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Abstract

We demonstrate how the incentives of firms that partially own their suppliers or customers to foreclose rivals depend on how the partial owner can extract profits from the target. Compared to a fully vertically integrated firm, a partial owner may obtain only a share of the target's profit but influence the target's strategy significantly. We show that the incentives for customer and input foreclosure can be higher, equal, or even lower with partial ownership than with a vertical merger, depending on how the protection of minority shareholders and transfer price regulations affect the scope for profit extraction.

JEL classification: G34, L22, L40

Keywords: Foreclosure; Minority shareholdings; Partial ownership; Profit shifting; Vertical integration

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1 Introduction

Foreclosure is a major policy concern related to vertical mergers. A vertically integrated entity may not be willing to supply rivals of its downstream unit (input foreclosure) or on-sell the products of a competing upstream firm (customer foreclosure). The Chicago School has argued that an integrated entity that can write efficient contracts does not foreclose other vertically related firms if there are gains from trade. Meanwhile, economists have formally shown that this argument may not apply in certain situations, and foreclosure can occur as a result of vertical mergers ([Rey and Tirole, 2007](#)).

There are crucial differences between a vertical merger and partial controlling ownership of the downstream or upstream incumbents. For instance, the direction of acquisition crucially affects the market outcome in the case of partial ownership but typically not in the case of full mergers.¹ [Baumol and Ordover \(1994\)](#), [Spiegel \(2013\)](#), and [Levy, Spiegel and Gilo \(2018\)](#) mainly consider the effects of controlling an upstream or downstream firm via partial ownership and argue that the foreclosure incentives may be even stronger with partial vertical ownership that involves control than with a full merger. These articles emphasize that with controlling partial shareholdings, a firm only internalizes parts of another firm's profits and losses, although it can fully distort its strategy to increase its own profit.² Consequently, dedicated

¹For the case of non-controlling partial vertical ownership, see [Flath \(1989\)](#); [Fiocco \(2016\)](#); [Greenlee and Raskovich \(2006\)](#); [Hunold and Stahl \(2016\)](#); [Hunold \(2020\)](#). For instance, [Hunold and Stahl \(2016\)](#) also study the difference between vertical partial ownership and a full merger.

²A partial owner may have control over a target if, for example, there are voting and non-voting shares and all voting shares or a large part thereof belong to the partial owner.

foreclosure strategies (such as a refusal to supply) can be more attractive when compared to full integration. A crucial assumption for these results on controlling partial ownership is how the controlling owner can extract profits from the partially owned target firm.

In this article, we add to this literature by studying contracting and corporate governance of partially integrated firms. Our main contribution is to show that the effects of foreclosure depend on how profit shifting is restricted in surprising and policy-relevant ways. When a partial owner has control over a target firm but only obtains part of its profits, the questions arise whether, how, and to what extent the controlling owner can extract profits from the target firm. Whereas minority shareholder protection aims to limit the profits being shifted out of the target firm, profit shifting does take place in practice.³ We show that different restrictions on profit shifting lead to distinctively different incentives to foreclose rivals. Certain restrictions indeed strengthen the incentives to foreclose with partial ownership compared to a full vertical merger, in line with the literature. However, with other restrictions on profit shifting, there are the same or weaker incentives to foreclose in case of partial vertical ownership. Overall, institutional insights indicate that the restrictions we consider are plausible in practice.⁴ For competition policy, it is crucial to understand under what conditions partial ownership tends to create high foreclosure incentives. We complement the literature in this respect.

³See [Atanasov et al. \(2014\)](#) for a detailed discussion of three main types of profit shifting: through cash flow, assets, and equity. Our Appendix B contains a review of the literature on profit shifting which also provides empirical evidence.

⁴See Appendix B for the discussion of tools used by minority shareholders to limit profit shifting.

We focus on studying the restriction on the amount that can be taken out of the target firm (Restriction 1) and the restriction on the amount that must be left in the target firm (Restriction 2). Both types of restrictions can naturally result from rules that aim to protect minority shareholders of the upstream firm. The motivation for Restriction 2 is that a certain profit level might be necessary for minority shareholders to not be suspicious, whereas Restriction 1 relies on the idea that there is a limit on the amount of money that the target firm can extract. Restriction 1 reflects situations where the minority shareholders might be able to successfully sue the controlling shareholders or fire the top manager if the amount of money or resources moving between the target firm and the partial owner is “suspiciously” large. Restriction 2 describes situations where the minority shareholders’ primary concern is the firm’s profit. Essentially, if the firm is significantly underperforming compared to certain benchmarks, the minority shareholders would initiate an investigation against the controlling shareholders and/or the top management.

At first sight, it might seem that the restrictions are equivalent. For instance, if the target’s profit is 100\$, one can either specify that at most 40\$ can be taken out ($t \leq 40\$$) or that 60\$ need to be left ($\pi^U \geq 60\$$). However, we will show below that the foreclosure incentives differ substantially. We demonstrate that, for different restrictions on profit shifting, a partial owner’s optimal strategy may vary between higher incentives to foreclose than under vertical integration (as discussed in [Levy, Spiegel and Gilo \(2018\)](#), henceforth LSG), the same incentives and no incentives at all. We analyze the partial owner’s foreclosure incentives for different market environments.

When a downstream firm partially owns a supplier, the restriction on the maximal profit shifting amount increases partial owner's incentives to foreclose its downstream rivals (input foreclosure). Suppose that the target's profit before profit shifting is 100\$ without foreclosure and 70\$ with foreclosure of a downstream rival. The upstream profit loss due to foreclosure is thus 30\$. Under full integration with the upstream firm, the controlling downstream firm would fully internalize this loss. Suppose, instead, that the downstream owner can extract at most 40\$ through profit shifting and internalizes 50 of the target's remaining profits, so that it will get in total $40\$ + 50\%$ of the upstream profits absent foreclosure. With foreclosure, the partial owner gets $40\$ + 50\%$ so that it internalizes only an upstream loss of 15\$ due to foreclosure. The partial owner consequently has less to lose from upstream foreclosure than under full integration, which improves the cost-benefit trade-off of foreclosure for given downstream gains.

Interestingly, the alternative restriction on the minimal profit that needs to be left in the target firm yields the same customer and input foreclosure incentives as full integration. Intuitively, this happens because the minimal profit restriction can be seen as a fixed fee the partial owner has to pay to the target firm. Hence, all the target firm's incentives are taken over by the partial owner. Suppose that the partial owner needs to leave profits of 60\$ in the upstream target. As before, absent foreclosure, the upstream profit before profit extraction is 100\$, so that the partial owner can extract 40\$ and earns $50\% \cdot 60\$$ through its profit participation, which yields a total of 70\$ for the partial owner. With foreclosure, the upstream profit decreases to 70\$, so that

the partial owner can only extract 10\$ to ensure a minimal upstream profit of 60\$, of which it again internalizes 50, providing the partial owner a total of 40\$. The partial owner thus internalizes the full difference of upstream losses from foreclosure of 30\$ as it obtains the residual upstream profit in any case.

Additionally, the restriction on the minimal profit might necessitate shifting profit into the target firm (*propping*) to foreclose.⁵ For the case that propping is not feasible at all, or not to a required extent, we find lower incentives for input foreclosure compared to a full integration benchmark. Building once more on the numerical example, suppose that the minimal upstream profit is now 80\$ instead of 60\$. As inducing the upstream target to foreclose the downstream rival reduces the target's profit from 100\$ to 70\$. The partial owner would need to shift an amount of 10\$ into the target firm to make foreclosure feasible. As the partial owner can extract 20\$ absent foreclosure, foreclosure in combination with propping is thus profitable if the downstream gains from foreclosure exceed 30\$.

The above example covers the case where an upstream firm holds shares of a customer (partial forward ownership) and considers foreclosure of a downstream rival (input foreclosure). We also review the case of several upstream firms where one of them partially owns a downstream firm. In this case the incentives of the upstream partial owner to force the target to not trade with its own upstream rivals (customer foreclosure) are of particular interest. The restriction on the profit shifting amount decreases the incentives of the partial upstream owner to induce customer foreclosure by the downstream target.

⁵The literature documents that propping takes place in practice ([Friedman et al., 2003](#); [Solarino and Boyd, 2020](#)). See Appendix B for details.

Again, this restriction follows LSG and the results are in line with their findings as well. The minimal profit restriction, however, yields the same foreclosure incentives as full integration, provided that the partial owner can prop its target firm when the required minimal profit level is relatively high. Additionally, if propping is not feasible at all, or not to a required extent, there are lower customer foreclosure incentives in comparison to a fully integrated firm. The results are thus largely analogous to the case of backward ownership and input foreclosure.

The structure of the remaining text is as follows. We describe the different restrictions in Section 2 and argue under which circumstances each of them is feasible in practice. Section 3 studies the input foreclosure incentives under the different profit shifting restrictions.⁶ Section 4 concludes with a discussion of implications for regulation and competition policy.

2 Foundation of profit shifting restrictions

We focus on studying the restriction on the amount that can be taken out of the target firm (Restriction 1) and the restriction on the amount that must be left in the target firm (Restriction 2). Both types of restrictions can naturally result from rules that aim at protecting minority shareholders of the upstream firm. In this section, we explain how the institutional setting, in particular shareholder protection and transfer price regulations, can give rise to these different restrictions. The most prominent source of limitations on

⁶As the analysis for customer foreclosure is largely analogous, we report it in Appendix D and provide an overview of all results in Appendix F.

profit shifting is transfer price regulation, in particular, the arm's length principle. According to §1.6 of the OECD (2022)'s Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations, "by seeking to adjust profits by reference to the conditions which would have obtained between independent enterprises in comparable transactions and comparable circumstances [], the arm's length principle follows the approach of treating the [firms] as operating as separate entities rather than as inseparable parts of a single unified business". Due to this, the arm's length principle focuses on comparing the conditions of the transactions to the conditions that "would be obtained in comparable uncontrolled transactions". This notion relies on the §1 of Article 9 of the OECD Model Tax Convention.

Restriction 1: limit on the profit shifting amount. Veto rights can protect minority shareholders.⁷ If the minority shareholders are well informed, they might be able to directly observe the amount of profit shifting that has materialized, at least if it surpasses a certain threshold. They might then be able to use their veto rights to prevent profit shifting. This could lead to a restriction on the maximum amount that can be extracted by the controlling shareholders (Restriction 1). Intuitively, we expect the maximal amount that can be extracted (\bar{t} in the model) to be higher if the protection of minority shareholders is weaker: the less the minority shareholders are protected, the easier it should get for the controlling shareholder to shift the profits out of the firm.

⁷See Appendix B for further discussion of veto rights as a minority shareholder protection tool.

To the extent that profit shifting takes place through the input prices between the target firm and the firm of the controlling shareholders, transfer price regulations may also restrict the maximum amount that can be extracted. In particular, the arm’s length principle prescribes that the price agreed in a transaction between two related parties must be the same as the price agreed in a comparable transaction between two unrelated parties.⁸ If effectively enforced, this could again give rise to Restriction 1. We expect the profit shifting threshold \bar{t} to be higher if the transfer price regulation is weaker. If the arm’s length principle applies, there could be a tension between shifting profits out of a target firm through a favorable input price while requiring the target firm to not trade with a rival of the controlling owner, which one may think of as a particularly unfavorable price. However, there can be a difference between charging different firms different prices – which creates an observable price benchmark – and not supplying a firm at all, which may be justified with shortages, technical incompatibility or a breakdown of negotiations. Moreover, besides input prices, other channels for shifting profits out of a firm may exist, as discussed in Appendix B. Although we model profit shifting as an adjustment of the input price between the vertically related firms, our results also extend to the case that profit shifting does not take place through the input price but through other channels.

Restriction 2: minimum profit of target firm. One general problem with minority shareholder expropriation is asymmetric information. First of

⁸See, e.g., [Wittendorff \(2010\)](#) for a comprehensive overview of the arm’s length principle and transfer pricing.

all, there is the well-known and extensively studied information asymmetry between the owner of a firm, the principal, and the manager, the agent (Ross, 1973). In the context of partial ownership, there is scope for additional asymmetry. Minority shareholders are structurally at an informational disadvantage. They tend to have fewer or no board seats and potentially fewer informal channels of communication with the managers than controlling shareholders. Different from our stylized model, many real firms are active in different product markets and locations, making it more complex and burdensome for outsiders to be well informed. Under such asymmetric information, minority shareholders might find it impossible to identify and limit profit shifting in a specific market directly. Although they observe a low profit, attributing this unambiguously to profit shifting may be impossible. A similar argument applies to foreclosure actions of the target firm that are only in the interest of the controlling owner but hurt the minority shareholders.

Restriction 2 is more relevant when minority shareholders cannot directly observe profit shifting (and foreclosure actions) and these are not prevented by regulation. Analyzing the firm's performance compared to benchmarks like other firms in related markets, business cycles and key performance indicators may nevertheless allow the minority shareholders to identify that the low profit is firm-specific and presumably caused by wrong decisions of its management, including possibly the extraction of profits by the controlling shareholder.

Although minority shareholders may not be able to identify the exact cause for the low performance, they may be able to discipline the firm's management in the case of low profits. This could take place, for instance, at the general

assembly through veto rights regarding the discharge of the management, or a lawsuit against the firm or the top managers, possibly even against majority shareholders. In the case of such asymmetric information, the trigger for an action of minority shareholders against the management is the firm's low profit that cannot be explained by general market trends or idiosyncratic events, such as a fire in a factory. In the context of profit extraction, this naturally shapes a restriction on the profit that controlling owners need to leave in the target firm (Restriction 2). For instance, one can imagine that, in case of a profit level below the predetermined threshold, minority shareholders would be able to sue the management of the target firm and/or the controlling shareholder successfully. So, the controlling shareholder needs to leave at least this amount of profit with the target firm. The minimal profit of the target firm could be an industry benchmark that provides an indication of what profit to expect under normal circumstances. Moreover, as minority shareholders should be essentially interested in the firm's profit level, they may, as long as a certain profit level is reached, not exert effort to closely monitor and regulate the firm's strategy with respect to market foreclosure and the terms of the supply contracts in specific product markets.

The management of the target firm may itself be interested in the firm's profit as their bonus payments may depend on a the firm's performance or they may have received stocks of the firm as part of their compensation. This may make the management reluctant to carry out strategies that lower the profits too much. Alternatively, the partial owner might take such a restriction upon itself as corporate law foresees control agreements and profit transfer

agreements for controlling shareholders and requires adequate compensation of minority shareholders. For example, the German stock corporation law states in §304 (2): “As a compensation payment, at least the annual payment of the amount is to be guaranteed, which could probably be distributed as an average profit share among the individual shares based on the company’s previous earnings situation and its future earnings prospects, taking into account appropriate depreciation and value adjustments, but without the formation of other retained earnings.” The minimum profit restriction in our model can be interpreted as the compensation payment of such an agreement.

In summary, the plausibility of restrictions 1 and 2 presumably depends on how informed minority shareholders are about profit shifting (and foreclosure) actions, the relevance of transfer prices as the channel through which profit shifting takes place and, correspondingly, the effectiveness of transfer price regulations. It thus depends on the institutional context which restriction on profit shifting an analyst should assume to be most relevant. Both restrictions may also co-exist, for instance, in the case of poorly informed minority shareholders and strict transfer price regulations. One then would need to assess which restriction is likely to bind first. In what follows, we study the incentives of input foreclosure (in Section 3) and customer foreclosure (in Appendix D) under both restrictions and show that the modeling choice of the profit shifting restriction decisively influences the outcome.

3 Model

3.1 Framework

There is one upstream firm U which potentially supplies the two symmetric downstream firms D_1 and D_2 , as shown in Figure 1. Firm U can sell each downstream firm D_i with $i \in \{1, 2\}$ one unit of the input at a price of f_i . To keep the model simple and focus on the main mechanism, we abstract from upstream production costs. One can interpret upstream product either being indeed one unit, such as an engine of which a downstream firm only needs one, or as multiple units, such as merchandise, for which the price is a fixed transfer of f_i . For instance, fixed transfers and unit prices equal to costs can result from secret contracting, see [Hart and Tirole \(1990\)](#).

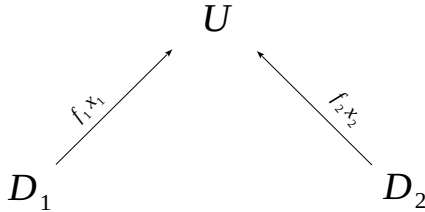


Figure 1: Market structure: input foreclosure setup.

The profit of U is

$$\pi^U = f_1x_1 + f_2x_2, \tag{1}$$

where $x_i \in \{0, 1\}$ denotes the input sales to firm i . We follow LSG and denote the profit of the downstream firm i as

$$\pi_i = \pi(x_i, x_{-i}) - f_i x_i,$$

where $\pi(x_i, x_{-i})$ is the downstream flow profit before input costs. A firm can produce the output in a more competitive way with the input from U (cheaper or at a higher quality):

Assumption 1. $\pi(1, x_{-i}) > \pi(0, x_{-i})$.

A firm's profit decreases if its rival has obtained a unit of input because this intensifies competition:

Assumption 2. $\pi(x_i, 1) \leq \pi(x_i, 0)$, holding strictly at least for $x_i = 1$.

These assumptions on the downstream profits allow for the case that a firm cannot make a positive profit without the input, which is consistent with a downstream monopoly if only one firm has the input. The assumptions also allow for a situation where a firm without the input from upstream firm U can still get the input from another source, such as a fringe supply. The reduced form downstream profits also allow for markets where there are other downstream competitors besides D_1 and D_2 which are supplied by other upstream firms than U .

We study the cases of vertical separation, a full merger between U and D_1 , and partial vertical ownership where D_1 owns a share $\alpha \in (0; 1)$ of U and can influence the strategy of U to some degree (we explain the restrictions below).⁹ For a given ownership structure, the timing is as follows:

⁹One example where the ownership share α may be very low (in theory, α may approach zero) while the partial owner still has full control over the target's strategy is a pyramidal

1. Upstream firm U sets input prices f_1 and f_2 .
2. Each downstream firm $D_i, i \in \{1; 2\}$, chooses whether to purchase the input $x_i \in \{0; 1\}$ and then sells its output.

For the analysis of profit shifting, we define the *market price* f^* . We let the market price have any level in the interval $[\underline{f}, \bar{f}]$. The lower bound \underline{f} is the reservation value of U , which equals its marginal costs of 0, and the upper bound equals the willingness-to-pay of each D_i under vertical separation.¹⁰ It is defined as the maximal price that U can charge each firm, which is equal to the incremental profit from the input, given the other downstream firm also uses the input:

$$\bar{f} = \pi(1, 1) - \pi(0, 1). \quad (\textit{take-it-or-leave-it price}) \quad (2)$$

One can thus think of f^* as a price that results for a certain level of bargaining power in the price negotiations under vertical separation. In our model, we treat f^* as exogenous, i.e., the upstream firm can either sell the input to an independent downstream firm at a price of f^* or refuse to sell the input.¹¹

ownership structure where several firms form a business group. This business group is a top-down chain of companies usually controlled by the ultimate shareholder who may only own a small part of firms located in the lower levels of the pyramidal structure but can control it fully (Riyanto and Toolsema, 2008). Furthermore, if the target firms has voting and non-voting shares and the majority of voting shares belongs to the partial owner, it would be able to exert full control while possibly owning only a share $\alpha < 0.5$ of the target firm.

¹⁰One can interpret the price f^* as the result of Nash bargaining in the case of vertical separation. The lower bound price $f^* = \underline{f}$ results if all the bargaining power is downstream whereas $f^* = \bar{f}$ results if upstream firm U has all the bargaining power. Similarly, LSG's model focuses on take-it-or-leave-it prices but generalizes to a bargaining approach.

¹¹Exogenous market price allows us to abstract from partial foreclosure in the sense of charging an independent firm a higher input price at which trade still takes place. In

In the present setting, serving both downstream firms maximizes the profit of the upstream firm (Equation (1)) under vertical separation.¹² Vertical ownership can change these incentives and lead to input foreclosure.

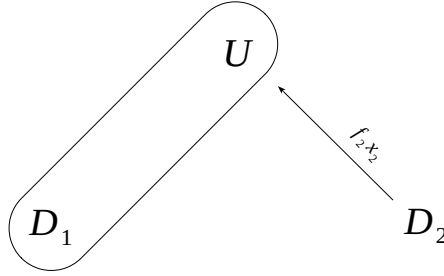


Figure 2: Full integration: input foreclosure setup.

Definition 1. Input foreclosure refers to a situation where U is (partially) integrated with D_1 and does not sell input to D_2 . This implies $x_2 = 0$.

Benchmark: full vertical integration. Full integration between U and D_1 is our benchmark in the subsequent sections where we show that the input foreclosure incentives of partial ownership depend crucially on how we model the restrictions on profit shifting and transfer prices (see Figure 2). The joint profit of U and D_1 is

$$\pi_{D_1}^U = \pi(x_1, x_2) + f_2 x_2. \quad (3)$$

To start, let us establish

Appendix C we show that our results hold when allowing for the endogenous input pricing for different ownership structures and profit shifting restrictions.

¹²This is a natural benchmark. If, on the contrary, it was already optimal to only supply one downstream firm under vertical separation, there would be no scope for vertical ownership to lead to foreclosure.

Lemma 1. *It is always optimal for the fully integrated unit of U and D_1 to supply its downstream business with the input.*

Proof. This and most other proofs are in Appendix A. Certain proofs, which we consider to be particularly instructive, are below the respective lemma or proposition. \square

It is optimal for the integrated entity to supply both downstream firms if the joint profit, when doing so, exceeds the joint profits under foreclosure:

$$\pi(1, 1) + f^* \geq \pi(1, 0) \tag{4}$$

$$\implies f^* \geq \pi(1, 0) - \pi(1, 1). \tag{5}$$

We refer to (5) as “*non-foreclosure condition under vertical integration*” in this section.

The non-foreclosure condition together with the definition of \bar{f} implies $2 \cdot \pi(1, 1) \geq \pi(1, 0) + \pi(0, 1)$. We illustrate in Appendix E for which types of competition models this condition holds. For instance, it can hold if getting the upstream firm’s input corresponds to a non-drastic marginal cost reduction. If the input is essential and there is a downstream duopoly of firms D_1 and D_2 , such that one downstream firm not getting the input from U transforms the downstream market from duopoly to monopoly, the condition does not hold. However, the condition may well hold for downstream oligopolies with more than two firms. This is fully consistent with our model. Some downstream firms may not get the input from upstream firm U , so that the downstream interaction is fully captured by the reduced form downstream profits $\pi(x_i, x_{-i})$.

3.2 Partial backward ownership

This section focuses on the case that D_1 has partial ownership of U , as shown in Figure 3. This partial ownership entitles D_1 to a share $\alpha \in (0, 1)$ of U 's profits, which yields for D_1 a total profit of

$$\pi_{D_1} = \pi(x_1, x_2) - f_1 x_1 + \alpha \underbrace{(f_1 x_1 + f_2 x_2)}_{\pi^U}. \quad (6)$$

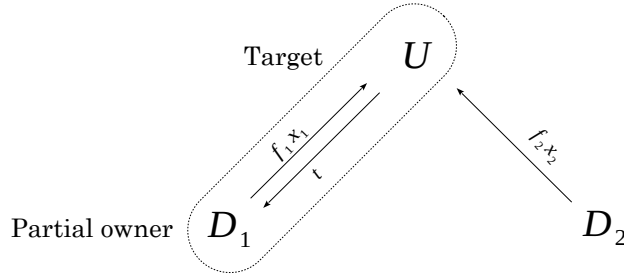


Figure 3: Partial backward ownership: D_1 owns stake of U .

In line with LSG, we assume that the ownership arrangement allows D_1 to exert control over the strategy of U , subject to different restrictions. The strategy of U essentially consists of setting the input prices f_1 and f_2 for the two downstream firms.

Firm D_1 can, if the restrictions allow so, use its control to require such a high input price from D_2 that D_2 does not buy the input (input foreclosure).

Any price above \bar{f} achieves this, for instance, $f_2 = \infty$.¹³

¹³We abstract from partial foreclosure in the sense of U charging the independent firm D_2 a higher input price at which D_2 still buys the input. This is not essential for our analysis of the foreclosure incentives under different profit shifting restrictions. Importantly, we keep

As regards the own input price f_1 , the partial owner D_1 can generally demand a price that differs from the market price f^* . We speak of *profit extraction* in the case of a lower input price ($f_1 < f^*$), whereas we speak of *propping* in the case of a higher input price ($f_1 > f^*$). We denote by t the amount that D_1 extracts out of U :

$$t = f^* - f_1. \quad (7)$$

The profit of supplier U is

$$\pi^U = f_1 x_1 + f_2 x_2 = (f^* - t) x_1 + f_2 x_2. \quad (8)$$

In what follows, we focus on the natural case that D_1 never forecloses itself, which means $x_1 = 1$.¹⁴ We can write the profit of D_1 as

$$\pi_{D1} = \pi(1, x_2) - f^* + t + \underbrace{\alpha(f^* - t + f_2 x_2)}_{\pi^U}. \quad (9)$$

We now present alternative restrictions on profit shifting and compare how these restrictions affect the foreclosure incentives. We focus on restrictions on the amount to extract and on the minimal upstream profit. Both types of restrictions can naturally result from rules that aim at protecting minority shareholders of the upstream firm as discussed in Section 2. This protection

the input price for D_2 the same under different profit shifting restrictions.

¹⁴Supplying the own downstream unit is profitable under full integration (Lemma 1). If a downstream firm partially owns the upstream firm and obtains its full downstream profits but only part of the upstream profits, it is even less profitable to not supply itself as it would bear the full downstream loss and only obtain part of the upstream gain.

might require profits to reach at least the minimum threshold to be satisfied or restrict the amount of money to be transferred downstream. In some cases, however, it might be optimal for the partial owner D_1 to prop U , i.e., to transfer profits upstream. In this case, the minority shareholder protection of the downstream firm can play a role. They can also either restrict the minimal amount of D_1 's profits to be left in the firm or the amount of money that can be transferred upstream.

Profit shifting Restriction 1: exogenous limit on the extraction amount: $t \leq \bar{t}$. Following LSG, we assume that profit shifting from U to D_1 is limited to an exogenous amount of \bar{t} , which yields the restriction $t \leq \bar{t}$.¹⁵ For the following analysis we focus on the instance where this profit shifting restriction binds in both cases of foreclosure and supplying the independent downstream firm. If there are other restrictions, such as a zero profit restriction, this means that \bar{t} must not be too large because otherwise another restriction would bind first.

Lemma 2. *Under the restriction on the absolute profit extraction amount, the partial owner D_1 has strictly stronger incentives to foreclose its rival than in the case of full integration.*

Proof. The partial owner D_1 is not able to extract all profits, neither with nor without foreclosure. This means that D_1 can shift up to \bar{t} out of the upstream

¹⁵Assumption A5 of LSG reads $t \leq \min\{G, L\}$. The assumption implies that the amount to extract should not exceed the minimum of downstream gains and upstream losses from foreclosure: the authors define the difference between downstream profits with and without foreclosure as G (gains) and the respective difference between upstream profits as L (losses).

firm independent of whether it supplies D_2 or not. Substituting $t = \bar{t}$ in the profit of D_1 yields

$$\pi_{D_1}^F = \pi(1, 0) - f^* + \bar{t} + \alpha (f^* - \bar{t}) \quad (10)$$

in the case of foreclosure, and

$$\pi_{D_1}^S = \pi(1, 1) - f^* + \bar{t} + \alpha (2f^* - \bar{t}) \quad (11)$$

when supplying D_2 . Supplying is weakly more profitable than foreclosure if $\pi_{D_1}^S \geq \pi_{D_1}^F$, which implies

$$f^* \geq 1/\alpha [\pi(1, 0) - \pi(1, 1)]. \quad (12)$$

As $\alpha < 1$, Condition (12) implies that foreclosure is more profitable for D_1 than in the case of a vertical merger (Condition (5)). \square

Intuitively, the partial owner internalizes its own profits compared to the target firm's profits with the relative weight of $1/\alpha$. Therefore, for a given profit extraction restriction, foreclosure is more profitable when the profit share α from partial ownership is smaller. This condition is similar to the foreclosure incentive condition in LSG as they assume an exogenous limit on profit extraction and restrict the amount of profit extraction to be smaller than the downstream gains and upstream losses from not supplying to D_2 .¹⁶

¹⁶See their foreclosure condition on page 143.

Profit shifting Restriction 2: minimal upstream profit ($\pi^U \geq \underline{\pi}^U$).

Instead of restricting the amount that the downstream firm can extract ($t \leq \bar{t}$), minority shareholders might require a lower limit $\underline{\pi}^U$ on the profits that need to be left in the upstream firm instead. We restrict $\underline{\pi}^U$ to the natural upper bound of $2f^*$ because $\underline{\pi}^U > 2f^*$ would mean that U 's profits need to be higher than the highest profit achievable at market prices absent vertical ownership.

Assumption 3. $\underline{\pi}^U \leq 2f^*$.

In the present case, the profit extraction restriction

$$\pi^U \geq \underline{\pi}^U$$

can be written as

$$f^* - t + f_2 x_2 \geq \underline{\pi}^U, \tag{13}$$

using the definition of π^U from Equation (8) for $x_1 = x_2 = 1$. Setting f_2 to the market price of f^* , the restriction implies a maximal amount to be extracted of

$$t = f^* + f^* x_2 - \underline{\pi}^U.$$

Assumption 3 implies that the extracted amount is non-negative if U supplies both downstream firms with input.

Lemma 3. *Under the restriction that a minimal profit that needs to be left in the upstream firm, the partial owner D_1 has the same incentive to foreclose its downstream rival as under full vertical integration.*

Proof. Substituting for t in the profit of D_1 in Equation (6) yields

$$\pi_{D_1} = \pi(1, x_2) - f^* + \underbrace{(f^* + f^*x_2 - \underline{\pi}^U)}_t + \alpha\underline{\pi}^U \quad (14)$$

$$= \pi(1, x_2) + f^*x_2 - (1 - \alpha)\underline{\pi}^U. \quad (15)$$

D_1 prefers to supply D_2 if the resulting profits are higher than the profits in the case of foreclosure:

$$\pi(1, 1) + f^* - (1 - \alpha)\underline{\pi}^U \geq \pi(1, 0) - (1 - \alpha)\underline{\pi}^U,$$

which reduces to

$$f^* \geq \pi(1, 0) - \pi(1, 1). \quad (16)$$

This is the same condition as under full vertical integration (Equation (5)). Firm D_1 has the same foreclosure incentives as when U and D_1 are fully integrated. \square

The non-foreclosure condition does not depend on the degree of minority shareholder protection and the share α . The reason is that the partial owner internalizes the full difference of upstream losses from foreclosure as it obtains the residual upstream profit in any case. In other words, irrespective of whether D_1 forecloses D_2 or not, it has to leave U with a certain minimum level of profits. Hence, if D_1 tries to foreclose D_2 , D_1 does it at its own expense. For example, if foreclosure implies a profit loss for U , then D_1 can extract less profits from U directly than absent foreclosure. This is different from the non-foreclosure condition (12) that we obtained when restricting the amount

that D_1 can shift with the condition $t \leq \bar{t}$. In this case, the partial owner can extract a certain amount, leaving the residual profits in the upstream firm. Of these profits, the partial owner only obtains a share of $\alpha < 1$, which implies higher foreclosure incentives. The latter condition is also the relevant foreclosure condition of LSG for their partial (backward) ownership case.

Propping and foreclosure. Without profit shifting ($t = 0$), the minimum profit condition (13) in the case of foreclosure ($x_2 = 0$) becomes $\underline{\pi}^U > f^*$. To ensure the minimum profit of U , D_1 would need to engage in propping ($t < 0$) in the case of foreclosure. Therefore, we specifically analyze the case when $\underline{\pi}^U$ is in the interval $(f^*; 2f^*]$.¹⁷ This is a subset of the cases considered under Lemma 3.

Lemma 4. *If foreclosure is more profitable than supplying D_2 (Condition 16 does not hold) and the minimal profit that needs to be left in the upstream firm is relatively large ($\underline{\pi}^U > f^*$), the partial owner D_1 optimally props U to foreclose D_2 by shifting an amount of $\underline{\pi}^U - f^*$ to the target firm.*

Proof. See Appendix A. □

If propping is restricted or not possible, foreclosure may not be feasible with partial ownership, although it would be profitable. For example, suppose that $f^* = 50$, $\underline{\pi}^U = 60$, $\pi(1, 1) = 100$, $\pi(1, 0) = 200$. Absent foreclosure, U 's profit equals

$$2f^* - t = 100 - t \geq \underline{\pi}^U = 60,$$

¹⁷The upper bound of the interval is determined by Assumption 3.

which implies that D_1 optimally extracts an amount of $t = 40$ in this case and obtains a profit of

$$\pi(1, 1) - f^* + t = 100 - 50 + 40 = 90.$$

With foreclosure, the profit of U becomes

$$f^* - t = 50 - t \geq \underline{\pi}^U = 60,$$

which implies an optimal amount of profit shifting of $t = -10$ and yields a profit for D_1 of

$$\pi(1, 0) - f^* + t = 200 - 50 - 10 = 140.$$

Foreclosure is only feasible with propping ($t \leq -10$) and turns out to be profitable for D_1 at $t = -10$ because its foreclosure profit is 140 and thus larger than the profit of 90 absent foreclosure. Note that if propping were not possible (which corresponds to $t \geq 0$), then there would not be foreclosure and D_1 would earn the profit of 90. We generalize these insights in

Lemma 5. *Foreclosure of the downstream rival does not occur with partial backward ownership in situations where it would occur with a full vertical merger if the target firm's minimum profit level is above the profit obtainable with foreclosure ($\underline{\pi}^U > f^*$) and profit shifting into the target firm (propping) is not feasible at all, or not to the required extent (this corresponds to the restriction $t > \underline{\pi}^U - f^*$).*

This lemma sheds new light on the foreclosure effects of partial vertical ownership: Restrictions on the amount of money a partial owner can prop into the target firm as part of a foreclosure strategy may render foreclosure impossible. For instance, transfer price regulations may limit the feasibility of propping. Moreover, it may be impossible to communicate to and agree with minority shareholders of D_1 on the strategy of shifting profits into U in order to foreclose a downstream rival, even if that is in their interest.

Consequently, even if the vertically related partial owner has full control over the target firm and seemingly more incentives to foreclose than in the case of a full vertical merger (as argued by LSG), foreclosure may nevertheless not occur, although it would have occurred with a merger.

The next proposition summarizes the results on the input foreclosure incentives with partial backward ownership of the lemmas 2, 3, and 4.

Proposition 1. *Relative to full vertical integration, partial backward ownership (PBO) affects the incentives for input foreclosure in the following ways:*

1. *PBO strengthens the foreclosure incentives if the absolute amount of profit extraction is effectively restricted (Lemma 2);*
2. *PBO has the same effect as full vertical integration if profit extraction is restricted by a minimum profit that needs to be left in the target firm, provided that propping is unrestricted (Lemma 3);*
3. *The foreclosure incentives are lower with PBO if profit extraction is restricted by a minimum profit that needs to be left in the target firm and if propping is restricted as well (Lemma 4).*

Comment on the role of propping when the foreclosure strategy is continuous. We have derived the result that propping can be optimal to enable foreclosure only holds in cases where the supply choice of U is binary: either supply the independent downstream firm with the input or do not. Such binary cases can occur, for instance, if the question is whether to supply an essential piece of equipment or not. In other cases, the supply choice can be continuous, e.g., how many units to supply to the independent downstream firm. Even in this case, full foreclosure might be optimal.

In the case of a continuous supply choice, partial foreclosure, in the sense of supplying less units than otherwise optimal, may be feasible without propping. Even in this case, the optimal foreclosure strategy might involve propping. For instance, it might be optimal to fully foreclose the independent downstream firm and compensate the upstream firm through propping if supplying even one unit of input to the independent downstream could yield a discrete drop in the profits of the vertically related downstream rival. For example, the independent downstream firm may be able to advertise that it has products of U once it has one unit of them and this could induce many consumers to start visiting stores of this downstream firm.

More generally, suppose there is a fixed unit input price w^* . At the margin, supplying one less unit of input reduces the upstream profit by w^* but may increase the profit of the integrated downstream rival by more than w^* . In this case propping would be preferable over marginally reducing the supply of the independent downstream firm.

3.3 Partial forward ownership

For the industry structure with one upstream and two downstream firms, we now consider the case where U owns a share $\alpha \in (0, 1)$ of D_1 's profits. The market structure is shown in Figure 4. The partial owner U can exert full control over its target's strategy, subject to the profit extraction restrictions.

As the derivations are similar to the case of partial backward ownership in the previous section, we present the detailed analysis in Appendix A and only summarize and discuss the result in this section.

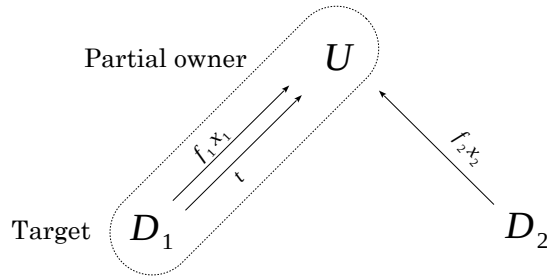


Figure 4: Partial forward ownership: U owns stake of D_1 .

Proposition 2. *Relative to full vertical integration, partial forward ownership (PFO) tends to affect the incentives for input foreclosure in the following ways:*

1. *PFO decreases the foreclosure incentives if the absolute amount of profit extraction is effectively restricted (Lemma 6);*
2. *PFO has the same effect as full vertical integration if profit extraction is restricted by a minimum profit that needs to be left in the target firm (Lemma 7).*

Proof. See Appendix A for the lemmas and their proofs. □

The intuition for result 1 of the proposition is that the partial owner U values additional upstream profits more than additional downstream profits of D_1 , of which it obtains only a fraction. Consequently, it has fewer incentives to foreclose than under full integration where both profits have the same weight. This is in line with [Levy et al. \(2018\)](#). The result mirrors result 1 from Proposition 1 where the firm internalized additional upstream profits less than additional downstream profits and, hence, had more incentives to foreclose than under full integration. Result 2 is analogous to the result 2 in Proposition 1. Under both partial forward and partial backward ownership structures, the partial owner fully internalizes both upstream and downstream incentives resulting in the same foreclosure incentives as under full integration.

Note that propping is not an issue here as foreclosure requires an upstream action from the partial owner but not from the downstream target and we assume that the owner maximizes its own profit without minority shareholder restrictions within its own entity.

4 Conclusion

We study the incentives of a firm that partially owns an upstream or downstream firm to foreclose its rivals. The partial owner only obtains part of its target's profits but it may substantially change the target's strategy of dealing with rivals of the owner and thereby induce foreclosure. We focus on the phenomena of shifting profits out of and into the target firm, and demon-

strate how the different restrictions imposed on these activities alter the partial owner's incentives to induce foreclosure of a rival. This phenomenon has, to our knowledge, so far received only limited and, arguably, insufficient attention in theoretical competition policy analyses.

We show that, depending on the type of profit extraction restriction, a partial owner's optimal strategy may vary between higher incentives to foreclose than under vertical integration, as discussed by [Levy et al. \(2018\)](#), the same incentives (because of fully taking into account the target firm's residual profit) and no incentives at all (if propping is sufficiently restricted). We analyze the partial owner's foreclosure incentives for a variety of market environments.

For partial backward ownership, we confirm that the restriction on the maximal profit extraction amount increases the partial owner's incentives to foreclose its downstream rivals (input foreclosure) and decreases the incentives to foreclose the rivals of the upstream target (customer foreclosure, see Appendix D). This result is in line with LSG who exclusively use this kind of profit extraction restriction. Interestingly, we find that the alternative restriction on the minimal profit that needs to remain in the target firm yields the same customer and input foreclosure incentives as full integration. Additionally, the restriction on the minimal profit might necessitate propping money into the target firm in order to foreclose. If propping is not feasible at all, or not to a required extent, the partial backward owner faces lower incentives for input foreclosure compared to the full integration benchmark.

For partial forward ownership we also confirm the results of LSG whereby the restriction on profit extraction decreases the incentives of the partial owner

to foreclose its target's downstream rivals (input foreclosure) but increases the incentives to foreclose its own upstream rivals (customer foreclosure). Analogous to above, we find that the minimal profit restriction yields the same foreclosure incentives as full integration, provided that the partial owner can prop its target firm if the minimal profit level is relatively high. Additionally, if propping is not feasible at all, or not to a required extent, the partial forward owner has lower customer foreclosure incentives in comparison to a fully integrated firm.

In summary, the way profit shifting is regulated or restricted can substantially affect the results of a foreclosure analysis in the case of partial vertical ownership. A precise understanding of the profit shifting restrictions is thus crucial for a correct assessment of possible foreclosure incentives. Albeit, as the literature reveals, profit shifting is a common phenomenon, it so far appears to be less clear how one should think of the restrictions on profit extraction in a vertical relations framework. We have argued that the choice of the most plausible profit extraction restriction presumably depends on how informed minority shareholders are about profit shifting actions as well as on the effectiveness of transfer price regulations if profit extraction is expected to take place through the input prices. This suggests that an analyst should study the information flows between the target firm and its shareholder as well as the regulatory context to assess which profit extraction restriction are likely most relevant. The restrictions on the extracted amount and the minimal profit of the target firm may also co-exist, for instance in the case of poorly informed minority shareholders and strict transfer price regulations. One then would

need to assess which restriction is likely to bind first. It would be fruitful for future research to look more closely at different institutional contexts, possibly also from a legal perspective, to provide more precise guidance on what kind of profit shifting restrictions are most relevant in practice.

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Appendix

A. Input foreclosure: additional lemmas and proofs

Proof of Lemma 1. Suppose that the integrated entity can commit to not supplying itself (for instance, by setting a fee of $f_1 = \infty$ if that is public). The integrated entity's profit in Equation (3) when not supplying itself equals $\pi(0, 1) + f^*$ and if supplying itself equals $\pi(1, 0)$. If the entity does not supply D_2 , but only D_1 , its joint profits are

$$\pi_{D_1}^U(x_1 = 1, x_2 = 0) = \pi(1, 0).$$

It is weakly more profitable for the integrated unit to supply itself than only D_2 because

$$\begin{aligned}\pi_{D_1}^U(x_1 = 0, x_2 = 1) &\leq \pi_{D_1}^U(x_1 = 1, x_2 = 0) \\ \iff \pi(0, 1) + f^* &\leq \pi(1, 0) \\ \iff f^* &\leq \pi(1, 0) - \pi(0, 1).\end{aligned}$$

The latter holds as $f^* \leq \bar{f} = \pi(1, 1) - \pi(0, 1)$.

It is weakly more profitable for the integrated unit to supply itself when not supplying D_2 because

$$\begin{aligned}\pi_{D_1}^U(x_1 = 0, x_2 = 0) &\leq \pi_{D_1}^U(x_1 = 1, x_2 = 0) \\ \iff \pi(0, 0) &< \pi(1, 0),\end{aligned}$$

which holds by Assumption 1.

Provided it supplies D_2 , it is weakly more profitable for the integrated unit because

$$\begin{aligned}\pi_{D_1}^U(x_1 = 0, x_2 = 1) &\leq \pi_{D_1}^U(x_1 = 1, x_2 = 1) \\ \iff \pi(0, 1) + f^* &\leq \pi(1, 1) + f^* \\ \iff \pi(0, 1) &\leq \pi(1, 1),\end{aligned}$$

which again holds by Assumption 1.

Moreover, if f_1 and f_2 are set secretly (downstream firm 1 does not see f_2 when accepting the contract and vice versa), the integrated unit simply cannot commit to not supplying itself. Thus, it cannot charge D_2 a transfer price above f^* in equilibrium as it would do better with charging a price at which the downstream firm buys the input. \square

Proof of Lemma 4. We have shown in the proof of Lemma 3 that foreclosure is profitable in case of the minimal profit restriction under the same condition as under vertical integration (see Equation (5)), that is:

$$\pi(1, 0) > \pi(1, 1) + f^*.$$

Propping is equivalent to $t < 0$ and occurs as part of the foreclosure strategy when the above condition holds and, in addition, $\underline{\pi}^U > f^*$.

Note that in the absence of profit shifting and in particular propping ($t = 0$), U supplying both downstream firms at market prices fulfills the restriction $\pi^U \geq \underline{\pi}^U$ as $\underline{\pi}^U \in (f^*; 2f^*]$ and the profit π^U then equals $2f^*$.

Instead, foreclosure of D_2 does not satisfy $\pi^U \geq \underline{\pi}^U$ as the profit π^U then equals f^* and $\underline{\pi}^U > f^*$. In order to satisfy the minimal profit restriction of U , D_1 must shift profits to U , such that $\pi^U = f^* + t \geq \underline{\pi}^U$. The lowest transfer which satisfies this is given by $\underline{\pi}^U - f^*$, which implies

$$t = f^* - \underline{\pi}^U < 0,$$

which is negative as $\underline{\pi}^U > f^*$.

Therefore, if foreclosure is profitable for D_1 , the partial owner will optimally prop U to ensure that its profit level is not below $\underline{\pi}^U$. \square

Forward ownership: lemmas for Proposition 2 and their proofs

Lemma 6. *Under the restriction on the absolute profit extraction amount, the partial owner U has strictly lower incentives to foreclose its target's rival D_2 than in the case of a full integration.*

Proof. The upstream profits without and with foreclosure are

$$\pi_U^S = 2f^* + \bar{t} + \alpha (\pi(1, 1) - f^* - \bar{t}),$$

$$\pi_U^F = f^* + \bar{t} + \alpha (\pi(1, 0) - f^* - \bar{t}),$$

where superscripts S and F denote “supply” and “foreclosure”, respectively.

The upstream owner is better off when supplying D_2 if

$$\pi_U^S \geq \pi_U^F$$

$$\implies f^* \geq \alpha [\pi(1, 0) - \pi(1, 1)].$$

The foreclosure incentives for the upstream firm are lower than in the case of full integration (Condition (5)). \square

Lemma 7. *Under the profit extraction restriction of a minimal profit that needs to be left in the upstream firm, the partial owner U has the same incentive to foreclose its target’s downstream rival D_2 as under vertical integration.*

Proof. If both profit extraction and propping are feasible, the downstream firm D_1 ends up with the profit of $\underline{\pi}_{D1}$ in any case, but the extracted amount, t^S and t^F , differs. The upstream profits are

$$\pi_U^S = 2f^* + \underbrace{(\pi(1, 1) - f^* - \underline{\pi}_{D1})}_{t^S} + \alpha \underline{\pi}_{D1},$$

$$\pi_U^F = f^* + \underbrace{(\pi(1, 0) - f^* - \pi_{D1})}_{t^F} + \alpha \pi_{D1}.$$

The upstream owner is better off when supplying D_2 if

$$\pi_U^S \geq \pi_U^F$$

$$\implies f^* \geq \pi(1, 0) - \pi(1, 1). \quad (17)$$

The foreclosure incentives are the same as in the full integration case (Condition (5)). \square

B. Evidence on profit extraction, propping, and minority shareholder protection

In this section, we first present empirical evidence demonstrating that profit shifting is a relevant and prominent phenomenon and theoretical work analyzing its underlying mechanisms. We then discuss real-life applications of tools used for minority shareholder protection to prevent profit extraction or reduce its harmful impact.

Empirical evidence on profit extraction. Profit extraction can take a variety of different forms.¹⁸ The simplest form is shifting profits to the ben-

¹⁸See [Atanasov et al. \(2014\)](#) for a detailed discussion of three main types of profit extraction: via cash flow tunneling, assets, and equity. Cash flow profit extraction is shifting a part of the target firm's current profits (e.g. through transfer pricing, excessive salaries, etc). Asset profit extraction is buying the firm's major assets for a price above the market value or selling them for a price below the market value, thereby influencing the firm's long-term profitability. Equity profit extraction is increasing the controller's share at the expense of

efit of the controlling shareholder through self-dealing transactions. These may include the sale of over-priced output to the target firm, the purchase of under-priced input from the target firm, excessive salaries, and bonuses for top managers and executives, and even using a corporate jet for private reasons. According to [Johnson et al. \(2000\)](#), this form of profit extraction (also referred to as *tunneling*) is illegal everywhere if it includes theft or fraudulent behavior. However, the controlling shareholders may legally shift profits through asset sales or excessive pricing agreements, exploit corporate monetary and non-monetary opportunities, or use more complex instruments for profit-shifting.

The key obstacle in the empirical literature on profit extraction is how to quantify it as the exact amounts are often concealed and hardly directly observable. For example, [Bertrand et al. \(2002\)](#) analyze Indian business groups and compare the firm's actual reported performance and its predicted performance as well as the predicted performance of other firms in the same business group. They find evidence that profit shifting occurs mainly through the firm's non-operating profits and is partly incorporated into the stock market prices. Similarly, [Baek et al. \(2006\)](#) analyze private placements of listed South Korean firms and focus on business groups. They compare deals within one business group with other deals and provide evidence for profit extraction within business groups: the firms with favorable past performance sell their securities at a discount to other group members. In China, controlling shareholders widely use corporate loans to shift profits from listed Chinese companies. The

minority shareholders.

profit extraction problem is the most severe if the control rights are significantly larger than the profit rights (Jiang et al., 2010). Cheung et al. (2006) analyze transactions between partial owners and target firms of Hong Kong listed companies and document that excess returns from those transactions are significantly negative, and negatively related to the percentage ownership of a controlling shareholder. Additionally, they find that the connected party transactions are more likely to be undertaken if the controlling shareholder can be traced to the mainland of China. They explain that those firms find it easier to expropriate their minority shareholders because rulings by courts in Hong Kong are not enforceable in China and thus Hong Kong investors have little chance to recover shifted assets. Atanasov (2005) finds that the absence of regulation in Bulgaria allows majority shareholders to extract up to 85% of the target's firm value to its private benefit and provides several examples supporting his evidence: in the year 2000, the national oil refinery Neftochim's stock was only valued at 24% of the price paid by Lukoil for the majority block; Balkanfarma, a holding of three pharmaceutical companies, had a ratio of 21%; and Sodi, the second-largest producer of soda ash in the world, had a ratio of 10.8%. Atanasov argues that controlling shareholders have a strong preference for expropriating minority shareholders rather than adding value through monitoring.

Although a lot of empirical literature focuses on evidence of profit extraction from developing countries, Backus et al. (2021) point out the United States might be subject to it as well. Typically the US is not considered an environment particularly prone to profit shifting practices. Most of their

publicly-traded firms have diluted control (i.e., “widely-held” firms, [Berle and Means, 1932](#)), and investor protection in the US is quite strong which facilitates healthy financial markets ([La Porta et al., 1999](#)). However, [Backus et al. \(2021\)](#) find that there is a non-negligible share of firms that have incentives to shift profits and this share rapidly increases over time, especially in the period from 1993 to 2002 and again after 2015.

Profit shifting also occurs in the context of profit shifting across countries due to tax differences. In their seminal study, [Grubert et al. \(1991\)](#) focus on the ability of firms to shift profits from high-tax to low-tax countries through their foreign affiliates. They use data from 1982 from 33 countries and find that the US-based multinational enterprises shift disproportionately large amount of income to the countries with low statutory tax rates. Moreover, they export more to their foreign affiliates in low-tax countries. More recent examples include Microsoft allegedly shifting profits to its foreign affiliates in Ireland, Puerto Rico, and Singapore to reduce its tax burden in Europe and avoid the US corporate income tax.¹⁹ Moreover, Apple allegedly uses offshore structures to shift billions of dollars out of the United States.²⁰

Propping. Opposite to shifting profits from the target firm to the partial owner, firms might also shift profits from the owner to the target firm (propping). The literature documents that propping takes place in practice. For

¹⁹See [United States Congress Senate Committee on Homeland Security and Government Affairs. 2012. Offshore Profit Shifting and the U.S. Tax Code - Part 1 \(Microsoft and Hewlett Packard\), Hearings, September 20, 2012. 112th Cong. 2nd sess. Washington: GPO.](#)

²⁰See [United States Congress Senate Committee on Homeland Security and Government Affairs. 2013. Offshore Profit Shifting and the U.S. Tax Code - Part 2 \(Apple\). Hearings, May 21, 2013. 113th Cong. 1st sess. Washington: GPO.](#)

instance, partial owners use propping to avoid a potential bankruptcy of the target firm.²¹ [Friedman et al. \(2003\)](#) show theoretically that, in case of a moderate negative shock in the market, a partial owner may find it optimal to prop the target firm to prevent its bankruptcy. They focus on firms hit by the Asian crisis 1997-1998 and provide empirical evidence of propping. The Asian crisis 1997-1998 is a quasi-natural experiment that triggered a large and unexpected enough shock to induce propping. [Friedman et al. \(2003\)](#) analyze the effect of debt and corporate governance on firm-level performance by applying difference-in-difference analysis and find evidence for propping, especially pronounced in specific ownership structures, such as pyramids.²² In general, certain ownership structures are more prone to profit shifting than others. [Solarino and Boyd \(2020\)](#) empirically show that business groups and family-owned businesses are more likely to engage in profit shifting practices. They also document that state ownership is negatively associated with profit shifting.

We add to the literature by showing that, in addition to preventing the target's bankruptcy, partial owners might use propping to induce input foreclosure in the case of partial backward ownership.

Minority shareholder protection. There are several real-life tools that minority shareholders can use to limit their expropriation by controlling share-

²¹Similarly, the partial owner might engage in profit shifting to protect itself from bankruptcy.

²²In a pyramidal ownership structure, several firms form a business group. This business group is a top-down chain of companies usually controlled by the ultimate shareholder who may only own a small part of firms located in the lower levels of the pyramidal structure but can control it fully ([Riyanto and Toolsema \(2008\)](#)).

holders.²³ First of all, many profit shifting practices are illegal. Strong institutions help enforce controlling shareholders' lawfulness. According to [Johnson et al. \(2000\)](#), strong legal institutions are key and common-law countries tend to be more protective of minority shareholders than civil-law countries. Additionally, extralegal institutions play a crucial role. [Holmen and Knopf \(2004\)](#) focus on Sweden, where the share of pyramids and other company structures prone to profit shifting is particularly high, however, the actual shareholder expropriation is relatively low. They show that the presence of strong extralegal institutions in Sweden may significantly offset firms' incentives to shift profits.

Arguably, the most common minority shareholder protection tool is preemptive rights ([Holderness, 2018](#)). Preemptive rights give all shareholders access to buying new stock pro rata and hence do not allow controlling shareholders to obtain cheap stock.

Another effective corporate governance tool to limit minority shareholder expropriation is veto rights. [Fried et al. \(2020\)](#) study the 2011 reform in Israel that extended the rights of minority shareholders. In particular, it gave minority shareholders the right to veto the financial bonuses of controllers and controller executives. Their empirical analysis shows that this reform led to lower and no pay to certain executives as well as some resignations of top management. Overall, the authors conclude that the veto rights of minority shareholders might be an effective tool to limit their expropriation. [Fried and](#)

²³In our model, we reduce minority shareholder protection to two different profit extraction restrictions. Our modeling approach is general, yet it allows for flexible execution of the practices discussed in this section, i.e., minority shareholders might enforce the profit extraction restrictions through veto rights, preemptive rights, etc. We discuss the restrictions in detail in Section 2.

Spamann (2020) show that preemptive rights help prevent profit extraction if the minority shareholders are well-informed, meaning they understand when the newly issued stock is priced below or above its market value. If the information asymmetry is strong, although minority shareholders may still exercise their preemptive rights, it would not protect them from the expropriation from the controlling shareholders as well.

C. Endogenous transfer prices: Input foreclosure with partial backward ownership

We now consider a setup where f^* may change depending on the market structure. Let us assume that the upstream firm has bargaining power of a degree $b \in [0, 1]$. We compare cases of endogenous price formation under vertical separation, full integration and partial vertical ownership with Restrictions 1 and 2 on profit shifting. For each case, the market price is as follows:

$$f^* = b\bar{f} + (1 - b)\underline{f}.$$

First, let us determine the upper and lower bounds for each case. The minimal price at which U is willing to sell input to an independent downstream firm is \underline{f} . This price changes depending on the ownership structure. The maximal price the downstream firms would accept is \bar{f} . This price is unaffected by the ownership structure and is determined by the intensity of competition

downstream. It is a take-it-or-leave-it price the downstream firms would face:

$$\bar{f} = \pi(1, 1) - \pi(0, 1).$$

For vertical separation, $\underline{f}_S = 0$ because U only makes profit by selling units of input and has no additional incentives to withhold it. Under full vertical integration and partial backward ownership structures, U never forecloses D_1 . The minimal price at which the fully integrated firm is willing to sell to D_2 is the difference in profits it makes from selling only through D_1 compared to selling through both downstream suppliers: $\underline{f}_I = \pi(1, 0) - \pi(1, 1)$. For partial backward ownership ($\alpha < 1$), the minimal prices the partial owner is willing to accept are $\underline{f}_{BR1} = 1/\alpha[\pi(1, 0) - \pi(1, 1)]$ and $\underline{f}_{BR2} = \pi(1, 0) - \pi(1, 1)$ under Restrictions 1 and 2, respectively. Otherwise, it becomes more profitable to not supply D_2 . It holds that $\underline{f}_S < \underline{f}_I = \underline{f}_{BR2} < \underline{f}_{BR1}$. However, for $j \in \{I, BR1, BR2\}$, \underline{f}_j is not necessarily below \bar{f} . The relation $\underline{f}_j > \bar{f}$ implies that foreclosure is more profitable than supplying the downstream rival.

If the bargaining power parameter b is fixed across different ownership structures and profit extraction restrictions, the above implies the following order of the *market prices* under vertical separation, vertical integration, and partial ownership with Restrictions 1 and 2:

$$f_S^* < f_I^* = f_{BR2}^* < f_{BR1}^*.$$

We summarize the price ranges and market prices in Figure 5. In the left column, we illustrate cases where the operational profits $\pi(1, 0)$, $\pi(0, 1)$ and

$\pi(1, 1)$ are such that $\underline{f}_j < \bar{f}$. Then, it is profitable to supply the downstream rival under all ownership structures because $f_j^* < \bar{f}$. In the right column of Figure 5 we depict the cases where \underline{f}_j is higher: Keeping α constant, it can be due to a higher value of $\pi(1, 0)$ or a lower value of $\pi(1, 1)$.²⁴ While \underline{f}_I and \underline{f}_{BR2} are higher compared to the respective cases in the left column, they are still below \bar{f} , so supplying the downstream rival is still profitable. However, $\underline{f}_{BR1} > \underline{f}_{BR2}$ as $\alpha < 1$. We show the case where $\underline{f}_{BR1} > \bar{f}$, so $f_{BR1}^* > \bar{f}$ and foreclosure is more profitable than supplying the downstream rival.

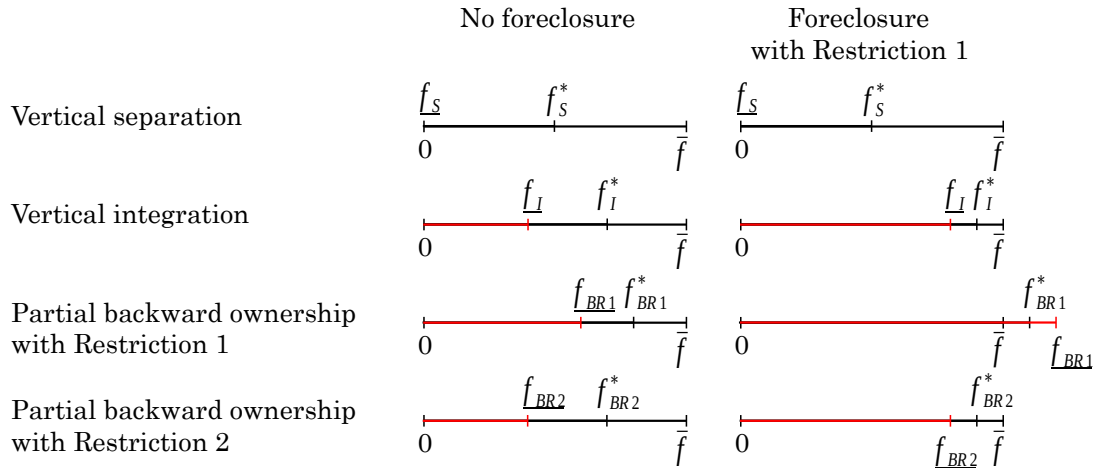


Figure 5: Endogenous market prices under different ownership structures for a given bargaining power parameter b : cases without and with downstream foreclosure as the result of different values of the lower bound price \underline{f}_j .

Foreclosure does not arise under any ownership structure if

$$f_S^* < f_I^* = f_{BR2}^* < f_{BR1}^* < \bar{f}. \quad (18)$$

²⁴In principle, f_{BR1} also decreases in α . In Figure 5, the change from the left to the right column affects all \underline{f}_j for $j \in \{I, BR1, BR2\}$. Hence, it cannot be triggered (exclusively) by the change in α .

Rearranging Condition (18) yields $\underline{f}_S < \underline{f}_I = \underline{f}_{BR2} < \underline{f}_{BR1} < \bar{f}$. This case is depicted on the left side of Figure 5. Instead, foreclosure arises under partial backward integration and Restriction 1 but does not arise under full integration and partial backward integration with Restriction 2 if

$$f_S^* < f_I^* = f_{BR2}^* < \bar{f} < f_{BR1}^*,$$

or, equivalently, $\underline{f}_S < \underline{f}_I = \underline{f}_{BR2} < \bar{f} < \underline{f}_{BR1}$. This is the case on the right side of Figure 5

Foreclosure arises under full integration and partial backward integration with any profit extraction restrictions if

$$f_S^* < \bar{f} < f_I^* = f_{BR2}^* < f_{BR1}^*,$$

or, equivalently, $\underline{f}_S < \bar{f} < \underline{f}_I = \underline{f}_{BR2} < \underline{f}_{BR1}$. Importantly, for each ownership structure, the comparison of \underline{f} and \bar{f} corresponds to the non-foreclosure conditions considered in Section 3 (Conditions (5), (12) and (16)).

To summarize, in the present formalization of endogenous input prices, foreclosure arises under the same conditions as with the pre-determined market price f^* . Namely, the scope for foreclosure under partial backward ownership and Restriction 1 is higher than under full integration. Also, the scope for foreclosure under partial backward ownership and Restriction 2 is the same as under full integration. Our results thus hold when allowing the input prices to arise endogenously in a reasonable way in each scenario in dependence on the different ownership structures and profit extraction restrictions.

D. Customer foreclosure with partial ownership

We now study the case of customer foreclosure where a downstream firm prevents an upstream firm from selling its products to consumers. We consider a setup with two upstream firms and one downstream firm now, symmetric to the one in Section 3. For customer foreclosure, the critical difference is partial forward ownership where an upstream firm has a stake of the downstream firm and thereby potentially the means and incentives to induce the downstream firm not to trade with the independent upstream firm. Our findings are analogous to the case of input foreclosure. Again, Restriction 1 on profit extraction facilitates foreclosure whereas Restriction 2 has the same effects as full integration, provided that propping is feasible. We discuss and compare the results of input and customer foreclosure in Appendix F where Table 1 summarizes the different results.

Model framework

We consider a setting with two symmetric upstream firms, U_1 and U_2 , and a downstream monopolist D , as shown in Figure 6. We assume that the

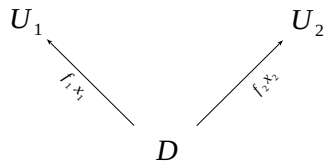


Figure 6: Market structure: customer foreclosure setup.

upstream firms produce differentiated input goods. Downstream firm D can

use at most two units of input. Those two units can be purchased from a single upstream firm or each input unit from each firm.

Definition 2. In the present setting, customer foreclosure refers to a situation where D buys no input from U_2 and two units of input from U_1 .

We further assume that the downstream firm's flow profits before input costs are higher when the input units are differentiated. In particular, we assume

$$\Pi(1, 1) > \Pi(2, 0) > \Pi(1, 0) > \Pi(0, 0) = 0, \quad (19)$$

where $\Pi(x_1, x_2)$ is the downstream flow profit as a function of the input quantities x_1 and x_2 from U_1 and U_2 , respectively.²⁵ We assume that both upstream firms produce at zero costs.²⁶ These assumptions lead to the natural benchmark where, under vertical separation, D finds it optimal to buy the input from both upstream firms.

Upstream firm $j \in \{1, 2\}$ sells at a unit price of f_j . The profit of upstream firm j when selling one unit is thus

$$\pi^{Uj} = x_j \cdot f_j = 1 \cdot f_j. \quad (20)$$

The minimal price at which an upstream firm could sell without making a loss

²⁵For homogeneous products (and no non-linear transaction costs, etc.), the first inequality would become an equality.

²⁶We consider zero production costs for the sake of simplicity and comparability to the setup of Section 3.1. Our model yields conceptually identical predictions if a firm's production costs are non-decreasing in the number of units produced.

is equal to the cost of producing the input:

$$\underline{f} = 0. \tag{21}$$

Such a price might arise if the downstream firm has all the bargaining power.

Lemma 8. *The maximal price at which the downstream firm is best off buying one unit from each upstream firm is*

$$\bar{f} = \min [\Pi(1, 1) - \Pi(1, 0), \Pi(1, 1)/2]. \tag{22}$$

Proof. The downstream firm buys one unit from each upstream firm if the following three requirements hold:

$$\begin{aligned} \Pi(1, 1) - 2\bar{f} &\geq \Pi(2, 0) - 2\bar{f} \quad (i), \\ \Pi(1, 1) - 2\bar{f} &\geq \Pi(1, 0) - \bar{f} \quad (ii), \\ \Pi(1, 1) - 2\bar{f} &\geq 0 \quad (iii). \end{aligned}$$

The first requirement holds by the assumption that $\Pi(1, 1) > \Pi(2, 0)$.

The second requirement implies

$$\begin{aligned} \Pi(1, 1) - \bar{f} &\geq \Pi(1, 0) \\ \implies \bar{f} &\leq \Pi(1, 1) - \Pi(1, 0). \end{aligned}$$

Suppose that $\bar{f} = \Pi(1, 1) - \Pi(1, 0)$. Does this satisfy the third requirement?

Substituting in (iii) yields

$$\begin{aligned}\Pi(1, 1) - 2(\Pi(1, 1) - \Pi(1, 0)) &\geq 0 \\ 2\Pi(1, 0) &\geq \Pi(1, 1).\end{aligned}$$

The latter inequality should hold for substitutes on the demand side and no costs. It might not hold in the case of economies of scale (e.g. fixed costs that arise once selling products).

In general, the largest price that satisfies all three requirements is

$$\bar{f} = \min [\Pi(1, 1) - \Pi(1, 0), \Pi(1, 1)/2].$$

□

In the following we use a general “*market price*” f^* , which we restrict to be in the interval $[\underline{f}, \bar{f}]$. For reference, let us describe prices which may arise when the upstream firms non-cooperatively and simultaneously set their prices.

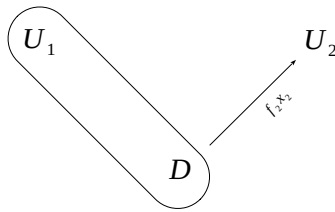


Figure 7: Full integration: customer foreclosure setup.

Lemma 9. *When the upstream firms non-cooperatively and simultaneously set their prices, a symmetric price of \bar{f} is an equilibrium if product differentiation,*

measured as the difference $\Pi(1, 1) - \Pi(2, 0)$, is large enough.

Proof. By construction, it is optimal at the price \bar{f} for the downstream firm to source one unit from each downstream firm. Can an upstream firm deviate profitably? It could benefit from selling two units by lowering the price. What is the largest deviation price p which leads to this outcome?

The price p needs to satisfy the following:

$$\Pi(2, 0) - 2p \geq \Pi(1, 1) - f^* - p \quad (i),$$

$$\Pi(2, 0) - 2p \geq \Pi(1, 0) - p \quad (ii),$$

$$\Pi(2, 0) - 2p \geq 0 \quad (iii).$$

Case 1: Suppose that

$$f^* = \min [\Pi(1, 1) - \Pi(1, 0), \Pi(1, 1)/2] = \Pi(1, 1) - \Pi(1, 0).$$

This case corresponds to no economies of scale – selling substitutes in isolation is better than selling them together:

$$\Pi(1, 1) - \Pi(1, 0) < \Pi(1, 1)/2$$

$$\implies \Pi(1, 1) < 2\Pi(1, 0).$$

The first condition (i) from above becomes

$$\Pi(2, 0) - 2p \geq \Pi(1, 1) - \Pi(1, 1) + \Pi(1, 0) - p$$

$$\implies \Pi(2, 0) - \Pi(1, 0) \geq p.$$

This is equivalent to the second condition. At $p = \Pi(2, 0) - \Pi(1, 0)$, the third condition holds as

$$\Pi(2, 0) - 2\Pi(2, 0) + 2\Pi(1, 0) = 2\Pi(1, 0) - \Pi(2, 0) > 2\Pi(1, 0) - \Pi(1, 1) > 0.$$

Is such a price cut profitable? It is not if

$$\begin{aligned} \Pi(1, 1) - \Pi(1, 0) &> 2[\Pi(2, 0) - \Pi(1, 0)] \\ \implies \Pi(1, 1) - \Pi(2, 0) &> \Pi(2, 0) - \Pi(1, 0), \end{aligned}$$

that is if the differentiation effect is larger than the quantity expansion effect.

Case 2: Suppose that

$$f^* = \min [\Pi(1, 1) - \Pi(1, 0), \Pi(1, 1)/2] = \Pi(1, 1)/2.$$

This corresponds to economies of scale: Selling more units together is better than selling each substitute in isolation:

$$\begin{aligned} \Pi(1, 1) - \Pi(1, 0) &> \Pi(1, 1)/2 \\ \implies \Pi(1, 1) &> 2\Pi(1, 0). \end{aligned} \tag{23}$$

The first condition (i) from above becomes

$$\begin{aligned} \Pi(2, 0) - 2p &\geq \Pi(1, 1) - \Pi(1, 1)/2 - p \\ \implies \Pi(2, 0) - \Pi(1, 1)/2 &\geq p. \end{aligned}$$

Together with the second condition (ii) from above, the highest possible devi-

ation price is

$$p = \min [\Pi(2, 0) - \Pi(1, 1)/2, \Pi(2, 0) - \Pi(1, 0)].$$

The first argument of the minimum function is smaller as:

$$\begin{aligned} \Pi(2, 0) - \Pi(1, 1)/2 &< \Pi(2, 0) - \Pi(1, 0) \\ \implies \Pi(1, 1) &> 2\Pi(1, 0), \end{aligned}$$

which corresponds to Condition (23) which constitutes this case. Hence the price has to satisfy $p \leq \Pi(2, 0) - \Pi(1, 1)/2$. At the price $p = \Pi(2, 0) - \Pi(1, 1)/2$, the third condition (iii) holds:

$$\begin{aligned} \Pi(2, 0) - 2p &= \Pi(2, 0) - 2[\Pi(2, 0) - \Pi(1, 1)/2] \\ &= \Pi(1, 1) - \Pi(2, 0) > 0. \end{aligned}$$

Is such a price cut profitable? It is not if

$$\begin{aligned} \Pi(1, 1)/2 &> 2[\Pi(2, 0) - \Pi(1, 1)/2] \\ \implies \Pi(1, 1) * 3/4 &> \Pi(2, 0), \end{aligned}$$

that is if the differentiation effect is large enough. □

Benchmark: full vertical integration. Full integration between U_1 and D is our benchmark in the subsequent sections where we show that the customer foreclosure incentives of partial ownership depend crucially on how we model the restrictions on profit extraction and transfer prices (see Figure 7). The joint profit of U and D is

$$\pi_I^S = \Pi(1, 1) - f^*$$

when the inputs of both upstream firms are used, and

$$\pi_I^F = \Pi(2, 0)$$

in the case where upstream firm 2 is foreclosed. The integrated entity decides to source from U_2 if $\pi_I^S \geq \pi_I^F$, which is equivalent to

$$\Pi(1, 1) - f^* \geq \Pi(2, 0)$$

$$\implies f^* \leq \Pi(1, 1) - \Pi(2, 0). \quad (24)$$

We refer to Equation (24) as the “*non-foreclosure condition under vertical integration*”. As $f^* \in [\underline{f}, \bar{f}]$, a necessary condition for foreclosure to arise is that $\bar{f} > \Pi(1, 1) - \Pi(2, 0)$.

Lemma 10. *The highest feasible input price \bar{f} is larger than the incremental profit of dual sourcing, $\Pi(1, 1) - \Pi(2, 0)$, if $2 \cdot \Pi(2, 0) > \Pi(1, 1)$.*

Proof. Case 1: $\bar{f} = \min [\Pi(1, 1) - \Pi(1, 0), \Pi(1, 1)/2] = \Pi(1, 1) - \Pi(1, 0)$.

$$\begin{aligned}\bar{f} &= \Pi(1, 1) - \Pi(1, 0) < \Pi(1, 1) - \Pi(2, 0) \\ \implies \Pi(2, 0) &< \Pi(1, 0).\end{aligned}$$

The latter condition contradicts the assumption in Condition (19) whereby selling two units is more profitable than selling one.

Case 2: $\bar{f} = \min [\Pi(1, 1) - \Pi(1, 0), \Pi(1, 1)/2] = \Pi(1, 1)/2$.

$$\begin{aligned}\bar{f} &= \Pi(1, 1)/2 < \Pi(1, 1) - \Pi(2, 0) \\ \implies \Pi(2, 0) &< \Pi(1, 1)/2.\end{aligned}$$

The latter condition implies $\Pi(1, 1) > 2\Pi(2, 0) > 2\Pi(1, 0)$, where the latter inequality follows from the assumption in Condition (19) again. Case 2 arises under condition $\Pi(1, 1) > 2\Pi(1, 0)$ from Equation (23), which is implied by the previous condition already. \square

Note that the requirement $2\Pi(2, 0) > \Pi(1, 1)$ in Lemma 10 is fulfilled in many plausible cases. In general, it holds if the inputs of the upstream firms are similar enough. Moreover, it may also hold with strong substitutes. Exceptional cases where the condition might not hold would be when it is not profitable to sell both units of the same kind, such that essentially $\Pi(2, 0) = \Pi(1, 0)$ or if there are fixed costs of selling products, such that $2 \cdot \Pi(1, 0)$ would be smaller than $\Pi(1, 1)$.

Corollary 1. *Together, lemmas 8, 9 and 10 imply that the competitive input price may feasibly be at the level \bar{f} where foreclosure of U_2 is jointly profitable for U_1 and D if they are vertically integrated.*

Partial forward ownership

Suppose that U_1 owns a share $\alpha \in (0, 1)$ of D 's profits. The partial owner U_1 can exert full control over its target's strategy, subject to the profit extraction restrictions. See Figure 8 for an illustration. Our results under these assumptions are summarized in Proposition 3.

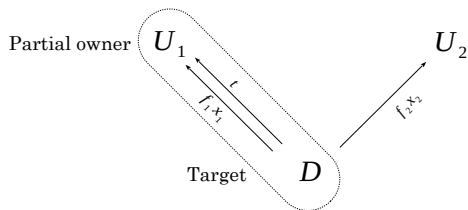


Figure 8: Partial forward ownership: U_1 owns a stake of D .

Our results under these assumptions are summarized in Proposition 3.

Proposition 3. *Relative to full vertical integration, partial forward ownership (PFO) tends to affect the incentives for customer foreclosure in the following ways:*

1. *PFO increases the foreclosure incentives if the absolute amount of profit extraction is effectively restricted (Lemma 11);*
2. *PFO has the same effect as full vertical integration if profit extraction is restricted by a minimum profit that needs to be left in the target firm*

$(\pi_D \geq \underline{\pi}_D)$, provided that propping is unrestricted (Lemma 12);

3. The foreclosure incentives tend to be lower with PFO if profit extraction is restricted by a minimum profit that needs to be left in the target firm and if propping is restricted as well (Lemma 13).

Lemma 11. *Under the restriction on the absolute profit extraction amount ($t \leq \bar{t}$), the partial owner U_1 has strictly higher incentives to foreclose its rival than in the case of full integration.*

Proof. Partial owner U_1 which owns a share α of its target's profits, may want D to source from both upstream competitors and get:

$$\pi_{U_1}^S = f^* + \bar{t} + \alpha (\Pi(1, 1) - 2f^* - \bar{t}),$$

or, alternatively, supply input to its downstream firm only by itself and obtain:

$$\pi_{U_1}^F = 2f^* + \bar{t} + \alpha (\Pi(2, 0) - 2f^* - \bar{t}).$$

D gets input from both downstream firms if

$$\pi_{U_1}^S \geq \pi_{U_1}^F$$

$$\implies f^* \leq \alpha [\Pi(1, 1) - \Pi(2, 0)].$$

Foreclosure is more profitable than under full integration because the partial owner U_1 puts relatively less weight on the downstream losses from foreclosure.

□

Lemma 12. *Under the restriction of a minimal profit that needs to be left in the downstream firm ($\pi_D \geq \underline{\pi}_D$), the partial owner U_1 has the same incentive to foreclose its rival as under vertical integration.*

Proof. When minimal profit, which has to remain in the downstream firms, is restricted, U_1 gets the following profits if D sources from both upstream firms:

$$\pi_{U_1}^S = f^* + \alpha \underline{\pi}_D + \underbrace{(\Pi(1, 1) - 2f^* - \underline{\pi}_D)}_{t_{U_1}^S},$$

or only from its partial owner:

$$\pi_{U_1}^F = 2f^* + \alpha \underline{\pi}_D + \underbrace{(\Pi(2, 0) - 2f^* - \underline{\pi}_D)}_{t_{U_1}^F}.$$

D gets input from both downstream firms if

$$\pi_{U_1}^S \geq \pi_{U_1}^F$$

$$\implies f^* \leq [\Pi(1, 1) - \Pi(2, 0)]. \quad (25)$$

The condition is the same as in the full integration case. \square

Lemma 13. *If sourcing from U_2 is less profitable than foreclosing it (Condition 25 does not hold) and the minimal profit that needs to be left in the downstream firm is relatively large ($\underline{\pi}_D > \Pi(2, 0) - 2f^*$), the partial owner U_1 optimally props D in order to foreclose U_2 . If propping is not feasible, no foreclosure takes place in this case.*

Proof. Propping is needed if for foreclosure if the target firm's minimal profit

restriction can only be met if input comes from both suppliers, i.e.,

$$\Pi(1, 1) - 2f^* > \underline{\pi}_D > \Pi(2, 0) - 2f^*.$$

As $\Pi(1, 1) > \Pi(2, 0)$, the above condition can be reduced to

$$\underline{\pi}_D > \Pi(2, 0) - 2f^*.$$

Foreclosure of U_2 is profitable for the partial owner U_1 if

$$\Pi(2, 0) > \Pi(1, 1) - f^*.$$

Conversely, if propping is limited or impossible, the partial owner U_1 would want to foreclose U_2 but D has to source from it if $\underline{\pi}_D > \Pi(2, 0) - 2f^*$. \square

The mechanism for result 1 of the proposition is analogous to the case of input foreclosure and PBO in Proposition 1. When the partial ownership values own profits more than the target's profits, then commanding a foreclosure action that hurts the target is more profitable than under full integration where both profits have the same value.

With the minimal profit restriction, the partial owner becomes the claimant of the full incremental profits of the target and thus has the same foreclosure incentives as under full integration (result 2). However, when the partial owner has to ensure a higher profit of the target D than would arise under foreclosure ($\underline{\pi}_D > \Pi(2, 0) - 2f^*$) but propping is not possible, foreclosure is harder than under full integration (result 3). This result is relevant as the competitive input

price may well be at the level \bar{f} where foreclosure of U_2 is jointly profitable for U_1 and D (Corollary 1).

Partial backward ownership

Downstream firm D owns a share $\alpha \in (0, 1)$ of U_1 's profits. The partial owner D can exert full control over its target's strategy, subject to the profit extraction restrictions (see details on the market structure in Figure 9). Absent foreclosure and absent profit extraction ($t = 0$), the profit of each upstream firm equals f^* . With customer foreclosure of U_2 and absent profit extraction ($t = 0$), the profit of U_1 equals $2f^*$ whereas the profit of U_2 equals 0. Analogously to Assumption 3, we assume that the minimal profit π_{U_1} is not larger than the equilibrium profit of the upstream firm under vertical separation (see Equation (20)). We summarize D 's incentives to foreclose U_2 subject to different profit extraction restrictions in Proposition 4.

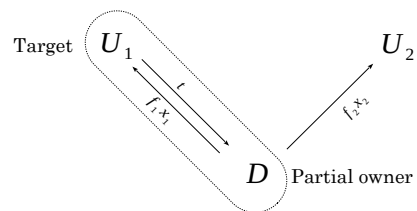


Figure 9: Partial backward ownership: D owns stake of U_1 .

Proposition 4. *Relative to full vertical integration, partial backward ownership (PBO) tends to affect the incentives for customer foreclosure in the following ways:*

1. PBO decreases the foreclosure incentives if the absolute amount of profit extraction is effectively restricted (Lemma 14);
2. PBO has the same effect as full vertical integration if profit extraction is restricted by a minimum profit that needs to be left in the target firm, provided that propping is unrestricted (Lemma 15).

Lemma 14. *Under the restriction on the absolute profit extraction amount, the partial owner D has strictly lower incentives to foreclose its target's rival than in the case of full integration.*

Proof. The partial owner D can choose to source from both upstream firms and obtain the following profits:

$$\pi_D^S = \Pi(1, 1) - 2f^* + \bar{t} + \alpha(f^* - \bar{t}).$$

Alternatively, D may only obtain input from its target firm and get:

$$\pi_D^F = \Pi(2, 0) - 2f^* + \bar{t} + \alpha(2f^* - \bar{t}).$$

The partial owner D sources from both upstream firms if

$$\pi_D^S \geq \pi_D^F$$

$$\implies f^* \leq 1/\alpha [\Pi(1, 1) - \Pi(2, 0)]$$

The partial owner D is more affected from a downstream loss of customer

foreclosure relative to the upstream gains and thus has fewer incentives to foreclose U_2 than under full integration. \square

Lemma 15. *Under the restriction that a minimal profit needs to be left in the upstream firm, the partial owner D has the same incentive to foreclose its target's downstream rival as under vertical integration.*

Proof. The downstream firm's profits when sourcing from either both or only one upstream firm are given by

$$\pi_D^S = \Pi(1, 1) - 2f^* + \underbrace{(f^* - \pi_{U1})}_{t^S} + \alpha\pi_{U1},$$

$$\pi_D^F = \Pi(2, 0) - 2f^* + \underbrace{(2f^* - \pi_{U1})}_{t^F} + \alpha\pi_{U1}.$$

Partial owner D sources from both upstream firms if

$$\pi_D^S \geq \pi_D^F$$

$$\implies f^* \leq [\Pi(1, 1) - \Pi(2, 0)]. \quad (26)$$

The foreclosure incentives are the same as in the full integration case. \square

The intuition for result 1 of the proposition is that when the partial owner D internalizes additional downstream profits more than additional upstream profits of U_1 , there is less incentive than under full integration to sacrifice downstream profits to the benefit of upstream profits.

Note that propping is not an issue here as foreclosure requires a downstream action from the partial owner but not from the upstream target and we assume that the owner maximizes its own profit without minority shareholder restrictions within its own entity.

E. Fundamental conditions under which foreclosure is unprofitable

In the full integration benchmark, supplying both firms is profitable if Condition (5) holds, that is

$$f^* \geq \pi(1, 0) - \pi(1, 1).$$

Moreover, f^* needs to be below $\bar{f} = \pi(1, 1) - \pi(0, 1)$ as defined in Equation (2). Taken together, this implies $\bar{f} \geq f^*$ and thus

$$\begin{aligned} \pi(1, 1) - \pi(0, 1) &> \pi(1, 0) - \pi(1, 1) \\ \implies 2 \cdot \pi(1, 1) &\geq \pi(1, 0) + \pi(0, 1). \end{aligned} \tag{27}$$

Let us demonstrate conditions under which Condition (27) holds.

Example 1. Suppose there are two downstream firms setting quantities and each facing an indirect demand of $p_i = 1 - q_i - \sigma q_{-i}$, where σ defines the degree of downstream product substitutability with $0 \leq \sigma \leq 1$. Each firm which is served by U has constant marginal costs of c with $0 < c < 1$. Suppose further

that being exclusively served by U makes the downstream firm the monopolist as the other firm cannot operate, so that $\pi(0, 1) = 0$. Fundamentally, this could be the case because the marginal input costs when not being served by U are prohibitively high because buying the input on the world market or producing it in-house is too expensive. One example could be a firm having access to cheap pipeline gas versus having to resort to expensive LNG gas otherwise. Not being competitive could also be the result of not being allowed to using a technology of which U holds the patent rights.

Condition (27) thus becomes $2 \cdot \pi(1, 1) \geq \pi(1, 0)$. This yields a duopoly profit of $\pi(1, 1) = \frac{(1-c)^2}{(\sigma+2)^2}$ and a monopoly profit of $\pi(1, 0) = \frac{(1-c)^2}{4}$. Condition (27) holds if $\sigma > 2\sqrt{2} - 2$. This means that twice the duopoly profit is above the monopoly profit if the products are sufficiently differentiated.

Example 2. Suppose now that being supplied by U implies a non-drastic marginal cost reduction. Non-drastic means that even without U 's supply a downstream firm can make a positive profit when the other downstream firm got U 's input: $\pi(0, 1) > 0$. For instance, suppose the downstream firms compete in prices with a demand of $q_i = 1 - p_i + \gamma(p_{-i} - p_i)$ with $\gamma > 0$ and profits of $(p_i - c_i)q_i$. Without being served by U , i 's marginal costs c_i equal c with $0 < c < 1$ whereas when being served they equal $c_i = 0$. Solving for the Nash equilibrium yields that Condition (27) holds if for all c if γ is smaller than approximately 0.91 and, if γ is larger, holds if c is not too large: $c < \frac{18\gamma^2+24\gamma+8}{2\gamma^4+10\gamma^3+21\gamma^2+16\gamma+4}$, where the right hand side decreases in γ . Economically speaking, serving both firms is profitable if the firms are not

too close substitutes for any marginal cost reduction. If the firms are closer substitutes, the marginal cost reduction must not be too high – otherwise, the merger-to-monopoly-effect dominates.

F. Overview of results for input and customer foreclosure

For Restriction 1 on the amount that a partial owner can extract, our results are in line with the existing literature ([Baumol and Ordover, 1994](#); [Spiegel, 2013](#); LSG). Compared to full integration, partial backward ownership leads to higher input foreclosure incentives than full integration but lower customer foreclosure incentives. Partial forward ownership has the opposite effects. See Table 1 for an overview of our main results.

We add to this the insight that the restriction on the minimal profit leads to the same foreclosure incentives as full integration. The reason is that the partial owner becomes a residual claimant of the joint profits – which implies the same incentives as full integration.

Table 1: Overview of results

Input foreclosure (not serving the downstream rival)		
Benchmark – non-foreclosure condition with full integration: $f^* \geq \pi(1, 0) - \pi(1, 1)$		
	Partial backward ownership	Partial forward ownership
Restriction 1: profit extraction amount	$f^* \geq 1/\alpha [\pi(1, 0) - \pi(1, 1)]$ Higher incentives to foreclose than with full integration;	$f^* \geq \alpha [\pi(1, 0) - \pi(1, 1)]$ Lower incentives to foreclose than with full integration;
Restriction 2: minimal profit	$f^* \geq \pi(1, 0) - \pi(1, 1)$ Same incentives to foreclose as with full integration; Propping needed if $\underline{\pi}^U > f^*$.	$f^* \geq \pi(1, 0) - \pi(1, 1)$ Same incentives to foreclose as with full integration; No propping needed. ⁺

Customer foreclosure (not buying rival's input)		
Benchmark – foreclosure condition with full integration: $f^* \leq [\Pi(1, 1) - \Pi(2, 0)]$		
	Partial backward ownership	Partial forward ownership
Restriction 1: profit extraction amount	$f^* \leq 1/\alpha [\Pi(1, 1) - \Pi(2, 0)]$ Less incentives to foreclose than with full integration;	$f^* \leq \alpha [\Pi(1, 1) - \Pi(2, 0)]$ More incentives to foreclose than with full integration;
Restriction 2: minimal profit	$f^* \leq [\Pi(1, 1) - \Pi(2, 0)]$ Same incentives to foreclose as with full integration; No propping needed. ⁺	$f^* \leq [\Pi(1, 1) - \Pi(2, 0)]$ Same incentives to foreclose as with full integration; Propping needed if $\underline{\pi}_D > \Pi(2, 0) - 2f^*$.

⁺No propping is needed in the sense that foreclosure requires an action from the partial owner and we assume that the owner maximizes its own profit without minority shareholder restrictions within its own entity.

When the minimal profit that needs to be left in the target firm is higher

than the profit obtainable in the case a foreclosure strategy is in place, the latter equivalence result relies on the assumption that propping is feasible. Propping means that the partial owner can shift funds into the target firm. The partial owner may need to prop to induce the target firm to foreclose a rival of the owner. A foreclosure action, which may be profitable for the partial owner, can reduce the target's profit below the critical level, such that propping may be necessary for foreclosure to be feasible. When propping is not feasible, the foreclosure incentives are eliminated under the minimal profit restriction and, thus, can be lower than with full integration. This holds at least in cases where the supply choice is binary: either trade with the independent firm or do not. In the case of a continuous supply choice, propping may not be necessary for foreclosure as a less costly partial foreclosure strategy may be feasible. Nevertheless, optimal foreclosure might still involve propping.²⁷

A key distinction between Restriction 1 on the extraction amount and Restriction 2 on the minimal profit of the target firm is whether or not propping might occur. Intuitively, Restriction 2 sets a target profit level that the partial owner has to assure, which means that if this target profit level is high enough, the partial owner cannot satisfy the restriction without additional transfers to the target firm. Under Restriction 1, the mechanism is different: The non-controlling shareholders of the target firm can only impose restrictions on how much value is extracted. Profit shifting into the target firm is thus not an issue when there is solely a restriction on the amount that can be extracted. Of course, in a real-world case, several restrictions on profit extraction can

²⁷See the discussion in Section 3.2.

be in place simultaneously, including the restrictions 1 and 2 that we study. Indeed, a restriction on propping is essentially a restriction on negative profit extraction. Table 1 summarizes our results.

G. A review of the results in [Levy, Spiegel and Gilo \(2018\)](#)

LSG base their analysis on comparing the downstream gains (G in their notation) and upstream losses (L) of foreclosing D_2 . Our model is sufficient to replicate their findings and can naturally extend to their setting with N upstream suppliers. We can rearrange Condition (4) to show that the fully integrated entity chooses to supply D_2 if the downstream gains of foreclosure (G) do not exceed the foregone upstream profits from supplying an additional retailer (L):

$$\underbrace{\pi(1, 0) - \pi(1, 1)}_G \leq \underbrace{\pi(1, 1) - \pi(0, 1)}_L.$$

Our exogenous restriction on the profit extraction amount, $t \leq \bar{t} < f^*$, corresponds to the case considered in LSG. Their Assumption 5 requires that the effect of profit extraction on D_1 's and U 's payoffs is smaller than the effect of foreclosure, i.e., $t \leq \min\{G, L\}$. The partial owner has stronger incentives to foreclose its rival in comparison to the full integration case, namely, D_1 chooses to let U supply D_2 with an input if

$$\underbrace{\pi(1, 0) - \pi(1, 1)}_G \leq \underbrace{\alpha [\pi(1, 1) - \pi(0, 1)]}_{\alpha L}.$$

We argue that the way one specifies the restriction on profit extraction plays a crucial role in shaping the incentives of the partial owner to foreclose its rival. By restricting the minimal profit which has to stay in the upstream firm (what we call Restriction 2) instead of imposing an exogenous limit on profit extraction (what we call Restriction 1), the foreclosure condition becomes

$$\underbrace{\pi(1, 0) - \pi(1, 1)}_G \leq \underbrace{\pi(1, 1) - \pi(0, 1)}_L.$$

This condition is the same as it would have been for the full merger with U and is strictly weaker than under an exogenous profit extraction restriction.

LSG implicitly assume that the profit extraction amount t is non-negative.²⁸ This is not critical under Restriction 1 but could be restrictive under Restriction 2. We show in Lemma 5 that propping restrictions may eliminate the incentives to foreclose D_2 completely. If the minimal profit which has to stay in the upstream firm is large enough, i.e. $\underline{\pi}^U$ is in the interval $(\pi(1, 1) - \pi(0, 1); 2(\pi(1, 1) - \pi(0, 1))]$, and profit extraction is restricted to be non-negative, it becomes impossible for the partial owner to foreclose its rival. Foreclosure is not feasible, although it could be profitable for the partial owner.

Therefore, the ability and incentives to foreclose depend crucially on the assumptions on the minority shareholder protection structure and the types of profit extraction restrictions minority shareholders may impose. As LSG show, restrictions on the profit extraction amount in partial backward ownership may

²⁸LSG write on page 142: “ D_1 pays for $[U]$ ’s input the same amount it pays under non-integration, but minus a discount t if D_1 controls $[U]$ ”.

increase the input foreclosure incentives compared to the full integration case. In this article, we show that other profit extraction restrictions may leave the foreclosure incentives of partial vertical owners unchanged or even eliminate them.