**Does blockchain facilitate responsible sourcing?**

What is the impact of blockchain technology on responsible sourcing of perfectly differentiated durable goods? For example, Everledger, company providing blockchain service in a supply chain of diamonds, claims that by tracking the transaction history of diamonds they help to reduce problems of certificates tampering, diamond counterfeiting and mining from conflict zones, where slavery is used. Intuitively, Everledger’s value proposition seems attractive but are there any hidden costs to it and do some parties benefit more than others do from blockchain technology?

We operationalize blockchain as a database, which contains a history of transactions and has no centralized control. It means that there is no principal of the database, who can tamper its records, including certificates of origin of a product. For example, NGO itself or a retailer can’t bribe NGO to change records of origin in blockchain. This is the key difference between blockchain and common databases already used by NGOs. Perfectly differentiated product (such as a diamond) implies that there is one-to-one correspondence between physical asset and records of its parameters and history of its transactions in a database. This uniqueness eliminates an opportunity to counterfeit the physical good. For example, diamonds are unique in its parameters and they don’t change over time. Lab-grown diamonds can’t enter the blockchain as they should first be registered by a supplier. Moreover, one can’t send the same stone for certification twice (as was often the case before blockchain) to obtain several certificates and attach them to different stones because the uniqueness of the physical asset will lead to detection of the double certification attempt. Recorded history of transactions eliminates uncertainty for the customer about the origin of a product. Hence, blockchain brings transparency, which can affect both the retailer and the customer.

Sourcing strategies of a monopolistic retailer who sells to naïve customer have been already studied by (Gou, et. al., 2015). In this paper, we study rational customers who can resell durable good on the secondary market provided he has a certificate of origin of a product. In this context, blockchain brings transparency to the supply chain and the ability of a customer to trade on the secondary market with non-tampered certificates.

Given features of blockchain described above, we ask the following questions. When does retailer want to implement blockchain? How does blockchain affect prices, volumes of trade of responsibly sourced goods, sourcing strategies of retailer and welfare of a customer?
Our model is as follows. Customer market size is normalized to one. Fraction of consumers is socially conscious and ready to pay extra for responsibly sourced products. A posteriori valuation of item bought can be higher or lower than its initial valuation. All these parameters known to a retailer, but customer doesn’t know market parameter of a fraction of socially conscious customers. Customers choose whether to buy a single product from a retailer or on the secondary market. After an item has been bought (no matter at a retailer or on the secondary market), customer has an opportunity to resell it on the secondary market only if it has a certificate of origin. The certificate can be issued only by a retailer. On the secondary market all goods traded with certificates. However, a certificate can be tampered, if it is issued by retailer in a non-transparent supply chain. When blockchain is introduced, it is also accepted by the market and can’t be tampered by a retailer. Customer is willing to resell item back to other customers if she has low a posteriori valuation. Once item is resold or customer decided to hold it, customer exits the market.

Retailer sources the product from two suppliers (responsible (R) and non-responsible (NR)) before the selling season. NR supplier has non-zero exogenous probability of violation of sourcing conditions. Products from both suppliers are the same in quality, but responsible product’s sourcing cost is higher. Retailer can attach a certificate of origin to a product. After retailer selects suppliers and determines quantities of sourcing, suppliers produce needed quantities and accidental violations of sourcing conditions could happen. If retailer sourced something from NR supplier and violation happened, some part of customers quit the market and retailer pays violation penalty. We model interaction of customers and retailers as a Bertrand sequential game with SPNE. Retailer determines prices for goods, and then secondary market price is determined. Finally, customers decide whether to buy from retailer or from the secondary market and then they decide whether to resell it on the secondary market if ex post valuation is low.

We find the following results. In non-transparent supply chain, customers remain to be “naive” and trust claims of the retailer about the origin of a product, but agree on the lower price in exchange. Because the reason is that socially conscious customer benefits from tampered certificates by reselling on the secondary market. Moreover, responsible sourcing strategy is optimal for higher range of parameters than for naïve customer, and for some range of parameter values we observe uniform pricing strategy being dominant.

Blockchain brings the possibility for a retailer to increase price for responsibly sourced good, as due to its transparency, customer has no uncertainty about the product’s origin. Moreover, it also enables
a customer to resell the diamond on the secondary market with blockchain certificate. It implies that instead of price increase, retailer competes with the secondary market and should lower prices to save monopolistic power. Retailer can benefit from killing the secondary market as it will increase his demand. In the end, blockchain becomes optimal only if advantage of increased demand outweighs the loss from decreased prices.

Secondary market influences a retailer in two ways. On the one hand, it helps retailer implement double-branded strategies with rational customer and obtain positive surplus in non-transparent environment. On the other hand, it becomes a competitor in the transparent environment with blockchain. It reduces prices compared with the non-transparent case. Along with price reduction, retailer has no need in secondary market in the transparent case and establishes such prices that volume of trade on the secondary market becomes zero. Hence, it allows retailer to attract new customers from the secondary market.

In addition, blockchain can be a tool for regulation. In the non-transparent supply chain, the only thing regulator can do when violation happens is impose a lump-sum fee on the retailer who sourced from the risky region. The reason is that the only thing which is observable in this case is the fact of violation. However, with blockchain, the regulator can automate the system of punishments without involving a court in the process and impose fees on products that were sourced from the risky supplier. The reason is that blockchain, as a tracking system, can identify which products were sourced from any given supplier.

Finally, retailer can implement blockchain technology to protect its market share, if an incumbent with new production technology enters the market. By introducing the blockchain, retailer offers lower price, but doesn’t let the competitor on the secondary market. This can be the optimal strategy, when the cost of competing with an incumbent is higher than the cost of blockchain implementation.

In sum, blockchain increases competition of the retailer with the secondary market, decreases prices of the retailer, kills secondary market trade, brings new customers from the secondary market to a retailer. Surprisingly, it can reduce OR increase responsible sourcing in supply chains, depending on values of model parameters. It also can serve as a tool for a regulation of responsibility for the government and be a way to protect the market share against an incumbent entering the market with new technology of production.