there are an infinite number of small, independent standardization choices rather than one big standardization decision.

2.2 Discussion of modeling choices

Organizational Structure An organizational structure, in this paper, corresponds to a particular task allocation or division of labor. If there were no returns to specialization – and all four tasks could be allocated to one and the same agent– the only agency problem in the firm would be to motivate the agent to exert effort. Indeed, one can show that standardization decisions would be first-best.[14] Organizations, however, exist to coordinate specialized activities and exploit the gains of division of labor. The key assumption we make is that there exists one activity – labeled marketing – in which there are substantial returns to specialization. As a result, the two marketing activities are optimally carried out by a different manager allowing the latter, for example, to gain specialized market and product knowledge or build specialized customer relationships. No such returns to specialization exist in the other activity, labeled manufacturing. In fact, manufacturing is characterized by economies of scope: by integrating the two manufacturing activities and assigning it them to a single manager, that manager can identify opportunities to save costs by sharing inputs, consolidating production, or

[11] See section 2.2 for a discussion of our contractibility assumptions.

[12] See, for example, Athey and Roberts (2001), Prendergast (2002) and Raith (2008).

[13] Standardization of manufacturing results in additional noise in both revenue and cost streams, which is absent under non-integration. While this makes output more risky under integration, this feature is not very interesting and model dependent.

[14] Since effort is equally productive in manufacturing as in marketing, and output measures are equally noisy, the agent is then given an equal share in cost and revenues. The agent therefore optimally trades off the cost savings and revenue losses associated with standardization.

standardizing packaging. In the absence of such economies of scope, the raison d'etre for integration disappears. Taken together, and subject to the constraint that a single manager can be in charge of at most two activities, this yields three possible organizational structures: (i) a non-integrated structure with one manager for each activity, (ii) a non-integrated structure with one manager in charge of all product 1 activities and one manager in charge all product 2 activities, iii) an integrated structure with two business-unit level marketing managers and one company-wide manufacturing manager. As there are no synergies between marketing and manufacturing and managers have a reservation wage equal to 0, structure (ii) is equivalent to structure (i) in our model.

Timing: Our timing aims to capture that the organizational design decision has a level of permanence – organizations cannot be changed with every decision that must be taken. Thus we assume that first the organizational design decision is taken (including who is allocated what task and on what basis they are rewarded) and only then managers learn the benefits of standardization and local adaptation on some particular decision. That is, the organization designer only knows the probability distribution of future synergies, not their realization, and chooses a structure that shapes how decisions to standardize are made once managers learn the specific costs and benefits.

Contractibility assumptions: Non-verifiability of effort is a standard assumption, non-verifiability of standardization merits further discussion. We use the word standardization as shorthand for the myriad of tasks that must be undertaken to capture synergies. For an outsider, it is impossible to tell whether two widgets are customized in a meaningful way (hence, allowing the business-unit managers to benefit from local adaptation) or only in appearance. In other words, a judge will always observe that products are in fact different without knowing the extent to which their designs or production processes have been harmonized to produce cost savings.[15] Second, we have in mind that a common manufacturing manager periodically makes choices which trade off adaptation and standardization. These specific choices are surely hard to anticipate, so contracting on standardization will be infeasible. The organization is thus a governance structure which manages standardization decisions ex post.[16]

[15] Formally, we assume that the functional manager exerts two types of non-contractible efforts, $e_{ci} \in \mathbb{R}$ and $e_s \in \{0, 1\}$, both of whom reduce costs C_i, respectively by ve_{ci} and $ke_s/2$. The only fundamental difference between the two efforts is that the cost of e_{ci}, namely $e_{ci}^2/2$, is privately incurred by the functional manager, whereas the cost of e_s, namely $(\Delta_1 + \Delta_2)\, e_s^2/2$, comes in form of reduced revenues for business units 1 and 2. As a result, a functional manager which is mainly rewarded on cost-reductions tends to underprovide e_{ci} but overprovide e_s.

[16] Other papers which emphasize the importance of organizations as governance structures when

2.3 Effort choices and expected profits

Managers are risk averse with CARA utility, so they maximize a linear combination of expected income and its variance. The organization can set positive or negative fixed payments to keep managers' utility at their individual rationality constraint, so we can focus entirely on the surplus-maximizing shares of costs and revenues.

Under Non-Integration, there are four managers, who respectively choose efforts e_{c1}, e_{c2}, e_{r1} and e_{r2}. The Manufacturing manager of good i is given a share α in C_i as incentives, the Marketing manager of good i is given a share β in R_i as incentives. Given that the privately-incurred cost of effort equals $e^2/2$ for effort e, this yields $e_{ci} = v\alpha$ and $e_{ri} = v\beta$. Normalizing the reservation utilities of managers to 0, expected profits under non-integration can be written as

$$\pi^{NI} = \sum_{i=1,2} \left(E[R_i - C_i] - \frac{1}{2}e_{ci}^2 - \frac{1}{2}e_{ri}^2 - \frac{1}{2}r(\sigma_c\alpha)^2 - \frac{1}{2}r(\sigma_r\beta)^2 \right),$$

where r is the coefficient of absolute risk aversion. Setting $r = 1$ and substituting optimized efforts, this yields

$$\pi^{NI} = v^2\alpha(2-\alpha) + v^2\beta(2-\beta) - (\sigma_c\alpha)^2 - (\sigma_r\beta)^2 \tag{3}$$

Under Integration, there are two business-unit level marketing managers but only one company-wide manufacturing manager, who chooses both e_{c1} and e_{c2}, and is given a share α in the cost savings of his own activities, C_i, $i = 1, 2$ as incentives. There is no benefit, but there is a cost, from giving a risk-averse manager a share in the risky output from decisions he does not affect. Marketing manager $i's$ contract therefore only consists of a share β in the revenues of his own activity, R_i and a fixed (positive or negative) payment which we can ignore. Exactly as under non-integration, this yields efforts $e_{ci} = v\alpha$ and $e_{ri} = v\beta$. Finally, the organization must give the manufacturing manager incentives for making efficient standardization decisions. In addition to a share α in cost savings, it may thus also be optimal to give him a share γ in the revenue streams. We analyze the standardization decision below. Normalizing the reservation utilities of managers to 0, expected profits under integration can then be written as

$$\pi^{I} = \sum_{i} \left(E[R_i - C_i] - \frac{1}{2}e_{ci}^2 - \frac{1}{2}e_{ri}^2 - \frac{1}{2}(\sigma_c\alpha)^2 - \frac{1}{2}(\sigma_r\beta)^2 - \frac{1}{2}(\sigma_r\gamma)^2 \right), \tag{4}$$

actions are ex post non-contractible are Aghion, Dewatripont and Rey (2004), Hart and Moore (2006), Hart and Holmstrom (forthcoming), and Baker, Gibbons and Murphy (2006).

or substituting optimized efforts,

$$\begin{aligned} \pi^I &= E[(k-\Delta_1-\Delta_2)|I=1]\times \Pr[I=1]+ && (5)\\ & v^2\alpha(2-\alpha)+v^2\beta(2-\beta)-(\sigma_c\alpha)^2-(\sigma_r\beta)^2-(\sigma_r\gamma)^2. && (6)\end{aligned}$$

Profits under integration differ from profits under non-integration on two dimensions. First, there is the standardization component of profits, line (5) in π^I which is missing in π^{NI}. Under integration, the organization may realize some gains of standardization and some adaptation losses which are both absent under non-integration. Second, there is the effort component of profits, line (6) under integration and the full profit expression (3) under non-integration. Note that the number of agents (four under non-integration, three under integration) has no direct effect on profits. The only difference between (6) and (3) is that there is an extra share γ (as the manufacturing manager may get a share of the revenues even though they are under the marketing managers' control), but that is a choice; the designer could choose to set that share at $\gamma = 0$. In other words, only the total amount of effort involved matters, rather than who undertakes it.[17] The objective function of the designer is to set up the organizational structure and incentives to maximize these profits.

2.4 Non-integration benchmark

Under non-integration, the strength of incentives α and β reflect the classic trade-off between risk and incentives. In particular, the designer maximizes

$$\max_{\alpha,\beta}\pi^{NI} = v^2\alpha(2-\alpha)+v^2\beta(2-\beta)-(\sigma_c\alpha)^2-(\sigma_r\beta)^2-(\sigma_r\gamma)^2,$$

yielding

$$\alpha=\alpha^{**}\equiv\frac{v^2}{v^2+\sigma_c^2} \qquad \text{and} \qquad \beta=\beta^{**}=\frac{v^2}{v^2+\sigma_r^2}.$$

We will refer to $e_{ci}^{**}=v\alpha^{**}$ and $e_{ri}^{**}=v\beta^{**}$ as the second-best effort levels, and to α^{**} and β^{**} as the second-best cost and revenue shares under non-integration.

[17] In particular, this means that, holding effort fixed, profits are the same under integration without implementing standardization and non-integration. There are no losses in local adaptation from shifting control, just from implementing standardization. If employing a functional manager increases wage costs, our results are unchanged, since it would result in a fixed reduction of integration profits.

3 The Integrated Organizational Structure

In this section, we analyze the structure where both manufacturing activities are integrated and assigned to a single company-wide functional manager. This functional manager then can identify potential cost savings from standardization and has the authority to implement them. The marketing activities for each product, in contrast, are non-integrated and are assigned to a business-unit manager. This allows each business-unit manager to gain the required product or market-specific knowledge necessary to carry out his tasks.

3.1 Effort and cooperation incentives

Efficiency requires that the standardization decision is contingent on the cost savings of standardization k, and the revenue losses due to lost adaptation, Δ_1 and Δ_2. In this section, we assume that k, Δ_1 and Δ_2 are observable to all managers. In section 4, we study the impact of private information, where only business-unit manager i observes Δ_i and only the functional manager observes k, and managers communicate this information strategically.

Recall that the manufacturing manager obtains a share α of the cost savings from standardization, and suffers a share γ of the revenue losses for each product. In choosing effort e_{c1} and e_{c2} and deciding whether or not to standardize, he then maximizes:

$$\sum_i \left(\gamma E[R_i] - \alpha E[C_i] - \frac{1}{2}e_{ci}^2\right) = \sum_i \left(\gamma\left(ve_{ri} - \Delta_i I\right) - \alpha(\mathbb{C} - ve_{ci} - \frac{k}{2}I) - \frac{1}{2}e_{ci}^2\right). \tag{7}$$

Hence, the manufacturing manager chooses efforts $e_{ci} = v\alpha$, $i = 1, 2$, and standardizes if $\alpha k - \gamma(\Delta_1 + \Delta_2) > 0$. This condition determines a decision rule with three cutoff points, k_{LL}, k_{LH} and k_{HH}, with

$$k_{ij} = \frac{\gamma}{\alpha}\left(\Delta_i + \Delta_j\right) \qquad i, j \in \{L, H\}. \tag{8}$$

If adaptation costs are Δ_i and Δ_j, standardization takes place if $k > k_{ij}$. Note that the first best standardization cut-off is $k_{ij}^{fb} = (\Delta_i + \Delta_j)$. Thus the extent to which we have too much or too little standardization depends on whether $\gamma/\alpha \gtrless 1$. We define

$$A \equiv \frac{\gamma}{\alpha}, \tag{9}$$

which is a measure of incentive alignment. If:

- $A = 0$ the manufacturing manager cares only about cost savings and always standardizes;
- $0 < A < 1$, $k_{ij} < k_{ij}^{fb}$, the manufacturing manager standardizes too often;
- $A = 1$ the standardization decision is first-best.

Standardization decisions that are sensitive to the size of cost savings relative to the benefits of adaptation require some alignment of incentives, $A > 0$. Narrowly-focused incentives are thus an obstacle to the organization's ability to implement trade-offs between standardization and adaptation. This problem is mitigated only if the manufacturing manager's compensation depends on business-unit revenues, thereby making him bear some of the costs of lost adaptation from standardization. A manufacturing manager that shares in revenues from the local adaptation will give up on standardization (when k is low) and allow local adaptation by the business-unit managers. However, this increases the risk the functional manager bears.

The incentive design problem of the organization can be written as an optimization over incentive alignment, $A = \gamma/\alpha$, and output incentives α:[18] $\max_{A,\alpha} \pi =$

$$\frac{(1-p)^2}{K}\int_{k_{LL}}^{K}(k-2\Delta_L)dk + \frac{2p(1-p)}{K}\int_{k_{LH}}^{K}(k-\Delta_L-\Delta_H)\,dk + \frac{p^2}{K}\int_{k_{HH}}^{K}(k-2\Delta_H)\,dk$$
$$+\left[\alpha(2-\alpha)+\beta^{**}(2-\beta^{**})\right]v^2 - \left[(\alpha\sigma_c)^2+(\beta^{**}\sigma_r)^2+(\alpha A\sigma_r)^2\right]. \tag{10}$$

where the revenue share of the business-unit managers is set at its second-best level, β^{**} (the optimization over β is identical as in the non-integration benchmark above). Integrating over k and simplifying,

$$\begin{aligned}\max_{A,\alpha}\pi \;&=\; E[k-\Delta_1-\Delta_2] + A(2-A)\tfrac{1}{2K}E[(\Delta_1+\Delta_2)^2] + \\ &\quad \left[\alpha(2-\alpha)+\beta^{**}(2-\beta^{**})\right]v^2 - \left[(\alpha\sigma_c)^2+(\beta^{**}\sigma_r)^2+(\alpha A\sigma_r)^2\right]. \end{aligned}\tag{11}$$

The first-order conditions with respect to α and A yield

$$\pi_\alpha = 2(1-\alpha)v^2 - 2\alpha(\sigma_c^2+(A)^2\sigma_r^2) = 0, \tag{12}$$

and

$$\pi_A = \tfrac{1}{2K}E[(\Delta_1+\Delta_2)^2]2(1-A) - 2A(\alpha\sigma_r)^2 = 0. \tag{13}$$

[18] To simplify notation, we drop the superscript I in this section and write π for profits under integration.

First-order condition (12) yields a cost share α that is strictly below the second-best level α^{**} whenever the manufacturing manager is not completely biased ($A > 0$). Thus, in order to reduce decision-making distortions, effort incentives are muted in an integrated organization relative to the second-best level and less effort is produced, $e_{ci} < e_c^{**}$. Integrating and coordinating business-units thus comes at the expense of the motivation of managers.

First-order condition (13) implies that decision-making incentives are always partially aligned, that is $0 < A < 1$. The fact that $A < 1$ implies that the manufacturing manager is endogenously biased towards cost reduction. There is excessive standardization: the manufacturing manager sometimes standardizes even though expected synergies are negative. His share of business-unit revenues is not high enough to compensate him completely for foregoing standardization benefits. The fact that $A > 0$ implies that the manufacturing manager is partially rewarded on business-unit revenues in order to align his decision-making. This increases risk exposure for a given level of effort. In fact, it is easy to construct examples where the risk exposure under integration is higher than in the non-integration benchmark, even though actual effort provision is always lower under integration.

Proposition 1 *Incentive provision in the integrated structure is as follows:*

1. *Effort provision is below the second-best level provided under non-integration:* $e_{ci} < e_{ci}^{**}$ *and* $\alpha < \alpha^{**}$

2. *While the manufacturing manager is partially rewarded on business-unit revenues, that is* $\gamma > 0$, *he is biased towards cost reduction, that is* $A = \gamma/\alpha < 1$. *The manufacturing manager therefore engages in excessive standardization:*

3. *The power of cost-reducing incentives,* α, *and the alignment of the manufacturing manager* $A = \gamma/\alpha$ *move in opposite directions: Cost incentives* α *are increasing in value of effort* v, *the expected value of synergies* $K/2$, *and decreasing in noise in cost measures* σ_c^2 *and the local adaptation term* $E[(\Delta_1 + \Delta_2)^2]$. *Opposite comparative statics hold for* A.

Proof: Only the last point remains to be proven. Profits are supermodular in the endogenous variable α, $-A$ and the exogenous variable $t \in \left\{-\frac{\psi}{K}, v, 1/\sigma_c^2\right\}$ for $A \in [0,1]$ and $\alpha \in [0,1]$ where $\psi \equiv E[(\Delta_1 + \Delta_2)^2]$, yielding unambiguous comparative statics as stated in the proposition. **QED**

Previous models of organizational decision-making generally treat managerial biases as exogenous (Hart and Moore (2005), Alonso, Dessein, Matouschek (2008), Rantakari

(2008)); our model allows decision-making biases to be the endogenous outcome of a trade-off between effort incentives, decision-making/coordination incentives and risk. At the optimum, the organization then (1) biases the manufacturing manager towards his own functional performance, (2) mutes effort incentives (relative to the standard second-best risk-incentives trade-off) and, for a given level of effort, (3) loads some extra risk on the manufacturing manager by giving him a share in business-unit revenues and, hence, broadening his incentives. In equilibrium, decision-making incentives are always partially aligned, that is $0 < A < 1$ and effort incentives and decision-making alignment move in opposite directions as a response to changes in external variables.

3.2 The costs and benefits of an integrated structure

An organization can realize synergies by integrating a functional activity (labeled manufacturing) and by employing a company-wide functional manager to identify and implement these synergies. As we have shown, such a manager will be endogenously biased in favor of standardization. Typically, however, the expected value of a standardization decision (though not all standardization decisions) will be positive. In other words, the benefit of integration is that synergies may be captured. There are two costs. First, effort incentives on the integrated activities will be muted relative to non-integration in order to reduce decision-making distortions. Second, for the same reason, incentives must be broadened. This increases risk exposure for a given effort level. As we show next, a firm may therefore strictly prefer to forego any potential synergies and choose a non-integrated organization.

The following proposition provides comparative statics for when integrating a functional activity is more likely to be optimal. Naturally, integration is more likely to be optimal when cost-savings are larger and revenue losses smaller. More interestingly, the proposition relates integration with the incentive costs of realizing synergies in an integrated structure:

Proposition 2 *If $K < 2E[\Delta_1 + \Delta_2]$, there exist values of v, σ_c^2 and σ_r^2 such that non-integration is strictly preferred to integration. Integrating a functional activity is more likely to be optimal if:*[19]

- *Expected cost-savings from standardization are larger (K is larger)*
- *Adaptation cost parameters Δ_L, Δ_H and/or p are smaller.*

[19] That is, the following changes in exogenous variables may result in a shift from non-integration to integration, but never the other way around.

- *Motivating managers is less important* (v *is smaller);*
- *Functional cost measures are more noisy* (σ_c^2 *is larger*) *or business-unit revenue measures are less noisy* (σ_r^2 *is smaller).*

Proof. See Appendix.

Figure 3 illustrates the incentive costs of integration and the move towards non-integration when motivation becomes more important. When $v < v^*$ (the vertical line in the picture), integration is optimal, but effort incentives (solid line) are lower than those that would be provided in a non-integrated organization (dotted line). Still, because the functional manager is also partially rewarded on business-unit revenues, total variable compensation of the functional manager is actually larger than in the second-best benchmark (where incentives only trade-off risk and effort). Finally, there is excessive standardization as the functional manager is endogenously biased in favor of functional cost minimization. Indeed, his share in business-unit revenues (solid bold line) is between 1/2 and $3/5th$ of his share in his own functional unit, $1/2 < A < 3/5$. Since an increase in v increases the wedge between α and γ, his decision-making becomes increasingly distorted as motivation becomes more important. When $v > v^*$, the organization then optimally adopts a non-integrated structure which foregoes any synergies, but provides managers with high-powered incentives that are focused purely on their areas of responsibility (their task allocations).

One implication of Proposition 2 is that a merger between two firms may not increase value despite anticipated synergies, because the incentive costs from integration (the need to mute and broaden incentives) may exceed the benefits (implementing value-increasing standardization). Thus, there is a gap between the expected benefits from a first-best exploitation of synergies (ignoring incentive issues) and the change in surplus from a merger. This gap is an 'organizational discount' that should be incorporated in valuing a merger. The analysis in the propositions above provides some insights into the size of this organizational discount. First, the higher the synergies, the lower the 'organizational discount' that must be applied to a merger, all else constant. The reason is that, as positive synergies become sufficiently likely, contingent decision-making is less important and so are balanced incentives. For sufficiently high synergies, providing the functional manager with targeted incentives does not lead to much inefficient decision-making. Second, the organizational discount increases with the importance of incentives and integration decisions are less likely to be undertaken when effort incentives are important.

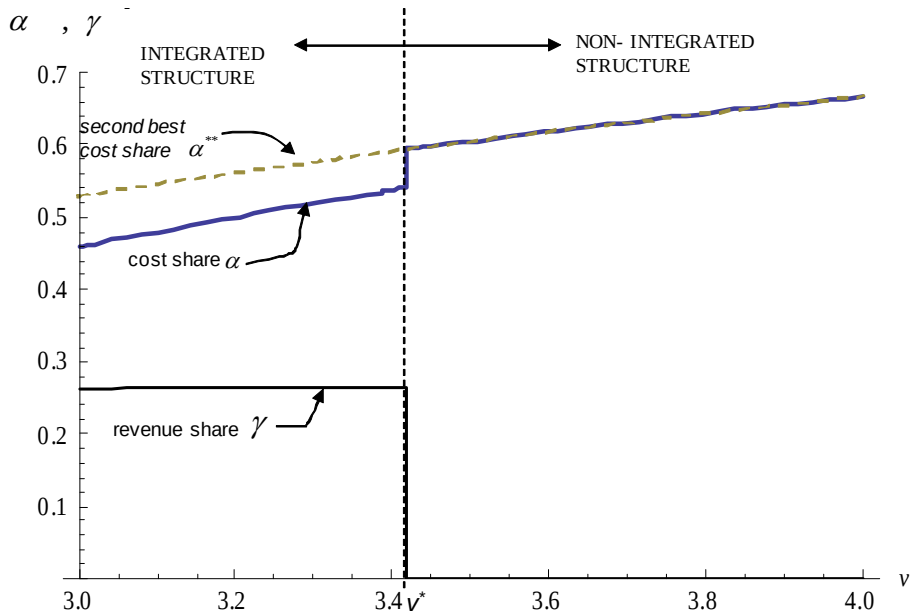

Figure 3: Non-integrated structure: Cost shares set at second-best level. Integrated structure: (i) Cost share of the functional manager set below the second-best level (muted effort provision). (ii) Functional manager is given substantial share in business-unit revenues (broadly targeted incentives).

4 Strategic Communication

We now enrich the analysis by introducing private information, where adaptation costs Δ_i are privately observed by business-unit manager i, and the cost-savings of standardization k are private information to the functional manager. To make this analysis tractable, we further set $p = 1/2$. We analyze how strategic communication, where managers can choose to truthfully report their realized adaptation costs, affect the integration and incentive choices. Our analysis shows that strategic communication sharpens the trade-offs in Section 3: the organization can choose to either give up on communication, in which case the organization can achieve a solution similar to the one we just studied, but with worse information (since messages cannot be trusted); or it induces business unit managers to communicate truthfully, which requires reducing their effort incentives while potentially increasing the risk premium that they need to receive. We also show that communication is induced when it is most valuable, that is when adaptation costs are most variable and large, so that decisions are in expectation highly contingent on information.

Whenever $\Delta_L > 0$, the need to induce truthtelling requires the business-unit manager to be given a stake $\zeta > 0$ in the cost savings C_i attained through standardization.

Consider first the case where the organization chooses not to induce communication, so that business unit managers cannot be trusted to report Δ truthfully (a pooling equilibrium).[20] In this case, business managers stakes are $\zeta = 0$ (there is no value to making these stakes positive, but there would be a risk-related cost of doing so). The functional manager must form an expectation over the value of adaptation, since he has no information. He will impose synergies whenever they are sufficiently high relative to that expectation. Then there exists a cutoff k^{nc} such that if $k < k^{nc}$, the functional manager does not standardize and the business-unit managers can adapt locally, while if the cost savings are high enough, $k > k^{nc}$, the functional manager standardizes. The cutoff k^{nc} is the value of cost savings at which the functional manager is indifferent between standardizing operations or not given the expected loss from adaptation, $\Delta_H + \Delta_L$.[21] Clearly, the problem is analogous to the one in with full information in Section 3, except with worse information – the excepted adaptation cost replaces the realized values.

Suppose instead that the organization chooses to provide business units with a stake in the synergy implementation, so that they are truthful. The business unit manager may misrepresent the actual adaptation cost to make standardization less likely. Figure 4 shows the value of truthtelling versus lying graphically. By lying, the manager shifts the implementation rule from either k_{LL}(the rule when the functional manager rightly believes both costs are low) to k_{LH} (the rule when he believes one manager is Δ_H) or from k_{LH} (the rule when the functional manager believes one manager is Δ_H) to k_{HH} (when the functional manager believes both are high Δ_H).

That is, the value of lying is in the increase in the value of k that the functional manager has to observe before he decides about implementing synergies.

Our first result (proven formally in the Appendix) is that strategic communication sharpens the trade-off between communication and incentives. To see this, it suffices to compare the solution of the problem with a communication constraint with the one that would obtain if the two business unit $\Delta_i's$ were observable. The optimization problem would be the same, except that now there is a communication constraint. Trivially (since this constraint is strictly binding) the problem where the $\Delta_i's$ are observable always yields higher profits than the constrained one; moreover, it is easy to check that the problem with communication yields point by point (for all A, α, β and ζ) higher profits than the one where the organization gives up on communication. The reason is that all the expressions are identical, except for the better quality of decision making

[20] For a formal discussion of what follows, please see the Appendix.

[21] That is, k^{nc} solves $\alpha k - 2\gamma(\Delta_H + \Delta_L)/2 = 0$, which implies $k^{nc} = \frac{\gamma}{\alpha}(\Delta_H + \Delta_L) = A(\Delta_H + \Delta_L)$.

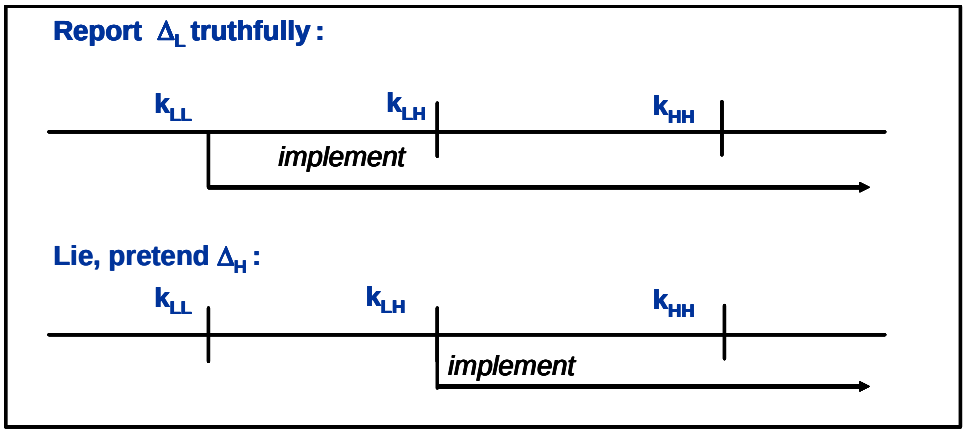

Figure 4: Communication choice of a business unit manager who draws Δ_L when the other manager draws Δ_L. By lying, the manager shifts upwards the threshold value of the standardization savings k.

under communication (since there is better information). Since strategic communication plays no role under non-integration, but lowers expected profits under integration, the following result holds.

Proposition 3 *Strategic communication makes integration less attractive, compared to a situation where business-unit managers cannot hide their information. If the integrated organization chooses to induce communication, then the incentive choice is constrained; if it does not, decision-making deteriorates.*

Truthful communication is costly in terms of incentives, as it requires distorting the incentives of the business-unit managers to induce truth-telling. On the other hand, it results in better decision-making, as the standardization decision is taken conditionally on the realized adaptation costs. Intuitively, making the business-unit manager willing to be truthful requires balancing his incentives, by giving him a stake in both business-unit revenues (in order to induce effort) and cost savings from standardization (in order to align objectives). Organizations must choose between strong effort incentives with little information flow between units or weaker effort incentives with better communication.

The following proposition establishes that as the average size of the synergies K increases, as the importance of effort v increases, and as the variance of adaptation costs decreases, inducing communication becomes less attractive to the organization.

Proposition 4 *Consider a set of parameters $\Delta_i, k, v, \sigma_r^2, \sigma_c^2$ such that the organization is indifferent between inducing or not communication in the business-unit managers. Then:*

1. *An increase in the value of synergies, K or in the value of incentives, v, leads to no communication; a decrease in either makes communication preferred.*
2. *A mean-preserving spread in Δ makes communication preferred.*
3. *The move from no communication to communication is accompanied by a discrete drop in effort incentives α, β, and a decrease in decision-making alignment A.*

Proof. See Appendix.

Finally, it remains to consider the integration versus non-integration decision. Similar results to the ones in Proposition 2 hold. That is, as then, and for the same reasons, the non-integration threshold is lower (non-integration will be more likely to be preferred) if motivating managers is more important (v is larger) and if expected synergies are smaller.

Proposition 5 *If $K/2 < \Delta_L + \Delta_H$, there exist values of v, σ_c^2 and σ_r^2 such that non-integration is strictly preferred to integration. Integrating a functional activity is more likely to be optimal if:*

- *Expected cost-savings from standardization are larger (K is larger)*
- *Expected adaptation costs, $\Delta_H + \Delta_L$, are smaller, keeping $\Delta_H - \Delta_L$ constant.*
- *Motivating managers is more important (v is larger).*

Proof. See Appendix.

We can summarize our analysis of this extension as follows. First, the results of our analysis in Section 3 become sharper, as communication brings about a new reason to soften managerial incentives, now for both functional and business-unit managers (rather than only functional managers). Second, we have obtained some new results concerning when an organization will choose to forego communication from business-unit managers and implement a coarser form of control, in which local managers have strong effort incentives, the information from these local managers is not credible, and functional managers take standardization decisions without information from the business units.

5 Functional Control versus Business-unit Control

In Section 3, we posited that in the integrated structure, the functional manager in charge of manufacturing has unfettered control over standardization decisions. For certain activities, however, it may be possible to allocate the implementation of standardization decisions to the business-unit managers, effectively giving them veto power over standardization. In this section, we explore when such a decentralized approach to realizing synergies may be optimal.

To illustrate the differences between functional control and business-unit control, suppose opportunities for economies of scope do not arise in manufacturing but do arise in purchasing. Realizing synergies in purchasing still requires a company-wide purchasing manager, whose role is to identify standardization opportunities. However, the company has the option to keep sufficient purchasing activities in the business units, so that each business-unit manager can refuse to cooperate with the purchasing manager's suggestions for standardization and effectively veto the initiative.[22] Conditional on the purchasing activities being integrated, two organizational structures are then possible:

- *Integrated structure with functional control:* Purchasing is consolidated, and assigned to a purchasing manager. All decisions regarding purchasing, including choices regarding standardization in supplier choice, products sourced, terms offered to suppliers, quality standards, etc. are then inalienable from this functional manager. Standardization in purchasing has the same (independently realized) costs and benefits as in manufacturing, and are subject to the same asymmetric information.

- *Integrated structure with business-unit control:* While key elements of the Purchasing function are consolidated and assigned to a purchasing manager, each business-unit manager retains an individual purchasing department responsible for implementation of purchasing policies. By refusing to implement the purchasing manager's suggestions, business-unit managers can then block any undesired standardization initiative.

[22] Thus, the key difference between Manufacturing and Purchasing is that we assume that realizing economies of scope in Manufacturing requires taking away authority from the business units, while we assume this is not the case for purchasing decisions.

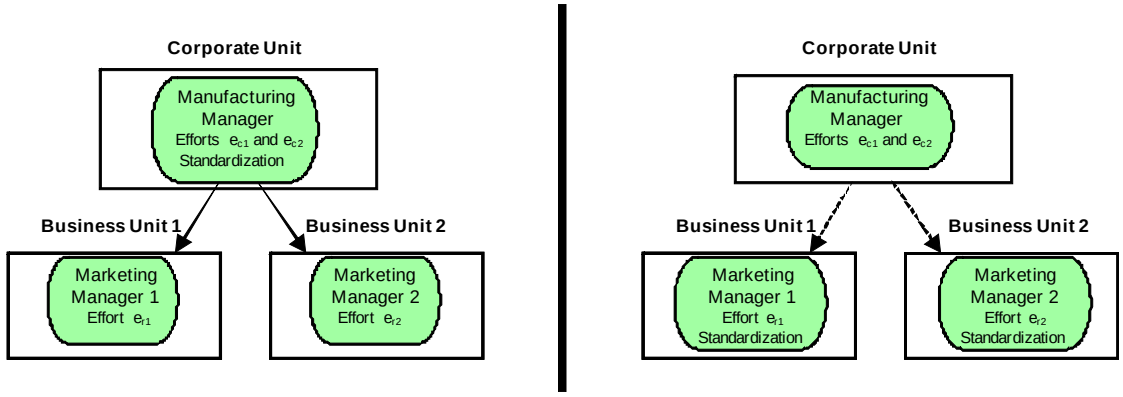

Figure 5: Integration– Functional Control Integration– Business Unit Control

5.1 Analysis

We need to modify the extensive form of the game slightly in order to analyze business-unit control. The functional manager (in charge of the integrated functional activity) still exerts the cost-reducing efforts for each product, but control over the decision to standardize is now with the business-unit level managers accountable for the revenues (see figure 5). We therefore add a second stage in which each business-unit manager decides whether or not to block standardization. The preceding stages are as before. First, the managers learn about the costs and benefits of the particular standardization opportunity. Second, the functional manager decides if he wants to standardize. If he does, each business-unit manager then decides whether or not to block standardization. Note that it may now also be optimal to give the business-unit managers a stake in cost savings in order to increase cooperation in standardization initiatives by the functional manager.

We make two additional assumptions. To simplify the analysis, we assume that $\Delta_i \in \{0, \Delta\}$. Under functional control, a business-unit manager with $\Delta_i = 0$ is then willing to reveal his type to the functional manager, even if he is only rewarded on business-unit revenues.[23] Under business-unit control, this same manager is willing to rubberstamp a standardization proposal by the functional manager.[24] For expositional ease, we also assume that k is observable to both business-unit managers. As we show, however, business-unit decision-making will be independent of k at the optimum.

We will show that the incentive costs (that is, the need to mute and broaden in-

[23] That is, the communication constraint discussed in section 3 is always slack: informative cheap talk is always an equilibrium.

[24] If $\Delta_L > 0$, both credible communication and rubberstamping (under business-unit control) requires giving a low-type business-unit manager a stake in the cost-savings from standardization.

centives) of implementing win-lose synergies – where one business unit suffers from standardization ($\Delta > 0$) and the other not ($\Delta = 0$) – are high unless the functional manager has control. In contrast, implementing only win-win synergies – where none of the business units suffer from adaptation costs ($\Delta_1 = \Delta_2 = 0$) – can be achieved at no incentive costs. As a result, when effort incentives are not important, it is desirable to implement win-lose synergies and, as we show, functional control is preferred. As effort incentives become more important, however, it may be optimal to decentralize control to the business-unit level and standardize only if both business-unit managers face no adaptation costs and are willing to go along with standardization. This allows the organization to provide managers with narrowly-targeted incentives (hence reducing manager's risk exposure), and may generate more surplus than simply letting the functional manager impose standardization unilaterally.

Implementing synergies under business-unit control Let α and γ be the shares the functional manager receives in respectively costs and revenues of product i, $i = 1, 2$, and ζ and β the shares that each business-unit manager receives in respectively cost and revenues of product i. We further allow business unit manager i, $i = 1, 2$, to get a share β^- in the revenues of business unit $j \neq i$.[25] Given shares α, γ, β, β^- and ζ, the functional manager initiates standardization if and only if

$$\alpha k > \gamma(\Delta_1 + \Delta_2)$$

and business-unit manager i cooperates with such a standardization initiative if and only if

$$\zeta k/2 > \beta\Delta_i + \beta^-\Delta_j$$

If both managers face low adaptation costs ($\Delta_1 = \Delta_2 = 0$), standardization is always implemented. If only one business unit faces low adaptation costs, standardization is implemented if and only if

$$k > k_{LH} = \max\{2\beta\Delta/\zeta, \gamma\Delta/\alpha\}$$

If both business-unit managers face high adaptation costs ($\Delta_1 = \Delta_2 = \Delta$), standardization is implemented if and only if

$$k > k_{HH} = \max\left\{2(\beta + \beta^-)\Delta/\zeta, 2\gamma\Delta/\alpha\right\}$$

[25] As in the previous section, we restrict attention to symmetric organizations.

Let α^*, γ^*, β^*, $\beta^{-\,*}$ and ζ^* be the profit maximizing shares under business-unit control. We distinguish two cases:

1) Only win-win synergies: If $2\beta^*\Delta/\zeta^* \geq K$, then standardization is implemented only if both managers face low adaptation costs. Profits are given by

$$\begin{aligned}\pi &= (1-p)^2K/2 \\ &\quad +v^2\alpha(2-\alpha)+v^2\beta(2-\beta)-(\alpha^2+\zeta^2)\sigma_c^2-\left(\gamma^2+\beta^2+\beta^{-2}\right)\sigma_r^2\end{aligned}$$

Optimization yields $\alpha^* = \alpha^{**}$, $\beta^* = \beta^{**}$ and $\zeta^* = \gamma^* = \beta^{-\,*} = 0$. We refer to this corner-solution as business-unit control with "win-win" synergies.

2) Business-unit control with win-lose synergies: If $2\beta^*\Delta/\zeta^* < K$, then $k_{LH} < K$ at the optimum (otherwise $\zeta^* > 0$ cannot be optimal) and, hence, sometimes standardization is implemented even though only one manager faces low adaptation costs. We refer to such standardization as "win-lose" synergies. Expected profits are then given by

$$\begin{aligned}\pi &= (1-p)^2K/2+\frac{2p(1-p)}{K}\int_{k_{LH}}^{K}(k-\Delta)\,dk+p^2\int_{k_{HH}}^{K}(k-2\Delta)\,dk \\ &\quad +v^2\alpha(2-\alpha)+v^2\beta(2-\beta)-(\alpha^2+\zeta^2)\sigma_c^2-\left(\gamma^2+\beta^2+\beta^{-2}\right)\sigma_r^2 \qquad (14)\end{aligned}$$

In what follows, we will limit attention to the case where $\sigma_c^2 \geq \sigma_r^2-\varepsilon$, with $\varepsilon > 0$ but small. In other words, costs/functional performance measures are at least comparable in terms of noise to revenues/business-unit performance measures. Under this condition, we show that business-unit control with "win-lose" synergies is always dominated by functional control.

Proposition 6 *If $\sigma_c^2 \geq \sigma_r^2-\varepsilon$ with $\varepsilon > 0$ but small, functional control dominates business-unit control with win-lose synergies..*

Proof: See Appendix.

The intuition for the above result is that business-unit control typically applies the same threshold for the implementation of "win-lose" standardization (where only one unit has high adaptation costs) as for the implementation of "lose-lose" standardization (where both units face high adaptation costs). Indeed, if $\gamma = \beta^- = 0$ (which is often satisfied at the optimum) then $k_{LH} = k_{HH}$. In contrast, under functional control, $k_{HH} = 2k_{LH}$. Functional control is therefore more effective at implementing win-lose standardization.

By imposing $\sigma_c^2 \geq \sigma_r^2 - \varepsilon$, we created a level-playing field between business-unit control and functional control, without restricting ourselves to the knife-edge case where $\sigma_c^2 = \sigma_r^2$. In contrast, if say, $\sigma_c^2 = 0$ and $\sigma_r^2 >> 0$, then, trivially, business-unit control may be preferred over functional control. Indeed, business-unit managers then can be aligned with functional performance at no incentive cost, whereas aligning functional managers with overall performance is very expensive. Business-unit control then often results in better decision-making.

Business-unit control with win-win synergies. In what follows, we will maintain the assumption $\sigma_c^2 \geq \sigma_r^2 - \varepsilon$, with ε small. A direct consequence of proposition 6 is then that we can then restrict our analysis to organizations that set incentives so only business-unit managers with no standardization costs ($\Delta_i = 0$), cooperate. While many synergies go unrealized, this organizational structure has the advantage that both business-unit managers and the functional manager in charge of purchasing can be provided with narrowly-targeted and high-powered incentives that only trade off effort and risk exposure. In particular, the functional manager only receives a share α in cost savings and business-unit managers only receive a share β in business-unit revenues, where these shares are set at the second-best level, as in the non-integrated structure:

$$\alpha^{**} = \frac{v^2}{v^2 + \sigma_c^2}, \qquad \beta^{**} = \frac{v^2}{v^2 + \sigma_r^2}.$$

Standardization occurs with probability $(1-p)^2$, yielding expected synergies of $(1-p)^2 K/2$. Hence, expected profits under business-unit control with win-win synergies equal

$$\begin{aligned} \pi &= (1-p)^2 K/2 + v^2\alpha^{**}(2-\alpha^{**}) + v^2\beta^{**}(2-\beta^{**}) - \alpha^{**2}\sigma_c^2 - \beta^{**2}\sigma_r^2 \\ &= \pi^{NI} + (1-p)^2 K/2. \end{aligned}$$

where π^{NI} are the profits under non-integration.

Comparative Statics. Business-unit control with win-win synergies is always strictly preferred over non-integration.[26] The comparative statics of when business-unit control dominates functional control are very similar to those of when non-integration dominates functional control, the only difference is the impact of an increase in the variance in adaptation cost.

[26] Of course, this is because we have abstracted away from any costs from hiring a functional manager.

Proposition 7 *If* $(1-(1-p)^2)K < 2p\Delta$, *there exists values of* v, σ_c^2 *and* σ_r^2 *such that business-unit control is strictly preferred over functional control. Assume* $\sigma_c^2 \geq \sigma_r^2 - \varepsilon$ *with* $\varepsilon > 0$ *but small, then functional control is more likely to be optimal if:*[27]

- *Standardization is more valuable (*K *is larger)*
- *Average adaptation costs* $2p\Delta$ *are smaller;*
- *The variance in adaptation costs decreases, keeping average adaptation costs* $2p\Delta$ *constant.*
- *Motivating managers is less important (*v *is smaller);*
- *Functional performance measures are less precise (*σ_c^2 *is larger) or business-unit performance measures are more precise (*σ_r^2 *is smaller).*

Proof: See Appendix.

In Section 3, we showed that a mean-preserving spread in adaptation costs makes integration (through functional control) more attractive to non-integration as contingent decision-making is then more valuable. When the choice is between integration through functional control versus business-unit control, however, the above proposition shows that increasing the variance in adaptation costs favors business-unit control, hence making functional control less likely to be optimal.

Intuitively, unlike non-integration, business-unit control allows for some contingent decision-making, namely standardization is implemented if both units face low adaptation costs. Moreover, an increase in the variance in adaptation cost now implies that, conditionally on at least one business-unit manager opposing standardization, the (expected) adaptation costs of standardization are larger. Hence, an increase in the variance of adaptation costs reduces the expected value of synergies that are foregone under business-unit control, and therefore makes business-unit control more attractive.

We next show that not only an increase in variance but also in correlation of adaptation costs favors business-unit control.

Correlation of adaptation costs. So far, we have assumed that Δ_1 and Δ_2 are independent. In many settings, one would expect the costs of standardization to be correlated across divisions because the impact of a standardization initiative on the business units

[27] That is, the following changes in exogenous variables may result in a shift from business-unt control to functional control, but never the other way around.

may be similar. For example, standardization may involve a common product design in one dimension that is a compromise between the ideal product for each business unit. The sensitivity of consumer demand to these changes may be similar across markets and private information of the business-unit managers. Then Δ_1 and Δ_2 will be positively correlated. Let

$$\rho = \Pr\left(\Delta_i = \Delta | \Delta_j = \Delta\right),$$

where $\rho \geq p$. Then profits under business-unit control with win-win synergies become

$$\pi = \pi^{NI} + K/2\left[(1-p)^2 + p(\rho - p)\right].$$

The next proposition shows that not only an increase in the variance of adaptation costs (Proposition 7) but also an increase in the correlation of adaptation costs across business units makes business-unit control more attractive.

Proposition 8 *An increase in the correlation of adaptation costs ρ may result in a shift from Functional Control to Business-Unit Control, but never the other way around.*

Proof. See Appendix.

To understand this result in more detail, note first that a higher correlation of adaptation costs across business units reduces the incidence of win-lose synergies, where standardization is value-increasing but reduces the profits of one of the business units. Business-unit control is unable to implement such win-lose synergies. Secondly, a higher correlation increases the probability that both business-units are opposed to standardization. Functional control then often implements standardization even though no (or negative) synergies are present. Business-unit control prevents such value-reducing standardization. Finally, business-unit control and functional control are equally efficient at implementing win-win synergies, where none of the business-units face adaptation costs. Such win-win synergies are more frequent when the correlation is higher.

6 Conclusion

Organizations exist to coordinate complementary activities in the presence of specialization. Specialization expands the production frontier but results in organizational challenges. In particular, since agents are in charge of a narrower set of activities, their objectives also become narrower if they are paid based on their own performance. In this paper, the purpose of organizational design is to govern this trade-off. Employing

a functional manager specialized in identifying synergies potentially increases production efficiency. However, ensuring coordination between this manager and business-unit managers requires muting and broadening incentives. As a result, the organizational costs of coordination may exceed the functional cost savings. Thus our paper integrates the coordination and motivation problems that result from trying to integrate multiple business units to extract synergies.

Integrating both problems highlights the limits of purely 'structural' solutions to the coordination problem. Simply integrating two units and placing a common manager in charge is not enough. The incentives of the manager, and of those communicating to the manager must be aligned as well. Otherwise, as we show, decision-making will be too biased, and communication will not be truthful, as agents try to influence decisions in their favor.[28]

Our model allows us to characterize the extent to which organizational costs constrain the ability of firms to capture synergies through integration. When synergies are large and self-evident, the organizational designer need not worry about when and whether the implementation of standardization is value-increasing. As a result, it is possible for the organization to keep high-powered incentives without fearing the resulting conflicts, and a large share of the potential synergies may be captured through integration of previously separate units. Instead, if contingent decision-making is important, where standardization must be decided on a case-by-case basis, it is harder to capture synergies; managers' incentives must be sufficiently aligned to ensure efficient decision-making and truthful communication. This requires muting and broadening incentives, thereby reducing the gains from integration.

Our model also sheds some light on the trade-off between a centralized versus a decentralized approach to the realization of synergies. In particular we study when 'business-unit control' over standardization is optimal, where functional managers may propose standardization but cannot implement it without the consent of the business units. We show that business-unit control is only efficient at implementing win-win standardization – the functional manager cannot impose synergies when at least one of

[28] The importance of aligning incentives in addition to reorganizing is dramatically illustrated by the reaction of the FBI to the first World Trade Center attack in 1993. The FBI was structured in a decentralized way around field offices and it determined that this structure served the counterterrorism task poorly. It thus created a separate Counterterrorism and Counterintelligence Division "intended to ensure sufficient focus on these two national security missions." However, the FBI changed neither the career incentives nor the authority of the local offices, and by all accounts, it captured very few between-office synergies particularly in counterterrorism. (National Commission on Terrorist Attacks upon the United States, Staff Statement No. 9: "Law Enforcement, Counterterrorism, and Intelligence Collection in the United States Prior to 9/11.")

the business units is opposed to standardization. But this design can implement win-win synergies at relatively low incentive costs, as there is no need to align the functional manager by muting and broadening his incentives. As a result, the choice between business-unit control and functional control presents organizations with a trade-off between efficiently implementing synergies and providing strong local incentives. This trade-off is similar in nature to the one between non-integration and integration with functional control: when incentives are not too important, functional control is always preferred; when they are important, business-unit control may be chosen. Similarly, activities whose performance cannot be easily measured are better candidates to be put under functional control. Our analysis thus highlights an important interaction between incentive provision and the allocation of control.

The different effects of functional authority and business-unit control in hybrid organizations are illustrated clearly by Jacobs Suchard's attempt to capture synergies in the late 1980s. Suchard was a European coffee and confectionery company which had a decentralized organizational structure with largely independent business units organized around products and countries run by a general manager.[29] The non-integrated structure facilitated measurement and, as in our model, strong local incentives, but made cross-country synergies hard to capture. The tariff reductions, open borders, and standardization of regulation of the upcoming 1992 European integration created the opportunity for Jacobs Suchard to achieve cost savings by combining manufacturing plants across countries and creating global marketing initiatives.

The company planned to shift from nineteen plants to six primary plants that would serve all of Europe. General managers were to lose responsibility for manufacturing, but maintain control of sales and marketing. Profit measurements for business units would be based on transfer prices from the manufacturing plants. The manufacturing unit's decisions appear to have created significant conflict with the business units.

Suchard tried a different approach to attain marketing synergies than its approach to manufacturing synergies. It appointed "global brand sponsors" for each of the five major confectionery brands. General managers of geographically-defined business who were given the additional responsibility to promote their brands globally, develop new products, and standardize brands and packaging across countries. However, control remained with the country general managers; the sponsors could only suggest standardization initiatives. Many of the sponsors' suggested initiatives appear to have gone unheeded by the business-unit managers.[30]

[29] What follows comes from Eccles and Holland (1989).

[30] Although we cannot say if the organizational changes were good decisions or not, it is clear that

Our analysis yields several testable empirical implications. Mergers in which the merging companies have (pre-merger) high-powered incentives are more likely to fail. Since achieving synergies requires muting incentives, the motivation/coordination trade-off will be largest in these cases. As a result, we expect such mergers to be subject to a more stringent test in terms of the profit threshold required for a merger to go ahead. Additionally, contingent decision-making may be important when there are many small decisions that must be taken that may lead to synergies, rather than a small number of key, large decisions. This suggests an explanation for the fact that cost synergies are easier to realize than revenue synergies. Cost synergies often involve a few key consolidation and standardization decisions, while revenue synergies (for example through cross-selling) may require repeatedly determining the benefits and costs of combined offerings.[31] Our model also has empirical implications for the breadth of the managerial incentives used. While functional managers need broad incentives to take into account business-units' objectives when they have the ultimate decision-making authority over synergies, they should have higher powered but focused incentives (e.g. based on accounting measures of costs in their own unit, rather than firm-wide profits) when the business-unit managers retain authority over key decisions. Finally, our model has a broader implication for empirical work: the size of incentive pay is a bad proxy for how high-powered incentives are. The relation between effort level or motivation, risk, and coordination incentives is more subtle than a simple risk-incentive trade-off. Functional managers with broad incentives may have a larger overall risk exposure, as we have shown, than narrowly-motivated functional managers, and yet the former have lower effort incentives and lower motivation than the latter.

We view this paper as a starting point towards a deeper exploration of the way organizational structure can be designed to facilitate coordination while maintaining incentives. Much remains to be done. We have sought to present the simplest possible model involving the four elements we consider critical: coordination, adaptation, effort incentives and (strategic) communication. In doing this, we have drastically simplified incentive and information structures. Future work should explore the robustness of the model to larger, more complex organizations with richer incentive and information structures.

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the benefits from the attempt to create cross-border synergies did not come without costs. These costs take the form that is the focus of this paper – poorer coordination and incentives within business units, increased conflict from centralized decision-making, and the communication costs that go with it.

[31] According to a McKinsey study, some 70% percent of mergers fail to achieve expected revenue synergies, versus 35% fail to achieve cost synergies (Early, Steward "New McKinsey research challenges conventional M&A wisdom", Strategy & Leadership, 2004, 32 (2): 4 - 11). See also the detailed studies in Kaplan (2000).

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A Appendix

Proof of Proposition 2. (i) We first show that if $K/2 < E[\Delta_1 + \Delta_2]$, then non-integration is optimal provided that v and σ_r are sufficiently large.
(ia) If σ_r^2 goes to infinity, then non-integration is optimal provided that v is sufficiently large. Indeed, note that $\lim_{\sigma_r \to \infty} \gamma = \beta = 0$ and thus also $\lim_{\sigma_r \to \infty} A = 0$. Denoting profits under non-integration as π^{NI} and under integration as π^I, then

$$\lim_{\sigma_r \to \infty} \pi^I - \lim_{\sigma_r \to \infty} \pi^{NI} = \frac{K}{2} - E(\Delta_1 + \Delta_2) - \left[v^2 \alpha(2-\alpha) - (\alpha)^2 \sigma_c^2\right],$$

where, from the first-order conditions, $\alpha = 2v^2/(\sigma_c^2 + 2v^2)$. Since $\frac{K}{2} < E(\Delta_1 + \Delta_2)$, the above expression is negative if v is sufficiently large.

(ib) Similarly, if v goes to infinity, non-integration is optimal provided that σ_r^2 is sufficiently large. Indeed, note that $\lim_{v\to\infty}\alpha = 1$ and thus

$$\lim_{v\to\infty}\pi^I - \lim_{v\to\infty}\pi^{NI} = \frac{K}{2} - E(\Delta_1+\Delta_2) + A(2-A)\left(\frac{\psi}{2K}\right) - (\gamma)^2\sigma_r^2,$$

where $\psi = E[(\Delta_1+\Delta_2)^2]$ and

$$\lim_{v\to\infty} A = \lim_{v\to\infty}\gamma = \frac{1}{1+\frac{K}{\psi}\sigma_r^2}.$$

It follows that

$$\lim_{v\to\infty}\pi^I - \lim_{v\to\infty}\pi^{NI} = \frac{K}{2} - E(\Delta_1+\Delta_2) + \frac{\psi}{2K}\left(\frac{\frac{\psi}{K}}{\frac{\psi}{K}+\sigma_r^2}\right).$$

Since $\frac{K}{2} < E(\Delta_1+\Delta_2)$, the above expression is negative if σ_r^2 is sufficiently large.
(ii) To prove the comparative statics, it is sufficient to show that $d(\pi^{NI}-\pi^I)/dt > 0$ for $t \in \{v, 1/\sigma_c^2, \sigma_r^2, -K, \Delta_1, \Delta_2, p\}$. Recall that π^I is given by

$$\begin{aligned}\pi &= K/2 - E(\Delta_1+\Delta_2) + A(2-A)\tfrac{1}{2K}E[(\Delta_1+\Delta_2)^2] + \\ &\quad + [\alpha(2-\alpha)+\beta(2-\beta)]\,v^2 - [(\alpha\sigma_c)^2 + (\beta\sigma_r)^2 + (\alpha A\sigma_r)^2].\end{aligned} \tag{15}$$

Since $d\pi^{NI}/dK = 0$, $d\pi^{NI}/d\Delta_i = 0$ and $d\pi^{NI}/dp = 0$, we only need to show that $d\pi^I/dK > 0, d\pi^I/d\Delta_L < 0, d\pi^I/d\Delta_H < 0$ and $d\pi^I/dp < 0$. Using the envelope theorem, we have that

$$\frac{d\pi^I}{dK} = \frac{\partial\pi^I}{\partial K} = \frac{1}{2} - \frac{1}{2}\frac{E[(\Delta_1+\Delta_2)^2]}{K^2}A(2-A) > 0$$

since $\Delta_1+\Delta_2 < K$ and $A(2-A) < 1$. Following a similar argument, $d\pi^I/d\Delta_L < 0, d\pi^I/d\Delta_H < 0$ and $d\pi^I/dp < 0$. For example:

$$\begin{aligned}\frac{d\pi^I}{d\Delta_H} &= p^2K\frac{\partial}{\partial\Delta_H}\left[-\left(\tfrac{2\Delta_H}{K}\right) + \left(\tfrac{2\Delta_H}{K}\right)^2\tfrac{A(2-A)}{2}\right] \\ &\quad + p(1-p)K\frac{\partial}{\partial\Delta_H}\left[-\left(\tfrac{\Delta_L+\Delta_H}{K}\right) + \left(\tfrac{\Delta_L+\Delta_H}{K}\right)^2\tfrac{A(2-A)}{2}\right] \\ &= p^2K\left[-\tfrac{2}{K} + \tfrac{2}{K}\left(\tfrac{2\Delta_H}{K}\right)A(2-A)\right] + p(1-p)K\left[-\tfrac{1}{K} + \tfrac{1}{K}\left(\tfrac{\Delta_L+\Delta_H}{K}\right)A(2-A)\right]\end{aligned}$$

which is negative since $\Delta_1+\Delta_2 < K$ and $A(2-A) < 1$.

Consider now the comparative statics with respect to v. Again, using the envelope

theorem, and abusing notation, both under integration and non-integration

$$d\pi/dv = 2v\alpha(2-\alpha) + 2v\beta(2-\beta).$$

Under integration, α is given by (12) where $A > 0$. Under non-integration, α is given by (12) with $A = 0$. It follows that α is always smaller under integration than under non-integration. Since β is not affected by the integration decision, it thus follows that $d\pi/dv$ is larger under non-integration than under integration. Finally, consider comparative statics with respect to to σ_c^2 and σ_r^2. Using the envelope theorem, $d\pi/d\sigma_c^2 = -\alpha/2$ where α is again higher under non-integration. Similarly $d\pi/d\sigma_r^2$ equals $-(A\alpha+\beta)/2$ under integration and $-\beta/2$ under non-integration, where the optimized value of β is identical under both structures. Since $A\alpha$ is strictly positive, it follows that $d\pi/d\sigma_r^2$ is larger under non-integration. **QED**

Strategic communication.

Proof of Proposition 3.

We begin by first stating formally the communication constraint in Figure 4. Tuthfully reporting Δ_L is preferred if:

$$\begin{aligned} & \frac{(1-p)}{K}\int_{k_{LL}}^{K}\left(\zeta\frac{k}{2}-\beta\Delta_L\right)dk + \frac{p}{K}\int_{k_{LH}}^{K}\left(\zeta\frac{k}{2}-\beta\Delta_L\right)dk \\ \geq\ & \frac{(1-p)}{K}\int_{k_{LH}}^{K}\left(\zeta\frac{k}{2}-\beta\Delta_L\right)dk + \frac{p}{K}\int_{k_{HH}}^{K}\left(\zeta\frac{k}{2}-\beta\Delta_L\right)dk. \end{aligned}$$

That is, the value of lying is in the increase in the value of k that the functional manager has to observe before he decides about implementing synergies. For transparency, we focus on the case where $p = \frac{1}{2}$. Then the integrals simplify in the obvious way, and the IC constraint becomes

$$\int_{k_{LL}}^{k_{HH}}\left(\zeta\frac{k}{2}-\beta\Delta_L\right)dk \geq 0. \tag{16}$$

or equivalently

$$\frac{\zeta}{\beta}\frac{\gamma}{\alpha} \geq \frac{2\Delta_L}{\Delta_H+\Delta_L}. \tag{17}$$

We have two cases. Either $\zeta = 0$, in which case trivially communication is not incentive-compatible, and we have a pooling equilibrium, where no informative communication takes place; or alternatively, $\zeta > 0$ and β is such that (16) holds at equality, and communication is incentive-compatible.

Consider first the pooling case. If $\zeta = 0$, there exists only one cutoff k^{nc} such that if $k < k^{nc}$, the functional manager does not standardize and the business-unit managers can adapt locally, while if the cost savings are high enough, $k > k^{nc}$, the functional manager standardizes. The cutoff k^{nc} is now the value of cost savings at which the functional manager is indifferent between standardizing operations or not given the expected loss from adaptation, $\overline{\Delta} = (p\Delta_H + (1-p)\Delta_L)$. That is, k^{nc} solves $\alpha k - 2\gamma\overline{\Delta} = 0$, which implies

$$k^{nc} = \frac{\gamma}{\alpha} 2\overline{\Delta} = A2\overline{\Delta}. \tag{18}$$

And thus the incentive design problem of an organization with functional control without communication is

$$\pi^{nc} = \max_{A,\alpha,\beta,\zeta} \frac{1}{K} \int_{k^{nc}}^{K} (k - 2\overline{\Delta}) dk + \alpha(2-\alpha)v^2 + \beta(2-\beta)v^2 - [(\alpha)^2\sigma_c^2 + (\alpha A)^2\sigma_r^2], \tag{19}$$

or

$$\begin{aligned} \pi^{nc} &= \max_{A,\alpha} E[K - 2\Delta] + A(2-A)\tfrac{4}{2K}\overline{\Delta}^2 + \alpha(2-\alpha)v^2 + \beta(2-\beta)v^2 && (20) \\ &\quad -[(\alpha)^2\sigma_c^2 + (\alpha A)^2\sigma_r^2] - ((\beta\sigma_r)^2 + (\zeta\sigma_c)^2). && (21) \end{aligned}$$

The first-order condition with respect to α is identical to the one with full information (12), while the choice of the balance A is analogous to (13):

$$\pi_A = \tfrac{1}{2K} 4\overline{\Delta}^2 2(1-A) - 2(\alpha)^2 A\sigma_r^2 = 0. \tag{22}$$

Now consider the separating case. Clearly, the communication constraint (16) must bind, as otherwise ζ can be lowered with a decrease in risk and thus an increase in profits. Thus, the organizational problem is

$$\begin{aligned} \pi^c &= \max_{A,\alpha,\beta,\zeta} E[k - \Delta_1 - \Delta_2] + A(2-A)\tfrac{1}{2K}E[(\Delta_1 + \Delta_2)^2] + && (23) \\ &\quad \alpha(2-\alpha)v^2 + \beta(2-\beta)v^2 - [(\alpha)^2\sigma_c^2 + (\alpha A)^2\sigma_r^2] - ((\beta)^2\sigma_r^2 + (\zeta)^2\sigma_c^2) \end{aligned}$$

subject to (16) at equality.

Proposition **3** follows immediately: compare the solution of the above problem with the one that would obtain if the two business unit $\Delta_i's$ were observable. The optimization problem would be exactly like (23), except without the communication constraint (16) . Trivially (since the constraint is absent) this problem always yields higher profits than the (constrained) (23); moreover, it is easy to check that (23) yields point by point (for all A, α, β and ζ) higher profits than (19). To see this, note that the expressions are identical except for the term multiplying $A(2-A)/2K$. But it is easy to see that this term is higher when decision-making is better: $4\overline{\Delta} < E[(\Delta_1+\Delta_2)^2]$. Since strategic communication plays no role under non-integration, but lowers expected profits under integration, the proposition holds.**QED.**

Before comparing the integration and non-integration profits when communication is strategic, we compare the incentive levels both with and without communication. The following lemma obtains the necessary result.

Lemma 1 *Effort incentives under integration are lower than under non-integration for a given v,, σ_c, σ_r.*

Proof. The incentives under non-integration are the solution to:

$$\pi = \max_{\alpha,\beta} v^2\alpha(2-\alpha) + v^2\beta(2-\beta) - (\sigma_c\alpha)^2 - (\sigma_r\beta)^2,$$

with first-order conditions

$$\frac{v^2}{\sigma_c^2} = \frac{\alpha}{1-\alpha}; \text{ and} \tag{24}$$

$$\frac{v^2}{\sigma_r^2} = \frac{\beta}{1-\beta}. \tag{25}$$

While under integration they depend on whether communication is or not possible.
(1) If communication is possible, the incentive design solves the following problem (recall the IC constraint is $\frac{\zeta}{\beta}\frac{\gamma}{\alpha} \geq \frac{2\Delta_L}{\Delta_H+\Delta_L}$) :

$$\pi_c = \max_{A,\alpha_f,\alpha_{bu},\beta_{bu}} E[k-\Delta_1-\Delta_2] + A(2-A)\tfrac{1}{2K}E[(\Delta_1+\Delta_2)^2] + \tag{26}$$

$$\alpha(2-\alpha)v^2 + \beta(2-\beta)v^2 - (\alpha\sigma_c)^2 - (\alpha A)^2\sigma_r^2] \tag{27}$$

$$-(\beta\sigma_r)^2 + (\zeta\sigma_c)^2 + \lambda\left(\frac{\zeta}{\beta}\frac{\gamma}{\alpha} - \frac{2\Delta_L}{\Delta_H+\Delta_L}\right), \tag{28}$$

with the first-order conditions for α and β

$$\frac{v^2}{\sigma_c^2+(A)^2\sigma_r^2}-\lambda\frac{1}{4[\sigma_c^2+(A)^2\sigma_r^2]}\frac{2\Delta_L}{\Delta_H+\Delta_L}\frac{1}{\alpha(1-\alpha)} = \frac{\alpha}{(1-\alpha)}, \tag{29}$$

$$\frac{v^2}{\sigma_r^2}-\lambda\frac{1}{4}\frac{2\Delta_L}{\Delta_H+\Delta_L}\frac{1}{\beta(1-\beta)} = \frac{\beta}{1-\beta}. \tag{30}$$

Note that we only present the two first-order conditions for effort incentives; there are two more, but they are not necessary for this argument. Now note that the right-hand side of (24) is the same as that of (29) and the right-hand side of (25) is the same as that of (30). Now look at the left-hand sides. In each case it is unambiguously smaller. In (29) the denominator is larger (A is positive, as it is the ratio between two positive numbers; that both α and γ are positive is trivial to verify), and then a positive quantity (λ is positive if the communication constraint is binding) is subtracted. Thus α must be smaller, as incentives are now more costly for two reasons: first, decisions matter, and thus incentives must be more balanced (the 'larger denominator' term, which is a consequence of A, alignment) and communication must be incentivized (the λ term)– higher powered incentives make communication non-credible.
(2) If communication is not possible, incentives are the solutions to

$$\pi_{nc} = \max_{A,\alpha_f,\beta} E[K-2\Delta]+A(2-A)\tfrac{4}{2K}\overline{\Delta}^2+\alpha(2-\alpha)v^2+\beta(2-\beta)v^2 \tag{31}$$

$$-[(\alpha\sigma_c)^2+(\alpha A)^2\sigma_r^2]-(\beta\sigma_r)^2, \tag{32}$$

with first-order conditions for α :

$$\frac{v^2}{(\sigma_c^2+(A)^2\sigma_r^2)} = \frac{\alpha}{1-\alpha} \text{ and}$$

$$\frac{v^2}{\sigma_r^2} = \frac{\beta}{1-\beta}.$$

Clearly here incentives for the functional manager are lower under integration, for the first reason above: the denominator is larger, as there is an extra term in the marginal cost of incentives, coming from decision-making incentives. **QED.**

Proof of Proposition 4. 1. Consider first the impact of an increase in K. Using the envelope theorem, and since K does not enter the communication constraint (16), we have:

$$\frac{d\pi^c}{dK}-\frac{d\pi^{nc}}{dK}=-\tfrac{1}{2}\frac{1}{K^2}\left(A^c(2-A^c)E[(\Delta_1+\Delta_2)^2]-A^{nc}(2-A^{nc})4\overline{\Delta}^2\right)<0, \tag{33}$$

where the inequality follows from $A^c > A^{nc}$ and $E[(\Delta_1 + \Delta_2)^2 > 4\overline{\Delta}^2$.
2. As for v, again applying the envelope theorem (again v does not enter in the communication constraint).

$$\frac{d\pi^c}{dv^2} - \frac{d\pi^{nc}}{dv^2} = \alpha^c(2-\alpha^c) + \beta^c(2-\beta^c) - \alpha^{nc}(2-\alpha^{nc}) - \beta^{nc}(2-\beta^{nc}) < 0, \qquad (34)$$

since, as we have shown, communication induces lower powered incentives, $\alpha^c < \alpha^{nc}$ and $\beta^c < \beta^{nc}$.
3. To see the impact of an increase in the mean-preserving spread, $\Delta_H - \Delta_L$ simply note (applying the envelope theorem) that, while the no communication profits are unaffected, the profits under communication are increasing in $E[(\Delta_1 + \Delta_2)^2]$. Moreover, for given $\beta, \zeta, \alpha, \gamma$ the communication constraint $\frac{\zeta}{\beta}\frac{\gamma}{\alpha} > \frac{2\Delta_L}{\Delta_H + \Delta_L}$ is easier to satisfy when the spread increases, and thus π^c unambiguously increases in $\Delta_H - \Delta_L$. **QED**

Proof of Proposition 5. (i) This is immediate. Proposition 2 shows this is the case when communication is non-strategic. Proposition 3 shows that the performance of the integrated structure becomes worse when communication is strategic.

(ii) We proceed as in Proposition 2: To prove the comparative statics, it is sufficient to show that $d(\pi^{NI} - \pi^I)/dt > 0$ for $t \in \{v, -K, \Delta_H + \Delta_L\}$. Recall that

$$\pi^{NI} = v^2\alpha(2-\alpha) + v^2\beta(2-\beta) - (\sigma_c\alpha)^2 + (\sigma_r\beta)^2.$$

Consider now the comparative statics with respect to $Ek = \frac{K}{2}$. Since $d\pi^{NI}/dK = 0$, it suffices to show $d\pi^I/dK > 0$. K does not enter the constraint, and we can apply the envelope theorem (see the proof of Proposition 2) to show $d\pi^I/dK > 0$.

Consider now the impact an increase in the average adaptation costs, $\overline{\Delta} = (\Delta_H + \Delta_L)/2$ (holding the variance constant). First, $d\pi^{NI}/d\overline{\Delta} = 0$. The term $d\pi^I/d\overline{\Delta}$ with no communication is negative: local adaptation is a net cost and decreases synergies and profits (as in the proof of Proposition 2). With communication $d\pi^I/d\overline{\Delta}$ has two components: the direct effect, which is the same as in Proposition 2 ($d\pi^I/d\Delta_H < 0$ and $d\pi^I/d\Delta_L < 0$): if costs of local adaptation are higher, the synergies are lower and so are profits. Second, the truthtelling constraint is harder to satisfy when local adaptation is more costly. To see this, write $\Delta_L = \overline{\Delta} - \delta$ and $\Delta_H = \overline{\Delta} + \delta$. Then the IC constraint is $\left(\frac{\zeta}{\beta}\frac{\gamma}{\alpha} - \frac{\overline{\Delta}-\delta}{\overline{\Delta}}\right)$, and $d\left(\frac{\zeta}{\beta}\frac{\gamma}{\alpha} - \frac{\overline{\Delta}-\delta}{\overline{\Delta}}\right)/d\overline{\Delta} < 0$ (the constraint is harder to meet). Formally, since $\lambda > 0$, this term is also negative, thus $d\pi^I/d\overline{\Delta} < 0$.

Finally, consider the effect of v. Using the envelope theorem we have that

$$\begin{aligned}\frac{d\pi^I}{dv} &= 2v\left(\alpha^I(2-\alpha^I)+\beta^I(2-\beta^I)\right)\\ &< 2v(\alpha^{NI}(2-\alpha^{NI})+\beta^{NI}(2-\beta^{NI}))=\frac{d\pi^{NI}}{dv}.\end{aligned}$$

Where the inequality proceeds immediately from **Lemma 1** (incentives are lower in the non-integrated structure). **QED**

Proof of Proposition 6. We show that functional control strictly dominates business unit control with win-lose synergies whenever $\sigma_c^2 \geq \sigma_r^2$. By continuity, the same is true for $\sigma_c^2 \geq \sigma_r^2 - \varepsilon$, with $\varepsilon > 0$. Let α^*, γ^*, β^*, β^{-*} and ζ^* be the shares that maximize profit function (14). For there to be win-lose synergies, it must be that $2\beta^*\Delta/\zeta^* < K$. We distinguish two cases.

(1) Consider first $\beta^* \geq \zeta^*$ and thus $2\Delta \leq 2\beta^*\Delta/\zeta^*$. Then profits are maximized by setting $\gamma = 0$ and $\beta^- = 0$ such that $k_{LH} = k_{HH} = 2\beta\Delta/\zeta > 2\Delta$. Optimization further yields $\alpha = \alpha^{**}$ and, as in the proof of proposition 2, one can show that $\beta^* \leq \beta^{**} = \alpha^{**} = \alpha^*$. Hence,

$$\pi = (1-p)^2K/2 + \frac{2p(1-p)}{K}\int_{2\beta^*\Delta/\zeta^*}^{K}(k-\Delta)\,dk + p^2\int_{2\beta^*\Delta/\zeta^*}^{K}(k-2\Delta)\,dk \quad (35)$$

$$+v^2\alpha^*(2-\alpha^*) + v^2\beta^*(2-\beta^*) - (\alpha^{*2}\sigma_c^2 + \beta^{*2}\sigma_r^2 + \zeta^{*2}\sigma_c^2) \quad (36)$$

Consider now functional control with incentives $\alpha = \beta^*, \beta = \alpha^*, \gamma = \zeta^*$ and $\zeta = 0$. This yields expected profits

$$\pi = (1-p)^2K/2 + \frac{2p(1-p)}{K}\int_{\beta^*\Delta/\zeta^*}^{K}(k-\Delta)\,dk + p^2\int_{2\beta^*\Delta/\zeta^*}^{K}(k-2\Delta)\,dk \quad (37)$$

$$+v^2\alpha^*(2-\alpha^*) + v^2\beta^*(2-\beta^*) - (\beta^{*2}\sigma_c^2 + \alpha^{*2}\sigma_r^2 + \zeta^{*2}\sigma_r^2) \quad (38)$$

Note first that effort provision is equivalent under both structures. Second, since $\alpha^* \geq \beta^*$ and $\sigma_c^2 \geq \sigma_r^2$, the risk-premium is weakly lower than under business-unit control (with equality if and only if $\sigma_r^2 = \sigma_c^2$). Finally, since $\Delta \leq \beta^*\Delta/\zeta^* < 2\beta^*\Delta/\zeta$, decision-making is more efficient than under business-unit control whenever only one business-unit faces high adaptation costs (win-lose synergies). Since $\beta^* > 0$ at the

optimum, it follows that functional control strictly dominates business-unit control whenever $\sigma_c^2 > \sigma_r^2$.
2) Second, consider $2\beta^*\Delta/\zeta^* < 2\Delta$ and thus $\beta^* < \zeta^*$. An upper bound for (14) is then given by

$$\begin{aligned}\tilde{\pi} &= (1-p)^2 K/2 + \frac{2p(1-p)}{K}\int_{k_{LL}}^{K}(k-\Delta)\,dk + p^2\int_{k_{LH}}^{K}(k-2\Delta)\,dk \\ &\quad +v^2\alpha^{**}(2-\alpha^{**}) + v^2\beta^*(2-\beta^*) \\ &\quad -(\alpha^{**2}+\zeta^{*2})\sigma_c^2 - (\beta^{*2}+\beta^{-*2}+\gamma^{*2})\sigma_r^2 \end{aligned} \tag{39}$$

where α^{**} is the second-best cost share and $k_{LH} = \max\{2\beta^*\Delta/\zeta^*, \gamma^*\Delta/\alpha\}$ and $k_{HH} = \max\left\{2(\beta^*+\beta^{-*})\Delta/\zeta^*, 2\gamma^*\Delta/\alpha^*\right\}$.
Consider now functional control with incentives $\alpha, , \gamma, \beta$, and ζ, where we set $\alpha = \gamma = \beta^*, \beta = \alpha^{**}$ and $\zeta = 0$. This yields expected profits

$$\begin{aligned}\pi &= (1-p)^2 K/2 + \frac{2p(1-p)}{K}\int_{\Delta}^{K}(k-\Delta)\,dk + p^2\int_{2\Delta}^{K}(k-2\Delta)\,dk \\ &\quad +v^2\beta^*(2-\beta^*) + v^2\alpha^{**}(2-\alpha^{**}) \\ &\quad -\beta^{*2}\sigma_c^2 - \left(\alpha^{**2}+\beta^{*2}\right)\sigma_r^2 \end{aligned} \tag{40}$$

Note first that, since $\beta^* < \zeta^*$ (by assumption) and $\sigma_c^2 \geq \sigma_r^2$, hence the third line in expression (39) is strictly more negative than the third line in expression (40). Second, effort provision (second line) is equivalent. Finally, functional control uses a first-best decision-rule for standardization decisions, hence also the first line in (40) is larger than the first line in expression (39). It follows that whenever $\sigma_r^2 \leq \sigma_c^2$, functional control strictly dominates business-unit control with win-lose synergies. **QED**

Proof of Proposition 7. The proof of statement (i) and the comparative statics with respect to v, σ_r^2, σ_c^2, and Δ are identical as for the proof of Proposition 2. Consider now the comparative statics with respect to to K. Using the envelope theorem, we have that

$$\frac{d\pi}{dK} = \frac{1}{2} - A(2-A)\left(\frac{\psi}{2K^2}\right)$$

under functional control and $d\pi/dK = (1-p)^2/2$ under business-unit control. Hence,

$d\pi/dK$ is larger under functional than under business-unit control if and only if

$$\frac{1}{2}\left[1-(1-p)^2\right]-\frac{1}{2}A(2-A)\left(\frac{\psi}{K^2}\right)>0, \tag{41}$$

where A is the optimized bias under functional control. Since $K \geq 2\Delta$,

$$A(2-A)\left(\frac{\psi}{K^2}\right)<\frac{\psi}{K^2}=\frac{2p(1-p)\Delta^2+p^2 4\Delta^2}{K^2}<\frac{1}{2}p(1-p)+p^2<(1-(1-p)^2),$$

so that (41) is indeed satisfied. Consider, finally, changes in p, leaving $p\Delta$ and thus $E(\Delta_1+\Delta_2)$ fixed. Using the envelope theorem, under functional control

$$\begin{aligned}\frac{d\pi}{dp} &= A(2-A)\frac{\partial E((\Delta_1+\Delta_2)^2)}{\partial p}\\ &= A(2-A)\frac{2(1+2p)\Delta^2}{K^2}>0.\end{aligned}$$

whereas under business-unit control $d\pi/dp=-2(1-p)K/2<0$. **QED.**

Proof of Proposition 8. When adaptation costs are correlated, one can verify that profits under integration through functional control are still given by (11), but now

$$E((\Delta_1+\Delta_2)^2)=2(1+\rho)p\Delta^2.$$

Applying the envelope theorem, it follows that under integration through functional control

$$\frac{d\pi}{d\rho}=A(2-A)\frac{1}{2K}2p\Delta^2.$$

Since $A<1$ and $K>2\Delta$, we have that under functional control

$$\frac{d\pi}{d\rho}<p\frac{1}{2K}2\Delta^2<p\frac{K}{4}.$$

In contrast, under integration through business-unit control

$$\frac{d\pi}{d\rho}=\frac{K}{2}p.$$

QED.

B Appendix - Not for publication

Throughout the analysis, we have ignored the impact that uncertainty over the costs and benefits of standardization has on the risk-averse managers' utility. In this Appendix, we show that this assumption can be formally justified by assuming that there are an infinite number of small independent standardization choices rather than one big standardization decision.

Consider a variant of our model where there are N standardization opportunities, each of which, if implemented, results in revenue losses Δ_{it}/N in business unit i and total cost savings k_t/N, $t \in \{1, ..., N\}$, where for all t, $\Delta_{it} = \Delta$ with an independent probability p and 0 otherwise, and where for all t, k_t is independently and *normally* distributed on $[0, K]$. The normalization of standardization gains and losses by N ensures that the expected value of always implementing standardization remains given by $K/2 - 2p\Delta$, as in our basic model.

As in our basic model, profits (gross of wages), can then be written as $\sum_i (R_i - C_i)$, but now

$$\begin{aligned} R_i &= ve_{ri} + \varepsilon_{ri} - \sum_{i=1}^{i=N} \frac{\Delta_{it}}{N} I_t \\ C_i &= \mathbb{C} - ve_{ci} + \varepsilon_{ci} - \sum_{i=1}^{i=N} \frac{k_{it}}{N} I_t \end{aligned}$$

with

$$I_t = \begin{cases} 0 & \text{if no standardization;} \\ 1 & \text{if standardization.} \end{cases}$$

Managers are further risk-averse with CARA utility and a zero reservation wage.

The following proposition states that, as N goes to infinity, the above model yields the same expected profit function as our basic model, even though decision-risk is explicitly taken into account:

Proposition: *Let π^I denote expected profits net of wages under integration, and let α and γ be the shares given in respectively C_i and R_i to the functional manager and ζ and β those to the business unit managers, then*

$$\begin{aligned} \lim_{N\to\infty} \pi^I &= E[(k_t - \Delta_{1t} - \Delta_{2t})|I_t = 1] \times \Pr[I_t = 1] \\ &\quad + v^2\alpha(2-\alpha) + v^2\beta(2-\beta) - (\sigma_c\alpha)^2 - (\sigma_r\beta)^2 - (\sigma_r\gamma)^2 - (\zeta\sigma_c)^2 \quad (42) \end{aligned}$$

Proof: Managers must be rewarded for their effort and compensated for their risk exposure. When making standardization choice I_t, the functional manager faces no uncertainty anymore and, hence, he will standardize if and only if $\alpha k_t > \gamma(\Delta_{1t} + \Delta_{2t})$, a rule which is independent of N. Applying the law of large numbers, we then have that

$$\lim_{N\to\infty} \sum_{i=1}^{i=N} \frac{k_{it}}{N} I_t = E(k_{it}|I_t = 1) * \Pr[I_t = 1]$$

and

$$\lim_{N\to\infty} \sum_{i=1}^{i=N} \frac{\Delta_{it}}{N} I_t = E(\Delta_{it}|I_t = 1) * \Pr[I_t = 1]$$

and, hence

$$\lim_{N\to\infty} var\left(\sum_{i=1}^{i=N} \frac{\Delta_{it}}{N} I_t\right) = \lim_{N\to\infty} var\left(\sum_{i=1}^{i=N} \frac{k_{it}}{N} I_t\right) = 0.$$

It follows that, in the limit as N goes to infinity, R_i and C_i are Normally Distributed with variance σ_r^2 and σ_c^2 respectively. For given shares α, γ, β and ζ, expected profits, net of wages, are therefore given by

$$\lim_{N\to\infty} \pi^I = \sum_i \left(E[R_i - C_i] - \frac{1}{2}(e_{ci}^*)^2 - \frac{1}{2}(e_{ri}^*)^2 - \frac{1}{2}(\sigma_c\alpha)^2 - \frac{1}{2}(\sigma_r\beta)^2 - \frac{1}{2}(\sigma_r\gamma)^2 - \frac{1}{2}(\zeta\sigma_c^2)^2\right)$$

Substituting optimized effort levels this yields (42).**QED**.