



WIDER Working Paper 2017/197

Contracts between smallholders and private firms in Mozambique and their implications on food security

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November 2017

Abstract: The focus of this paper is the role played in rural contexts by contract farming agreements between smallholders and private investors. These contracts can take different forms, but in general are agreements under which producers commit to supply produce to a buyer firm. They are—at least on paper—at the centre of agrarian policies in Mozambique, through the Strategic Plan for the Development of the Agricultural Sector 2011-2020. Studies on the effect of these contracts on producers usually find out an increase in income, but the effect is still unclear with respect to other variables. The focus of this paper is on contracts' effects—in the Mozambican case—on food security. We may expect contrasting effects to be at work: on the one hand, the effects of increased income, while, on the other, the effects of giving up food production and of monopsonistic market relations. This paper exploits a panel dataset (2002-2005) collected by the Mozambican Ministry of Agriculture among a nationally representative sample of rural households. Overall, the main findings of the paper indicate that selection in contracts is the main driver of the observed differences.

Keywords: contract farming, food security, Mozambique, propensity score matching

JEL classification: Q13, O13, C21, C23

All the tables and figures are the author's own calculation/illustration based on the Trabalho de Inquérito Agrícola 2002-2005 (TIA) panel dataset.

Acknowledgements: This work has been possible thanks to the UNU-WIDER visiting scholar program. I would like to thank all UNU-WIDER staff, researchers and seminar, the Development Studies seminar at the University of Helsinki, and the ASWEDE conference for their comments. I especially acknowledge the precious suggestions of Saurabh Singhal, Miguel Niño-Zarazúa, Vincenzo Salvucci, Ricardo Santos, Sam Jones and Carlos Gradin. I also thank Benedito Cunguara for his support on the data. Any errors and omissions are the author's responsibility alone.

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This study has been prepared within the UNU-WIDER Visiting Scholar programme.

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ISSN 1798-7237 ISBN 978-92-9256-423-0

Typescript prepared by Ans Vehmaanperä.

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The Institute is funded through income from an endowment fund with additional contributions to its work programme from Denmark, Finland, Sweden, and the United Kingdom.

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1 Introduction

In this paper we analyse the effects for smallholders of being in contract farming agreement, focusing especially on the effects in terms of food security. Contract farming arrangements are contracts whereby producers commit to provide a pre-defined quantity of crop to a buyer firm that buys it at an agreed price; this may imply that the firm provides inputs and technical assistance to the producers, depending on the type of agreement. Methodologically, the main issue to be addressed to analyse the consequences of being in such agreements, is the effect of selection in contracts. We cannot claim that the evidence of a relationship means a causal effect because households that enter in contracts plausibly differ significantly with respect to households that do not.

Contract farming has been considered in the last ten years as a way in which agribusiness systems could benefit smallholders. The World Bank, in the 2007 World Development Report, stated that ‘the private sector drives the organization of value chains that bring the market to smallholders and commercial farms’ and encourages the governments to promote contract farming type of agreements in this direction. At least on paper, these policies are at the core of current agrarian policies in Mozambique: the *Plano Estratégico Para o Desenvolvimento do Sector Agrário* (PEDSA) 2011-2020 promotes the ‘development of value chains according to an agro-industry model [...] establishment of public-private partnerships to link smallholders to markets’. Contracts are considered tools to ‘market integration’, to push a switch from subsistence production to commercial farming; they may relax a number of constraints to cash crop production with respect to spot markets: namely they may reduce marketing costs, decrease price uncertainty and allow for increased access to input and services.

As pointed out by Oya (2012), in Sub-Saharan Africa (SSA) this role had been played by state agencies until these were largely dismantled during the structural adjustment phase, when the dominant idea was that supply of crops would have simply responded to price incentives and therefore ‘getting the prices right’ would automatically promote commercial farming. As we will briefly discuss in the next section, market incentives alone have proven not enough to stimulate agrarian production in many Sub-Saharan African contexts; policies of promotion of contract farming came up as mitigations of this approach that try to integrate the need to correct market failures.

The empirical literature is not conclusive on the possible effects that the participation in these contracts may have on food security. Indeed, the effects that we may expect to be at work are multiple and the direction of the overall effect is not clearly predictable. The first is a positive impact on food security via an income effect: participation in cash crop production allowed by contacts is expected to lead to increased incomes of rural households and this may have a positive effect on food security by relaxing the budget constraint of the household. On the other hand, the switch to cash crop production may engender a substitution effect at the expense of food production, that may harm food security in case of food market failures and may expose food consumption to increased vulnerability to shocks. Moreover, by linking smallholders to one specific firm, contracts may lock producers in monopsonistic relations, thus limiting their market power.

The paper is organized as follows: we first go through a brief literature review where we sketch the possible (contrasting) effects for smallholders of entering in contract farming agreements. Section 3 provides some elements of contract farming in Mozambique and describes the data used. Section 4 describes the variables used and sets the field of analysis through descriptive statistics and time patters. Section 5 describes the identification strategy and presents the results, including some robustness checks. Section 6 discusses the results and section 7 concludes.

2 Brief literature review: contested effects

Contract farming arrangements are contracts where farmers agree to supply cash crops to a buyer firms. They usually establish time and price and often set quality standards (Smalley, 2013). Studies on the effect of these contracts on producers' usually find out an increase of income (e.g. Warning and Key, 2002, in Senegal; Bellmare, 2012, in Madagascar; Briones, 2015, in the Philippines), but the effect is still unclear with respect to other variables. The increase in income can improve the calorie intake of the households, but can also change the intra-household distribution of resources away from basic items (Smalley, 2013).

On what concerns food security, we have evidence of a positive relationship in Bellmare and Novak (2014): participating in contract farming (controlling for experimental results on willingness to participate) reduces the duration of the hungry season and increases the likelihood that the hungry period ends in each month. Minten et al. (2009) find that participants in contract farming have greater welfare, higher income stability and shorter lean periods. At the same time, there can be a reallocation of land and labour away from food production with increased dependency on food markets, as it has been the case for sugar outgrowers in Kenya (Smalley, 2013). As an indication of how risky it is to abandon food production, there is abundant evidence of cases where food production continues together with cash crop production, especially where there are limits of acreage of the contracted crop or limited take-up by farmers. This implies that negative consequences can be stronger for poor producers who have less land and limited food yields (Smalley, 2013).

Other works testify of possible negative consequences, especially related to producers' dependency on a monopsonistic buyer and their vulnerability to his changes in strategy (Bijman, 2008, Sivramkrishna and Jyotishi 2008). The WDR 2007 states that 'The state—through enhanced capacity and new forms of governance—corrects market failures, regulates competition, and engages strategically in public-private partnerships to promote competitiveness in the agribusiness sector and support the greater inclusion of smallholders and rural workers.' At the same time, as Oya (2012) points out, monopsony is a necessary condition for contract farming agreements to emerge, since buyer firms are likely to accept only agreements where farmers do not have outside options. In fact, decision making power is substantially displaced towards bigger firms (Reardon and Barrett, 2000).

It has to be noted that before structural adjustment the role of buying main cash crops was carried out by state agencies, that were largely dismantled during the '90s (Oya, 2012). After the big push to agrarian market liberalization, in Sub-Saharan Africa it became clear that the supply response of smallholder agrarian production to price incentives alone was limited. The reasons explored to explain this supply rigidity, focus especially on failures in labour and food markets. First of all, producers are often net purchasers of food grains, and they are therefore harmed by price increases (Barrett, 2008). Second, agrarian markets may be characterized by high marketing costs (Jayne, 1994; Haltberg and Tarp, 2002) that make autarchy a rational choice. This is also a consequence of price volatility: own-production of food crops can work as a risk management strategy against food excessive price variations (Fafchamps, 1992; Haltberg and Tarp, 2002). There is moreover recent evidence that food production works as insurance tool against weather shocks (Salazar-Espinoza, Jones, Tarp, 2015). Furthermore, several authors underline that marketing decisions of agrarian producers crucially depend on their level of assets (Haltberg and Tarp, 2002; Boughton et al., 2007; Salvucci, 2010) and that marketing of food products occurs above a threshold of asset endowment.

Contract farming appeared as a tool to tackle market failures, but the evidence on its achievement in this direction is mixed. There is evidence that selection effects operate in contract farming too. According to the review done by Smalley (2013), there is often evidence of a failure in reaching

the poorest farmers. For example, there is asset-based selection evidence in Benfica et al. (2006) on cotton and tobacco production in the Zambezi River Valley. Moreover, according to Oya (2012), contract farming is attractive for smallholders if it manages to meet some of the following requirements: a reliable selling outlet with respect to spot markets with no transport costs for smallholders, a more reliable source of inputs, technological spillovers, guaranteed prices before harvest.

3 The context and the data

In this paper, we explore these research questions in the context of Mozambique, exploiting the rich panel dataset offered by the *Trabalho de Inquérito Agrícola* (TIA), collected by the Mozambican Ministry of Agriculture (MINAG) in collaboration with Michigan State University (MSU). Panel waves are in 2002 and 2005 and, selecting observations in order to obtain a balanced panel, we end up with 4014 households. The sample is exclusively rural.

The years 2000s have been years of important growth rates for the Mozambican economy, but with limited results in terms of poverty reduction, especially in rural areas (Cunguara and Hanlon, 2010). In the years of interest (as it is today, more than 10 years later), the structure of land ownership is characterized by very small landholdings, that, especially in that decade, started to be often living side by side with large land acquisition projects. According to Hanlon and Smart (2014) the median size of plot of land in Mozambique is 1 ha; in our sample this is a little bit bigger, but still very small, i.e. 1,75 ha. Parallel to this, there is evidence of large land acquisitions in the country: estimations are difficult, but figures indicate that usage rights for more than 2,5 million hectares have been acquired by private investors in the 2000s. This may explain the discrepancy between the changes in weight of agriculture on the GDP and the lack of substantial changes in rural livelihood conditions. From one of the first analysis on the issue, it appears that a big proportion of these projects are still inactive or lagging behind schedule and that they are located in wealthier and better infrastructure areas (Glover et al, 2016).

Contract farming in Mozambique is especially relevant in cotton and tobacco growing, even if it is increasingly found in the horticulture sector. These are productions concentrated in the centre/north of the country. Contract farming in these two main cash crops is based on a concession system: it entails an exclusive sale agreement that binds smallholders to sell to that company (it is indeed a monopsonistic relationship) and in principle requires that the company supports smallholders in the production process. In other crops, e.g. maize and soya (Hanlon and Smart, 2014), there are several buyers who compete among each other. Although the concessions are authorized by the public authority, the buying companies are private companies, since the sector has been privatized in the 1990s. As an example, the biggest tobacco buyer in Mozambique is currently the Universal Corporation, an American company, trading as Mozambique Leaf Tobacco (MLT)¹.

The descriptive statistics of the TIA balanced panel 2002-2005 are displayed in Table 1.

¹ This company became sadly famous because of a corruption scandal they were involved in, in order to obtain a concession in the Tete province. See <http://fcpa.stanford.edu/enforcement-action.html?id=341> (accessed on 16 November 2017).

Tab. 1. Descriptive statistics (standard deviation in parenthesis)

	2002	2005
<i>Income²</i>		
Total income	9,220 (24,500)	10,760 (25,999)
Farm income	5,051 (11,423)	6,207 (16,970)
Non-farm income	4,106 (20,938)	4,517 (18,631)
<i>Household characteristics</i>		
Female-headed h	0.23 (0.42)	0.27 (0.44)
Age h head	44 (15)	46.64 (14.89)
Education of h head	2.78 (3.93)	3.12 (3.90)
Size of h	5.76 (3.51)	7.18 (4.24)
<i>Assets</i>		
Land (ha)	2.46 (5.54)	2.94 (4.20)
Land (number of plots)	2.53 (1.39)	2.02 (1.18)
Non-farm workers	0.23 (0.59)	0.26 (0.59)
Has lamp	0.55 (0.50)	0.50 (0.50)
Has radio	0.54 (0.50)	0.56 (0.50)
Has wc	0.42 (0.49)	0.46 (0.50)
Has irrigation	0.16 (0.37)	0.08 (0.27)
<i>Inputs</i>		
Hires workers?	0.23 (0.42)	0.23 (0.42)
Uses animal traction	0.21 (0.41)	0.18 (0.38)
Uses fertilizers	0.05 (0.22)	0.05 (0.22)
<i>Market participation</i>		
Association member	0.05 (0.22)	0.09 (0.29)
Received extension	0.15 (0.36)	0.19 (0.39)
Received info prices	0.31 (0.46)	0.39 (0.49)
Cultivates cash crops	0.40 (0.49)	0.23 (0.42)

4 The relevant variables and patterns over time

A first step is to identify who are the farmers who participate in contract farming agreements. We know, for each cultivated crop, which is the main sale outlet, among which one can be *companbia fomentadora* (the supporting company, that is the way the buyer company is defined). A household that has a contract farming agreement is a household who has a ‘supporting company’ as main outlet for at least one cultivated crop.

The number of households that are in a contract are clearly a minority: 254 in 2002 (6.19 per cent of the sample) and 323 in 2005 (7.87 per cent of the sample)³. If we look at these data disaggregated by crop, we confirm the fact that tobacco and cotton are the most represented crops in contract farming agreements (table 2).

² Constant 2002 prices

³ This confirms the evidence of an overall limited actual incidence of the phenomenon like in Oya (2012), but the extent of contract farming may have increased since the mid-2000s.

Table 2. Number of contract farmers by crop (share on total of farmers cultivating that crop)

	2002	2005
Maize	20 (0,56%)	0
Rice	13 (1,17%)	3 (0,49%)
Cotton	87 (32,22%)	208 (76,19%)
Tobacco	91 (52,6%)	98 (67,12%)
Sesame	8 (2,68%)	14 (4,95%)
Soy	1 (7,14%)	6 (20%)
Paprika	0	5 (71,43%)
Others	4 (0,14%)	2 (0,06%)

Exploiting the panel dimensions, we can observe movements ‘in’ and ‘out’ of contracts. This allows us to identify 4 subgroups: those who never enter in contract farming, those who always do (in both our points in time), those who were in a contract in 2002 but are not anymore in 2005, and those, on the contrary, who were not in a contract in 2002, but are in 2005. The 4 groups and the respective magnitudes are the following.

- 1) households that are never in contract farming N=3618;
- 2) households that were not in 2002, but are in contract farming in 2005 N= 232;
- 3) households that were in contract farming in 2002, but stopped by 2005 N= 163;
- 4) households that always are in a contract farming agreement N=91.

We observe different patterns in income dynamics in the four subgroups (Fig. 1). Income increased among those who entered into contract farming agreements and, as expected, this is mainly due to farm income (Fig. 2A).

Fig 1. Total income in 2002 and 2005 in the four groups (constant 2002 prices)

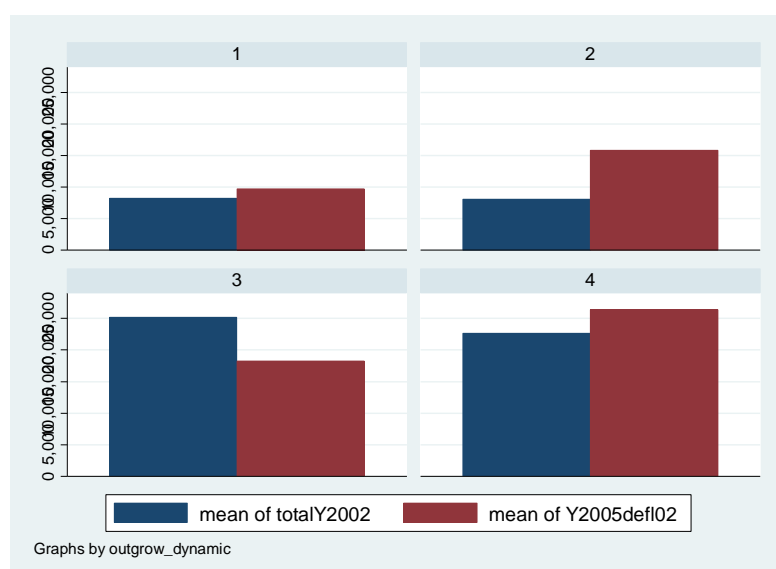
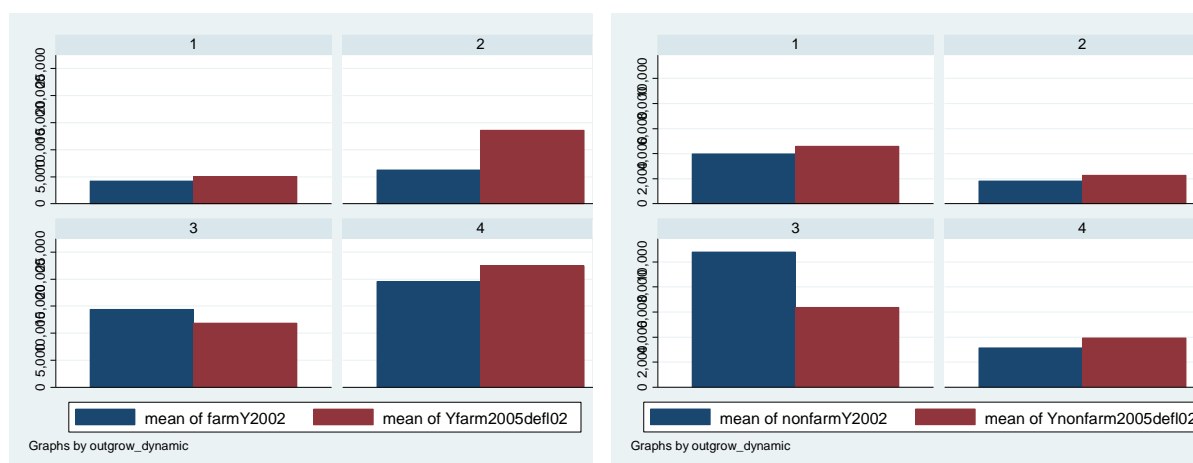


Fig 2. A) Farm income in 2002 and 2005 in the four groups B) Non-farm income in 2002 and 2005 in the four groups; (constant 2002 prices)



It is interesting to remark that households that exit from contracts experience a decrease in income, but this is surprisingly mainly due to a decrease in non-farm income (Fig. 2B). It seems therefore that there is something else that is driving both a decrease in income and a ‘drop-out’ of the contracts. A more detailed analysis of this group is left for further research, but this finding points in the direction to which we will later come, that is the existence of a big selection effect in (and out of) contracts.

Food security is directly elicited through a number of questions:

- had time of hunger in the last year;
- number of months with food reserves;
- number of meals during hunger time.

These questions are unfortunately asked only in 2005, the second wave of the panel. In order to have the possibility of a comparison between the two waves, we will therefore introduce a new variable, that is food production per capita, measured as the sum (in kg) of all own food production of the household divided by the number of members of the household itself.

It is of course questionable whether own food production is a good proxy for food security. An observed reduction in food production can be both a measure of worsening of food availability, but can also be interpreted as a measure of shift out of subsistence. To interpret it as a measure of food security we have to assume partial autarchy of rural households; this may be a reasonable assumption because it is quite safe to assume that households commonly use food production as a risk-reducing strategy (Fafchamps, 1992). This is supported by the evidence brought, in the same setting of our analysis, by Salazar-Espinoza, Jones and Tarp (2015) that food production works as insurance tool. Moreover, to support the use of our proxy, we check that food production is significantly correlated to the direct measure of food security, i.e. the dummy variable ‘having had periods of starvation’ in 2005. The result is shown in table 3 and the significance level is checked by performing a simple t test on mean differences: food production per capita in 2005 is significantly lower in households that have experienced hunger times in the same year.

Table 3. Correlation with 'having had periods of starvation' in 2005

	Had periods of hunger	Did not have periods of hunger	
Food production pc	54.04	110.82	***

Note: *** p<0.01, ** p<0.05, * p<0.1

If we look at simple correlations (Table 4), all the measures of food security are positively correlated with the participation in contract farming agreements.

Table 4. Food security indicators in households having or not contract farming agreements

	Non contract farming	Contract farming	
Had time of hunger in the last year (only 2005)	0.42	0.28	***
Number of months with food reserves (only 2005)	7.3	8.8	***
Number of meals during hunger time (only 2005)	1.8	2.1	***
Food production pc (kg) (pooled)	106.78	217.48	***

Note: *** p<0.01, ** p<0.05, * p<0.1

Since this correlation is far to prove a causality link, the main aim of our contribution is to inquire in the causality relationship between participation in contracts and rural households' food security. In fact, households that are part of contract farming agreements significantly differ from households that are not; these differences are significant in an important set of variables (Table 5), especially asset endowment and access to inputs. It is to be noted that female-headed households are significantly under-represented among those who participate in contracts.

Table 5. Household characteristics for participants and non-participants in contract farming arrangements. Data at baseline (2002).

	Non-contract farming	Contract farming	Difference
Age household head	44.42	43.28	
Education household head	2.75	3.17	
size of the household	5.76	5.80	
land size (ha)	2.38	3.75	***
number of plots	2.49	3.15	***
number of non-farm workers	0.24	0.13	**
female headed household	0.24	0.11	***
owns a lamp?	0.55	0.55	
owns a radio?	0.54	0.69	***
owns a wc?	0.41	0.56	***
has irrigation (at least on one plot)?	0.15	0.25	***
hires workers?	0.21	0.44	***
uses animal traction?	0.21	0.25	
uses fertilizers?	0.03	0.34	***
is association member?	0.05	0.11	***
receives extension services?	0.14	0.30	***
received information on prices?	0.30	0.46	***
produces cash crops?	0.37	0.85	***
N	3850	254	

Note: *** p<0.01, ** p<0.05, * p<0.1

5 Analysis of food security accounting for selection bias

Our identification strategy uses propensity score matching in order to identify a group, among the households that are not in contracts, that is comparable to the households that are in contracts. We then exploit, when possible, the variation in the outcome variables in the two points in time.

The analysis is restricted to group 1 and 2 in Figure 1, thus we exclude the households that were in a contract in 2002 at baseline. This allows to compare, among the households that were not in contracts in 2002, those who entered in a contract farming agreement and those who did not. The descriptive pictures of the two groups are shown in Table 6. The households that enter in contract farming between 2002 and 2005 start from a comparable income level with respect to the others, but have a greater increase between the two waves. Concerning food production, on the one hand, the initial level per capita is higher in the households that are going to start contract farming; on the other hand, food production decreases in both groups between the two waves, but those who enter in contracts reduce food production more than those who do not. Direct measures of food security in 2005 are systematically better in households that entered in contracts.

Table 6. Differences in income, food production, and food security indicators between households that never enter in contract farming agreements and households that enter between 2002 and 2005.

	Never contract farming	Start contract farming in 2005	Difference
Total income in 2002 (Mt)	8167	8026	
Food production pc (kg) in 2002	125.5	221.1	***
Change in income 2002-2005 (constant 2002 Mt)	1591	8580	***
Change in food production (kg) 2002-2005	-45.06	-89.02	***
Had time of hunger in the last year (only 2005)	0.43	0.30	***
Number of months with food reserves (only 2005)	7.3	8.8	***
Number of meals during hunger time (only 2005)	1.97	2.06	***

Note: *** p<0.01, ** p<0.05, * p<0.1

To see if these differences are due to the effect of entering in contracts or to some other variables that affect the selection in contracts, we use propensity score matching (PSM). We therefore use the predicted values of a Probit model to identify, for each ‘treated’ household (households that participate in a contract farming agreement) the closest non-treated, on the basis of observable pre-treatment variables. This allows identifying two groups that have the same probability to be treated conditional on a set of observables. These observables are measures of income, food production, asset endowment, access to inputs and a vector of household characteristics, all measured at baseline (2002)⁴. Selection equation includes province fixed effects⁵.

Results are displayed in Table 7. We have two groups of outcome variables: the three direct measures of food security where we can only observe the 2005 outcomes (col 3-5) and the variables where the outcome is the difference between the 2005 and the 2002 levels. Col 1-2 are therefore similar to difference-in-difference estimations: in column 1 the outcome variable is the difference in income levels, and in column 2 it is the difference in food production per capita. Dependent variables are therefore:

$$(1) y = (Y_{T,2005} - Y_{T,2002}) - (Y_{C,2005} - Y_{C,2002})^6$$

$$(2) y = (FP_{T,2005} - FP_{T,2002}) - (FP_{C,2005} - FP_{C,2002})$$

$$(3) y = \text{had times of starvation in the last year (dummy)}$$

$$(4) y = \text{how many months of food reserves did the household have}$$

$$(5) y = \text{how many meals did the household have during the last starvation time}$$

Table 7 displays the average treatment effect on the treated (ATT) on the outcome variables mentioned above, where by ‘treatment’ we mean the fact of being in a contract farming agreement in t_1 (2005).

$$ATT = E (y_1 - y_0 \mid t=1)$$

⁴ The Probit model used to estimate the propensity score is in Appendix, together with the graph of common support across propensity score distribution.

⁵ This means that we had to drop the provinces where no contract farming is observed, that means dropping the observations of two southern provinces, Maputo and Inhambane.

⁶ Calculated at 2002 prices.

These treatment effects are calculated with a one-to-one match and the Abadie-Imbens (Abadie and Imbens, 2016) standard error is calculated, in order to take in account that propensity scores are estimated.

Table 7. ATT of 'being in contract farming' 2005, after matching

	(1) Y ₂₀₀₅ -Y ₂₀₀₂	(2) FP ₂₀₀₅ -FP ₂₀₀₂	(3) Hunger times	(4) Months with food reserves	(5) Number of meals in hunger time
ATT of contract farming in 2005	6,239** (2,657)	13.60 (29.23)	-0.0609 (0.0455)	0.317 (0.338)	0.0783 (0.0639)
Observations	3,153	3,149	3,153	2,558	3,150

Notes: Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

We observe that the impact of entering in contracts is positive and significant on income: there is a significant greater increase in income among the households that entered in such kind of arrangements on cash crops (col 1). Column 2 presents the results on the change in food production per capita and we don't see a significant impact of contracts on it. Although we cannot observe its dynamics, the three measures that we have of food security in 2005 are not significantly affected by the fact of entering in contracts (columns 3 to 5). These results therefore indicate a positive impact on income but no impact on food security.

5.1 Robustness checks

Concerning robustness of our results, we have two main concerns.

First, our results may be sensitive to the matching model chosen and, most of all, it is important to check that they hold selecting a matching model that allows for the best balance. According to the pre-matching analysis, kernel matching leads to a better covariate-specific balance across treatment and control group. The previous results do not incorporate this because they use the Stata *teffect* command that does not allow for kernel weighting. To allow for this, we carry on the same analysis by estimating propensity scores, then using it to estimate the ATT and bootstrapping standard errors (Leuven and Sianesi. 2003). The results are displayed in table 8 and are consistent with our main specification.

Table 8. ATT of 'being in contract farming' 2005, after matching, using kernel matching.

	(1) Y ₂₀₀₅ - Y ₂₀₀₂	(2) FP ₂₀₀₅ -FP ₂₀₀₂	(3) Hunger times	(4) Months with food reserves	(5) Number of meals in hunger time
ATT of contract farming in 2005	6,156*** (2,012)	22.07 (24.06)	-0.0483 (0.0395)	0.324 (0.268)	0.0375 (0.0655)
Observations	3,153	3,149	3,153	2,558	3,150

Notes: Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Second, propensity score matching only allows for selection on observables: we might nevertheless think that some unobservable variables affecting the participation in contracts impact our results. As a robustness check, we use the Abadie semi-parametric difference-in-difference (Abadie, 2005, Hounghbedji, 2016), that uses a reweighting technique to address the imbalance of characteristics between treatment and control group. The aim is to make the assumption of parallel trends in the outcome variables between the two groups more credible. We only focus on the outcome variables of which we know the variation over time, and we find similar results as before.

Table 9. Abadie semi-parametric DID

	(1) Y ₂₀₀₅ -Y ₂₀₀₂	(2) FP ₂₀₀₅ -FP ₂₀₀₂
ATT of contract farming in 2005	5,716*** (1,999)	11.10 (15.00)
Observations	2,544	2,542

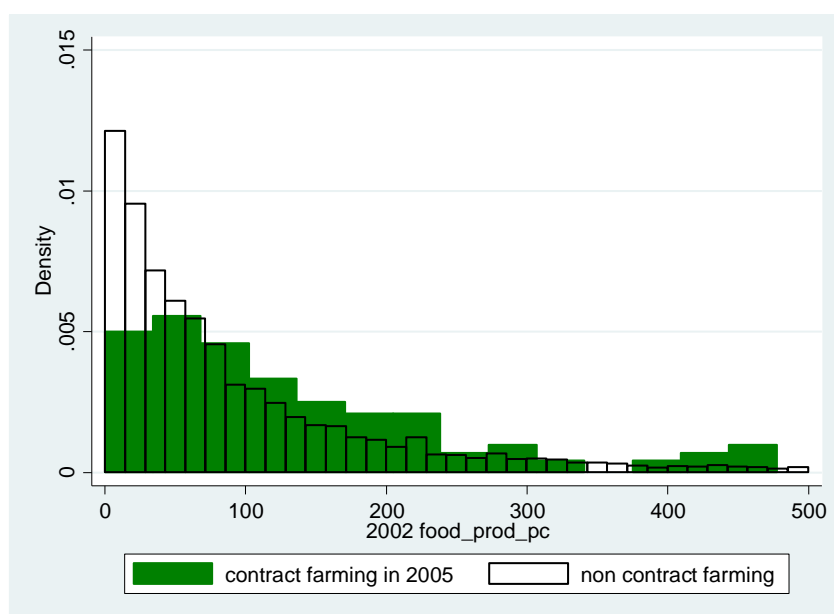
Notes: Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6 Discussion

To sum up, if we look at simple correlations, apparently we have a strong relationship between the fact of entering in a contract farming agreement and income, food production, and food security indicators. After matching we observe three main results. First, entering in contract farming agreements produces an increase in income; second, the effect on direct food security measures is nil (but we don't have measure of variation over time); third, contract farming doesn't produce any significant change in food production. If we interpreted food production as a proxy for food security, we would have expected an increase when entering in contracts; the absence of a significant effect indicates that entering in contracts does not have a food security increasing impact. To compensate for the imperfect proxy, we can observe that this evidence is coherent with the result obtained on direct measures of food security. The first conclusion that can be derived is that the correlation between participation in contract farming and food security measures that we observed in the descriptive statistics is to be ascribed to a selection effect in contracts, rather than to a causal effect of contracts on food security. More food secure households have higher probability to enter in contract farming agreements. Figure 3 shows the distribution of food production per capita in 2002 in the two subgroups: households that enter in contact farming by 2005 and households that did not.

Fig 3. Histogram of food production (tons per capita) in 2002 in households that then entered in contract farming in 2005 and that did not.



This is confirmed if we look at the determinants of participation in contracts with a simple binary model (Table 10)⁷.

Table 10. Determinants of the probability of being in a contract farming agreement in 2005. Marginal effects after Probit.

	Marginal Effects after Probit
Was in a contract farming agreement in 2002?	0.0796*** (0.0140)
Female-headed household 2005	-0.0468*** (0.0128)
Age of head of household 2005	-0.00140*** (0.000355)
Household head education 1 2005	-0.0156 (0.0108)
Household head education 2 2005	-0.0120 (0.0173)
Household head education 3 2005	-0.0435 (0.0283)
Size of the household 2005	0.00348*** (0.00130)
Size of landholding (ha) 2002	-0.000336 (0.00138)
Number of plots 2002	0.0120*** (0.00369)
Owns a lamp? 2002	-0.0232** (0.00994)

⁷ This specification is similar to the one used as selection equation in the matching model. Here we use lagged variables on asset endowment, market access and food production and contemporary variables on household characteristics. Also households that were in contracts in 2002 are included in the regression, and this information is captured by a dummy variable, that is positive and significant.

Owns a radio? 2002	-0.00440 (0.00998)
Owns a wc? 2002	0.0193* (0.0104)
Has irrigation (at least on one plot)? 2002	-0.0233 (0.0153)
Hires workers? 2002	0.00439 (0.0120)
Uses animal traction? 2002	0.0207 (0.0170)
Uses fertilizers? 2002	0.0376** (0.0171)
Received extension services? 2002	0.0114 (0.0114)
Member of association? 2002	0.00213 (0.0202)
Received information on prices? 2002	0.0247** (0.0101)
Has wage worker in household? 2002	-0.0372** (0.0146)
Cultivates cash crops? 2002	0.0801*** (0.0108)
Food production per capita (ton) 2002	0.0358** (0.0149)
Log of total income 2002	-0.00537 (0.00506)
PROVINCE FE	YES
Observations	3,401

Notes: Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The positive and significant coefficient of (lagged) food production per capita corroborates the idea that more food-secure households (in terms of food production) in t_0 are more likely to enter into contracts in t_1 .

As we mentioned earlier, food production can have a twofold interpretation: if it is a measure of food security, we would have expected an increase in households entering contract farming, while, if we interpret it as a measure of dependency on subsistence production, we might have expected a negative effect of contract farming on it. We nevertheless do not observe any of them. The fact that also the second effect is not observed indicates that contracts do not have a specialization effect on crop production and do not allow for a shift out of subsistence.

This is confirmed if we look for the effect of entering in contract on the number of crops cultivated by the household. To do so, we use propensity score matching as in the previous section to estimate the ATT, where 'treatment' is the fact of entering in contract farming between 2002 and 2005. The outcome variable is now the total number of crops cultivated. Table 11 shows that this effect is significantly greater than zero: introducing contracts on cash crops increases the number of crops cultivated, instead of reorienting the production to a limited number of crops.

Table 11. Effect of entering into contract farming on the number of crops cultivated

	(1) Difference in the number of crops cultivated
ATT of contract farming in 2005	1.300*** (0.442)
Observations	3,149

Notes: Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Some case studies on the Mozambican context, coherently with our results, underline that the gains for very small producers of participating in cash crop production under contract are expected to be positive, but marginal—i.e. they ‘add up’ to the usual livelihood strategy, but are not able to radically change it (Hanlon and Smart, 2014). This is moreover consistent with the results of Navarra and Pellizzoli (2012): in the observed cases, contracts allow for increased income (in most interviews also food security often showed improvements), but do not change substantially the livelihood strategy. Producers in the Manica Province, who were growing *piri-piri* to be sold to a private company were using contracts as ways to differentiate their income sources. Producers that were in similar contracts in the dairy sectors declared having additional monthly income, that nevertheless doesn’t turn them in proper ‘commercial farmers’. Enforceability problems, that appear as major limitation factor in the literature (Freeman et al, 2008), were raised in the interviews: in one case the buyer company did not buy the production as agreed because they considered it below the quality requirements, but from the farmers’ point of view this possibility was not previously agreed and they did not receive the adequate training. In this case, farmers did not have an outside option for selling their production and they incurred important losses (Navarra and Pellizzoli, 2012).

In case of tobacco and cotton—the major cash crops under contract in our sample—a salient characteristic is the monopsonistic position of the firm. According to Oya (2012), this is a feature strongly entrenched in contract farming agreements to push firms to enter. This leaves the buyer with important market power: there are some recent accounts in Mozambique of firms having broken contracts after a change in market conditions, especially in cotton and baby corn sectors (Hanlon and Smart, 2014). Very recently, farmers in the Tete province complained to the Prime Minister⁸ about the local concessionary company for tobacco, pointing at an anomalous increase in the price of inputs.

7 Conclusions

In this paper we focused on the effect of participating in contract farming on smallholders’ livelihoods. Contract farming in Mozambique is especially relevant for two cash crop productions: cotton and tobacco. If we look at simple correlations, we observe that both income and food security display a strong positive relationship with participation in contracts.

Food security is measured in two main ways: first, through direct elicitation in the questionnaire (did the household have times of hunger in the last year; how many months has the household been with food reserves; how many meals did the household have during hunger time), where we have the information only in t_1 (2005). Second, approximated by food production per capita. We

⁸ <http://allafrica.com/stories/201707020124.html> (accessed on 16 November 2017).

assume this is a good proxy since most rural households in Mozambique are at least partly dependent on own production, and we corroborate this assumption through a robust negative correlation between food production and probability of having had periods of hunger. We nevertheless discuss also the possibility that food production has to be interpreted differently.

To identify the direction of causality, we use propensity score matching and, when we have a longitudinal dimension, difference-in-difference estimation. After matching, we observe that participating in contract farming increases household income, but has no effect on the variables measuring food security, nor on food production.

Therefore, we conclude that most of the observed differences are due to selection: more food-secure households have higher probability of entering into contracts. This is coherent with the literature underlying that better-off households are more likely to enter into contract farming agreements (Benfica et al.; 2006, Hanlon and Smart, 2014). We contribute to this literature the observation that this selection does not seem to operate on income, but seems to operate instead on food security: households that are able to enter into contract farming agreements are those households that are already food secure before the contract is established.

As we mentioned, food production can be interpreted in different ways. According to the interpretation, we could have expected two effects: if food production is a measure of food security, we would have expected that the increase in income allowed by contract farming would have led to an increase in food production. On the other hand, we might have expected a negative effect, if contracts allow for a stable shift out of food production in favour of cash crop production. None of this seems to happen. Our last conclusion is therefore that contracts have a differentiation, not a specialization effect. They ‘add up’ to the usual livelihood strategy, but are not able to radically change it. This is consistent with other evidence in the continent since risk associated to a complete reliance on cash crops and on a monopsonistic buyer are too high (Smalley, 2013).

A possible way forward is to identify some characteristics that may influence the contract-food security nexus, for example by influencing smallholder market power, and how this changes across the income and land distribution. This paper suffers of course of many limitations. First of all, food security can be directly elicited only in one point in time and this limits the possibility to exploit the panel dimension of our data. Second, the data are somehow old to analyse a phenomenon that, at least on paper, is expected to have grown in the last decade. A further step can therefore be an analysis at the district level, where we might be able to use the following TIA repeated cross-sections.

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Appendices

Appendix 1. Selection equation for the definition of the propensity score. Probit model. All regressors are measured at baseline (2002).

	Probit coefficients
Female-headed household	-0.434*** (0.117)
Age of head of household	-0.0119*** (0.00301)
Household head education 1	-0.161* (0.0884)
Household head education 2	0.00124 (0.153)
Household head education 3	-0.189 (0.287)
Size of the household	0.0274** (0.0139)
Size of landholding (ha)	0.00767 (0.0125)
Number of plots	0.0979*** (0.0315)
Owns a lamp?	-0.168** (0.0831)
Owns a radio?	-0.0312 (0.0831)
Owns a wc?	0.134 (0.0885)
Has irrigation (at least on one plot)?	-0.211 (0.135)
Hires workers?	0.0141 (0.100)
Uses animal traction?	0.234 (0.151)
Uses fertilizers?	0.427** (0.174)
Received extension services?	0.122 (0.0974)
Member of association?	-0.142 (0.190)
Received information on prices?	0.211** (0.0846)
Has wage worker in household?	-0.272** (0.118)
Cultivates cash crops?	0.566*** (0.0852)
Food production per capita (kg)	0.000295** (0.000132)
Total income	-6.11e-06* (3.38e-06)
Constant	-2.463*** (0.309)
PROVINCE FE	YES
Observations	3,153

Notes: Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix 2. Common support across propensity score distribution

