Under the Spotlight: Corporate Social Responsibility Choices and Fragile Supply Chains

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Abstract

With the rise in the interest of civil society for ensuring the respect of social, working, and environmental standards, importing firms are left with the burden of verifying the respect of standards from their suppliers from different countries, to ultimately avoid being subject to boycotts. In this project, we study the firm's trade-off in choosing its number of suppliers, to build a more resilient supply chain, and whether to monitor them or not, to secure itself against the possibility of a boycott. In modelling the firm's decision, we focus on the interaction between the firm's supply preferences (i.e. the number of suppliers on which the firm relies), the monitoring choice, and how these decisions change with the possibility of a boycott by an attentive society. We provide some empirical evidence in support of the theoretical predictions of the model, using sector-level import data, combined with data on child labour incidence, and NGO campaigns. This study contributes to the policy debate by helping public policy and local governments in understanding where to act to limit the legislative void and create a more reliable, equitable and sustainable economic environment.

Keywords: CSR, supply chain, fragility, monitoring, sustainability, trade.

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1 Introduction

Over the last decade, large firms from developed countries have established commercial relations with suppliers located in countries with cheaper inputs and cost of labour, but also very different legislation and regulations. Together with the rate of globalisation and economic growth, it expanded the interest of civil society and non-governmental organisations (NGOs) for the respect of ethical, working, and environmental standards, commonly accepted in developed countries, but not necessarily required by the legislation of the firms' source country. Differences in labour and environmental standards, or in the ability to enforce them, have created a regulatory void (Short, 2013), in which public policy has very limited room for intervention. This hardship generates a source of fragility in the value chains, which may be disrupted at any time if a violation of the standards is detected by civil society and consumer boycotts follow. Indeed, internationally active advocacy NGOs campaign against infringements of ethical minimum standards in global value chains (Herkenhoff and Krautheim, 2022), and attack multinationals that are closer to them for their suppliers' behaviour (Hatte and Koenig, 2018).

Firms are therefore left with the burden of monitoring the respect of such standards from their suppliers if they want to reduce the probability of being subject to a boycott by the general public.

A growing literature analyses the trade-offs of participating in global value chains (GVCs) and the diversification of suppliers as a strategy of multinationals to mitigate risks. In addition to reducing production costs, this literature suggests that GVC participation propagates and amplifies risks (Zhang (2021), Huang et al (2022), Mohommad et al (2022)), but could also improve economies' resilience (Ando and Hayakawa (2022), Barrot and Sauvgnat (2016), Kashiwagi et al (2021)). We apply this reasoning to one particular type of shock, namely the violation of labor standards. We argue that, depending on the structure of the value chain, firms can re-adapt more or less easily after discovering a violation: the larger the number of suppliers, the more resilient the sourcing strategy is if a violation is detected.

A striking example of how firms re-adapt their supply chains concerns the cobalt industry. Cobalt is a necessary input in the production of lithium-ion batteries for smartphones and electric vehicles, and the state of cobalt mines' working conditions in the Congo, the largest producer, was the object of several reports, as demand for this input skyrocketed. Among other tech giants, Apple also relies on cobalt for the batteries of iPhone and iPads. Following news concerning

child labour and dangerous working conditions, Apple announced that it would stop buying cobalt from mines in Congo, and it will start buying directly from the miners.[3]

Big firms are also often the sole, or the largest, buyers of suppliers located in developing countries, and can control the entire market. Eventually, if firms do monitor their supply chain, they could exploit their market power to put pressure on their suppliers to adopt a "clean" production technology. In this context, this project aims to understand the optimal behaviour of a firm with monopsony power that has to choose the number of its suppliers, as well as how intensively it would monitor them. In particular, to offset the risk of a boycott, the firm faces a trade-off between having few suppliers, easier to monitor but harder to change in case of a violation, and many suppliers, more costly to monitor but providing a more resilient strategy in the need of change.[4] In modelling the firm's technology decision, we focus on the interaction between the supplying choice of the firm (i.e, how many suppliers it relies on to ensure against the fragility of the value chain) and the monitoring choice this involves, and how the optimal decision changes when the possibility of a boycott by the society in fragile value chains is taken into account by the firm. In the last part of the paper, we bring the prediction on the determinants of the number of suppliers to the data, using French sector-level data, combined with data on child labour incidence, and NGO campaigns. The empirical findings are in line with the predictions of the model.

The relevance of this project is twofold. On one side, the paper sheds a light on the determinants of firms' choice to act first-hand in the control of their workplace standards. We link the firm's decision to the role of civil society in pushing for higher attention from the firm itself along its value chain. On the other hand, the results would help public policy and local governments in understanding where to act to limit the legislative void, and create a more reliable, equitable and sustainable economic environment.

The paper also contributes to the academic debate by connecting two branches of literature, namely the international economics literature to the one on private politics. On one hand, it adds to the literature on international organisation of production. The focus of this stream is usually on the choice between vertical integration and outsourcing, starting with the seminal paper by Antràs (2003), who first introduced as the main determinant of this choice the existence

[3] https://fortune.com/2017/03/03/apple-cobalt-child-labor/

[4] This paper does not focus on the supplier's technology choice that is required to produce the intermediate good, which could be dirty or clean. Instead, we take the share of dirty suppliers as given in the baseline setting of the model. However, this hypothesis could be relaxed, allowing for the supplier's technology choice.

of incomplete contracts. The possibility of unethical production in this setting is then first introduced by Krautheim and Verdier (2016) and then by Herkenhoff and Krautheim (2022). We fill a gap in this literature by including an additional dimension, namely the number of suppliers. Also, the effects of CSR choices along the value chain are the focus of a series of papers strictly related to ours, in particular Schiller (2018), Herkenhoff et al. (2021) and Alfaro-Ureña et al. (2022). Interestingly, the latter studies the effect of responsible sourcing requirements, imposed by multinational enterprises on their suppliers, on the sales and employment of exposed suppliers. On the other hand, the paper enriches the literature on private politics, pioneered by Baron (2001). This branch focuses on the role of activists in affecting firms' behaviour not through lobbying for regulation (public politics), but through campaigns and boycotts (private politics). Main contributions are Baron and Diermeier (2007), Emmelhainz and Adams (1999), Daubanes and Rochet (2019), and Koenig et al. (2021). While a different approach towards CSR defines that as a provision of a public good linked to the private one (as in Bagnoli and Watts (2003)), we move from another work of Baron (2003) who frames the origin of CSR as a threat from activists. We take a step further from this literature, in that we identify the impact of NGO and society's attention for the ethical standards of the firm and its suppliers on both the production and the monitoring choices of the firm. Differently from recent literature on the strategic choice of NGO targets (see for example Couttenier and Hatte (2016)), we do not model the strategic behaviour of NGOs. Instead, we assume the firm considers the probability of a boycott as already the best response of NGOs, and it takes it as given to formulate in turn its best response. Although this assumption could be relaxed at a later stage, this allows us to focus on the behaviour of the multinational firm in choosing the number of suppliers and monitoring effort in fragile environments.

Lastly, our paper contributes to the literature on the fragility of the value chain. Moving from Short (2013), some of the main contributions that are most linked to our work are Carvalho et al. (2021), Grossman, Helpman, and Lhuillier (2021), and Elliott, Golub, and Leduc (2022). We expand this literature by looking at NGO activity and monitoring shock as sources of fragility of GVC.

2 Model set-up

Consider an economy with a continuum of individuals (of mass L = 1) caring about environmental and social sustainability and consuming a bundle of normal goods and a credence good, which could entail either a clean or dirty production process. The production of the credence good involves some suppliers s and a firm f with monopsony power, which is the only buyer of intermediate goods (inputs) from the suppliers. The technology used ("clean" or "dirty") in the production inputs for the credence good is *a priori* unobservable for consumers and for the firm. In fact, our model is a static model (i.e., it can be though as the first period of a dynamic game, in which nobody has any information on the other agents) where agents do not have prior knowledge. It follows that the firm cannot learn from experience and update its expectations. Since we model the firm as a monopsonist in the input market, it cannot either learn about the technology from its competitors.

Similarly, consumers do not have information about the technology of the credence good sold by the firm, which could have been either produced with clean or dirty technology. They also ignore the firm's CSR and monitoring actions (i.e., the characteristics of the credence good do not reveal the firm's monitoring effort).[5]

2.1 Preference for clean goods

We consider the following utility function for a given consumer consuming the credence good Q:

$$U = c_0 + \mathbb{1}\ v(Q) \tag{1}$$

where c_0 is the =numéraire produced under constant returns to scale and exchanged in perfectly competitive markets. In addition, consumers get utility from consuming a differentiated good, namely the credence good Q, produced by the firm, whose inputs of production can be sourced by one or more suppliers. Consumers do not only care about the physical properties of the credence good, but also the technology used in its production. Moreover, they do not distinguish whether the supplier or the firm is responsible for dirty technology; instead, they always blame

[5]One might be concerned that, in the real world, firms that spend more in monitoring activities also invest more in labelling to better advertise their CSR. In this sense, our model is simplistic as it assumes the credence good to be homogeneous. The assumption is made possible by the fact that the firm is a monopolist in the final market.

and boycott the firm if they find out, through an NGO, that the good was produced using a dirty technology. This assumption is in line with two studies that analyse NGOs' behaviour and consumer boycotts (Krautheim and Verdier, 2016; Hatte and Koenig, 2018). Anecdotal evidence also suggests that NGOs' boycotts are biased towards more salient multinational corporations. As hinted by the Rana Plaza disaster, "the spotlight is on the multinational companies whose orders from local factory owners have led to the rapid recent growth of the garment industry in Bangladesh" (Source: *The Economist*).[6] This example also suggests that firms are targeted by NGOs even for infringements that occurred at the level of their suppliers.

We assume that the valuation of the credence good is high when it was produced with clean technology and negative if it was produced with dirty technology. This is reflected by the indicator variable $\mathbb{1}$, which equals one if the good is clean and zero otherwise (reflecting a boycott by consumers). In case of a boycott, consumers stop consuming the credence good, and they only consume c_0.

Consumers maximize utility under the budget constraint:

$$y = c_0 + P * Q \tag{2}$$

where the price of the consumption bundle is equal to 1, and the price of the credence good Q is P. Consumers' demand is thus given by:

$$Q = V(P)^{-1} = max(v(P)^{-1}, 0) \tag{3}$$

with $v(P)^{-1}$ being indirect utility.

2.2 Technology of the firm

We model a firm that produces a credence good, which is directly sold to consumers, with a constant return to scale (CRS) technology. The firm uses a unique input, Q^i, which can be purchased from one or multiple suppliers.[7]

The firm has monopsony power in the input market, and thus it also decides on the input price p^i, which is the same for all its suppliers. Suppliers, therefore, are price takers on the market

[6] https://www.economist.com/leaders/2013/05/04/disaster-at-rana-plaza.

[7] We do not model the firm's internationalization choice in this paper, but we assume the firm is already internationalized.

of intermediate goods. The monopsony assumption is motivated by the fact that large firms sourcing from developing countries are often the sole buyer of suppliers and can therefore exert market power over them. We also assume that the firm is also a monopolist on the final market of the credence good.[8]

Depending on the intensity of its monitoring activity on its supplier(s), and on the number of suppliers, the firm faces different costs (respectively, monitoring costs and switching costs of interrupting a supplying relationship), as well as different probabilities of incurring in a boycott by the NGO, which acts on behalf of consumers. Whenever the NGO finds out a dirty technology at the supplier's level, consumers boycott the product and the firm faces zero demand for the credence good (hence, zero revenues).[9]

To offset the risk of a boycott the firm can choose its monitoring effort. We denote with m the intensity of the firm's monitoring effort, with $m \in [0, 1]$. All things equal, m can also be regarded as the (linear) probability that monitoring is successful in discovering a violation, if a violation occurred. This probability can be interpreted as the chance of finding an existing violation, which is increasing in the intensity of monitoring. As suppliers are ex-ante identical, the firm will choose the same level of monitoring for all of them.

Monitoring suppliers is costly. In particular, for each supplier the firm pays a fixed entry cost of monitoring $\alpha(m)$, which is increasing in the level of monitoring but does not depend on the quantity of inputs purchased. We assume a quadratic cost of monitoring, i.e. $\alpha(m) = \frac{m^2}{2}$, homogeneous across suppliers and across sourcing countries, as these are assumed to be homogeneous in terms of (lax) regulation. The total cost of monitoring is, therefore, $\alpha(m)N = \frac{m^2}{2}N$, where N is the optimal number of suppliers chosen by the firm.[10] One could think at the intensity of monitoring as, for example, the relative frequency of inspections, or as the fraction of the budget that is spent on monitoring, and at the fixed cost of monitoring as the cost of setting up such inspections.

If monitoring is effective, and the firm discovers a dirty technology employed by one or some of

[8]This assumption is for tractability only, and could easily be relaxed. However, it helps overcome possible concerns related to heterogeneous credence goods, whose characteristics (e.g., level of advertisement, labelling etc.) might reveal the firms' level of monitoring to consumers. By contrast, our setting predicts a sole monopolist firm that sells a unique, homogeneous good to final consumers.

[9]In other words, we are only modelling the segment of the consumers' demands that cares about sustainability along the consumed goods' production process. The boycott can be interpreted as a share of consumers in the economy that stops buying from the firm, or as consumers boycotting the firm only temporarily. In case of a boycott, consumers will only purchase c_0.

[10]We assume that the firm has no "flat constraint" for monitoring, i.e. there is no specific allocated budget for the monitoring activity.

its suppliers (i.e., the "dirty ones"), the firm interrupts its contract with the dirty suppliers and redirects the share of input sourced towards new suppliers, not yet in its network (i.e., which were thus not producing before).

The firm always starts its monitoring activity before the NGO investigates the supply chain. Thus, the monitoring cost associated with entering a new supplying relationship with the new supplier will only be paid in the subsequent period of the game, as new suppliers are not monitored by the NGO in the current period and cannot cause any boycott. Moreover, as the NGO only investigates the initial network of the firm, new suppliers could never lead to a boycott in the same period in which they replace the dirty ones.[11] It follows that, by changing all its dirty suppliers in case of a violation, the firm can effectively offset the possibility of a boycott by the NGO. For each supplier that it changes, the firm pays a switching cost equal to $\lambda \in (0, 1]$, which is the cost of interrupting the whole business activity. This is a fixed cost, in the sense that it does not depend on the quantity of the credence good produced. Moreover, this cost is the same for all the supplying relationships of the firm. You could think of the switching cost as the wasted prepayment of an order if the inputs produced with the dirty technology are eventually not purchased.

The total switching cost is decreasing in the number of supplying contracts the firm has, in particular the cost of switching associated with each supplier is equal to $\frac{\lambda}{N}$, where N is the number of suppliers. The idea is that it is less costly to interrupt a purchasing relationship, if this accounts for only a small fraction of the total supply.

The firm faces the input price, p^i, from purchasing the intermediate goods from the suppliers, Q^i. Note that, acting as a monopsony, the firm is the only buyer of the suppliers and therefore sets the input price p^i. This price is the same regardless of whether the intermediate good was produced with clean or dirty technology because dirty suppliers mimic the behaviour of clean suppliers. Indeed, the firm cannot discriminate between dirty and clean suppliers by offering different quantity-price contracts to them, because dirty suppliers will always mimic the behaviour of clean suppliers (i.e., no signalling is possible,[12] and we end up in a pooling equilibrium). The intuition for this assumption is that if a dirty supplier accepted a price lower than the price a clean supplier would accept, the firm would understand the dirty nature of the

[11] If dirty, new suppliers could instead lead to a boycott in the subsequent periods of the repeated game, which is not considered in this static game - one period game.

[12] Since we do not allow for signalling, we also assume that in the sector of the intermediate good, no certification is available.

supplier and it would thus not start a commercial relationship.[13]

Production Choice

For each unit of output produced, the firm needs one unit of an intermediate good. We assume that the firm can transform the intermediate good into the credence good (output) with no additional cost. The intermediate good is the sole input of production needed by the firm. More specifically, the firm's production function is:

$$Q = 1 * Q^i = N * q^i \tag{4}$$

As the firm has monopsony power on the market of intermediate goods, the firm faces an upward-sloping inverse market supply of intermediate goods by its suppliers. Based on the curve of supply of intermediate goods, the firm decides on the price p^{i*} and quantity Q^{i*} of intermediate goods. Note that in equilibrium the quantity purchased from each identical supplier, q^i, would be the same. In other words, the total quantity of inputs used by the firm would be equally split among its suppliers: $q^i = \frac{Q^i}{N}$.

2.3 Technology of the supplier

We model a continuum of ex-ante identical suppliers that can only sell to firm f at the price it sets.[14] Therefore, only the (number of) suppliers chosen by the firm enter the game. Accordingly, N can be interpreted as the share of suppliers, over total available suppliers, that are in the monopsony firm's network (i.e., $N \in (0, 1)$). Suppliers produce homogeneous intermediate goods, but they differ in the technology used (the firm cannot distinguish between intermediate goods that use a clean or a dirty technology). In particular, there is an exogenous share q^c of clean suppliers. It follows that q^c can be regarded by the firm as the probability that a supplier is clean. For a given technology, suppliers have the same efficiency in producing the intermediate goods, and the same constant marginal cost of clean and dirty technology, namely c^c and c^d, with $c^c > c^d$. This assumption holds at every level of the value chain. In other words, suppliers are homogeneous in their cost functions, whatever their position in the value chain. This allows us to focus only on a single stage of the supply chain, and denote with c, p^i, and q^i respectively

[13] It is possible to prove pooling equilibrium is consistent with a share of clean and dirty suppliers entering the game. For sake of brevity, we did not report the proof here.

[14] As suppliers face monopsony power by the downstream firm, the type of competition upstream is not relevant.

the cost, the price, and the quantity of that given input.

In particular,

$$c^d = c^c - \Delta, \ with \ \Delta \in (0, c^c) \tag{5}$$

Dirty suppliers always mimic the behaviour of clean suppliers, but the cost of production, and thus profits, changes depending on the technology used.[15]

As suppliers are price takers on the market of intermediate goods and their outside option is zero profit from not producing, the inverse market supply of intermediate goods is given by:

$$p^i(Q^i) = AC^i(Q^i) = c^c \tag{6}$$

Marginal costs equal average costs for the suppliers since there is no fixed cost of production and cost function is assumed to be linear. Therefore, the inverse market supply of intermediate goods provides the supplier's reservation price for the inputs supplied, namely c^c. The reservation price is the same for all suppliers, as dirty suppliers mimic the behaviour of clean suppliers. In fact, the inverse market supply of intermediate goods is the supply curve of clean suppliers.

2.4 NGO

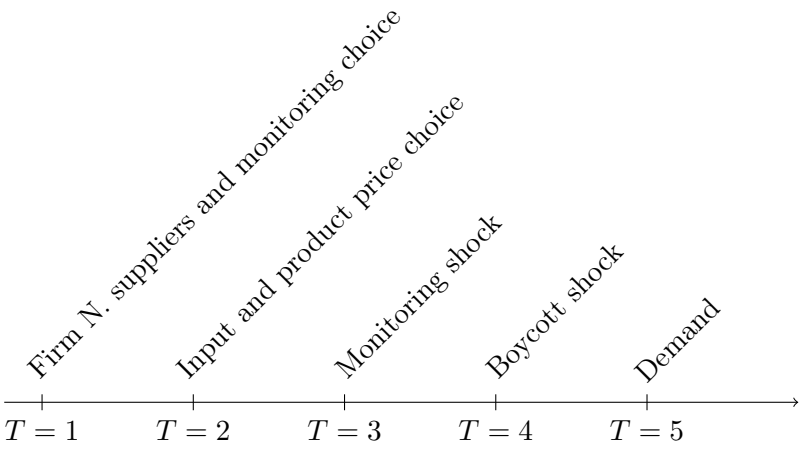
We define an NGO which is identified with consumers, sharing the same utility function. At the beginning of the game, the NGO gets informed about the network of the firm. Taking this initial network of the firm as given, the NGO only monitors the suppliers of the firm. In fact, it would be inefficient for the NGO to monitor also those suppliers that are not active in the market, as they do not employ any technology (nor clean nor dirty) by construction. When monitoring the firm's suppliers, with probability ϕ the NGO learns about a dirty technology and informs consumers about it. We consider here that the choice of ϕ by the NGO is already the best response. Consequently, the firm will take this probability as given to design its best response. As the NGO acts after the firm's monitoring investigation have occurred, and it does not investigate the new suppliers of the firm, ϕ is the probability that the NGO discovers a

[15] Note that the following condition has to be satisfied for the existence of both dirty and clean suppliers, namely that the expected profits of a dirty and of a clean supplier are the same. This requires $\Delta = c^c [m + \phi - \phi m]$, where ϕ is the probability that the NGO learns about a dirty technology and it informs consumers about it. If this condition is satisfied, the expected profits of a dirty or a clean supplier are the same and there will be a share $q^c \in (0, 1)$ of clean suppliers. In other terms, the cost advantage of being dirty is equal to the cost of being clean, weighted by the probability of being discovered by the firm or by the NGO.

violation, conditional on the supplier's employing a dirty technology and on the monitoring by the firm being unsuccessful.

Consumers trust the NGO and, as soon as they get informed, they boycott the firm. For simplicity, we assume that the NGO faces no costs nor revenues for its activity.

3 Timing



3.1 Stage 1: The firm's decision on the number of suppliers and monitoring

The firm decides how many suppliers to have and how intensively to monitor them. As the firm is responsible for the entire demand of the intermediate good, having monopsony power, only suppliers selected by the firm enter the game in the current period. Therefore, the firm's choice on the number of suppliers has to occur at Stage 1. As the outside option for the suppliers is not to produce (hence zero profit), they do not have any bargaining power over the monopsonistic firm.

At the same time, the firm also chooses its monitoring intensity m accordingly.

In taking these decisions, the firm anticipates the probability of a supplier being dirty and the probability of facing a boycott by the NGO in case the supplier is dirty. The firm also knows in advance the unit cost of monitoring m and the cost of switching λ, which depends on the number of suppliers. As the firm chooses in Stage 1 the optimal number of suppliers, it will revert to the same number in case a violation is found and dirty suppliers are replaced.

3.2 Stage 2: The firm sets the price

The firm maximizes its monopoly profits and sets the price and quantity for the final credence good. Having monopsony power, the firm also sets the input price while maximizing profits. Dirty suppliers mimic the behaviour of clean suppliers in selling to the firm. In other words, the firm buys at the same price from dirty and clean suppliers. The price setting of the intermediate input occurs before any possible monitoring or boycott. In fact, the firm sets the price for all its suppliers, including those that would eventually be boycotted.

3.3 Stage 3: Monitoring shock

The firm monitors its suppliers (facing a monitoring cost $c_m = \alpha m$ for its monitoring intensity m and for each of its N suppliers) and discovers the dirty technology (i.e., violation), if any, with probability m. We model the choice to monitor N suppliers as a contemporaneous choice: the idea is that choosing to monitor all suppliers at once is cheaper than doing it sequentially. The firm cannot discover the dirty technology without monitoring, because dirty suppliers mimic the selling strategy of clean suppliers. For each dirty supplier that the firm might find, it will pay a switching cost to interrupt the supplying relationship equal to $\frac{\lambda}{N}$. Moreover, it will replace the dirty suppliers by establishing new supplying relationships, keeping the number of suppliers fixed and equal to N. Monitoring happens before realisation of the boycott shock, so no consequence on the demand of credence good occurs.

3.4 Stage 4: Boycott shock

The NGO acts and discovers a dirty technology with probability ϕ, which leads to a boycott, and the demand for the credence good goes to zero. ϕ is the probability that the NGO discovers a violation along the value chain, conditional on the supplier employing a dirty technology, and on the monitoring having been unsuccessful at Stage 3.

3.5 Stage 5: Demand

Consumers purchase the credence good. Recall that, if a boycott occurred in Stage 4, consumers, who trust the NGO, demand zero quantity.

In the next section, we solve the model by backward induction.

4 Solving the model

Stage 5: Demand

In Stage 5, consumers observe the price set by the firm. By maximising the utility subject to the budget constraint, the inverse demand for not-boycotted products is:

$$P = v'^{-1}(Q) \tag{7}$$

The demand for boycotted products is zero. Clean products are never boycotted, since they are produced with a clean technology (i.e., the probability of boycott conditional on the technology being clean is null). Note that a boycott occurs with probability ϕ if, at Stage 4, the NGO discovers a dirty technology of the supplier. However, if the firm's monitoring is successful, the firm changes supplier before the boycott occurs. Therefore, ϕ is the probability that a boycott occurs conditionally on the technology being dirty and monitoring being unsuccessful. If monitoring is successful and the firm discovers its suppliers, the firm will match with some new suppliers that cannot be subjected to boycott in the same period.

Stage 4: Boycott shock

In Stage 4, a boycott happens with probability ϕ.

Stage 3: Monitoring shock

The firm finds dirty suppliers with probability m.

Stage 2: The firm sets the price

In Stage 2, the firm sets the final price and the input price, maximizing monopoly (and monopsony) profits. The firm ignores the type of technology used by its suppliers since dirty suppliers mimic the behaviour of clean suppliers, but it knows the share of clean suppliers in its network. Therefore, the price set by the firm does not depend on the technology implemented by the suppliers. If no boycott occurs at Stage 4, the firm faces full demand, being a monopolist. Otherwise, in case of boycott the firm faces 0 demand.

The firm maximizes its profits and chooses its optimal level of price and quantity for the final credence good, as well as the price for the intermediate goods, having monopsony power. In a

monopsony equlibrium, in fact, it is the firm that sets the quantity and price for the intermediate goods that it is going to buy from the suppliers. The price setting is independent of the number of suppliers of the firm, and it is the same for all suppliers. The quantity purchased would be equally divided among the number of suppliers.

We derive the optimal pricing strategy and the corresponding profits in the baseline scenario (no boycott, no monitoring) by maximizing the firm's monopoly profits.[16]

According to the cost of production outlined in Section 2.2, the firm's total cost function is:

$$TC = p^i(Q) * Q^i + fixed\ costs \tag{8}$$

where p^i is the price of the intermediate input. Fixed costs include the fixed cost of monitoring, i.e., $\frac{m^2}{2}N$, and switching costs of interrupting a supplying contract, i.e., $\frac{\lambda}{N}$. We ignore fixed costs for the profit maximization as they are decided in Stage 1, and already sunk.

By substituting the inverse production function, as defined by Equation 4, into the cost function, we get:

$$TC = p^i(Q) * Q \tag{9}$$

We further substitute the inverse market supply of intermediate goods into the former expression and we get:

$$TC = p^i(Q)Q = c^c * Q \tag{10}$$

The marginal cost of production is:

$$MC(Q) = \frac{\partial TC(Q)}{\partial Q} = \frac{\partial P^i(Q)}{\partial Q}Q + P^i(Q) = c^c \tag{11}$$

Then we get marginal revenues and we substitute the inverse market demand (as given by Equation 7) into the revenues function:

$$TR(Q) = PQ(P) = P(Q)v(P)^{-1} \tag{12}$$

$$MR(Q) = \frac{\partial TR(Q)}{\partial Q} = \frac{\partial P(Q)}{\partial Q}v(P)^{-1} + P(Q)\frac{\partial v(P)^{-1}}{\partial Q} = \frac{\partial P(Q)}{\partial Q}Q + P \tag{13}$$

[16] In the following proof we proceed by equalizing the marginal revenues and marginal costs of production, but the maximization problem could be also solved in other ways.

Finally, equating MC and MR we get to the optimal quantity of credence good:

$$c^c = (1 + \frac{1}{\epsilon})P \tag{14}$$

$$P^* = \frac{c^c}{(1 + \frac{1}{\epsilon})} \tag{15}$$

By plugging P^* in the inverse market demand we get the final output quantity Q^*:

$$Q^* = v(P^*)^{-1} \tag{16}$$

Lastly, to get the input quantity and price, respectively Q^{i^*} and p^{i^*}, we use the input supply function. By recalling that:

$$p^{i^*}(Q^i) = c^c$$

for all suppliers, we obtain that:

$$q^{i^*} = \frac{Q^{i^*}}{N} = \frac{p^i(Q^i i^*)^{-1}}{N} \tag{17}$$

Profits of the firm are given by:

$$\Pi^f = TR(Q^*) - TC(Q^*) = \begin{cases} (P^* - c^c)Q^* = (\frac{c^c}{(1+\frac{1}{\epsilon})} - c^c)v(P^*)^{-1} = \frac{-c^c}{(1+\epsilon)}v(P^*)^{-1} \; if \; no \; boycott; \\ 0 \; if \; boycott \end{cases} \tag{18}$$

The above equations identify operating profits. Since ϵ is the elasticity of quantity to price, which is by definition negative, operating profits Π^f are positive.

However, the firm's final profits will be decreased by the monitoring cost based on the monitoring intensity that the firm chooses in Stage 1. Final profits will also depend on the monitoring and boycott shocks that respectively occur in Stages 3 and 4:

- If the firm decides to monitor in Stage 1, and monitoring is successful in Stage 3 with the dirty technology being identified, profits are decreased by the monitoring and switching fixed costs.
- If the NGO boycotts the firm in Stage 4 because a dirty technology is identified, the firm's

demand and revenues are 0 regardless of the price set by the firm. Note that the firm's profits would still depend on the monitoring choice made in Stage 1.

Profits outcomes as resulting from the firm's choices and the occurrence of a boycott or monitoring shock are analysed in detail in Stage 1.

Stage 1: Firm's decisions

In Stage 1 the firm decides its monitoring intensity, m, and the number of suppliers, N.

For a given probability of NGO boycott and share of clean suppliers, the firm chooses its monitoring intensity, m. It does so to maximize its expected profits. The firm can choose a level of monitoring m. In Stage 3, monitoring can turn out to be successful or not. If monitoring is successful and the firm discovers a dirty technology, then the firm changes supplier. If the firm does not find any dirty technology, in Stage 4 the NGO activity could lead to a boycott, if the NGO finds at least one dirty supplier among the suppliers that are in the initial network of the firm (this occurs with a probability ϕ). If a boycott occurs, the firm faces 0 demand from consumers, namely 0 revenues, but still has to pay the costs of production.

Recall from Equation 18 the expression for operating profits:

$$\Pi^f = \frac{-c^c}{(1+\epsilon)} v(P^*)^{-1}$$

It is necessary to distinguish two cases, based on whether the monitoring happens to be successful or not.

In the first case, final profits $F\Pi^f$ of a monitoring strategy, with monitoring being successful with probability m, are the following:

$$F\Pi^f_{success} = \begin{cases} q^c(\Pi^f - \frac{m^2}{2}N), \ clean; \\ (1-q^c)[\Pi^f - \frac{m^2}{2}N - \frac{\lambda}{N}(1-q^c)], \ dirty. \end{cases} \tag{19}$$

where q^c is the probability of clean technology, and $\frac{m^2}{2}$ is the cost of monitoring one supplier, which we multiply by the number of suppliers N. For each violation that the firm discovers, it pays a cost of switching supplier equal to $\frac{\lambda}{N}$. Accordingly, the final set of suppliers of the firm remains equal to N. The switching cost is multiplied by the share of dirty suppliers, in order

to model the general case where the firm monitors (and, if monitoring is successful, changes) all dirty suppliers $(1 - q^c)$ at the same time.[17]

Note that, when monitoring is successful, the conditional probability of a NGO boycott is null ($\phi = 0$). In fact, as monitoring occurs before the NGO acts, and the NGO only monitors the initial network of the firm's suppliers, there is no probability of boycott in the case of monitoring being successful (i.e., if the firm discovers and changes all its dirty suppliers). Consequently, the firm has no incentive to pay any extra monitoring costs for the new suppliers replacing the dirty ones. In fact, the new suppliers are not monitored by the NGO in the current period. However, if we considered a repeated game, in subsequent periods newly added suppliers will be eventually monitored by the NGO, since they would be part of the future initial network of the firm. Accordingly, the firm would monitor all its suppliers and pay the monitoring cost accordingly. Yet, this case is not analyzed in our model, as we are only considering one single time period of the game.

Profits from an unsuccessful monitoring strategy, with monitoring being unsuccessful with probability $(1 - m)$, are given by:

$$F\Pi^f_{fail} = \begin{cases} q^c(\Pi^f - \frac{m^2}{2}N), \ no\ boycott, \ clean; \\ (1 - q^c)(1 - \phi)(\Pi^f - \frac{m^2}{2}N), \ no\ boycott, \ dirty; \\ \phi(1 - q^c)(0 - \frac{m^2}{2}N), \ boycott, \ dirty. \end{cases} \tag{20}$$

Now, boycott is possible, and it occurs with probability ϕ, conditional on monitoring having failed, which occurs with probability $(1 - m)$, and the supplier being dirty, which occurs with probability $(1 - q^c)$.

Note that, again, the boycott case does not exist when all suppliers are clean.

Expected final profits $F\Pi^f$ for given boycott probability ϕ, share of clean suppliers q^c, switching cost λ, and operating profits Π^f, are:

[17] This case can be easily generalised for the case in which monitoring activities discover only one dirty supplier in each period.

$$\mathbb{E}[F\Pi^f] = m\mathbb{E}[F\Pi_s^f] + (1-m)E[F\Pi_f^f] = \\ \Pi^f(1-\phi+q^c\phi+m\phi-mq^c\phi) - \frac{m^2}{2}N - m(1-q^c)^2\frac{\lambda}{N} \tag{21}$$

Hence, the firm chooses its monitoring intensity m such that it maximizes its expected profits. First Order Conditions (FOC) for expected final profits maximization with respect to m read as:

$$\frac{\partial\mathbb{E}[F\Pi^f]}{\partial m} = -mN + \phi\Pi^f - q^c\phi\Pi^f - \frac{(1-q^c)^2\lambda}{N} \tag{22}$$

Equating FOC to 0 and solving for m leads to the following zero for the FOC, namely:[18]

$$m^{FOC} = \frac{\Pi^f(\phi - q^c\phi)}{N} - \frac{(1-q^c)^2\lambda}{N^2} \tag{23}$$

In Stage 1 the firm also chooses the optimal number of suppliers N that maximizes expected final profits. Maximizing expected profits with respect to N, we get:

$$\frac{\partial\mathbb{E}[F\Pi^f]}{\partial N} = -\frac{m^2}{2} + m\frac{(1-q^c)^2\lambda}{N^2} \tag{24}$$

We equate the FOC to zero, and we plug the optimal level of m^{FOC} found before into Equation 24 to get the optimal number of suppliers:

$$N^* = \frac{3(1-q^c)\lambda}{2\Pi^f\phi} \tag{25}$$

The number of suppliers increases in the switching cost, λ, and decreases with both the probability of a boycott, ϕ, and the share of clean suppliers, q^c.

Plugging N^* into Equation 23, we get the optimal monitoring intensity:

$$m^* = \frac{2(\Pi^f\phi)^2}{9\lambda} \tag{26}$$

[18]Note that the equation admits both the negative and positive root. However, as $m \geq 0$, we only consider the positive one. The same holds when solving for the optimal number of suppliers N.

The optimal intensity of monitoring effort m depends on the conditional probability that a boycott occurs, ϕ, the cost of switching supplier in case a violation is found, λ, the share of clean suppliers, q^c, and operating profits, Π^f.

The best response monitoring intensity m decreases as the cost of switching, λ, increases, and it increases with the probability of boycott, ϕ. Also, m decreases as the number of suppliers N increases, as it appears from Equation 23. The negative first derivative confirms our initial hypothesis on the trade-off between monitoring intensity and the number of suppliers.

In Figures 1 and 2, we plot the optimal choice of N^* derived in Equation 25 as a function of the share of clean suppliers, q^c, and the conditional probability of boycott ϕ (fixing λ),[19] and ϕ and λ respectively (fixing q^c=0.5).

In Figure 3, instead, we plot the optimal level of monitoring m^*, as derived in Equation 26, for a fixed value of λ. $m \in [0, 1]$ represents at the same the intensity of the firm's monitoring effort and the probability of successful monitoring.

Note that in all cases N^* is $\in (0, 1]$, as it represents the share of suppliers, over total available suppliers, that are in the monopsony firm's network. The graphs thus provide a visual representation of the relationships that have already been described above.

[19]We attribute the value of 0.05% to the share of switching costs over operating profits, namely $\frac{\lambda}{\Pi^f}$. This value is based on Thomson Reuters' estimate of the average legal spend at companies around the world, as a percentage of revenue.

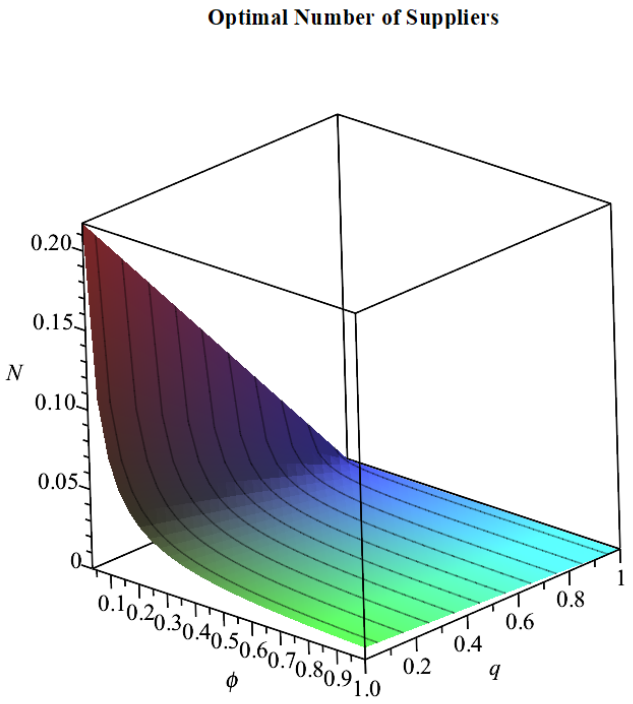


Figure 1: Optimal number of suppliers as a function of ϕ and q^c

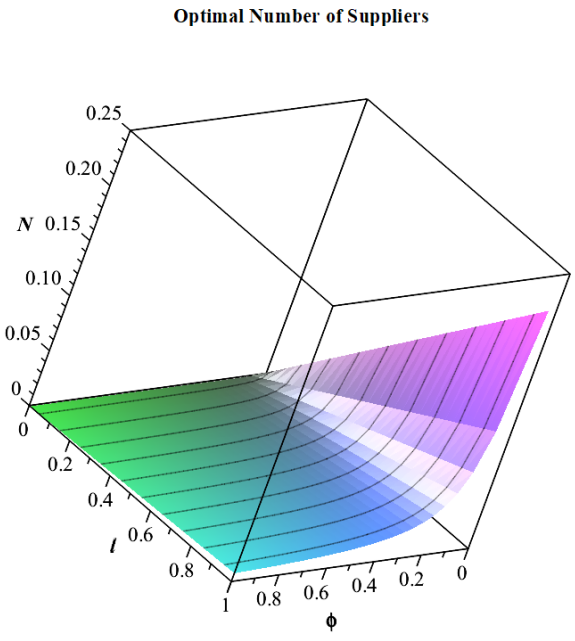


Figure 2: Optimal number of suppliers as a function of ϕ and λ

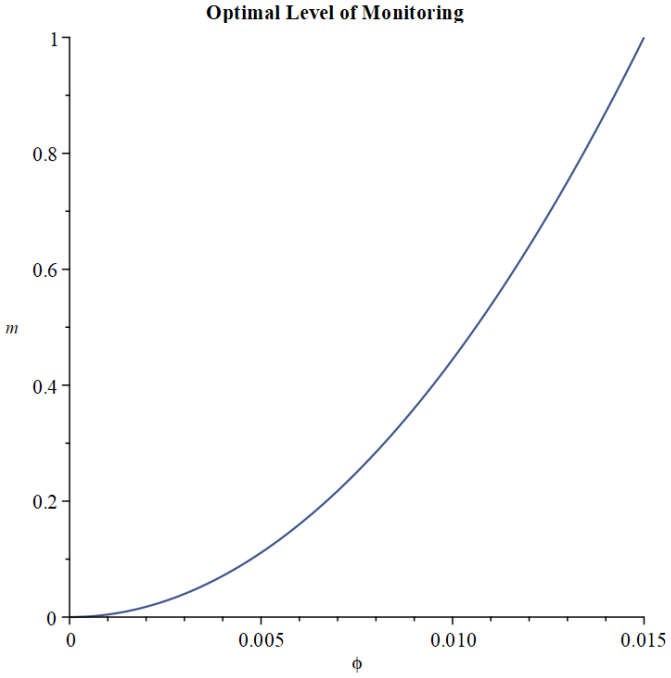


Figure 3: Optimal monitoring intensity as a function of ϕ

5 Empirical Evidence

In this section, we provide some empirical evidence supporting the theoretical predictions of the model. In particular, we focus on the result on the number of suppliers, which we can measure using trade import data.

We use data from three sources. First, we rely on French trade data. The French economy provides an ideal setting for our model. France is a developed economy deeply integrated with international trade. Moreover, society's attention toward environmental and social sustainability is particularly high in France. For example, as of 2017, France's Duty of Vigilance Law requires all large companies headquartered in France to publish an annual vigilance plan that establishes effective measures to prevent severe impacts on human rights and the environment resulting from the company's own activities, the activities of companies it controls directly or indirectly, and its subcontractors and suppliers.

The analysis is at the level of the downstream industries, as these are targets of NGO activism (Hatte and Koenig, 2018).

For each final sector j, we proxy the total number of suppliers with the number of countries from which France has positive imports for the inputs of the final good j. We get the number

of suppliers N of final product j as:

$$N_{j,t} = \sum_{i}^{I} \left(\sum_{k=1}^{K} 1_{(M_{i,k,t}>0)} \right) \times w_{i,j}$$

where $M_{i,k,t}$ is France's imports of input i in year t from country k, from WITS data (2010-2019). Also, the weights $w_{i,t}$ are the coefficient from the 2010 Leontief inverse matrix from STAN input-output tables (OECD data), which we use to connect the upstream sectors to the downstream ones.

Second, we calculate the share of dirty suppliers at the industry level. As the model can be applied to different kinds of ethical violations, here we decided to use the incidence of child labour by country-industry combinations (ILO data, 2007-2015). Child labour is defined by the ILO as "work that deprives children of their childhood, their potential, and their dignity, and that is harmful to physical and mental development." [20]

In addition, child labour is cheaper than adult work, being here the "clean" option, and as such this choice allows us to respect the assumptions of the model of $c^d \leq c^c$.

We therefore calculate $CL_{j,t}$ as percentage of sectoral employment in industry i in year t across all sourcing countries, with weights again equal to $w_{i,j}$:

$$CL_{j,t} = \sum_{i=1}^{I} w_{i,j} \times \frac{ChildLabour_{i,t}}{Employment_{i,t}}$$

Lastly, we evaluate the probability of being subjected to a boycott using the Sigwatch NGO campaigns database by firm-country-industry (2010-2019). We proxy the NGO attention measure to downstream sector j in year t as:

$$NGO_{j,t} = \frac{\sum_k 1 \times Campaign_{k,j,t}}{\sum_t \sum_k 1 \times Campaign_{k,j,t}}$$

where $Campaign_{k,j,t}$ indicates an NGO Campaign started in year t and targeting French firm k in sector j.

From a brief analysis of the data we put together, it emerges clearly from Figure 4 that there is a

[20] We chose to consider this type of violation since, because of the severity of the violation, it would be impossible for the importing firm not to change a supplier if found dirty. At the same time, NGOs and society take into serious consideration these kinds of unethical behaviours.

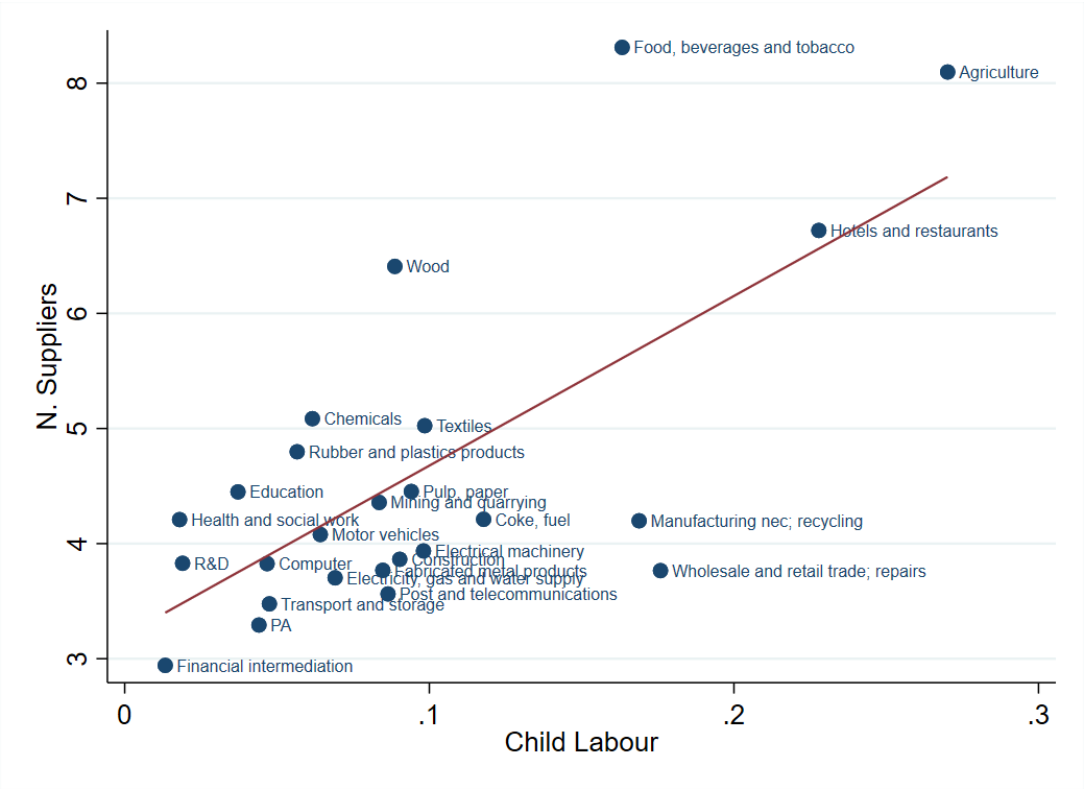


Figure 4: Number of sourcing countries (log), averaged over French industries, as a proxy of number of suppliers Nj,t . Child labour violations are measured among suppliers' industries in developing countries (ILO's definition), as a share of total employment. Time: 2007-2015.

positive correlation between the number of France sourcing countries, and the incidence of child labour, in the period between 2007 and 2015. It is interesting to note the large heterogeneity across sectors: the most labour-intensive sector are those with the highest number of suppliers, and also with the largest share of child labour evidence, while service sectors, such as finance intermediation or R&D, are closer to the origin.

To test our prediction on the number of suppliers, we run a regression of our proxy for N on the child labour incidence, and the NGO attention, including both year t and sector j fixed effects, over the period 2010-2015. Precisely, the regression equation is:

$$ln(N_{j,t}) = CL_{j,t} + NGO_{j,t} + \alpha_j + \alpha_t + \epsilon$$

The results are reported in Table 1 below.

	Number of Sourcing Countries
Child Labour Exposure	0.249***
	(0.0540)
NGO Attention	-0.0819
	(0.188)
Observations	78
N. of Industries	23
R-squared	0.052
Sector FE	YES
Year FE	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1: OLS results of number of sourcing countries (log) on child labour exposure and NGO attention, 2010-2015.

The coefficient on child labour exposure is positive and significant at 1%, while the coefficient on NGO attention is negative, although not significant. This could be due to the broad aggregation of the data used and the small number of observations, or from the effect of the monitoring choices that we cannot estimate.

Overall, although we cannot claim causality, these results confirm the prediction of our model for the determinants of the number of suppliers in a fragile value chain environment, where the fragility comes both from the possibility of unethical conduct of the suppliers, and from the attention of the society.

6 Possible Extensions of the Model

This section completes the paper by discussing the effect of changing certain features of the model. In particular, we discuss the consequences of relaxing specific assumptions, leaving the actual derivations to future extensions of the model.

1. **Quadratic form of monitoring cost.** The quadratic form of monitoring is useful for the derivation of the model. However, it is also a good proxy of reality, as it suggests that costs increase with the number of suppliers, but less than proportionately.

2. **Fixed cost of entry for monitoring.** For tractability, we set the fixed cost equal to zero. With a non-zero value for the entry cost, it would add a non-informative constant to the predictions of the model.

3. **Repeated games.** For the sale of simplicity, our model features a static game. However, the results could be possibly extended to consider the case of repeated interactions between the firm and its suppliers. Yet, in a repeated game setting, the roles of reputation and signalling should be also considered, with the firm and consumers updating their beliefs based on past monitoring outcomes and NGO activities.

4. **Endogenous suppliers' choice of technology.** In the present version of the model, we assume a fixed and exogenous share of dirty suppliers in the firm's network. In the Appendix, we demonstrate that, with only one value for Δ, it exists a threshold value such that both clean and dirty suppliers exist. This threshold is a function of the exogenous parameters of the model, meaning the cost of being clean, and the probabilities of being found by either the firm or the NGO. Relaxing the assumption of an exogenous share of dirty suppliers, and assuming a uniform distribution of Δ, instead, suppliers would optimally choose the clean or the dirty technology based on their relative value of Δ, and the probability of being caught.

5. **Endogenous NGO choice of monitoring effort.** In the present version of the model, we treat NGO monitoring success as exogenous. However, possible extensions of the model could endogenise the NGO's monitoring and target choice as well. Accordingly, the NGO would also have a utility function, mirroring that of consumers, and it would maximise it with respect to its budget constraint.

7 Conclusion

Over the last decade, the interest of civil society and NGOs for the respect of ethical, working and environmental standards has notoriously grown. Not only the society cares about the respect of production standards in the final domestic market, but also along the international global value chain. Consequently, internationalized firms that source from countries with lax regulation face the risk of being subjected to boycotts by final consumers if a violation is spotted along their value chain.

In this project, we study the firm's optimal behaviour in choosing between two different but complementary strategies to ensure against the risk of a boycott, namely supplying chain monitoring and reliance on a wider and more resilient network.

We model the trade-off of a firm with monopsony power that, to ultimately offset the risk of a boycott, decides on the number of suppliers in its value chain, and on the intensity of their monitoring. In particular, the firm faces a trade-off between having few suppliers, easier to monitor but harder to change in case of a violation, and many suppliers, which are more costly to monitor but provide a more resilient strategy in the need of change. We study how these decisions change with an increase in the probability of facing a boycott by the society.

The model delivers important testable predictions. Firms face a trade-off between relying on a larger and more resilient network, and monitoring their suppliers. Society's attention plays an important role in this trade-off. On one hand, when the probability of being boycotted by final consumers increases, firms increase their monitoring intensity. On the other hand, the probability of being subjected to a boycott is negatively related to the ideal number of suppliers, as the relationship between the latter and society's attention is mediated by monitoring and the substitution effect. Second, higher switching costs nudge firms towards larger networks and less intense monitoring (the latter is again because of the substitution effect). Finally, the share of dirty suppliers positively affects the dimension of the firm's network but does not influence the monitoring choice.

We then provide empirical evidence on the result on the number of suppliers. To do so, we use French sector-level trade data, combined with data on child labour incidence and NGO campaigns. Results show a positive and strong effect of the probability of dirty suppliers, and a negative effect of NGO attention, on the number of suppliers in an environment characterised by fragile global value chains.

References

[1] Alonso Alfaro-Ureña et al. "Responsible Sourcing? Theory and Evidence from Costa Rica". In: *mimeo* (2022).

[2] Pol Antràs. "Firms, contracts, and trade structure". In: *The Quarterly Journal of Economics* 118.4 (2003), pp. 1375–1418.

[3] Mark Bagnoli and Susan G Watts. "Selling to socially responsible consumers: Competition and the private provision of public goods". In: *Journal of Economics & Management Strategy* 12.3 (2003), pp. 419–445.

[4] David P Baron. "Private politics". In: *Journal of Economics & Management Strategy* 12.1 (2003), pp. 31–66.

[5] David P Baron. "Private politics, corporate social responsibility, and integrated strategy". In: *Journal of economics & management strategy* 10.1 (2001), pp. 7–45.

[6] David P Baron and Daniel Diermeier. "Strategic activism and nonmarket strategy". In: *Journal of Economics & Management Strategy* 16.3 (2007), pp. 599–634.

[7] Vasco M Carvalho et al. "Supply chain disruptions: Evidence from the great east japan earthquake". In: *The Quarterly Journal of Economics* 136.2 (2021), pp. 1255–1321.

[8] Mathieu Couttenier and Sophie Hatte. "Mass media effects on non-governmental organizations". In: *Journal of Development Economics* 123 (2016), pp. 57–72.

[9] Julien Daubanes and Jean-Charles Rochet. "The rise of NGO activism". In: *American Economic Journal: Economic Policy* 11.4 (2019), pp. 183–212.

[10] Matthew Elliott, Benjamin Golub, and Matthew V Leduc. "Supply network formation and fragility". In: *Available at SSRN 3525459* (2022).

[11] Margaret A Emmelhainz and Ronald J Adams. "The apparel industry response to "sweatshop" concerns: A review and analysis of codes of conduct". In: *Journal of Supply Chain Management* 35.2 (1999), pp. 51–57.

[12] Gene M Grossman, Elhanan Helpman, and Hugo Lhuillier. *Supply Chain Resilience: Should Policy Promote Diversification or Reshoring?* Tech. rep. National Bureau of Economic Research, 2021.

[13] Sophie Hatte and Pamina Koenig. "The Geography of NGO Activism against Multinational Corporations". In: *The World Bank Economic Review* 00 (2018), pp. 1–21.

[14] Philipp Herkenhoff and Sebastian Krautheim. "The international organization of production in the regulatory void". In: *Journal of International Economics* (2022), p. 103572.

[15] Philipp Herkenhoff et al. "Corporate Social Responsibility along the Global Value Chain". In: *Available at SSRN 4007780* (2021).

[16] Pamina Koenig et al. "Local global watchdogs: Trade, sourcing and the internationalization of social activism". In: (2021).

[17] Sebastian Krautheim and Thierry Verdier. "Offshoring with endogenous NGO activism". In: *Journal of International Economics* 101 (2016), pp. 22–41.

[18] Christoph Schiller. "Global supply-chain networks and corporate social responsibility". In: (2018).

[19] Jodi L Short. "Self-Regulation in the Regulatory Void: "Blue Moon" or "Bad Moon"?" In: *The ANNALS of the American Academy of Political and Social Science* 649.1 (2013), pp. 22–34.

Appendices

A Consistency of pooling equilibrium

Suppose that, instead of offering an input price c^c, the firm would offer $c^d < c^c$. By doing that, the firm anticipates this would only attract dirty suppliers, and no clean one would enter the game. Consequently, the firm would choose zero level of monitoring.

Suppose there is at least one supplier that accepts the contract. Its expected profits will be:

$$\Pi_d^s = \begin{cases} 0 \ no \ boycott \\ -c^d q^i \ boycott \end{cases}$$

It follows:

$$\mathbb{E}[\Pi_d^s] = 0(1-\phi) - c^d q^i \phi = -c^d q^i \phi$$

Expected profits of the supplier are negative, it would prefer the outside option, i.e. no production, and no supplier would enter the game.

Hence, the firm would only offer a price $c^c > c^d$, attracting both clean and dirty suppliers.

B Existence of a share of clean suppliers

There will be a share $q^c \in (0,1)$ of clean suppliers if the indifferent condition between expected profits from being clean and being dirty holds, i.e. $\mathbb{E}[\Pi_c^s] = \mathbb{E}[\Pi_d^s]$.

Expected profits of a clean supplier are:

$$\Pi_{clean}^s = 0$$

Expected profits of a dirty supplier instead are:

$$\Pi_{dirty}^s = \begin{cases} (1-\phi)(1-m)[\Delta q^i] \ not \ found, \ no \ boycott \\ m[(-c^c + \Delta)q^i] \ found, \ no \ boycott \\ \phi(1-m)[(-c^c + \Delta)q^i] \ not \ found, \ boycott \end{cases}$$

Equating $\mathbb{E}[\Pi_c^s] = \mathbb{E}[\Pi_d^s]$ yields the following condition for the existence of a share $q^c in (0,1)$:

$$\Delta = c^c[m + \phi - m\phi] \tag{27}$$

In other words, the cost advantage of being dirty must be equal to the cost of the clean technology (and the price of the intermediate good), weighted by the probability of being found either by the firm or by the NGOs.

C No collusion

To rule out the possibility of collusion, i.e. the decision of the firm to keep a supplier once found dirty, it must be that expected profits from finding and replacing a dirty supplier are greater than expected profits from finding one, not replacing and risking a boycott.
In other worlds, we compare expected profits of the firm, for a successful monitoring strategy happening with probability m, that changes all dirty suppliers found:

$$\Pi^f_{success,change} = (1 - q^c)[\Pi^f - \frac{m^2}{2}N - \frac{\lambda}{N}(1 - q^c)]$$

against expected profits of the firm, for a successful monitoring strategy happening with probability m, that keeps the dirty suppliers and risks facing a boycott:

$$\Pi^f_{success,keep} = \begin{cases} (1 - q^c)(1 - \phi)[\Pi^f - \frac{m^2}{2}N] \ no\ boycott \\ (1 - q^c)\phi[-\frac{m^2}{2}N] \ boycott \end{cases}$$

The firm would never collude, i.e. would always change suppliers, if $\mathbb{E}[\Pi^f_{s,change}] > \mathbb{E}[\Pi^f_{s,keep}]$, which yields the following condition:

$$\phi\Pi^f > \frac{\lambda}{N}(1 - q^c)$$

Replacing the equilibrium optimal number of suppliers $N^* = \dfrac{3\lambda(1 - q^c)}{2\Pi^f\phi}$ in the expression above leads to:

$$\phi\Pi^f > \frac{2}{3}\phi\Pi^f \longrightarrow 1 > \frac{2}{3} \tag{28}$$

which is always verified. Hence, collusion is not an equilibrium of this model.