

# The Value of Relationships: Evidence from a Supply Shock to Kenyan Flower Exports

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## Abstract

Enforcement problems, insurance considerations and uncertainty over trading parties are salient features of real-life relationships between firms. In the context of supply relationships in the Kenya rose export sector we show that 1) the value of the relationship for the seller increases with the age of the relationship; 2) during a negative supply shock sellers prioritize the most valuable relationships; and 3) compliance at the time of the shock positively correlates with future survival, orders, prices and relationship value. The evidence is consistent with sellers valuing a reputation for reliability and rejects models exclusively focussing on enforcement or insurance considerations.

Keywords: Relational Contracts, Repeated Games, Reputation.

JEL Codes: C73, D23, L14, O12.

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# 1 Introduction

In the absence of formal contract enforcement trading parties rely on informal mechanisms to guarantee contractual performance (see, e.g., Johnson, McMillan and Woodruff (2002), Greif (2005), Fafchamps (2006)). Among those mechanisms, long-term relationships based on trust or reputation are perhaps the most widely studied and have received enormous theoretical attention. The theoretical literature has developed a variety of models that capture salient features of real-life relationships, e.g., enforcement problems (see, e.g., MacLeod and Malcolmson (1989), Baker, Gibbons, and Murphy (1994, 2002), Levin (2003)), insurance considerations (see, e.g., Thomas and Worrall (1988)), or uncertainty over parties commitment to the relationship (see, e.g., Gosh and Ray (1996), Watson (1999)).<sup>1</sup> While these different models share the common insight that future rents are necessary to deter short-term opportunism, they also differ in important respects. Empirical evidence on informal relationships between firms, therefore, has the potential to identify which frictions are most salient in a particular context. In turn, such knowledge can be beneficial for policy, particularly in a development context.

Relative to the parallel literature on formal contracts (see, e.g., Chiappori and Salanié (2005)), empirical analysis of informal supply relationships between firms poses additional challenges. First, data on transactions between firms in environments with limited or no formal contract enforcement are hard to come by. Second, the theoretical literature captures trust and reputation through (beliefs about) the future value of rents in the relationship that are hard to observe, or even proxy, by the econometrician.

This paper provides an empirical analysis of supply relationships in the Kenya rose export sector; a context particularly well-suited to study informal relationships between firms.<sup>2</sup> A survey we conducted among exporters in Kenya reveals that relationships with foreign buyers are not governed by written contracts enforceable by courts. The perishable nature of roses makes it unpractical to write and enforce contracts on supplier's reliability. Upon receiving the flowers, the buyer could refuse payment and claim that the flowers sent did not arrive with the appropriate conditions while the seller could always claim otherwise. The resulting contractual imperfections, exacerbated by the international nature of the transaction, imply that firms rely on repeated

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<sup>1</sup>The literature is large and often different authors refer to similar concepts using different terminology. For a comprehensive review, see Mailath and Samuelson (2006). For the purpose of this paper, the discussion in Levin (2003) is extremely useful.

<sup>2</sup>All flowers produced in Kenya are destined to export markets. Kenya is one of the largest exporter of flowers in the world.

transactions to assure contractual performance. Unlike domestic sales, however, export sales are administratively recorded by customs. This paper uses several years of transaction-level data of all exports of roses from Kenya, including the names of the domestic sellers and foreign buyers, as well as information on units traded, prices and date. An important advantage of looking at the flower industry is that supply relationships coexist alongside a well-functioning spot market, the Dutch Auctions.<sup>3</sup> The spot-market provides a reference price that can be used, through a revealed preference argument, to compute a lower bound to the future rents exporters derive from a particular relationship. Finally, the reaction of the relationships to a negative supply shock induced by the post-election ethnic violence in January 2008 provides a unique opportunity to distinguish among competing models.<sup>4</sup>

The paper documents three facts. First, we compute a direct measure of (a lower bound to) the net present value of the future rents associated with each relationship for the sellers. The key idea is that the future rents associated with a relationship must be large enough to compensate the exporters for not side-selling to the spot market at higher prices. The procedure exclusively relies on information on quantities transacted, prices in the relationships and auction prices; which are all observable in the data. The estimated relationship values positively correlate with the age and past amount of trade in the relationship. These results hold controlling for both relationships (which include firm and cohort), time and selection effects.

Second, at the time of the violence, exporters located in the region directly affected by the violence could not satisfy commitments with all their buyers. The violence was a large shock and exporters had to choose which buyers to prioritize. We find that exporters prioritized the most valuable relationships.

Third, we show that the demonstrated reliability at the time of the violence correlates with future outcomes in the relationships: controlling for both buyer and seller effects, reliability at the time of the violence positively correlates with the likelihood of relationship survival, with higher increases in trade volumes, prices and future values of the relationship one year after the violence.

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<sup>3</sup>The “Dutch”, or “clock”, auction is named after the flower auctions in the Netherlands. In a Dutch auction the auctioneer begins with a high asking price which is lowered until some participant is willing to accept, and pay, the auctioneer’s price. This type of auction is convenient when it is important to auction goods quickly, since a sale never requires more than one bid.

<sup>4</sup>Following heavily contested presidential elections in Kenya at the end of December 2007, several, but not all, regions of the country plunged into intense episodes of ethnic violence. Flower exporters located in regions where conflict occurred suddenly found themselves lacking significant proportions of their labor force and suffered dramatic drop in exports. In Ksoll et al. (2010) we document that at the average firm in the conflict region 50% of the labor force was missing and exports volumes dropped by 38% at the pick of the violence.

We interpret these facts under the light of existing theoretical models of informal relationships. We argue that the evidence is best accounted by models in which sellers value acquiring and maintaining a reputation for reliability and reject models that exclusively focus on enforcement or insurance considerations.<sup>5</sup>

The findings and methodology of the paper contribute to the empirical literature on relationships between firms.<sup>6</sup> McMillan and Woodruff (1999) and Banerjee and Duflo (2000) are closely related contributions that share with the current paper a developing country setting. In an environment characterized by the absence of formal contract enforcement, McMillan and Woodruff (1999) find evidence consistent with long term informal relationships facilitating trade credit. Banerjee and Duflo (2000) infer the importance of reputation by showing that a firm's age strongly correlates with contractual forms in the Indian Software industry. Both McMillan and Woodruff (1999) and Banerjee and Duflo (2000) rely on cross-sectional survey evidence and cannot control for unobserved firm, or client, heterogeneity. In contrast, we exploit an exogenous supply shock and rely on within relationship evidence to prove the existence, study the source, and quantify the importance of the future rents necessary to enforce the implicit contract. In the context of domestic markets, particularly for credit and agricultural products, Fafchamps (2000, 2004, 2006) has documented the importance of informal relationships between firms in Africa and elsewhere.<sup>7</sup> In the context of exports, Macchiavello (2010) and Antras and Foley (2011) provide two closely related studies. Macchiavello (2010) focuses on the implications of learning about new suppliers in the context of Chilean wine exports. Antras and Foley (2011), instead, focus on the use of prepayment to attenuate the risk of default by the importer. Using data from a U.S. based exporter of frozen and refrigerated food products they find that prepayment is more common at the beginning of a relationship and with importers located in countries with weaker institutional environment.<sup>8</sup>

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<sup>5</sup>We discuss the policy implications of these findings, particularly from the point of view of export development in developing countries, in the concluding Section.

<sup>6</sup>A discussion of the much larger theoretical literature is postponed until Section 2.

<sup>7</sup>Banerjee and Munshi (2004), Andrabi et al. (2006), Munshi (2010) provide interesting studies of contractual relationships in a development context, but with rather different focus. For example, Munshi (2010) and Banerjee and Munshi (2004) provide evidence on the trade enhancing role of long term relationships based on community ties. Andrabi et al. (2006) provide evidence of how flexible specialization attenuates hold-up problems.

<sup>8</sup>Alongside a larger literature that studies formal contracts between firms (see Lafontaine and Slade (2009) for a survey), some studies have focused on the relationship between informal enforcement mechanisms and formal contract choice (see, e.g., Corts and Singh (2004), Kalnins and Mayer (2004), and Lyons (2002)). These papers, however, also rely on cross-sectional data and proxy the rents available in the relationship with product, firm, or market characteristics that might affect contractual outcomes in other ways. Gil and Marion (2010), however, separate the effects of past and future anticipated interactions. In the context of public procurement, they show that a larger stock of prior

The rest of the paper is organized as follows. Section 2 reviews the relevant theoretical literature. Section 3 describes the industry, its contractual practices, and the ethnic violence. Section 4 presents the empirical results. Section 5 offers some concluding remarks. An Appendix presents a stylized theoretical framework to guide the empirical exercise and provides further information on the data.

## 2 Theoretical Literature and Testable Implications

Empirical work on formal contracts starts with a principal-agent model that maps characteristics of the players and the environment into observable contractual forms (see, e.g., Chiappori and Salanié (2005)). For example, in moral hazard models, a higher degree of agent's risk aversion leads to low power incentives; in transaction costs models higher assets specificity leads to long-term contracts.

Obtaining testable predictions on informal long-term relationships is, however, more complicated. Long-term relationships are modelled using the tools developed by the repeated games literature. As is well known, the set of equilibria in repeated games can be very large. Many realistic features of real-life relationships, moreover, are captured in games with incomplete information. In these games limiting attention to equilibria that are subgame perfect and (constrained) Pareto optimal is often not sufficient to obtain precise predictions. In other games, e.g., those with private monitoring, it is often a great challenge to characterize even *a* particular equilibrium.

In reviewing the theoretical literature, therefore, we focus on a selected number of applied contributions that characterize equilibrium behavior and deliver predictions we can test in our setting. We build upon the discussion in Levin (2003) and present the different models according to the assumptions that drive the testable implications of interest.<sup>9</sup> The contributions we review focus on different types of relationships, including buyer-seller, employee-employer and general partnership relationships. Given our empirical application, however, we maintain the buyer-seller framework throughout.

To facilitate the discussion let us recall the structure of the seller's incentive constraint. For concreteness, we consider a highly stylized moral hazard problem, although

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interactions between contractors and subcontractors leads to lower prices and higher likelihood of participation in the auctions except in periods and areas with little future contract volume, suggesting the importance of the self-enforcing mechanism. Finally, Brown et al. (2004, 2009) study the role of self-enforcing agreements and reputation in facilitating trade in the context of controlled laboratory experiments.

<sup>9</sup>The reader interested in an exhaustive review of the theoretical literature organized around the technical aspects of the different models is referred to Mailath and Samuelson (2006).

the basic point applies to other scenarios as well. The seller can exert two levels of effort,  $e \in \{\underline{e}, \bar{e}\}$ , at cost  $c(e)$ , with  $c(\bar{e}) > c(\underline{e})$ . Given effort  $e$ , output  $y$  is realized from the distribution  $f(y|e)$ . Time is discrete, the horizon is infinite and the buyer and the seller have a common discount factor  $\delta < 1$ . The seller exerts high effort if the following incentive constraint is satisfied:

$$\mathbf{E}_{y|\bar{e}}P(y) - c(\bar{e}) + \delta\mathbf{E}_{y|\bar{e}}U(y) \geq \mathbf{E}_{y|\underline{e}}P(y) - c(\underline{e}) + \delta\mathbf{E}_{y|\underline{e}}U(y), \quad (1)$$

where  $\mathbf{E}_{y|e}P(y)$  is expected current monetary transfers and  $\mathbf{E}_{y|e}U(y; \theta)$  expected future continuation value; with expectations taken conditional on effort  $e$ . The constraint can be rewritten as

$$\underbrace{\mathbf{E}_{y|\bar{e}}P(y) - \mathbf{E}_{y|\underline{e}}P(y)}_{\text{Current Monetary Transfers}} + \delta \underbrace{(\mathbf{E}_{y|\bar{e}}U(y) - \mathbf{E}_{y|\underline{e}}U(y))}_{\text{Future Continuation Values}} \geq \underbrace{c(\bar{e}) - c(\underline{e})}_{\text{Temptation to Deviate}}. \quad (2)$$

The expression clarifies that there are essentially two instruments to provide incentives in the relationships: current monetary transfers and future continuation values. The models discussed below deliver different testable implications by making different assumptions regarding parties ability and desire to use various combinations of those two instruments to manage incentives in the relationship.

#### *Models with Monetary Transfers and Risk Neutral Parties*

In an important paper, Levin (2003) extends the previous relational contracts literature (see, e.g., MacLeod and Malcolmson (1989), Baker et al. (1994, 2002)) to consider both adverse selection and moral hazard. Levin (2003) shows that *i*) if parties are risk-neutral and have access to monetary transfers, and *ii*) the buyer's actions are perfectly observable, then the (constrained) optimal relational contract is stationary. A contract is stationary if, on the equilibrium path, effort and compensation are stationary functions of the performance outcome realized in that date. Because of risk neutrality, current monetary transfers and future continuation values are perfect substitutes from the point of view of the trading parties. Since the buyer's behavior is perfectly observable, a (constrained) optimal relational contract never destroys surplus along the equilibrium path. Good performance is rewarded using only current monetary transfers without distorting future continuation payoff and lack of enforcement simply places limits on the amount of incentives that can be provided. The stationarity of the equilibrium implies that the relationship's history, including temporary shocks, does not affect future continuation values.

Levin (2003) and Fuchs (2007) extend the analysis to the case in which the buyer privately observes outcomes.<sup>10</sup> This extension transforms the setting into a repeated game with private monitoring. Stationary contracts, then, are no longer effective: while the payoff of the seller must depend on the realized output to motivate effort, the buyer's payoff cannot since she privately observes output. Surplus must then be destroyed along the equilibrium path with positive probability, e.g., by inefficiently terminating the relationship. Levin (2003) and Fuchs (2007) shows that the optimal contract, however, is a simple termination contract in which trade between parties continues in a stationary fashion provided that performance is above a certain threshold during a certain period of time. If performance falls below the threshold, the relationship ends.

We summarize the testable implications of these models as follows: if *i*) parties are risk-neutral and *ii*) have access to monetary transfers, then the contract is stationary, i.e.,:

1. *controlling for relationship, time and selection effects, the length and amount of past trade in the relationship are uncorrelated with future continuation values for the seller, and*
2. *controlling for changes in the environment, short-run shocks do not correlate with long-run outcomes in the relationship.*

#### *Models with Monetary Transfers and Risk Averse Parties*

When parties are risk-averse it is not optimal to provide incentives purely relying on current monetary transfers. Parties, instead, rely on combinations of future continuation values and current monetary transfers to provide incentives (see, e.g., Thomas and Worrall (1988)). The equilibrium outcome is then non-stationary, in the sense that past realizations of the shock influence future continuation values.

While the non-stationarity of the equilibrium in principle distinguishes these models from those discussed above, the trajectory of future continuation values depends on features that are hard to control for empirically, such as past realizations of shocks. To empirically test whether insurance considerations are important, therefore, we focus on the reaction of the relationship to an observable shock. In particular, if insurance considerations are an important source of value in the relationship, at the time of a large negative shock to the seller, insurance models predict that:

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<sup>10</sup>This feature is likely to be relevant in export contexts in general and, given perishability, in flower exports in particular. Fuchs (2007) considers an export transaction as a motivating example.

1. *the amount of produce sold to the buyer at the time of the shock, (an inverse proxy for the insurance given to the seller) negatively correlates with the future continuation value for the seller,*
2. *both current monetary transfers, i.e., prices, and future continuation values are changed to provide insurance to the seller.*

#### *Models without Transfers*

When parties cannot use monetary transfers, future continuation values are the only instrument available to provide incentives. In repeated games with perfect information optimal equilibria can always be stationary (see, e.g., Abreu (1988)): parties play the best possible equilibrium forever under the threat that a deviation triggers the worst possible punishment. In models with imperfect information, instead, low performance might arise because of unobservable shocks rather than opportunism. Punishments, i.e., switching to lower future continuation values, occur in equilibrium with positive probability and optimal equilibria, i.e., those that minimize the punishment that deter deviations, are non-stationary (see, e.g., Green and Porter (1984), Abreu et al. (1990)).

The set of optimal equilibria in repeated games with imperfect information is large and, consequently, it is hard to derive testable predictions that allow to reject these models. We focus, therefore, on two intuitive comparative statics. First, the length and amount of past trade are proxies for past realizations of good outcomes and, therefore, positively correlate with future continuation values for the seller. Second, in an optimal equilibrium, the length of the punishment period that follows a bad outcome realization reflects how informative about deviations the observed outcome is. If failure to delivery most likely stems from adverse observable circumstances, rather than opportunism, the length of the punishment period will be short.

We summarize the testable implications of repeated games with no transfers and imperfect monitoring as follows:

1. *controlling for relationship, time and selection effects, the length and amount of past trade in the relationship positively correlate with future continuation values for the seller, and*
2. *controlling for changes in the environment, responses to short-run shocks do not correlate with long-run outcomes in the relationship.*

#### *Models with Uncertainty over Types: Reputation*



The notion of reputation is captured in models that introduce uncertainty over a player’s type (see, e.g., Gosh and Ray (1996), Watson (1999), Mailath and Samuelson (2006)). Uncertainty is introduced by the possibility that one or more players are commitment types, i.e., players that always play the same action regardless of circumstances. For example, by frequently being reliable, a seller develops a reputation which induces expectations that she will be reliable in the future too. This makes buyers more willing to trade with her. Short-term opportunism is deterred by fear of depleting the reputation. Reputation models have a non-stationary structure. Beliefs about a player’s type evolve over time and, therefore, the history of the relationship determines future relationship’s outcomes for potentially long periods of time. A common prediction of reputation models is that the relationship starts small, i.e., the game is played in a way that limits scope for opportunism in the initial phases of the relationship.<sup>11,12</sup>

During the reputation building phase, reputation models imply that:

1. *controlling for relationship, time and selection effects, the length and amount of past trade in the relationship is positively correlated with future continuation values for the seller, and*
2. *controlling for changes in the environment, responses to short-run shocks that reveal positive news about seller types positively correlate with long-run outcomes in the relationship.*

#### *Testing the Predictions in the Data*

The discussion above suggests the three empirical tests we conduct in Section 4. The three tests rely on the unique features of our dataset: a long panel of transactions in buyer-seller relationships; a lower bound to the future continuation value for the seller in each relationship; a negative supply shock. The three tests are:

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<sup>11</sup>Since reputational stakes originate from uncertainty over types, the incentives to maintain a good reputation eventually die out as the uncertainty is resolved. If the seller tries to separate herself from a bad commitment type parties converge to the equilibrium of a repeated game. If the seller mimics a good commitment type, instead, the temptation to cheat increases over time and eventually the seller’s type is revealed (see, e.g., Mailath and Samuelson (2006) for a discussion).

<sup>12</sup>Halac (2011) introduces reputational considerations in an otherwise standard relational contract model by assuming that the outside option of the principal is unknown to the agent. By introducing monetary transfers and incentives considerations, all types of principal in the model have incentive to cooperate or cheat, depending on circumstances. Beyond presenting a more realistic description of real life relationships than one based on commitment types, the model delivers a rich characterization of relationship dynamics.

**Test 1:** *controlling for relationship, time and selection effects, are the length and amount of past trade in the relationship positively correlated with future continuation values for the seller?*

**Test 2:** *at the time of a negative supply shock, does the amount of produce transacted in the relationship positively or negatively correlate with the future continuation value for the seller?*

**Test 3:** *controlling for changes in the environment, does the response to short-run shocks correlate with long-run outcomes in the relationship?*

### **3 Background: Contractual Practices in the Flower Industry and the Ethnic Violence in Kenya**

This section provides background information on the industry, its contractual practices and the ethnic violence. The Section relies on information collected through a representative survey of the Kenya flower industry conducted by the authors through face-to-face interviews in the summer of 2008.<sup>13</sup>

#### *The Flower Industry in Kenya*

Over the last decade, Kenya has become one of the largest exporters of flowers in the world. The flower industry, one of the largest foreign-currency earner for the Kenyan economy, counts around one hundred and a handful of established exporters located at various clusters in the country.

Flowers are a fragile and perishable commodity. To ensure the supply of high-quality flowers to distant markets, coordination along the supply chain is crucial. Flowers are hand-picked in the field, kept in cool storage rooms at constant temperature for grading, then packed, transported to Nairobi's international airport in refrigerated trucks owned by firms, inspected and sent to overseas markets. The industry is labor intensive and employs mostly low educated women in rural areas. Workers receive training in harvesting, handling, grading, packing, and acquire skills which are difficult to replace in the short-run. Because of both demand (e.g. particular dates such as Valentines day and Mothers day) and supply factors (it is costly to produce flowers in

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<sup>13</sup>Note that the empirical analysis only relies on transaction-level data on exports of flowers which are administratively collected by the customs authority. Further information about data sources is provided in Appendix.

Europe during winter), floriculture is a seasonal business. The business season begins in mid-august.

### *Contractual Practices*

Flowers are exported in two ways: flowers can be sold in the Netherlands at the Dutch auctions or can be sold to direct buyers located in the Netherlands and elsewhere. The two marketing channels share the same logistic operations associated with exports, but differ with respect to their contractual structure. The Dutch auctions are close to the idealized Walrasian market described in textbooks. There are no contractual obligations to deliver particular volumes or qualities of flowers at any particular date. Upon arrival in the Netherlands, a clearing agent transports the flowers to the auctions where they are inspected, graded and finally put on the auction clock. Buyers bid for the flowers accordingly to the protocol of a standard descending price Dutch auction. The corresponding payment is immediately transferred from the buyer account to the auction houses and then to the exporter, after deduction of a commission for the auctions and the clearing agent. A part from consolidating demand and supply of flowers in the market, the Dutch Auctions act as a platform that provides contract enforcement between buyers and sellers located in different countries: they certify the quality of the flowers sold and enforce payments from buyers to sellers.<sup>14</sup>

Formal contract enforcement, in contrast, is missing in the direct relationships between the flower exporter and the foreign buyer, typically a wholesaler. The export nature of the transaction and the high perishability of flowers makes it impossible to write and enforce contracts on supplier's reliability. Upon receiving the flowers, the buyer could refuse payment and claim that the flowers sent were not of the appropriate variety and/or did not arrive in good conditions while the seller could always claim otherwise. Accordingly, exporters do not write complete contracts with foreign buyers.<sup>15</sup>

Exporters and foreign buyers negotiate a marketing plan at the beginning of the season. With respect to volumes, the parties typically agree on some minimum volume of orders year around to guarantee the seller a certain level of sales. Parties might, however, agree to allow for a relatively large percentage (e.g., 20%) of orders to be

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<sup>14</sup>It is common practice in the industry to keep open accounts at the auctions houses even for those firms that sell their production almost exclusively through direct relationships. The costs of maintaining an account are small, while the option value can be substantial.

<sup>15</sup>Among the surveyed 74 producers, only 32 had a written contract with their main buyer. When a contract is written, it is highly incomplete. Among the 32 firms with a written contract, less than a third had any written provision on the volumes, quality, and schedule at which flowers have to be delivered. Written contracts often include clauses for automatic renewal. Some firms report to have had a written contract only in the first year of their relationship with a particular buyer.

managed “ad hoc”. With respect to prices, most firms negotiate constant prices with their main buyer throughout the year but some have prices changing two times a year, possibly through a catalogue or price list.<sup>16</sup>

Contracts do not specify exclusivity clauses. In particular, contracts do not require firms to sell all, or even a particular share, of their production to a buyer or to not sell on the spot market. In principle, it would seem possible to write enforceable contracts that prevent firms from side-selling flowers at the auctions. The ability to sell on the spot market, however, gives producers flexibility to sell excess production as well as some protection against buyers defaults and/or opportunism. It is, therefore, not obvious whether these contractual provisions would be desirable.<sup>17</sup>

This paper takes the existence of direct relationships as given and does not explain why relationships coexist along-side a spot-market.<sup>18</sup> Beside lower freight and time costs, a well-functioning relationship provide buyers and sellers with stability. Buyers commitment to purchase pre-specified quantities of flowers throughout the season allows sellers to better plan production. Buyers also value reliability in supply of flowers sourced from different regions and combined into bouquets. Parties trade-off these benefits with the costs of managing and nurturing direct relationships in an environment lacking contract enforcement.

#### *Ethnic Violence as Short-Run Supply Shock*

An intense episode of ethnic violence affected several parts of Kenya following contested presidential elections at the end of December 2007. The ethnic violence had two major spikes lasting for a few days at the beginning and at the end of January 2008. The regions in which flowers producers are clustered were not all equally affected. Only firms located in the Rift Valley and in the Western Provinces were directly affected by the violence (see Figure 1).<sup>19</sup> The main consequence of the violence was that firms located in the regions affected by the violence found themselves lacking significant numbers of their workers. Among the 74 firms surveyed, 42 were located

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<sup>16</sup>Prices are not indexed on quality nor on prices prevailing at the Dutch auctions. This is probably best explained by the contractual incompleteness described above rather than insurance considerations. As documented in Figure 4 seasonal price fluctuations on the spot market are highly predictable.

<sup>17</sup>Furthermore, such provisions, could be circumvented by selling on the spot markets through other exporters. The interviews we conducted with exporters however reveal that sales to, and purchases from, other exporters are a very insignificant fraction of total sales.

<sup>18</sup>Similar two-tier market structures have been documented in several markets in developing countries (see Fafchamps (2006) for a review). The coexistence of direct relationships alongside spot markets is also observed in several other contexts, such as perishable agricultural commodities, advertising and diamonds. We are grateful to Jon Levin for pointing this to us.

<sup>19</sup>The classification of affected and unaffected regions is strongly supported by the survey conducted in the summer following the crisis and is not controversial. See Appendix for details.

in regions that were directly affected by the violence. Table A1 shows that while firms located in regions not affected by the violence did not report any significant absence among workers (1%, on average), firms located in regions affected by the violence reported an average of 50% of their labor force missing during the period of the violence. Furthermore, firms were unable to replace workers. On average, firms in areas affected by the violence replaced around 5% of their missing workers with more than half of the firm replacing none. Many firms paid extra-hours to the remaining workers in order to minimize disruption in production.

With so many workers missing, firms suffered large reduction in total output. Figure 2 plots deseasonalized export volumes around the period of the violence for the two separate groups of firms relative to the previous season. The Figure clearly illustrates that the outbreak of the violence was a large and negative shock to the quantity of flowers exported by the firms in the conflict locations.

In the survey, we asked several questions about whether the violence had been anticipated or not. Not a single respondent among the 74 producers interviewed reported to have anticipated the shock (and to have adjusted production or sales plans accordingly): the violence has been a large, unanticipated and short-run negative shock to the production function of firms.

## 4 Empirical Results

### 4.1 Relationships Characteristics

Using the customs data, we build a dataset of relationships. Overall, we focus on the period August 2004 to August 2009, i.e., five entire seasons. The violence happened in January 2008, i.e., in the middle of the fourth season in the data, which runs from August 2007 to August 2008.

We define the baseline sample of relationships as those links between an exporter and a foreign buyer that were active in the period immediately before the violence. A relationship is active if the two parties transacted at least twenty times in the twenty weeks before the eruption of the violence, i.e., at least once a week on average. The data show clear spikes in the distribution of shipments across relationships at one, two, three, four and six shipments per week in the reference period. The cutoff is chosen to distinguish between relationships versus sporadic orders. Results are not sensitive to the choice of cutoff, however.

In total, this leaves us with 189 relationships in the baseline sample. Panel A in Table 1 reports summary statistics for the relationships in the baseline sample. The average relationship had 60 shipments in the period from the beginning of the season until the week preceding the violence, i.e., three shipments per week on average. The average age of the relationship in the sample, measured as the number of days from the first shipment observed in the data, is 860 days, i.e., two years and a half. Immediately before the violence, contracting parties in the average relationship had transacted with each other 298 times. Note, however, that these figures are left-censored, since they are computed from the customs data from August 2004 onward. Since our records begin in April 2004, we are able to distinguish relationships that were new in August 2004 from relationships that were active before. Among the 189 relationships in the baseline sample, 44% are classified as censored, i.e., were already active before August 2004.<sup>20</sup>

Exporters specialize in one marketing channel alone. The majority of exporters either exports more than 90% of their produce through direct relationships, or through the auctions. As a result, among the one hundred established exporters, only fifty six have at least a direct relationship with a foreign buyer in our baseline sample. On average, therefore, exporters in the sample have three direct relationships (see Panel B in Table 1). Similarly, there are seventy one buyers with at least a relationship in our baseline. The average buyer, therefore, has about two and a half Kenyan suppliers.

## 4.2 Future Rents for the Seller in the Relationship

### *The Incentive Constraint*

This Section uses the model described in Appendix A to estimate a lower bound on the value of a direct relationship for the seller. The basic set up of the model is as follows. Time is discrete, the buyer and the seller have an infinite horizon and discount the future at a common and constant rate. In each period, the cost of producing  $q$  units of flowers is given by  $c(q)$ , with  $c'(\cdot) > 0$  and  $c''(\cdot) > 0$ , and the buyer always needs  $q^*$  units of flowers. A source of relationship surplus is needed for any relational contract to be sustainable. For simplicity, we assume that, relative to the spot market, where price  $p_s$  oscillate between a high and a low season with  $p_s \in \{\underline{p}, \bar{p}\}$ , a relationship saves transportation and intermediation costs. Denoting with  $t_s$  the FOB price in the relationship during season  $s$ , a necessary, but not sufficient, condition for the

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<sup>20</sup>This confirms the findings of the survey, in which several respondents reported to have had relationships longer than a decade.

relationship to be self-enforcing is

$$\delta (U_{s+1} - U_{s+1}^o) \geq q^*(p_s - t_s) \quad (3)$$

where  $U_{s+1}$  is the future continuation values for the seller following delivery of  $q^*$  and  $U_{s+1}^o$  is the future continuation values for the seller associated with side-selling on the spot market. The incentive constraint in (3) is the analogue of the expression in (2) and provides the foundation for the empirical exercise. Specifically, the constraint says that the net present value of the future rents in the relationship is at least as large as the additional revenues the seller could get by selling on the auctions at higher prices. In general, the condition in (3) is not sufficient to guarantee that the relationship is self-sustaining because side selling  $q^*$  on the market might not be the best deviation available to the seller. The right hand side of the constraint in (3), therefore, only provides a *lower bound* to the value of the relationship for the seller. The model in the Appendix formally shows that if the incentive compatibility constraint in the high season, i.e., when  $p_s = \bar{p}$ , is satisfied, then the corresponding constraint in the low season cannot be binding. In other words, only the maximum temptation to deviate has to be considered to obtain an estimate of a lower bound to the value of the relationship.

#### *Empirical Implementation of the Incentive Constraint*

From an empirical point of view, the appeal of the incentive constraint in (3) is that  $q^*$ ,  $p_s$  and  $t_s$  are directly observable in the data and, therefore, the lower bound to the value of the relationship can be easily computed in each season. In particular, the computation does not rely on information on the cost structure of the firm, nor on expectations of future trade between the parties, which are typically unobservable and/or difficult to estimate.

In bringing the constraint to the data we need to choose a deviation window, i.e., the length of the period of time during which the deviation is computed. For each relationship  $i$ , therefore, we compute the lower bound to the value of the relationship during season  $\mathcal{S}$ , as

$$\mathbf{V}_{i\mathcal{S}} = \max_{t \in \mathcal{S}} \{(p_{i,t} - t_{i,t}) q_{i,t}\}, \quad (4)$$

where  $p_{i,t}$  is the price at the auctions in week  $t$  during season  $\mathcal{S}$ ,  $t_{i,t}$  is the unit price in relationship  $i$  in week  $t$ .<sup>21</sup> Following the model, the operator  $\max_{t \in \mathcal{S}}$  selects the highest

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<sup>21</sup>Information on auction prices for large and small roses allows to index  $p_{i,t}$  by relationship  $i$ . We chose a conservative deviation window of one week. Different choices lead to larger bounds that are

temptation to renege during the season. In other words,  $\mathbf{V}_{i\mathcal{S}}$  is the maximum amount of revenue foregone in any given week of the season by the firm by selling to the buyer rather than selling on the spot market at higher prices. Denote with  $\tau$  the particular week of the season selected by the operator  $\max_{t \in \mathcal{S}}$ .

In the empirical specifications below, we normalize the value of the rents by either the yearly revenue generated by the relationship in season  $\mathcal{S}$ , i.e.,  $\mathbf{R}_{i\mathcal{S}} = \sum_{t \in \mathcal{S}} t_{it} q_{it}$ , or by the average weekly revenues generated by the relationship during the season,  $\mathbf{R}_{iS_i} = \frac{1}{|S_i|} \sum_{t \in \mathcal{S}} t_{it} q_{it}$ , where  $S_i$  is the number of weeks the relationship was active during the particular season. Denote by  $\mathbf{V}_{i\mathcal{S}}^N$  the normalized measure.

The variation in the estimated values across relationships, therefore, comes from two sources. First, there is the variation in the differences between relationship and spot market prices,  $(p_{i,\tau} - t_{i,\tau})$ . Figure 3 shows that prices in direct relationships are more stable than prices at the auctions. The second source of variation, is the quantity of flowers transacted within the relationship at the time in which the temptation to renege on the relational contract is highest,  $q_{i,\tau}$ . Since prices in direct relationships are stable during the season, variation in the normalized estimates  $\mathbf{V}_{i\mathcal{S}}^N$  is largely driven by variation in  $q_{i,\tau}$  relative to the average quantity transacted,  $\bar{q}_i = \frac{1}{|S_i|} \sum_{t \in \mathcal{S}} q_{it}$ .

For most relationships, the maximum temptation to deviate arises during the Valentine Day pick. Figure 4 shows that prices at the auctions are highly predictable. A regression of the weekly price at the auction on week and season dummies explains 76% of the variation in prices in the three seasons preceding the violence period. This implies that the estimated value is not driven by surprises, i.e., by unexpectedly high prices. This is confirmed by Figure 5. The Figure shows that the number of relationships ending in a given week does not correlate with the price at the Auctions in that week during the two seasons preceding the violence period. This is consistent with the fact that prices at the auctions are highly predictable. Regardless of whether week dummies are controlled for or not, the level of prices at the auctions does not predict the number of relationships ending. A regression of the number of relationships dying in a given week on week and season dummies explain 57% of the variation in relationship deaths. These two facts suggest that parties design their relationship to navigate through the season, i.e., they agree on relatively stable prices and orders that provide enough rents to offset the short-run gains of side-selling on the spot market at higher prices.

#### *The Estimated Values*

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very strongly correlated with the measure used in the text and do not affect the results.



For the 189 relationships in the baseline sample, Panel C in Table 1 shows that the estimated values in the season that preceded the violence was 10% (respectively, 331%) of the seasonal (respectively, average weekly) revenues in the average relationship. From a theoretical point of view, under free-entry, initial sunk investments dissipate the ex-post rents generated by the relationship (see, e.g., Klein and Leffler (1981), Shapiro (1983)). Under free-entry, therefore, our estimate yield a lower bound to the fixed costs of starting a relationship and can be compared to structural estimates of fixed costs of exporting.<sup>22</sup>

### 4.3 Test 1: Future Continuation Values and History of the Relationship

The estimated  $V_{iS}$  provide a proxy for the future continuation value for the seller and can, therefore, be used to test the predictions of the models discussed in Section 2. Figure 6 plots the distribution of the estimated  $V_{iS}$  (in logs) for three different samples of relationships in the season before the violence: relationships in the baseline sample that were active at the Valentine peak of the season prior to the violence; relationships in the baseline sample that were not active during the Valentine peak of the season prior to the violence; and relationships that were active during the Valentine peak of the season prior to the violence but that are not in the baseline sample since they did not survive until the violence period. The Figure shows two patterns. First, the relationships that have survived have higher values than the relationships that did not. Second, young relationships had lower values than established relationships.

The latter observation, however, cannot be interpreted as evidence that the value of a relationship increases with age since, mechanically, the estimated value of a relationship that is too young to have gone through a seasonal pick is low. Table 2, therefore, presents regression results between the value of a relationship and various measures of a relationship history under alternative specifications.

Column 1 and 2 report results using the age of the relationship, measured in days since the first shipment observed in the data. Column 1 reports results from the

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<sup>22</sup>Das et al. (2007) report that in the Colombian chemicals industry, fixed costs of exports in each year represent 1% of the export revenues of the firm. The corresponding figure for the initial sunk costs is between 18 to 42%. Our estimates are a very conservative lower bound. Figures 4 and 5 suggest that the optimal time for the seller to deviate is at the beginning of the period in which prices at the auctions start being above prices in the relationship. The value of the rent should then be given by the (discounted) integral of the temptations to deviate over the corresponding weeks. For reasonable discount factors, this number is significantly larger than, but highly correlated with, the estimates reported above.

cross-sectional specification

$$V_{fb} = \mu_f + \eta_b + \beta Age_{fb} + \mathbf{C}_{fb} + \varepsilon_{fb}, \quad (5)$$

where  $V_{fb}$  is the value of the relationship between exporter  $f$  and buyer  $b$  in the season before the violence,  $\mu_f$  and  $\eta_b$  are exporter and buyer fixed effects respectively,  $\mathbf{C}_{fb}$  is a dummy that takes value equal to one if the relationship is left censored in the data and  $\varepsilon_{fb}$  is an error term. The regression is estimated in the sample of relationships that were active in the season before the violence. Column 1 shows that the age of the relationship positively correlates with the estimated value of the relationship for the seller.

From a cross-section it is not possible to disentangle age and cohort effects. The inclusion of buyer and seller fixed effects controls for cohort effects at the contractual-party level, but does not control for relationships cohort effects, i.e., the fact that more valuable relationships might have started earlier. Column 2, therefore, presents results from an alternative specification that exploits the time variation across seasons. This allow to include relationships fixed effects that control for cohort effects. The specification is given by

$$V_{fbs} = \mu_{fb} + \beta Age_{fbs} + \varepsilon_{fbs}, \quad (6)$$

where notation has been modified to consider variation across seasons  $s$ . The specification is estimated on a balanced sample of relationships to control for the positive selection effects documented in Figure 6. The results confirm a positive correlation between the relationship's age and the continuation value for the seller.

Even with panel data, it is not possible to separately identify age, cohort and time effects since, given a cohort, age and time are collinear. The specification in Column 2, therefore, cannot control for season fixed effects. In order to control for both relationship and season fixed effects, Columns 3 to 6 consider alternative measures for the past interactions in the relationship,  $H_{fbs} \in \{PF_{fbs}, PT_{fbs}\}$ . Columns 3 and 4 proxy for the past amount of trade in the relationship with the number of previous transactions between the parties, denoted  $PF_{fbs}$ ; while Columns 5 and 6 use the cumulative value of past temptations,  $PT_{fbs}$ . These two variables capture information that has been revealed during the course of the relationship and are not collinear with time and cohort. For the sake of comparison, Columns 3 and 5 replicate the cross-section specification in Column 1 and confirm a positive association between past interactions in the relationship and value for the seller. Columns 4 and 6, instead, report results

from the specification

$$V_{fbs} = \mu_{fb} + \phi_s + \beta H_{fbs} + \varepsilon_{fbs}, \quad (7)$$

in which  $\phi_s$  are season fixed effects. The results confirm the positive association between the age and past trade in the relationship and the future continuation value for the seller. In sum:

**Fact 1:** *Controlling for relationship, time and selection effects, the length and amount of past trade in the relationship positively correlate with future continuation values for the seller.*

#### 4.4 Test 2: Transactions During a Negative Supply Shock

##### *Reliability at the Time of the Violence*

The previous Section showed that future continuation values for the seller positively correlates with the age and past trade in the relationship. To understand the sources of value in the relationships and discriminate between competing models, we now examine how relationships reacted to a negative supply shock.

We exploit the regularity of shipments within relationships to construct a counterfactual measure of the volumes of flowers that should have been exported in a particular relationship during the time of the violence, had the violence not occurred. For each relationship in the baseline sample, we separately estimate a model that predicts shipments of flowers in a particular day, as a function of shipments in the same day of the week the previous week, total shipments in the previous week, week and season fixed effects. For each relationship, we obtain a predicted shipment of flowers in a particular day. We aggregate these predicted value at the week level. The model predicts more than 80% of both in sample and out of sample variation in weekly shipments for the median relationship in the sample.

Denote by  $y_{fb}$  the observed shipments of flowers in the relationship between firm  $f$  and buyer  $b$  during the week of the violence, and by  $\hat{y}_{fb}$  the predicted shipments of flowers in the same relationship, obtained using the observed shipments in the week immediately before the violence and the coefficients from the relationship specific model described above. The measure of reliability at the time of the violence is given by

$$R_{fb} = \frac{y_{fb}}{\hat{y}_{fb}}. \quad (8)$$

The measure  $R_{fb}$  captures the percentage of predicted shipments of flowers exported

by a firm during the violence period to a particular buyer.

The first question we ask is whether the violence reduced reliability  $R_{fb}$ . To answer this question, Table 3 reports results from the regression

$$R_{fb} = \alpha_b + \beta \mathbf{I}_f(C = 1) + \gamma Z_{fb} + \eta X_f + \varepsilon_{fb}, \quad (9)$$

where  $\mathbf{I}_f(C = 1)$  is an indicator function that takes value equal to one if firm  $f$  is located in the region directly affected by the violence and zero otherwise;  $X_f$  is a vector of firm controls,  $Z_{fb}$  is a vector of relationship controls, and  $\alpha_b$  are buyer fixed effects. To account for the fact that shocks to relationships that involve one or more common contractual parties might be correlated, the error term,  $\varepsilon_{fb}$ , is estimated through multi-way clustering at the firm and buyer level (see, Cameron et al. (2009)).

Note that the reliability measure  $R_{fb}$  is a deviation from a relationships-specific counterfactual that already accounts for relationship-specific average and seasonal fluctuations in exports.<sup>23</sup> The controls included in specification (9), then, allow the violence period to have affected export volumes in a particular relationship differentially across buyers, sellers and relationship characteristics.

Table 3 shows that the violence reduced the ability of firms to maintain a regular supply to the foreign buyers. The Table reports results using different empirical specifications that differ in the number of controls included. In particular, in the last Column, which controls for buyer fixed effects as well as firm and relationship controls as in equation (9), we find that the estimated reliability was 15% lower, on average, in relationships involving firms located in the conflict region.

#### *Did Exporters Prioritize More Valuable Relationships?*

Because of the violence, firms located in the conflict region could not satisfy the entirety of orders from their buyers. The next question we ask is whether the future continuation value for the seller  $f$  in the relationship with buyer  $b$ , estimated in the season before the violence, i.e.,  $\mathbf{V}_{fb}^N$ , correlates with the reliability measure  $R_{fb}$ . Table 4 reports results from the regression

$$R_{fb} = \alpha_b + \mu_f + \beta \mathbf{V}_{fb}^N + \gamma Z_{fb} + \varepsilon_{fb}. \quad (10)$$

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<sup>23</sup>The cross-sectional results derived from specification (9), therefore, are similar to a regression of volumes of exports  $\tilde{y}_{fb\tau s}$  at time  $\tau$  in season  $s$ , on relationship-specific seasonality and season fixed effects,  $\mu_{fb\tau}$  and  $\mu_{fbs}$ , in which the effects of the violence are recovered from an interaction between a dummy for the period of the violence,  $v_{\tau s}$ , and a dummy for the conflict region,  $c_f$ , after controlling for the interactions between  $v_{\tau s}$  and seller, buyer and relationship characteristics.

This specification is very similar to equation (9), but note that it now includes firm fixed effects  $\mu_f$ . Since we are interested in determining how a particular firm chooses to prioritize among different relationships, given that the firm was under the effects of the violence, we can include firm fixed effects and estimate regression (10) separately on the sample of firms located in the conflict and in the no-conflict regions.

Table 4 shows that exporters prioritized the most valuable relationships. Columns 1 and 2 in the Table report the correlation between the measure of reliability at the time of the violence and the relationship value for the seller computed from the season before the violence in the sample of relationships of firms located in the conflict region. The two columns differ in so far as Column 2 also controls for buyer fixed effects. Controlling for seller fixed effects and for relationship characteristics, we find that the value of the relationship positively correlate with the observed reliability. Note that we use the value of the relationship normalized by the weekly average revenues and, therefore, the positive correlation is not simply picking up the fact that exporters prioritize larger relationships.<sup>24</sup>

Furthermore, Columns 3 and 4 use an alternative proxy for the value of the relationship which is given by the ratio of the shipment volumes at the time of the maximum temptation to renege over the average weekly shipment volumes. This measure does not rely on prices and captures how much the relationship can be “stretched” at the time of the maximum temptation to deviate. The results confirm the findings in Columns 1 and 2.

Finally, Columns 5 and 6 repeat the same exercise for the baseline specification on the sample of relationships located in the no conflict region. The results show that there is no correlation between the value of the relationship and reliability in the region not affected by the violence.<sup>25</sup> In sum:

**Fact 2:** *At the time of a negative supply shock sellers prioritized most valuable relationships.*

## 4.5 Test 3: Reaction to the Shock and Long-Run Outcomes

### *Reliability and Relationship’s Survival*

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<sup>24</sup>The regression includes the age of the relationship and average price as controls. The age of the relationship positively correlates with reliability if the value of the relationship is not controlled for but ceases to be statistical significant once the value is controlled for. Prices are positively, but weakly, correlated with reliability.

<sup>25</sup>Since buyers knew which areas were affected by the conflict, being unreliable in a non-conflict area would have had a very negative effect on reputation. The evidence suggests that sellers in the non-conflict region were generally reliable.

The violence made it difficult for firms to maintain regular shipments across the entire portfolio of direct buyers. Exporters, therefore, had to choose which relationships to prioritize and, as shown in Table 4, they prioritized the most valuable relationships. We now examine whether the measure of reliability at the time of the violence correlates with subsequent outcomes in the relationships. We focus on the period starting from the beginning of the following season, i.e., after mid August 2008. This is the time in which the contractual parties negotiate the marketing plans for the new season.

Figure 7 begins with evidence on relationship's survival. Figure 7 plots the distribution of reliability across the sample of relationships that did survive until the following season and those that did not, for the conflict and no-conflict regions separately. The Figure illustrates three facts. First, more relationships did not survive in the conflict region (16 out of 94) than in the no-conflict region (8 out of 95). Second, relationships that survived in the conflict region had higher reliability than those that did not survive. The difference in mean is statistically significant at the 3% level. Third, the relationship between reliability at the time of the violence and relationship survival does not exist in the sample of relationships that were not directly affected by the violence.

Table 5 confirms these results.<sup>26</sup> The Table shows that across the entire sample of relationships, and controlling for buyer fixed effects and relationship characteristics, reliability at the time of the violence correlates with relationship survival. In particular, higher reliability reduces the likelihood of relationship's death in the conflict region, but does not in the no-conflict region. In other words: the conflict destroyed relationships, particularly those towards which exporters have not been reliable. Consistently with this result, Figure 8 shows that, on average, the conflict destroyed relatively less valuable relationships in the conflict region, but not in the no-conflict region.<sup>27</sup>

#### *Reliability and the Evolution of Volumes and Prices*

Table 6 reports results on the volume of exports and average prices in the season following the violence on the sample of surviving relationships. The Table reports

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<sup>26</sup>Since reliability  $R_{fb}$  is a predicted variable, all the Tables in this Section report bootstrapped standard errors.

<sup>27</sup>In Figure 8 there is a gap of two years, rather than one, between the time at which the survival of the relationship is measured and the time at which the relationship value is estimated. This explains the difference with the findings in Figure 6. Results are reported in this way because the seasonal pick came after the violence and values measured at that time might already confound the effects of the violence.

results from specifications of the form

$$y_{fb}^{sv+1} = \mu_f + \eta_b + \beta R_{fb} + \phi y_{fb}^{sv} + \gamma Z_{fb} + \varepsilon_{fb}; \quad (11)$$

where  $y_{fb}^{sv+1}$  can be either average export volumes or prices in the first twenty weeks of the season that followed the violence,  $y_{fb}^{sv}$  is the corresponding variable for the same period just before the violence, and  $R_{fb}$ ,  $Z_{fb}$  and  $\varepsilon_{fb}$  are as defined above. Since the specification controls for the value of the dependent variable in the corresponding period before the violence the results are best interpreted as correlations between reliability at the time of the violence and growth in the dependent variable.

Column 1 shows that reliability at the time of the violence correlates with an increase in volumes of transactions at the beginning of the season that followed the violence for the relationships located in the conflict region. The coefficient should not be interpreted in a causal way since exporters might have chosen to prioritize those relationships for which they expected larger increases in trade volumes the following season. Column 2, therefore, controls for the future continuation value of the relationship before the violence. This variable should control for the increase in trade volumes that was expected by the exporter at the time of the violence. Results are robust to the inclusion of this additional control. The evidence, therefore, is consistent with reliability at the time of the violence having induced an increase in the volume of trade in the relationship. Column 3, shows that reliability does not correlate with increases in trade volumes in the season following the violence for the sample of relationships in the no-conflict region. Finally, Columns 4 to 6 find the corresponding results for increases in prices. Reliability at the time of the violence strongly correlates with increases in prices, regardless of whether the estimated value of the relationship before the violence is controlled for.<sup>28</sup>

#### *Reliability and the Evolution of Relationship's Value*

Finally, Table 7 explores the correlation between the reliability at the time of the violence and the evolution of future values in the relationship. The Table reports the corresponding results from specification (11), considering two alternative measures. Column 1 reports results using the (normalized) value of the relationship for the seller,  $\mathbf{V}_{fb}^N$ . Reliability at the time of the violence positively correlates with future relation-

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<sup>28</sup> Unreported results show that the age of the relationship does not correlate with increases in volumes and prices. However, the interaction between reliability and age is negative and marginally statistically significant, suggesting that the effects of reliability on future outcomes were stronger for newer relationships.

ship's value for the seller. Column 2 uses an alternative proxy for the value of the relationship which is given by the ratio of the shipment volumes at the time of the maximum temptation to renege over the average weekly shipment volumes. This measure does not rely on prices and captures how much the relationship can be stretched at the time of the maximum temptation to deviate. The results confirm the findings in Column 1. Finally, Columns 3 and 4 show that the reliability at the time of the violence does not correlate with the future continuation value for the seller in the regions not affected by the violence. In sum:

**Fact 3:** *Long-run outcomes in the relationship positively correlate with seller's reaction to the short-run negative shock.*

## 4.6 Further Evidence

### *Direct Relationships versus Spot Market*

If relationships are valuable, exporters should have exerted effort to maintain supply to direct buyers during the violence. For instance, exporters could have hired security and organized protection, paid higher wages to remaining employees to work extra-hours, and so on. A particular form of effort that is observable in the data is whether firms prioritized shipments to direct buyers relative to the spot-market. Note that, by definition, the spot market is the relationship with zero continuation value for the seller.

For every firm in the industry, we construct the reliability towards the spot market, following the construction of the reliability towards direct buyers  $R_{fb}$ . Column 1 in Table 8 shows that, for the firms in the conflict region, exports volumes to the spot market drop significantly more than export volumes to direct buyers. Export volumes to the spot market drop by about 80%, while export volumes to direct relationships only drop by 20%. Since firms that only sell to the spot market might have been affected by, and reacted to, the violence differently than firms that also sell to direct buyers, Column 2 includes firm fixed effects. While the effect of the conflict dummy can no longer be identified, the result shows that firms have prioritized shipments to direct buyers over shipments to the spot market.

Column 3 shows that direct relationships of firms that, in normal times, do not sell to the spot market suffer larger declines in shipments during the violence. Consistently with the fact that firms stopped selling on the spot market to maintain supply to direct buyers, those firms that normally do not sell to the spot market did not have access



to production that was not already committed to a buyer, and found it more difficult to maintain supply to buyers during the violence.<sup>29</sup>

#### *Evidence on Prices*

Firms, therefore, have prioritized shipments to direct buyers over shipments to the spot market during the time of the violence. Figure 9 reports the distribution of prices in direct relationships at the time of the violence. The two vertical bars show the average prices prevailing on the spot market during the time of the violence for both small and large roses. Prices in most direct relationships at the time of the violence were lower than prices on the spot market.

Figure 10 shows that FOB prices during the violence are very similar to prices in the twenty weeks before the violence: prices in direct relationships were not renegotiated upward at the time of the violence. At the time of the violence, therefore, firms have foregone short-run gains to continue supplying direct buyers. Firms must derive future rents from maintaining supply to the direct buyers, and those future rents were sufficient to compensate for the foregone gains and increases in costs.

### **4.7 Discussion of Empirical Results**

To summarize, we have documented three facts: *i*) the value of the relationship for the seller increases with the age of the relationship, *ii*) at the time of a negative supply shock, sellers prioritized the most valuable relationships, and *iii*) these choices correlate with future long-term outcomes in the relationship. Based on the discussion in Section 2, the evidence is best accounted by a model in which sellers value acquiring and maintaining a reputation for reliability (and buyers privately observe the quality of flowers received).

The findings in Section 4.3 and Section 4.5 are inconsistent with models with monetary transfers and risk neutral parties, e.g., the baseline relational contract model in Levin (2003). These models predict stationary outcomes and cannot account for the strong correlation between the age and past trade in the relationship and the value of the relationship nor for the fact that the reaction to a temporary shock is associated with changes in long run outcomes.

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<sup>29</sup>Ksoll et al. (2010) shows that, among the firms located in the regions affected by the violence, those that specialize in selling to direct buyers experienced a significantly smaller loss in *total* volume exported and lost a significantly lower proportion of workers during the conflict. The results control for many potentially confounding factors, including characteristics of a firm's labor force, such as education, gender, ethnicity, contract type and housing programs, as well as ownership type, certifications and size. The evidence is, therefore, consistent with the idea that firms engaging in direct relationships have exerted effort to maintain production and keep their workers.

The assumption of monetary transfers between risk neutral parties must, therefore, be relaxed in order to account for the evidence. The findings in Section 4.4, however, are inconsistent with models purely emphasizing insurance considerations. Insurance models are inconsistent with the positive correlation between reliability and the value of the relationship for the seller and with the lack of price renegotiation at the time of the violence.<sup>30</sup>

Repeated games models without monetary transfers and with imperfect information have non-stationary outcomes that are consistent with the positive relationship between the age and past amount of trade and the value of the relationship for the seller. Limiting attention to subgame perfect and optimal equilibria it is often not sufficient to obtain precise predictions and, therefore, it is hard to reject these models. While the findings in Section 4.5 could be rationalized as the outcomes of a punishment phase in which the relationship is scaled down following low reliability at the time of the violence, this interpretation is somewhat inconsistent with the context of the analysis. Unreliability at the time of the violence was most likely caused by adverse circumstances, rather than opportunism and, consequently, we might not find a punishment phase that persists into the following season.<sup>31</sup>

The findings are consistent with the violence having created an opportunity to learn about persistent features that determine sellers ability, or willingness, to cooperate. The strong and persistent association between past interactions and future continuation values is consistent with buyers learning about a seller's reliability over time. At the time of the violence, sellers exerted effort to protect their reputation in the most valuable relationships by, e.g., stopping to sell on the spot market at higher prices. Finally, a seller's higher reputation for reliability is rewarded with increases in future volumes, prices and values at the time of negotiating contracts for the new season. The findings, therefore, are broadly consistent with reputation models with uncertainty over types (see, e.g., Gosh and Ray (1996), Watson (1999)).<sup>32</sup>

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<sup>30</sup>Insurance considerations are not needed to explain the fact that prices in direct relationships are constant throughout the season. First, as noted in Figure 4, price fluctuations on the spot market are highly predictable. Second, a model along the lines of Fuchs (2007) in which the buyer privately observes the quality of the flowers received imply that prices will be constant and incentives will be provided by terminating the relationship.

<sup>31</sup>On the other hand, parties might have agreed to play an (optimal) equilibrium in which the punishment phase only starts months after the violence has occurred, when the implicit contracts for the new season are negotiated.

<sup>32</sup>Chassang (2010) and Halac (2011) present models in which parties learn over time about the amount of cooperation that can be sustained in the relationship. We conjecture that appropriate versions of these models also generate relationships dynamics consistent with the evidence.

## 5 Conclusion

In the absence of formal contract enforcement trading parties rely on the future rents associated with long term relationships to deter short-term opportunism and facilitate trade. Empirical evidence on the structure of informal arrangements in supply relationships between firms has the potential to identify salient microeconomic frictions in specific contexts and inform policy, particularly in a development context. This paper presents an empirical study of supply relationships in the Kenya rose export sector, a context particularly well-suited to study informal relationships between firms.

We find evidence consistent with models in which learning and reputation matter and reject models purely based on enforcement or insurance considerations. In particular, the evidence is consistent with a model in which sellers value acquiring and maintaining a reputation for reliability. From a policy perspective, it is important to know whether learning and reputation are important determinants of firms success in export markets. Firms might have to operate at initial losses in order to acquire a good reputation. Furthermore, if reputation is an important determinant of contractual outcomes, prior beliefs about sellers affect buyers willingness to trade, at least for a while. This generates externalities across sellers and over time, justifying commonly observed institutions such as common certifications, business associations and subsidies to common marketing.

This paper does not focus on explaining why direct relationships coexist alongside a spot-market. Similar two-tier market structures, however, have been documented in several markets such as agricultural commodities, advertising and diamonds in both developed and developing countries. Extending the analysis in this paper to understand the interconnections between spot markets and direct relationships in this and other contexts provides an exciting area for future work.

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## 6 Appendix A: The Seller’s Incentive Constraint

### *Set Up: Revenues, Costs and Markets*

A stylized theoretical framework is introduced to guide the use of price and volumes data to derive a lower bound on the value of the relationship for the seller. There is one buyer and one seller. Time is discrete, the buyer and the seller have an infinite horizon and discount the future at a common and constant rate  $\delta < 1$ . In each period, the cost of producing  $q$  units of flowers is given by  $c(q) = \frac{cq^2}{2}$ . The buyer derives revenues  $R(q) = vq - \frac{(q-q^*)^2}{2} - k\mathbf{I}_{q \neq q^*}$  from procuring  $q$  units of flowers, where  $\mathbf{I}_{q \neq q^*}$  is an indicator taking value equal to one if  $q \neq q^*$  in a given period.

Alongside the relationship between the buyer and the seller, there is a market, where the supplier can sell and the buyer can purchase unlimited quantities of flowers at given prices. Market prices  $\tilde{p}$  oscillate between periods in which  $\tilde{p} = \bar{p}$  and periods in which  $\tilde{p} = \underline{p}$ . The buyer can purchase flowers on the market at an additional per unit intermediation cost  $\tau$  (i.e., the buyer faces price  $\tilde{p}_b = \tilde{p} + \tau$ , for  $\tilde{p} \in \{\underline{p}, \bar{p}\}$ ). To simplify the algebra, assume  $\underline{p} = 0 < \tau < \bar{p} = p < v$ . Results easily generalize to price cycles with different periods.

### *First Best Contracts*

In the first best contracts are perfectly enforceable and the two parties maximize joint profits period by period. Denote by  $q_s$  the quantity supplied by the seller to the buyer,  $q_a$  the quantity that the buyer procures on the market and by  $q_A$  the quantity sold on the market by the seller. We make the following assumption:

**Assumption 1:**  $k > \frac{1}{2} \frac{(v-cq^*)^2}{1+c}$ , and  $q^* < \frac{\tau}{c}$ .

The first assumption implies that  $q^* = q_a + q_s$ , i.e., the buyer sources a quantity  $q^*$  of flowers in each period. The optimal sourcing and production decisions when the price on the spot market is  $\tilde{p}$  solve the following problem

$$\max_{q \equiv [q_s, q_A]} vq^* - (\tilde{p} + \tau)(q^* - q_s) + \tilde{p}q_A - \frac{c(q_s + q_A)^2}{2}.$$

Denoting by  $\underline{q}$  and  $\bar{q}$  the solution vector in the high and low period respectively, we have the following Lemma,

**Lemma 1** *Under Assumption 1 the optimal sourcing policy is given by*

$$\underline{q} = \begin{cases} q_s = q^* \\ q_a = 0 \\ q_A = 0 \end{cases} \quad \text{and} \quad \bar{q} = \begin{cases} q_s = q^* \\ q_a = 0 \\ q_A = \frac{p}{c} - q^* \end{cases} .$$

**Proof of Lemma 1**

When  $\tilde{p} = \underline{p}$ , then obviously  $q_A = 0$ . Under Assumption 1, the interior solution is given by the first order conditions

$$\begin{aligned} v &= (q_a + q_s) - q^* + cq_s, \\ v &= (q_a + q_s) - q^* + \tau. \end{aligned}$$

This gives  $q_s = \frac{\tau}{c}$ , and  $q_a = v - \tau + q^* - \frac{\tau}{c}$ . Denote the associated joint profits by  $\Pi_{p=0}^q$ . This sourcing policy needs to be compared with sourcing  $q^*$  directly from the seller and setting  $q_a = q_A = 0$ , which gives joint profits  $\Pi(\underline{p}) = vq^* - \frac{c(q^*)^2}{2}$ . By Assumption 1, we have  $\frac{\tau}{c} < q^*$ , which implies  $\Pi(\underline{p}) > \Pi_{p=0}^q$  if  $k > \frac{(v-\tau)^2}{2}$ .

When, instead, the price at the auction is  $\tilde{p} = \bar{p}$ , the optimal strategy is to set  $q_a = 0$ ,  $q_s = q^*$  and  $q_A = \frac{p}{c} - q^*$ , which gives profits equal to  $\Pi(\bar{p}) = (v - p)q^* + \frac{p^2}{2c}$ . The alternative interior solution gives  $q_s = v - p + q^*$ , and  $q_A = \frac{p}{c} - (q^* - (p - v))$ . This implies profits  $\Pi_{p=\bar{p}}^q = \frac{(v-p)^2}{2} + \frac{p^2}{2c} + q^*(v - p)$ , which are smaller than the assumed optimum if  $k > \frac{(v-p)^2}{2}$ . This is guaranteed by Assumption 1 combined with  $p > \tau$ . ■

Assumption 1 captures well established practices in the industry. Since  $\tau > 0$ , the marginal benefit of selling to the auction is always smaller than the marginal cost of procuring on the auction. So, if  $q_A > 0$ , it must be that  $q_a = 0$  (and viceversa). The optimal sourcing policy, therefore, entails a constant order flow  $q^*$  from the buyer to the seller throughout the season. Sales to the spot market, instead, fluctuate through the season. In the low season, the assumption  $q^* < \frac{\tau}{c}$  guarantees that the marginal cost of producing  $q^*$  is smaller than the marginal cost of sourcing on the spot market. In the high season, it is instead profitable to sell quantity in excess of  $q^*$  on the spot market.

*Seller's Incentive Compatibility*

We are interested in determining the conditions under which the first best contract can be implemented, so that a constant level of trade  $q_s = q^*$  can be sustained between the parties throughout the relationship when contracts on prices and quantities are not



enforceable. The informal arrangement is therefore described by unit prices  $\underline{t}$  and  $\bar{t}$  paid upon successful delivery of quantity  $q^*$  in the low and high season respectively.

In this environment, both the buyer and the seller might have incentives to renege on the implicit contract. The buyer might be tempted to avoid paying the price  $tq^*$  once the flowers have been received. The seller, instead, might prefer to produce and sell to the buyer a quantity different from the agreed one,  $q^*$ . We assume that, if any of the two parties renege on the implicit contract, the relationship ends and parties revert to the spot market forever.

We focus of the incentive constraints for the seller. Denote by  $U \in \{\underline{U}, \bar{U}\}$  the value of the relational contract for the seller and by  $U^o \in \{\underline{U}^o, \bar{U}^o\}$  the value of selling flowers to the spot market forever. When the prices on the spot market are high, the arrangement must prevent the supplier from selling the flowers on the spot at a higher price; when, instead, prices on the spot market are low, the supplier must be given incentives to deliver  $q^*$ .

The following Proposition justifies the use of equation (4) as (a lower bound to) the value of the relationship for the seller.

**Proposition** *Assume that, as observed in the data,  $p > \bar{t}$ . Then, the seller's incentive compatibility constraint in the low season is never binding. The temptation to renege in the high season, given by  $q^*(p - \bar{t})$ , therefore provides a correct lower bound to the value of the relationship for the seller.*

**Proof:**

In each period, there are two incentive constraints since the seller might deviate by changing production plans and/or by side-selling on the spot market. The set of constraints associated with changing production plans,  $IC_P$ , is derived as follows. Taking into account the fact that  $q_{A^*} = 0$  in the low season, the set of incentive constraints in the high and low season respectively is given by:

$$\begin{aligned} \overline{IC}_P &: \bar{t}q^* + pq_A - C(q^* + q_A) + \delta\underline{U} \geq pq_{A^*} - C(q_{A^*}) + \delta\underline{U}^o, \\ \underline{IC}_P &: \underline{t}q^* - C(q^*) + \delta\bar{U} \geq \delta\bar{U}^o. \end{aligned}$$

The best possible deviation satisfies  $C'(q_{A^*}) = p$ . Since  $q_A > 0$ , however, the same holds true for  $q^* + q_A$ , hence  $q_{A^*} = q^* + q_A$ . Therefore, this set of incentive constraints

can be rewritten as

$$\begin{aligned}\delta(\underline{U} - \underline{U}^o) &\geq (p - \bar{t}) q^*, \\ \underline{t}q^* - C(q^*) + \delta\bar{U} &\geq \delta\bar{U}^o.\end{aligned}$$

To avoid side selling, instead, we must have:

$$\begin{aligned}\overline{IC}_2^S &: \bar{t}q^* + pq_A + \delta\underline{U} \geq p(q^* + q_A) + \delta\underline{U}^o, \\ \underline{IC}_2^S &: \underline{t}q^* + \delta\bar{U} \geq \delta\bar{U}^o.\end{aligned}$$

Inspection of the four constraints shows that the only relevant ones are:

$$\begin{aligned}\overline{IC}^S &: \bar{t}q^* + \delta\underline{U} \geq pq^* + \delta\underline{U}^o, \\ \underline{IC}^S &: \underline{t}q^* - C(q^*) + \delta\bar{U} \geq \delta\bar{U}^o\end{aligned}\tag{12}$$

We now derive the necessary value functions. Denote by  $\bar{\Pi}(q^*) = (\bar{t} - p)q^* + \frac{p^2}{2c}$  and  $\underline{\Pi}(q^*) = \underline{t}q^* - c(q^*)$  the per period profits from the relationships in the high and low season. We then have

$$\bar{U} = \frac{\bar{\Pi}(q^*) + \delta\underline{\Pi}(q^*)}{1 - \delta^2} \text{ and } \underline{U} = \frac{\underline{\Pi}(q^*) + \delta\bar{\Pi}(q^*)}{1 - \delta^2}.\tag{13}$$

The values of the outside option following a deviation are given by

$$\bar{U}^o = \frac{1}{1 - \delta^2} \frac{p^2}{2c} \text{ and } \underline{U}^o = \frac{\delta}{1 - \delta^2} \frac{p^2}{2c}.\tag{14}$$

The incentive compatibility can be derived, after some manipulation, by substituting (13) and (14) in 12. This gives

$$\begin{aligned}\overline{IC}^S &: \delta(\underline{t}q^* - C(q^*)) \geq (p - \bar{t})q^*, \\ \underline{IC}^S &: \frac{(\underline{t}q^* - C(q^*))}{\delta} \geq (p - \bar{t})q^*.\end{aligned}\tag{15}$$

Provided that  $p > \bar{t}$ ,  $\overline{IC}^S$  implies  $\underline{IC}^S$  since  $\delta < 1$ . ■

## 7 Appendix B: Data Sources

### *Transaction-Level Export Data*

The data cover all exports of flowers during the period from April 2004 to August 2009. The data are obtained from the Horticultural Crops Development Authority (HCDA), a parastatal body which promotes and regulates the horticultural industry in Kenya. Records of each export transaction are entered in close collaboration with the Customs Authority. The invoice for each transaction is directly entered into the database at HCDA before the flowers are exported. Each invoice contains information on name of the Kenyan exporter, name of foreign consignee/client, type of produce, weight (kgs), units, unit value, total value, date, destination, currency and freight clause (C&F, FOB). We restrict our sample to established exporters that export throughout most of the season in the year preceding the violence. The sample covers more than ninety five percent of export records in the data.

#### *Survey and Administrative Data*

Information provided in the background section was collected through a firm-level survey. The survey was designed in collaboration with Chris Ksoll and was implemented by the authors in July to September 2008. The survey covered i) general questions about the firm (history, farm certification, ownership structure, level of vertical integration, location of farms etc.), ii) contractual relationships in export markets and marketing channels (direct wholesaler and/or auction houses), iii) firm production (covering detailed information on labor force, input use and assets), iv) retrospective post-election violence period (effect on operations, loss of workers by week, issues on transportation and air-freight, financial losses and extra-costs incurred). The survey was administered to the most senior person at the firm, which on most occasions was the owner himself/herself. Upon previous appointment, face-to-face interviews of one to two hours were conducted by the authors with the respondent.

The location of exporters in the sample is obtained from HCDA, the Kenya Flower Council (KFC) and field visits during the survey. The names and nationality of firms owners and directors are obtained from the Registrar of Companies at the Attorney General's Office. Internet search and interviews guided the classification of foreign buyers into different marketing channels. Prices and volumes at the auctions is obtained at the weekly level from the International Trade Centre, UNCTAD/WTO, Geneva.

#### *Time and Location of the Violence*

To classify whether a location was affected by the violence we rely on the Kenya Red Cross Society's (KRCS) Information Bulletins on the Electoral Violence which were issued daily during the relevant period (see Kenya Red Cross Society (2008) for

details). Various other sources were used to supplement and verify the information, including: i) *Disaster Desk* of the Data Exchange Platform for the Horn of Africa (DEPHA),<sup>33</sup> ii) *Ushahidi*,<sup>34</sup> iii) the Kenya National Commission on Human Rights Report (2008), and iv) the Independent Review Commission Report (2008). Finally, we confront this information with the responses in the firm survey. For the locations relevant to the flower industry, the first outbreak of violence occurred on the 29<sup>th</sup> December 2007 and lasted until January 4<sup>th</sup> 2008, around Eldoret, Kitale, Kericho and Nakuru. The second outbreak occurred between the 25<sup>th</sup> and 30<sup>th</sup> of January 2008 and also involved the towns of Naivasha and Limuru.

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<sup>33</sup>DEPHA provides geographic information data and services to the region under the UN. DEPHA maps of the violence were accessed at [http://www.depha.org/Post\\_election\\_Violence.asp](http://www.depha.org/Post_election_Violence.asp) on September 23<sup>rd</sup>, 2008.

<sup>34</sup>*Ushahidi* is an open-source site launched to gather information from the general public on the events in real time. The general public could on a map of Kenya pin up a town/area where conflict had erupted and when. For details, see <http://legacy.ushahidi.com/> (accessed on September 30<sup>th</sup> 2008).

**Table 1: Direct Relationships, Descriptive Statistics**

Variable	Observations	Mean	St. Dev.	Min	Max
<b>Panel A: Relationships Characteristics</b>					
Number of Shipments	189	60.60	35.69	20	140
Number of Stems per Week (in 1000s)	189	102.39	165.14	1.53	971.72
Av. FOB Price (Euro Cents per stem)	189	12.11	11.65	1.25	25.75
Age (in Days)	189	860.12	449.45	33	1352
Number of Previous Transactions	189	298.23	288.80	20	1128
Left Censored (Yes = 1, No =0)	189	0.44	0.49	0	1
<b>Panel B: Number of Relationships per Buyer and Seller</b>					
Number of Relationships per Seller	56	3.38	2.88	1	14
Number of Relationships per Buyer	71	2.66	2.82	1	14
<b>Panel C: Estimated Relationships Values (Season Before the Violence)</b>					
Estimated Value (Relative to Week)	189	3.31	4.23	0.00	26.90
Estimated Value (Relative to Season)	189	0.10	0.19	0.00	1.78
Highest Volume (Relative to Week)	189	2.45	3.11	1.04	6.51

Source: Authors calculations from HCDA Transaction level data on all flower exports. The sample is given by all relationships active immediately before the violence, i.e., only relationships that had more than 20 transactions from the beginning of the season. Left censored refers to relationships that were already active before the beginning of the period covered in the data, i.e., relationships that were active before September 2004.

**Table 2: History and Future Value of Relationships**

<b>Dependent Variable: Relationship Value</b>	[1]	[2]	[3]	[4]	[5]	[6]
Relationship Age (in Days)	0.381** [0.181]	0.223*** [0.069]				
Number of Previous Shipments			0.440*** [0.099]	0.229*** [0.058]		
Past Temptations to Deviate (Cumulative)					0.257*** [0.057]	0.285*** [0.045]
Firm and Buyer Fixed Effects	yes	--	yes	--	yes	--
Relationship Fixed effects	no	yes	no	yes	no	yes
Season Fixed Effects	no	no	no	yes	no	yes
Number of observations	146	444	146	444	146	444

\*\*\*, \*\*, \* denote statistical significance at the 1%, 5% and 10% level respectively. The Table reports correlation between the estimated value of a relationship and different measures of the past history of the relationship. The value is computed for the season before the violence and the sample refers to relationships that were active during the period. The sample excludes relationships that are in the baseline sample but were not active in the season preceding the violence and includes relationships that did not survive until the violence season. A dummy for whether the relationship is left-censored is included as control. Robust standard errors, two-way clustered at the firm and buyer level are reported in parenthesis.

**Table 3: The Violence Reduced Exports in Direct Relationships**

<b>Dependent Variable: Reliability at Time of Violence</b>	[1]	[2]	[3]	[4]
	Conflict Region	-0.414** [0.206]	-0.392* [0.205]	-0.302* [0.157]
Relationship Controls	no	yes	yes	yes
Exporter Controls	no	no	yes	yes
Buyer Controls	no	no	no	yes
Number of observations	189	189	189	189

\*\*\*, \*\*, \* denote statistical significance at the 1%, 5% and 10% level respectively. The Table reports the difference in mean in estimated reliability between direct relationships of firms located in regions directly affected by the violence against direct relationships of firms located in regions not directly affected. Reliability is computed as the ratio of realized exports over predicted exports during the second spike of the violence. The predicted values are obtained by fitting a relationships specific regression of shipments in any given day of the week with shipments in the corresponding day for the previous week, taking into account seasonality patterns. For the median relationship in the sample, this regression has an R-square equal to 0.85. Robust standard errors, two-way clustered at the firm and buyer level, are reported in parenthesis.

**Table 4: Relationship Value and Reliability**

<b>Dependent Variable: Reliability at Time of Violence</b>	<b>Conflict Region</b>				<b>No Conflict Region</b>	
	[1]	[2]	[3]	[4]	[5]	[6]
Relationship Value	0.066*** [0.023]	0.077* [0.048]			-0.011 [0.040]	
Maximum Sustainable Quantity			0.182** [0.085]	0.128* [0.070]		-0.089 [0.170]
Firms Fixed Effects	yes	yes	yes	yes	yes	yes
Relationship Controls	yes	yes	yes	yes	yes	yes
Buyer Fixed Effects	no	yes	no	yes	no	no
Number of observations	94	94	95	94	94	95

\*\*\*, \*\*, \* denote statistical significance at the 1%, 5% and 10% level respectively. The Table reports within firms correlations between estimates of the value of the relationships before the violence and reliability at the time of the violence. Reliability is computed as the ratio of realized exports over predicted exports during the second spike of the violence. The predicted values are obtained by fitting a relationships specific regression of shipments in any given day of the week with shipments in the corresponding day for the previous week, taking into account seasonality patterns. For the median relationship in the sample, this regression has an R-square equal to 0.85. Relationship controls include buyer location and size, relationship age, estimated value and export volumes before the violence. Robust standard errors, two-way clustered at the firm and buyer level, are reported in parenthesis.

**Table 5: Conflict and No-Conflict Regions**

<b>Dependent Variable: Relationship Death (Season Following the Violence)</b>	[1]	[2]	[3]	[4]
Conflict Region	0.057 [0.051]	0.041 [0.061]	0.213* [0.117]	0.168* [0.094]
Reliability at Time of Violence			0.007 [0.032]	-0.007 [0.032]
Conflict Region X Reliability at Time of Violence			-0.130* [0.069]	-0.113* [0.059]
Relationship Controls	yes	yes	yes	yes
Firm Controls	no	yes	no	yes
Buyer Fixed Effects	no	yes	no	yes
Number of observations	189	189	189	189

\*\*\*, \*\*, \* denote statistical significance at the 1%, 5% and 10% level respectively. The Table shows that the violence has destroyed relationships for which reliability at the time of the violence was sufficiently low. No relationship exists between reliability and relationship survival in regions not affected by the violence. The sample is given by all relationships active immediately before the violence. Reliability is computed as the ratio of realized exports over predicted exports during the second spike of the violence. The predicted values are obtained by fitting a relationships specific regression of shipments in any given day of the week with shipments in the corresponding day for the previous week, taking into account seasonality patterns. For the median relationship in the sample, this regression has an R-square equal to 0.85. Relationship controls include buyer location and size, relationship age, estimated value and export volumes before the violence. Firm controls include size, number of relationships, and share of exports to direct relationships. Bootstrapped standard errors are reported in parenthesis.

**Figure 6: Reliability and Future Relationship Outcomes**

<b>Dependent Variable and Sample (Beginning of Season Following Violence):</b>	<b>Average Weekly Volumes</b>			<b>Average FOB Prices</b>		
	Conflict Region		No-Conflict Region	Conflict Region		No-Conflict Region
	[1]	[2]	[3]	[4]	[5]	[6]
Reliability	0.356** [0.170]	0.307* [0.168]	0.046 [0.100]	0.149** [0.069]	0.148** [0.070]	0.018 [0.042]
Past Estimated Value		0.081 [0.056]			0.011 [0.026]	
Relationship Controls	yes	yes	yes	yes	yes	yes
Firm Fixed Effects	yes	yes	yes	yes	yes	yes
Buyer Fixed Effects	yes	yes	yes	yes	yes	yes
Number of observations	78	78	87	78	78	87

\*\*\*, \*\*, \* denote statistical significance at the 1%, 5% and 10% level respectively. The Table shows that reliability at the time of the violence correlates with volumes and unit prices of exports at the beginning of the season following the violence in the region directly affected by the violence but not in regions not directly affected. The sample is given by the set of surviving relationships. Reliability is computed as the ratio of realized exports over predicted exports during the second spike of the violence. The predicted values are obtained by fitting a relationships specific regression of shipments in any given day of the week with shipments in the corresponding day for the previous week, taking into account seasonality patterns. For the median relationship in the sample, this regression has an R-square equal to 0.85. Past estimated value corresponds to estimated values before the violence. Regressions controls include buyer location and size, relationship age, estimated value as well as the corresponding dependent variable before the violence. Bootstrapped standard errors are reported in parenthesis.

**Table 7: Reliability and Future Values**

Dependent Variable and Sample (Season Following Violence):	Max. Temptation to Deviate		Max. Temptation to Deviate	
	Estimated Value		Estimated Value	
	Conflict Region		No Conflict Region	
	[1]	[2]	[3]	[4]
Reliability at Time of Violence	0.672*** [0.277]	0.847** [0.391]	0.084 [0.196]	0.022 [0.187]
Relationship Controls	yes	yes	yes	yes
Firm Fixed Effects	yes	yes	yes	yes
Number of observations	78	78	87	87

\*\*\*, \*\*, \* denote statistical significance at the 1%, 5% and 10% level respectively. The Table shows that reliability at the time of the violence correlates with estimates of the value of the relationship in the season following the violence in the region directly affected by the violence but not in regions not directly affected. Reliability is computed as the ratio of realized exports over predicted exports during the second spike of the violence. The predicted values are obtained by fitting a relationships specific regression of shipments in any given day of the week with shipments in the corresponding day for the previous week, taking into account seasonality patterns. For the median relationship in the sample, this regression has an R-square equal to 0.85. Regressions controls include buyer location and size, relationship age, estimated value and shipments before the violence. Bootstrapped standard errors are reported in parenthesis.

**Table 8: Reliability: Direct Relationships vs. Auctions**

Dependent Variable: Reliability at Time of Violence	[1]	[2]
Conflict Region	-0.865*** [0.082]	-0.175* [0.096]
Direct Relationship	-0.088 [0.103]	0.023 [0.095]
Direct Relationship X Conflict Region	0.650** [0.312]	0.512* [0.271]
Only Direct Relationships [yes = 1]		0.008 [0.113]
Only Direct Relationships [yes = 1] X Conflict Region		-0.473** [0.239]
Relationship Controls	no	no
Firm Fixed Effects	no	yes
Direct Relationships Only	no	no
Number of observations	274	274

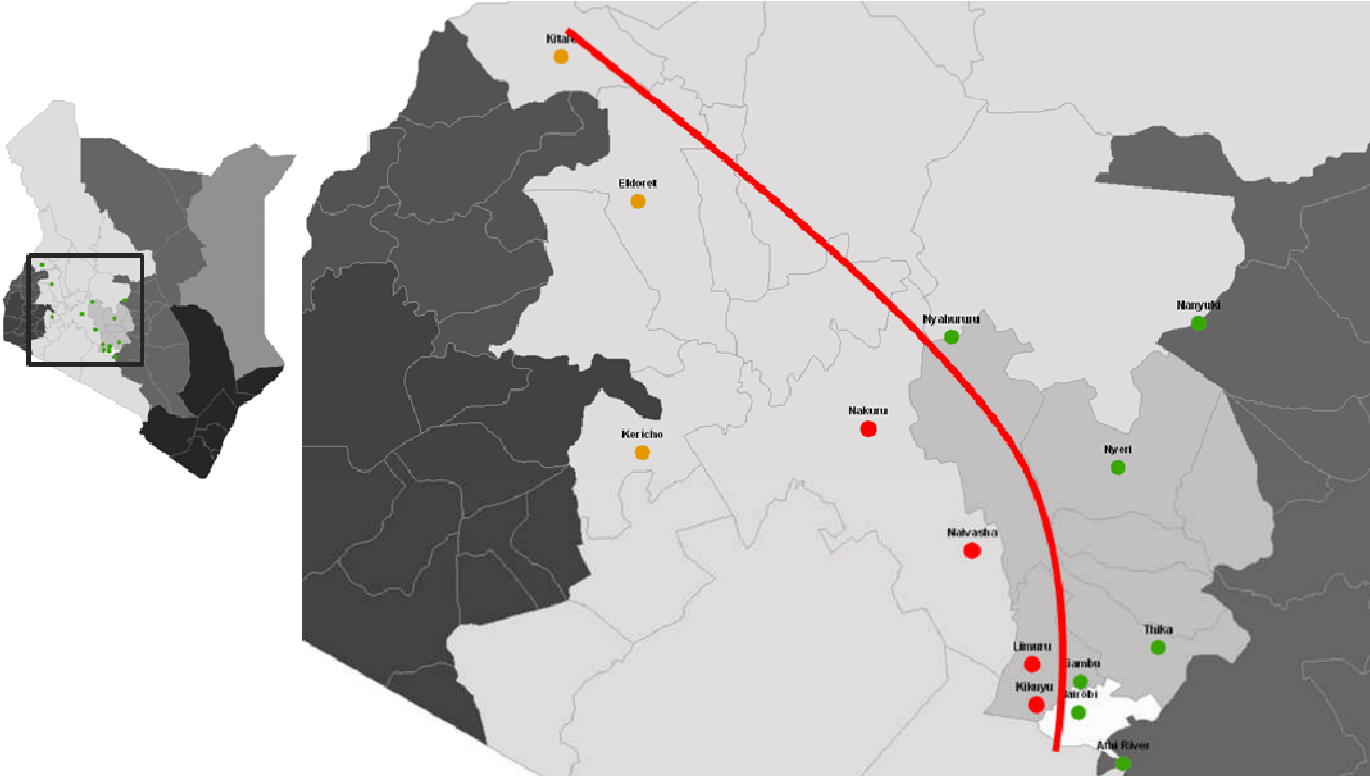
\*\*\*, \*\*, \* denote statistical significance at the 1%, 5% and 10% level respectively. The Table reports the difference in mean in estimated reliability between direct relationships and auctions for firms located in regions directly affected by the violence and firms located in regions not directly affected by the violence respectively. Only direct relationship takes value equal to one if the firm exports more than ninety percent of its produce to direct relationships. Robust standard errors, two-way clustered at the firm and buyer level, are reported in parenthesis.

**Table A1: The Violence, Self-Reported Records**

	[1]	[2]	[3]	[4]	[5]	[6]
<b>Dependent Variable:</b>	Did Violence Affect at all the Operations of Your Firm?	Were there any days in which members of your staff did not come to work because of the Violence?	What was the highest proportion of Workers Absent due to the Violence?	To What Extent did Worker Absence Cause a Loss in Production?	Did you Experience Any Transportation Problem to Ship Flowers to the Airport?	Did you Hire Extra Security?
Conflict Region (yes=1)	0.575*** [0.103]	0.702*** [0.072]	43.898*** [5.609]	2.333*** [0.124]	0.477*** [0.100]	0.311*** [0.099]
Dep. Var. in No-Conflict Region (Mean)	0.333	0.206	1.511	0.167	0.233	0.071
Adjusted R-squared	0.36	0.51	0.35	0.55	0.136	0.116
Number of Firms	74	74	74	74	74	74

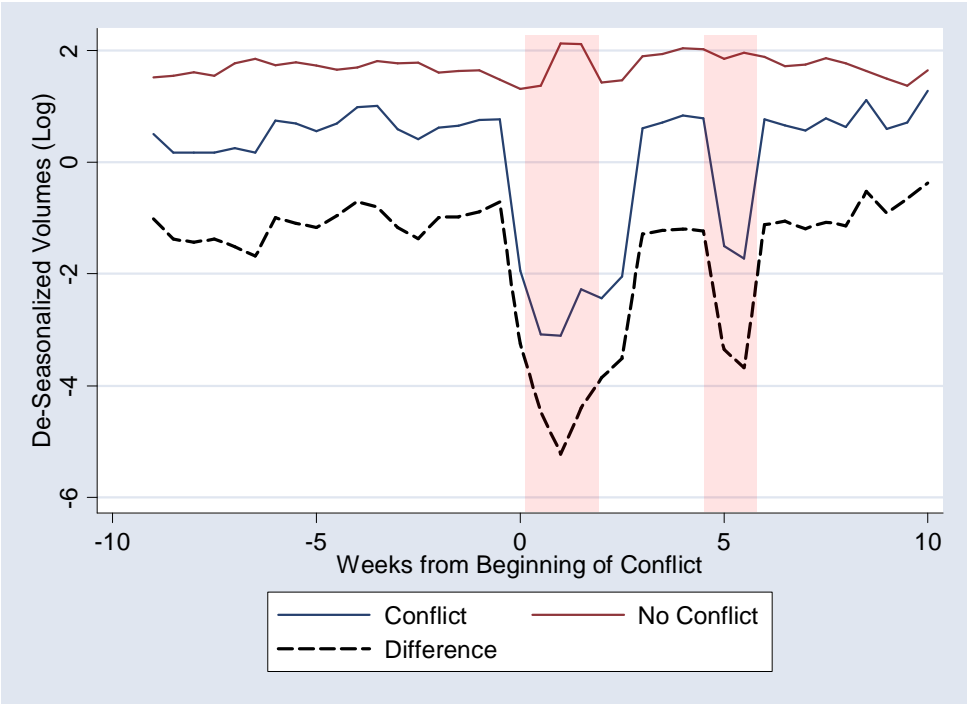


**Figure 1: Conflict and No-Conflict Regions**



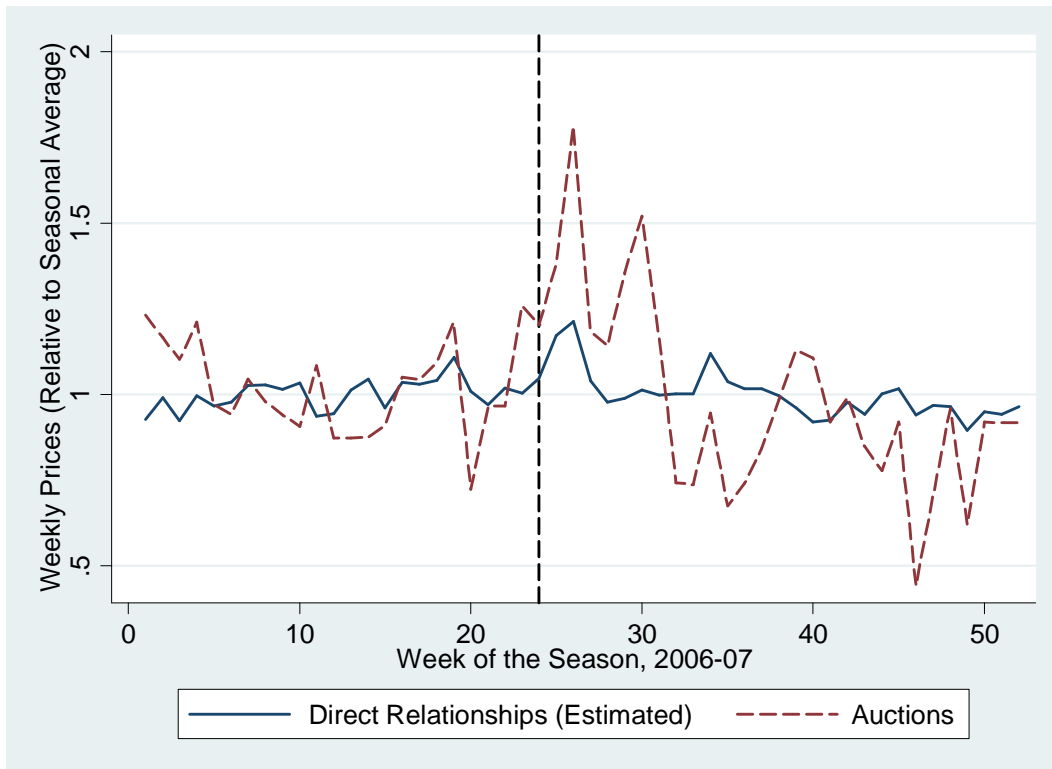
Among the towns around which flower firms are located, the Figure illustrates those locations that were directly affected by the violence to the left of the red line and those locations that were not affected by the violence to the right.

**Figure 2: Effect of Violence on Export Volumes**



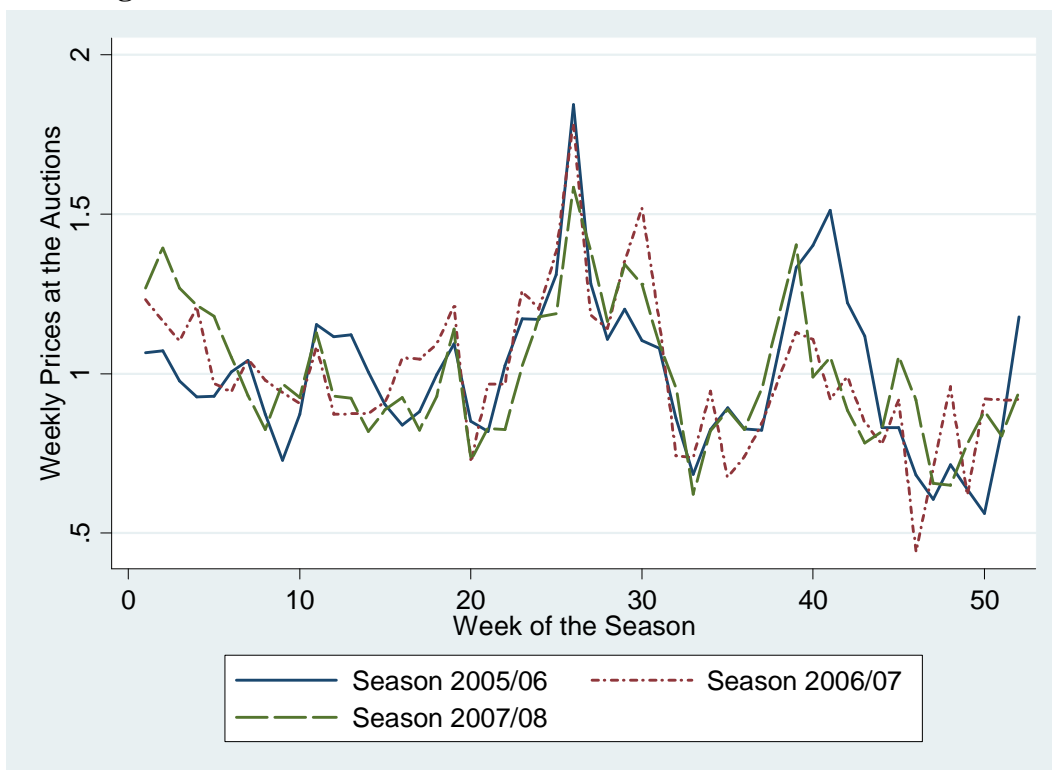
The figure shows the median biweekly residual of a regression that controls for firm specific seasonality and growth patterns in *conflict* and in *non-conflict* locations for the 10 weeks before and 10 weeks after the first outbreak of violence.

**Figure 3: Fluctuations in Prices, Direct Relationships vs. Auction**



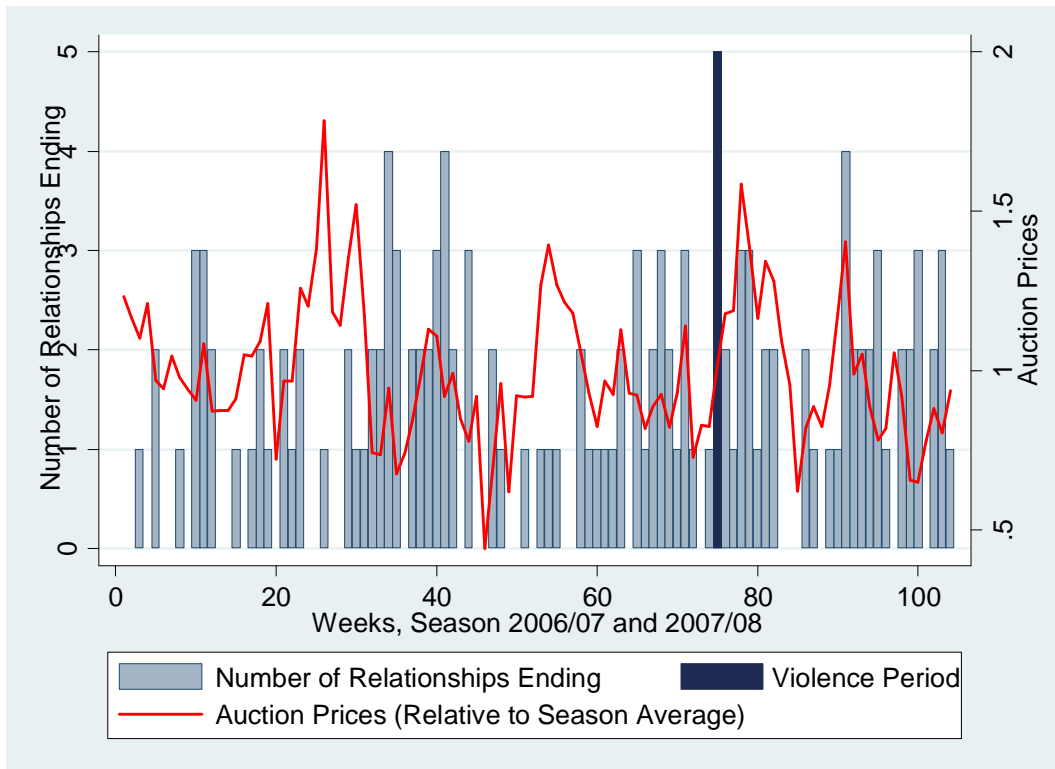
The Figure shows that FOB Prices in Direct Relationships are more stable than prices at the auctions throughout the season. The Figure shows the weekly variation relative to the season mean of FOB prices in direct relationships and at the Auctions. The FOB prices in direct relationships are obtained as week dummies in a regression of FOB prices on relationship fixed effects on the corresponding season. A season begins in mid august.

**Figure 4: Seasonal Fluctuations in Auction Prices are Predictable**



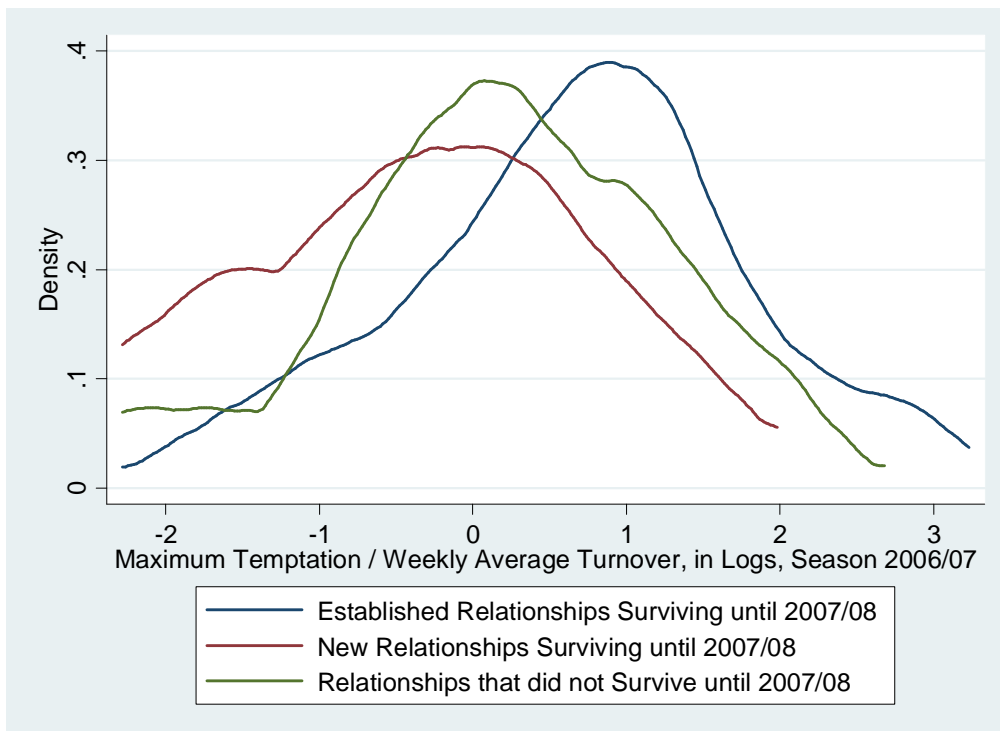
The Figure shows that FOB Prices at the Auctions are highly predictable. A regression of the weekly price at the auction on week and season dummies explains 76% of the variation in prices in the three season preceding the violence period. A season begins in mid august.

**Figure 5: Separations Do Not Occur when Auction Prices are High**



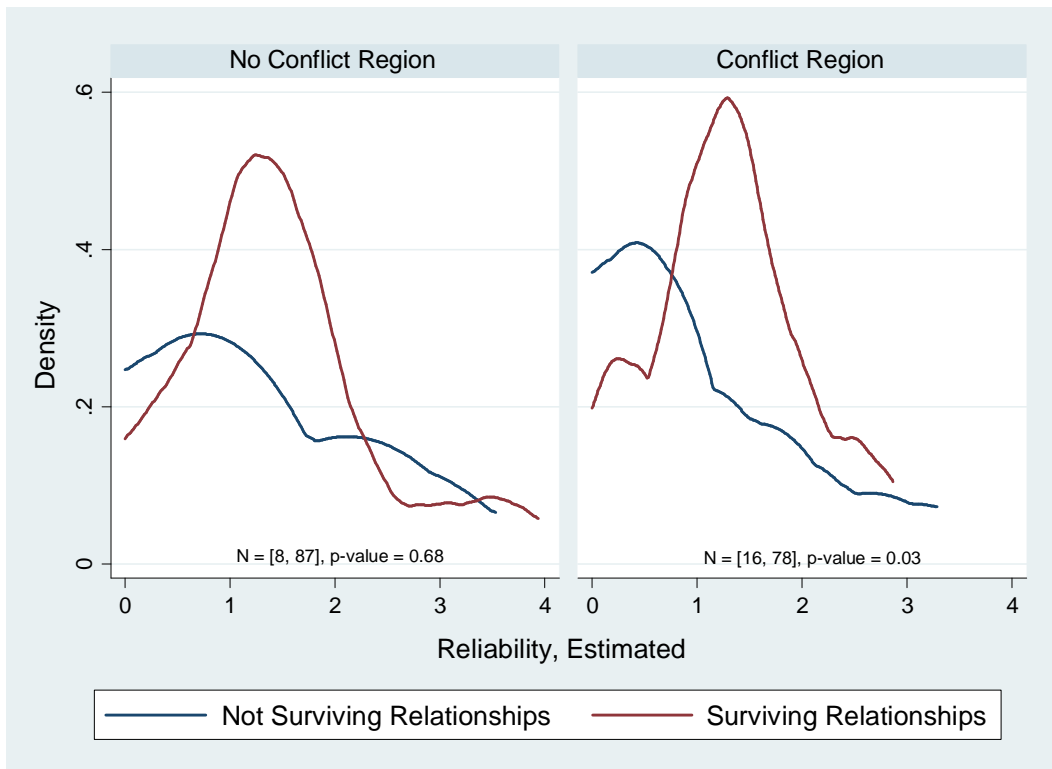
The Figure shows that the number of relationships dying in a given week does not correlate with the price at the Auctions in that week during the two season preceding the violence period. This is consistent with the fact that prices at the auctions are highly predictable. In a regression of the number of relationships dying in a given week that controls for week and season dummies, the coefficient on the violence period is positive and significant. The R-square for the same regression is 0.57. Regardless of whether week dummies are controlled for or not, the level of prices at the auctions do not predict the number of relationships dying.

**Figure 6: Surviving Relationships Afford Higher Temptations**



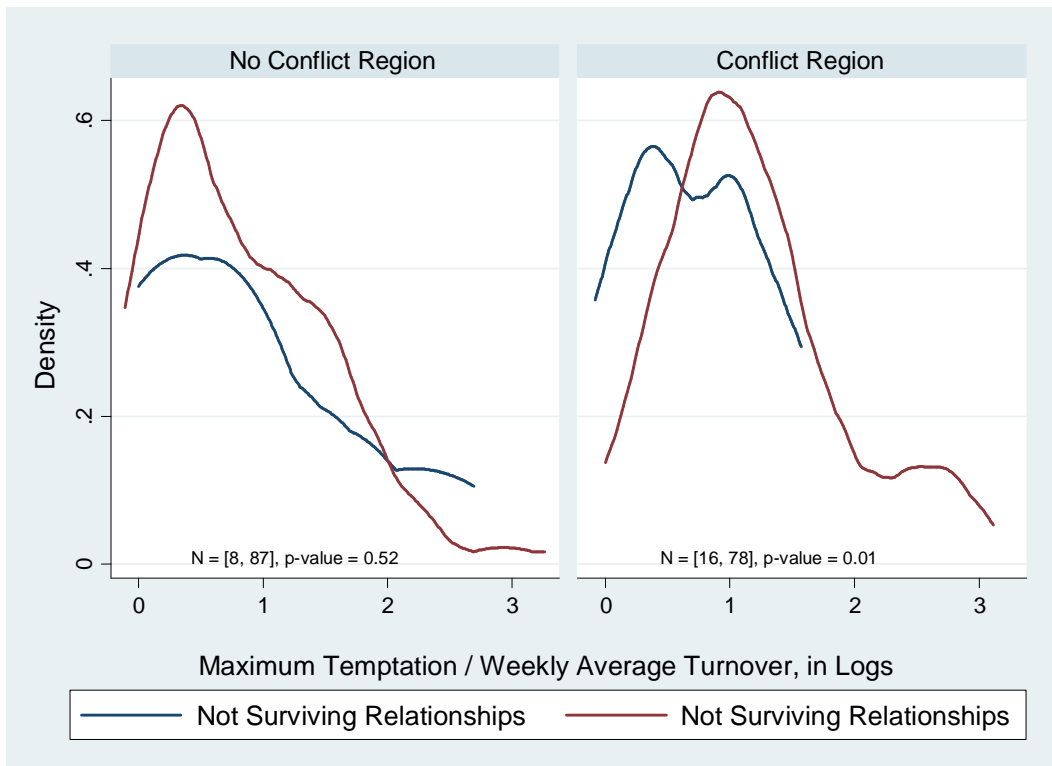
The Figure shows the distribution of the (log of the) value of relationships in the season 2006/07. The value is given by the ratio of the maximum temptation to deviate in any given week of the season, divided by the average weekly value of transactions in the relationship during the season. The maximum temptation to deviate is given by the maximum revenues foregone by the exporter for not selling on the auctions at higher prices during any particular week. Among the relationships in our baseline sample, i.e., those active immediately before the violence period, relationships that were already active before 2006/07 are in blue, new relationships are in red, and relationships that were active in 2006/07 but did not survive are in green. The Figure shows that most valuable relationships, i.e., those that are robust to the higher temptations, are more likely to survive. The equality of mean (and distribution) between surviving and dying relationships is rejected with 1% confidence interval.

**Figure 7: Reliability and Survival, Conflict vs. No-Conflict Region**



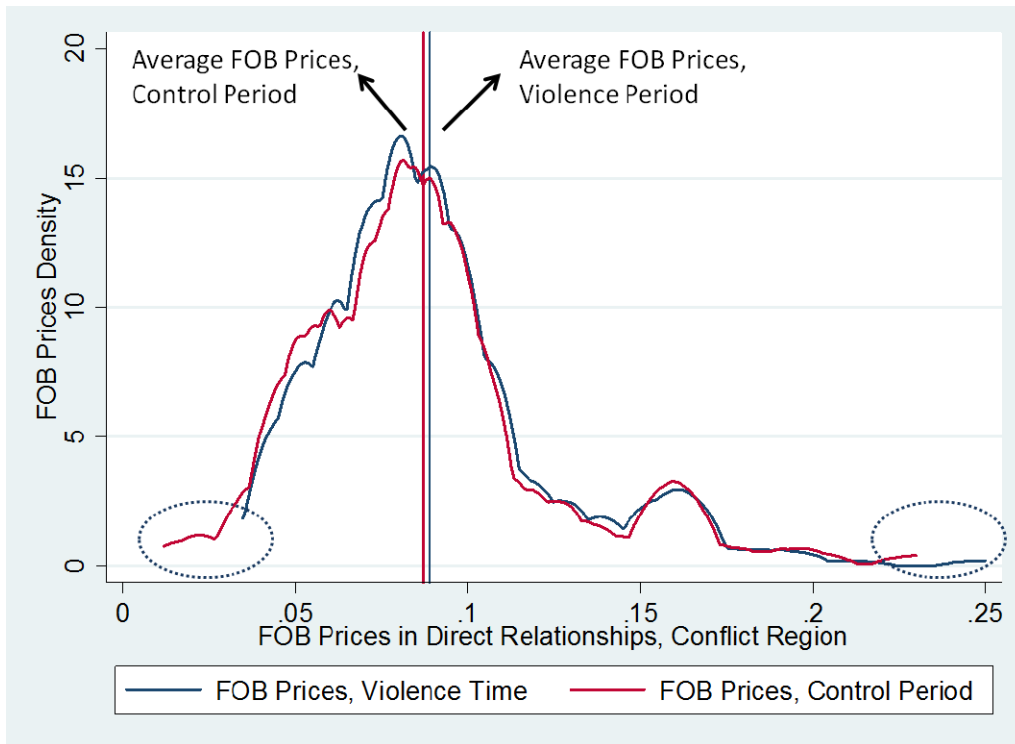
The Figure shows the distribution of the estimated reliability at the time of the violence in the two regions depending on whether the relationship survived until the following season. The Figure shows that the estimated reliability is higher for relationships that survived relative to relationships that did not survive in the conflict region (p-value = 0.03) but not in the no-conflict region (p-value = 0.68).

**Figure 8: The Value of Destroyed Relationships: Conflict vs. No-Conflict**



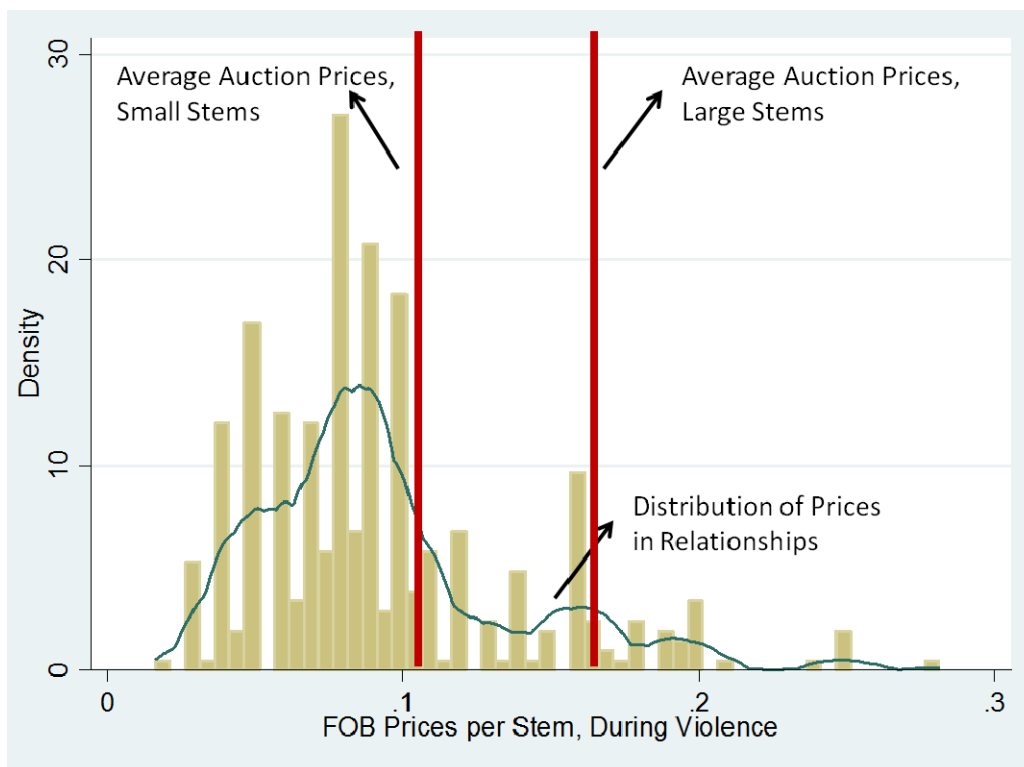
The Figure shows the distribution of the (log of the) value of relationships in the season 2006/07 for relationships in the conflict and no-conflict regions depending on whether the relationship survived until the following season. The value is given by the ratio of the maximum temptation to deviate in any given week of the season, divided by the average weekly value of transactions in the relationship during the season. The maximum temptation to deviate is given by the maximum revenues foregone by the exporter for not selling on the auctions at higher prices during any particular week. The Figure shows that in the conflict region the violence destroyed relationships that were the least valuable (p-value = 0.001).

**Figure 9: No Renegotiation of FOB Prices at the Time of the Violence**



The Figure shows the distribution of average FOB prices per stem in direct relationships at the time of the violence and in the control period, i.e., the ten weeks prior to the violence. The two vertical lines show average FOB prices at the time of the violence and in the control period. The figure shows that prices were not renegotiated upward at the time of the violence. (Source: authors calculations from HCDA Data).

**Figure 10: FOB Prices at the Time of the Violence: Auctions vs. Direct Relationships**



The Figure shows the distribution of average FOB prices per stem in direct relationships at the time of the violence. The two vertical lines show the average prices of small and large stems of roses at the Dutch auctions at the time of the violence. The figure shows that most relationships paid prices lower than at the spot market. (Source: authors calculations from HCDA Data and Auctions Data).

**Figure A1: Temporal Structure of the Study**

