Online Appendix for:

Internalizing Global Value Chains: A Firm-Level Analysis

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October 2017

A-1 Theoretical Appendix

A-1.1 Derivation of Program (7)

In this Appendix, we provide more details on firm behavior conditional on the path of ownership structure along the value chain. Notice first that solving program (5), we obtain the following optimal choice of investment by the supplier at stage m:

$$x(m) = \left[(1-\beta(m))\, \rho \left(A^{1-\rho}\theta^{\rho}\right)^{\frac{\alpha}{\rho}} r(m)^{\frac{\rho-\alpha}{\rho}} \frac{\psi(m)^{\alpha}}{c(m)} \right]^{\frac{1}{1-\alpha}}.$$

Plugging this express into the marginal contribution function $r'(m) = \frac{\rho}{\alpha}\left(A^{1-\rho}\theta^{\rho}\right)^{\frac{\alpha}{\rho}} r(m)^{\frac{\rho-\alpha}{\rho}} \psi(m)^{\alpha} x(m)^{\alpha}$ delivers the following separable differential equation:

$$r'(m) = \frac{\rho}{\alpha}\left(A^{1-\rho}\theta^{\rho}\right)^{\frac{\alpha}{\rho(1-\alpha)}} r(m)^{\frac{\rho-\alpha}{\rho(1-\alpha)}} \left(\rho \frac{(1-\beta(m))\,\psi(m)}{c(m)}\right)^{\frac{\alpha}{1-\alpha}}.$$

It is straightforward to verify that the solution to this differential equation (with the initial condition $r(0)=0$) is given by:

$$r(m) = A\theta^{\frac{\rho}{1-\rho}} \left(\frac{1-\rho}{1-\alpha}\right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} \rho^{\frac{\rho}{1-\rho}} \left[\int_0^m \left(\frac{(1-\beta(i))\,\psi(i)}{c(i)}\right)^{\frac{\alpha}{1-\alpha}} di\right]^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}}, \tag{A-1}$$

from which we can obtain the expression for $x^*(m)$ in equation (6).

The firm thus chooses the path of $\beta(i)$ that maximizes its profits $\pi_F = \int_0^1 \beta(i) r'(i) di$. Differentiating (A-1) and substituting into π_F, we can express this profit function as:

$$\pi_F = A\theta^{\frac{\rho}{1-\rho}} \frac{\rho}{\alpha} \left(\frac{1-\rho}{1-\alpha}\right)^{\frac{\rho-\alpha}{\alpha(1-\rho)}} \rho^{\frac{\rho}{1-\rho}} \int_0^1 \beta(i) \left(\frac{(1-\beta(i))\,\psi(i)}{c(i)}\right)^{\frac{\alpha}{1-\alpha}} \left[\int_0^i \left(\frac{(1-\beta(k))\,\psi(k)}{c(k)}\right)^{\frac{\alpha}{1-\alpha}} dk\right]^{\frac{\rho-\alpha}{\alpha(1-\rho)}} di,$$

which coincides with the expression in program (7) in the main text.

A-1.2 Derivation of Equation (10)

As pointed out in the main text, we can express program (7) as a standard calculus of variation problem where the firm chooses the real-value function v that maximizes the functional:

$$\pi_F(v) = \Theta \int_0^1 \left(1 - v'(i)^{\frac{1-\alpha}{\alpha}} \frac{c(i)}{\psi(i)}\right) v'(i)\, v(i)^{\frac{\rho-\alpha}{\alpha(1-\rho)}} di,$$

where $\Theta = A\theta^{\frac{\rho}{1-\rho}} \frac{\rho}{\alpha} \left(\frac{1-\rho}{1-\alpha}\right)^{\frac{\rho-\alpha}{\alpha(1-\rho)}} \rho^{\frac{\rho}{1-\rho}}$, and:

$$v(i) \equiv \int_0^i \left(\frac{(1-\beta(k))\,\psi(k)}{c(k)}\right)^{\frac{\alpha}{1-\alpha}} dk. \tag{A-2}$$

The Euler-Lagrange equation associated with this problem is given by:

$$\frac{\rho-\alpha}{\alpha(1-\rho)} \left[1 - v'(i)^{\frac{1-\alpha}{\alpha}} \frac{c(i)}{\psi(i)}\right] v'(i) \left[v(i)\right]^{\frac{\rho-\alpha}{\alpha(1-\rho)}-1} = \frac{d}{di}\left[v(i)^{\frac{\rho-\alpha}{\alpha(1-\rho)}} \left(1 - \frac{1}{\alpha} v'(i)^{\frac{1-\alpha}{\alpha}} \frac{c(i)}{\psi(i)}\right)\right],$$

which after a few manipulations can be reduced to the following differential equation:

$$\frac{\rho-\alpha}{1-\rho}\frac{v'(i)}{v(i)}+\frac{v''(i)}{v'(i)}=-\frac{\alpha}{1-\alpha}\frac{d\left(c(i)/\psi(i)\right)/di}{c(i)/\psi(i)}. \tag{A-3}$$

To solve (A-3), integrate both sides with respect to i, and exponentiate to get:

$$v'(i)\,v(i)^{\frac{\rho-\alpha}{1-\rho}}=C_1\left(\psi(i)/c(i)\right)^{\frac{\alpha}{1-\alpha}}, \tag{A-4}$$

where $C_1>0$ is a constant of integration. Given the definition of $v(i)$ in (A-2), equation (A-4) can be rewritten as:

$$(1-\beta(i))^{\frac{\alpha}{1-\alpha}}=C_1\left(\int_0^i\left(\frac{(1-\beta(k))\,\psi(k)}{c(k)}\right)^{\frac{\alpha}{1-\alpha}}dk\right)^{\frac{\alpha-\rho}{1-\rho}}. \tag{A-5}$$

Denoting $z(i)\equiv(1-\beta(i))^{\frac{\alpha}{1-\alpha}}$, we can express (A-5) as:

$$\left(\frac{z(i)}{C_1}\right)^{\frac{1-\rho}{\alpha-\rho}}=\int_0^i z(k)\left(\frac{\psi(k)}{c(k)}\right)^{\frac{\alpha}{1-\alpha}}dk, \tag{A-6}$$

which after differentiation delivers:

$$\frac{1-\rho}{\alpha-\rho}\left(\frac{z(i)}{C_1}\right)^{\frac{1-\rho}{\alpha-\rho}}\frac{z'(i)}{z(i)}=z(i)\left(\frac{\psi(i)}{c(i)}\right)^{\frac{\alpha}{1-\alpha}}.$$

This change of variable has thus allowed us to arrive at a separable differential equation in $z(i)$, which has solution:

$$z(m)^{\frac{1-\alpha}{\alpha-\rho}}-z(0)^{\frac{1-\alpha}{\alpha-\rho}}=(C_1)^{\frac{1-\rho}{\alpha-\rho}}\left(\frac{1-\alpha}{1-\rho}\right)\left[\int_0^m\left(\frac{\psi(k)}{c(k)}\right)^{\frac{\alpha}{1-\alpha}}dk\right].$$

To simplify the above, note that (A-6) implies $z(0)^{\frac{1-\alpha}{\alpha-\rho}}=0$. Recalling the definition $z(m)\equiv(1-\beta(m))^{\frac{\alpha}{1-\alpha}}$, and imposing the transversality condition:

$$1-\frac{1}{\alpha}v'(1)^{\frac{1-\alpha}{\alpha}}\frac{c(1)}{\psi(1)}=0 \implies 1-\beta(1)=\alpha,$$

we finally obtain the full solution as spelled out in equation (10) in the main text.

A-1.3 Proof of Proposition 1

The proof is a generalization of that for Proposition 2 in Antràs and Chor (2013). It is straightforward to see from equation (10), that when $\rho>\alpha$, $\lim_{m\to0}\beta^*(m)\to-\infty$, and it is thus optimal for the firm to choose β_O (namely outsourcing) for the most upstream stages in the neighborhood of $m=0$. Conversely, when $\rho<\alpha$, $\lim_{m\to0}\beta^*(m)=1$, and it is optimal for the firm to choose β_V (namely integration) for those upstream stages in the neighborhood of $m=0$.

To fully establish Proposition 1 for the case $\rho>\alpha$, we proceed to show that we cannot have a positive measure of integrated stages located upstream relative to a positive measure of outsourced stages in the optimal organizational structure. Since the limit values above indicate that stage 0 will be outsourced, it follows that if any stages are to be integrated, they have to be downstream relative to all outsourced stages. In other words, there exists an optimal cutoff $m_C^*\in(0,1]$ such that all stages in $[0,m_C^*)$ are outsourced and stages in $[m_C^*,1]$ are integrated. (If $m_C^*=1$, then all stages along the production line are outsourced.)

We establish the above by contradiction. Suppose that, contrary to the claim in Proposition 1, there were to exist a stage $\tilde{m} \in (0,1)$ such that a measurable set of stages immediately upstream from $\tilde{m}$ are integrated, while a measurable set of stages immediately downstream from $\tilde{m}$ are outsourced. Now consider two positive constants ε_L and ε_R such that:

$$\int_{\tilde{m}-\varepsilon_L}^{\tilde{m}} \left(\psi\left(i\right)/c\left(i\right)\right)^{\alpha/(1-\alpha)} di = \int_{\tilde{m}}^{\tilde{m}+\varepsilon_R} \left(\psi\left(i\right)/c\left(i\right)\right)^{\alpha/(1-\alpha)} di. \tag{A-7}$$

These constants can always be chosen to be small enough such that they satisfy (A-7), and moreover are such that the set of stages $(\tilde{m}-\varepsilon_L, \tilde{m})$ is integrated, while stages in $(\tilde{m}, \tilde{m}+\varepsilon_R)$ are outsourced. Denote by Π_1 firm profits under this suggested ownership structure. We shall consider an alternative organizational mode in which the firm instead chooses to outsource the stages in $(\tilde{m}-\varepsilon_L, \tilde{m})$ and to integrate the stages in $(\tilde{m}, \tilde{m}+\varepsilon_R)$, while retaining the same organizational decision for all other stages in the unit interval. Denote the profits of this alternative organizational form by Π_2. We will now show that this reorganization necessarily increases firm profits, i.e., $\Pi_1 < \Pi_2$, so that the posited deviation from the optimal pattern in Proposition 1 is inconsistent with profit maximization.

Note that we can rewrite firm profits in (7) as:

$$\pi_F = \Theta \frac{\alpha(1-\rho)}{\rho\left(1-\alpha\right)} \int_0^1 \beta(i) \frac{\partial \left(\left[\int_0^i \left(\left(1-\beta\left(k\right)\right) \psi\left(k\right)/c\left(k\right) \right)^{\frac{\alpha}{1-\alpha}} dk \right]^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} \right)}{\partial i} di. \tag{A-8}$$

It is useful to distinguish four regions in the set of stages: (i) all stages upstream from $\tilde{m}-\varepsilon_L$; (ii) those in $(\tilde{m}-\varepsilon_L, \tilde{m})$; (iii) those in $(\tilde{m}, \tilde{m}+\varepsilon_R)$; and (iv) all stages downstream from $\tilde{m}+\varepsilon_R$. Note that the profits generated by all stages in the first region are common for the profit functions Π_1 and Π_2, so we can ignore them hereafter. Less trivially, the profits generated in the last region are also common in the profit functions Π_1 and Π_2. To see this, and to keep the notation manageable, define:

$$\begin{aligned}
\gamma\left(i\right) &= \left(\psi\left(i\right)/c\left(i\right)\right)^{\frac{\alpha}{1-\alpha}}, \\
\mathcal{A} &= \int_0^{\tilde{m}-\varepsilon_L} \left(\left(1-\beta\left(k\right)\right) \psi\left(k\right)/c\left(k\right) \right)^{\frac{\alpha}{1-\alpha}} dk, \text{ and} \\
\mathcal{D} &= \int_{\tilde{m}+\varepsilon_R}^{i} \left(\left(1-\beta\left(k\right)\right) \psi\left(k\right)/c\left(k\right) \right)^{\frac{\alpha}{1-\alpha}} dk.
\end{aligned}$$

Notice that in light of equation (A-8), the part of profits Π_1 associated with stages $m > \tilde{m}+\varepsilon_R$ is:

$$\Theta \frac{\alpha(1-\rho)}{\rho\left(1-\alpha\right)} \int_{\tilde{m}+\varepsilon_R}^1 \beta(i) \frac{\partial}{\partial i} \left(\mathcal{A} + \left(1-\beta_V\right)^{\frac{\alpha}{1-\alpha}} \int_{\tilde{m}-\varepsilon_L}^{\tilde{m}} \gamma\left(k\right) dk + \left(1-\beta_O\right)^{\frac{\alpha}{1-\alpha}} \int_{\tilde{m}}^{\tilde{m}+\varepsilon_R} \gamma\left(k\right) dk + \mathcal{D} \right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} di,$$

while for profits Π_2, these same profits are given by:

$$\Theta \frac{\alpha(1-\rho)}{\rho\left(1-\alpha\right)} \int_{\tilde{m}+\varepsilon_R}^1 \beta(i) \frac{\partial}{\partial i} \left(\mathcal{A} + \left(1-\beta_O\right)^{\frac{\alpha}{1-\alpha}} \int_{\tilde{m}-\varepsilon_L}^{\tilde{m}} \gamma\left(k\right) dk + \left(1-\beta_V\right)^{\frac{\alpha}{1-\alpha}} \int_{\tilde{m}}^{\tilde{m}+\varepsilon_R} \gamma\left(k\right) dk + \mathcal{D} \right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} di,$$

But given (A-7), we have that $\int_{\tilde{m}-\varepsilon_L}^{\tilde{m}} \gamma\left(k\right) dk = \int_{\tilde{m}}^{\tilde{m}+\varepsilon_R} \gamma\left(k\right) dk$, and so these two expressions are equal.

In order to compare the relative size of Π_1 and Π_2, it thus suffices to compare profits associated only with the intervals $(\tilde{m}-\varepsilon_L, \tilde{m})$ and $(\tilde{m}, \tilde{m}+\varepsilon_R)$. Again invoking equation (A-8), and after some manipulations, we find that:

$$\Pi_1 - \Pi_2 \propto (\beta_V - \beta_O) \left[\left(\mathcal{A} + (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \int_{\tilde{m}-\varepsilon_L}^{\tilde{m}} \gamma(i)\, di \right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} + \left(\mathcal{A} + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \int_{\tilde{m}-\varepsilon_L}^{\tilde{m}} \gamma(i)\, di \right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} \right.$$
$$\left. - \left(\mathcal{A} + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \int_{\tilde{m}-\varepsilon_L}^{\tilde{m}} \gamma(i)\, di + (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \int_{\tilde{m}}^{\tilde{m}+\varepsilon_R} \gamma(i)\, di \right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} - \mathcal{A}^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} \right].$$

Since $\beta_V - \beta_O > 0$, it suffices to show that the expression in square parentheses is negative. To see this, consider the function $f(y) = y^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}}$. Simple differentiation will show that for $y, a > 0$ and $b \geq 0$, $f(y+a+b) - f(y+b)$ is an increasing function in b when $\rho > \alpha$. Hence, $(y+a+b)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} - (y+b)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} > (y+a)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} - (y)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}}$. Setting $y = \mathcal{A}$, $a = (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \int_{\tilde{m}-\varepsilon_L}^{\tilde{m}} \gamma(i)\, di$ and $b = (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \int_{\tilde{m}-\varepsilon_L}^{\tilde{m}} \gamma(i)\, di$, it follows that the term in square brackets is negative, so $\Pi_1 - \Pi_2 < 0$. This yields the desired contradiction as profits can be strictly increased by switching to the organizational mode that yields profits Π_2.

The proof for the $\rho < \alpha$ case can be established using an analogous proof by contradiction. The limit values in this case imply that it is optimal to integrate stage 0. One can then show that if any stages are to be outsourced, they occur downstream to all the integrated stages, so that there is a unique cutoff $m_S^* \in (0,1]$ with all stages prior to m_S^* being integrated and all stages after m_S^* being outsourced.

A-1.4 Derivation of m_C^* and m_S^* Thresholds

Consider first the complements case ($\rho > \alpha$), in which all stages upstream from m_C^* are outsourced, while all stages downstream from m_C^* are integrated. We can then use (A-8) to express profits as:

$$\begin{aligned} \pi_F = {} & \Theta \frac{\alpha(1-\rho)}{\rho(1-\alpha)} \beta_O (1-\beta_O)^{\frac{\rho}{1-\rho}} \left(\int_0^{m_C} \left(\frac{\psi(k)}{c(k)} \right)^{\frac{\alpha}{1-\alpha}} dk \right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} \\ & + \Theta \frac{\alpha(1-\rho)}{\rho(1-\alpha)} \beta_V \left[\begin{array}{c} \left((1-\beta_O)^{\frac{\alpha}{1-\alpha}} \int_0^{m_C} \left(\frac{\psi(k)}{c(k)}\right)^{\frac{\alpha}{1-\alpha}} dk + (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \int_{m_C}^1 \left(\frac{\psi(k)}{c(k)}\right)^{\frac{\alpha}{1-\alpha}} dk \right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} \\ - \left((1-\beta_O)^{\frac{\alpha}{1-\alpha}} \int_0^{m_C} \left(\frac{\psi(k)}{c(k)}\right)^{\frac{\alpha}{1-\alpha}} dk \right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} \end{array} \right]. \end{aligned} \tag{A-9}$$

Taking the first-order-condition with respect to the threshold m_C and rearranging, we then find:

$$(\beta_V - \beta_O)(1-\beta_O)^{\frac{\rho}{1-\rho}} = \beta_V \left((1-\beta_O)^{\frac{\alpha}{1-\alpha}} - (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \right) \left[(1-\beta_O)^{\frac{\alpha}{1-\alpha}} + (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \frac{\int_{m_C^*}^1 (\psi(k)/c(k))^{\frac{\alpha}{1-\alpha}} dk}{\int_0^{m_C^*} (\psi(k)/c(k))^{\frac{\alpha}{1-\alpha}} dk} \right]^{\frac{\rho-\alpha}{\alpha(1-\rho)}},$$

from which equation (11) can easily be obtained. Notice that for a strictly interior solution, i.e., $m_C^* \in (0,1)$, the right-hand side of (11) would need to be smaller than one, which in turn requires:

$$\left(\frac{1-\beta_O}{1-\beta_V} \right)^{-\frac{\alpha}{1-\alpha}} > \frac{\beta_O}{\beta_V},$$

or simply $\beta_V (1-\beta_V)^{\frac{\alpha}{1-\alpha}} > \beta_O (1-\beta_O)^{\frac{\alpha}{1-\alpha}}$, as claimed in the main text.

The threshold in the substitutes case can be derived in an analogous way. In fact, it is straightforward to see that m_S will be chosen to maximize a profit function identical to that in (A-9) with β_O replacing β_V

throughout, and vice versa. As a result, m_S^* is given by:

$$\frac{\int_0^{m_S^*}\left(\psi\left(k\right)/c\left(k\right)\right)^{\frac{\alpha}{1-\alpha}}di}{\int_0^1\left(\psi\left(k\right)/c\left(k\right)\right)^{\frac{\alpha}{1-\alpha}}di}=\left\{1+\left(\frac{1-\beta_V}{1-\beta_O}\right)^{\frac{\alpha}{1-\alpha}}\left[\left(\frac{\frac{\beta_V}{\beta_O}-1}{\left(\frac{1-\beta_V}{1-\beta_O}\right)^{-\frac{\alpha}{1-\alpha}}-1}\right)^{\frac{\alpha(1-\rho)}{\rho-\alpha}}-1\right]\right\}^{-1}. \tag{A-10}$$

A-1.5 Derivation of Equation (12) and Proposition 2

In the extension in Section 2.2.A, recall that the profits of the firm are given by: $\tilde{\pi}_F=\pi_F-\int_0^1\frac{(\psi(i))^{\phi}}{\mu(i)}di$, where the second term captures the contracting costs. Focus first on the π_F term.

Consider the complements case. We begin by plugging equation (11), which pins down the m_C^* threshold, into the profit function (A-9). After a few simplifications, this delivers:

$$\pi_F=\Theta\frac{\alpha\left(1-\rho\right)}{\rho\left(1-\alpha\right)}\left[\int_0^1\left(\frac{\psi\left(i\right)}{c\left(i\right)}\right)^{\frac{\alpha}{1-\alpha}}di\right]^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}}\left(1-\beta_O\right)^{\frac{\rho}{1-\rho}}\left(\mathcal{H}_C\right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}}\left[\left(\beta_O-\beta_V\right)+\beta_V\left(\frac{1-\frac{\beta_O}{\beta_V}}{1-\left(\frac{1-\beta_O}{1-\beta_V}\right)^{-\frac{\alpha}{1-\alpha}}}\right)^{\frac{\rho(1-\alpha)}{\rho-\alpha}}\right],$$

where:

$$\mathcal{H}_C=\left\{1+\left(\frac{1-\beta_O}{1-\beta_V}\right)^{\frac{\alpha}{1-\alpha}}\left[\left(\frac{1-\frac{\beta_O}{\beta_V}}{1-\left(\frac{1-\beta_O}{1-\beta_V}\right)^{-\frac{\alpha}{1-\alpha}}}\right)^{\frac{\alpha(1-\rho)}{\rho-\alpha}}-1\right]\right\}^{-1}.$$

Hence, we can write profits as:

$$\pi_F=\Theta\frac{\alpha\left(1-\rho\right)}{\rho\left(1-\alpha\right)}\left[\int_0^1\left(\frac{\psi\left(i\right)}{c\left(i\right)}\right)^{\frac{\alpha}{1-\alpha}}di\right]^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}}\Gamma_C\left(\beta_V,\beta_O,\rho,\alpha\right).$$

In the substitutes case, we have an analogous expression:

$$\pi_F=\Theta\frac{\alpha\left(1-\rho\right)}{\rho\left(1-\alpha\right)}\left[\int_0^1\left(\frac{\psi\left(i\right)}{c\left(i\right)}\right)^{\frac{\alpha}{1-\alpha}}di\right]^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}}\left(1-\beta_V\right)^{\frac{\rho}{1-\rho}}\left(\mathcal{H}_S\right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}}\left[\left(\beta_V-\beta_O\right)+\beta_O\left(\frac{1-\frac{\beta_V}{\beta_O}}{1-\left(\frac{1-\beta_V}{1-\beta_O}\right)^{-\frac{\alpha}{1-\alpha}}}\right)^{\frac{\rho(1-\alpha)}{\rho-\alpha}}\right],$$

where:

$$\mathcal{H}_S=\left\{1+\left(\frac{1-\beta_V}{1-\beta_O}\right)^{\frac{\alpha}{1-\alpha}}\left[\left(\frac{1-\frac{\beta_V}{\beta_O}}{1-\left(\frac{1-\beta_V}{1-\beta_O}\right)^{-\frac{\alpha}{1-\alpha}}}\right)^{\frac{\alpha(1-\rho)}{\rho-\alpha}}-1\right]\right\}^{-1},$$

so that:

$$\pi_F=\Theta\frac{\alpha\left(1-\rho\right)}{\rho\left(1-\alpha\right)}\left[\int_0^1\left(\frac{\psi\left(i\right)}{c\left(i\right)}\right)^{\frac{\alpha}{1-\alpha}}di\right]^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}}\Gamma_S\left(\beta_V,\beta_O,\rho,\alpha\right).$$

Overall, we then see that profits can be expressed compactly as:

$$\pi_F = \Theta \frac{\alpha(1-\rho)}{\rho(1-\alpha)} \left[\int_0^1 \left(\frac{\psi(i)}{c(i)} \right)^{\frac{\alpha}{1-\alpha}} di \right]^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} \Gamma(\beta_V, \beta_O), \tag{A-11}$$

where:

$$\Gamma(\beta_V, \beta_O) = \begin{cases} \Gamma_C(\beta_V, \beta_O, \rho, \alpha) & \text{if } \rho > \alpha \\ \Gamma_S(\beta_V, \beta_O, \rho, \alpha) & \text{if } \rho < \alpha \end{cases}.$$

It is straightforward to verify that the expression for $\Gamma_S(\beta_V, \beta_O, \rho, \alpha)$ is identical to that for $\Gamma_C(\beta_V, \beta_O, \rho, \alpha)$, except for the fact that β_V is replaced by β_O and β_O is replaced by β_V.

Obtaining equation (12) from the more general equation (A-11) is then trivial. Notice, however, that when studying the optimal choice of $\psi(m)$ that maximizes $\tilde{\pi}_F$, the first-order condition with respect to $\psi(m)$ now delivers that, for two inputs at stages m and m', we have:

$$\left(\frac{\psi(m)/c(m)}{\psi(m')/c(m')} \right)^{\phi - \frac{\alpha}{1-\alpha}} = \frac{\mu(m)}{\mu(m')} \left(\frac{c(m)}{c(m')} \right)^{-\phi}. \tag{A-12}$$

Note that in the special case where $c(m) = c$ for all stages m, (A-12) reduces to: $(\psi(m)/\psi(m'))^{\phi - \frac{\alpha}{1-\alpha}} = \mu(m)/\mu(m')$, as reported in Section 2.2.A in the main text.

Using (A-12), one can show that the second-order condition with respect to $\psi(m)$, when evaluated at the optimal $\psi(m)$, simplifies to:

$$\frac{\rho - \alpha}{(1-\alpha)(1-\rho)} \frac{(\psi(m)/c(m))^{\frac{\alpha}{1-\alpha}}}{\int_0^1 (\psi(i)/c(i))^{\frac{\alpha}{1-\alpha}} di} + \frac{\alpha}{1-\alpha} - \phi \; < \; 0.$$

In particular, the restriction: $\phi > \alpha/(1-\alpha)$ is necessary to ensure that the second-order condition holds in the complements case. Equation (A-12) thus illustrates that the ratio $\psi(m)/c(m)$ will tend to comove with contractibility along the value chain as long as contractibility and marginal costs are not positively correlated. But notice that plugging (A-12) into (A-11), we have that the effect of a reduction in the marginal cost of a given stage m will be increasing in the level of contractibility $\mu(m)$. As a result, if we were to interpret the path of marginal costs as being the outcome of an optimal global sourcing model, then we would expect, other things equal, that the firm would be particularly willing to achieve marginal cost reductions for highly contractible stages, thus resulting in a negative correlation between $c(m)$ and $\mu(m)$.

Turning now specifically to Proposition 2, we have developed the argument in the main text that the characterization of the optimal organizational mode from Proposition 1, in particular how this hinges on whether ρ is greater or less than α, continues to hold. This is because these predictions hold taking the profile of the $\psi(m)$'s as given; the mapping of these $\psi(m)$'s to heterogeneous contractibility across stages does not detract from this conclusion. Assuming that marginal costs of production are constant ($c(m) = c$) across all stages m, the optimal level of the $\psi(m)$'s that will be specified in the initial contract varies inversely with the exogenous contracting cost $1/\mu(m)$ pertaining to that stage. We thus associate a larger $\psi(m)$ with a higher degree of contractibility, in the sense that it is less costly to contract upon $\psi(m)$.

The second part of Proposition 2 speaks to how an increase in the contractibility of upstream relative to downstream inputs affects the m_C^* and m_S^* thresholds. To ease notation, define: $\tilde{\psi}(m) \equiv \psi(m)^{\frac{\alpha}{1-\alpha}}$. In the complements case, in light of equation (11), the natural notion of what constitutes a greater degree of "upstream contractibility" is an increase in the integral of the $\tilde{\psi}(m)$'s over all $m \in [0, m_C^*)$, that nevertheless holds the overall contractibility of the production process constant. In differential calculus notation, this translates to: $\int_0^{m_C^*} d\tilde{\psi}(m)dm > 0$ and $\int_0^1 d\tilde{\psi}(m)dm = 0$. Taking the total derivative of (11), one obtains:

$$\tilde{\psi}(m_C^*)dm_C^* + \int_0^{m_C^*} d\tilde{\psi}(m)dm = 0,$$

from which it follows that $dm_C^* < 0$ in response to an increase in upstream contractibility, as claimed in the proposition. For the substitutes case, a similar argument can be applied to (A-10) to establish that $dm_S^* < 0$ in response to a differential change in the profile of the $\tilde{\psi}(m)$'s that satisfies: $\int_0^{m_S^*} d\tilde{\psi}(m)dm > 0$ and $\int_0^1 d\tilde{\psi}(m)dm = 0$.

A-1.6 Proof of Proposition 3

With firm heterogeneity in core productivity and incorporating fixed costs of integration, the firm's profits are now given by: $\pi_F - \int_0^1 f_V \mathbf{1}(\beta(i) = \beta_V)di$, where $\mathbf{1}(\beta_i = \beta_V)$ is an indicator function equal to 1 if and only if stage i is integrated by the firm. The proof is presented below for the complements case; that for the substitutes case follows in analogous fashion.

Suppose that $\rho > \alpha$. We first show that despite the introduction of fixed costs of integration, the optimal organizational mode continues to feature outsourcing of stages $[0, m_C^*)$ up to a cutoff stage m_C^*, and integration for all stages $[m_C^*, 1]$ further downstream. This is established through a proof by contradiction. Suppose there exists a $\tilde{m} \in (0, 1)$, such that there is a non-zero measure of integrated stages immediately upstream of $\tilde{m}$ and a non-zero measure of outsourced stages immediately downstream of it. Pick two positive constants ε_L and ε_R satisfying equation (A-7); these two constants can always be chosen to be sufficiently small so that $(\tilde{m} - \varepsilon_L, \tilde{m})$ lies within the subset of integrated stages immediately upstream of $\tilde{m}$, and $(\tilde{m}, \tilde{m} + \varepsilon_R)$ is within the subset of outsourced stages immediately downstream of $\tilde{m}$.

If $\varepsilon_L \geq \varepsilon_R$, compare profits under the organizational mode where stages $(\tilde{m} - \varepsilon_L, \tilde{m})$ are integrated and stages $(\tilde{m}, \tilde{m} + \varepsilon_R)$ are outsourced, against an alternative where $(\tilde{m} - \varepsilon_L, \tilde{m})$ is outsourced and $(\tilde{m}, \tilde{m} + \varepsilon_R)$ is integrated, holding the organizational decisions over all other stages constant. The proof in Section A-1.3 showed that π_F is strictly higher under the latter organizational mode. The fixed costs of integration that are incurred would also be (weakly) lower under the latter option, since a (weakly) smaller measure of stages is integrated. This alternative organizational mode is thus more profitable, and yields the desired contradiction.

If instead $\varepsilon_L < \varepsilon_R$, a more involved argument is needed. Compare now profits under the organizational mode where stages $(\tilde{m} - \varepsilon_L, \tilde{m})$ are integrated and stages $(\tilde{m}, \tilde{m} + \varepsilon_L)$ are outsourced, versus an alternative where $(\tilde{m} - \varepsilon_L, \tilde{m})$ is outsourced and $(\tilde{m}, \tilde{m} + \varepsilon_L)$ is integrated, holding the organizational decisions over all other stages constant. Let the profits associated with the former set of organizational decisions be Π_1^f, while that for the latter be Π_2^f. By construction, the incurred fixed costs of integration are exactly equal under both organizational modes, so one can focus solely on π_F. Bearing in mind the expression for π_F from (A-8), consider the respective contribution to profits of: (i) stages in $[0, \tilde{m} - \varepsilon_L]$; (ii) those in $(\tilde{m} - \varepsilon_L, \tilde{m})$; (iii) those in $(\tilde{m}, \tilde{m} + \varepsilon_L)$; and (iv) stages in $[\tilde{m} + \varepsilon_L, 1]$.

It is straightforward to see that the contribution of stages in the first region is identical in both Π_1^f and Π_2^f. As for the fourth region, the contribution of these stages to Π_1^f is:

$$\Theta \int_{\tilde{m}+\varepsilon_L}^{1} \beta(i) \left(\mathcal{A}^f + (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \mathcal{B}^f + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \mathcal{C}^f + \mathcal{D}^f\right)^{\frac{\rho-\alpha}{\alpha(1-\rho)}} (1-\beta(i))^{\frac{\alpha}{1-\alpha}} \gamma(i)di,$$

where we define: $\gamma(i) \equiv (\psi(i)/c(i))^{\frac{\alpha}{1-\alpha}}$, $\mathcal{A}^f \equiv \int_0^{\tilde{m}-\varepsilon_L} (1-\beta(k))^{\frac{\alpha}{1-\alpha}} \gamma(k)\,dk$, $\mathcal{B}^f \equiv \int_{\tilde{m}-\varepsilon_L}^{\tilde{m}} \gamma(k)\,dk$, $\mathcal{C}^f \equiv$

$\int_{\tilde{m}}^{\tilde{m}+\varepsilon_L} \gamma(k)\, dk$, and $\mathcal{D}^f \equiv \int_{\tilde{m}+\varepsilon_L}^{i} (1-\beta(k))^{\frac{\alpha}{1-\alpha}} \gamma(k)\, dk$. On the other hand, the contribution from these stages to Π_2^f is equal to:

$$\Theta \int_{\tilde{m}+\varepsilon_L}^{1} \beta(i) \left(\mathcal{A}^f + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \mathcal{B}^f + (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \mathcal{C}^f + \mathcal{D}^f\right)^{\frac{\rho-\alpha}{\alpha(1-\rho)}} (1-\beta(i))^{\frac{\alpha}{1-\alpha}} \gamma(i) di.$$

Since $\varepsilon_L < \varepsilon_R$, we have: $\mathcal{B}^f = \int_{\tilde{m}-\varepsilon_L}^{\tilde{m}} \gamma(k) dk = \int_{\tilde{m}}^{\tilde{m}+\varepsilon_R} \gamma(k) dk > \int_{\tilde{m}}^{\tilde{m}+\varepsilon_L} \gamma(k) dk = \mathcal{C}^f$. Bear in mind also that: $(1-\beta_O)^{\frac{\alpha}{1-\alpha}} > (1-\beta_V)^{\frac{\alpha}{1-\alpha}}$. Comparing the last two equations above, it follows that when $\rho > \alpha$, the stages in $[\tilde{m}+\varepsilon_L, 1]$ contribute more to profits in Π_2^f than in Π_1^f.

It remains to compare the relative contributions due to the middle two sets of stages, i.e., $(\tilde{m}-\varepsilon_L, \tilde{m})$ and $(\tilde{m}, \tilde{m}+\varepsilon_L)$. Let $\tilde{\Pi}_1^f$ refer to the profits under Π_1^f that accrue from these subsets of stages, and likewise define $\tilde{\Pi}_1^f$ analogously for Π_2^f. Using (A-8) and after some algebra, it can be shown that:

$$\begin{aligned}
\tilde{\Pi}_1^f - \tilde{\Pi}_2^f \;\propto\; & (\beta_V - \beta_O) \left[\left(\mathcal{A}^f + (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \mathcal{B}^f\right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} + \left(\mathcal{A}^f + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \mathcal{B}^f\right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} - \left(\mathcal{A}^f\right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} \right] \\
& - \beta_V \left(\mathcal{A}^f + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \mathcal{B}^f + (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \mathcal{C}^f\right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} \\
& + \beta_O \left(\mathcal{A}^f + (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \mathcal{B}^f + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \mathcal{C}^f\right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}}
\end{aligned}$$

We now proceed to show that if the value of ε_L that was initially chosen was sufficiently small, then $\tilde{\Pi}_1^f - \tilde{\Pi}_2^f < 0$. Observe that $\tilde{\Pi}_1^f - \tilde{\Pi}_2^f = 0$ at $\varepsilon_L = 0$. Given this, it then suffices to show that $\frac{\partial}{\partial \varepsilon_L}\left(\tilde{\Pi}_1^f - \tilde{\Pi}_2^f\right) < 0$ at $\varepsilon_L = 0$. Differentiating the above expression with Leibniz's rule yields:

$$\begin{aligned}
\frac{\partial}{\partial \varepsilon_L}\left(\tilde{\Pi}_1^f - \tilde{\Pi}_2^f\right) \propto\; & (\beta_V - \beta_O) \left(\mathcal{A}^f + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \mathcal{B}^f\right)^{\frac{\rho-\alpha}{\alpha(1-\rho)}} \left(-(1-\beta_V)^{\frac{\alpha}{1-\alpha}} \gamma(\tilde{m}-\varepsilon_L) + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \gamma(\tilde{m}-\varepsilon_L)\right) \\
& - \beta_V \left(\mathcal{A}^f + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \mathcal{B}^f + (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \mathcal{C}^f\right)^{\frac{\rho-\alpha}{\alpha(1-\rho)}} \\
& \quad \times \left(-(1-\beta_V)^{\frac{\alpha}{1-\alpha}} \gamma(\tilde{m}-\varepsilon_L) + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \gamma(\tilde{m}-\varepsilon_L) + (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \gamma(\tilde{m}+\varepsilon_L)\right) \\
& + \beta_O \left(\mathcal{A}^f + (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \mathcal{B}^f + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \mathcal{C}^f\right)^{\frac{\rho-\alpha}{\alpha(1-\rho)}} (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \gamma(\tilde{m}+\varepsilon_L).
\end{aligned}$$

The above steps use the fact that: (i) $\frac{\partial}{\partial \varepsilon_L}\mathcal{A}^f = -(1-\beta_V)^{\frac{\alpha}{1-\alpha}} \gamma(\tilde{m}-\varepsilon_L)$, since for ε_L sufficiently small, $\tilde{m}-\varepsilon_L$ is within the positive measure of stages immediately upstream of $\tilde{m}$ that is initially integrated; (ii) $\frac{\partial}{\partial \varepsilon_L}\mathcal{B}^f = \gamma(\tilde{m}-\varepsilon_L)$; and (iii) $\frac{\partial}{\partial \varepsilon_L}\mathcal{C}^f = \gamma(\tilde{m}+\varepsilon_L)$. As $\varepsilon_L \longrightarrow 0$, the above simplifies to: $\frac{\partial}{\partial \varepsilon_L}\left(\tilde{\Pi}_1^f - \tilde{\Pi}_2^f\right) \propto -(\beta_V - \beta_O)(1-\beta_V)^{\frac{\alpha}{1-\alpha}} (\mathcal{A})^{\frac{\rho-\alpha}{\alpha(1-\rho)}} \gamma(\tilde{m}) < 0$. It follows that $\tilde{\Pi}_1^f - \tilde{\Pi}_2^f < 0$ when ε_L is positive but sufficiently small. Summarizing the comparison of profits across all four subsets of stages under Π_1^f and Π_2^f, the alternative organizational mode that generates Π_2^f delivers higher profits than Π_1^f, which yields the desired contradiction once again. This concludes the proof that the optimal organizational mode remains as described in Proposition 2, even though fixed costs of integration have been introduced.

To solve for the cutoff stage m_C^* in the complements case, we appeal to the expression for π_F in (A-9). Taking the first-order condition with respect to m_C in the profit function $\pi_F - \int_0^1 f_V \mathbf{1}(\beta(i) = \beta_V) di =$

$\pi_F - (1 - m_C) f_V$ and rearranging, this delivers the implicit function that pins down m_C^*:

$$\left(\frac{\psi\left(m_C^*\right)}{c\left(m_C^*\right)}\right)^{\frac{\alpha}{1-\alpha}}\left[\int_0^{m_C^*}\left(\frac{\psi\left(k\right)}{c\left(k\right)}\right)^{\frac{\alpha}{1-\alpha}}dk\right]^{\frac{\rho-\alpha}{\alpha(1-\rho)}}\times$$
$$\left\{\left(1-\frac{\beta_O}{\beta_V}\right)-\left(1-\left(\frac{1-\beta_V}{1-\beta_O}\right)^{\frac{\alpha}{1-\alpha}}\right)\left[1+\left(\frac{1-\beta_V}{1-\beta_O}\right)^{\frac{\alpha}{1-\alpha}}\frac{\int_{m_C^*}^1\left(\frac{\psi(k)}{c(k)}\right)^{\frac{\alpha}{1-\alpha}}dk}{\int_0^{m_C^*}\left(\frac{\psi(k)}{c(k)}\right)^{\frac{\alpha}{1-\alpha}}dk}\right]^{\frac{\rho-\alpha}{\alpha(1-\rho)}}\right\} = \frac{f_V}{\Psi A\theta^{\frac{\rho}{1-\rho}}}, \tag{A-13}$$

where $\Psi = (1-\beta_O)^{\frac{\rho}{1-\rho}}\beta_V\frac{\rho}{\alpha}\left(\frac{1-\rho}{1-\alpha}\right)^{\frac{\rho-\alpha}{\alpha(1-\rho)}}\rho^{\frac{\rho}{1-\rho}}$. Note that in the special case of $f_V = 0$, (A-13) simplifies to the expression for m_C^* in the benchmark model in (11).

It remains to show that the predictions related to how "upstream contractibility" affects the cutoff stage carry through even in the presence of fixed costs of integration. As in Section A-1.5, suppose $c(m) = c$ for all stages and define $\tilde{\psi}(m) \equiv \psi(m)^{\frac{\alpha}{1-\alpha}}$. Consider the effects of an increase in upstream contractibility, wherein: $\int_0^{m_C^*} d\tilde{\psi}(m)dm > 0$ while $\int_{m_C^*}^1 d\tilde{\psi}(m)dm = -\int_0^{m_C^*} d\tilde{\psi}(m)dm < 0$, so that $\int_0^1 d\tilde{\psi}(m)dm = 0$. Denote the left-hand side of equation (A-13) by $F(m_C^*)$. Taking the total derivative of (A-13), one obtains:

$$0 = F'(m_C^*)dm_C^* + \tilde{\psi}(m_C^*)\frac{\rho-\alpha}{\alpha(1-\rho)}\left[\int_0^{m_C^*}\tilde{\psi}\left(k\right)dk\right]^{\frac{\rho-\alpha}{\alpha(1-\rho)}-1} G(m_C^*)\int_0^{m_C^*} d\tilde{\psi}\left(k\right)dk,$$

where:

$$\begin{aligned} G(m_C^*) &= \left(1-\frac{\beta_O}{\beta_V}\right)-\left(1-\left(\frac{1-\beta_V}{1-\beta_O}\right)^{\frac{\alpha}{1-\alpha}}\right)^2\left[1+\left(\frac{1-\beta_V}{1-\beta_O}\right)^{\frac{\alpha}{1-\alpha}}\frac{\int_{m_C^*}^1\tilde{\psi}\left(k\right)dk}{\int_0^{m_C^*}\tilde{\psi}\left(k\right)dk}\right]^{\frac{\rho-\alpha}{\alpha(1-\rho)}-1} \\ &> \left(1-\frac{\beta_O}{\beta_V}\right)-\left(1-\left(\frac{1-\beta_V}{1-\beta_O}\right)^{\frac{\alpha}{1-\alpha}}\right)\left[1+\left(\frac{1-\beta_V}{1-\beta_O}\right)^{\frac{\alpha}{1-\alpha}}\frac{\int_{m_C^*}^1\tilde{\psi}\left(k\right)dk}{\int_0^{m_C^*}\tilde{\psi}\left(k\right)dk}\right]^{\frac{\rho-\alpha}{\alpha(1-\rho)}} \\ &= \frac{F(m_C^*)}{\tilde{\psi}(m_C^*)}\left[\int_0^{m_C^*}\tilde{\psi}\left(k\right)dk\right]^{-\frac{\rho-\alpha}{\alpha(1-\rho)}}. \end{aligned}$$

This last step follows from a substitution that uses the first-order condition for m_C^*. Clearly, the coefficient of the $\int_0^{m_C^*} d\tilde{\psi}\left(k\right)dk$ term in the total derivative is positive in the complements case. Recall also that the second-order condition for m_C^* implies that $F'(m^*) > 0$. A quick inspection of the total derivative then shows that $dm_C^* < 0$ when $\int_0^{m_C^*} d\tilde{\psi}\left(k\right)dk > 0$. Thus, the response of the cutoff stage to a greater degree of upstream contractibility continues to be characterized by the statement in Proposition 2, even in this extension of the model.

As a further consequence of this argument, it is in general not straightforward to sign the cross-partial effect of θ and upstream contractibility on the cutoff stage, m_C^*, as this would require making non-standard assumptions regarding the third-derivative of the firm's profit function, i.e., on the behavior of $F''(m_C^*)$. This is why we do not pursue specifications in the empirics that involve triple interactions between the ρ quintiles, upstream contractibility, and firm productivity.

A-1.7 Proof of Proposition 4

We illustrate this for the complements case ($\rho > \alpha$); the mechanics of the proof carry over to the substitutes case. Suppose to the contrary that $I_0 \equiv (\tilde{m}, \tilde{m}+\varepsilon) \in \Omega$ is a positive measure of discretionarily outsourced stages, located downstream of a positive measure of integrated stages. Denote this latter positive measure of integrated stages by I_1, where $I_1 \in \Omega$ by definition. There are two cases to consider: (i) I_1 is immediately upstream of $\tilde{m}$, i.e., $I_1 = (\tilde{m}-\tilde{\varepsilon}, \tilde{m})$, for some $\tilde{\varepsilon} > 0$; and (ii) I_1 is not immediately upstream of $\tilde{m}$, i.e., $I_1 = (m_1 - \tilde{\varepsilon}, m_1)$, where $m_1 < \tilde{m}$ and $[m_1, \tilde{m}] \in \Upsilon$, i.e, the intervals I_0 and I_1 are separated by a positive measure of exogenously outsourced stages.

Consider first case (i). Without loss of generality, we can select two positive constants ε_L and ε_R such that $\varepsilon_L, \varepsilon_R < \min\{\varepsilon, \tilde{\varepsilon}\}$, which moreover satisfy equation (A-7). The same argument from the proof of Proposition 1 in Section A-1.3 can then be applied: If we were to interchange the organizational mode, to instead outsource the stages in $(\tilde{m}-\varepsilon_L, \tilde{m})$ and integrate the stages in $(\tilde{m}, \tilde{m}+\varepsilon_R)$, this necessarily results in a strict increase in profits. This yields the desired contradiction, as it cannot then be optimal to have the stages in $(\tilde{m}-\tilde{\varepsilon}, \tilde{m})$ integrated, while those in $(\tilde{m}, \tilde{m}+\varepsilon)$ are discretionarily outsourced.

Consider next case (ii). Denote by $\tilde{\Pi}_1$ the configuration of organizational modes in which the stages in $I_1 = (m_1 - \tilde{\varepsilon}, m_1)$ are integrated, while those in $I_0 = (\tilde{m}, \tilde{m}+\varepsilon)$ are discretionarily outsourced. We will compare this against $\tilde{\Pi}_2$, which is the profits from the configuration where I_1 is instead outsourced and I_0 is integrated, holding the organizational mode of all other stages in $[0, m_1 - \varepsilon_L]$, $[m_1, \tilde{m}]$, and $[\tilde{m}+\varepsilon_R, 1]$ constant. Note in particular that the stages in $[m_1, \tilde{m}]$ are all exogenously outsourced. We now select ε_L and ε_R, so that $0 < \varepsilon_L, \varepsilon_R < \min\{\varepsilon, \tilde{\varepsilon}\}$ and:

$$\int_{m_1-\varepsilon_L}^{m_1} (\psi(i)/c(i))^{\alpha/(1-\alpha)}\, di = \int_{\tilde{m}}^{\tilde{m}+\varepsilon_R} (\psi(i)/c(i))^{\alpha/(1-\alpha)}\, di.$$

We now use the expression for firm profits from (A-8), and distinguish between five sets of stages: (i) all stages upstream of $m_1 - \varepsilon_L$; (ii) stages in $(m_1 - \varepsilon_L, m_1)$; (iii) in $[m_1, \tilde{m}]$; (iv) in $(\tilde{m}, \tilde{m}+\varepsilon_R)$; and (v) in $[\tilde{m}+\varepsilon_R, 1]$. Using the same arguments as in Section A-1.3, the profits associated with both the first and fifth sets of stages can be shown to cancel out exactly when comparing their contributions to $\tilde{\Pi}_1$ and $\tilde{\Pi}_2$. As for the remaining three sets of stages, one can show after some algebra that:

$$\begin{aligned}
\tilde{\Pi}_1 - \tilde{\Pi}_2 \;\propto\; (\beta_V - \beta_O) \Bigg[& -\tilde{\mathcal{A}}^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} + \left(\tilde{\mathcal{A}} + (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \int_{m_1-\varepsilon_L}^{m_1} \gamma(k)dk \right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} \\
& + \left(\tilde{\mathcal{A}} + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \int_{m_1-\varepsilon_L}^{m_1} \gamma(k)dk + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \int_{m_1}^{\tilde{m}} \gamma(k)dk \right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} \\
& - \left(\tilde{\mathcal{A}} + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \int_{m_1-\varepsilon_L}^{m_1} \gamma(k)dk + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \int_{m_1}^{\tilde{m}} \gamma(k)dk + (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \int_{\tilde{m}}^{\tilde{m}+\varepsilon_R} \gamma(k)dk \right)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} \Bigg],
\end{aligned}$$

where: $\gamma(k) = (\psi(k)/c(k))^{\frac{\alpha}{1-\alpha}}$, and: $\tilde{\mathcal{A}} = \int_0^{m_1-\varepsilon_L} ((1-\beta(k))\psi(k)/c(k))^{\frac{\alpha}{1-\alpha}} dk$. Again, we can show that $\tilde{\Pi}_1 - \tilde{\Pi}_2 < 0$ by invoking the inequality: $(y+a+b)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} - (y+b)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} > (y+a)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}} - (y)^{\frac{\rho(1-\alpha)}{\alpha(1-\rho)}}$, which holds when $\rho > \alpha$, and substituting in: $y = \tilde{\mathcal{A}}$, $a = (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \int_{m_1-\varepsilon_L}^{m_1} \gamma(k)dk + (1-\beta_O)^{\frac{\alpha}{1-\alpha}} \int_{m_1}^{\tilde{m}} \gamma(k)dk$ and $b = (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \int_{\tilde{m}}^{\tilde{m}+\varepsilon_R} \gamma(k)dk = (1-\beta_V)^{\frac{\alpha}{1-\alpha}} \int_{m_1-\varepsilon_L}^{m_1} \gamma(k)dk$.

A-2 Data Appendix

A-2.1 Descriptive Statistics

Table A-1

Firm Characteristics

	10th	Median	90th	Mean	Std Dev
A: Firm variables					
All (320,254 obs.)					
Number of Establishments (incl. self)	1	1	1	1.22	3.44
Number of countries (incl. self)	1	1	1	1.05	0.62
Number of integrated SIC codes	1	2	3	1.95	2.21
Year started	1948	1984	1999	1976.84	24.68
Log (Total employment)	3.045	3.807	5.557	4.088	1.080
Log (Sales in USD) (288,627 obs.)	12.522	15.202	17.059	14.803	2.573
Log (Sales/Employment) (288,627 obs.)	8.479	11.429	12.545	10.731	2.635
MNCs only (6,370 obs.)					
Number of Establishments (incl. self)	2	3	17	8.48	22.74
Number of countries (incl. self)	2	2	6	3.47	3.64
Number of integrated SIC codes	2	5	17	8.10	11.88
Year started	1917	1968	1995	1960.29	33.88
Log (Total employment)	3.912	5.737	8.522	6.031	1.788
Log (Sales in USD) (5,891 obs.)	15.895	17.997	20.934	18.208	1.978
Log (Sales/Employment) (5,891 obs.)	11.229	12.145	13.040	12.110	0.921
Integrated inputs (All firms)					
Total Requirements, tr_{ij}	0.000086	0.003861	0.053442	0.019241	0.052952
Total Requirements, tr_{ij} (excl. self-SIC)	0.000035	0.001232	0.009568	0.006774	0.036741
B: From Input-Output Tables					
Total Requirements, tr_{ij}	0.000006	0.000163	0.002322	0.001311	0.008026
Baseline Upstreamness measure (mean)	1.838	3.094	4.285	3.097	0.955
C: Ratio-Upstreamness measures					
All inputs (mean)	0.494	0.561	0.691	0.590	0.141
All inputs (random pick)	0.495	0.561	0.692	0.590	0.141
Ever-integrated inputs only	0.583	0.656	0.803	0.692	0.179
Manufacturing inputs only	0.548	0.633	0.798	0.657	0.174
Exclude parent sic, manufacturing only	0.590	1.100	2.128	1.269	0.625

Notes: Panels A and C are tabulated for the sample of 320,254 firms with primary SIC in manufacturing and at least 20 employees in the 2004/2005 vintage of D&B WorldBase. In Panel A, the total requirements summary statistics for "Integrated inputs" are computed over the set of integrated input by parent primary industry pairs pooled across firms in our D&B WorldBase sample; there are 666,656 such pairs, with the count equal to 336,168 if the self-SIC is removed from consideration. In Panel B, the summary statistics are computed over the tr_{ij} coefficients in the 1992 U.S. Input-Output Tables, over all input (i) and output (j) SIC industry pairs for which j is in manufacturing and $tr_{ij} > 0$ (416,349 observations); i includes both manufacturing and non-manufacturing inputs. In Panel C, the Ratio-Upstreamness measures under "mean" and "random pick" refer to the treatment adopted for non-manufacturing inputs when mapping from the original IO1992 to SIC codes.

Table A-2

Industry Characteristics

	10th	Median	90th	Mean	Std Dev
Demand elasticity$_j$ (all codes)	2.300	4.820	20.032	8.569	10.181
Demand elasticity$_j$ (BEC cons. & cap.)	1.983	4.500	20.289	8.819	11.722
Demand elasticity$_j$ (BEC cons. only)	2.000	4.639	15.992	8.366	11.881
Demand elasticity$_j$ (BEC cons. only) minus α_j proxy	-9.086	-4.266	7.783	-1.294	12.314
Log (Skilled Emp./Workers)$_j$	-1.750	-1.363	-0.778	-1.308	0.377
Log (Equip. Capital/Workers)$_j$	2.869	4.043	5.163	4.039	0.867
Log (Plant Capital/Workers)$_j$	2.517	3.302	4.524	3.426	0.755
Log (Materials/Workers)$_j$	3.898	4.596	5.681	4.702	0.726
R&D intensity$_j$	-6.908	-6.097	-3.426	-5.506	1.463
(Value-added/Shipments)$_j$	0.357	0.518	0.660	0.514	0.119
Contractibility$_j$	0.091	0.362	0.816	0.410	0.265
Upstream-Contractibility$_j$	-0.069	0.018	0.101	0.015	0.069

Notes: The table reports industry-level summary statistics taken over the 459 SIC manufacturing industries, except for: (i) the "BEC cons. & cap." elasticity, which is available for only 305 industries; and (ii) the "BEC cons. only" elasticity, which is available for 219 industries. See Appendix A-2.2 for definitions.

Table A-3

"Bunching" of Integrated Inputs by Quintiles of Upstreamness

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Quintile 1	0.455	0.057	0.057	0.060	0.041
Quintile 2	0.057	0.011	0.007	0.006	0.004
Quintile 3	0.057	0.007	0.010	0.007	0.005
Quintile 4	0.060	0.006	0.007	0.013	0.008
Quintile 5	0.041	0.004	0.005	0.008	0.007

Notes: Probability matrix constructed using the subset of 34,651 firms that have integrated at least two manufacturing inputs other than the parent industry self-SIC. For the a-th row and b-th column, we compute the probability that any two randomly drawn integrated manufacturing input SICs of the firm in question come from the a-th and b-th quintiles of $Upstreamness_{ij}$ values, where j is the SIC output industry of the firm and the quintiles are taken over all SIC manufacturing inputs i. A simple average of the probabilities across all 34,651 firms is reported.

Table A-4

Industry-pair Characteristics

	10th	Median	90th	Mean	Std Dev
Upstreamness_{ij}	1.106	1.869	3.384	2.115	0.908
Contractibility-up-to-i_{ij}	0.045	0.378	0.976	0.432	0.325
Log (Total Requirements)$_{ij}$	0.001	0.003	0.022	0.010	0.026
Upstream-Complementarity$_{ij}$	-0.009	0.078	0.924	0.252	0.334
Downstream-Complementarity$_{ij}$	-0.022	0.028	0.971	0.212	0.340
Diff. Log (Skilled Emp./Workers)$_{ij}$	0.037	0.270	0.754	0.343	0.289
Diff. Log (Equip. Capital/Workers)$_{ij}$	0.100	0.681	1.876	0.854	0.706
Diff. Log (Plant Capital/Workers)$_{ij}$	0.089	0.622	1.635	0.763	0.626
Diff. R&D Intensity$_{ij}$	0.004	1.187	3.242	1.429	1.208
Same-SIC2$_{ij}$	0	0	1	0.245	0.430
Same-SIC3$_{ij}$	0	0	0	0.064	0.244

Notes: The table reports summary statistics for the industry-pair variables included in the within-firm regressions, based on the subset of inputs i that rank in the top 100 manufacturing inputs (by tr_{ij} value) that have been "ever-integrated" by at least one parent firm with primary or secondary activity in j. See Appendix A-2.2 for definitions.

A-2.2 Construction of the Industry Variables

Industry Controls

Import demand elasticities: Based on the U.S. HS10 product import demand elasticities estimated by Broda and Weinstein (2006). These are mapped into SIC categories using concordance weights based on total U.S. imports between 1989-2006 from Feenstra *et al.* (2002). For each HS10 code missing an elasticity value, we assigned a value equal to the trade-weighted average elasticity of the available HS10 codes with which it shares the same first nine digits. This was done successively up to codes that share the same first two digits, to assign as many HS10 codes with elasticities as possible. The elasticity for each 4-digit SIC code is then calculated as the trade-weighted average over its constituent HS10 elasticities. After these steps, 61 out of the 459 4-digit SIC manufacturing codes remain without elasticities, as these codes are not used in the U.S. import records. This arises because customs is unable to distinguish the source industry of certain goods on the basis of their physical specimen; for example, it cannot distinguish SIC2011 (Meat Packing Plants) from SIC2013 (Sausages and Other Prepared Meats). In such instances, U.S. customs assigns all the goods value to one of the possible SIC codes, and excludes the others. Table 3 in Feenstra *et al.* (2002) provides a list of such excluded codes and their corresponding destination codes, allowing us to compute a trade-weighted elasticity value of the respective destination codes to obtain an elasticity for each excluded code. There were 51 4-digit SIC codes that were successfully assigned in this way. For the remaining 10 4-digit SIC codes, a trade-weighted average elasticity over all 4-digit SIC categories that share the same first three digits, and if necessary those that share the same first two digits, was computed.

Contractibility: Following the methodology proposed by Nunn (2007), which in turn relies on the Rauch (1999) classification of goods as either homogeneous, reference-priced, or differentiated. Rauch's original classification is in SITC Rev 2. Based on Feenstra *et al.* (2002), we obtained a master-list of HS by SITC Rev 2 by SIC triplets. The Rauch codings for each SITC Rev 2 category are then associated to all the HS10 products that fall under it. For each SIC 4-digit code, we calculated the specificity of the SIC industry as the fraction of HS10 constituent codes classified as neither reference-priced nor traded on an organized exchange. The procedure described above for import demand elasticities is used to assign the specificity values for missing 4-digit SIC manufacturing codes. The Nunn (2007) measure of contract-intensity of each

4-digit SIC code is then calculated as a direct requirements weighted-average over the specificities of the inputs purchased, using direct requirements coefficients from the 1992 U.S. Input-Output Tables. We take one minus the contract-intensity to get a measure of contractibility.

Factor intensities: From the NBER-CES Manufacturing Industry Database (Becker and Gray, 2009). Skill intensity is the log of the number of non-production workers divided by total employment. Equipment capital intensity and plant capital intensity are respectively the log of the equipment and plant capital stock per worker. Materials intensity is the log of materials purchases per worker. These are computed as averages over 2001-2005, using the annual data for 4-digit SIC industries. For a small number of industries without 2001-2005 data, we used an average over an earlier in-sample window: for SIC 3292 (Asbetos), a 1986-1990 average was used, while for SIC 2411, 2711, 2721 2731, 2741, 2771, and 3732, a 1991-1995 average was used. One further variable – value-added over total shipments – was constructed in the same manner.

R&D intensity: From Nunn and Trefler (2013), who calculated R&D expenditures to total sales on an annual basis for HS6 products, using U.S. firms in the Orbis dataset. For HS6 products missing an R&D intensity value, a procedure analogous to that described above for the import demand elasticities was used, to first assign a value using the trade-weighted average over HS codes that share the same first five digits, and successively until the same first two digits. These are then converted to 4-digit SIC codes using a trade-weighted average R&D intensity of constituent HS6 codes; all concordance weights are based on total U.S. imports between 1989-2006, from Feenstra *et al.* (2002). The procedure described above for import demand elasticities is used to assign the R&D intensity values for missing 4-digit SIC manufacturing codes.

Industry-pair Controls

Complementarity measures: Based on the methodology proposed by Fan and Lang (2000), and constructed using the 1992 U.S. Input-Output Tables. For each pair of SIC 4-digit industries i and j, $\textit{Upstream-Complementarity}_{ij}$ is equal to the correlation between the direct requirements coefficients of manufacturing inputs $k \neq i, j$ used in the production of i and j respectively. In other words, this is computed as the correlation between dr_{ki} and dr_{kj}, across all $k \neq i, j$ in the manufacturing sector. For the measure $\textit{Downstream-Complementarity}_{ij}$, we first construct the "allocation coefficients", a_{ik}, of each industry i's use as an input by industry k, as the share of industry-i gross output that is purchased directly by industry k.[1] This measure is then equal to the correlation between a_{ik} and a_{jk}, across all buying industries $k \neq i, j$ in the manufacturing sector.

Differences in factor intensities: For each SIC 4-digit manufacturing industry, the construction of the skill intensity, equipment capital intensity, plant capital intensity, and R&D intensity measures has been detailed above. For each of these measures, the absolute value of the difference between each pair of SIC 4-digit industries i and j is then taken.

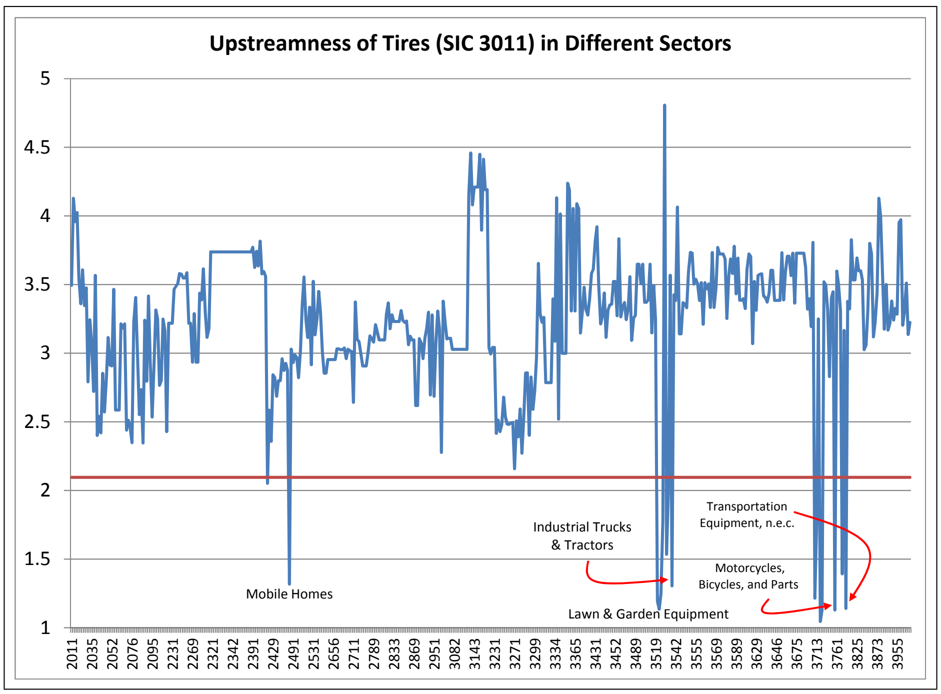
Same-SIC indicators: Dummy variables identifying "close" industries based on their SIC classification. $\textit{Same-SIC2}_{ij}$ is a dummy variable equal to 1 if industries i and j share the same first 2 digits of the SIC1987 classification. $\textit{Same-SIC3}_{ij}$ is a dummy variable equal to 1 if industries i and j share the same first 3 digits of the SIC 1987 classification.

[1] There are instances where a IO1992 manufacturing industry maps to multiple SIC manufacturing codes; when this is the case, the direct use value of inputs purchased by this IO1992 manufacturing industry is split equally across the destination SIC output industries in the calculation of the allocation coefficients.

A-2.3 Further Discussion on the *Upstreamness*$_{ij}$ and *Ratio-Upstreamness*$_{jp}$ Measures

Upstreamness$_{ij}$**:** Figure A-1 below provides an illustration of the variation contained in the *Upstreamness*$_{ij}$ measure, even when focusing on one particular input industry, in this case Tires and Inner Tubes (SIC 3011). Notice that *Upstreamness*$_{ij}$ is indeed smaller for j sectors such as Mobile Homes (2451), Lawn and Garden Equipment (3524), Industrial Trucks and Tractors (3537), Motorcycles, Bicycles, and Parts (3751), and Transportation Equipment, n.e.c. (3799), these being industries that use tires almost exclusively as a direct input. For comparison and to illustrate the difference, Figure A-1 also depicts the upstreamness of Tires with respect to final demand (from Antràs *et al.* 2012); this is the horizontal line with value 2.0954.

Figure A-1: Upstreamness of Tires (SIC 3011) as an Input to all Other Manufacturing Industries



Ratio-Upstreamness$_{jp}$**:** From Panel C of Table A-1, note that *Ratio-Upstreamness*$_{jp}$ tends to take on values smaller than one for the constructions that include the self-SIC of the parent in the set $I(p)$. This is because the upstreamness of j's use of itself as an input (*Upstreamness*$_{jj}$) tends to be relatively small in value, and this acts to lower the numerator of *Ratio-Upstreamness*$_{jp}$. When we drop the self-SIC, this results in a *Ratio-Upstreamness*$_{jp}$ measure with a median value closer to 1. The pairwise correlation between the different versions of *Ratio-Upstreamness*$_{jp}$ is high (typically > 0.8), except when the self-SIC is excluded, in which case the correlation with the baseline measure drops to about 0.15.

A-3 Robustness Checks

A-3.1 Cross-Firm Regressions

In this Appendix, we document the robustness tests we conduct on our cross-firm regressions.

In Table A-5, we have verified that prediction P.1 (Cross) of our model holds strongly when using a simple median cutoff specification to distinguish between the complements from the substitutes case. Column (1) controls for a dummy variable for whether the industry of the final-good producer has an above-median demand elasticity, as well as parent country fixed effects. The estimated coefficient on our proxy for the complements case is negative and significant at the 10% level, already confirming that the propensity to integrate upstream stages is lower in industries that face a high demand elasticity. This result becomes even more significant (at the 1% level) as we successively add the output industry variables X_j in column (2), and the parent controls W_p in column (3). We obtain similar findings when using the refinements of the demand elasticity ρ_j based on consumption and capital goods elasticities in column (4), and on consumption goods elasticities only in column (5). The results hold as well when using the proxy for $\rho_j - \alpha_j$ in column (6).

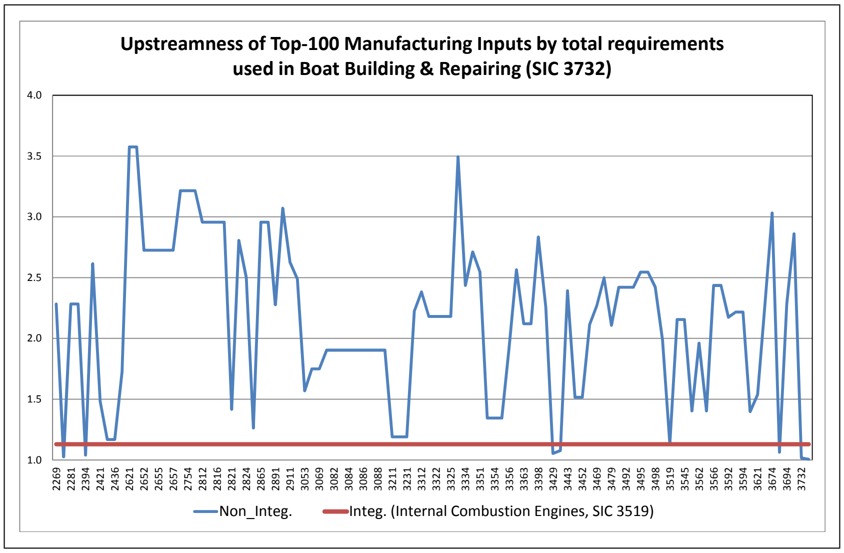
Figures A-2 and A-3 provide an illustration of the results of Table A-5, using examples from our sample of firms. The complements case is illustrated by a Danish firm whose primary activity is Boat Building and Repairing (SIC 3732), an industry that exhibits an above-median ρ_j and $\rho_j - \alpha_j$ value regardless of the variant of the demand elasticity proxy considered. The firm has integrated one activity other than its primary SIC (reflecting the sparsity of integration): Internal Combustion Engines (SIC 3519), one of the most downstream among the top 100 manufacturing inputs by total requirements value used by SIC 3732. Conversely, the substitutes case is exemplified by a Swedish producer of Household Furniture (SIC 2519), an industry that consistently exhibits below-median ρ_j and $\rho_j - \alpha_j$ values. The firm has integrated one activity other than its primary SIC: Fabricated Metal Products (SIC 3499), which is among the most upstream of its top 100 manufacturing inputs.

In Table A-6, we verify the role of upstream contractibility, using a median cutoff specification to distinguish between the complements and substitutes cases. Notice that the estimated coefficient on the proxy for the complements case, $\mathbf{1}(\rho_j > \rho_{med})$, is negative and significant, as in the previous regressions in Table A-5.[2] Turning to the interactions with *Upstream-Contractibility*$_j$, the estimated coefficient in the complements case is positive and statistically significant, while that in the substitutes case is negative and also highly significant. This is entirely in line with prediction P.2 (Cross) of the model: firms that fall under the complements case should have a lower propensity to integrate upstream stages, but this tendency is weakened among those industries whose production processes inherently exhibit a greater degree of upstream contractibility. The converse holds for the substitutes case, with *Upstream-Contractibility*$_j$ instead lowering the propensity to integrate upstream stages when $\rho_j < \rho_{med}$. Note that these results hold when restricting the elasticity measure to HS codes classified as consumption or capital goods in column (2), when further limiting this to consumption goods elasticities only in column (3), and when using the proxy for $\rho_j - \alpha_j$ to distinguish between the two cases in column (4).

In the remainder of this section, we revert to the quintile elasticity specification to report a series of robustness checks. In Table A-7, we verify that the results from Table 2 in the main paper continue to hold when the ratio-upstreamness dependent variable is constructed by restricting the inputs under consideration to the subset of "ever-integrated" inputs, i.e., the subset of inputs i that have been integrated by at least one

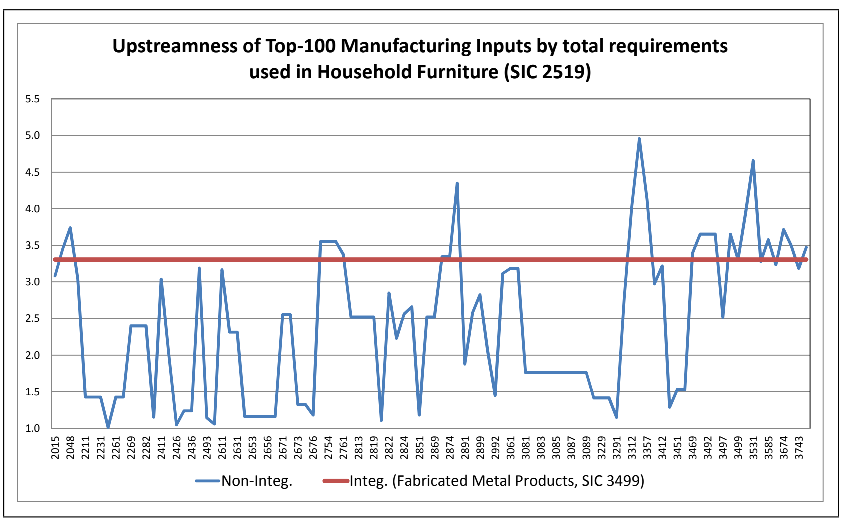
[2] We have verified that the overall effect of the $\mathbf{1}(\rho_j > \rho_{med})$ variable – taking into account its main effect and that through the interaction term with upstream contractibility – is indeed negative when evaluated at the median in-sample value of *Upstream-Contractibility*$_j$ for industries that exhibit an above-median ρ_j. The p-value for this test is reported in each column of Table A-6.

Figure A-2: Integration Decisions in the Complements Case: An Example



Notes: The figure plots the $Upstreamness_{ij}$ measure for the top-100 manufacturing inputs of SIC 3732 (Boat Building and Repairing), a sector exhibiting an above-median ρ_j and $\rho_j - \alpha_j$ value regardless of the demand elasticity proxy considered. The labels on the horizontal axes reflect the SIC codes of its top-100 inputs. The example is based on a firm that has only one integrated manufacturing input other than the self-SIC; the bold red line illustrates the upstreamness of this input (SIC 3519).

Figure A-3: Integration Decisions in the Substitutes Case: An Example



Notes: The figure plots the $Upstreamness_{ij}$ measure for the top-100 manufacturing inputs of SIC 2519 (Household Furniture), a sector exhibiting a below-median ρ_j and $\rho_j - \alpha_j$ value regardless of the demand elasticity proxy considered. The labels on the horizontal axes reflect the SIC codes of its top-100 inputs. The example is based on a firm in our sample that has only one integrated manufacturing input other than the self-SIC; the red line illustrates the upstreamness of this input (SIC 3499).

parent firm in industry j in the WorldBase sample. As discussed in the main paper, this in principle provides a sharper test of the theory – in light of Proposition 4 – when integration is sparse. Regardless of the elasticity proxy used, we find that the propensity to integrate upstream stages is lower for firms in higher elasticity quintiles. Furthermore, we continue to obtain a positive and significant effect of $\textit{Upstream-Contractibility}_j$ in the fifth-elasticity quintile, and a negative and significant effect of $\textit{Upstream-Contractibility}_j$ in the first-elasticity quintile.

In Table A-8, we show that the results are robust to examining different subsamples of firms. (In this and subsequent appendix tables, we report results using the ρ_j proxy constructed from consumption-goods elasticities only, unless otherwise stated; the results based on the other versions of the ρ_j proxy are available on request.) In Column (1), we restrict the sample to single-establishment firms, while in column (2), we focus on domestic firms (these being either single-establishment firms or multi-establishment firms with plants in only one country). In both these cases, we continue to find significant effects on the quintile elasticity dummies, as well as similar patterns on the interaction terms with $\textit{Upstream-Contractibility}_j$, i.e., a negative and significant coefficient for the first-quintile interaction, but the opposite sign for the fifth-quintile interaction. Column (3) focuses on multinational firms, i.e., parents that have establishments in more than one country. The empirical findings remain largely intact, despite the fact that the number of observations decreases substantially with this cut of the dataset.[3]

In Table A-9, we consider several variables that have appeared elsewhere in the literature on firm-level vertical integration. Column (1) adds the share of direct input use in the production of j that could be obtained from within firm boundaries; for each parent, this is the sum of the direct coefficients of the inputs in $I(p)$ (see Acemoglu *et al.* 2009, and Alfaro *et al.* 2016). Column (2) controls for the share of total requirements value that each parent could in principle source from an overseas affiliate, together with a set of country fixed effects that indicate whether the parent has an establishment located in the country in question. Column (3) tests for whether the results might be driven by double marginalization motives, wherein parent firms would have an incentive to integrate inputs that exhibit a low demand elasticity, for which the markups charged by arm's length suppliers would be higher. We control here for the (log) tr_{ij}-weighted average of the demand elasticity of inputs used by industry j. In addition, we include a tr_{ij}-weighted covariance of the input demand elasticity and $\textit{Upstreamness}_{ij}$, to see if the correlation between these elasticities and production line position might matter. (Here, the demand elasticity associated with each input is computed using only those constituent HS10 products classified as intermediates by the UN BEC.) Our results remain robust to the inclusion of these variables, even when they are jointly entered into the regression (column (4)). Interestingly, the weighted covariance between the input elasticity and upstreamness has a coefficient with the expected sign (negative and significant), consistent with the interpretation that the presence of demand-*inelastic* inputs upstream in the production process would be associated with more upstream integration.[4]

A key issue that we give due consideration to is how to designate the primary output industry of multi-product firms. In Table A-10, we present several alternative treatments of parent firms that could be active as output producers in multiple manufacturing industries. We first verify whether the patterns are similar when limiting the sample to parents that have only one manufacturing SIC code, i.e., that do not report any secondary SIC manufacturing activities (columns (1) and (2)). Alternatively, we can designate the output industry j to be the SIC code of the parent (among the up to six codes reported) that is the most

[3]The results are also unaffected if we expand the sample by lowering the employment threshold to a minimum of 10 employees, or if we restrict the sample to parents labeled as "global ultimates" (results available upon request).

[4]We have also explored the robustness of our results to the inclusion of several controls related to various dimensions of input contractibility, such as: (i) the contractibility of the output industry j itself; (ii) a tr_{ij}-weighted average of the contractibility of the inputs used by j; and (iii) a set of interactions between each quintile dummy and a tr_{ij}-weighted variance of the contractibility of the inputs used by j. The results are available upon request.

proximate to final demand, on the basis of the upstreamness measure of Fally (2012) and Antràs *et al.* (2012) (columns (3) and (4)). Last but not least, we have constructed $\textit{Ratio-Upstreamness}_{jpc}$ taking in turn each secondary manufacturing SIC code as the parent's output industry j. The regression in (18) is then run, pooling across the multiple $\textit{Ratio-Upstreamness}_{jpc}$ values per parent (columns (5) and (6)); two-way clustered standard errors by SIC output industry and by parent firm are reported (Cameron *et al.* 2011). Overall, our regression findings remain stable under each of these approaches to account for multi-product firms.

In Table A-11, we report several checks based on alternative constructions of the ratio-upstreamness dependent variable. The version of $\textit{Ratio-Upstreamness}_{jpc}$ in column (1) is based on $\textit{Upstreamness}_{ij}$ values obtained from a random pick when the mapping from I-O to SIC codes yielded multiple matches for a non-manufacturing input i. In column (2), we alternatively restrict $S(j)$ to the set of manufacturing inputs used by industry j, $S^m(j)$. Column (3) further drops the parent SIC from $S^m(j)$, to explore the sensitivity of the results to the default treatment thus far where the parent SIC is always viewed as an integrated input. (There is a decrease in the number of available observations in column (3), since this variant of the ratio-upstreamness measure can only be computed for those parent firms that have integrated at least one other manufacturing input apart from the parent's primary SIC code.) Our findings are broadly retained, with the main exception being the final column of Table A-11. There, $\textit{Upstream-Contractibility}_j$ does reduce the propensity to integrate upstream in the first quintile (the substitutes case), but the point estimates for the fifth-quintile interactions (the complements case) are not significantly different from zero. Note, however, that the overall effect of being in quintile-5 (when evaluated at the median value of $\textit{Upstream-Contractibility}_j$) remains negative and significant, with the p-value from this coefficient test being 0.0043; in other words, the results in column (3) are still very much consistent with prediction P.1 (Cross).

Table A-12 explores a further robustness check where we restrict the construction of $\textit{Ratio-Upstreamness}_{jpc}$ to more relevant inputs. The findings are largely intact when considering those inputs with $tr_{ij} \geq 0.001$ (columns (1)-(2)), even though this threshold already exceeds the median total requirements coefficient in the 1992 U.S. I-O Tables (see Table A-1). We lose some precision in our estimates when applying a higher minimum threshold of either $tr_{ij} \geq 0.01$ (columns (3)-(4)) or $tr_{ij} \geq 0.05$ (columns (5)-(6)), but that should not come as a surprise as more than 95% of the inputs are discarded in these exercises.

We make two further observations to round off this appendix section related to the cross-firm regressions. First, following up on column (2) of Table A-11, we have verified that the value-chain position of the "never-integrated" inputs is not systematically correlated with the quintiles of the various demand elasticity proxies adopted in this paper. In particular, this means that the greater propensity to outsource upstream stages in the complements case is not arising simply because "never-integrated" stages tend to be clustered upstream in high demand elasticity industries. This check is implemented in a series of cross-industry regressions in Table A-13, where the dependent variable is a (log) tr_{ij}-weighted average upstreamness of inputs that are "never-integrated" by firms in industry j relative to the tr_{ij}-weighted average upstreamness of the "ever-integrated" inputs in that industry.

Second, we have performed similar robustness tests on the within-sector, cross-firm regressions in Table 3. (These results are available in full upon request.) These findings are entirely robust when adopting the alternative constructions of the ratio-upstreamness measure seen earlier in Table A-11, such as that based on a random pick or on manufacturing inputs only. We also obtain similar results when focusing on single-establishment, domestic, or multinational firms, as in Table A-8, although we lose statistical significance. This should not come as a surprise, as the regressions related to firm heterogeneity in log output per worker exploit variation in integration patterns across firms at different productivity levels within an industry, and some of this variation is lost when focusing on specific subsamples of firms.

Table A-5

Upstreamness of Integrated vs Non-Integrated Inputs: Median Elasticity Cutoff

Dependent variable:	Log Ratio-Upstreamness$_{jpc}$					
	(1)	(2)	(3)	(4)	(5)	(6)
Ind.(Elas$_j$ > Median)	-0.0354*	-0.0612***	-0.0604***	-0.0593***	-0.1138***	-0.1073***
	[0.0204]	[0.0188]	[0.0185]	[0.0215]	[0.0261]	[0.0275]
Log (Skilled Emp./Workers)$_j$		0.0100	0.0091	0.0111	-0.0219	-0.0082
		[0.0243]	[0.0245]	[0.0278]	[0.0360]	[0.0364]
Log (Equip. Capital/Workers)$_j$		0.1139***	0.1120***	0.0808***	0.0835***	0.0960***
		[0.0206]	[0.0202]	[0.0207]	[0.0254]	[0.0262]
Log (Plant Capital/Workers)$_j$		-0.0405*	-0.0397*	-0.0174	-0.0320	-0.0417
		[0.0229]	[0.0225]	[0.0274]	[0.0322]	[0.0317]
Log (Materials/Workers)$_j$		-0.0279	-0.0289	-0.0393*	-0.0059	-0.0129
		[0.0222]	[0.0222]	[0.0229]	[0.0296]	[0.0294]
R&D intensity$_j$		0.0049	0.0039	0.0103	0.0058	0.0024
		[0.0058]	[0.0058]	[0.0074]	[0.0085]	[0.0091]
(Value-added/Shipments)$_j$		-0.1050	-0.1141	-0.0705	0.1683	0.1600
		[0.1278]	[0.1286]	[0.1294]	[0.1587]	[0.1573]
Log (No. of Establishments)$_p$			0.0574***	0.0614***	0.0661***	0.0652***
			[0.0032]	[0.0037]	[0.0049]	[0.0048]
Year Started$_p$			0.0001	0.0001	0.0002*	0.0002**
			[0.0001]	[0.0001]	[0.0001]	[0.0001]
Multinational$_p$			0.0102**	0.0147**	0.0259***	0.0286***
			[0.0050]	[0.0065]	[0.0081]	[0.0083]
Log (Total Employment)$_p$			-0.0010	-0.0002	-0.0007	-0.0006
			[0.0016]	[0.0017]	[0.0019]	[0.0020]
Log (Total USD Sales)$_p$			0.0006	0.0000	0.0001	0.0005
			[0.0008]	[0.0010]	[0.0013]	[0.0013]
Elasticity based on:	All goods	All goods	All goods	BEC cons. & cap. goods	BEC cons. goods	BEC cons. & α proxy
Parent country dummies	Y	Y	Y	Y	Y	Y
Observations	316,977	316,977	286,072	206,490	144,107	144,107
No. of industries	459	459	459	305	219	219
R^2	0.0334	0.1372	0.1447	0.1511	0.2051	0.2027

Notes: The sample comprises all firms with primary SIC in manufacturing and at least 20 employees in the 2004/2005 vintage of D&B WorldBase. The dependent variable is the log ratio-upstreamness measure described in Section 3. A median cutoff dummy is used to distinguish firms with primary SIC output that are in high vs low demand elasticity industries. Columns (1)-(3) use a measure based on all available HS10 elasticities from Broda and Weinstein (2006); column (4) restricts this construction to HS codes classified as consumption or capital goods in the UN BEC; column (5) further restricts this to consumption goods; column (6) uses the consumption-goods-only demand elasticity minus a proxy for α to distinguish between the complements and substitutes cases. All columns include parent country fixed effects. Columns (3)-(6) also include indicator variables for whether the reported employment and sales data respectively are estimated/missing/from the low end of a range, as opposed to being from actual data (coefficients not reported). Standard errors are clustered by parent primary SIC industry; ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Table A-6

Effect of Upstream Contractibility: Median Elasticity Cutoff

Dependent variable:	Log Ratio-Upstreamness$_{jpc}$			
	(1)	(2)	(3)	(4)
Ind.(Elas$_j$ > Median)	-0.0910***	-0.1306***	-0.1432***	-0.1372***
	[0.0210]	[0.0256]	[0.0263]	[0.0249]
Upstream-Contractibility$_j$				
× Ind.(Elas$_j$ < Median)	-0.8943***	-1.1148***	-1.2395***	-1.2195***
	[0.2869]	[0.3838]	[0.4345]	[0.4363]
× Ind.(Elas$_j$ > Median)	0.5044***	1.0224***	0.8871***	0.9451***
	[0.1717]	[0.1571]	[0.1505]	[0.1415]
p-value: High elas. at median Upst.-Cont.$_j$	[0.0004]	[0.0054]	[0.0000]	[0.0000]
Elasticity based on:	All goods	BEC cons. & cap. goods	BEC cons. goods	BEC cons. & α proxy
Industry controls	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y
Parent country dummies	Y	Y	Y	Y
Observations	286,072	206,490	144,107	144,107
No. of industries	459	305	219	219
R^2	0.1882	0.2609	0.2910	0.2888

Notes: The sample comprises all firms with primary SIC in manufacturing and at least 20 employees in the 2004/2005 vintage of D&B WorldBase. The dependent variable is the log ratio-upstreamness measure described in Section 3. *Upstream-Contractibility*$_j$ is the total requirements weighted covariance between the contractibility and upstreamness of the manufacturing inputs used to produce good j. A median cutoff dummy is used to distinguish firms with primary SIC output that are in high vs low demand elasticity industries. Column (1) uses a measure based on all available HS10 elasticities from Broda and Weinstein (2006); column (2) restricts this construction to HS codes classified as consumption or capital goods in the UN BEC; column (3) further restricts this to consumption goods; column (4) uses the consumption-goods-only demand elasticity minus a proxy for α to distinguish between the complements and substitutes cases. All columns include the full list of SIC output industry controls, firm-level variables, and parent country dummies that were used in the earlier specifications in Table 1, columns (3)-(6). Standard errors are clustered by parent primary SIC industry; ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Table A-7

Effect of Upstream Contractibility: Ever-Integrated Inputs

Dependent variable:	Log Ratio-Upstreamness$_{jpc}$			
	(1)	(2)	(3)	(4)
Ind.(Quintile 2 Elas$_j$)	-0.0026	-0.0270	-0.0240	0.0640**
	[0.0279]	[0.0346]	[0.0413]	[0.0324]
Ind.(Quintile 3 Elas$_j$)	-0.1094***	-0.0369	-0.0402	-0.0083
	[0.0273]	[0.0413]	[0.0341]	[0.0288]
Ind.(Quintile 4 Elas$_j$)	-0.1106***	-0.1388***	-0.1293***	-0.0979***
	[0.0321]	[0.0272]	[0.0307]	[0.0347]
Ind.(Quintile 5 Elas$_j$)	-0.1264***	-0.1598***	-0.1313***	-0.0834***
	[0.0303]	[0.0271]	[0.0261]	[0.0293]
Upstream-Contractibility$_j$				
× Ind.(Quintile 1 Elas$_j$)	-1.0938***	-0.8652***	-0.8338***	-1.2735**
	[0.3932]	[0.2251]	[0.3137]	[0.5769]
× Ind.(Quintile 2 Elas$_j$)	-1.0768***	-0.7624	-0.8880	-1.0878
	[0.3664]	[0.6365]	[0.7960]	[0.6967]
× Ind.(Quintile 3 Elas$_j$)	0.8087***	-0.0093	0.0377	0.3803
	[0.3008]	[0.4820]	[0.4977]	[0.3569]
× Ind.(Quintile 4 Elas$_j$)	0.2975	0.9812***	0.9039***	1.2706***
	[0.3192]	[0.3072]	[0.3313]	[0.3851]
× Ind.(Quintile 5 Elas$_j$)	0.6385**	1.0652***	1.3664***	1.3721***
	[0.2665]	[0.3073]	[0.2992]	[0.2916]
p-value: Q5 at median Upst.-Cont.$_j$	[0.0005]	[0.0000]	[0.0000]	[0.0035]
Elasticity based on:	All goods	BEC cons. & cap. goods	BEC cons. goods	BEC cons. & α proxy
Industry controls	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y
Parent country dummies	Y	Y	Y	Y
Observations	286,072	206,490	144,107	144,107
No. of industries	459	305	219	219
R^2	0.1320	0.1825	0.1950	0.2146

Notes: The sample comprises all firms with primary SIC in manufacturing and at least 20 employees in the 2004/2005 vintage of D&B WorldBase. The dependent variable is the log ratio-upstreamness measure described in Section 3, constructed based on the set of ever-integrated inputs. *Upstream-Contractibility*$_j$ is the total requirements weighted covariance between the contractibility and upstreamness of the manufacturing inputs used to produce good j. Quintile dummies are used to distinguish firms with primary SIC output in high vs low demand elasticity industries. Column (1) uses a measure based on all available HS10 elasticities from Broda and Weinstein (2006); column (2) restricts this construction to HS codes classified as consumption or capital goods in the UN BEC; column (3) further restricts this to consumption goods; column (4) uses the consumption-goods-only demand elasticity minus a proxy for α to distinguish between the complements and substitutes cases. All columns include the full list of SIC output industry controls, firm-level variables, and parent country dummies used in the specifications in Table 1, columns (3)-(6). Standard errors are clustered by parent primary SIC industry; ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Table A-8
Cross-Firm Regressions: Different Subsamples

Dependent variable:	Log Ratio-Upstreamness$_{jpc}$		
	Single-plant firms	Domestic firms	Multinationals
	(1)	(2)	(3)
Ind.(Quintile 2 Elas$_j$)	-0.0461	-0.0487	-0.0870***
	[0.0445]	[0.0432]	[0.0288]
Ind.(Quintile 3 Elas$_j$)	-0.0630*	-0.0681**	-0.0787***
	[0.0338]	[0.0330]	[0.0279]
Ind.(Quintile 4 Elas$_j$)	-0.1625***	-0.1619***	-0.1103***
	[0.0284]	[0.0278]	[0.0268]
Ind.(Quintile 5 Elas$_j$)	-0.1638***	-0.1649***	-0.1206***
	[0.0299]	[0.0294]	[0.0330]
Upstream-Contractibility$_j$			
× Ind.(Quintile 1 Elas$_j$)	-1.8620***	-1.8635***	-1.5014***
	[0.4612]	[0.4498]	[0.3691]
× Ind.(Quintile 2 Elas$_j$)	-0.7401	-0.7030	0.2330
	[0.8055]	[0.7713]	[0.3979]
× Ind.(Quintile 3 Elas$_j$)	-0.4965	-0.4335	0.2476
	[0.3919]	[0.3899]	[0.2838]
× Ind.(Quintile 4 Elas$_j$)	0.6749***	0.6890***	0.5686**
	[0.2162]	[0.2117]	[0.2484]
× Ind.(Quintile 5 Elas$_j$)	1.1025***	1.1195***	0.9941***
	[0.2321]	[0.2286]	[0.2949]
p-value: Q5 at median Upst.-Cont.$_j$	[0.0000]	[0.0000]	[0.1000]
Elasticity based on:	BEC cons.	BEC cons.	BEC cons.
Industry controls	Y	Y	Y
Firm controls	Y	Y	Y
Parent country dummies	Y	Y	Y
Observations	117,956	141,617	2,490
No. of industries	219	219	199
R^2	0.2990	0.3027	0.2467

Notes: Columns (1)-(3) restrict to different subsets of firms from the 2004/2005 vintage of D&B WorldBase, as described in each column heading. The dependent variable is the baseline log ratio-upstreamness measure described in Section 3. *Upstream-Contractibility*$_j$ is the total requirements weighted covariance between the contractibility and upstreamness of the manufacturing inputs used to produce good j. Quintile dummies are used to distinguish firms with primary SIC output that are in high vs low demand elasticity industries; the elasticity measure used is that whose construction is restricted to only the HS10 elasticities from Broda and Weinstein (2006) classified as consumption goods in the UN BEC. All columns include the full list of SIC output industry controls, firm-level variables, and parent country dummies that were used in the earlier specifications in Table 1, columns (3)-(6). Standard errors are clustered by parent primary SIC industry; ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Table A-9

Cross-Firm Regressions: Additional Controls

Dependent variable:	Log Ratio-Upstreamness$_{jpc}$			
	(1)	(2)	(3)	(4)
Ind.(Quintile 2 Elas$_j$)	-0.0429	-0.0491	-0.0492	-0.0418
	[0.0414]	[0.0430]	[0.0403]	[0.0386]
Ind.(Quintile 3 Elas$_j$)	-0.0549*	-0.0683**	-0.0532*	-0.0384
	[0.0305]	[0.0328]	[0.0308]	[0.0293]
Ind.(Quintile 4 Elas$_j$)	-0.1601***	-0.1613***	-0.1437***	-0.1444***
	[0.0253]	[0.0277]	[0.0230]	[0.0213]
Ind.(Quintile 5 Elas$_j$)	-0.1546***	-0.1642***	-0.1666***	-0.1565***
	[0.0269]	[0.0292]	[0.0258]	[0.0233]
Upstream-Contractibility$_j$				
× Ind.(Quintile 1 Elas$_j$)	-1.6826***	-1.8554***	-1.6147***	-1.4820***
	[0.4083]	[0.4451]	[0.3643]	[0.3275]
× Ind.(Quintile 2 Elas$_j$)	-0.6775	-0.6876	-0.5599	-0.6227
	[0.7338]	[0.7626]	[0.7994]	[0.7701]
× Ind.(Quintile 3 Elas$_j$)	-0.5875	-0.4186	-0.4597	-0.6614*
	[0.3681]	[0.3854]	[0.4041]	[0.3966]
× Ind.(Quintile 4 Elas$_j$)	0.5891***	0.6850***	0.6457***	0.5434***
	[0.1714]	[0.2105]	[0.2157]	[0.1890]
× Ind.(Quintile 5 Elas$_j$)	0.9582***	1.1183***	1.1302***	0.9516***
	[0.2165]	[0.2272]	[0.2518]	[0.2393]
Vertical Integration Index$_p$	-1.1296***			-1.1144***
	[0.2065]			[0.2044]
Foreign integrated tr. share$_p$		-1.0690***		-0.2034*
		[0.1330]		[0.1214]
Log (Input Elasticity)$_j$			-0.2999***	-0.2853***
			[0.1099]	[0.1024]
Wtd. Cov. of Input Elasticity$_j$			-0.4963***	-0.4330***
and Upstreamness$_{ij}$			[0.1718]	[0.1555]
p-value: Q5 at median Upst.-Cont.$_j$	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Elasticity based on:	BEC cons.	BEC cons.	BEC cons.	BEC cons.
Industry controls	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y
Parent country dummies	Y	Y	Y	Y
Subsidiary country dummies	N	Y	N	Y
Observations	144,107	144,107	144,107	144,107
No. of industries	219	219	219	219
R^2	0.3526	0.3079	0.3204	0.3655

Notes: The dependent variable is the log ratio-upstreamness measure described in Section 3. *Upstream-Contractibility*$_j$ is the total requirements weighted covariance between the contractibility and upstreamness of the manufacturing inputs used to produce good j. Quintile dummies are used to distinguish firms with primary SIC output that are in high vs low demand elasticity industries; the elasticity measure used is that whose construction is restricted to only the HS10 elasticities from Broda and Weinstein (2006) classified as consumption goods in the UN BEC. All columns include the full list of SIC output industry controls, firm-level variables, and parent country dummies that were used in the earlier specifications in Table 1, columns (3)-(6). Standard errors are clustered by parent primary SIC industry; ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Table A-10

Parent Firms with Multiple SIC Output Activities

Dependent variable:	Log Ratio-Upstreamness$_{jpc}$					
	Single mfg. output SIC		Most downstream mfg. output SIC		Firm by mfg. output SIC (two-way cluster)	
	(1)	(2)	(3)	(4)	(5)	(6)
Ind.(Quintile 2 Elas$_j$)	-0.0779	-0.0419	-0.0586	-0.0387	-0.0744*	-0.0476
	[0.0527]	[0.0464]	[0.0446]	[0.0414]	[0.0426]	[0.0428]
Ind.(Quintile 3 Elas$_j$)	-0.1147**	-0.1021***	-0.0588	-0.0218	-0.0793*	-0.0362
	[0.0465]	[0.0292]	[0.0446]	[0.0458]	[0.0412]	[0.0398]
Ind.(Quintile 4 Elas$_j$)	-0.1671***	-0.1521***	-0.1422***	-0.1455***	-0.1645***	-0.1642***
	[0.0503]	[0.0305]	[0.0444]	[0.0293]	[0.0411]	[0.0256]
Ind.(Quintile 5 Elas$_j$)	-0.1789***	-0.1521***	-0.1559***	-0.1481***	-0.1834***	-0.1680***
	[0.0493]	[0.0306]	[0.0463]	[0.0316]	[0.0431]	[0.0286]
Upstream-Contractibility$_j$						
× Ind.(Quintile 1 Elas$_j$)		-1.9121***		-1.5439***		-1.7766***
		[0.4691]		[0.4575]		[0.4150]
× Ind.(Quintile 2 Elas$_j$)		-0.7892		-0.4447		-0.5588
		[0.7723]		[0.6291]		[0.7887]
× Ind.(Quintile 3 Elas$_j$)		0.1059		-0.8775		-0.8416
		[0.2068]		[0.6081]		[0.5438]
× Ind.(Quintile 4 Elas$_j$)		0.6619***		0.6950***		0.6808***
		[0.2346]		[0.2115]		[0.2039]
× Ind.(Quintile 5 Elas$_j$)		1.1166***		1.2290***		1.1637***
		[0.2104]		[0.2640]		[0.2544]
p-value: Q5 at median Upst.-Cont.$_j$		[0.0000]		[0.0000]		[0.0000]
Elasticity based on:	BEC cons.	BEC cons.	BEC cons.	BEC cons.	BEC cons.	BEC cons.
Industry controls	Y	Y	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y	Y	Y
Parent country dummies	Y	Y	Y	Y	Y	Y
Observations	97,174	97,174	146,829	146,829	211,232	211,232
No. of industries	219	219	219	219	—	—
R^2	0.2469	0.3308	0.1951	0.2649	0.2204	0.2881

Notes: The dependent variable is the log ratio-upstreamness measure described in Section 3. *Upstream-Contractibility*$_j$ is the total requirements weighted covariance between the contractibility and upstreamness of the manufacturing inputs used to produce good j. Columns (1) and (2) restrict the sample to those firms with at least 20 employees that report only one SIC manufacturing output activity, this being their primary SIC industry; robust standard errors clustered by output industry are reported. For columns (3) and (4), we designate as the output industry the SIC manufacturing activity of the firm that has the smallest upstreamness value with respect to final demand, this being the measure developed by Antràs *et al.* (2012); robust standard errors clustered by this output industry are reported. For columns (5) and (6), each observation is a parent firm by SIC output activity pair, and the ratio-upstreamness variable is constructed treating in turn each SIC manufacturing activity as the output industry for the firm in question; two-way clustered standard errors – by parent firm and by SIC output activity – are reported. Quintile dummies are used to distinguish firms with primary SIC output that are in high vs low demand elasticity industries; the measure used here is based only on HS10 codes classified as consumption goods in the UN BEC. All columns include the full list of SIC output industry controls, firm-level variables, and parent country dummies that were used in the earlier specifications in Table 1, columns (3)-(6). ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Table A-11

Alternative Constructions of Ratio-Upstreamness

Dependent variable:	Log Ratio-Upstreamness$_{jpc}$		
	Random pick	Mfg. inputs only	Mfg. inputs only, drop parent SIC
	(1)	(2)	(3)
Ind.(Quintile 2 Elas$_j$)	-0.0481	-0.0385	-0.0262
	[0.0428]	[0.0497]	[0.0926]
Ind.(Quintile 3 Elas$_j$)	-0.0687**	-0.0786**	-0.0642
	[0.0329]	[0.0394]	[0.0514]
Ind.(Quintile 4 Elas$_j$)	-0.1574***	-0.1825***	-0.1388**
	[0.0277]	[0.0320]	[0.0661]
Ind.(Quintile 5 Elas$_j$)	-0.1652***	-0.1762***	-0.2958***
	[0.0303]	[0.0396]	[0.0934]
Upstream-Contractibility$_j$			
× Ind.(Quintile 1 Elas$_j$)	-1.8583***	-2.1696***	-1.1117*
	[0.4454]	[0.4819]	[0.5749]
× Ind.(Quintile 2 Elas$_j$)	-0.6960	-0.9343	0.0021
	[0.7602]	[0.9046]	[0.8379]
× Ind.(Quintile 3 Elas$_j$)	-0.4193	-0.2726	-1.8093*
	[0.3873]	[0.4890]	[0.9849]
× Ind.(Quintile 4 Elas$_j$)	0.6473***	0.8981***	-2.5374***
	[0.2126]	[0.2504]	[0.7379]
× Ind.(Quintile 5 Elas$_j$)	1.1816***	1.1370***	-0.0754
	[0.2803]	[0.3822]	[1.1158]
p-value: Q5 at median Upst.-Cont.$_j$	[0.0000]	[0.0000]	[0.0043]
Elasticity based on:	BEC cons.	BEC cons.	BEC cons.
Industry controls	Y	Y	Y
Firm controls	Y	Y	Y
Parent country dummies	Y	Y	Y
Observations	144,107	143,846	46,992
No. of industries	219	219	218
R^2	0.3059	0.3311	0.1216

Notes: The sample comprises firms with primary SIC in manufacturing and at least 20 employees in the 2004/2005 vintage of D&B WorldBase. The three columns use variants of the log ratio-upstreamness measure as the dependent variable, as described in the column headings. "Upstream-Contractibility" is the total requirements weighted covariance between the contractibility and upstreamness of the manufacturing inputs used to produce good j. Quintile dummies are used to distinguish firms with primary SIC output that are in high vs low demand elasticity industries; the elasticity measure used is that whose construction is restricted to only the HS10 elasticities from Broda and Weinstein (2006) classified as consumption goods in the UN BEC. All columns include the full list of SIC output industry controls, firm-level variables, and parent country dummies that were used in the earlier specifications in Table 1, columns (3)-(6). Standard errors are clustered by parent primary SIC industry; ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Table A-12

Dropping Inputs with Small Total Requirements Coefficients

Dependent variable:	Log Ratio-Upstreamness$_{jpc}$ limited to inputs with $tr_{ij} \geq \kappa$					
	$\kappa = 0.001$		$\kappa = 0.01$		$\kappa = 0.05$	
	(1)	(2)	(3)	(4)	(5)	(6)
Ind.(Quintile 2 Elas$_j$)	-0.0960**	-0.0772**	-0.0371	-0.0573*	0.0936	-0.0691
	[0.0480]	[0.0318]	[0.0292]	[0.0304]	[0.0969]	[0.0604]
Ind.(Quintile 3 Elas$_j$)	-0.1007**	-0.0967***	-0.0169	-0.0672*	0.2292*	0.0901
	[0.0456]	[0.0306]	[0.0402]	[0.0380]	[0.1159]	[0.0986]
Ind.(Quintile 4 Elas$_j$)	-0.1584***	-0.1509***	-0.1357***	-0.1416***	-0.2755*	-0.3050***
	[0.0492]	[0.0308]	[0.0470]	[0.0415]	[0.1593]	[0.1138]
Ind.(Quintile 5 Elas$_j$)	-0.1882***	-0.1624***	-0.1109*	-0.1047**	0.0980	0.0943
	[0.0493]	[0.0299]	[0.0597]	[0.0469]	[0.1768]	[0.1472]
Upstream-Contractibility$_j$						
× Ind.(Quintile 1 Elas$_j$)		-1.8097***		0.3782		-2.2377*
		[0.4775]		[0.7651]		[1.1530]
× Ind.(Quintile 2 Elas$_j$)		-0.1884		0.7700		0.7183
		[0.3140]		[0.5218]		[0.8877]
× Ind.(Quintile 3 Elas$_j$)		0.2387		1.5469***		-4.8807**
		[0.2381]		[0.4525]		[2.0299]
× Ind.(Quintile 4 Elas$_j$)		0.7049***		1.2898***		3.1515***
		[0.2172]		[0.4787]		[0.7650]
× Ind.(Quintile 5 Elas$_j$)		1.4457***		2.5916***		4.5668***
		[0.2034]		[0.3724]		[0.7617]
p-value: Q5 at median Upst.-Cont.$_j$		[0.0000]		[0.0002]		[0.7171]
Elasticity based on:	BEC cons.	BEC cons.	BEC cons.	BEC cons.	BEC cons.	BEC cons.
Industry controls	Y	Y	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y	Y	Y
Parent country dummies	Y	Y	Y	Y	Y	Y
Observations	139,053	139,053	81,970	81,970	13,677	13,677
No. of industries	219	219	214	214	98	98
R^2	0.3144	0.4308	0.4995	0.6285	0.4950	0.6873

Notes: The sample comprises firms with primary SIC in manufacturing and at least 20 employees in the 2004/2005 vintage of D&B WorldBase. The dependent variable is the log ratio-upstreamness measure constructed when limiting the set of integrated and non-integrated inputs under consideration to those with total requirements coefficient respectively greater than or equal to κ, where $\kappa = 0.001$ in columns (1)-(2), $\kappa = 0.01$ in columns (3)-(4), and $\kappa = 0.05$ in columns (5)-(6). The sample size decreases with higher κ, as firms that do not have any integrated inputs satisfying $tr_{ij} \geq \kappa$ are dropped. "Upstream-Contractibility" is the total requirements weighted covariance between the contractibility and upstreamness of the manufacturing inputs used in the SIC output industry in question. Quintile dummies are used to distinguish firms with primary SIC output that are in high vs low demand elasticity industries; the measure used here is based only on HS10 codes classified as consumption goods in the UN BEC. All columns include the full list of SIC output industry controls, parent country dummies, and the full list of firm-level variables used in the earlier specifications of Table 1, columns (3)-(6). Standard errors are clustered by the parent primary SIC industry; ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Table A-13

Diagnostic: Upstreamness of Never- vs Ever-Integrated Inputs

Dependent variable:	$\log\left(\frac{\text{Wtd. Avg. Upstreamness}_{ij}\text{ of Never-Integrated Inputs}}{\text{Wtd. Avg. Upstreamness}_{ij}\text{ of Ever-Integrated Inputs}}\right)$				
	(1)	(2)	(3)	(4)	(5)
Ind.(Quintile 2 Elas_j)	0.0263	0.0213	-0.0006	-0.0228	-0.0142
	[0.0201]	[0.0191]	[0.0253]	[0.0336]	[0.0326]
Ind.(Quintile 3 Elas_j)	0.0284	0.0139	-0.0017	0.0127	0.0272
	[0.0214]	[0.0203]	[0.0239]	[0.0318]	[0.0306]
Ind.(Quintile 4 Elas_j)	0.0000	0.0103	0.0101	0.0108	0.0108
	[0.0228]	[0.0226]	[0.0276]	[0.0362]	[0.0346]
Ind.(Quintile 5 Elas_j)	-0.0024	-0.0033	-0.0188	-0.0460	-0.0371
	[0.0210]	[0.0224]	[0.0277]	[0.0384]	[0.0385]
p-value: F-test, Elas_j quintile coeffs.	[0.3437]	[0.6596]	[0.8364]	[0.2270]	[0.1980]
Elasticity based on:	All goods	All goods	BEC cons. & cap. goods	BEC cons. goods	BEC cons. & α proxy
Industry controls	N	Y	Y	Y	Y
Observations	459	459	305	219	219
R^2	0.0093	0.2335	0.2408	0.2918	0.2913

Notes: The sample comprises all SIC manufacturing industries. Robust standard errors are reported; ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively. For each output industry j, the set of never-integrated inputs is the list of inputs i that are never found among the SIC activities of D&B parent firms with either primary or secondary output industry listed as j, while the set of ever-integrated inputs is the list of inputs i that are integrated within firm boundaries by at least one D&B parent firm with primary or secondary industry listed as j. The D&B parent firms considered are those from the 2004/2005 vintage with at least 20 employees. The dependent variable is the log ratio of the weighted average upstreamness of never-integrated to that of ever-integrated inputs, where the weights are proportional to tr_{ij}. Quintile dummies are used to distinguish firms with primary SIC output that are in high vs low demand elasticity industries. Columns (1)-(2) use a measure based on all available HS10 elasticities from Broda and Weinstein (2006); Column (3) restricts this construction to HS codes classified as consumption or capital goods in the UN BEC; Column (4) further restricts this to consumption goods only; Column (5) uses the consumption-goods-only demand elasticity minus a proxy for α to distinguish between the complements and substitutes cases. The p-value reported is that from a F-test with null hypothesis that the coefficients of the Quintile 2 through Quintile 5 Elas_j dummies are jointly equal to zero.

A-3.2 Within-Firm Regressions

In this Appendix, we report a series of additional estimations to verify the robustness of the results of the within-firm regressions.

In Table A-14, we show that our results concerning the role of upstreamness are robust to restricting the analysis to specific subsamples of firms, namely single-establishment, domestic, and multinational firms. In addition to the interactions between $Upstreamness_{ij}$ and the elasticity quintile dummies, the regressions include the same controls as in columns (5) and (6) in Table 4 in the main paper, namely: the self-SIC dummy, log tr_{ij}, the various measures of proximity between industries i and j, as well as parent firm and input industry fixed effects. Reassuringly, these tests retain the broad patterns seen in Table 4: the coefficient of $Upstreamness_{ij}$ in the first demand elasticity quintile is positive and significant, while that for $Upstreamness_{ij}$ in the fifth demand elasticity quintile is negative and significant. This result is consistent with prediction P.1 (Within) of our model, according to which a firm would be less likely to integrate upstream inputs in the complements case compared to the substitutes case.

In Table A-15, we check the robustness of our results concerning the role of contractibility when restricting the analysis to the same subsamples of firms. As in Table 5, we find that the coefficients of the interactions between $Contractibility\text{-}up\text{-}to\text{-}i_{ij}$ and the demand elasticity quintile dummies become larger in the higher elasticity quintiles. This finding is in line with prediction P.2 (Within), according to which an increase in the contractibility profile of inputs upstream of i would raise the propensity to integrate input i more in the complements than in the substitutes case.

Table A-16 shows that the results concerning the role of upstreamness continue to hold in a series of additional specifications. Column (1) drops firms that do not have an integrated manufacturing input (apart from the self-SIC) among the top-100 manufacturing inputs as ranked by the total requirements value.[5] Alternatively, column (2) retains only those parents that have integrated at least three of their top-100 manufacturing inputs. Note that this is a relatively stringent cut of the data that reduces the size of our sample substantially, since the median number of integrated SIC codes across firms is equal to two (see Table A-1). Column (3) adopts a different treatment of the self-SIC code, which is classified mechanically as an integrated input in our regressions. Here, the self-SIC is instead dropped altogether from the estimation. The last column reproduces the results when we include all top-100 manufacturing inputs, rather than restricting the analysis (as has been done in the main paper) to the subset of ever-integrated inputs. The findings we obtain from these different specifications turn out to be similar to those presented already in Table 4, pointing to a lower propensity to integrate upstream inputs in the complements case compared to the substitutes case. (Although the fifth-quintile interaction in columns (1) and (4) is marginally insignificant, the p-value nevertheless confirms that the negative effect of $Upstreamness_{ij}$ in this fifth elasticity quintile differs significantly from that in the first quintile.)

In Table A-17, we undertake an analogous set of robustness checks for the results concerning the role of contractibility. The specifications in columns (1)-(4) are as in Table A-16, except that we examine now the interaction between $Contractibility\text{-}up\text{-}to\text{-}i_{ij}$ and the elasticity quintile dummies. The regression findings here remain consistent with what was seen earlier in Table 5 in the main paper, in accord with prediction P.2 (Within). In column (5), we further include the full set of elasticity dummies interacted with $Contractibility\text{-}at\text{-}i_{ij}$. This variable is given by: $\frac{tr_{ij}cont_i}{\sum_{k\in S^m(j)} tr_{kj}cont_k}$. In words, this is the component of $Contractibility\text{-}up\text{-}to\text{-}i_{ij}$ that is accrued at stage i itself. The findings for column (5) confirm that the role of the profile of contractibility prior to input i remains relevant for explaining integration patterns, even when

[5] By contrast, the sample used for the within-firm regressions in the main paper drops parents that do not report any integrated SIC codes in manufacturing (apart from the self-SIC), independently of whether these are among the top-100 manufacturing inputs in the production of the firm's primary output activity.

one controls for the contractibility at input i itself.

Finally, in Table A-18, we examine how upstreamness affects integration choices, when looking separately at final-good industries where $\rho_j < \alpha_j$ vs $\rho_j > \alpha_j$. Notice that the effect of upstreamness on integration is negative across low and high ρ_j industries, when the industry proximity measures are not included in the regression (columns (1) and (3)). However, the role of upstreamness is no longer precisely estimated when we include the industry proximity measures and input fixed effects (columns (2) and (4)). We view these patterns as a reason to be cautious about using the actual values of ρ_j and α_j to partition the final-goods industries. Given the limitations of our empirical proxies for ρ_j and α_j, using the quintiles of $\rho_j - \alpha_j$ to distinguish empirically between the complements and substitutes cases arguably provides more reliable estimates of the effects of the upstreamness variable on integration decisions within firms.

Table A-14

Integration Decisions within Firms: The Role of Upstreamness (Different Subsamples)

Dependent variable:		Integration$_{ijp}$	
	Single-plant (1)	Domestic (2)	Multinationals (3)
Upstreamness$_{ij}$			
× Ind.(Quintile 1 Elas$_j$)	0.0036*	0.0036*	0.0051*
	[0.0020]	[0.0020]	[0.0029]
× Ind.(Quintile 2 Elas$_j$)	-0.0043	-0.0046	-0.0002
	[0.0035]	[0.0035]	[0.0035]
× Ind.(Quintile 3 Elas$_j$)	-0.0018	-0.0025	-0.0101**
	[0.0025]	[0.0027]	[0.0043]
× Ind.(Quintile 4 Elas$_j$)	0.0016	0.0012	-0.0004
	[0.0022]	[0.0023]	[0.0039]
× Ind.(Quintile 5 Elas$_j$)	-0.0068**	-0.0074**	-0.0111**
	[0.0033]	[0.0034]	[0.0049]
p-value: Upstreamness$_{ij}$, Quintile 1 minus Quintile 5	[0.0010]	[0.0008]	[0.0003]
Elasticity based on:	BEC cons.	BEC cons	BEC cons.
Observations	1,900,549	2,365,074	102,407
R^2	0.5825	0.5748	0.4182
Firm fixed effects	Y	Y	Y
Input industry i fixed effects	Y	Y	Y
Industry i-j controls	Y	Y	Y
No. of i-j pairs	7,225	7,225	6,932
No. of parent firms	32,070	40,281	1,650

Notes: The dependent variable is a 0-1 indicator for whether the SIC input is integrated. Each observation is a SIC input by parent firm pair, where the set of parent firms comprises those with primary SIC industry in manufacturing and employment of at least 20, which have integrated at least one manufacturing input apart from the output self-SIC. The sample is restricted to the set of the top 100 ever-integrated manufacturing inputs, as ranked by the total requirements coefficients of the SIC output industry. The sample in each column is further restricted to different subsets of firms, as described in each column heading. The quintile dummies are based on the elasticity measure constructed using only those HS10 elasticities from Broda and Weinstein (2006) classified as consumption goods in the UN BEC. All columns include parent firm fixed effects and SIC input industry fixed effects, as well as the i-j industry controls included in columns (5)-(6) of Table 4. Standard errors are clustered by input-output industry pair; ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Table A-15

Integration Decisions within Firms: The Role of Contractibility
(Different Subsamples)

Dependent variable:	Integration$_{ijp}$		
	Single-plant	Domestic	Multinationals
	(1)	(2)	(3)
Contractibility-up-to-i_{ij}			
× Ind.(Quintile 1 Elas$_j$)	0.0007	0.0007	0.0100
	[0.0060]	[0.0063]	[0.0106]
× Ind.(Quintile 2 Elas$_j$)	0.0227***	0.0235***	0.0168*
	[0.0068]	[0.0071]	[0.0096]
× Ind.(Quintile 3 Elas$_j$)	0.0200***	0.0208***	0.0520***
	[0.0073]	[0.0074]	[0.0123]
× Ind.(Quintile 4 Elas$_j$)	0.0109	0.0116	0.0178
	[0.0085]	[0.0086]	[0.0120]
× Ind.(Quintile 5 Elas$_j$)	0.0387***	0.0406***	0.0524***
	[0.0108]	[0.0110]	[0.0142]
p-value: Contractibility-up-to-i_{ij}, Quintile 1 minus Quintile 5	[0.0002]	[0.0001]	[0.0034]
Elasticity based on:	BEC cons.	BEC cons	BEC cons.
Observations	1,900,549	2,365,074	102,407
R^2	0.5826	0.5749	0.4183
Firm fixed effects	Y	Y	Y
Input industry i fixed effects	Y	Y	Y
Industry i-j controls	Y	Y	Y
No. of i-j pairs	7,225	7,225	6,932
No. of parent firms	32,070	40,281	1,650

Notes: The dependent variable is a 0-1 indicator for whether the SIC input is integrated. Each observation is a SIC input by parent firm pair, where the set of parent firms comprises those with primary SIC industry in manufacturing and employment of at least 20, which have integrated at least one manufacturing input apart from the output self-SIC. The sample is restricted to the set of the top 100 ever-integrated manufacturing inputs, as ranked by the total requirements coefficients of the SIC output industry. The sample in each column is further restricted to different subsets of firms, as described in each column heading. The *Contractibility-up-to-i_{ij}* measure is the share of the total-requirements weighted contractibility of inputs that has been accrued in production upstream of and including input i in the production of output j. The quintile dummies are based on the elasticity measure constructed using only those HS10 elasticities from Broda and Weinstein (2006) classified as consumption goods in the UN BEC. All columns include parent firm fixed effects and SIC input industry fixed effects, as well as the i-j industry controls included in columns (5)-(6) of Table 5. Standard errors are clustered by input-output industry pair; ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Table A-16

Integration Decisions within Firms: The Role of Upstreamness
(Further Robustness)

Dependent variable:	Integration$_{ijp}$			
	# non-self-SIC integ. inputs ≥ 1	# integ. inputs ≥ 3	Drop self-SIC	All Inputs
	(1)	(2)	(3)	(4)
Upstreamness$_{ij}$				
$\times$ Ind.(Quintile 1 Elas$_j$)	0.0061**	0.0050	0.0038*	0.0025**
	[0.0030]	[0.0045]	[0.0021]	[0.0013]
$\times$ Ind.(Quintile 2 Elas$_j$)	-0.0056	-0.0114	-0.0044	-0.0020
	[0.0049]	[0.0074]	[0.0038]	[0.0020]
$\times$ Ind.(Quintile 3 Elas$_j$)	-0.0017	-0.0061	-0.0018	-0.0006
	[0.0036]	[0.0056]	[0.0028]	[0.0017]
$\times$ Ind.(Quintile 4 Elas$_j$)	0.0028	0.0007	0.0005	0.0018
	[0.0034]	[0.0054]	[0.0024]	[0.0015]
$\times$ Ind.(Quintile 5 Elas$_j$)	-0.0064	-0.0127**	-0.0085**	-0.0023
	[0.0046]	[0.0064]	[0.0038]	[0.0015]
p-value: Upstreamness$_{ij}$, Quintile 1 minus Quintile 5	[0.0039]	[0.0016]	[0.0005]	[0.0020]
Elasticity based on:	BEC cons.	BEC cons.	BEC cons.	BEC cons.
Observations	1,637,457	396,339	2,426,064	4,177,420
R^2	0.4808	0.4018	0.1058	0.5627
Firm fixed effects	Y	Y	Y	Y
Input industry i fixed effects	Y	Y	Y	Y
Industry i-j controls	Y	Y	Y	Y
No. of i-j pairs	7,225	7,073	7,063	16,630
No. of parent firms	27,770	6,745	41,931	41,931

Notes: The dependent variable is a 0-1 indicator for whether the SIC input is integrated. Each observation is a SIC input by parent firm pair, where the set of parent firms comprises those with primary SIC industry in manufacturing and employment of at least 20, which have integrated at least one manufacturing input apart from the output self-SIC. The sample is restricted to the set of the top 100 ever-integrated manufacturing inputs, as ranked by the total requirements coefficients of the SIC output industry, except in column (4) where all the top 100 manufacturing inputs are included. The sample in columns (1) and (2) is further restricted to different subsets of firms, as described in the column headings. The quintile dummies are based on the elasticity measure constructed using only those HS10 elasticities from Broda and Weinstein (2006) classified as consumption goods in the UN BEC. All columns include parent firm fixed effects and SIC input industry fixed effects, as well as the i-j industry controls included in columns (5)-(6) of Table 4. Standard errors are clustered by input-output industry pair; ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Table A-17

Integration Decisions within Firms: The Role of Contractibility
(Further Robustness)

Dependent variable:	Integration$_{ijp}$				
	# non-self-SIC integ. inputs ≥ 1	# integ. inputs ≥ 3	Drop self-SIC	All Inputs	Contractibility at i
	(1)	(2)	(3)	(4)	(5)
Contractibility-up-to-i_{ij}					
$\times$ Ind.(Quintile 1 Elas$_j$)	0.0033	0.0093	-0.0037	0.0031	-0.0002
	[0.0091]	[0.0137]	[0.0062]	[0.0041]	[0.0065]
$\times$ Ind.(Quintile 2 Elas$_j$)	0.0371***	0.0492***	0.0191***	0.0184***	0.0279***
	[0.0104]	[0.0155]	[0.0069]	[0.0055]	[0.0075]
$\times$ Ind.(Quintile 3 Elas$_j$)	0.0312***	0.0398**	0.0140*	0.0148***	0.0240***
	[0.0103]	[0.0159]	[0.0073]	[0.0051]	[0.0077]
$\times$ Ind.(Quintile 4 Elas$_j$)	0.0207	0.0197	0.0103	0.0072	0.0105
	[0.0129]	[0.0196]	[0.0085]	[0.0059]	[0.0088]
$\times$ Ind.(Quintile 5 Elas$_j$)	0.0529***	0.0603***	0.0383***	0.0225***	0.0335***
	[0.0148]	[0.0188]	[0.0108]	[0.0061]	[0.0099]
Contractibility-at-i_{ij}					
$\times$ Ind.(Quintile 1 Elas$_j$)					0.0874***
					[0.0272]
$\times$ Ind.(Quintile 2 Elas$_j$)					-0.0313
					[0.0334]
$\times$ Ind.(Quintile 3 Elas$_j$)					0.0109
					[0.0428]
$\times$ Ind.(Quintile 4 Elas$_j$)					0.1021*
					[0.0613]
$\times$ Ind.(Quintile 5 Elas$_j$)					0.1938
					[0.1430]
p-value: Upstreamness$_{ij}$, Quintile 1 minus Quintile 5	[0.0004]	[0.0042]	[0.0001]	[0.0021]	[0.0005]
Elasticity based on:	BEC cons.	BEC cons.	BEC cons.	BEC cons.	BEC cons.
Observations	1,637,457	396,339	2,426,064	4,177,420	2,467,486
R^2	0.4809	0.4018	0.1058	0.5628	0.5649
Firm fixed effects	Y	Y	Y	Y	Y
Input industry i fixed effects	Y	Y	Y	Y	Y
Industry i-j controls	Y	Y	Y	Y	Y
No. of i-j pairs	7,225	7,073	7,063	16,630	7,225
No. of parent firms	27,770	6,745	41,931	41,931	41,931

Notes: The dependent variable is a 0-1 indicator for whether the SIC input is integrated. Each observation is a SIC input by parent firm pair, where the set of parent firms comprises those with primary SIC industry in manufacturing and employment of at least 20, which have integrated at least one manufacturing input apart from the output self-SIC. The sample is restricted to the set of the top 100 ever-integrated manufacturing inputs, as ranked by the total requirements coefficients of the SIC output industry, except in column (4) where all the top 100 manufacturing inputs are included. The sample in columns (1) and (2) is further restricted to different subsets of firms, as described in the column headings. The *Contractibility-up-to-*i_{ij} measure is the share of the total-requirements weighted contractibility of inputs that has been accrued in production upstream of and including input i in the production of output j. Column (5) further controls for the full set of quintile elasticity dummies interacted with the *Contractibility-at-*i_{ij} measure, namely the share of the total-requirements weighted contractibility of inputs accrued at stage i itself. The quintile dummies are based on the elasticity measure constructed using only those HS10 elasticities from Broda and Weinstein (2006) classified as consumption goods in the UN BEC. All columns include parent firm fixed effects and SIC input industry fixed effects, as well as the i-j industry controls included in columns (5)-(6) of Table 5. Standard errors are clustered by input-output industry pair; ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.

Table A-18

Within-Firm Regressions: $\rho_j < \alpha_j$ vs $\rho_j > \alpha_j$

Dependent variable:	Integration$_{ijp}$			
	$\rho_j < \alpha_j$		$\rho_j > \alpha_j$	
	(1)	(2)	(3)	(4)
Upstreamness$_{ij}$	-0.0126***	-0.0070	-0.1170***	0.0333
	[0.0017]	[0.0045]	[0.0410]	[0.0534]
Self-SIC$_{ij}$	0.9566***	0.8380***	0.8460***	0.5486***
	[0.0066]	[0.0262]	[0.0476]	[0.0781]
Log (Total Requirements$_{ij}$)	0.0044**	0.0027	-0.0132	0.0340
	[0.0022]	[0.0021]	[0.0183]	[0.0239]
Upstream-Complementarity$_{ij}$		0.0169**		0.1679**
		[0.0067]		[0.0805]
Downstream-Complementarity$_{ij}$		0.0271**		-0.0022
		[0.0118]		[0.0756]
Diff. Log (Skilled Emp./Workers)$_{ij}$		-0.0393***		0.0230
		[0.0105]		[0.0583]
Diff. Log (Equip. Capital/Workers)$_{ij}$		-0.0048		-0.0065
		[0.0054]		[0.0387]
Diff. Log (Plant Capital/Workers)$_{ij}$		-0.0004		-0.0566
		[0.0050]		[0.0555]
Diff. R&D Intensity$_{ij}$		0.0021		-0.0252
		[0.0013]		[0.0306]
Same-SIC2$_{ij}$		0.0272***		-0.1075
		[0.0051]		[0.1267]
Same-SIC3$_{ij}$		0.0520***		0.1365*
		[0.0183]		[0.0732]
Observations	916,843	846,461	58,389	46,336
R^2	0.6763	0.6950	0.6578	0.7306
Firm fixed effects	Y	Y	Y	Y
Input industry i fixed effects	N	N	N	N
No. of i-j pairs	3252	2745	291	227
No. of parent firms	46,942	41,893	13,039	11,016

Notes: The dependent variable is a 0-1 indicator for whether the SIC input is integrated. Each observation is a SIC input by parent firm pair, where the set of parent firms comprises those with primary SIC industry in manufacturing and employment of at least 20, which have integrated at least one manufacturing input apart from the output self-SIC. The sample is restricted to the set of ever-integrated inputs among the top 100 manufacturing inputs, as ranked by the total requirements coefficients of the SIC output industry. The sample in columns (1) and (2) comprises firms that fall in output industries where $\rho_j < \alpha_j$, where ρ_j is based on the elasticity measure constructed using only those HS10 elasticities from Broda and Weinstein (2006) classified as consumption goods in the UN BEC; the sample in columns (3) and (4) comprises those firms that fall in output industries where $\rho_j > \alpha_j$. All columns include parent firm fixed effects. Standard errors are clustered by input-output industry pair; ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively.