



**CORPORATE RESPONSIBILITY
IN THE
TELECOM SECTOR**

**Corporate Responsibility
Standards**

High Corporate Responsibility Standards and Reallocated Monitoring Costs

Implementing a Mechanism to Ensure Standards in the Supply Chain

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Keywords

Sectoral Contract, Corporate Responsibility, Competitive Market, Supply Chain, Production Standards

This paper presents a new game theoretical approach to reduce and reallocate the costs of monitoring supply chains in the telecommunication industry. The complex structure of supplier relations is understood as tiers of production. These can be seen as markets in which the suppliers act as competitors. This structure opens the approach to shift monitoring costs from the producer to the actors on the lower tiers where compliance with an existing code of ethics is a requirement so as not to suffer from market exclusion. The suppliers have an incentive to identify competitors who defect in order to benefit from their foreclosure. Thus, the monitoring costs which are shifted from one final producer reverse the supply chain. By using game theoretical modelling, this structure of individual incentives is backed and proven to function under certain assumptions. The paper's approach is of relevance for the telecommunication industry, which becomes apparent when considering joint efforts in the branch.

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1. The Role of Corporate Responsibility in the Supply Chain

In the last decades, the importance of corporate responsibility (CR) has increased significantly. The media, the public, and politics expect especially transnational corporations to engage in sustainable and caring business practices. Consequently, the vast majority of corporations employ a code of conduct as the basis for their work (cf. Schelhove/Heydenreich 2012: 17). Nevertheless, this appears to be insufficient. Especially in the media and the public, the idea is broadly spread that these companies must make sure that not only their own employees respect certain CR standards, but other stakeholders do, too. This is true particularly for their supply chain. When suppliers of established corporations are disreputable for reasons of environmentally unfriendly or inhumane working conditions, this often backfires for the large corporation. This could be observed when Apple was publicly blamed for the poor working conditions of Foxconn, its Chinese supplier for the iPhone and iPad (cf. Biermann 2011). However, this example reveals one more thing about the role of CR: It might be a topic that heats up public debate, but it is apparently not yet highly significant in an economic sense: Apple did not suffer from the Foxconn scandal economically. The same holds true for other corporations, as for example Primark.

From these examples, the question arises of what these companies can do to fulfil the external expectations about CR standards in their supply chain. When we talk about such management of the supply chain, we refer to *The Blackwell Encyclopaedia of Management*: “Supply Chain Management is the Formation of Long-Term Partnerships or Relationships with Suppliers” (Slack 1997: 211). The supply chain includes all companies that are involved in the production process of one product that the company sells to consumers. Achieving a high degree of compliance with CR standards of the suppliers appears to be a huge task. Its great economic significance justifies the need to find a way to cope with this challenge. We see in corporate responsibility a fast-growing issue. The public and politics increase the pressure on transnational corporations. In the near future, we assume that the general business environment will develop in a way that makes it necessary for companies to handle their supply chain in a way that considers CR standards of utmost importance. This might be due to the increased public awareness of CR that will have direct economic consequences for the companies, or due to political legislation and regulation aiming at an improvement of CR standards in the supply chain. Arguably, these may not be the only causes. Many different developments could lead to such situations that put the manufacturers in a position where they have no other choice than to enforce CR standards in the supply chain. It

is also conceivable that the manufacturers will voluntarily decide to enforce certain CR standards throughout the production process. Either way, we proceed from the assumption that the final producers have a real interest in managing their supply chains in a way that guarantees compliance with the established CR standards.

In this paper, we will present a way for companies to guarantee compliance with CR standards. We will first identify the concrete challenges any final producer faces when he decides to enforce compliance with CR standards throughout the production process. These challenges will be illustrated by describing the relation between the manufacturer and his suppliers by means of the principal-agent theory. We will emphasise the importance of the direct competitors of all suppliers in order to develop a mechanism that works in accordance with the demands of the final producer. The principal idea is that the supplier's direct competitors shall be incentivized to report misconduct to a whistle-blower hotline operated by an independent third party. What will trigger them to do so is the fact that those suppliers take the position of non-complying actors in the supply chain. We will embed this mechanism in game theoretical analysis and rational choice theory in the second section of the paper. This will help to understand that our mechanism is the result of the individual actor's rational behaviour.

2. The Principal-Agent Model as a Theoretical Framework to Understand Challenges in Supply Chain Governance

Before presenting our own work on how final producers can efficiently manage their supply chain with regard to the compliance of CR standards, we must first identify the major challenge they face doing so. Why is it actually so difficult for final producers to survey whether their suppliers stick to certain CR standards? To answer this question, we will have a look at the standard way of depicting a supply chain.

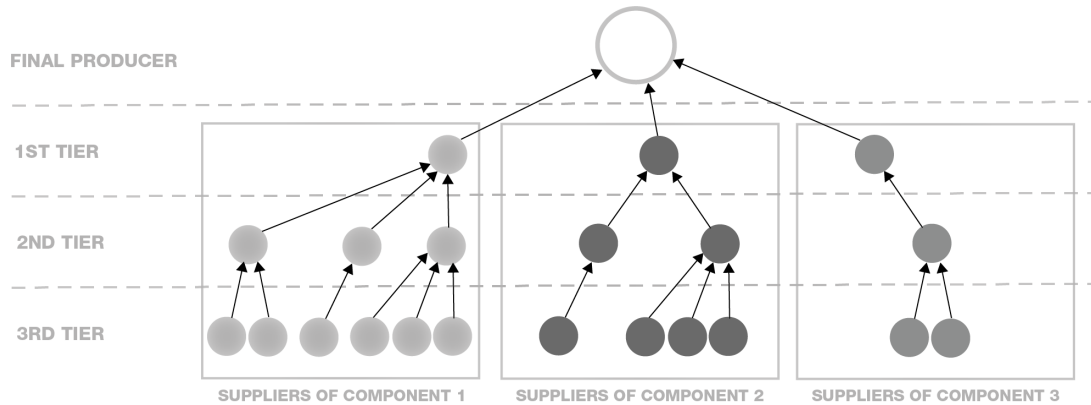


FIGURE 1: DEPICTION OF THE SUPPLY CHAIN (SOURCE: OWN ILLUSTRATION)

We see that the lower the tier, the more complex the supply chain is. This is obvious as most suppliers purchase goods and services on their part from more than one supplier. Regarding this, implementing CR standards leads to a two-dimensional governance problem: First, the final producer must make sure that all suppliers comply with these standards. This not only affects the top-tier suppliers but also those on lower tiers of production – his supplier’s suppliers, so to speak. For large and multinational corporations, the number of suppliers can be extremely high. Identifying all of them alone be seen as a massive challenge (cf. Schelhove/Heydenreich 2012: 19). Moreover, the final producer has to find a way to control his suppliers’ actions.

Jensen and Meckling have developed a theory about agency relationships for similar situations which is called principal-agent theory:

“We define an agency relationship as a contract under which one or more persons, [the principals], engage another person, [the agent], to perform some service on their behalf which involves delegating some decision making authority to the agent. If both parties to the relationship are utility maximizers, there is good reason to believe that the agent will not always act in the best interest of the principal” (Jensen/Meckling 1976: 5).

This description precisely applies to our examination of the relation between a final producer and suppliers. The two parties conclude a contract that defines the required CR production standards. Unfavourably for the final producer, he cannot know whether the supplier really complies with the contract. In this sense, the contract is incomplete (cf. Williamson 2002: 174). If the supplier is a profit-seeking actor and compliance with the CR standards is costly, he will not comply if, presumably, the final producer will not find out. That is to say, he would utilise the information asymmetry between himself and the final producer. Consequently, the principal – in this case, the final producer – must make use of certain control mechanisms in order to guarantee the supplier’s compliance: “The principal can limit divergences from his interest by establishing appropriate incentives for the agent and by incurring monitoring costs designed to limit the aberrant activities of the agent” (Jensen/Meckling 1976: V.3: 3). Obviously, the final producer is stuck in a situation where he has to incur monitoring costs to be sure that the supplier complies with the CR standards even if he has already paid for the supplier’s compliance. What might look like an undesirable side effect at first glance becomes quite problematic for the final producer when considering the high number of suppliers in the complex supply chains of transnational corporations such as telecommunication companies. These kinds of companies face immense monitoring costs that make the enforcement of CR standards throughout the supply chain a real Herculean task. We will present an alternative approach to enforce compliance with CR standards. In our model, this process starts with all the final producers entering an initial contract containing the agreement not to purchase components from suppliers who do not meet the required CR standards. From this point on, we will name this type of contract “sectoral CR contract”. We will show that this is to the final producers’ advantage as it significantly increases their bargaining power. Indeed, first signs of such collaboration can be observed in the telecommunication industry:

“At the beginning of 2010, Deutsche Telekom, France Telekom and Telecom Italia initiated the so called Joint Audit Cooperation (JAC) in order to accomplish supplier auditing together. [...]. At present [2012], eight telecommunication companies have joined the JAC: Belgacom, Deutsche Telekom, France Telekom, KPN, Swisscom, Telecom Italia, Telenor and Vodafone” (Schelhove/Heydenreich 2012: 17).¹

1 Trans. by Schwersen and Damm

To place our argumentative procedure on a solid basis, it is necessary to start with some basic assumptions. Two of them are fundamental to secure coherence in the mechanism we want to develop: (1) We assume all actors in our model to be profit seeking and acting rationally in specific fields, such as consistency in choice, self-interested behaviour and perfect information about the actor's own preferences and the range of choices he faces (cf. Caldwell 1993: 55f.). This means every actor decides on the basis of those means. Effectively, this says that the actor is aware of all of the feasible actions and ranks these actions according to his preferences. This preference order is never violated by his actions. (2) The theoretical framework consists of effective supplier markets. This term implies a competitive environment and excludes possible market failure (cf. Melody 2006: 2f.).²

In this paper, we differentiate among specific groups of actors: The final producer is the connection between the value-creation process and the consumer. He sells the end product. Every actor involved in the value-creation process is a supplier. Suppliers build components, deliver raw material or provide services. Taking as an example the creation of a mobile phone, a component could be a display which is bought by the final producer for the composition of the final product. However, a component could also be an element of the display itself. We will name the suppliers who sell their goods and services to the final producer “top-tier” or “first-tier suppliers”. Accordingly, the suppliers selling their products to these first-tier suppliers are second-tier suppliers and so on. For every supplier, there exists at least one direct competitor which is able to replace this supplier in the value-creation process. Together they form a supplier market.

3. Reallocating Monitoring Costs

3.1 The High Complexity of the Supply Chain

The principal idea of our mechanism is to introduce institutional competition of self-controlling markets to the supply chain. The current discussion of supply chains tends to disregard all actors that are not directly involved in the process of production. This is reasonable, as a model by definition must always simplify. Still, we do want to consider one other kind of actor in order to understand

² We are aware that assumption (2) does not apply to all supplier markets in telecommunication industry. This is the case as some major suppliers, for example Samsung, Foxconn and Pegatron, merged high market power which makes it appropriate to assume a certain market failure in this industry.

the dynamic markets any supply chain is embedded in. Namely, we consider direct competitors of all suppliers to have a considerable impact on the function and development of the supply chain. We hold that reciprocal interaction between the suppliers and their direct competitors strongly affects the supplier's behaviour.

Taking a three-tier supply chain, where every component or resource of service is offered by four competing suppliers, the total number of actors rises to $42 + 43 + 44 = 336$. Obviously, this manner of looking at a supply chain makes things complex very quickly (cf. Schelhove/Heydenrich 2012: 19). What is the benefit of considering the direct competitors of the suppliers? It allows us to propose that the final producer could – instead of monitoring all of his suppliers – focus on his suppliers' weak points, namely their competitors, and use them as leverage in order to be sure that all suppliers act according to CR standards.

3.2 Competitors as Decisive Actors in the Supply Chain

When speaking of the suppliers' competitors, we refer to those companies and only those that compete directly with the supplier for orders from the buyer. Under the assumption that they are profit-seeking actors, they have an incentive to replace competing suppliers and to take their place in the supply chain. They might even be willing to invest in legal business practices that enable them to replace a competing supplier as long as those costs do not exceed the profits from receiving the offer. In an industry where goods and services are offered by several competitors, competition in the supplier markets strengthens the position of the final producer (cf. Hongmin Li 2012: 1f.). Ever since Adam Smith described the system of competition in free markets, this has been understood as the main trigger of efficiency and progress (cf. Smith 1904: 51ff.). Smith uses the 'invisible hand of the markets' as a metaphor for the phenomenon that actors act according to their self-interest and by doing so indirectly contribute to the other actors' benefit. Basically, the mechanism we want to introduce to the diverse supplier markets corresponds to this metaphor: It should establish that the actors, as if they were driven by an invisible hand, comply with the CR contract so that the final producer receives a creation of value that is produced in the way he demands. As a first step, this way of looking at the supply chain leads to a different understanding of the institutional arrangements. Individual suppliers as irreplaceable actors are pushed to the background in our concept. Instead, we focus on supplier markets as a whole, as can be seen in the depiction below.

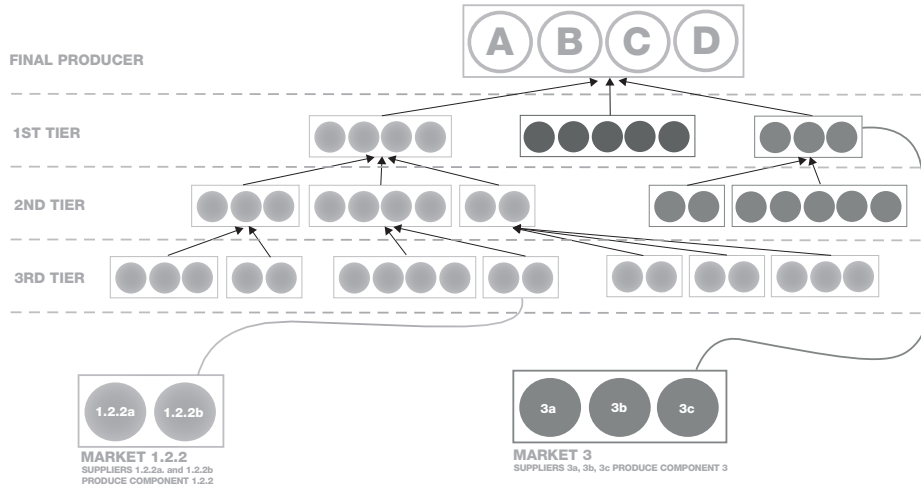


FIGURE 2: A WAY TO DEPICT THE SUPPLY CHAIN WITH RESPECT TO COMPETITION IN SINGLE SUPPLIER MARKETS ON EVERY SINGLE TIER (SOURCE: OWN ILLUSTRATION)

Figure 2 shows the supply chain of an industry with the four final producers A, B, C, and D. The several production tiers show that markets instead of individual suppliers define the image in this illustration. In practice, this whole system could work in the following manner: Final producer A is one of x final producers that need amongst other things the specific component 3 in order to create a product. For this component 3, there is a market we name market 3 that again contains y suppliers who all produce component 3. For this reason, they are labelled supplier 3a, 3b and so on. They again must purchase components for the creation of their product, which they buy from second-tier suppliers. Supplier 3a might need a component 3.1 that is offered by n suppliers in market 3.1, which are labelled 3.1a, 3.1b and so forth. This nomenclature helps to maintain some technical overview over the great number of suppliers that already appear in rather simple supply chain models.

3.3. Achieving Compliance via a Market Based CR Mechanism

How does this new understanding of the supply chain help to implement compliance with a CR contract throughout the whole production process? Even if competition as a general tendency

encourages the selling side of the market to put a lot of effort into improving their products, this will not do the trick in our case. Competition will definitely lead to a situation where the buyer will most likely be able to purchase products that fulfil those of his requirements that are easily verifiable. However, this is not the case when it comes to compliance with the CR contract. Only if the final producer is willing to invest in a very costly monitoring system does compliance with the CR contract result in a competitive advantage and become a winning strategy for the suppliers. As long as the final producers do not survey the suppliers, they might ask for compliance but cannot rely on it. In this case, compliance is a losing strategy for the competitors. Producers undertake an investment that cannot be verified and therefore does not lead to a competitive advantage. Obviously, the final producer must introduce stronger incentives for CR compliance in the supplier markets.

One important part of such an incentive is the sectoral CR contract between the final producers which states that they will purchase components from only those firms that comply with the required CR standards. Consequently, if the non-compliant behaviour of one supplier is detected, this leads to that supplier's exclusion from all current and potential orders in the industry. To speak in terms of game theory, this would mean that the profit allocated to a non-cooperative player is available for redistribution between the remaining players in the market. This incentivises all competitors to blow the whistle on non-compliant suppliers and invest in monitoring each other. This results in a new form of monitoring the supply chain which – if the mechanism is once installed – works for all the markets in the supply chain without constant observation, respectively spending, of the final producers. When the final producers agree on a sectoral CR contract, they acquire a great deal of power in their relationship with the suppliers. The act of excluding non-complying actors is the first condition for our mechanism. The second one can be derived from the characteristics of the actors, which we assume to be of egoistic and profit-seeking nature. The actors have an interest in seeing one of their direct competitors being excluded from the market and taking his place in the supply chain in order to raise their profits. Those two conditions together lead us directly to the mechanism we are about to propose: The final producer could escape the dilemma of trading off between costly monitoring and the risk of being tricked by quasi delegating the monitoring expenses to the supplier's direct competitors. There are several reasons that make us think that this will result in a highly effective mechanism:

First, a system in which direct competitors monitor each other is somewhat more efficient than no system at all. This is because we can assume that monitoring costs are higher if the monitoring actor does not know much about the business of the actor whose work he wants to examine. These

costs decrease if he is an expert in the business of the actor he is monitoring. This is reasonable because the less the monitoring party already knows about the actor's business, the more he must invest in expertise in order to be able to understand what the supplier is doing and whether he does it well. We can conclude that direct competitors might need to invest much less in monitoring activities than the final producer (cf. Williamson 1979: 246). The deeper the supply chain, the less the final producer might understand about the agent's business. Direct competitors, however, are highly aware of their competitor's business. This enables them to gather knowledge about their competitors quite easily. Furthermore, such monitoring might not even be necessary in most cases. Due to the fact that competing actors are in the same market as the supplier, they may already know a lot about the other side's business routines. Additionally, information spreads much more quickly between the actors of one market than across the entire supply chain. Interactions on a personal level between the competing actors and close connections through common business partners may do the rest. Finally, the competing actors have a strong incentive to blow the whistle on their fellow competitors as they can thereby target their profits.

We adduce as an instance a market of cell phone display producers with one actor who earns an amount of 100 units per year for supplying a buyer with displays. Under the assumption that his deviation from the CR contract was common knowledge in the market of display producers, his competitors would tell his buyer about this breach of the rules.³ If this buyer was a final producer, he would cancel his orders and commit to a competitor instead. Alternatively, his buyer might be another supplier. Then, this one would also cancel his orders in the same way. If the buyer acted in any other way, he would risk being eliminated from the supply chain as well. This is because the other display producers would inform the final producer if necessary.

In another case, an actor could deviate from the CR contract if this contract was not common knowledge in the market. Here, one competitor who had the second-best offer would rationally be willing to invest up to 99 units to reveal the cheating in order to eliminate the actor and replace him. If such a mechanism is established in the various markets, the risk of exposure for all suppliers is very high.⁴ As a result, we obtain an idea of a supply chain where market competition between the suppliers and their fellow competitors leads to a stable market system that penalises deviation from the sectoral CR contract. Non-complying actors must consequently fear being exposed. This

3 Of course, in order to performing this action, the competitors still had to pay some institutional costs that we will focus on later in this section when we look at a whistle-blower hotline.

4 A more detailed approach to these game theoretical strategies follows in section 3 of this paper.

system incentivises the suppliers to comply with the CR contract to avoid the risk of exclusion. The final producer clearly is the first beneficiary of this mechanism. Monitoring as an institution of the supply chain is effectively redefined. What originally appeared to be of interest for one final producer can now be designed as a decentralised method. In the following, we identify additional measures the final producer can undertake in order to stabilise this system of monitoring.

3.4 Operating a Whistle-blower Hotline and Managing Auditing Costs

Without any additional arrangements by the final producer, the mechanism introduced could easily result in chaos. This is due to the fact that the mechanism is based on a rather high degree of healthy reciprocal suspicion. The whole setting might lead to a situation where all actors start to denounce their direct competitors on the mere suspicion of non-compliance. Evidently, the final producers must implement specific institutions to prevent such adverse effects. Two institutions could do the job here: First, the final producers should launch a joint whistle-blower hotline. This would allow the competitors to report non-compliance directly to a centrally located authority. The hotline must be operated by an independent third party that has a certain capacity of audit teams which are in charge of following up on all allegations. Indeed, the final producers must bite the bullet and invest in such an infrastructure. However, the costs of running a whistle-blower hotline are worlds apart from the immense costs that would result from monitoring every supplier. Such hotlines already exist in practice. Siemens, for example, operates a whistle-blower hotline named “Tell Us” that “gives all employees and external stakeholders a secure mechanism for the reporting of compliance violations” (Siemens.com Global Website © Siemens AG). The Siemens whistle-blower hotline is operated by an independent third-party attorney.

By introducing a second institution, the final producers must find a way to incentivise the suppliers not to use the whistle-blower hotline without good reason. If this can be achieved, the hotline will be highly effective as only those competitors who really do not comply with the sectoral CR contract will be reported. One way to achieve this goal is by implementing the following rule: The final producers should bear the costs of only those investigations that lead to the successful, evidence-based exclusion of a non-complying actor. By contrast, the costs of investigations initiated by false accusations must be paid by the accuser. This system guarantees a high degree of effectiveness in that the mechanism of reciprocal control will not be misused by the actors.

4. Compliance as Individual Rational Choice

4.1 A Strategic Form Model for Reaching Compliance

To deepen the understanding of the above-presented market-based CR mechanism, it is necessary to model it in a more formal way. Although means of non-cooperative game theory will be applied in this paragraph, it is not necessary to have more than very basic knowledge in game theory to understand the following model. The purpose of our reference to game theoretical means in this section is based on one assumption of David M. Kreps, namely that: “[...] [T]he point of game theory is to help economists understand and predict what will happen in economic contexts” (Kreps 1990: 5). So, the appeal of these means should not lie in their formal complexity, but in their explanatory and predictive power.

As assumed before, market competition is present on every single tier of the supply chain. All actors in one market are in the position to choose an action strategy in the competitive situation presented which leads to a defined outcome or payoff. This interpretation of the market situation in the supply chain contains the three components necessary to build a game theoretic strategic form model:

- a list of participants, or players
- for each player, a list of strategies
- for each array of strategies, one for each player, a list of payoffs that the players receive (Kreps 1990: 10)

The strategic form game reflecting the mechanism of self-enforcing CR contracts in the supply chain is defined as following:

- ad (1) The players in this strategic form game are represented by the number of different actors competing in one market of the supply chain, for example, the market of chip suppliers for the cell phone producing companies. If there are i different suppliers, the set of players is: $\mathbb{N}=\{S_1, S_2, \dots, S_i\}$.
- ad (2) The action set for supplier S_i is defined as $A_{S_i}=\{\theta_1, \theta_2, \theta_3, \theta_4\}$ with θ_x ($x \in \{1, 2, 3, 4\}$) representing one of the following strategies in the single games with each competitive supplier:

- θ_1 : S_i announces the strategy to comply with the CR contract, and truly acts on it;
- θ_2 : S_i announces the strategy to comply with the CR contract, but does not act on it;
- θ_3 : S_i announces the strategy not to comply with the CR contract, but acts on it;
- θ_4 : S_i announces the strategy not to comply with the CR contract, and does not act on it
- whereas θ_3 and θ_4 are not rationally feasible under the assumption, that announced (and certainly real) defection with the CR contract will lead to direct market foreclosure if it is reported to the final buyer.⁵
- ad (3) The payoffs are designed as defined numbers mirroring the possible net benefit a supplier can gain by entering into a contract with the buyer. It is important to understand the payoffs as setting an ordinal ranking of the different strategies. This is the case as it is highly complex to cardinally represent the different benefits of the multitude of possible supplier-buyer contracts. In this strategic game, we just refer to one strategy being more worthwhile or less worthwhile for the competing suppliers from a rational point of view.

Considering all the assumptions and prerequisites mentioned above, we take a closer look at the game taking place between two suppliers (S_1 and S_2) who are both interested in entering a contract with the same buyer. To make the contract possible, S_1 and S_2 have to show compliance with the CR contract of the buyers. Meeting the standards required by the contract will raise the cost of providing goods and services for the supplier. Providing the service or good under compliance will lead to a less worthwhile profit (let us assume a profit of 8) than under non-compliance (we assume 10). So, payoffs of four, respectively five benefit units are the expected payoffs for the competing suppliers⁶ if they both play θ_1 , respectively θ_2 . Those are the cases in which two competing suppliers play the same strategy at the same time.

But the crucial cases, giving emphasis to the core part of this paper, are those when the two players meet playing different strategies. Those cases will lead to payoffs as shown and highlighted in Figure 3 and will be clarified in more detail below.

5 θ_3 and θ_4 are listed here just for reasons of completeness.

6 We assume that both actors have an equal chance to enter a contractual relation with the buyer ($p=0.5$). Also, both actors are risk-neutral.

S_1/S_2	θ_1	θ_2
θ_1	4, 4	8, 0
θ_2	0, 8	5, 5

FIGURE 3: STRATEGIC FORM GAME BETWEEN TWO COMPETING SUPPLIERS S_1 AND S_2
(SOURCE: OWN ILLUSTRATION)

From a rational point of view, S_1 and S_2 could benefit the suppliers the most if they mutually agreed on always playing θ_2 , which means both signaling compliance with the required CR standards, but collusively deciding not to meet them to lower costs. Roughly speaking, the collusive behaviour could increase their benefit on the costs of the buyer who enters the contract expecting and monetarily buying CR compliance. Trying to reveal the strategy played by the actors, the final producer faces the problem of immense monitoring costs as seen in section 2. But this Pareto-optimal strategy⁷ combination is not a stable Nash equilibrium. A Nash equilibrium is a state in which no actor has an incentive to change his own strategy regarding the other player's strategy choice: “[...] an array of strategies, one for each player, such that no player has an incentive (in terms of improving his own payoff) to deviate from his part of the strategy array” (Kreps 1990: 26 ff.). It is not, because both S_1 and S_2 have an individual incentive to change their behaviour and defect from the collusive strategy combination $\{\theta_2, \theta_2\}$. This incentive exists as S_1 as well as S_2 can leave actors better off by individually deciding to play θ_1 and to report the competitor's non-compliance with the CR contract in order to profit from his market exclusion. It is not rational in the long term to play θ_2 because every single supplier fears being reported by a competitor for violating the contract. To refer back to Figure 3, both suppliers individually tend to change the initially announced collusive strategy combination $\{\theta_2, \theta_2\}$ to profit from the (expected) higher payoff of (0,8) under $\{\theta_2, \theta_1\}$ and (8,0) under $\{\theta_1, \theta_2\}$. Thereof, we derive that the dominant strategy for the competing actors in the strategic form game between S_1 and S_2 in the long term is always to play θ_1 . In this single game, $\{\theta_1, \theta_1\}$ is the dominant strategy. Taking into account that the above-mentioned rational strategy of the individuals in the game between S_1 and S_2 is representative for every pairing of the

⁷ A strategy is Pareto-optimal if no single player can achieve a better result without another player being placed in a worse position (cf. Holler/Illing 1993: 25).

elements of N , there is a stable Nash equilibrium in the single games between the competing actors. This equilibrium is Pareto-inferior for them but guarantees every supplier's compliance with the sectoral CR contract on the basis of rational strategy choice.

Setting this intermediate result in a bigger framework, the whole market of suppliers reaches a state as described in Figure 4.

S_1/S_2	S_i/S_j	θ_1	θ_2
θ_1		Stable Nash Equilibrium	
θ_2			

FIGURE 4: EXEMPLARY MARKET OF THE SUPPLY CHAIN WITH THE GAME-THEORETIC PAIRINGS S_1/S_2 TILL S_i/S_j (SOURCE: OWN ILLUSTRATION)

This figure visualises which overall strategy combinations lead to a stable Nash equilibrium in the long term for all possible pairings in one market of the supply chain. The S_1/S_2 -game's dominant strategy is the combination $\{\theta_1, \theta_1\}$.⁸ It leads to a stable equilibrium of compliance in this specific game between two competing suppliers. This insight can be transferred as the case for all the pairings from S_1/S_2 till S_i/S_j where $\{\theta_1, \theta_1\}$ is always the stable state in the long term. The dominant strategy leading to the stable equilibrium of compliance is valid for every single pairing in every single market on all tiers of the supply chain. Conclusively, mutual compliance with the sectoral CR contract will be reached just by means of competition between rational suppliers in effective markets.

To mirror a real business situation more appropriately and extend the proof of theoretical applicability of our developed mechanism, we will now take time flow into account and model what we have seen above in an extensive form game (cf. Kreps 1990: 13ff.).

⁸ For further information on dominance arguments as a solution technique in non-cooperative game theory see: (Kreps 1990: 26ff.).

4.2 Taking Time into Account – An Extensive Form Game

The reason to exceed the field of strategic form games is that in "[...] an extensive form game, attention is given to the timing of actions that players may take and the information they will have when they must take those actions" (Kreps 1990: 13). That focus allows us to model a situation of competing suppliers in one market more appropriately as we can start from the point where for example S_1 is already in a contractual relation with a buyer. In this case, S_2 's incentive to detect his competitor's potential defection from the CR contract is increased even more.

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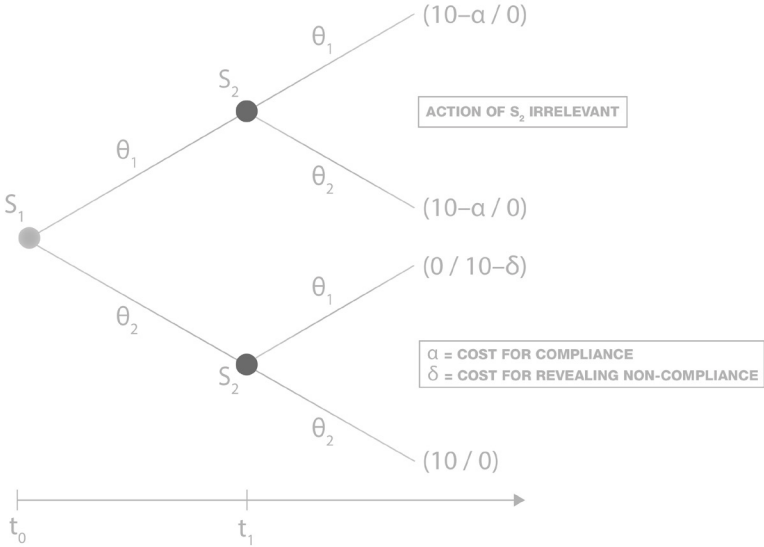


FIGURE 5: EXTENSIVE FORM GAME OF THE TWO COMPETING SUPPLIERS S_1 AND S_2 (SOURCE: OWN ILLUSTRATION)

The situation on hand in t_0 is defined by the fact that S_1 already has a supply contract with the relevant buyer. This contract assigns him fixed revenue; we assume 10 benefit units. At that point of time, S_1 has to choose whether to play strategy θ_1 and to comply with the contract or to play θ_2 and not to meet its requirements. But S_1 has to take into account and anticipate how his competitor S_2 will react to his individual choice of strategy. To figure out the behaviour of the two competitors in an appropriate way, backward induction, a game theoretical refinement for simple equilibrium solutions, will be applied. Backward induction, as applied below, describes the way to figure out the individual actor's optimal sequence of action. The optimal actions can be found by reasoning backwards all possible decisions at every single point of time. This reasoning takes the competitors' possible action into account (Kreps 1990: 110ff.).

Of the four generally feasible payoff combinations, the most attractive outcome for S_1 would be (10/0), because for S_1 's possible payoffs applies $10 > (10 - \alpha) = (10 - \alpha) > 0$.⁹ So initially S_1 would choose θ_2 . But S_1 also anticipates S_2 's strategy: Be it the case that S_1 plays θ_2 , S_2 will individually choose θ_1 to set himself better off with the payoff of (10- δ), as (10- δ) > 0. In other words, by revealing his competitor's non-compliance with the required CR standards, S_2 can take the place of his competitor and generate profit in his stead. With this perspective, it is rational for the competitor to invest the revealing cost δ . The anticipation of S_2 's above-explained rational strategy choice in t_{-1} makes it initially irrational for S_1 to play θ_2 .

Therefore, we can assume that S_1 , having a supply contract, will always play θ_1 and comply with the CR contract, as he fears being excluded by his competitor in case he plays θ_2 . The competitor who is not bound to a supplier contract has the strong incentive to reveal any potential collusive and defective behaviour of his market competitors. This incentive is very strong because it enables the actor to possibly enter business relations with a buyer.

5. Conclusion

As seen in the previous section, all suppliers in the supply chain have individual incentives to comply with the CR contract. Additionally, they, as well as their direct competitors, have an incentive to monitor each other's CR compliance. The identification of this mechanism is what we aimed for

⁹ To be in accord with our assumption that we model a situation in effective markets with real competition, it has to be the case that $\alpha < 10$ and $\delta < 10$. Otherwise, entering the contract in the first place would violate the profit-seeking nature of the actors.

at the beginning of the paper. Although some parts of this modelling need further refinement, we are convinced that the model's strengths lie in its predictive and explanatory power.

We are aware of the fact that criticism can be passed on our model from different sides, as for example the question of why a group of final producers should have an interest in obliging the multitude of suppliers to meet CR standards in their production at all. One could imagine external institutional requirements, such as EU laws or changes in consumer preferences. However, it is not the purpose of this paper to give an ample answer to this question at this point, but to provide a theoretical mechanism to enforce some CR standards in supply chains once the necessity is given.

The above-presented new systematisation of the supply chain and the resulting market mechanism to secure certain CR standards in the production process have, from our perspective, an impact on further research: It is clearly the perspective on how to manage the process of monitoring that is new in this paper, not the elements our approach is composed of. The existing reconstruction of supply chain relations as principal-agent problems, the resulting problem of immense monitoring costs as well as inventing a watchdog institution, here called whistle-blower hotline, link our approach to what could be called prevalent economic thinking. Combining these elements with our new systematisation of the supply chain structure as composed of single markets exceeds the field for which this paper can be seen as relevant. This is even truer as our model can be backed by game theory as a means of clarifying and systemising individual behaviour.

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