

Web Appendix to Organizing for Synergies

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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 , $t \in \{1, \dots, N\}$, 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

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

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

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

and

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

and, hence

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

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

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

Substituting optimized effort levels this yields (1). **QED.**