Asymmetric Information and Bargaining: Experimental Evidence From Rural Guinea-Bissau

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Abstract

We study how reducing asymmetric information affects market outcomes using a nationwide cluster-randomised trial with cashew producers across 290 villages in Guinea-Bissau. Treated producers received weekly digital updates with market news, farmgate prices, and sales guidance over two trading seasons. Access to this information increased sale prices and encouraged producers to spread sales across multiple transactions. We find evidence of increased bargaining power among treated producers and between-village spillovers, likely transmitted via itinerant buyers that interacted with treated producers. Our results show that low-cost digital market information systems can increase price pass-through to producers in export-oriented commodity markets.

[PRE-ANALYSIS PLAN]

We randomised author order using the AEA tool, confirmation code: IdIRV40J4H3d. Corresponding author: gschinaia@uchicago.edu
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1 A market information experiment

Prices in agricultural commodity markets fluctuate considerably (Deaton and Laroque, 1992). Yet, for export crops, pass-through rates from international to farmgate prices are low. Low pass-through rates could be due to high transport costs and competitive forces along the value chain (Casaburi et al., 2013; Casaburi and Reed, 2022) or informational asymmetries. Producers of export crops might lack sufficient information about price fluctuations compared to intermediary buyers who are well-integrated into global value chains. As a result, intermediary buyers are likely to be better informed about prices and market news (Fafchamps and Hill, 2008). Lack of accurate price information could weaken producers' bargaining power and lower the prices they can negotiate.

This paper studies whether and how digital technologies affect producers' outcomes by increasing the availability of accurate price and market information. Our study takes place in Guinea-Bissau among producers of cashew nuts, an export crop with high price volatility. Cashew nuts account for 90% of the Guinea-Bissau's exports and are a key source of income for producers. To support producers in their sales decisions, we introduced a new market information system in the country, which combined market and price information from both international and local markets.[1] Our market information system provided selected producers with weekly voice and text messages to their mobile phones during the trading season, which runs between March and July. These messages were tailored to be easy to understand and to provide producers with up-to-date market information.

We evaluate the effect of providing market information by implementing a two-level cluster randomised control trial. We randomised treatment assignment both across and within villages. In treated villages, a randomly selected group of cashew producers received free messages from our market information system during the trading season across two years, in 2020 and 2021. Our research design enabled us to estimate within-village spillover effects due to the presence of both treated and untreated producers in treated villages. We assessed the intervention's impact on various outcomes through an in-person survey and a second phone-based follow-up conducted after the 2020 and 2021 trading seasons, respectively. Analysis plans were registered for each follow-up survey before their completion.[2] During the first year of the intervention, only the treated group had access to these messages. In the second year,

[1] We partnered with the Ministry of Finance and Economy of Guinea-Bissau, the National Cashew Agency, and the mobile operator MTN to introduce to Guinea-Bissau the *n'kalô* service. *n'kalô* is a market information system designed by the French NGO Nitidae, which already operates in several cashew-producing countries and is a globally trusted source of information for this commodity market. The intervention is described further in Section 4.1.

[2] See `https://www.socialscienceregistry.org/trials/4740` for the trial registration and analysis plan.

after the in-person survey, we informed untreated producers about the service and told them how they could subscribe to it for a monthly fee charged by the mobile network operator.
The cashew-nut market in Guinea-Bissau is a useful setting to understand how market information can help producers negotiate higher prices. First, Guinea-Bissau is a price taker in the global cashew-nut market. Cashew prices fluctuate across and within the trading seasons largely due to exogenous fluctuations in international prices. Prior to our intervention, these price fluctuations were not well communicated to producers. Second, producers make a high-stakes decision when deciding at what price to sell their cashews. Most producers earn their annual revenue from selling all their production in one or two transactions. Third, every year, producers have about four months during the trading seasons to make their transactions. While producers do not store their stock across different trading seasons, most producers can store raw cashew nuts post-harvest for several months within the same trading season since raw cashew nuts are not a highly perishable commodity. Fourth, there are few opportunities for spatial arbitrage for producers. Most producers sell their cashews at the farmgate to intermediary buyers, who live or visit the village during the trading season, with very few producers selling in centralised wholesale markets.
We have three main results showing that access to market information can support producers in their sales decisions. First, we find that the information system increased farmgate prices. We find a 2% intent-to-treat effect on average prices comparing treated producers with control producers in 2021. Whereas in 2020, we find a small and not statistically significant treatment effect. *Between*-village spillovers can explain why we did not find a larger increase in average prices. Our intent-to-treat estimates could be an underestimate of the effect of the intervention, which could have reached some control producers in more intensely-treated areas. We find that an additional treated producer within a 5 km radius increases the average farmgate price by 1%, affecting also producers in control villages closer to treated villages.[3] When accounting for between-cluster spillovers we find a positive and direct treatment effect of the intervention in both trading seasons, comparing treated producers with control producers without any treated producers within a 5 km radius. Second, we show that treated producers sold their cashews more frequently relative to the other producers across both trading seasons. This result is consistent with the advice that treated producers received through our messages, which advised them to sell their stock in multiple transactions. Treated producers report that they preferred to sell more than once as a result of the advice received and because they wanted to smooth their income. We interpret the changes in the frequency of sales as evidence that

[3] Although we acknowledge that we had not pre-specified our between-cluster analysis, our estimates of between-cluster spillovers are robust to endogenous exposure to our exogenous cluster-level randomisation, once we follow the methodology recently proposed by Borusyak and Hull (2021).

better informed producers attempt less risky sales strategies. Third, treated producers earned 20-23% higher revenue from all sales and barters, relative to the control group mean. The increase in revenue is consistent with the positive price effect and is also due to a larger amount of cashews sold in market transactions, instead of barters, own consumption, or towards repayment of loans. We are cautious in not over-interpreting the magnitude of this effect, as the estimates on revenue are noisy, and we cannot fully account for the increase in the quantity sold. The main mechanisms that explain our results is that our intervention increased bargaining power of producers. First, we find that treated producers in 2021 are 7% more likely than the control group to report having negotiated a higher price than the one that they were initially offered. Second, compared to control producers, treated producers are 6% more likely to sell to itinerant traders. Itinerant buyers can negotiate prices more freely than local buyers who typically receive a fixed fee from an exporter. Third, treated producers are less likely to rely on their buyers as a source of information for prices. Instead, treated producers are more likely to report having used the messages as a source of information to guide their sales decisions. Exploiting interviews conducted with buyers across a sub-sample of study villages, we find that treated villages had higher pass-through than control villages, as buyers earned lower margins but bought higher quantities. While these differences across villages are not statistically significant, they are consistent in their direction and magnitude with those obtained using the producers' data. Fourth, we find that our effects are more pronounced for producers with larger plots, consistent with the idea that producers with more cashews to sell have more room for negotiation.

Our findings are not consistent with other behavioural explanations. First, we do not find evidence that producers changed the timing of their sales to increase prices. Instead, we find that treated producers start selling some of their stock earlier, despite prices being lower at the beginning of the trading season. These earlier sales are consistent with the treatment reducing price uncertainty leading producers to revise downwards their reservation prices.[4] With lower reservation prices, treated producers are more likely to accept offers that they would have otherwise rejected. These earlier sales also help producers smooth their income during the trading season. By shifting some transactions earlier, treated producers are less likely to barter their cashew for rice later in the trading season, when the terms of barter are worse than market transactions. Second, we do not find evidence consistent with our effects being the result of better record-keeping induced by our intervention or by changes in preference parameters, such as risk aversion. Third, we also do not find evidence consistent

[4] Consistent with this interpretation, we find some weak evidence that treated producers had a more realistic outlook on prices for the upcoming trading season, suggesting that the information revised downward producers' reservation prices.

with the timing of the messages changing the salience of transactions. Receiving regular messages could have induced producers to sell more frequently just by making transactions more salient. We do not observe producers being more likely to report a transactions within two days of having received a message, leveraging transaction diaries that producers filled with the exact date of their transaction.

We add to the literature on the effects of information communication technologies in agricultural markets.[5] Prior work found mixed results on the benefits of market information systems for farmers.[6] Our study has three novel differences compared with previous studies. First, we focus on an export commodity, whose local price is primarily driven by international price fluctuations. Previous studies have not focused on export commodities but rather on internally consumed commodities. We argue that intra-seasonal price variation for internally consumed commodities is more likely to be known to producers than the price variation of internationally traded commodities, though both types of commodities expose farmers to price risk (Cardell and Michelson, 2023). Second, we are the first to evaluate a market information system that disseminated price information via audio messages (through robocalls and an interactive voice-response system) as opposed to text-based messages. This novel means of communication addresses the barriers faced by users with low levels of literacy in interpreting the information they received. Previous studies identified low levels of literacy as a potential explanation for the lack of positive effects of similar text-based interventions (Fafchamps and Minten, 2012).[7] Third, our messages provided not only a point estimate for the wholesale market price (Mitra et al., 2018) but also a range of farmgate prices for all regions in Guinea-Bissau. The messages also included market information on expected price developments and sales advice on when and at which price to sell production.

We contribute to the literature on agricultural commodity markets by showing that imperfect information can affect the timing of sales. Information frictions could be both spatial and temporal. Producers may lack information on both *where* and *when* to sell their output to maximise profits. With the introduction of new information technologies producers have been better able to decide *where* to sell (Jensen 2007; Aker 2010; Casaburi et al. 2013; Allen

[5] See Nakasone et al. (2014) or Aker et al. (2016) for reviews of this literature.

[6] Randomised evaluations of MIS in Colombia (Camacho and Conover, 2019) and India (Fafchamps and Minten, 2012; Mitra et al., 2018) have failed to find a significant average treatment effect on producer prices. In contrast, Svensson and Yanagizawa (2009) and Soldani et al. (2023) find that a MIS in Uganda and Ghana, respectively, increased producer prices by 7-10% for specific crops. In a related intervention, Goyal (2010) studies the expansion of information kiosks in district markets in Andhra Pradesh, and finds that the kiosks increased producer prices by about 1-3%.

[7] Cole and Fernando (2021) and Gupta et al. (2021) study an agricultural extension service that informed Indian farmers of different production practices via audio-based messages. But, they did not provide sales advice or price information.

2014; Parker et al. 2016). Instead, our study shows that producers may also lack information on *when* it is better to sell and how much to sell at different points in time. Credit or storage constraints may prevent producers from selling at the optimal time (Aggarwal et al. 2018; Kadjo et al. 2018; Burke et al. 2019; Mukherjee et al. 2021). We are the first to experimentally document how information frictions affect market timing in commodity markets. Earlier studies in this literature relied on non-experimental data to look at the effects of information on market performance over time (Osborne 2004; Fafchamps and Hill 2008).

Finally, our study contributes to the literature on information exchanges in agricultural markets. A large literature has documented the role that communication networks within rural communities play in the adoption of new technologies and sharing of agricultural practices, with a strong focus on within-village spillovers (Foster and Rosenzweig, 1995; Conley and Udry, 2010; Magruder, 2018; Beaman et al., 2021). Similarly to Fabregas et al. (2019); Nakasone (2013), who respectively evaluated an SMS-based agricultural advice service and a price information system, our study was explicitly designed to estimate potential *within*-cluster spillovers of our intervention.[8] More recent work has attempted to also measure the extent to which spillovers of market information systems may occur *between*-clusters, especially within groups of villages that had pre-existing strong networks (Soldani et al., 2023; Falcao Bergquist et al., 2021). Our study covers a vast geographic area, encompassing nearly the entire country, enabling us to identify between-village spillovers by leveraging the random intensity of treatment induced by our cluster-level randomisation, as in Miguel and Kremer (2004) or Egger et al. (2022).

This article is structured as follows. We begin by illustrating the main features of the market for cashew nuts in Guinea-Bissau, briefly describing its supply chain and the characteristics of the sample of producers we work with. To motivate the intervention, in Section 3 we lay out a simple conceptual framework to illustrate how the intervention may affect the frequency, timing, and prices of sales. In Section 4, we describe our intervention, our sampling and randomization protocol, and our estimation and inference strategy. Section 5 presents results on our main outcomes of interest. Before concluding, in Section 6, we analyze a set of potential competing explanations for the underlying mechanisms of our main results.

[8] A few papers study the presence of spillovers without relying on randomised saturation design. For example, (Cole and Fernando, 2021) and (Camacho and Conover, 2019) use variation induced by the experiment to also estimate spillovers *within*-clusters, such as the share of producers treated within a cluster or the share of producers' network that was randomly assigned to treatment. The design of Fafchamps and Minten (2012)'s study also allows for the estimation of *within*-village spillovers, but the authors do not report them, presumably since they did not find any direct effect of the SMS-based intervention evaluated.

2 Context of the study

2.1 International market outlook and the cashew value chain

Cashew nuts account for 90% of Guinea-Bissau's exports and are a key source of income for producers. The majority of production is exported unprocessed to countries such as India, Vietnam, and China, with only 10% serving the domestic market. The country's cashew market is significantly influenced by international supply and demand dynamics, similar to other internationally traded raw agricultural commodities like coffee and cocoa. However, the difference between export and farmgate prices varies greatly across years (see Figure 1), suggesting that market imperfections may reduce pass-through rates to producers.[9] To curb speculation, the government sets a reference farmgate price at the beginning of the trading season. However, this price may not always reflect market dynamics. Although it can influence market expectations, buyers are not obliged to pay this price when purchasing cashews.[10]
The cashew nut value chain in this market involves producers, intermediaries, wholesalers, and exporters. Intermediaries purchase raw cashew nuts from producers and either sell them to wholesalers or exporters. Intermediaries are either local or itinerant. Local intermediaries that reside in the village usually rely on exporters or wholesalers for pre-financing and earn a fixed commission. Itinerant intermediaries are more likely to self-finance their cashew purchases through other businesses or informal credit. Wholesalers collect cashews from smaller intermediaries and handle transportation and storage until selling to exporters. The export segment is relatively competitive. Exporters finance most of the operations in the value chain, fix contracts with processing plants, and bear the costs from farmgate to shipping, including insurance, banking, transport, and storage (Cont and Porto, 2014).
Margins between export and farmgate prices can vary also within the same year. Figure 2 reports the month-by-month average prices during the 2019, 2020, and 2021 trading seasons. During these years, the difference between export and producer prices moved by almost 50 XOF (17% of the farmgate prices) across different months. In general, farmgate prices tend to increase towards the end of the trading season. However, the starting point and

[9] All monetary values reported are in nominal West African CFA francs (XOF), which is pegged to the euro at an exchange rate of 1 EU for 656 XOF.

[10] For example, the difference between export and farmgate prices spiked in 2018, the year before our study. Export prices were twice the farmgate price. This spike was partly due to the government setting a reference farmgate price of 1000 XOF/kg, which exceeded what buyers were willing to pay and deterred entry among buyers. Consequently, many producers eventually sold their cashews at considerably lower prices as they could not wait any longer for the expected higher price.

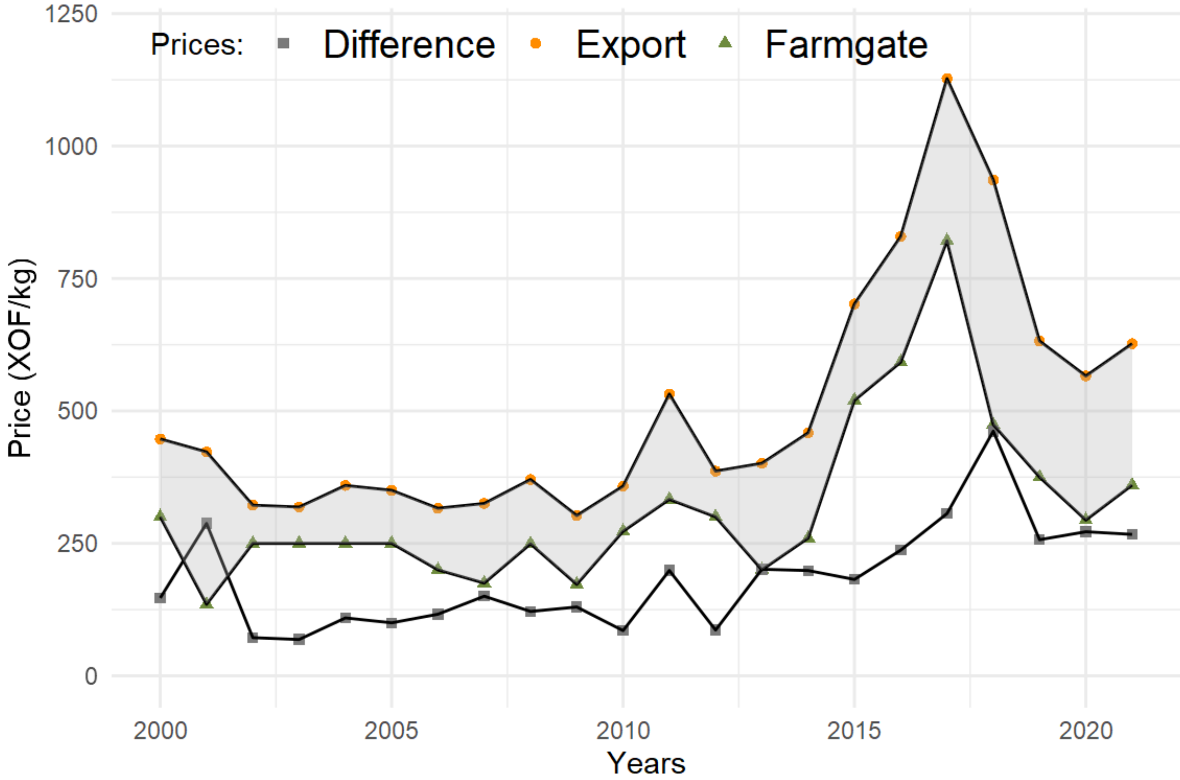

Figure 1: Margin between export and farmgate prices across years.[a]

[a] Source: Directorate for Macroeconomic Forecasting, Ministry of Economy and Finance of Guinea-Bissau. Raw cashew-nut prices per kg reported in nominal West African CFA francs (XOF). Export prices are free-on-board annual average prices from the Bissau port collected by the Ministry of Commerce, and farmgate prices are national annual averages collected by the National Statistics Institute.

peak of prices within the trading season still exhibit volatility from year to year.[11]

2.2 Descriptive statistics on cashew producers

At least 40% of households in the country are involved in cashew production. The majority (85%) of raw cashew nuts producers are smallholders. The remainder of this section characterizes producers in this market using data from our baseline survey. Our sample comprises 1,988 producers across 290 villages in the country and is fairly representative of the majority of cashew producers in Guinea-Bissau.[12]

[11] For example, overall prices dropped from 2019 to 2020 in part as a result of the COVID-19 pandemic shock, and increased between 2020 and 2021, in part due to the resumption of normal operation of processing factories. Appendix Section D.3 provides more details on how the trading seasons were affected by the COVID-19 pandemic.

[12] Appendix A provides details of our sampling strategy.

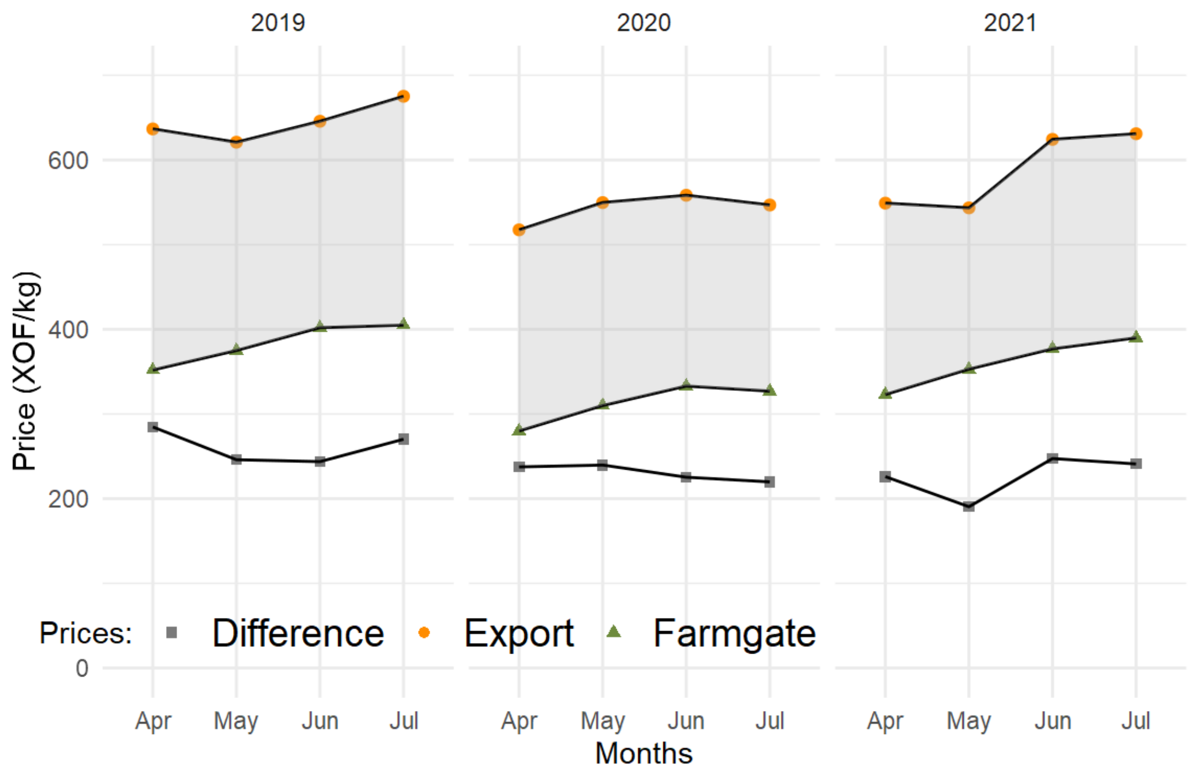

Figure 2: Margin between export and farmgate prices *within* years.[a]

[a] Source: Directorate for Macroeconomic Forecasting, Ministry of Economy and Finance of Guinea-Bissau. Raw cashew-nut prices per kg reported in nominal West African CFA francs (XOF). Export prices are free-on-board monthly average prices from the Bissau port collected by the Ministry of Commerce, and farmgate prices are monthly averages collected from producers in our study.

Villages in our study are in rural, often remote, areas. The median village has 24 cashew producers and three buyers that reside in the village. They are distant from markets. The median village is 22 km away from the closest sector capital, 46 km from the closest regional capital, and 155 km away from the capital, Bissau, where most of the raw cashew nuts are exported from.[13]

Producers in our study own relatively small plots and rely heavily on cashew production as a source of income. Our descriptive statistics, in Table 1, show that cashew sales constitute the primary source of income for 80% of our sample. The size of the median cashew field was around 3.4 hectares. In 2019, the average producer had reported producing about 1,500

[13] Guinea-Bissau is administratively divided into 9 regions, including a semi-urban region for the capital, Bissau. Regions are sub-divided into sectors, which are a smaller administrative unit. There are on average four sectors per region.

Table 1: Sample characteristics at baseline

	Mean	St. Dev.	25th percentile	Median	75th percentile
Individual-level characteristics:					
1 if cashews are the main source of income	0.80	0.40	1.00	1.00	1.00
Area plantation (hectares)	3.45	2.58	2.00	3.00	4.00
Total quantity produced (kg)	1526.59	1627.36	669.50	1125.00	1935.00
1 if a woman	0.06	0.23	0.00	0.00	0.00
Age	42.91	14.53	32.00	41.00	52.00
Household size	13.66	8.16	8.00	12.00	17.00
Years of education	3.95	3.85	0.00	3.00	6.00
Years of experience in cashew sector	10.41	7.11	5.00	9.00	15.00
1 if can read	0.29	0.45	0.00	0.00	1.00
1 if faces storage limitations	0.31	0.46	0.00	0.00	1.00
Number of sales	1.64	0.79	0.00	1.00	2.00
Number of potential buyers that made offers	2.82	1.77	1.00	2.00	4.00
Average price (XOF/kg)	390.92	100.58	332.18	370.94	450.00
1 if thinks that the reference price is important	0.38	0.48	0.00	0.00	1.00
1 if sold cashews in their own village	0.97	0.17	1.00	1.00	1.00
1 if sold most to local buyer	0.39	0.49	0.00	0.00	1.00
1 if sold most to itinerant buyer	0.54	0.50	0.00	1.00	1.00
1 if sourced market information from family	0.57	0.50	0.00	1.00	1.00
1 if sourced information on best time to sell	0.54	0.50	0.00	1.00	1.00
1 if heard of mobile MIS	0.06	0.24	0.00	0.00	0.00
Village-level characteristics:					
Number of cashew producers in the village	32.66	24.26	17.00	24.00	41.00
Number of cashew buyers in the village	3.57	3.41	1.00	3.00	5.00
Road distance in km to nearest sector capital	27.86	22.84	10.88	21.67	37.39
Road distance in km to nearest region capital	51.51	33.28	26.43	46.45	67.19
Road distance in km to the capital	160.63	68.37	102.08	155.56	215.86
Observations	1988				

kg of cashews. In terms of demographic characteristics, almost all producers in our sample are men (94%) with a median age of 41. Household sizes are large: the median household had twelve individuals. The median producer completed three years of education and had been working in the cashew sector for the previous nine years. About 30% of respondents were unable to read a basic sentence, hence developing a service that takes into account low literacy skills is important for many producers.

In general, producers sell their entire annual harvest during the same trading season between March and June. Most producers do not store cashews across seasons because their quality would deteriorate significantly during the rainy season, which starts in July. About two thirds of our respondents reported having no difficulties storing their cashews within the same trading season. Most producers reported that they concentrate their sales into a single transaction, as shown in Table 1. The median number of potential buyers is two, but the median number of sales is just one. This finding implies that deciding when to sell has high stakes for the majority of producers, as it will determine the largest share of their annual income. The reported farmgate price across all sales averages 390 XOF per kg. This price is significantly below the reference price of 500 XOF per kg that the government had originally proposed at the beginning of the 2019 trading season. In part due the discrepancy between the reference and the farmgate price, 38% of the respondents stated they believed the government reference price to be an important factor in their sales decisions.

Spatial arbitrage is rare in this market, as 97% of sales occur at the producers' home or somewhere else in the producer's village. Producers rarely transport their output to other markets, as doing so poses more risks and costs for them. Most producers do not have a network of potential buyers beyond the ones in their own village.[14] 54% of buyers are traders that temporarily visit the villages, whilst 39% are intermediaries that live regularly in the same village as the producers and that usually act as agents for an exporter.

Over half of the respondents mainly rely on family and friends for sales advice, while only a few use formal channels like producer associations. Among those seeking advice, the timing of the sale is one of the most sought-after types of information, along with the right price. Only 6% of producers in our sample had heard of any market information systems.

3 Conceptualising producers' sales decisions

To motivate our intervention, we outline a simple framework that examines the impact of increased information access on timing, sales frequency, and average prices. We borrow the model from Mitra et al. (2018) and incorporate our insights to explain specific aspects of the market in our experiment. The section aims to demonstrate that a straightforward framework capturing essential elements of our environment can lead to uncertain predictions about the effect of providing market information, contingent on behavioural assumptions.

3.1 A two-period model of producer sales

A producer negotiates with an intermediary buyer (a trader). There are two periods, $t=1$ and $t=2$, representing the first and second half of the trading season, respectively. Intermediaries resell cashews at export price x, which producers cannot directly access. Producers can sell to intermediaries in the village or go to wholesale markets, where they receive the reservation price $M(x_t)$, as an alternative if they cannot agree on a price with the intermediary. The total quantity for sale is normalised to 1, and producers choose proportions q_1 and q_2 to

[14] Based on qualitative interviews implemented in villages in our study.

sell in each period. They have a prior belief about x following distribution G, with support $[\overline{x}, \underline{x}]$. Producers maximise revenue $W(y_1)+\delta W(y_2)$, where y_t is revenue at time t, $W(.)$ is a strictly concave and strictly increasing function with $W'(0)=\infty$, and $\delta \in (0,1)$ is the discount rate. Producers cannot borrow across periods, and traders are risk-neutral.

To solve the producers' problem, we use backward induction. In period 2, the producer takes q_1 and p_1 as given. The equilibrium is non-revealing, characterized by the farmgate price offered $p_2^* = E(M(x_2)|p_1)$ and a quantity sold $(1-q_1)$, meaning the producer accepts the trader's offer without gaining information about export prices. In the first period, the non-fully revealing equilibrium offer, as in Mitra et al. (2018), is accepted if $p_1 \geq E[M(x_1)]$. To maximise revenue $W(p_1 q_1)+\delta W(p_2(1-q_1))$, the producer chooses q_1^* with the associated first-order condition given by Equation (1).

$$p_1 W'(p_1 q_1) = \delta p_2^* W'(p_2(1-q_1)) \tag{1}$$

The relationship between the first-period price and quantity sold depends on wealth and substitution effects. The concavity of $W(.)$ represents the wealth effect, where an increase in p_1 reduces the marginal value of revenue in that period. The substitution effect is represented by p_1 pre-multiplying the left-hand side of Equation (1). The net effect depends on the curvature of $W(.)$. For instance, assuming $W(y) = \frac{y^{1-\theta}}{1-\theta}$, if θ is greater than 1, a price increase in the first period decreases q_1. Otherwise, if θ is smaller than 1, the substitution effect dominates, leading to an increase in q_1.

3.2 How would an information intervention change sales and prices?

The intervention is modeled as a binary signal σ_t in each period, updating the producer's beliefs about the price distribution. If $\sigma_t = L$ and the signal indicates a low price, the producer expects $x_t \in [\underline{x}, \hat{x}]$. Alternatively, if $\sigma_t = H$ and the signal indicates a high price, the producer expects $x_t \in [\underline{x}, \overline{x}]$.

The farmgate price in each period depends on the signal, $p_{t(\sigma_t)}$ such that $p_{t(L)} < \tilde{p}_t \leq p_{t(H)}$, where $\sigma_t \in \{L, H\}$ and $\tilde{p}_t$ is the pre-intervention price. The proportion of output sold at $t=1$ satisfies the following first order condition:

$$p_{1(\sigma_1)} W'(p_{1(\sigma_1)} q_1) = \delta[\alpha_{(\sigma_2)} p_{2(H)} W'(p_{2(H)}(1-q_1)) + (1-\alpha_{(\sigma_2)})(p_{2(L)} W'(p_{2(L)}(1-q_1)))] \tag{2}$$

where the producer believes that the price will be high with probability $\alpha_{(\sigma_t)}$.

In both the 2020 and 2021 trading seasons, the information provided to producers indicated negatively correlated export price shocks across the two periods, with $\alpha_{(H)} \leq \alpha_{(L)}$. In this scenario, producers who received a low signal in the first period could infer a higher probability of increased prices in the second period. Given the concavity of $W(.)$, if the producer observed a low signal in the first period, they would sell more in that period to smooth revenue across periods. Treated producers might receive lower prices in the first period but higher prices in the second period if wealth effects dominate.[15]

The model yields an ambiguous prediction on the effect of information on the average sale price of treated producers, depending on how the following two scenarios balance each other. First, receiving a low price signal in the first period, may actually reduce the sale price of informed producers in that period. This is in part due to the fact that these producers may be more likely to accept price offers that uninformed producers will not accept because uninformed producers' reservation price may be higher, as shown also in the theoretical frameworks proposed by Courtois and Subervie (2015) and Albuquerque et al. (2022). Second, since treated producers received a signal about higher prices in the latter half of the trading season, they may extract more of the trade surplus during that period compared to uninformed producers. If wealth effects dominate, we would expect an increase in the frequency of sales among treated producers, as they are likely to sell both earlier and later in the trading season. Our framework serves to highlight some less intuitive features of the decision producers face, but we do not claim it is the only way to model our intervention.[16]

4 Study design, data, and empirical strategy

4.1 Intervention: a Mobile Market Information System

Our intervention consists in providing market information to cashew producers in Guinea-Bissau during the trading season, via text or audio messages.

The weekly market information messages included three components: (i) current cashew-nut prices in different regions of Guinea-Bissau, (ii) important market news, and (iii) sales advice based on expected market trends. These messages were developed on a weekly basis by a network of market analysts known as the *n'kalô* service, a market information system already operating in other West African countries that we introduced to Guinea-Bissau. The content was generated by combining analysis from national market analysts, who gather farmgate

[15] A similar result is true if we assume the export prices to be independent across the two periods, i.e., $\alpha_{(H)} = \alpha_{(L)}$. In this case, the right-hand side of Equation (2) is independent of the signal, but a low signal in the first period would still induce more sales by concavity of $W(.)$.

[16] For example, an extension of our model could include different types of buyers, such as risk-averse itinerant traders and risk-neutral local buyers. The negotiation process between a risk-averse buyer and producer would yield predictions akin to the risk-sharing model with full commitment, also discussed by Mitra et al. (2018). These predictions would be qualitatively consistent with those of our simple framework. Since we do not have data on itinerant traders preferences, we prefer to leave this extension for future work.

prices and local market updates, with insights from neighboring or international markets collected and summarised by an international analyst. Appendix Table A.19 provides the complete content of the messages sent during both trading seasons.

As a part of the intervention, treated producers received a one-hour training on the main factors determining the farmgate price and how receiving our weekly messages could improve their sales decisions. The research team provided the training on the same day of the baseline survey, shortly after the baseline interviews were completed. The messages were delivered during the trading seasons through a combination of text messages, robocalls, and through an Interactive Voice Response (IVR) service that replayed the latest robocall sent. Specifically, in 2020 our weekly messages were delivered between April and August 2020, whereas in 2021 we delivered messages between March and July 2021, as we detail in Appendix Section E.

4.2 Experimental design

We implemented a two-stage sampling and randomisation to conduct our study. In Appendix Section A, we provide the details of how we conducted the sampling and randomisation, which we briefly summarise here. In the first sampling stage, we selected a random sample of 290 villages with the aim of picking villages that were as far from each other as possible. Second, upon visiting each village, the research team randomly sampled seven producers to be interviewed, with the support of the local village authority, to obtain an overall sample at baseline of 1988 producers.

In the first stage of randomisation, we randomly allocated two thirds of villages to receive our intervention, and one third to act as our control group. We stratified random assignment by creating triplets of villages that were most similar along a set of village-level characteristics. In the second stage, in treated villages, the research team randomly allocated the intervention only to four out of the seven interviewed producers through a public lottery. Figure 3 shows how we allocated participants across treatment, spillover, and control groups.

We collected three rounds of interviews with cashew producers to evaluate the effects of our market information system. First, we conducted an in-person baseline survey between October and December 2019. Second, between April and May 2021 we conducted an in-person follow-up survey to ask about the trading season in 2020, once it was safe to resume face-to-face contact with sanitary precautions. During this survey we interviewed 86% of producers that had taken part in the baseline in 2019. We also recovered a transaction diary that we had left with producers during the baseline survey for them to fill with details of each sale during the 2020 trading season. After completing the in-person follow-up survey, producers in both the treatment and control villages were provided with information on the

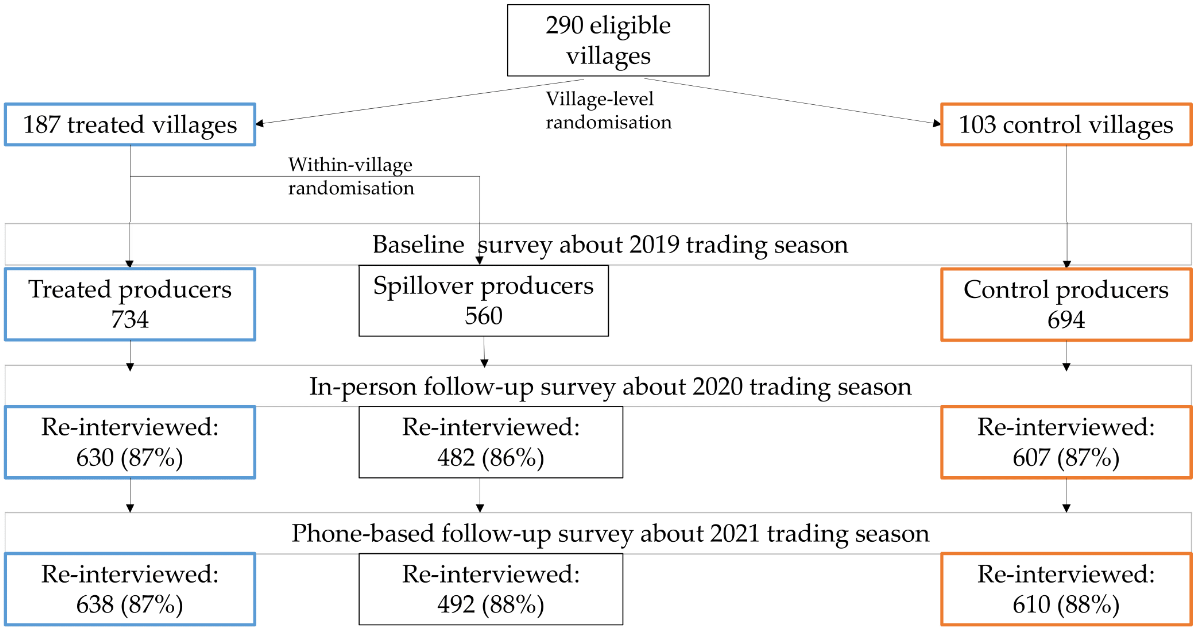

Figure 3: Flowchart of participants through the study[a]

[a] Notes: Each box denotes the number of participants (or villages) in the study, by treatment group and survey rounds. Percentages in parentheses indicate the re-interview rate relative to the baseline.

n'kalô service and were shown how to subscribe as fee-paying users to receive information during the remainder of the 2021 trading season. Treated producers continued to receive free messages in 2021. Third, to assess the effects of our information in 2021, we conducted a phone-based follow-up on a key set of outcome variables between December 2021 and March 2022, during which we reached almost 88% of the baseline sample.[17]

4.3 Empirical strategy

Our main specification is:

$$y_{iv} = \beta \cdot treatment_{iv} + \delta \cdot spillover_{iv} + \gamma \cdot y_{0iv} + \alpha_{t(v)} + \epsilon_{iv} \tag{3}$$

[17] Between July and October 2020 we had also conducted a shorter phone-based follow-up to check how our study participants were coping with the COVID-19 pandemic. Though in our first pre-analysis plan we had intended to use the data from this interim phone-based follow-up to assess the impact of the service, we decided against using it for two reasons. First, we had mistakenly contacted treated producers and later control producers making the timing of the call correlated with treatment status. Second, we only reached 66% of the baseline sample during this survey, partly because we detected fraud by one member of the research team which meant we had to discard about 10% of the interviews. Results from this interim survey are available upon request and are broadly consistent with the data we collected in person in 2021.

where: i and v index individuals and villages, respectively; y_{iv} denotes the outcome of interest measured in the follow-up; y_{0iv} denotes the outcome of interest measured in the baseline; $treatment_{iv}$ denotes individual-level assignment to the treatment group; $spillover_{iv}$ denotes individual-level assignment to the spillover group in treated villages; $\alpha_{t(v)}$ denotes the randomisation triplet fixed effect (as described in Section A.3) and $t(v)$ indexes the triplet of villages; ϵ_{iv} is the unobserved variation in the outcome. We present estimates from Equation 3 separately for the 2020 (Year 1) and 2021 (Year 2) trading seasons.

We cluster standard errors at the village-level, the unit of our first level of randomisation. Our coefficient of interest is β, the intent-to-treat (ITT) effect. In Appendix Section C we also describe alternative empirical specifications (e.g. top-winsorizing continuous variables, including additional controls to account for baseline imbalances, clustering at the triplet-level) to test the robustness of our main specification.

4.4 Inference and multiple-hypothesis testing adjustments

For each of our pre-specified outcomes, we test the following hypothesis:

(i). $H_0 : \beta = 0$: The intervention had no effect;

(ii). $H_0 : \delta = 0$: The intervention had no spillover effect;

(iii). $H_0 : \beta = \delta$: The intervention had no effect relative to the spillover group;

For each of these hypothesis tests, we report the False Discovery Rate (FDR) adjusted q-values, taken across the family of outcomes (Benjamini et al., 2006). For each type of test, we construct a q-value for that test across outcomes.[18]

For clarity, we link the statistical hypotheses above with the underlying economic predictions. A rejection of the null hypothesis (i) implies that the random allocation to receive market information did affect producers' outcomes, such as prices and revenue. Whereas a rejection of the null hypothesis (ii) implies that the intervention has affected the outcomes of untreated producers living *within* treated villages. These spillovers may be due, for example, to communication between treated producers and untreated producers living within the same village. Rejecting null hypothesis (iii) implies that producers that were allocated to the intervention (and also participated in the training) are affected by the treatment relative to untreated producers living in the same village.

[18] Specifically, we construct a set of q-values using all p-values for the null hypothesis 'The intervention had no effect'; we construct a set of q-values using all p-values for the null hypothesis 'The intervention had no spillover effect', and a set of q-values using all p-values for the null hypothesis 'The intervention had no effect relative to the spillover group'.

4.5 Experimental integrity

Appendix Table A.1 show that our baseline sample is relatively balanced across treatment arms for our main outcome variables of interest, except for two of the nine variables. The differences between the mean of the quantity (and value) of cashews exchanged for rice at baseline is larger in the treatment group compared to the spillover and control groups, but these differences are not very large, accounting for about 4% of the quantity sold in monetary transactions. Our empirical strategy includes the baseline value of the outcomes as control variables, which would allay concerns that imbalance in the outcome variables of interest would affect our estimates of the treatment effects.

Appendix Tables A.2 and A.4 show that our baseline sample is also relatively balanced across treatment arms across producer-level and village-level baseline characteristics. The differences between the mean of 9 of the 25 producer-level characteristics are statistically significant across treatment groups. However, these differences are not large, as none of the pairwise standardised differences in means are larger than 0.21 standard deviations. Out of the eight village characteristics considered, we find that treated villages have one more village trader relative to control group villages on average. As a robustness check for our main outcomes of interest, we control for the producer and village characteristics unbalanced at baseline, and report these results in Appendix Section C.2.

Overall attrition in both our follow-up surveys was small and uncorrelated with treatment assignment. In the in-person follow-up survey attrition was 14% and in the subsequent phone-based survey attrition was less than 13% overall, as shown in Appendix Table A.5.[19] We have at least one follow-up with about 78% of our baseline sample, though we focus our analysis on the sample present in either round.

Our measures of compliance confirm that the information was successfully delivered to the allocated group of producers. To measure compliance, we use both self-reported and administrative data. The measure constructed using self-reported data is an indicator based on the question "Did you use the service in [2020/2021]?".

In Table 2, we find a large positive difference in compliance between treated producers and the other producers. Using survey data, in 2020 (Year 1), 25% of treated producers reported using the service, while 2% and 3% of control and spillover producers, respectively, also reported using it. After completing the in-person survey, all study participants were informed of the existence of the service and shown how to subscribe to it. In 2021 (Year 2),

[19] These estimates are unchanged if we predict attrition indicators via post-double least absolute shrinkage and selection operator (Belloni et al., 2014), adding as potential controls all variables we analyse in our balance tests. None of these variables are retained as controls once we partial out the triplet fixed effects and the treatment and spillover indicators.

after all participants had been informed about the service, 43% of the control group producers reported using it. Treated producers were still 18 percentage points more likely to use the service, as they continued receiving messages at no cost during the study. The administrative data, collected by our partner mobile network operator, supported the patterns observed in the self-reported data. According to this data, 53% of treated producers received at least eight messages in 2020 (a third of the total), while no messages were sent to other producers. In 2021, 28% of treated producers still received at least five messages (a third of the total), and 8% of other producers received a similar amount. Despite contamination across groups, we still find a large take-up difference between treated and non-treated producers.

We prefer not to estimate treatment-on-the-treated (TOT) effects but focus our attention to the intention-to-treat estimates. Given the potential presence of spillovers within the cluster, assuming that non-compliers might have had no effect of treatment is too strong an assumption to entertain. A naive estimate of the treatment-on-the-treated would overestimate the effect of the treatment on compliers, inflating the intention-to-treat estimates by the inverse probability of take-up.

5 Results

In this section, we present the main effects of the intervention, estimated using the data collected in our two follow-up surveys. We first show results on the primary outcomes of interest (price and revenue), before turning our analysis to quantities of raw cashew nuts sold for cash or exchanged for rice. The analysis follows our pre-analysis plan, and we note where we may have deviated from it.

5.1 Prices and revenue

We find that producers earn higher prices once they receive better market information. Table 3 shows our results from both follow-up surveys on prices and revenue.

We find a positive treatment effect on prices that corresponds to about 7 XOF per kg, equivalent to 2% of the control group mean (q-value: 0.06). This effect comes from the 2021 trading season (column 6), whereas in 2020 (column 2) the effect is also positive but smaller (less than 1% of the control mean) and not statistically significant. For 2021, we also find a difference between the treatment group and the spillover group in the average prices though not robust to multiple hypothesis testing. There is no difference between treatment

Table 2: Compliance — Take-up of the intervention

	Year 1 (1) Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treatment-Spillover	Year 2 (5) Mean (SD) Total obs.	(6) Treatment	(7) Spillover	(8) Treatment-Spillover
Self-reported data:								
1 if heard of mobile MIS	0.14	0.30***	0.10***	0.20***	0.68	0.12***	0.04	0.08***
	(0.35)	(0.02)	(0.03)	(0.03)	(0.47)	(0.03)	(0.03)	(0.02)
	1714	[0.00]***	[0.00]***	[0.00]***	1724	[0.00]***	[0.13]	[0.00]***
1 if used mobile MIS	0.02	0.25***	0.03	0.22***	0.43	0.18***	0.05*	0.13***
	(0.16)	(0.02)	(0.02)	(0.02)	(0.49)	(0.03)	(0.03)	(0.03)
	1714	[0.00]***	[0.10]	[0.00]***	1724	[0.00]***	[0.13]	[0.00]***
Administrative data:								
Take-up rate	0.00	0.53***	0.00	0.53***	0.08	0.28***	0.01	0.27***
	(0.00)	(0.02)	(0.01)	(0.02)	(0.27)	(0.02)	(0.02)	(0.02)
	1988	[0.00]***	[0.86]	[0.00]***	1988	[0.00]***	[0.52]	[0.00]***

Notes: Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 across year 1 (2020) and year 2 (2021). Columns 4 and 8 test for differences in parameters obtained in previous two columns. The top panel presents self-reported measures of engagement and take-up of the mobile market information system. The bottom panel presents a measure of take-up derived from administrative data from the mobile partner operator, MTN, that managed the technology of the service. The measure of take-up is equal to one if at least a third of the messages sent reached the respondent, where we define "reached" as an SMS being received or the robocall being listened for at least 45 seconds. In 2020, we sent 24 messages, so we codetake-up equal to 1 if respondents were reached by eight messages. In 2021, we sent 15 messages, so we code take-up equal to one if the respondents were reached by five messages. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 and column 5 display the control mean; standard deviation; and total number of observations across all groups in the estimation sample.

and spillover group in 2020.[20]

We also find noisy increase in revenue from cashews overall. The second row in Table 3 shows that the total value of cashews that were either sold or exchanged (directly for rice) increased by about 21-23% of the control group mean in both years for the treatment group, by 61,650 XOF (q-value: 0.05) in 2020 and by 105,533 XOF (q-value: 0.00) in 2021.[21] Relative to the spillover group, producers in the treatment group earn a marginally higher revenue from sales and exchanges, on average, but this difference is not statistically significant in 2020 and only significant at the 10% level in 2021 (q-value: 0.10). The spillover effect corresponds to around 13-15% of the control group mean, but is only statistically significant in 2021 according to naive p-values. The coefficient decreases and loses statistical significance in our robustness checks, but it remains always positive and of a similar magnitude.

In the bottom rows of Table 3, we separately analyse the effects of the intervention on the value of monetary sales and the value of cashews exchanged for rice. The results in both years show that an increase in the value of monetary sales accounts for the treatment effects on the sum of these two components. In 2021, treated producers obtain on average 95,366 XOF (q-value: 0.00) more earnings from sales of cashew nuts relative to the control group, a 26% increase relative to control group mean, also significant at the 1% level. In 2020, treated producers obtain on average 51,336 XOF (q-value: 0.05) more earnings from sales of cashew nuts relative to the control group, a 22% increase relative to control group mean, also significant at the 5% level. We find that producers in the spillover group report higher value of cashews exchanged for rice relative to the control group across both years, though this effect is not statistically significant once we account for multiple hypothesis testing. We do not find significant differences between the treatment and the spillover group, which are small in magnitude and negative. Overall, we find that price increase for the treated producers in 2021 and that the intervention increased the value of sales and exchanges, mostly through an increase in the value of sales across both years. These results remain broadly robust to a number of alternative specifications. The effect on prices are not driven by large outliers, as our conclusions do not change once we top-winsorize the data at the 99th or 95th percentile (Appendix Table A.6 and

[20] The estimation sample includes all the producers that we reached in the respective follow-up survey. In order to not condition our outcome on the decision to sell, we recode the average price across sales to be equal to zero for producers that did not conduct any sales and add as a control an indicator equal to one for observations for which we impute this zero price. Our results are not affected by this imputation strategy once we control for it in the regression model.

[21] While the average price of sales is only computed for monetary transactions, the total value of all sales and exchanges includes also the total revenue from cashew trades that were repaid in rice. We value the rice received in exchange of cashews using elicited hypothetical valuations from producers. We obtained these valuations through a specific module in our questionnaire designed to ask how much producers think the rice individuals in their village receive in exchange for cashews is worth in monetary terms.

A.7). The inclusion of unbalanced controls reduces the magnitude of the effect on prices by 1-3 XOF per kg in either year, which remain positive but not statistically significant (Appendix Table A.8). Re-clustering reduces the statistical significance of the 2021 difference between the treatment and the spillover group. We still find a positive and significant difference in prices between treatment and control group once we pool across years (Appendix Table A.11).

We note that our effects on revenue are noisy, judging from the standard error of the coefficients. When we winzorize the total value of sales and exchanges at the 99th and 95th percentiles, respectively in Appendix Table A.6 and A.7, the treatment effect remain positive but smaller and not statistically significant in 2020, corresponding to about 8-10% of the control group mean, and of a similar magnitude in 2021, but not statistically different from the spillover effect. Our estimates of the effect on revenue remain broadly similar across other robustness checks, though not always robust to multiple hypothesis testing in 2020.

To better understand the impact of treatment on average producer prices, we plot the cumulative distribution of prices across treatment arms in Figure 4 for 2020 and 2021. We can see that price effects are hard to detect in 2020. However, in 2021, our effects appear to be driven by the top half of the distribution of prices. In particular, treated producers are more likely to sell at the median price of 350 XOF/kg relative to other treatment groups. There are no differences across groups in the likelihood of reporting no sales at all, as hinted by the left-most vertical bar in the figure.

5.2 Quantity sold or exchanged

To unpack our results on price and revenue, we next analyse the producers' quantities of cashews sold or exchanged, on the extensive and intensive margins. Changes in the amounts of cashews sold or exchanged can help us understand our effects on revenue, given the modest effects on average prices. Indeed, in Table 4 we see that treatment group report selling on average 142 kg (q-value: 0.05) in 2020 and 211 kg (q-value: 0.00) in 2021 more than those in the control group, about a 20% increase relative to the control group mean.[22]

We also find statistically significant differences between the control and spillover producers in the amount of cashews sold in 2021, but not in 2020. The spillover effects are positive and lower than our treatment effects.

Our intervention induced producers to sell more frequently their cashews relative to the control and spillover groups, consistently across both years. Treated producers sell their cashews more times during the season, with the average number of sales being 0.20 higher (q-value: 0.00) relative to the control group, which represents 12-14% of the control group mean. This

[22] In our robustness specifications the coefficients on quantity sold remain smaller but broadly robust in 2021, whereas in 2020 they also decrease and remain statistically significant at the 10% according to naive p-values.

Table 3: Results — Prices and revenue

	Year 1				Year 2			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Mean (SD) Total obs.	Treatment	Spillover	Treatment-Spillover	Mean (SD) Total obs.	Treatment	Spillover	Treatment-Spillover
Average price (XOF/kg)	295.71	2.07	2.33	-0.26	355.77	6.89**	1.32	5.57*
	(104.36)	(3.46)	(3.35)	(3.30)	(83.13)	(3.41)	(3.37)	(3.05)
	1587	[0.55]	[0.49]	[0.94]	1704	[0.06]*	[0.69]	[0.10]
Value of all sales and exchanges (XOF)	287786	61650**	44747	16904	440724	105533***	58183**	47351*
	(315353)	(25296)	(26607)	(22543)	(461069)	(30721)	(28816)	(26518)
	1520	[0.05]**	[0.19]	[0.61]	1686	[0.00]***	[0.13]	[0.10]
Value of all sales (XOF)	233495	51336**	24129	27207	364477	95366***	41746*	53620**
	(292722)	(22678)	(23274)	(19951)	(428369)	(26633)	(25166)	(24217)
	1591	[0.05]**	[0.40]	[0.61]	1705	[0.00]**	[0.13]	[0.10]
Value of exchanges (XOF)	52326	10969	17252*	-6282	75662	9775	15941*	-6165
	(88038)	(8146)	(9739)	(7314)	(111393)	(8464)	(8616)	(7953)
	1635	[0.24]	[0.19]	[0.61]	1710	[0.25]	[0.13]	[0.44]

Notes: Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 across year 1 (2020) and year 2 (2021). Column 4 and column 8 test for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 and column 5 display the control mean; standard deviation; and total number of observations across all groups in the estimation sample.

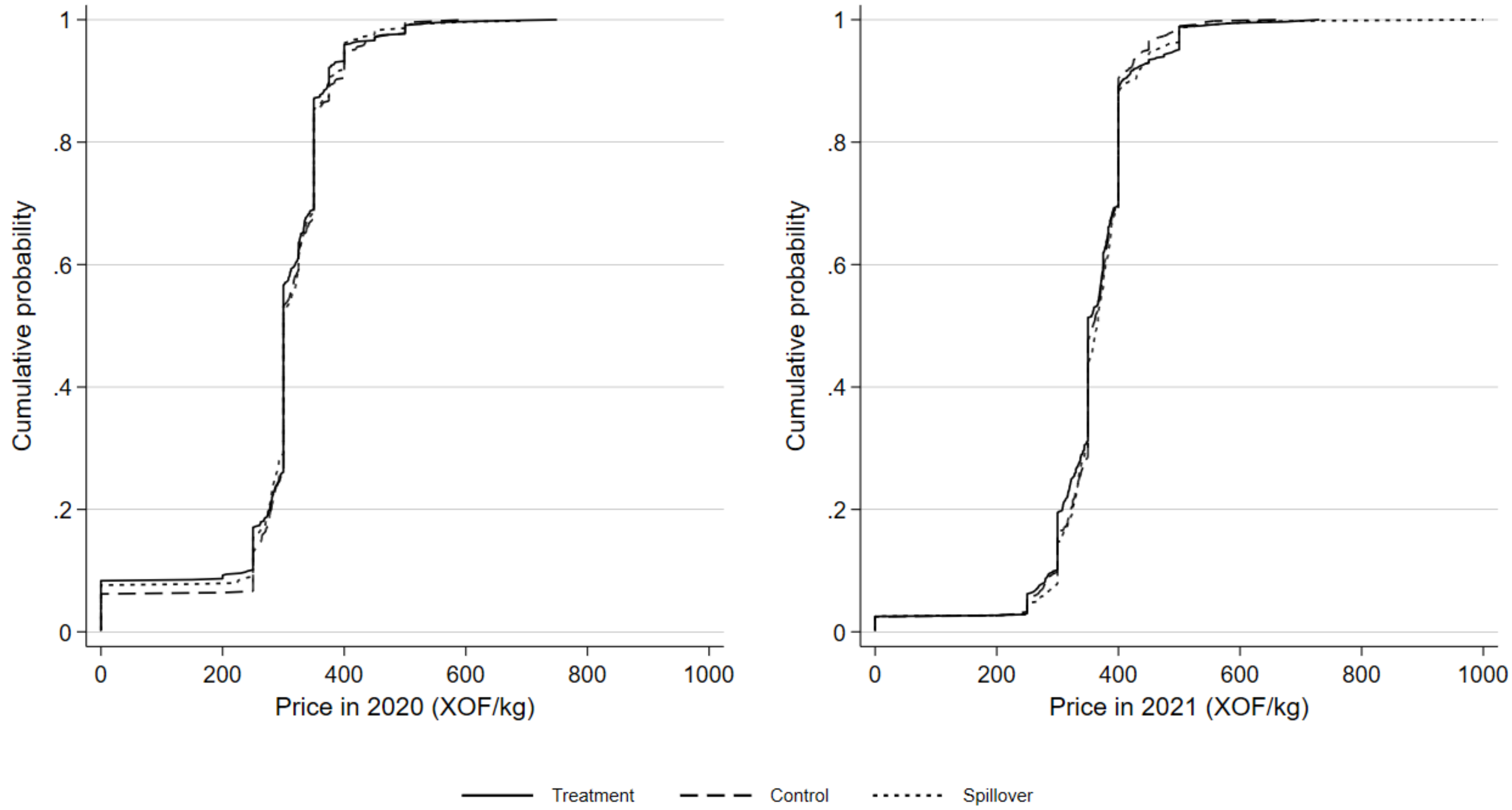

Figure 4: Distribution of average producer prices by treatment arm[a]

[a] Source: In-person (2020) and phone-based follow-up (2021) surveys. Prices (average across all sales for each producer) are reported in nominal West African CFA francs (XOF). We recode the price to be equal to zero for producers that did not conduct any sales.

treatment effect is statistically significant at the 1% level and is robust to our alternative specifications. The difference between the treatment and the spillover group is also robust to our alternative specifications and remains statistically significant (q-value: 0.08-0.10). This behaviour is consistent with the advice provided by our intervention, which advised producers to sell cashews in multiple sales, given an expected increase in prices in the latter half of the trading season. We only find an increase in the number of sales among producers in the spillover group in 2021. The estimated spillover effect is positive, smaller than for the treatment group but not statistically significant after controlling for multiple hypothesis testing. Our intervention does not have a large effect on the quantity of cashew exchanged for rice relative for treated producers to control producers, and the same is true for producers in the spillover group. The total quantity of cashew exchanged for rice is somewhat larger for both treated and spillover producers, more so for the latter. Spillover producers report an extra 70 kg of cashews exchanged for rice relative to the control group in 2021 (q-value: 0.07) and 26 kg more relative to the treated producers (q-value: 0.53). We find no treatment or spillover effects of the intervention on the share of the quantity sold over the quantity exchanged and sold.

6 Mechanisms

In this section, we explore mechanisms that can explain our results. First, we show some evidence consistent with our intervention having increased the bargaining power of producers. Second, we test for *between*-cluster spillovers to see whether our effects on prices may have been attenuated by the information affecting control producers, although we had not pre-specified this analysis. Third, we try to understand whether producers changed the timing of their sales or their knowledge about relevant information on the cashew market as a result of our messages. Finally, we explore alternative behavioural explanations to try to account for the increase in the quantity sold and to try to rule out whether our results may be explained by changes in outcomes where we would not expect to see any results *a priori* — a set of placebo outcomes.

6.1 Bargaining power

We find evidence that an increase in bargaining power can explain why prices increased. Four findings support this mechanism.

First, we find that producers, especially in 2021, report having been able to negotiate a higher price than the one they were originally offered (top panel, Table 5). We see that treated producers are 7% more likely to report having gained a higher price than the one originally offered relative to control producers, though this effect is only significant at the 10% using naive p-values. We find no evidence that the treatment induced producers to

Table 4: Results — Quantities sold and exchanged

	Year 1 (1) Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treatment-Spillover	Year 2 (5) Mean (SD) Total obs.	(6) Treatment	(7) Spillover	(8) Treatment-Spillover
Total quantity sold (kg)	708.21	141.75**	63.53	78.21	981.13	211.49***	93.73	117.77**
	(855.14)	(61.11)	(62.11)	(54.72)	(1163.13)	(64.24)	(61.88)	(54.62)
	1622	[0.05]*	[0.45]	[0.38]	1709	[0.00]***	[0.22]	[0.08]*
Number of sales	1.49	0.21***	0.07	0.14**	1.66	0.20***	0.08*	0.11**
	(1.01)	(0.06)	(0.06)	(0.06)	(0.92)	(0.05)	(0.05)	(0.05)
	1693	[0.00]***	[0.45]	[0.10]*	1730	[0.00]***	[0.21]	[0.08]*
1 if exchanged cashew for rice	0.56	-0.01	-0.03	0.03	0.56	-0.01	-0.00	-0.01
	(0.50)	(0.03)	(0.03)	(0.03)	(0.50)	(0.03)	(0.03)	(0.03)
	1706	[0.85]	[0.45]	[0.59]	1724	[0.60]	[0.99]	[0.58]
Total quantity exchanged (kg)	217.70	19.62	20.91	-1.30	231.72	44.46	70.75**	-26.28
	(323.48)	(24.38)	(25.70)	(23.10)	(346.31)	(27.70)	(28.41)	(26.38)
	1681	[0.53]	[0.45]	[0.96]	1707	[0.18]	[0.07]*	[0.53]
Share of quantity sold over quantity exchanged and sold	0.73	0.02	0.02	0.00	0.79	0.01	-0.00	0.01
	(0.32)	(0.02)	(0.02)	(0.02)	(0.25)	(0.02)	(0.02)	(0.01)
	1604	[0.53]	[0.45]	[0.96]	1691	[0.60]	[0.99]	[0.57]

Notes: Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 across year 1 (2020) and year 2 (2021). Column 4 and column 8 test for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 and column 5 display the control mean; standard deviation; and total number of observations across all groups in the estimation sample.

act as intermediary buyers. In our control group, 7% of producers report having bought cashews from other producers for resale. However, we find that producers in the spillover group reported receiving offers from more buyers relative to the control group in 2020. The difference between the treatment and spillover group is negative but not statistically significant after accounting for multiple-hypothesis testing. A possible explanation for the latter pattern may be that the service induced some traders to purchase cashew nuts from other producers in the same village, that were not as informed about market developments as the treated ones. On average the control group reported receiving offers from about 3 potential buyers. The spillover producers received offers from an extra 0.3 buyers (q-value: 0.01) relative to the control group, an increase of 10% of the control group mean.

Second, treated producers change the allocation of their sales to different buyers (middle panel, Table 5). Treated producers sell less to local buyers and more to itinerant buyers, especially in 2021. Treated producers sell, on average, 6 percentage points more of their output to itinerant buyers. Those type of buyers are more likely to self-finance their operations and have more room to negotiate with producers over a price. In 2020, we also see that treated producers sold 4 percentage points more of their output to itinerant buyers, but this effect is not statistically significant.[23]

Third, we find that producers that receive our information change the source of information about market conditions. They move away from intermediaries as a source of information and they start to rely more on the messages that we have sent them through their mobile phones (bottom panel, Table 5). In 2020, treated producers report being 4-6 percentage points (q-value: 0.00) less likely to rely on intermediaries as a source of market advice. We interpret this switch in source of information alongside the change in the type of buyer as evidence that the messages changed producers' negotiation strategy. We had not pre-specified this family of outcomes and only recorded this data in the in-person follow-up, so we can only speculate that the change in this behaviour might have persisted also in 2021.

Fourth, we find that our positive effects are larger for producers with more bargaining power to begin with. In Figure 5 we plot heterogeneous treatment effects on our two focal outcomes, average price and quantity sold across the two years. We find suggestive evidence that our effects on prices are larger for producers with cashew plots that are in the top tercile of the distribution (row 2, column 3, Figure 5). Producer with larger plots are those with larger amounts to

[23] We deviate slightly from our analysis plan in reporting the shares sold to different buyers, as opposed to the pre-specified indicator variables equal to one if the producer sold the majority of the stock to a specific type of buyer. In Appendix Table A.12 we present our pre-specified outcomes within this family of variables. Our conclusions remain qualitatively similar, though not robust to multiple hypothesis testing with the pre-specified measures.

sell, which may be able to negotiate harder for deals than those with fewer bags of cashew nuts to sell. There is no clear difference in treatment effects or consistent pattern based on whether producers were able to read, their level of assets, or the distance with the closest urban market (in the administrative capital of the sector), or the number of other producers in the village.

6.2 Between-cluster spillovers

To further unpack our main results, we explore whether spillover effects may have occurred across villages. While our sampling design aimed to minimize between-cluster spillovers by maximising distances between sampled villages, market information could still flow between closely connected villages, potentially influencing how itinerant traders negotiate prices across nearby areas (Soldani et al., 2023; Falcao Bergquist et al., 2021). We test for the presence of *between*-village using a similar approach to Miguel and Kremer (2004) and Egger et al. (2022), which we describe in detail in Appendix Section C.6. Specifically, we test whether the number of treated individuals within a radius of 5 km, conditional on the number of villages in our sample within that radius, significantly changes prices and quantities sold beyond the producer-level treatment assignment. Identification relies on our village-level randomisation— the number of treated producers within a 5 km radius should be plausibly exogenous after controlling for the number of villages in our study within a 5 km radius. Appendix Figure A.1 shows how treatment intensity varies spatially in our sample.[24] We find evidence of *between*-village spillovers, with prices being higher in more intensely treated areas than those without any treated producers (white markers in Figure 6). In 2020, our estimate of the effect of an additional treated producer within a 5 km is similar to our direct estimate of treatment effects, and is statistically significant at the 10% level. The magnitude of these spillovers on prices corresponds to a 0.7% increase for every treated producer within a radius of 5 km. To unpack these effect across our experimental arms, we interact the number of treated producers within 5 km and the indicators for whether producers are in either the treatment or spillover group (black markers in Figure 6). The *between*-cluster spillovers are driven by producers in control villages that neighbour treatment villages. These producers report an increase of about 2-4 XOF (1.3% of the control group mean) for every additional individual treated within a 5 km radius, relative to control group producers without any treated individual within a 5 km radius. The direct effects in treated villages that are not close to other treated villages are positive and statistically significant at the 10% level. Assuming a linear relationship between the number of treated individuals

[24] Specifically, 40% of villages have another sampled village within a 5 km radius, 9% of villages have two sampled villages, 1% had three sampled villages, and the remaining 50% had none. 27% of villages have another treated village within a 5 km radius, 8% of villages have two treated villages, and the remaining 65% had none.

Table 5: Mechanisms — Increased bargaining power

	Year 1 (1) Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treatment-Spillover	Year 2 (5) Mean (SD) Total obs.	(6) Treatment	(7) Spillover	(8) Treatment-Spillover
Panel A: Bargaining power								
Number of succesful bargains	0.14	-0.00	-0.02	0.01	0.46	0.07*	0.07	0.00
	(0.37)	(0.02)	(0.02)	(0.02)	(0.71)	(0.04)	(0.05)	(0.05)
	1690	[0.89]	[0.44]	[0.57]	1729	[0.29]	[0.41]	[0.95]
1 if acted as intermediary	0.07	0.01	0.01	-0.01	0.06	0.01	0.02	-0.01
	(0.26)	(0.01)	(0.02)	(0.02)	(0.23)	(0.01)	(0.02)	(0.02)
	1713	[0.89]	[0.44]	[0.57]	1725	[0.89]	[0.41]	[0.95]
Number of potential buyers that made offers	2.91	0.08	0.30***	-0.21**	3.18	0.01	0.05	-0.04
	(1.82)	(0.09)	(0.10)	(0.10)	(2.02)	(0.10)	(0.11)	(0.12)
	1671	[0.89]	[0.01]***	[0.12]	1703	[0.89]	[0.63]	[0.95]
Panel B: Share of cashews sold to...								
...a local buyer	0.47	-0.02	0.02	-0.05	0.57	-0.05*	-0.03	-0.02
	(0.49)	(0.03)	(0.03)	(0.03)	(0.48)	(0.03)	(0.03)	(0.03)
	1494	[0.47]	[0.69]	[0.25]	1651	[0.08]*	[0.56]	[0.54]
...an itinerant buyer	0.47	0.04	-0.01	0.04	0.41	0.06**	0.03	0.03
	(0.49)	(0.03)	(0.03)	(0.03)	(0.48)	(0.03)	(0.03)	(0.03)
	1494	[0.37]	[0.83]	[0.25]	1651	[0.08]*	[0.56]	[0.43]
...the wholesale market	0.05	-0.03**	-0.02	-0.01	0.01	-0.01	0.00	-0.01
	(0.20)	(0.01)	(0.01)	(0.01)	(0.11)	(0.01)	(0.01)	(0.01)
	1494	[0.06]*	[0.55]	[0.31]	1651	[0.42]	[0.62]	[0.43]
Panel C: Received market advice from...								
...family and friends	0.49	0.02	-0.02	0.04				
	(0.50)	(0.03)	(0.03)	(0.03)				
	1713	[0.46]	[0.57]	[0.20]				
...intermediaries	0.17	-0.06***	-0.02	-0.04**				
	(0.37)	(0.02)	(0.02)	(0.02)				
	1713	[0.00]***	[0.57]	[0.05]**				
...mobile messages	0.04	0.15***	0.01	0.14***				
	(0.19)	(0.02)	(0.01)	(0.02)				
	1713	[0.00]***	[0.57]	[0.00]***				
...other sources	0.12	-0.04***	-0.02	-0.02				
	(0.33)	(0.02)	(0.02)	(0.01)				
	1713	[0.01]***	[0.57]	[0.20]				

Notes: Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 across year 1 (2020) and year 2 (2021). Column 4 and column 8 test for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it is available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 and column 5 display the control mean; standard deviation; and total number of observations across all groups in the estimation sample.

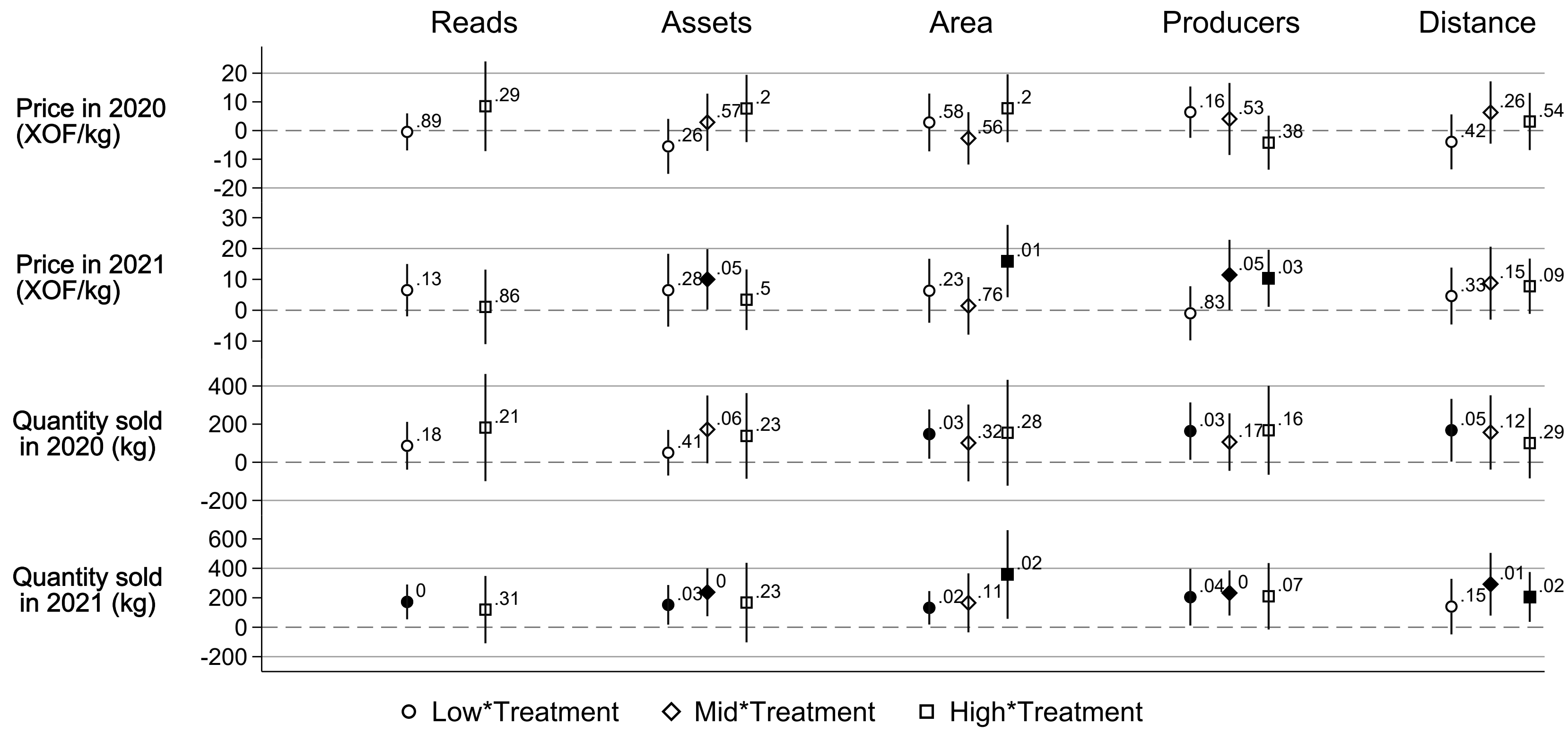

Figure 5: Treatment heterogeneity in price and quantity sold[a]

[a] Source: In-person (2020) and phone-based follow-up (2021) surveys. Each cell represents coefficients from a separate OLS regression. For continuous dimensions of heterogeneity, we trichotomize the variable — interacting in each case our treatment indicator with (i) an indicator equal to 1 if the baseline value lies at or below the lower tercile, (ii) an indicator equal to 1 if the baseline value lies strictly between the two terciles, and (iii) an indicator equal to 1 if the baseline values lies at or above the upper tercile, following Bari ⓡ, Faisal and Malik ⓡ, Kashif and Meki ⓡ, Muhammad and Quinn ⓡ, Simon (2021). For the first column (Reads), we interact treatment with an indicator variable equal to one if the respondent could read a sentence in Bissau-Guinean Kriol. Assets heterogeneity is based on the respondent's principal component of assets (Filmer and Pritchett, 2001). Area heterogeneity is based on the respondent's size of the cashew tree plot (in hectares). Producers heterogeneity is based on the number of producers in the respondent's village. Distance heterogeneity is based on the road distance to the nearest sector capital (in km). All regressions control for randomisation triplet fixed effects and indicators for the middle and upper tercile of the heterogeneity dimension. Standard errors are clustered at the village-level. Bars represent 95% confidence interval based on standard p-values. Filled markers imply statistical significance at the 5% level relative to the control group in the bottom tercile of the heterogeneity dimension, the omitted category.

within a 5 km radius and the price, these results imply an increase of around 4-8% in control villages that were more intensely treated. Our positive *between*-village spillover estimates imply that our intention-to-treat estimates may be a lower-bound of the overall effects of the intervention. Our estimates of *between*-village effects in 2021 are smaller than in 2020, but going in the same direction as the previous year. Finally, in the bottom half of Figure 6, we do not find effects of treatment intensity on the quantity sold. Our findings are consistent with buyers not being able to distinguish between treated and untreated producers and hence adapting their behaviour towards all producers, for instance by making better price offers across villages that are close to each other, as suggested by Fafchamps and Minten (2012).[25] Finally, we suggest three plausible reasons to reconcile our estimates in 2021 and 2020. First, the direct effects may have been greater in 2021 as a result of learning among treated producers, who use the information better in the second year. Second, it is plausible that since in 2021 all producers in the study had heard about the service, and some of the control group producers had also subscribed, our indirect effects may be attenuated. Third, if the indirect effects are influenced by buyer behaviour, there may also have been a learning process among buyers, and they could have started to differentiate between informed and uninformed producers better, leading to reduced spillover effects. In aggregate, these three reasons may help explain some of the small differences across years, which are nonetheless remarkably similar.

6.3 Timing of sales

A mechanism that could explain our results is that producers tried to change the timing of their sales in order to sell when prices were highest. Instead, we find that treated producers were more likely to sell during the first half of the trading season (in, or before, April and May) relative to the control group (Table 6). This period coincided with the time when we initially started sending messages to treated producers, though the messages advised producers to wait to sell, as prices were expected to increase. In 2020, treated producers are 4 percentage points more likely to sell in April relative to the control group, though this effect is not robust to multiple hypothesis testing. Whereas in 2021, they increased the probability of recording a sale in April or May by 7 percentage points (q-value: 0.02-0.03). In 2020, treated producers were 3 percentage points less likely to report exchanging cashew for rice towards the beginning of trading season and more likely to do so in July or later (when the terms of exchange had improved). Qualitatively, we see a similar pattern in 2021, though it is not statistically significant and effect sizes are smaller. The difference in timing of sales is consistent with treated producers selling more than once during the trading season.

[25] In line with this hypothesis, in Appendix Table A.22, we found that control villages reported receiving more itinerant traders than treated villages.

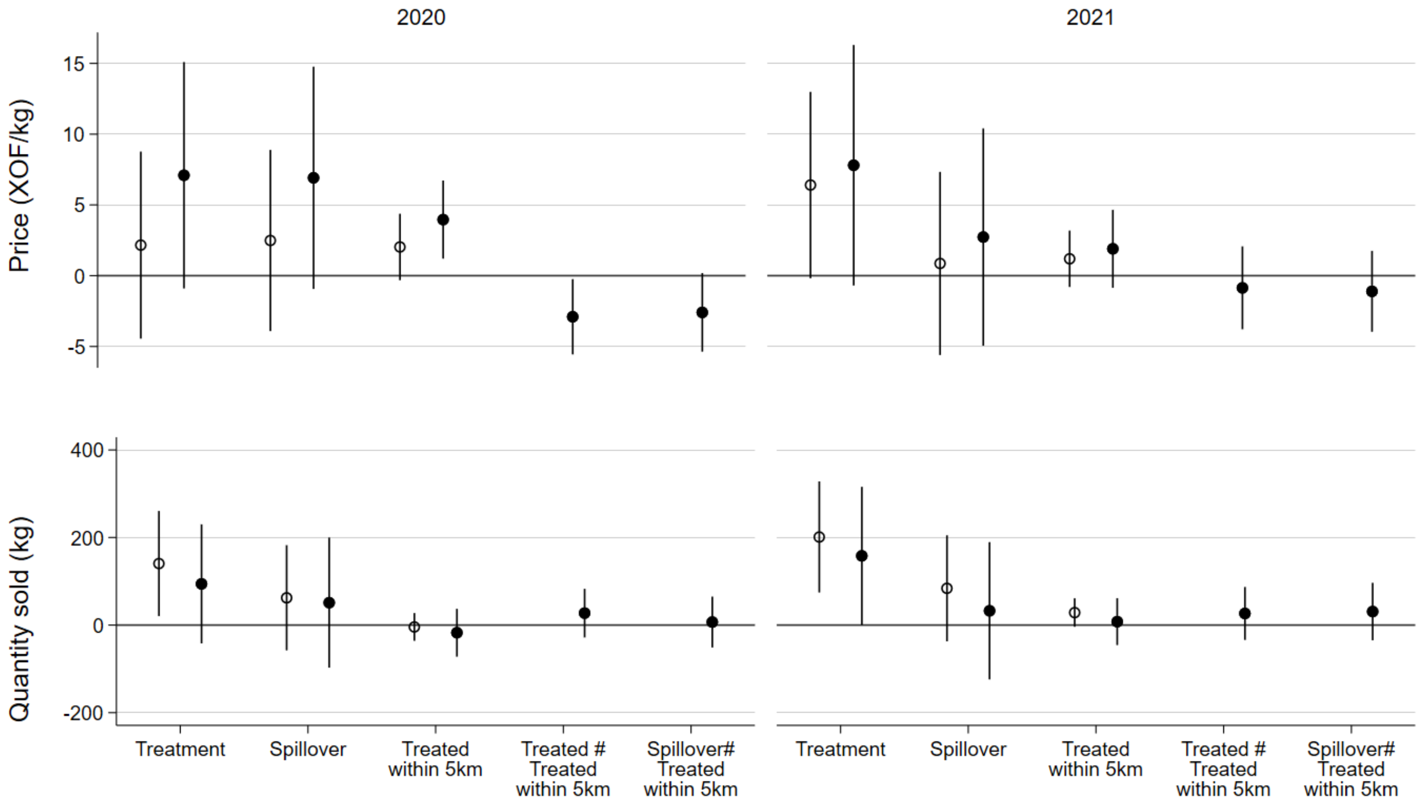

Figure 6: Spatial spillovers on prices and quantity sold[a]

[a] Source: In-person (2020) and phone-based follow-up (2021) surveys. Each sub-plot represents coefficients from two separate OLS regression where the unit of observation is the producer. The white coefficients are estimate from a regression that control for randomisation tripled fixed effects, the number of villages within a 5 km radius that are in our sample, and the baseline value of the outcomes. The black coefficients are estimated from a model where we add to the previous regression the interaction terms between the number of treated producers within 5 km and the treatment (and spillover) indicators. The radius of 5 km was selected after running a series of nested models as in Egger et al. (2022), selecting the model that minimised the Bayesian Information Criterion across all models. Bars represent 95% confidence interval based on Conley (1999) standard errors, accounting for spatial correlation within a 5 km radius.

Producers do not sell more frequently in high price periods, but they do report higher prices in those periods in 2021. To convey this finding descriptively, Figure 7 plots the interaction between our treatment indicator and an indicator for the month of sales, running the regression at the transaction-level. While there is no difference in the average effect by month of sales in 2020, prices for treated producers relative to control producers are almost 20 XOF per kg higher in June 2021, which was the month when prices peaked. In the bottom right quadrant, we also see that treated producers sold more on the intensive margin in June 2021 relative to control producers in the same month, though this effect is not statistically significant.

To understand what motivated producers to sell more than once, we used an open-ended question to elicit their reasons for adopting this sale strategy. In the first three rows of Appendix Table A.13, we report the producers' responses by treatment status.[26] Treated producers were 3 percentage points more likely than the control group to directly refer to the market information system as a reason for selling more than once. Treated producers were also 7 percentage points more likely than the control group to say they sold more than once because they thought that prices would increase in the future and because they thought this strategy would reduce their risk of price uncertainty. This reasoning is consistent with the information delivered by the market information system, which suggested that prices would increase in the second half of the trading seasons. Moreover, we see that treated producers are also 5 percentage points more likely to sell more than once because they report that this enabled them to smooth consumption (i.e. to avoid spending all the revenue at once or because they lacked liquidity) relative to the control group. In the second panel of the same table, we also see that treated producers report being 5-8 percentage points more likely to have sought advice on market timing, significantly so relative to the spillover group.

6.4 Alternative behavioural mechanisms

We do not find evidence consistent with several other behavioural mechanisms. Firstly, we find no evidence that treated producers changed their beliefs about the market (Appendix Table A.14). Producers, on average, expect high prices for the upcoming trading season. Treated producers had lower and more realistic expectations about their sale price. However, these differences were not statistically significant and noisy. Secondly, we did not observe an increase in information sharing among producers as a result of the intervention. Specifically, we did not find that treated producers were more likely to share or receive information about offers. Thirdly, we investigated various outcomes where we did not anticipate any effects (Appendix Table A.15). In 2020, we found no effects on those particular outcomes,

[26] We had not pre-specified the analysis of the outcomes in this table, which we only collected during the in-person survey.

such as producers being more likely to record their sales using a transaction diary or their (hypothetical) risk aversion.[27] However, we did observe a slight increase in the number of treated producers reporting greater trust, which may be a secondary effect of the intervention for the producers who benefited. Fourthly, we provide evidence from producers' transaction diaries and interviews conducted with a subset of intermediaries (Appendix Section F and G), which aligns qualitatively with the producers' interview responses.

Additionally, we explored alternative uses of cashews to determine whether producers used fewer cashews for other purposes. While we found lower amounts of cashews used by treated producers to repay loans (Appendix Table A.16) or for small exchanges, these reductions were not significant enough to fully explain the increases in quantity sold (Appendix Table A.17). Furthermore, in our phone-based follow-up survey, we examined whether the quantity increases were due to changes in production decisions made by producers but found no effects on the measures we collected. We remain cautious in interpreting our effects on the quantity sold, though they are consistent with a positive correlation between prices and quantity sold (Appendix Table A.18).

7 Conclusion

This paper estimated the effects of introducing a new market information system among cashew producers in Guinea-Bissau. The market information system provided free weekly text and voice-messages to treated producers during the 2020 and 2021 trading season. The information sent to producers contained up-to-date farmgate prices, market news, and sales advice on when to sell. On the whole, we see that treated producers benefited from these messages and were able to negotiate higher prices on average. These effects are larger for producers that had more output to sell. We find that *between*-village spillovers of the intervention could attenuate the intention-to-treat effects on average prices among treated producers relative to control producers. We speculate that these spillovers may occur through itinerant traders changing their negotiation strategy, as in Soldani et al. (2023).

Our findings yield several policy implications. First, providing up-to-date and reliable information on market conditions has improved market outcomes for producers in this context. Subscribers to the service could quickly repay the user-fee if they earned similar additional returns as those we observed among treated producers. Second, the government policy of providing a reference price only at the beginning of the trading season can be improved upon, by communicating price updates more frequently.

There are several open questions that remain unanswered. As the service continues to be

[27] We elicited risk aversion using an hypothetical choice between two lotteries, as in (Binswanger, 1980).

Table 6: Mechanisms — Changes in timing of sales

	Year 1				Year 2			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Mean (SD) Total obs.	Treatment	Spillover	Treatment-Spillover	Mean (SD) Total obs.	Treatment	Spillover	Treatment-Spillover
1 if sold cashews in April or before	0.15	0.04**	0.02	0.02	0.17	0.07***	0.05*	0.03
	(0.35)	(0.02)	(0.02)	(0.03)	(0.38)	(0.02)	(0.03)	(0.03)
	1361	[0.17]	[0.80]	[0.99]	1477	[0.02]**	[0.25]	[0.89]
1 if sold cashews in May	0.51	0.02	-0.01	0.03	0.49	0.07***	0.06*	0.02
	(0.50)	(0.03)	(0.04)	(0.03)	(0.50)	(0.03)	(0.03)	(0.03)
	1361	[0.71]	[0.88]	[0.99]	1477	[0.03]**	[0.25]	[0.89]
1 if sold cashews in June	0.49	0.05	0.05	-0.00	0.64	-0.02	-0.03	0.01
	(0.50)	(0.03)	(0.03)	(0.03)	(0.48)	(0.03)	(0.03)	(0.03)
	1361	[0.29]	[0.33]	[0.99]	1477	[0.84]	[0.84]	[0.89]
1 if sold cashews in July or later	0.07	0.01	0.01	0.00	0.12	0.02	0.00	0.02
	(0.25)	(0.02)	(0.02)	(0.02)	(0.33)	(0.02)	(0.02)	(0.02)
	1361	[0.71]	[0.81]	[0.99]	1477	[0.74]	[0.84]	[0.89]
1 if exchanged rice in April or before	0.09	-0.03*	-0.03*	0.00	0.10	-0.01	-0.00	-0.00
	(0.28)	(0.01)	(0.02)	(0.02)	(0.29)	(0.02)	(0.02)	(0.02)
	1591	[0.17]	[0.21]	[0.99]	1662	[0.84]	[0.84]	[0.93]
1 if exchanged rice in May	0.23	-0.01	-0.00	-0.00	0.22	0.00	0.02	-0.01
	(0.42)	(0.02)	(0.03)	(0.02)	(0.42)	(0.03)	(0.03)	(0.03)
	1591	[0.81]	[0.90]	[0.99]	1662	[0.95]	[0.84]	[0.89]
1 if exchanged rice in June	0.26	-0.01	-0.02	0.01	0.27	-0.01	-0.02	0.01
	(0.44)	(0.03)	(0.03)	(0.02)	(0.44)	(0.02)	(0.03)	(0.03)
	1591	[0.76]	[0.80]	[0.99]	1662	[0.84]	[0.84]	[0.89]
1 if exchanged rice in July or later	0.01	0.03***	0.03***	0.00	0.05	0.01	0.01	0.00
	(0.11)	(0.01)	(0.01)	(0.01)	(0.21)	(0.01)	(0.01)	(0.01)
	1591	[0.01]**	[0.05]*	[0.99]	1662	[0.84]	[0.84]	[0.89]

Notes: Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 across year 1 (2020) and year 2 (2021). Columns 4 tests for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 and column 5 display the control mean; standard deviation; and total number of observations across all groups in the estimation sample.

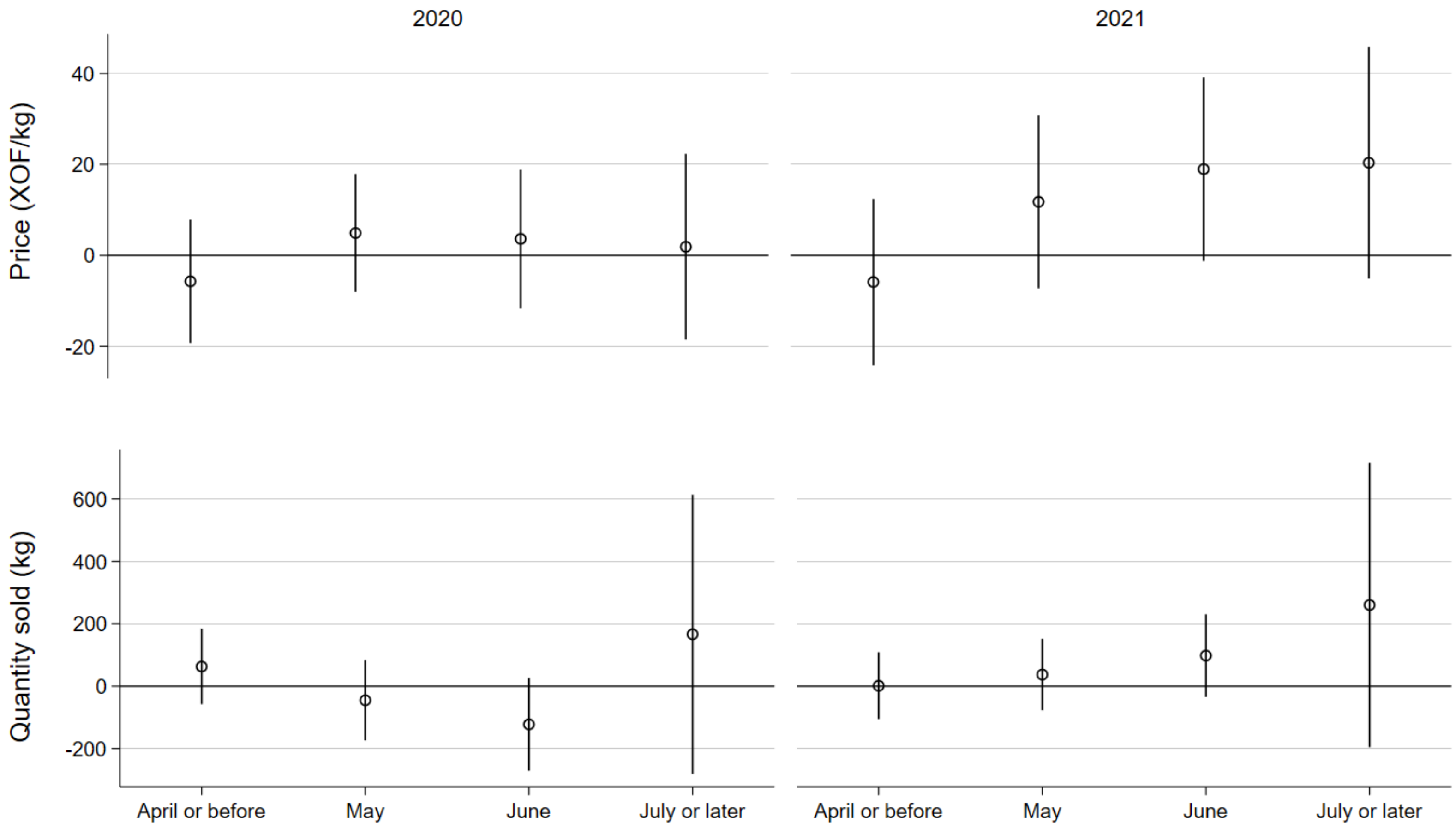

Figure 7: Treatment by month of transactions in price and quantity sold[a]

[a] Source: In-person (2020) and phone-based follow-up (2021) surveys. Each sub-plot represents coefficients from a separate OLS regression where the unit of observation is a transaction. All regressions control for randomisation triplet fixed effects. Bars represent 95% confidence intervals.

rolled-out and its user-base grows, the effects we estimated may change, as more producers become better informed about the market dynamics. We plan to explore some of these issues in future research.

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Appendix

This appendix has six sections. In Section A we provide details of the sampling and randomisation procedures we implemented. In Section B we provide balance tables and attrition. Section C shows robustness of our main results to alternative econometric specifications. It also illustrates effects of the intervention on additional outcomes not reported in the main text. In Section D, we provide additional details on the cashew nut production and commercialisation. In Section F and Section G we show complementary results based on a sub-sample of producers that kept written records of their transactions and from intermediaries based in a sub-sample of villages.

A Sampling and randomisation

A.1 Village-level sampling

Our sampling strategy has two main goals: (i) making the treatment and control groups statistically balanced across a set of baseline characteristics, and (ii) minimising spillovers of the treatment to untreated villages. There is a trade-off between these two goals: minimising spillovers requires that treatment and control groups be sufficiently far apart geographically; while statistical balance requires that treatment and control groups be similar to each other, which in turn often requires geographical proximity (Duflo et al., 2008). We address this trade-off as follows.

In order to select villages that would be part of our study, we created a grid containing $2.7km^2$ cells, covering the entirety of the country. We sample 290 villages from about 1,800 villages, using geo-coded census data, such that one village is chosen from each of those cells.[28] We compute for each village the closest distance to another sampled village. We store the value of the minimum distance in the sample of villages drawn. We iterate these steps 999 times and choose the sample that has the largest minimum distance.

We excluded from our sampling frame villages that have the following characteristics:

- with fewer than ten households according to the 2009 census (to allow a sufficiently large sample of cashew producers in every village),
- located on the islands (due to budget constraints),
- located in a circle of 15km in radius in the region of Tombali, which are closest to the river estuary (due to budget constraints, as reaching those villages is logistically difficult),
- located in the sector of Boé, in the East of the country (due to budget constraints and poor phone signal in the area),
- for which we did not have reliable GPS and population data (so those unmatched from the fuzzy merging of the census and the GPS data),
- located in Biombo, the region to the West of the capital Bissau (as it was used for the pilot).

These exclusions account for at most 40% of producers in the country, mostly driven by exclusion of the smaller villages. We posit that since most of the villages that were not included in the sampling frame are more remote

[28] We constructed our sampling frame by merging the 2009 census data, the latest census available to-date, with GPS coordinates obtained from a geocoded administrative dataset maintained by the United Nations Office for the Coordination of Humanitarian Affairs.

and smaller, producers living in those excluded villages are likely to be most affected by lack of information and could benefit more from the intervention. Once the final sample of villages was selected, we sought the contact details of the village leaders of our final sample of villages. Whenever possible, we contacted the village leaders ahead of the data-collection baseline visit to inform them of the study and seek their collaboration.

A.2 Producer-level sampling

After the data-collection team reached the sampled village and the village leaders granted them permission to work, they asked the village leader for a list of all producers living in the village owning a cashew tree plot. In eliciting this list, the data-collection team stressed that every producer with a cashew tree plot should be included, including small ones. On the day of the visit, the data-collection team used a random number generator to sample seven producers from this list.

A.3 Village-level randomisation

We follow the recommendations of Bruhn and McKenzie (2009), stratifying our randomisation to increase efficiency. Randomisation of treatment across villages was implemented constructing, in each region, triplets of villages that are as similar as possible along a number of dimensions that are likely to affect the impact of treatment. We combine the population data from the 2009 census and other geo-coded databases to construct the following variables:

(i). road distance to the nearest sectoral capital (to proxy the closest location where small intermediaries are based)

(ii). road distance to the nearest regional capital (to proxy the closest location where wholesale intermediaries are based)

(iii). road distance to the port in Bissau (to proxy for distance from the main export route, and inversely from distance to the closest borders)

(iv). linear distance to the nearest (MTN) mobile network tower, and

(v). number of households for each village, according to the 2009 census.

Because these characteristics are likely to be correlated, we use the Mahalanobis distance as a metric of similarity across villages that takes into account the correlation across these characteristics, as in Fafchamps and Minten (2012). The Mahalanobis distance between them is then defined as:

$$||z_l - z_j|| = ((z_l - z_j)' S^{-1} (z_l - z_j))^{1/2} \tag{4}$$

where z_l and z_j denote the vector or relevant characteristics from villages l and j, respectively, and S is the covariance matrix of characteristics z. Pairs of villages with a smaller Mahalanobis distance are more similar along these dimensions. Since these characteristics are weighted by the inverse of the covariance matrix S, correlation between characteristics — e.g. between our various distance measures — is given less weight.
We select, within each region, the allocation of villages into triplets that minimises the sum, over all triplets, of the Mahalanobis distances within each triplet. The search is conducted using an algorithm that randomly tries different combinations of villages into triplets. Within each triplet, one village was then randomly assigned to control and two villages to treatment. This ratio of treated to control villages yields a similar number of individual producers that are either treated, spillover, or control, in each triplet.

A.4 Within-village randomisation

Once the seven randomly sampled producers in treatment villages completed the baseline interview, an on-the-spot within-village lottery determined producer-level assignment to either the treatment or spillover groups. The supervisor of the data-collection team administered the lottery. Each producer drew one of two kinds of goodies from a bag. Using this lottery, four producers were assigned to the treatment group and three to the spillover one. After the producer-level randomisation, the treated producers took part in a training session about the intervention and the determinants of farmgate raw cashew-nut prices.

B Experimental integrity

B.1 Balance

Table A.1: Baseline balance — Primary outcome variables

	Control (1) Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treat. vs. spillover	(5) Max pairwise st. diff.
Average price (XOF/kg)	395.89	-3.66	1.35	-5.01	0.05
	(96.24)	(5.51)	(5.60)	(4.75)	1968
	1968	[0.74]	[0.81]	[0.50]	
Value of all sales and exchanges (XOF)	527100.44	35669.54	24404.24	11265.30	0.03
	(921775.27)	(44414.13)	(43399.62)	(29831.03)	1978
	1978	[0.74]	[0.80]	[0.88]	
Value of all sales (XOF)	486696.38	14815.85	15806.13	-990.28	0.01
	(912168.16)	(43992.64)	(43245.56)	(28614.91)	1984
	1984	[0.74]	[0.80]	[0.97]	
Value of exchanges (XOF)	39662.45	21556.26***	10321.69*	11234.56**	0.22
	(85677.82)	(6797.60)	(6024.35)	(5681.82)	1982
	1982	[0.01]**	[0.46]	[0.22]	
Total quantity sold (kg)	1206.35	54.39	36.52	17.87	0.01
	(1855.65)	(96.73)	(94.05)	(66.13)	1984
	1984	[0.74]	[0.80]	[0.88]	
Number of sales	1.62	0.01	0.07	-0.05	0.08
	(0.81)	(0.04)	(0.05)	(0.04)	1988
	1988	[0.74]	[0.46]	[0.50]	
1 if exchanged cashew for rice	0.30	0.04	0.02	0.02	0.15
	(0.46)	(0.03)	(0.03)	(0.02)	1985
	1985	[0.30]	[0.80]	[0.50]	
Total quantity exchanged (kg)	113.66	57.26***	25.75	31.51**	0.21
	(247.43)	(19.08)	(17.06)	(15.94)	1982
	1982	[0.01]**	[0.46]	[0.22]	
Share of quantity sold over quantity exchanged and sold	0.90	-0.02	-0.01	-0.02	0.13
	(0.20)	(0.01)	(0.01)	(0.01)	1979
	1979	[0.30]	[0.80]	[0.44]	

Notes: Coefficient of treatment and spillover at baseline (columns 2-3). Column 4 tests for differences in parameters obtained in previous two columns. Column 5 reports the standardised pairwise maximum difference between mean across all study groups. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. q-values reported in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 displays the control mean; standard deviation; and total number of observations.

Table A.2: Baseline balance — Producer characteristics

	(1) Control Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treat. vs. spillover	(5) Max pairwise st. diff.
1 if female	0.05	0.00	-0.00	0.00	0.02
	(0.23)	(0.01)	(0.01)	(0.01)	1985
	1985	[0.95]	[1.00]	[0.97]	
Age	43.47	-1.06	-1.11	0.05	0.06
	(14.96)	(0.79)	(0.77)	(0.75)	1988
	1988	[0.37]	[0.60]	[0.97]	
Household size	13.40	0.57	1.02*	-0.45	0.08
	(7.88)	(0.54)	(0.57)	(0.41)	1988
	1988	[0.45]	[0.38]	[0.92]	
Years of education	3.89	0.01	-0.10	0.11	0.04
	(3.77)	(0.23)	(0.23)	(0.18)	1988
	1988	[0.95]	[1.00]	[0.92]	
1 if Kriol is the most spoken language at home	0.21	-0.01	-0.01	0.00	0.05
	(0.41)	(0.02)	(0.02)	(0.02)	1988
	1988	[0.87]	[1.00]	[0.97]	
1 if cashew is the main source of income	0.79	0.02	0.00	0.02	0.06
	(0.41)	(0.02)	(0.02)	(0.02)	1988
	1988	[0.45]	[1.00]	[0.92]	
1 if faces storage limitations	0.27	0.06**	0.02	0.04*	0.15
	(0.45)	(0.03)	(0.02)	(0.02)	1988
	1988	[0.08]*	[0.99]	[0.92]	
Minimum age of trees (years)	3.32	-0.06	0.08	-0.14	0.06
	(3.43)	(0.17)	(0.20)	(0.20)	1966
	1966	[0.87]	[1.00]	[0.92]	
Max age of trees (years)	17.23	-0.20	0.04	-0.25	0.04
	(8.41)	(0.47)	(0.48)	(0.48)	1868
	1868	[0.87]	[1.00]	[0.93]	
1 if trees were plagued	0.69	-0.03	-0.01	-0.03	0.08
	(0.46)	(0.03)	(0.03)	(0.03)	1980
	1980	[0.37]	[1.00]	[0.92]	
1 if sells other crops	0.65	0.09***	0.10***	-0.01	0.21
	(0.48)	(0.02)	(0.02)	(0.02)	1988
	1988	[0.00]***	[0.00]***	[0.97]	

Notes: Coefficient of treatment and spillover at baseline (columns 2-3). Column 4 tests for differences in parameters obtained in previous two columns. Column 5 reports the standardised pairwise maximum difference between mean across all study groups. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. q-values reported in brackets and are calculated across all variables reported in Appendix Table A.2 and A.3. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 displays the control mean; standard deviation; and total number of observations.

Table A.3: Baseline balance — Producer characteristics (continued)

	(1) Control Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treat. vs. spillover	(5) Max pairwise st. diff.
Index of trust (Anderson, 2008)	0.00	0.07	0.07	0.00	0.06
	(1.00)	(0.05)	(0.05)	(0.05)	1988
	1988	[0.29]	[0.60]	[0.97]	
Index of food security (Anderson, 2008)	0.00	-0.02	0.01	-0.03	0.03
	(1.00)	(0.05)	(0.06)	(0.05)	1983
	1983	[0.87]	[1.00]	[0.92]	
1 if has a fixed buyer	0.30	0.05*	0.03	0.02	0.10
	(0.46)	(0.03)	(0.03)	(0.03)	1987
	1987	[0.23]	[0.83]	[0.92]	
Area plantation (hectares)	3.26	0.28**	0.27*	0.01	0.11
	(2.29)	(0.13)	(0.14)	(0.15)	1988
	1988	[0.19]	[0.38]	[0.97]	
Years of experience in cashew sector	10.17	0.65*	0.25	0.41	0.08
	(7.05)	(0.39)	(0.38)	(0.38)	1988
	1988	[0.23]	[1.00]	[0.92]	
Standardised principal component of wealth (Filmer and Pritchett, 2001)	-0.19	0.30***	0.37***	-0.07	0.20
	(1.63)	(0.10)	(0.10)	(0.09)	1979
	1979	[0.03]**	[0.00]***	[0.92]	
Index of numeracy (Anderson, 2008)	0.00	0.10*	0.02	0.08	0.11
	(1.00)	(0.06)	(0.06)	(0.05)	1988
	1988	[0.23]	[1.00]	[0.92]	
1 if can read	0.29	0.00	0.00	-0.00	0.02
	(0.45)	(0.03)	(0.03)	(0.02)	1988
	1988	[0.95]	[1.00]	[0.97]	
1 if present-biased	0.17	0.03*	0.00	0.03	0.07
	(0.37)	(0.02)	(0.02)	(0.02)	1985
	1985	[0.23]	[1.00]	[0.92]	

Notes: Coefficient of treatment and spillover at baseline (columns 2-3). Column 4 tests for differences in parameters obtained in previous two columns. Column 5 reports the standardised pairwise maximum difference between mean across all study groups. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. q-values reported in brackets are calcualted over all variables reported in Appendix Table A.2 and A.3.. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 displays the control mean; standard deviation; and total number of observations.

Table A.4: Baseline balance — Village characteristics

	Control (1) Mean (SD) Total obs.	(2) Treatment
Number of cashew producers in the village	33.87	-0.68
	(23.49)	(2.83)
	288	[0.81]
Number of cashew buyers in the village	2.90	1.13***
	(2.58)	(0.41)
	287	[0.04]**
Road distance in km to nearest sector capital	25.59	1.02
	(23.70)	(2.65)
	290	[0.81]
Road distance in km to nearest region capital	51.48	-0.85
	(33.51)	(2.96)
	290	[0.81]
Road distance in km to the capital	162.30	4.15
	(69.26)	(4.60)
	290	[0.81]

Notes: Coefficient of village-level treatment at baseline (columns 2). Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the village. All models control for the randomisation triplet fixed-effects. Standard errors are in parentheses and are robust. Stars on the coefficient estimates reflect unadjusted p-values. q-values reported in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 displays the control mean; standard deviation; and total number of observations.

B.2 Attrition

Table A.5: Attrition rates at either follow-up

1 if attrited at...	(1) Control Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treat. vs. spillover	(5) Max pairwise st. diff.
...the in-person follow-up	0.13	0.01	0.00	0.00	0.05
	(0.33)	(0.02)	(0.02)	(0.02)	1988
	1988	[0.81]	[0.88]	[0.92]	
...the phone-based follow-up	0.12	0.00	-0.01	0.01	0.03
	(0.33)	(0.02)	(0.02)	(0.02)	1988
	1988	[0.81]	[0.88]	[0.92]	
...either follow-up	0.22	0.01	0.00	0.00	0.04
	(0.42)	(0.02)	(0.02)	(0.02)	1988
	1988	[0.81]	[0.88]	[0.92]	

Notes: Coefficient of treatment and spillover at baseline (columns 2-3). Column 3 tests for differences in parameters obtained in previous two columns. Column 4 reports the standardised pairwise maximum difference between mean across all study groups. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. q-values reported in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 displays the control mean; standard deviation; and total number of observations.

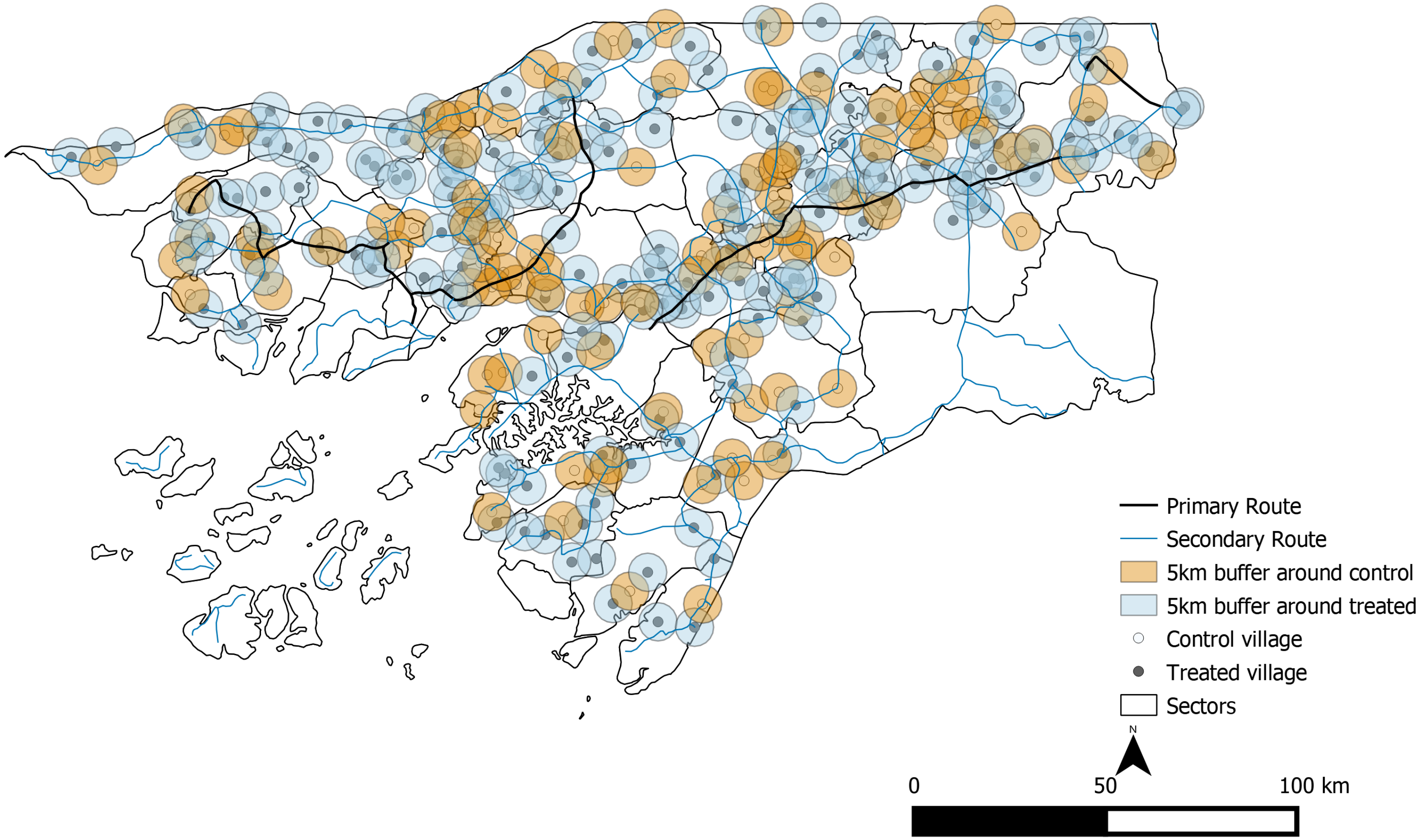

Figure A.1: Geographic distribution of treatment with 5 km buffer around villages

C Robustness checks

C.1 Winsorized outcomes

We winsorized at the 1% level our continuous main outcomes as a robustness check, as we had pre-specified. This affects the significance of our results on the quantity and revenue from sales, though the coefficients remain positive and relatively large. We also look at outcomes winsorized at the 5% level, which we had not pre-specified, which shows that increase in quantity sold and value from sales remains marginally significant using naive p-values.

C.2 Controlling for unbalanced baseline characteristics

We ran Equation (3) including as controls any producer or village characteristic that was found to be substantially unbalanced at baseline, in Appendix Tables A.2 and A.4. We include the following covariates:

- Household size
- 1 if faces difficulties storing
- 1 if sells other agricultural products
- Area of plantation
- Years of experience in the sector
- Standardized principal component of assets (Filmer and Pritchett, 2001)
- Numeracy index (Anderson, 2008)
- 1 if extremely present-biased (Ashraf et al., 2006)
- Number of traders in the village

When the baseline value of one of these covariates was missing, we impute to be equal to the sample mean and control for the imputations with an indicator variable.

C.3 Estimation using the post-double least absolute shrinkage and selection operator (PDSLASSO)

We estimated our intention-to-treat effects using the post-double least absolute shrinkage and selection operator (PDSLASSO), as described by Belloni et al. (2014). Instead of Equation (3), we increase precision of our estimates by letting this algorithm pick additional control variables from baseline values of the producer and village characteristics, and values of the main outcome variables.

C.4 Clustering standard errors at the randomisation triplet-level

We estimated our intention-to-treat effects clustering standard errors at the randomisation triplet-level following the recommendation of de Chaisemartin and Ramirez-Cuellar (2023), though we had not pre-specified this alternative strategy.

C.5 Pooling across trading seasons

We estimated our intention-to-treat effects pooling data from the 2020 and the 2021 trading seasons.

C.6 Between-village spillover specifications

We estimate the effects of treatment intensity on our main outcomes using the following specification:

$$\begin{aligned} y_{iv} = & \beta_1 \cdot treatment_{iv} + \delta_1 \cdot spillover_{iv} + \gamma_1 \cdot y_{0iv} \\ & \pi_1^{5km} \cdot \mathrm{V}_{iv\neg v}^{5km} + \pi_2^{5km} \cdot \mathrm{TP}_{iv\neg v}^{5km} + \alpha_v + \epsilon_{iv} \end{aligned} \tag{5}$$

where variables are defined as in Equation 3, $\mathrm{TP}_{iv\neg v}^{5km}$ is the total amount of producers *assigned* to treatment within 5 km of producer i (excluding treated producers in village v), and $\mathrm{V}_{iv\neg v}^{5km}$ is the number of villages within a 5 km radius (excluding village v). Conditional on the number of villages within a given radius, the total amount of treated individuals that are within this radius is exogenous.[29] This equation allows us to estimate the following effects: β_1 gives us the (direct) intent-to-treat effect of the intervention on producers in treated villages. δ_1 gives us the spillover effect of the intervention on producers *within* treated villages. π_2^{5km} gives us the (indirect) *between*-village effect of the total amount of treated individuals within a 5 km radius.

For analyses using spatial treatment intensity, we account for spatial dependence using Conley standard errors with a uniform kernel up to the boundary of the largest doughnut (Conley, 1999).

In order to pick the radius distance of 5 km, we estimate the effect of treatment intensity within a series of non-overlapping doughnuts, $d = 1, \ldots, D$, each with inner radius r and outer radius $r + c$ kilometres, as in Egger et al. (2022), with $c \in \{1,2,3,4,5\}$. We estimate a series of nested models: with a single doughnut ($d = 1$) with $r = 0$; with two doughnuts ($d = 1,2$) with $r \in \{0,1\}$; ...; with ten doughnuts ($d = 1,2,\ldots,10$) with $r \in \{0,1,\ldots,9\}$, and then iterate this procedure for doughnuts with a larger outer radius for each c. For each specification

[29] Conditional exogeneity of the number of producers treated within a doughnut comes from the fact that the number of treated producers is a fixed discrete number depending on the random assignment at the village-level. That is, treated villages had 4 treated producers, whereas the pure control villages had none.

and outcome, we then select the model which minimises the Bayesian Information Criterion (BIC).[30] Across all the fifty specifications we estimated for price, the specification with the lowest BIC for which we observed positive variation in treatment intensity in at least 10% of the sample is the doughnut with $r=0$ and $r+c=5$.[31] We therefore focus on presenting results from this specification.

[30] These specifications implicitly assume a linear relationship between the intensity of treatment within a given radius and the outcome variable of interest, but allows this effect to vary between the different 'doughnuts' specified in the regression.

[31] For example, the specification with doughnuts with $r=0$ and $r+c=2$ had a marginally lower BIC, but only 5% of the sample had any non-zero variation in this measure of spatial treatment intensity. The lack of variation in treatment intensity within smaller radii is due to our sampling strategy, which aimed to maximise the minimum distance between any village in our sample.

Table A.6: Robustness — Main outcomes winsorized at 99^{th} percentile

	Year 1				Year 2			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Mean (SD) Total obs.	Treatment	Spillover	Treatment-Spillover	Mean (SD) Total obs.	Treatment	Spillover	Treatment-Spillover
Price and revenue:								
Average price (XOF/kg)	294.76	1.73	2.76	-1.03	354.64	5.66*	1.22	4.44
	(101.66)	(2.96)	(3.16)	(2.98)	(79.70)	(2.98)	(3.23)	(2.79)
	1587	[0.56]	[0.52]	[0.73]	1704	[0.08]*	[0.71]	[0.17]
Value of all sales and exchanges (XOF)	284193.51	30127.41	18143.43	11983.98	434464.65	77702.81***	43159.75*	34543.06
	(289006.62)	(18509.29)	(21135.80)	(18573.33)	(423634.36)	(23248.72)	(25442.04)	(22831.16)
	1520	[0.26]	[0.52]	[0.73]	1686	[0.00]***	[0.18]	[0.17]
Value of all sales (XOF)	230293.14	25365.33	2140.42	23224.92	356704.84	73674.76***	29882.23	43792.53**
	(269143.16)	(16662.85)	(18341.82)	(15886.19)	(385129.20)	(19610.92)	(21728.01)	(19610.05)
	1591	[0.26]	[0.91]	[0.58]	1705	[0.00]***	[0.23]	[0.10]
Value of exchanges (XOF)	52020.20	9291.95	12687.02	-3395.07	75155.05	8983.78	14674.83*	-5691.05
	(86004.73)	(7644.53)	(8269.69)	(5759.07)	(108324.67)	(8204.34)	(8239.38)	(7541.22)
	1635	[0.30]	[0.50]	[0.73]	1710	[0.27]	[0.18]	[0.45]
Quantity sold and exchanged:								
Total quantity sold (kg)	695.97	82.83*	22.28	60.55	956.20	172.65***	80.48	92.17*
	(764.74)	(48.32)	(52.72)	(45.51)	(1013.12)	(50.53)	(54.31)	(48.30)
	1622	[0.22]	[0.67]	[0.46]	1709	[0.00]***	[0.23]	[0.14]
Number of sales	1.48	0.21***	0.08	0.13**	1.63	0.21***	0.10**	0.11**
	(0.94)	(0.06)	(0.06)	(0.06)	(0.81)	(0.04)	(0.04)	(0.05)
	1693	[0.00]***	[0.64]	[0.10]*	1730	[0.00]***	[0.07]*	[0.09]*
1 if exchanged cashew for rice	0.56	-0.01	-0.03	0.03	0.56	-0.01	-0.00	-0.01
	(0.50)	(0.03)	(0.03)	(0.03)	(0.50)	(0.03)	(0.03)	(0.03)
	1706	[0.85]	[0.64]	[0.59]	1724	[0.60]	[0.99]	[0.58]
Total quantity exchanged (kg)	217.70	13.48	16.16	-2.68	230.05	42.29	64.57**	-22.27
	(323.48)	(23.44)	(24.58)	(21.08)	(335.19)	(26.95)	(26.63)	(24.70)
	1681	[0.71]	[0.64]	[0.96]	1707	[0.20]	[0.07]*	[0.57]
Share of quantity sold over quantity exchanged and sold	0.73	0.02	0.02	0.00	0.79	0.01	-0.00	0.01
	(0.32)	(0.02)	(0.02)	(0.02)	(0.25)	(0.02)	(0.02)	(0.01)
	1604	[0.70]	[0.64]	[0.96]	1691	[0.60]	[0.99]	[0.57]

Notes: Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 across year 1 (2020) and year 2 (2021). Columns 4 tests for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 and column 5 display the control mean; standard deviation; and total number of observations across all groups in the estimation sample.

Table A.7: Robustness — Main outcomes winsorized at 95^{th} percentile

	Year 1 (1) Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treatment-Spillover	Year 2 (5) Mean (SD) Total obs.	(6) Treatment	(7) Spillover	(8) Treatment-Spillover
Price and revenue:								
Average price (XOF/kg)	291.62	2.12	2.28	-0.16	352.17	5.95**	2.28	3.67
	(96.87)	(2.49)	(2.63)	(2.37)	(75.51)	(2.71)	(2.93)	(2.57)
	1587	[0.40]	[0.69]	[0.95]	1704	[0.04]**	[0.44]	[0.31]
Value of all sales and exchanges (XOF)	268381.83	22670.69	10018.81	12651.88	411529.74	67367.14***	45968.37**	21398.77
	(227328.24)	(13876.99)	(15519.40)	(12974.91)	(344012.16)	(19570.91)	(21354.65)	(18289.62)
	1520	[0.21]	[0.69]	[0.66]	1686	[0.00]***	[0.07]*	[0.32]
Value of all sales (XOF)	212156.79	19263.07*	870.66	18392.41*	334113.48	68252.59***	38016.15**	30236.44*
	(198563.75)	(11401.24)	(12720.95)	(10984.52)	(308129.59)	(16615.62)	(18100.38)	(16243.81)
	1591	[0.21]	[0.94]	[0.38]	1705	[0.00]***	[0.07]*	[0.25]
Value of exchanges (XOF)	47953.99	5369.29	6359.93	-990.63	70998.43	7404.42	11033.59	-3629.16
	(69132.58)	(5582.65)	(6042.44)	(4439.21)	(93578.96)	(6835.91)	(6711.52)	(5762.07)
	1635	[0.40]	[0.69]	[0.95]	1710	[0.28]	[0.14]	[0.53]
Quantity sold and exchanged:								
Total quantity sold (kg)	644.94	59.06*	5.31	53.75*	887.45	173.22***	107.88**	65.33
	(572.80)	(33.74)	(37.73)	(32.42)	(778.79)	(42.32)	(45.85)	(42.01)
	1622	[0.20]	[0.89]	[0.25]	1709	[0.00]***	[0.05]**	[0.30]
Number of sales	1.43	0.19***	0.08	0.11**	1.61	0.20***	0.10**	0.11**
	(0.81)	(0.05)	(0.05)	(0.05)	(0.76)	(0.04)	(0.04)	(0.05)
	1693	[0.00]***	[0.61]	[0.10]*	1730	[0.00]***	[0.05]**	[0.10]*
1 if exchanged cashew for rice	0.56	-0.01	-0.03	0.03	0.56	-0.01	-0.00	-0.01
	(0.50)	(0.03)	(0.03)	(0.03)	(0.50)	(0.03)	(0.03)	(0.03)
	1706	[0.85]	[0.61]	[0.59]	1724	[0.60]	[0.99]	[0.58]
Total quantity exchanged (kg)	204.12	4.86	14.63	-9.77	215.94	31.11	42.41**	-11.31
	(270.63)	(20.20)	(21.21)	(16.49)	(282.80)	(21.15)	(20.43)	(17.81)
	1681	[0.85]	[0.61]	[0.69]	1707	[0.24]	[0.06]*	[0.58]
Share of quantity sold over quantity exchanged and sold	0.73	0.02	0.02	0.00	0.79	0.01	-0.00	0.01
	(0.32)	(0.02)	(0.02)	(0.02)	(0.25)	(0.02)	(0.02)	(0.01)
	1604	[0.70]	[0.61]	[0.96]	1691	[0.60]	[0.99]	[0.58]

Notes: Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 across year 1 (2020) and year 2 (2021). Columns 4 tests for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 and column 5 display the control mean; standard deviation; and total number of observations across all groups in the estimation sample.

Table A.8: Robustness — Main outcomes controlling for unbalanced characteristics

	Year 1 (1) Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treatment-Spillover	Year 2 (5) Mean (SD) Total obs.	(6) Treatment	(7) Spillover	(8) Treatment-Spillover
Price and revenue:								
Average price (XOF/kg)	295.71	0.43	0.65	-0.22	355.77	3.92	-1.03	4.95
	(104.36)	(3.46)	(3.40)	(3.31)	(83.13)	(3.35)	(3.27)	(3.07)
	1587	[0.90]	[0.85]	[0.95]	1704	[0.32]	[0.75]	[0.14]
Value of all sales and exchanges (XOF)	287785.22	48463.11**	29645.71	18817.40	440723.50	75783.73**	30559.25	45224.48*
	(315352.77)	(24318.03)	(25169.23)	(22167.60)	(461068.58)	(30027.99)	(27649.03)	(25103.27)
	1520	[0.17]	[0.48]	[0.68]	1686	[0.03]**	[0.54]	[0.14]
Value of all sales (XOF)	233494.84	39058.70*	13231.17	25827.52	364476.23	65761.91**	16116.88	49645.03**
	(292721.24)	(22580.75)	(22820.34)	(19575.44)	(428368.42)	(26544.51)	(24352.45)	(22738.07)
	1591	[0.17]	[0.75]	[0.68]	1705	[0.03]**	[0.68]	[0.12]
Value of exchanges (XOF)	52325.81	9586.30	14398.90	-4812.60	75661.67	7178.64	12237.10	-5058.46
	(88037.41)	(7668.80)	(9180.83)	(7242.70)	(111392.97)	(8136.67)	(8229.46)	(7713.05)
	1635	[0.28]	[0.47]	[0.68]	1710	[0.38]	[0.54]	[0.51]
Quantity sold and exchanged:								
Total quantity sold (kg)	708.21	113.11*	36.95	76.16	981.13	152.63**	39.23	113.40**
	(855.14)	(60.10)	(59.66)	(53.87)	(1163.13)	(65.32)	(62.96)	(52.43)
	1622	[0.15]	[0.67]	[0.40]	1709	[0.05]*	[0.86]	[0.08]*
Number of sales	1.49	0.18***	0.04	0.14**	1.66	0.17***	0.06	0.11**
	(1.01)	(0.06)	(0.06)	(0.06)	(0.92)	(0.05)	(0.05)	(0.05)
	1693	[0.01]**	[0.67]	[0.11]	1730	[0.00]***	[0.60]	[0.08]*
1 if exchanged cashew for rice	0.56	0.00	-0.03	0.03	0.56	-0.01	0.01	-0.01
	(0.50)	(0.03)	(0.03)	(0.03)	(0.50)	(0.03)	(0.03)	(0.03)
	1706	[0.92]	[0.67]	[0.44]	1724	[0.75]	[0.86]	[0.59]
Total quantity exchanged (kg)	217.70	14.48	10.12	4.37	231.72	34.74	56.83**	-22.09
	(323.48)	(23.18)	(24.29)	(23.09)	(346.31)	(26.69)	(27.08)	(25.54)
	1681	[0.80]	[0.68]	[0.85]	1707	[0.32]	[0.18]	[0.59]
Share of quantity sold over quantity exchanged and sold	0.73	0.01	0.01	-0.00	0.79	0.01	-0.00	0.01
	(0.32)	(0.02)	(0.02)	(0.02)	(0.25)	(0.02)	(0.02)	(0.01)
	1604	[0.80]	[0.67]	[0.85]	1691	[0.75]	[0.86]	[0.59]

Notes: Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 across year 1 (2020) and year 2 (2021). Columns 4 tests for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 and column 5 display the control mean; standard deviation; and total number of observations across all groups in the estimation sample.

Table A.9: Robustness — Main outcomes estimated using PDSLASSO

	Year 1 (1) Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treatment-Spillover	Year 2 (5) Mean (SD) Total obs.	(6) Treatment	(7) Spillover	(8) Treatment-Spillover
Price and revenue:								
Average price (XOF/kg)	295.71	2.07	2.33	-0.26	355.77	6.89**	1.32	5.57*
	(104.36)	(3.36)	(3.26)	(3.21)	(83.13)	(3.32)	(3.28)	(2.97)
	1587	[0.54]	[0.62]	[0.93]	1705	[0.05]*	[0.69]	[0.08]*
Value of all sales and exchanges (XOF)	287785.22	49955.96**	30500.25	19455.72	440723.50	92352.29***	39643.84	52708.45**
	(315352.77)	(23903.98)	(24599.16)	(21429.83)	(461068.58)	(29925.93)	(27802.66)	(25310.76)
	1527	[0.14]	[0.43]	[0.50]	1696	[0.00]***	[0.31]	[0.07]*
Value of all sales (XOF)	233494.84	39165.14*	10791.39	28373.75	364476.23	80224.19***	22902.73	57321.47**
	(292721.24)	(21653.65)	(21815.02)	(19148.46)	(428368.42)	(26425.18)	(24418.94)	(23194.90)
	1594	[0.14]	[0.62]	[0.50]	1710	[0.00]***	[0.46]	[0.05]*
Value of exchanges (XOF)	52325.81	11216.27	17525.80*	-6309.53	75661.67	9382.75	13794.64*	-4411.89
	(88037.41)	(7925.40)	(9502.94)	(7093.11)	(111392.97)	(7769.93)	(7972.89)	(7354.12)
	1639	[0.21]	[0.26]	[0.50]	1716	[0.23]	[0.31]	[0.55]
Quantity sold and exchanged:								
Total quantity sold (kg)	708.21	112.08*	28.20	83.88	981.13	177.22***	50.18	127.04**
	(855.14)	(58.72)	(58.31)	(52.46)	(1163.13)	(64.75)	(61.83)	(52.70)
	1625	[0.14]	[0.63]	[0.27]	1714	[0.01]**	[0.69]	[0.04]**
Number of sales	1.49	0.21***	0.07	0.14**	1.66	0.20***	0.08*	0.11**
	(1.01)	(0.06)	(0.06)	(0.06)	(0.92)	(0.05)	(0.05)	(0.05)
	1693	[0.00]***	[0.63]	[0.09]*	1731	[0.00]***	[0.19]	[0.04]**
1 if exchanged cashew for rice	0.56	-0.00	-0.03	0.03	0.56	-0.01	-0.00	-0.01
	(0.50)	(0.03)	(0.03)	(0.03)	(0.50)	(0.03)	(0.03)	(0.03)
	1707	[0.89]	[0.63]	[0.47]	1727	[0.62]	[0.90]	[0.72]
Total quantity exchanged (kg)	217.70	20.22	14.13	6.08	231.72	45.40*	63.69**	-18.30
	(323.48)	(22.92)	(24.44)	(22.13)	(346.31)	(25.46)	(26.22)	(24.52)
	1685	[0.63]	[0.63]	[0.86]	1713	[0.12]	[0.08]*	[0.59]
Share of quantity sold over quantity exchanged and sold	0.73	0.01	0.01	-0.00	0.79	0.01	-0.00	0.01
	(0.32)	(0.02)	(0.02)	(0.02)	(0.25)	(0.02)	(0.02)	(0.01)
	1610	[0.76]	[0.63]	[0.86]	1700	[0.62]	[0.90]	[0.59]

Notes: Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 across year 1 (2020) and year 2 (2021). Columns 4 tests for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 and column 5 display the control mean; standard deviation; and total number of observations across all groups in the estimation sample.

Table A.10: Robustness — Main outcomes clustering at the randomisation triplet-level

	Year 1 (1) Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treatment-Spillover	Year 2 (5) Mean (SD) Total obs.	(6) Treatment	(7) Spillover	(8) Treatment-Spillover
Price and revenue:								
Average price (XOF/kg)	295.71	2.07	2.33	-0.26	355.77	6.89*	1.32	5.57*
	(104.36)	(4.43)	(3.89)	(3.03)	(83.13)	(3.64)	(3.45)	(2.84)
	1587	[0.64]	[0.55]	[0.93]	1704	[0.08]*	[0.70]	[0.14]
Value of all sales and exchanges (XOF)	287785.22	61649.88**	44746.80	16903.08	440723.50	105532.81***	58182.34*	47350.47
	(315352.77)	(28196.67)	(30931.74)	(29016.04)	(461068.58)	(38646.95)	(31129.62)	(33431.31)
	1520	[0.06]*	[0.37]	[0.75]	1686	[0.01]**	[0.19]	[0.21]
Value of all sales (XOF)	233494.84	51335.03**	24128.93	27206.10	364476.23	95365.15***	41745.18*	53619.97*
	(292721.24)	(22663.69)	(23608.62)	(26001.84)	(428368.42)	(30726.31)	(24768.03)	(29301.24)
	1591	[0.06]*	[0.41]	[0.70]	1705	[0.01]***	[0.19]	[0.14]
Value of exchanges (XOF)	52325.81	10968.68	17251.21	-6282.54	75661.67	9774.72	15940.01	-6165.30
	(88037.41)	(9491.92)	(12859.48)	(6686.81)	(111392.97)	(10476.33)	(11222.08)	(8449.50)
	1635	[0.34]	[0.37]	[0.70]	1710	[0.35]	[0.21]	[0.47]
Quantity sold and exchanged:								
Total quantity sold (kg)	708.21	141.75**	63.53	78.21	981.13	211.49***	93.73	117.77*
	(855.14)	(67.14)	(65.52)	(71.98)	(1163.13)	(74.30)	(67.09)	(65.77)
	1622	[0.09]*	[0.55]	[0.54]	1709	[0.01]**	[0.28]	[0.19]
Number of sales	1.49	0.21***	0.07	0.14***	1.66	0.20***	0.08	0.11**
	(1.01)	(0.06)	(0.06)	(0.05)	(0.92)	(0.06)	(0.06)	(0.05)
	1693	[0.01]***	[0.55]	[0.03]**	1730	[0.00]***	[0.28]	[0.10]*
1 if exchanged cashew for rice	0.56	-0.01	-0.03	0.03	0.56	-0.01	-0.00	-0.01
	(0.50)	(0.04)	(0.04)	(0.03)	(0.50)	(0.04)	(0.04)	(0.02)
	1706	[0.88]	[0.55]	[0.54]	1724	[0.70]	[0.99]	[0.56]
Total quantity exchanged (kg)	217.70	19.62	20.91	-1.30	231.72	44.46	70.75*	-26.28
	(323.48)	(32.85)	(34.91)	(21.96)	(346.31)	(32.66)	(37.15)	(26.09)
	1681	[0.69]	[0.55]	[0.96]	1707	[0.29]	[0.28]	[0.52]
Share of quantity sold over quantity exchanged and sold	0.73	0.02	0.02	0.00	0.79	0.01	-0.00	0.01
	(0.32)	(0.02)	(0.03)	(0.02)	(0.25)	(0.02)	(0.02)	(0.01)
	1604	[0.68]	[0.55]	[0.96]	1691	[0.70]	[0.99]	[0.52]

Notes: Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 across year 1 (2020) and year 2 (2021). Columns 4 tests for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 and column 5 display the control mean; standard deviation; and total number of observations across all groups in the estimation sample.

Table A.11: Robustness — Main outcomes pooling across years

	(1) Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treat. vs. spillover
Price and revenue:				
Average price (XOF/kg)	326.60	4.79*	1.77	3.02
	(98.69)	(2.52)	(2.55)	(2.31)
	3292	[0.08]*	[0.49]	[0.26]
Value of all sales and exchanges (XOF)	367270.23	83574.12***	50786.10**	32788.02
	(404914.15)	(24422.26)	(23862.50)	(20451.26)
	3207	[0.00]***	[0.07]*	[0.22]
Value of all sales (XOF)	300792.18	72884.01***	31846.50	41037.51**
	(374321.08)	(21215.67)	(20495.86)	(18187.91)
	3297	[0.00]***	[0.16]	[0.10]*
Value of exchanges (XOF)	64140.44	9693.10	16223.28**	-6530.18
	(101175.95)	(6934.40)	(7730.56)	(6333.36)
	3346	[0.16]	[0.07]*	[0.30]
Quantity sold and exchanged:				
Total quantity sold (kg)	848.06	174.78***	77.30	97.48**
	(1033.22)	(53.00)	(51.45)	(44.18)
	3332	[0.00]***	[0.22]	[0.07]*
Number of sales	1.57	0.20***	0.08*	0.13***
	(0.97)	(0.04)	(0.04)	(0.04)
	3424	[0.00]***	[0.16]	[0.01]**
1 if exchanged cashew for rice	0.56	-0.01	-0.01	0.01
	(0.50)	(0.03)	(0.03)	(0.02)
	3431	[0.74]	[0.69]	[0.74]
Total quantity exchanged (kg)	224.72	33.01	46.87**	-13.86
	(335.03)	(21.61)	(22.78)	(18.89)
	3389	[0.21]	[0.16]	[0.74]
Share of quantity sold over quantity exchanged and sold	0.76	0.01	0.01	0.01
	(0.29)	(0.02)	(0.02)	(0.01)
	3296	[0.58]	[0.69]	[0.74]

Notes: Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 pooling across 2020 and 2021. Columns 4 tests for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 displays the control mean; standard deviation; and total number of observations across all groups.

Table A.12: Mechanisms — Marketing behaviour (pre-specified)

	Year 1 (1) Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treatment-Spillover	Year 2 (5) Mean (SD) Total obs.	(6) Treatment	(7) Spillover	(8) Treatment-Spillover
1 if delayed sales because expected price to raise	0.79	-0.01	-0.01	0.00	0.85	-0.04*	-0.02	-0.02
	(0.41)	(0.02)	(0.02)	(0.02)	(0.36)	(0.02)	(0.02)	(0.02)
	1703	[0.63]	[0.72]	[0.96]	1717	[0.13]	[0.76]	[0.61]
1 if sped up sales because expected price to drop	0.27	0.04	0.03	0.00	0.22	0.01	0.01	-0.01
	(0.44)	(0.02)	(0.02)	(0.03)	(0.41)	(0.02)	(0.02)	(0.02)
	1694	[0.28]	[0.39]	[0.96]	1713	[0.88]	[0.76]	[0.83]
1 if sold most to local buyer	0.43	-0.02	0.04	-0.06*	0.56	-0.05*	-0.02	-0.03
	(0.50)	(0.03)	(0.03)	(0.03)	(0.50)	(0.03)	(0.03)	(0.03)
	1622	[0.63]	[0.39]	[0.38]	1709	[0.13]	[0.76]	[0.61]
1 if sold most to itinerant buyer	0.43	0.04	0.01	0.04	0.39	0.06**	0.03	0.03
	(0.50)	(0.03)	(0.03)	(0.03)	(0.49)	(0.03)	(0.03)	(0.03)
	1622	[0.28]	[0.79]	[0.64]	1709	[0.13]	[0.76]	[0.61]
1 if sold most directly to a market	0.04	-0.02**	-0.02	-0.01	0.01	-0.00	0.00	-0.00
	(0.20)	(0.01)	(0.01)	(0.01)	(0.11)	(0.01)	(0.01)	(0.01)
	1622	[0.13]	[0.39]	[0.67]	1709	[0.88]	[0.76]	[0.83]

Notes: Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 across year 1 (2020) and year 2 (2021). Columns 4 tests for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted *p*-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 and column 5 display the control mean; standard deviation; and total number of observations across all groups in the estimation sample.

Table A.13: Mechanisms — Reasons for multiple sales and type of advice sought

	Year 1 (1) Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treat. vs. spillover
Sold more than once because...				
...they think they get better prices	0.23	0.07***	0.02	0.04
	(0.42)	(0.02)	(0.02)	(0.03)
	1693	[0.01]***	[0.91]	[0.12]
...it was adviced by *n'kalô*	0.01	0.03***	-0.00	0.03***
	(0.09)	(0.01)	(0.01)	(0.01)
	1693	[0.00]***	[0.91]	[0.01]***
...they can smooth consumption	0.22	0.05**	-0.01	0.06**
	(0.41)	(0.02)	(0.03)	(0.03)
	1693	[0.05]**	[0.91]	[0.04]**
Sought market advice on...				
...the best time to sell	0.48	0.05	-0.04	0.08***
	(0.50)	(0.03)	(0.03)	(0.03)
	1700	[0.31]	[0.28]	[0.01]**
...the price to sell at	0.61	0.01	-0.05	0.06**
	(0.49)	(0.03)	(0.03)	(0.03)
	1706	[0.76]	[0.28]	[0.06]*
...whom to sell to	0.24	0.03	-0.01	0.04
	(0.42)	(0.02)	(0.02)	(0.02)
	1632	[0.42]	[0.67]	[0.11]

Notes: Producer-level intention-to-treat (ITT) estimates in 2020 (year 1) reported in columns 2 and 3. Columns 4 tests for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 displays the control mean; standard deviation; and total number of observations across all groups.

Table A.14: Mechanisms — Beliefs about prices and sharing of offers

	Year 1 (1) Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treatment-Spillover	Year 2 (5) Mean (SD) Total obs.	(6) Treatment	(7) Spillover	(8) Treatment-Spillover
Beliefs about prices								
Expected sale price (XOF/kg)	512.48	-15.37	-7.21	-8.16	664.05	-15.28	-8.48	-6.79
	(193.57)	(10.51)	(11.24)	(11.84)	(251.30)	(14.08)	(14.86)	(14.48)
	1580	[0.43]	[0.54]	[0.71]	1562	[0.39]	[1.00]	[0.64]
Desired reference price (XOF/kg)	697.85	-15.66	-10.37	-5.30	815.13	-21.58	0.52	-22.10
	(277.93)	(16.21)	(17.03)	(14.40)	(252.18)	(15.79)	(17.17)	(16.72)
	1701	[0.50]	[0.54]	[0.71]	1693	[0.39]	[1.00]	[0.56]
1 if thinks that the reference price is important in marketing	0.38	0.01	0.02	-0.01	0.24	-0.02	0.00	-0.02
	(0.49)	(0.03)	(0.03)	(0.03)	(0.43)	(0.02)	(0.02)	(0.03)
	1689	[0.69]	[0.54]	[0.71]	1717	[0.39]	[1.00]	[0.64]
Number of producers...								
...informed of an offer received	6.82	0.35	0.13	0.23	11.28	-0.15	-0.90	0.75
	(8.66)	(0.48)	(0.48)	(0.44)	(13.32)	(0.72)	(0.78)	(0.77)
	1596	[0.46]	[0.79]	[0.73]	1633	[0.84]	[0.25]	[0.45]
...that shared their offers	4.78	0.71*	0.59	0.13	8.93	-0.78	-1.28	0.50
	(8.62)	(0.37)	(0.37)	(0.37)	(16.05)	(0.82)	(0.84)	(0.66)
	1583	[0.11]	[0.22]	[0.73]	1614	[0.69]	[0.25]	[0.45]

Notes: Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 across year 1 (2020) and year 2 (2021). Columns 4 tests for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 and column 5 display the control mean; standard deviation; and total number of observations across all groups in the estimation sample.

Table A.15: Mechanisms — Placebo outcomes

	Year 1 (1) Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treatment-Spillover	Year 2 (5) Mean (SD) Total obs.	(6) Treatment	(7) Spillover	(8) Treatment-Spillover
1 if filled the sale diary well	0.31	-0.03	-0.04	0.01				
	(0.46)	(0.03)	(0.03)	(0.02)				
	1719	[0.54]	[0.45]	[0.53]				
1 if is extremely risk averse	0.35	-0.00	0.03	-0.03				
	(0.48)	(0.03)	(0.03)	(0.03)				
	1627	[0.89]	[0.45]	[0.53]				
1 if trusts most people	0.70	0.04*	0.02	0.02	0.76	0.04**	0.01	0.04
	(0.46)	(0.03)	(0.03)	(0.03)	(0.43)	(0.02)	(0.02)	(0.03)
	1712	[0.27]	[0.45]	[0.53]	1713	[0.05]**	[0.79]	[0.15]

Notes: Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 across year 1 (2020) and year 2 (2021). Columns 4 tests for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 and column 5 display the control mean; standard deviation; and total number of observations across all groups in the estimation sample.

Table A.16: Mechanisms — Cashews used to repay loans

	Year 1				Year 2			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Mean (SD) Total obs.	Treatment	Spillover	Treatment-Spillover	Mean (SD) Total obs.	Treatment	Spillover	Treatment-Spillover
1 if borrowed money or rice	0.31	0.02	0.03	-0.01	0.42	-0.04	0.02	-0.06**
	(0.46)	(0.03)	(0.03)	(0.03)	(0.49)	(0.03)	(0.03)	(0.03)
	1702	[0.65]	[0.57]	[0.75]	1724	[0.15]	[0.62]	[0.08]*
Implicit price of loans repaid with cashews (XOF/kg)	58.96	12.62**	3.30	9.33	91.35	8.26*	-2.81	11.07*
	(142.79)	(5.49)	(6.13)	(5.79)	(147.69)	(4.61)	(3.74)	(6.61)
	1645	[0.09]*	[0.59]	[0.41]	1603	[0.15]	[0.62]	[0.13]
Total quantity paid for loans (kg)	44.09	-3.23	7.00	-10.24	57.17	-4.86	12.45	-17.30**
	(106.88)	(7.08)	(8.99)	(8.11)	(121.42)	(7.60)	(8.75)	(8.49)
	1686	[0.65]	[0.58]	[0.41]	1716	[0.52]	[0.62]	[0.08]*
Share of quantity sold over quantity exchanged and paid in loans	0.86	0.01	0.03	-0.02	0.91	0.02	0.00	0.01
	(0.29)	(0.02)	(0.02)	(0.02)	(0.20)	(0.01)	(0.01)	(0.01)
	1599	[0.65]	[0.49]	[0.44]	1696	[0.15]	[0.75]	[0.23]

Notes: Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 across year 1 (2020) and year 2 (2021). Columns 4 tests for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 and column 5 display the control mean; standard deviation; and total number of observations across all groups in the estimation sample.

Table A.17: Mechanisms — Other uses of cashews

	Year 1 (1) Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treatment-Spillover	Year 2 (5) Mean (SD) Total obs.	(6) Treatment	(7) Spillover	(8) Treatment-Spillover
Total quantity produced with imputations	1056.06	177.39**	113.68	63.71	1369.04	238.62***	193.34**	45.28
	(1046.24)	(71.32)	(72.66)	(64.28)	(1413.66)	(89.25)	(85.41)	(67.39)
	1718	[0.07]*	[0.47]	[0.55]	1739	[0.04]**	[0.12]	[0.63]
1 if lost cashew post-harvest	0.05	0.00	0.02	-0.02	0.08	-0.02	-0.00	-0.01
	(0.22)	(0.01)	(0.01)	(0.01)	(0.27)	(0.01)	(0.02)	(0.02)
	1708	[0.91]	[0.47]	[0.55]	1719	[0.39]	[0.88]	[0.63]
Quantity lost post-harvest (kg)	0.74	-0.03	0.23	-0.26	1.86	-0.43	-0.12	-0.31
	(5.05)	(0.27)	(0.37)	(0.36)	(14.77)	(0.52)	(0.75)	(0.74)
	1692	[0.91]	[0.67]	[0.59]	1704	[0.41]	[0.88]	[0.68]
1 if processed cashew nuts	0.00	0.00	0.00	-0.00	0.01	-0.00	0.00	-0.01
	(0.04)	(0.00)	(0.00)	(0.00)	(0.10)	(0.00)	(0.00)	(0.00)
	1699	[0.70]	[0.60]	[0.91]	1719	[0.41]	[0.88]	[0.61]
Quantity of processed raw cashews (kg)	0.15	0.59	0.08	0.52	2.07	-0.39	0.06	-0.45
	(3.68)	(0.52)	(0.34)	(0.53)	(37.27)	(0.27)	(0.40)	(0.38)
	1699	[0.63]	[0.82]	[0.55]	1719	[0.37]	[0.88]	[0.61]
Additional uses not pre-specified:								
Quantity traded in small weekly exchanges (kg)	145.40	-9.38	-9.47	0.09	83.73	2.52	-2.88	5.40
	(289.09)	(16.48)	(17.19)	(17.03)	(145.90)	(7.64)	(7.55)	(7.46)
	1604	[0.79]	[0.99]	[1.00]	1590	[0.74]	[0.88]	[0.85]
Total quantity of cashews stored (kg)	0.60	-0.35	-0.43	0.08	0.04	0.54	-0.07	0.61
	(10.70)	(0.31)	(0.39)	(0.14)	(1.02)	(0.58)	(0.76)	(1.30)
	1679	[0.79]	[0.99]	[1.00]	1699	[0.68]	[0.93]	[0.85]
Total quantity of cashews paid to labourers (kg)	162.72	8.85	-0.25	9.10	147.26	18.16	20.79	-2.64
	(261.04)	(17.21)	(16.03)	(14.24)	(245.84)	(15.92)	(15.97)	(13.55)
	1421	[0.79]	[0.99]	[1.00]	1392	[0.68]	[0.63]	[0.85]
1 if perceived production increased in 2021 relative to 2020	0.33	-0.01	0.00	-0.01	0.64	0.02	0.03	-0.01
	(0.47)	(0.03)	(0.03)	(0.03)	(0.48)	(0.03)	(0.03)	(0.03)
	1707	[0.79]	[0.99]	[1.00]	1723	[0.68]	[0.63]	[0.85]
1 if perceived production decreased in 2021 relative to 2020	0.56	0.01	0.01	0.00	0.33	-0.02	-0.03	0.01
	(0.50)	(0.03)	(0.03)	(0.03)	(0.47)	(0.03)	(0.03)	(0.03)
	1707	[0.79]	[0.99]	[1.00]	1723	[0.68]	[0.63]	[0.85]

Notes: Producer-level intention-to-treat (ITT) estimates reported in columns 2 and 3 across year 1 (2020) and year 2 (2021). Columns 4 tests for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 and column 5 display the control mean; standard deviation; and total number of observations across all groups in the estimation sample.

D Production and commercialisation details

D.1 Production costs

The production costs relate to the payment of labour for two main activities: cleaning of the field and collection of the nuts. The cleaning of the field under the cashew trees is necessary in order to have easier access to the nuts that have fallen from the trees. Family or hired seasonal labour is hired to clean the fields before fruits are ripe and start falling together with the nuts. The second activity involves actually picking up nuts that have fallen from the trees. For the product to be ripe and of good quality, the nut should be picked up from the floor after it has fallen from the tree. Occasionally, credit constrained producers may collect the nuts directly from the trees, but this means that the nut has not fully absorbed all nutrients from the tree and ends up being smaller and lower quality. Labour costs are noisy to measure, especially since they are often paid in-kind using a rule-of-thumb type of payment (e.g. every third day of work, the amount collected goes to the labourers), or through shared meals.

D.2 Rice exchanges and interlinked contracts

Many producers exchange their cashews in return for rice or to obtain loans to pay for their immediate needs. While technically illegal (according to national legislation), in-kind exchanges and loans of rice are common and represent an important margin on the commercialisation decisions of producers in this market. In our baseline sample, 35% of the producers have bartered cashews for rice and 34% have borrowed money or rice in exchange for cashews. The quantities involved in these transactions are generally a relatively small fraction of the overall production for most producers. In 2019, we estimate that on average 13% of marketable production was used for barters with rice or loans. The majority of these informal loans are reported to take place in the months preceding the trading season (November to February), when producers are most liquidity constrained. These interlinked contracts reduce the ability of producers to pick a better time during the trading season to sell their production. However, even those who take up a loan (in-kind or in-cash) often still make sales during the trading season.

D.3 Cashew trading seasons during the COVID-19 pandemic

The global surge of COVID-19 in the first quarter of 2020 occurred during the run-up to the cashew trading season in Guinea-Bissau, substantially affecting the market conditions due to a combination of international and local factors. The 2020 trading season started on the 27^{th} of May, two months after what would have been the usual start of the season. The delay was a result of COVID-19 and a contested presidential election held in December 2019. However, small trades of cashews were recorded from a number of buyers since March 2020. Internationally, the two largest importers of raw cashew nuts, India and Vietnam, had already closed their

Table A.18: Mechanisms — Perceived productivity changes

	Year 2 (1) Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treat. vs. spillover
1 if exerted very high effort in collection	0.30	-0.03	-0.05*	0.02
	(0.46)	(0.03)	(0.03)	(0.03)
	1719	[0.58]	[0.32]	[0.81]
1 if exerted very high effort in monitoring	0.34	-0.02	-0.04	0.02
	(0.47)	(0.03)	(0.03)	(0.03)
	1722	[0.75]	[0.49]	[0.81]
1 if exerted high effort in collection	0.70	-0.01	-0.02	0.00
	(0.46)	(0.03)	(0.03)	(0.03)
	1719	[0.75]	[0.65]	[0.87]
1 if exerted high effort in monitoring	0.72	-0.03	-0.00	-0.03
	(0.45)	(0.03)	(0.03)	(0.03)
	1722	[0.58]	[0.86]	[0.81]
1 if increased area of plantation	0.51	0.01	0.02	-0.01
	(0.50)	(0.03)	(0.03)	(0.03)
	1725	[0.83]	[0.65]	[0.81]
1 if new trees yielded	0.44	0.02	0.03	-0.01
	(0.50)	(0.03)	(0.03)	(0.03)
	1725	[0.75]	[0.63]	[0.81]

Notes: Producer-level intention-to-treat (ITT) estimates in 2021 (year 2) reported in columns 2 and 3. Columns 4 tests for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 displays the control mean; standard deviation; and total number of observations across all groups.

borders and cashew processing plants when Guinea-Bissau confirmed its first two positive cases of COVID-19 on March 25^{th}, 2020. Even though demand for processed cashew remained high in the first half of 2020, this disruption in the supply chain caused a substantial slump in the international demand for raw cashew nuts. Sales in other cashew-producing countries in West Africa almost came to a complete halt, as border closures all over the world brought additional market uncertainty. Guinea-Bissau's air and land borders were closed, as a preventive measures to reduce the spread of COVID-19. These measures prevented international and regional cashew value-chain agents, mostly buyers and intermediaries, from entering Guinea-Bissau, also reducing the influx of capital needed to buy raw cashew nuts from producers. National travel restrictions between regions also limited the movement of seasonal workers that support the labour-intensive collection of cashew nuts. Locally, the government delayed the start of the official trading season, typically starting by the end of March, until May 27^{th}. While trade between producers and intermediaries generally takes place before the official start of the season, this is technically illegal and demand for raw cashew nuts generally increases substantially once the government announces the official start of the season.

In 2021, the national market operated more regularly, as a result of both the government and other stakeholders in the cashew value chain agreeing on a set of measures to reduce risk of spreading COVID-19 during the trading season. The start of the official trading season was still delayed until April 7^{th}. However, the number of foreign exporters buying in the local market in 2021 was smaller than pre-pandemic years, due to reduced international travel.

E Weekly messages

Our intervention sent weekly messages using a combination of short messages, robocalls, and an interactive voice response (IVR) system during the 2020 and 2021 trading seasons. Short text messages were sent to those randomly selected producers between April 1^{st} and May 8^{th}, 2020. We also delivered a short text message as our first message of the 2021 trading season. In 2020, from May 16^{th}, the weekly messages were sent via robocalls. Finally, since June 26^{th}, the information was also available on demand through an IVR service. The IVR service was active for only two months prior to the end of the 2020 season, due to delays associated with COVID-19 and the implementing mobile operator, MTN. Our original plan was to develop the IVR service before the start of the 2020 season. According to our original plan, we would have had two separate treatment arms, with the first one receiving the service for free and the other one only after subscribing to it, paying a small monthly price. Given the delay in setting up the IVR service, we decided to merge these two treatment arms into one, providing the service for free to every treated producer. In 2021, while we also experienced some delays with our mobile operator in the sending of robocalls, almost all of the messages were sent as a robocall and the IVR service was active from April 23^{rd}.

Table A.19: Messages sent during the 2020 and 2021 cashew trading seasons

Date sent	Format	English translation
		2020 trading season
01/04/2020	SMS 1	BELAB and the *n'kalô* service will send you information each week on the cashew-nut market. Since the voice-messages are not ready yet, we will send you an SMS.
01/04/2020	SMS 2	Opening of the season was delayed because of coronavirus. We advise to wait to sell until the confusion is over. Dry your nuts well to keep quality
16/04/2020	SMS 3	Opening of the season was delayed still because of coronavirus. Wait to sell until it opens and until the price goes above 300 XOF/kg. Dry your nuts well to keep quality
28/04/2020	SMS 4 (placebo)	BELAB/*n'kalô* that interviewed you in 2019 wishes you a good cashew trading season. Remember to fill in your sales diary in order to take part in the lottery at the end of the season.
28/04/2020	SMS 5	Reference price was announced to be 375XOF/KG. Official opening is still delayed because of the state of emergency. Dry your nuts well to keep the quality.
08/05/2020	SMS 6	Port is still closed because of coronavirus. We think the price will increase in the next few weeks, so wait until the price reaches 375XOF/KG or more to sell.
16/05/2020	Robocall 1	Dear stakeholders of the cashew sector, this is André NANQUE, from n´kalô, to talk about the commercialization of cashew nuts this year. Each week, we will send messages to keep you informed about the market situation and prices. The official launch of the cashew trading season is still delayed due to the Coronavirus epidemic. But the season is due to launch in a few weeks. In neighboring countries like Senegal, Gambia and Guinea-Conakry, prices have increased in recent weeks. In fact, cashew processors in India and Vietnam are short of cashews and need it in the coming months. Prices in other countries have risen above 350 XOF/kg. We believe that as soon as the season really starts, prices will go up a lot; therefore, we recommend that you dry your nuts well and maintain your stocks until prices rise in June.
21/05/2020	Robocall 2	Unfortunately, the official launch of the cashew trade season has been delayed. It shouldn't be too late, but no date is known yet. Despite this, prices started to rise this week due to the high demand in the international market. In Biombo, Cacheu and Oio, prices range from 250 to 300 XOF/kg, in Gabu the prices fixed at 250 XOF/kg and remain the same as last week, in Bafata, Bolama, Quinará and Tombali, where the price is also at 250 XOF/kg. In neighboring countries, Senegal, Gambia and Guinea Conakry, prices have exceeded 350 XOF/kg. We recommend that you wait and start selling your product only if the price offered to you reaches 375 XOF/kg or more.
29/05/2020	Robocall 3	"Since the season has started late, it is also likely to end late. It will take a few more weeks for exporters from the port of Bissau to start shipping cashews on ships to India and Vietnam. The demand for Guinea-Bissau cashews is very strong there and, therefore, we believe prices will increase in the coming weeks. Currently, in the regions of Bafata, Gabu, Bolama, Quinara and Tombalí, prices have remained at 250 XOF/kg and in Oio, prices still vary between 250 - 300 XOF/kg. On the other hand, in Cacheu, prices started to rise and are between 300-350 XOF/kg, while in Biombo, the price increase is even stronger and sales are made between 350-375 XOF/kg. With competition that will rise, we believe that prices will still rise but in the coming weeks. In order not to take too much risk, but to take advantage of the price increase, we advise all producers to wait until 375 XOF/kg is offered before selling the first half of their production and keep the other half selling later when prices can still be higher. We remind you that in Senegal and The Gambia, prices exceed 400 XOF/kg."
11/06/2020	SMS 7	Prices are still rising: we advise to sell half of your stock if prices reach 375XOF/KG or more, and sell the rest later.
17/06/2020	Robocall 4	The commercialisation of cashew nuts is intensifying across the country and, in recent days, representatives of Indian and Vietnamese buyers have started to arrive in the country to check the quality. This week's prices have not changed much from last week. The purchase prices of producers remain between 300 and 350 XOF/kg in the regions of Bafata, Bolama, Gabu, Oio, Quinara and Tombali. Higher prices are practiced in Biombo regions, where sales of 375 XOF/kg are made and in Cacheu, where prices reach up to 400 XOF/kg in locations close to Senegal. At the port of Bissau, cashew nuts trucks are paid between 380 and 420 XOF/kg, depending on the quality of the nuts. When the nuts are very dry, they are more expensive. With increasing competition between buyers, we continue to think that prices will increase slightly in the coming weeks and we always advise to store the cashews until the price of 375 XOF/kg is offered, and to sell half of your stocks when that price is offered.
25/06/2020	Robocall 5	"Large quantities have arrived in Bissau since the season was launched. This slightly reduced demand at the port and caused a slight drop in prices for wholesale prices at the port of Bissau. As a result, producer prices have fallen slightly in some areas of production and are stable in others. Currently, prices are between 300 and 325 XOF/kg in the regions of Bafata and Gabu and between 300 and 350 XOF/kg in all other regions of the country. With the coronavirus epidemic still a problem in many countries around the world, cashew buyers have reduced their orders. Unlike the past few weeks, we are no longer sure that prices will rise. That is why we recommend that you sell most of your cashews if the prices offered are higher than 325 XOF/kg.

01/07/2020	Robocall 6	This week, the first shipment has already left the ports of Bissau, bound for India. Despite these first exports, there are still a lot of stocks in the port of Bissau and, therefore, exporters are not in a hurry to buy. Above all, they want to export the nuts they have in their stores before placing further orders with traders in the production areas. That is why prices practically do not change, always with sales between 300 and 350 XOF/kg in the areas of cashew production. We always recommend selling most of your nuts if a price of 325 XOF/kg or more offers you, because with the situation of the coronavirus, we do not know how the prices will evolve in the coming weeks.
14/07/2020	Robocall 7	This week, there was a certain slowdown in terms of cashew nut transactions in Bissau. Traders have reduced deliveries and are demanding higher prices from exporters. But at the same time, demand from the Vietnam and India factories remains low and cashew-nut prices have fallen in Senegal, Gambia and the Ivory Coast. In certain regions of Guinea Bissau, prices also drop a little. In the regions of Bolama, Quinara and Tombali, prices remained at 300 XOF/kg; in the regions of Bafata and Gabu, prices will vary between 250-350XOF/kg; in Biombo and Oio, prices are between 300-350 XOF/kg and in Cacheu, there were slight increases of 25 XOF in prices, with variations between 325-375 XOF/kg. We recommend selling most of the production when a price of 325 XOF/kg or more is offered to you"
16/07/2020	Robocall 8	This week, new exporters started to buy cashew nuts which increased demand at the port. Prices rose marginally at the port of Bissau. The prices at the weybridge averaged between 375 and 390 XOF/kg, whereas last week they were between 370 et 380 XOF/kg. This increase in demand also increased producer prices. In the regions of Bafata, Gabu, Oio and Bolama the producer price is around 300 XOF/kg. In Quinará and Tombali, producer prices are between 300 et 325 XOF/kg, slightly better than the previous week. In Biombo, certain producers can sell up to 330 XOF/kg, however in Cacheu prices are between 350 et 375 XOF/kg. As last week, we recommend to sell most or all production when a price of 325 XOF/kg or more is offered to you.
22/07/2020	Robocall 9	This week, the competition between cashew exporters in Bissau port further increased and prices reached 400 XOF/kg. The producer prices also slightly increased. Higher prices continue to be paid in Cacheu, where producer prices are between 350 and 375 XOF/kg. In the regions of Bafata, Bolama, Gabu, Biombo and Oio prices are between 300 and 350 XOF/kg i.e. an increase of between 10 and 50 XOF/kg. The lower prices are paid in Quinara and Tombali where cashews are purchased for prices between 300 and 325 XOF/kg. This increased demand is an excellent opportunity to try to negotiate a good price for the cashew nuts you still have with you. We recommend negotiating a price of 350 XOF/kg to sell all remaining stocks.
31/07/2020	Robocall 10	This week, the competition between nut exporters in the port of Bissau continues to be great and the prices also increased slightly. The producer prices also increased slightly in the production zones. The highest prices in Cacheu productor reached between 350 and 400 XOF/kg. In the regions of Bafata, Biombo, Bolama, Oio and Gabu prices were 350 XOF/kg, which was the same price of last week. In the regions of Quinara and Tombali the price increase was strong. In these two regions the prices went from 300 and 325 XOF/kg last week to 350 and 375 XOF/kg this week. The season will end in a few weeks. We therefore recommend negotiating a minimum price of 350 XOF/kg to sell all remaining stocks. You can get a good price without waiting too much more to sell.
06/08/2020	Robocall 11	This week, the cashew trading season is near the end in the regions of Bafata, Biombo, Bolama, and Oio where the last prices paid to producers were 350 XOF/kg. Quinara and Tombali persist in high demand for cashew nuts and prices paid are between 350 and 375 XOF/kg , like last week. In Cacheu, cashews nuts are still purchased between 375 and 400 XOF/kg but there is limited quantity available. In the port of Bissau, the competition fell slightly and prices decreased slightly. International demand is limited at this point so it is very unlikely that prices will keep increasing. Our advice is to sell the nuts that you still have as fast as possible.
13/08/2020	Robocall 12	This week, the commercialization season cashews finished in the regions of Bafata, Biombo, Bolama and Oio, where heavy rain began and the few available stocks made the trade very difficult. In Quinara and Tombali, there is still demand for cashews with stable prices between 350 and 375 XOF/kg. In Cacheu, nuts are still purchased between 375 and 400 XOF/kg. In the port of Bissau, the competition increased slightly and prices also marginally increased. International demand is limited at this point what makes very unlikely rising prices. Our advice and sell the nuts that are with you as fast as possible.
22/08/2020	Robocall 13	This week the trading season ended in all cashew producing regions. Almost all seasonal trading points of intermediaries from producers have closed, with no purchase and sales of cashews recorded inside the country, throughout the week. The last sales are made in the capital, Bissau, between traders and exporters with a sale price between 400 and 430 XOF/kg. As such, we'll stop sending weekly messages from next week. We hope you have enjoyed our information and we will work to continue to inform you from the beginning of the next cashew trading season. Until the next year!
09/09/2020	SMS 8 (placebo)	BELAB/*n'kalô* that interviewed you in 2019 reminds you to keep your sales diary in order to take part in the lottery before the next trading season.

		2021 trading season
SMS 1	24/03/2021	We are restarting the *n'kalô* messages for 2021. Producer prices are between 250-300 XOF/kg. We think they will increase in the coming months so we advise you not to sell yet. Have a good season!
Robocall 1	23/04/2021	This week, prices rose slightly in all Guinea-Bissau cashew producing areas. However, prices have not yet reached peak, as not all buyers and exporters received their permits and, therefore, the product cannot yet go out to the harbour. This week, the highest prices are observed in the regions of Biombo, Cacheu and Oio, where producer prices are between 350 and 360 XOF/kg. In the regions of Bafata, Quinara and Tombali prices range from 300 to 350 XOF/kg. The regions where the smallest prices are observed are Bolama and Gabu where prices are between 250 and 350 XOF/kg. Even in these regions, prices tend to increase. We continue to recommend waiting for prices to increase before selling. A price of 450 XOF/kg seems to us easily reach before sale.
Robocall 2	29/04/2021	Again this week, prices are slightly rising across the country. The competition between buyers begins to emerge but did not reach its maximum because deliveries in the port of Bissau are not yet possible. The producer prices recorded are: in the Gabu region, prices have been varied between 250 and 350 XOF/kg; In the Bolama region, the minimum price has grown by 50 XOF/kg, with prices between 300 and 350 XOF/kg, similar to the regions of Bafata, Quinara and Tombali; In the Biombo region, minimum price reductions were recorded at 50 XOF/kg and the maximum price at 10 XOF/kg compared to last week. In this region the prices ranged between 300 and 350 XOF/kg; In the Oio region, prices remained relatively stable throughout the week, with prices ranging between 350and 360 XOF/kg; In the Cacheu region, along with the borders with Senegal, maximum prices grew by 15 XOF/kg compared to last week, reaching values higher than the reference price announced by the government, prices are ranging between 350 and 375 XOF/kg along the border. In neighboring countries, prices continue to go up. They are between 400 and 525 XOF/kg in Senegal and most areas of West African cashews production, where the season started earlier. We are therefore convinced that prices will continue to increase in the coming weeks and therefore always recommend that you avoid selling at a price below 450 XOF/kg.
Robocall 3	13/05/2021	This week, despite the official opening of the scale in Bissau, the trucks did not begin to deliver the cashew nuts to the harbour. The reason stems from negotiations between cashew buyers and the government on taxes. Once the situation is resolved, sales can finally accelerate and prices should rapidly increase. In recent days, prices have continued to increase despite everything, exceeding 350 XOF/kg in most production zones prices of 400 XOF/kg that is already available in the regions of Biombo and Cacheu. Some buyers in the Cacheu region began offering 450 XOF/kg. We continue to recommend that you wait until this price of 450 XOF/kg is offered to you before selling most of your cashews stocks.
Robocall 4	21/05/2021	The cashew market in Guinea-Bissau, throughout the week, registered positive evolutions in terms of negotiations, which had been taking place between the government and the confederation of cashews associations, and also in relation to the price to the producer. From the information collected from the Cashew National Agency, soon the new fees and taxes resulting from the above mentioned negotiations should be announced. In recent days, the following variations have been recorded: in the Bolama region, prices remained relatively stable compared to last week, ranging between 300-350 XOF/kg; In the Tombali region, the prices were relatively stable throughout the week, with oscillation of around 350 XOF/kg, in the regions of Bafata and Biombo, this week, similar variations were registered to those last week, that is, between 350-400 XOF/kg; In Gabu and Oio regions, prices remained relatively stable throughout the week, with variations between 350-375 XOF/kg, similar variations for Quinara region, where prices grew by 25 XOF/kg compared to last week. Finally, in the Cacheu region, near the borders with Senegal, prices have been ranging between 400 - 450 XOF/kg like last week. Prices will increase in the next days after the Government announcements. We still advise to wait 450 XOF/kg to sell most of your production.
Robocall 5	28/05/2021	This week, cashew traders and exporters finally reached an agreement with the government about the level of export taxes and deliveries to the port of Bissau have began. The first sale prices of cashews that arrive in Bissau are between 450 and 490 XOF/kg. In the vast majority of production areas, prices increased to 400 XOF/kg, although some 350 XOF/kg sales are still observed in the Oio and Bolama regions. In the regions of Cacheu and Bafata some producers can negotiate 450 XOF/kg. Now that the campaign is fully launched, our recommendation is as follows: If you receive an offer of 400 XOF/kg, sell half of your cashews stocks and if 450 XOF/kg are offered, sell all your cashews stocks. Even if the demand is good, it is quite uncertain that prices rise above 450 XOF/kg, so we should avoid looking for higher prices because it is also possible for prices to fall at the beginning of the rainy season.
Robocall 6	09/06/2021	This week, in Bissau, the prices oscillated between 460-475 XOF/kg, ie there was a minimum price growth at 10 XOF/kg and a decrease in the maximum price at 15 XOF/kg, compared to last week. This decrease in the maximum price, next to the scales, is due to the mass arrival of significant amount (between 30,000 - 40,000 tons) of nuts from the regions, resulting from the recent opening of Bissau scales and also, due to the need to free space in the warehouses of the regions, so that there is continuity of the purchases of the intermediaries with the producers. This week, in the regions, overall, producer price variations continued between 350 and 450 XOF/kg with most purchases made at 400 XOF/kg. Like last week, our recommendation is as follows: If you receive an offer of 400 XOF/kg, sell at least half of your cashew stocks and if 450 XOF/kg are offered, sell all your cashews stocks.

Robocall 7	11/06/2021	This week prices are around 475 XOF/kg in Bissau, a slight increase over last week. The demand is strong in the port of Bissau, as in other cashew producing countries. Like the last week, in the regions, producer price variations remain between 350 and 450 XOF/kg with most purchases at 400 XOF/kg. In parts of the Cacheu region the prices have increased up to 475 XOF/kg. Like our recommendation last week: If you receive an offer of 400 XOF/kg, sell at least half of your cashew stocks and if 450 XOF/kg is offered, sell all your cashews stocks.
Robocall 8	18/06/2021	This week, prices are relatively stable in Bissau as in production areas. The demand remains good, but the supply is strong and more than 130,000 tons have already been delivered to the port of Bissau. Bissau prices are still between 465 and 475 XOF/kg and prices in production areas are between 350 and 475 XOF/kg. More precisely, in Bolama and Oio regions, price variations remain between 350 - 400 XOF/kg. Bafata and Biombo have prices of around 400 XOF/kg, i.e. a minimum price rise of 50 XOF/kg compared to last week; In the regions of Gabu, Quinara and Tombali, price variations are between 375 - 400 XOF/kg, i.e. minimum price increases of 25 XOF/kg compared to last week; In the Cacheu region, price variations remain between 350 - 475 XOF/kg. The rains are about to start, which is why our recommendation is now: If you are offerred 400 XOF/kg, sell all your cashew stocks.
Robocall 9	25/06/2021	This week, the shipments of cashews from the harbour finally could start and this caused a slight increase in Bissau prices as in most areas of cashews production. The prices of cashews that arrive in Bissau increased, ranging between 470 and 480 XOF/kg. At the level of production zones, the price of 400 XOF/kg to the producer tends to be most common in all regions. Only the Bolama and Oio regions still record some purchases at 350 XOF/kg, but even in these regions the price of 400 XOF/kg is offered by some buyers. In all other regions, prices reached 400 XOF/kg and in the Cacheu region prices reached 475 XOF/kg in some villages. As the rains are starting, we recommend that you enjoy this situation to negotiate the sale of your latest stocks at 400 XOF/kg and finish your season.
Robocall 10	02/07/2021	This week, the competition among cashew exporters to access the latest remaining stock increased markedly. Prices in the port of Bissau rose between 495 and 500 XOF/kg. This increase in port prices resulted in a slight increase in producer prices in production areas. The price of 400 XOF/kg spread virtually to all zones and prices even increase between 425 and 500 XOF/kg in the Cacheu region. As the campaign approaches the end, we continue to advise to take advantage of this good demand to negotiate at least 400 XOF/kg and sell your remaining stocks.
Robocall 11	09/07/2021	At the end of the past week, the quotations of cashew prices climbed in the international market. Processors in India and Vietnam have been informed that the harvest is coming to an end in West Africa and made large requests from the latest fresh cashew stocks available in Guinea-Bissau. With this increase in demand, Bissau prices have increased even more and are now between 500 and 510 XOF/kg for the cargo arriving in the port. In production areas, producers' purchase prices have increased even more and now range from 400 to 450 XOF/kg, with most purchases at 450 XOF/kg. This unexpected increase is an unexpected opportunity to sell your remaining cashews. Therefore, we recommend that you negotiate 450 XOF/kg to sell your latest fresh cashews stocks. Note that the season will end soon.
Robocall 12	17/07/2021	Now the commercialization of cashews ended in other major producing countries, such as Ivory Coast, Nigeria and Ghana, so Indian buyers and Vietnamese are increasing their requests for Guinea-Bissau cashews. Under these conditions, wholesale prices increased slightly in the port of Bissau and are between 515 and 520 XOF/kg. Producers prices remain between 400 and 450 XOF/kg, with more and more purchases at 450 XOF/kg. As last week, we recommend that you negotiate a price of 450 XOF/kg to sell your latest nuts and finish the season before rainfall decreases quality.
Robocall 13	23/07/2021	This week, the demand remains very strong in the port of Bissau to capture the latest cashew nuts available in Guinea-Bissau. The prices of trucks loaded with cashews delivered in the port of Bissau have increased even more and now between 520 and 540 XOF/kg. In production zones, the latest major sales are between 400 and 500 XOF/kg, with most sales at 450 XOF/kg. We always recommend negotiating at least a price of 450 XOF/kg to sell your latest stocks before rainfall degrade the quality. The season is coming to an end and we will soon be completing the spread of our cashew market information messages.
Robocall 14	29/07/2021	This week, the demand remains very high in the port of Bissau to buy the latest cashews available in Guinea-Bissau. Wholesale cashew prices delivered to the port of Bissau grew a lot and range from 535 to 550 XOF/kg. In production zones, the last major sales were between 400 and 500 XOF/kg, with most sales at 450 XOF/kg. We recommend negotiating at least this price of 450 XOF/kg to sell all your stock, as the campaign is at the end. Despite the end of the cashew trading season, N'Kalô will continue its services, informing you of various issues, which may help you make better decisions.

F Producers' transaction diaries

During our baseline survey, producers in our sample were provided with a simple paper-based template to record their transactions during the 2020 trading season. We refer to this template as a transaction diary.[32] The data-collection team showed producers how to correctly fill in this diary to record the date, quantity sold and price of a transaction.

Importantly, producers recorded the exact day in which they made a transaction. Instead, in our follow-up interviews, we only asked producer to recall in which month they had made a transaction.

During the in-person follow-up interview, the survey team collected the diaries that had been left after the baseline. After data-collection, two operators digitised the data from the sales diaries to check whether they had been correctly used to record the date, quantity and price of sales made during the 2020 seasons. In the rest of this sub-section we use the data recorded in these transaction diaries to provide further evidence on the impact of the intervention.

The information provided by the intervention matched the price dynamic observed in our sample. Appendix Figure A.2 shows the daily average prices recorded by the sample of producers that filled in the diaries.[33] The vertical lines show the dates in which producers received a message from *n'kalô*. Blue lines show a "bearish" message, that suggested that prices were low and it was better to wait. Orange lines provided a "bullish" message, that suggested that prices were high and it was a good time to sell. The price movements recorded in the transactions are consistent with the information that producers received.

The transaction diaries provide further evidence that the effects of our intervention may be due to the messages content, rather than just due to a salience effect, as in Bettinger et al. (2021). For example, we can rule out that producers mechanically sold more frequently when they received messages. As Appendix Figure A.3 illustrates, there is not a consistent pattern between days in which the messages were delivered and days in which producers recorded making a sale. The message content matters.

In Appendix Table A.20, we estimate treatment effects on outcomes constructed using the data from the transaction diaries. Several of these effects point in the same direction as those we had estimated for the full sample. Average prices are marginally higher for treated producers, but not significantly so, relative to the control group. The number of sales is not greater for the treatment group relative to the control group, but this may be because we are selecting a group of producers that is already making at least one transaction.

[32] To encourage the use of the sales diary, the data-collection team promised that producers that kept records could participate in a lottery to win a 50kg bag of rice. Two placebo messages sent to all producers in 2020 reminded producers to use the sales diary.

[33] Appendix Table A.15 shows that having filled in the diary is not correlated with treatment. Not all producers filled in the diaries. Other producers could not find the diary during the in-person follow-up interview.

The treatment effect on quantity sold and the value of sales point in the same direction as those estimated for the full sample using data from the in-person follow-up survey.

As Appendix Figure A.3 had alluded, we find no evidence that treated producers sell within days of receiving a message. Instead, we find that treated producers recorded making more transaction in June relative to the control group, a time when prices were at their highest and when the intervention messages had advised producers to sell. We do not find that they sold earlier in the trading season, but this lack of finding may also be because the sub-sample of control producers had recorded more sales in this period relative to the full sample of control producers.

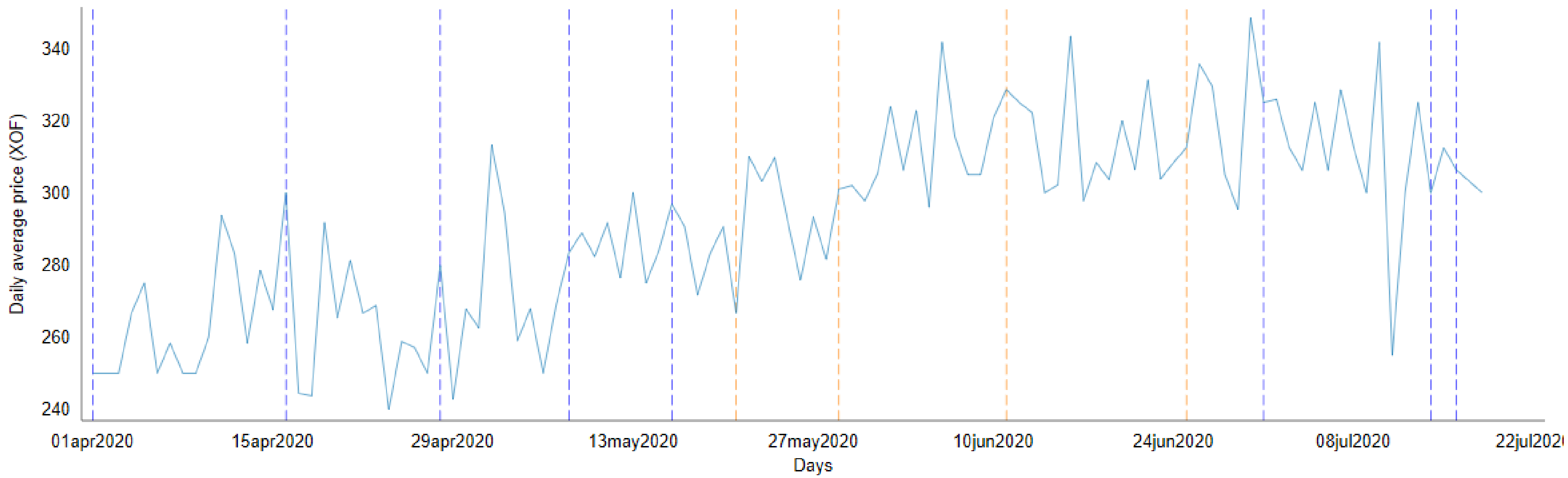

Figure A.2: Daily average prices recorded in transaction diaries[a]

[a] Daily average price recorded in transaction diaries left with producers after baseline. The vertical lines show the dates in which producers received a message from *n'kalô*. Blue lines show a "bearish" message that suggested that prices were low and it was better to wait. Orange lines show a "bullish" message that suggested that prices were high and it was a good time to sell.

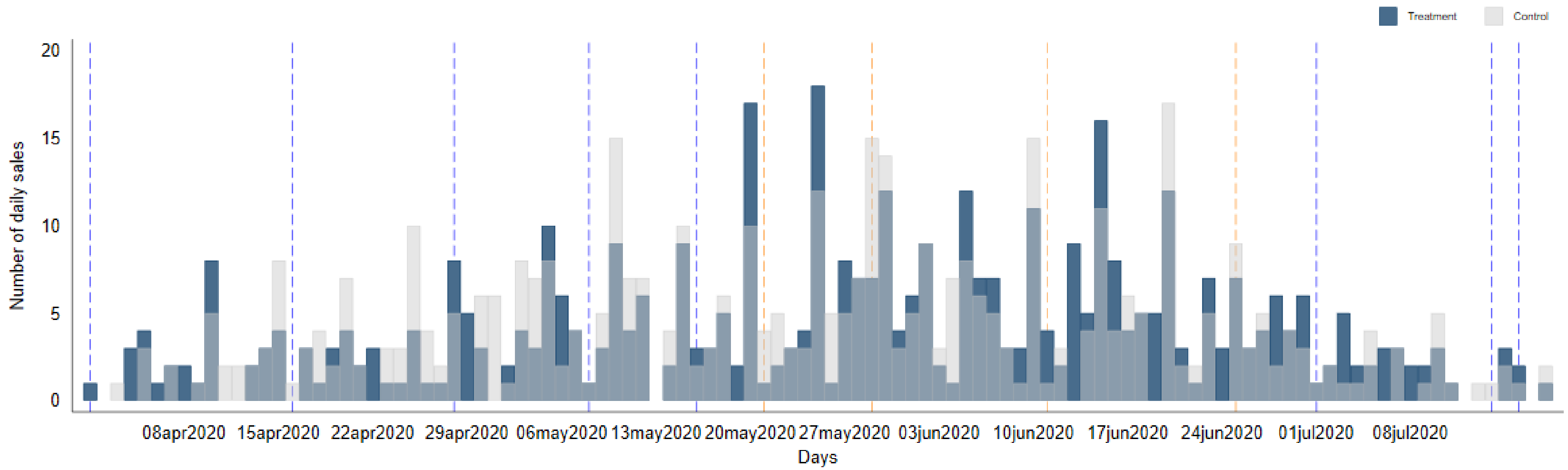

Figure A.3: Number of daily sales recorded in transaction diaries by treatment[a]

[a] Number of daily sales recorded in transaction diaries left with producers after baseline, between treatment and control producers (spillover group is omitted from the graph). The vertical lines show the dates in which producers received a message from *n'kalô*. Blue lines show a "bearish" message that suggested that prices were low and it was better to wait. Orange lines show a "bullish" message that suggested that prices were high and it was a good time to sell.

G Village-trader outcomes

During our in-person follow-up, we tried to interview an intermediary present in the village at the time the data-collection team surveyed producers. We were not able to survey an intermediary in every village, and almost all of the intermediaries that we interviewed were those that lived permanently in the village. Table A.21 shows the main outcomes measured at the intermediary-level across treated and control villages.

No outcome is statistically different between the two groups of villages. Consistent with the information provided by treated producers, village traders in treated villages record purchasing a larger amount of raw cashew nuts relative to those in control villages, though the difference is not statistically significant, it represents about 10% of the control mean. We also see a reduction in the margins earned by the sample of surveyed intermediaries in treated villages relative to control villages. We are cautious in not over-interpreting this difference because the sample for whom we can observe the resale price is small: many intermediaries reported not knowing the resale price but buying on commission for an exporter in exchange of a fixed income or quantity-based fee.

We also sought information on the number of intermediaries that visited the villages. We asked the village leader, or whom they had delegated, how many itinerant intermediaries had visited the village during the trading season. In line with our findings of positive *between*-village spillovers, we find in Appendix Table A.22 that control villages received a higher number of visits by itinerant intermediaries.

Table A.20: Mechanisms — Salience and diary-based measures

	Control (1) Mean (SD) Total obs.	(2) Treatment	(3) Spillover	(4) Treat. vs. spillover
Average price from the diary (XOF/kg)	310.96	3.92	-8.94	12.85**
	(59.06)	(6.14)	(5.97)	(5.81)
	448	[0.52]	[0.54]	[0.11]
Number of sales from the diary	3.00	-0.26	-0.16	-0.10
	(2.45)	(0.27)	(0.26)	(0.20)
	523	[0.44]	[0.67]	[0.62]
Total quantity sold from the diary (kg)	1022.76	259.82	-89.52	349.34
	(1856.30)	(235.80)	(203.95)	(235.91)
	462	[0.44]	[0.67]	[0.19]
Total value of sales from the diary (XOF)	338145.95	85771.11	-29425.56	115196.68
	(775014.25)	(81123.21)	(68545.01)	(74244.75)
	463	[0.44]	[0.67]	[0.19]
Timing:				
1 if sold cashews within two days of a message	0.46	-0.02	-0.00	-0.02
	(0.50)	(0.05)	(0.06)	(0.06)
	514	[0.87]	[1.00]	[0.89]
1 if sold cashews in April 2020 or before	0.27	-0.03	0.01	-0.04
	(0.44)	(0.05)	(0.05)	(0.05)
	514	[0.87]	[1.00]	[0.89]
1 if sold cashews in May 2020	0.58	0.01	-0.01	0.02
	(0.50)	(0.06)	(0.06)	(0.06)
	514	[0.87]	[1.00]	[0.89]
1 if sold cashews in June 2020	0.54	0.10*	0.04	0.06
	(0.50)	(0.06)	(0.06)	(0.05)
	514	[0.47]	[1.00]	[0.89]
1 if sold cashews in July 2020 or later	0.15	0.01	0.02	-0.01
	(0.35)	(0.04)	(0.04)	(0.05)
	514	[0.87]	[1.00]	[0.89]

Notes: Producer-level intention-to-treat (ITT) estimates in 2020 (year 1) from transaction diaries reported in columns 2 and 3. Columns 4 tests for differences in parameters obtained in previous two columns. Outcome variables are listed on the left and described in detail in the pre-analysis plan. The unit of observation is the individual producer. All models control for the randomisation triplet fixed-effects and the baseline value of the outcome when it was available. Standard errors are in parentheses and are clustered at the village-level. Stars on the coefficient estimates reflect unadjusted p-values. Sharpened q-values controlling the false discovery rate across outcomes within each family are shown in brackets. * denotes significance at 10 pct.; ** at 5 pct.; and *** at 1 pct. level. Column 1 displays the control mean; standard deviation; and total number of observations across all groups.

Table A.21: Village intermediaries outcomes

	(1) Control	(2) Treatment	(3) (1) - (2) [p-value]	(4) N
1 if intermediary was interviewed in 2021	0.42	0.47	-0.05	
	(0.50)	(0.50)	[0.39]	304.00
1 if made any purchase	0.85	0.83	0.02	
	(0.36)	(0.38)	[0.71]	136.00
Number of producers with whom they exchanged	4.23	6.32	-2.09	
	(6.47)	(10.21)	[0.16]	131.00
Quantity purchased (kg)	10626.15	11823.76	-1197.62	
	(17849.26)	(16001.22)	[0.70]	136.00
Purchase price (XOF/kg)	314.63	316.10	-1.46	
	(51.53)	(39.39)	[0.88]	114.00
Resale price (XOF/kg)	395.00	382.71	12.29	
	(71.06)	(81.00)	[0.57]	53.00
Margin (XOF/kg)	74.17	65.57	8.60	
	(67.37)	(78.32)	[0.68]	53.00
1 if made any exchange	0.56	0.60	-0.04	
	(0.50)	(0.49)	[0.66]	136.00
Quantity of cashews obtained from exchanges (kg)	2749.68	3145.35	-395.67	
	(4103.98)	(5085.62)	[0.63]	132.00
Quantity of rice exchanged for cashews (kg)	2545.21	2967.53	-422.32	
	(3942.35)	(4702.57)	[0.58]	133.00

Notes: Column 1 reports the mean in control villages for outcomes related to the 2020 trading season. Column 3 reports the mean in treatment villages. Outcome variables are listed on the left. The data comes from a survey of village-based intermediaries. Due to logistical issues it was not possible to interview an intermediary in every village. Standard deviations are reported in parentheses. Columns 3 reports the difference between columns 1 and 2 and the p-value from a t-test of equality between the means of intermediaries in treatment and control villages in brackets.

Table A.22: Village intermediaries visits

	(1) Control	(2) Treatment	(3) (1) - (2) [*p*-value]	(4) N
Number of itinerant traders that visited the village	10.13	6.75	3.38	
	(14.01)	(9.29)	[0.03]	284.00
Number of seasonal traders that stayed in the village	2.81	2.16	0.65	
	(4.54)	(3.32)	[0.20]	284.00
Number of traders based in the village	4.42	4.03	0.39	
	(5.00)	(4.71)	[0.52]	282.00
1 if itinerant traders visited in March	0.07	0.09	-0.02	
	(0.25)	(0.29)	[0.46]	284.00
1 if itinerant traders visited in April	0.62	0.51	0.11	
	(0.49)	(0.50)	[0.07]	284.00
1 if itinerant traders visited in May	0.78	0.68	0.11	
	(0.41)	(0.47)	[0.04]	284.00
1 if itinerant traders visited in June	0.72	0.57	0.15	
	(0.45)	(0.50)	[0.01]	284.00
1 if itinerant traders visited in July	0.10	0.08	0.02	
	(0.30)	(0.28)	[0.66]	284.00

Notes: Column 1 reports the mean in control villages for outcomes related to the 2020 trading season. Column 3 reports the mean in treatment villages. Outcome variables are listed on the left. The data comes from a survey of village leaders. Standard deviations are reported in parentheses. Columns 3 reports the difference between columns 1 and 2 and the p-value from a t-test of equality between the means between treatment and control villages in brackets.