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Strengthening the Links between Small-Scale Farmer Households and their Cooperatives: Evidence from AVCPO project on Durum Wheat in Ethiopia

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1. Introduction

Ethiopia is the leading producer of wheat in Sub-Saharan Africa (SSA) (FAOSTAT, 2015) as well as the only country where smallholders have a majority share in its production (Spielman et al., 2010; Shiferaw et al., 2014). Wheat consumption in Ethiopia has risen faster than any other major food grain, especially for pasta and bread consumption, and is expected to continue to rise rapidly in the future (Minot et al., 2015). Food security and agricultural-led industrialisation are pivotal development objectives in Ethiopia. One of the main challenges this country faces is increasing agricultural productivity by integrating smallholder farmers into a high-value agricultural commodity supply chain.

This paper examines an integrated project—the Agricultural Value Chains Project in Oromia (AVCPO)—that aims to improve the livelihoods of smallholders in the Bale Zone by involving them in a structured value chain (namely for the production of high-quality durum wheat) and linking them to the pasta industry via farmers' cooperatives.

Using primary data collected in 2014 and retrospective information, this paper investigates the AVCPO's effects on the cooperatives outcomes in terms of the growth of cereal production and net value of cereal production, and on participation on decision making and trust on cooperatives as well as satisfaction of farmers and sense of respect within the communities.

A number of empirical studies find positive effects of cooperatives on technology adoption (Shiferaw et al., 2008; Adebaw and Haile, 2013), prices (Wollni and Zeller, 2007; Bernard et al., 2008; Shiferaw et al., 2009), commercialisation (Francesconi and Heerink, 2010) and farm incomes (Fischer and Qaim, 2012; Ito et al., 2012; Vandeplas et al., 2013), while others come to more mixed results (e.g. Mujawamariya et al., 2013; Verhofstadt and Maertens, 2014). While there is little research in Ethiopia on trust and decision making process and farmers' satisfaction.

In order to account for potential violations of the exclusion restriction assumption, an instrumental variable approach is applied, together with three additional estimation strategies and a dose response model.

The remaining paper is structured as follows: Section 2 briefly introduces the food policies concerning cooperatives in Ethiopia. Section 3 explains the AVCPO project and the theory of change that frames our evaluation. Section 4 discusses the data and methodology. Section 5 presents the results while Section 6 features our concluding remarks and the policy implications of our findings.

2. Cooperatives, social capital, and collective action (to be extended)

The role of agricultural cooperatives in Ethiopia, which has become increasingly important in the agricultural systems throughout Sub-Saharan Africa (Wanyama et al, 2009), has been proved to be effective in terms of higher commercialisation (Francesconi and Heerink, 2010), higher price obtained for members per unit of output (Bernard et al, 2008), stabilisation of the local market in favour of producers (Teigist, 2008), better adoption of agricultural inputs (Abebaw and Haile, 2013), livelihood improvement (Getnet and Tsegaye, 2012), as well as increased members' technical efficiency through provision of support services (Abate et al, 2014).

Starting from a multilevel governance perspective, AVCPO aims at targeting leverage points in order to both strengthen vertical trust (up and down between actors along the chain, such as the trust between farmers and cooperatives) and enhance horizontal trust (i.e. trust and cooperative relationships among farmers and collective action of farmers' organisations) as well as connectedness with non-firm organisations (e.g. agricultural research centres) within the same territory. Therefore, AVCPO strategy aims at embracing all those multilevel relationships directly and indirectly influencing the process **.**

The effectiveness of the AVCPO depends on how these approaches interact with each other, as farm-level impacts are only achievable as long as action is taken collectively. For instance, the use of improved seeds is only sustainable if farmers, cooperatives and public agricultural research centres are connected in a sound durum wheat seed production cycle. Moreover, since the quality of durum wheat is measured at the cooperative/area level, individual farmers are only incentivised to invest in qualitative activities – such as better training, higher quality seeds and more fertiliser – if other members of the cooperative do likewise.

Regarding the cooperatives, the starting point is the recognition of the role the producer organisations – i.e. cooperatives in this case – can play to 'level the playing field' in the negotiations and coordination mechanisms within evolving value chains. This approach is made sustainable through an incentive-compatible structure, as the provision of sound economic incentives to all VC actors sustains the enhancement of structured coordination mechanisms and the introduction of improved agricultural practices. In addition, the provision of technical and support services for agricultural production is conceived to go beyond the top-down agricultural extension approach typical of many rural development strategies, by empowering local farmers and cooperatives4 in designing and demanding the most appropriate support they need.

Regarding the latter, these objectives require dealing with the systemic governance of the VC (Altenburg, 2006b). Indeed, the facilitation of linkages, dialogues and engagement opportunities in

decision-making at all levels, bringing together the core public and private stakeholders in the VC, is essential to build strategic and productive alliances and foster resource mobilisation. However, Faysse and Simon (2014) argue that limited attention has been devoted to how multilevel relations within the VC, and strategies by other VC actors, influence the room for manoeuvre cooperatives have in implementing quality management. As reported, the project has been implementing both hardware (e.g. store building, equipment procurement) and software activities (e.g. capacity-building, brokering between companies and cooperatives).

3. The AVCPO Project and data

3.1. The Agricultural Value Chains Project in Oromia (AVCPO)

The AVCPO was presided over by several Ethiopian stakeholders as part of the Ethiopian-Italian cooperation framework between 2011 and 2016 . It was based on a pre-existing large-scale Ethiopian-Italian development project in the region, specifically the Arsi-Bale Rural Development Project and involved a variety of different local actors – most notably cooperatives, local public research centres and government actors from the state and local levels.

The project is located in the wheat production area of the Bale Zone. Despite being part of one of the main wheat-producing areas of Ethiopia – the Federal State of Oromia – the Bale Zone has in the past been classified as a minor wheat-producing area (Hailu, 1991). Bernard et al. (2010) claim that it has low market access. Most wheat is grown between 1800 and 2500 metres above sea level. The project area is flat and located at an (average) elevation of 2000 metres above sea level. It has relatively homogeneous socio-economic conditions, agro-climatic conditions (e.g. soil types), rainfall levels and moisture types (BDoFED, 2004).

3.1. Objectives and main features

The AVCPO's general aim is to raise domestic production of durum wheat and facilitate greater access to value added markets. At the core of its strategy is an attempt to enable smallholders to produce large amounts of high-quality durum wheat that will meet the demands of the domestic pasta industry and increase the bargaining power of smallholders. The project identified a number of production and coordination problems that prevented farmers from achieving satisfactory results in terms of the quantity, quality and timing of production (see Table 1).

In 2011, the AVCPO launched a series of interlinked actions addressing two main areas: The first is focused on technical aspects of production, including the proliferation of appropriate agronomic practices, the introduction of adapted durum wheat varieties and the provision of key assets at the cooperative level. The second area concerned the overall institutional architecture of the VC – paying special attention to capacity-building among cooperatives, establishing links between cooperatives and public agricultural research centres and using cooperatives to establish contract farming arrangements, not practiced previously in the region. These arrangements involved establishing contracts between cooperatives and pasta makers as well as between cooperatives and the farmers (Chiari, 2015). Incentives aimed at ensuring that cooperatives and farmers adhere to their contracts

include significant price increases that are based on verified quality parameters (namely, the protein content of durum wheat).

The AVCPO was expected to induce a change in the power relations within the VC. Farmers in local markets are often negatively affected by the greater bargaining power of traders, intermediaries and lenders (Biggeri et al., 2017; Sultan, 2016). The ability of cooperatives to act as a link between farmers and the pasta industry was expected to result in a redistribution of bargaining power in favour of the farmers.

Insert Table 1. Major bottlenecks addressed by the AVCPO regarding the durum wheat VC

According to the data collected by the Sinana Agricultural Research Centre in the AVCPO area – where about 140,000 hectares are cultivated with bread wheat every year – the project worked with 15 cooperatives and second-level associations (e.g. unions). According to internal monitoring data, durum wheat production in the project area increased thirtyfold between 2012 and 2015 (Chiari, 2015).

Rationale and impact framework

The AVCPO has implemented a two-pronged approach to upgrading small-scale cereals production, emphasising, in particular, technical improvements and improvements to the VC's institutional architecture. The effectiveness of the AVCPO depends on how these approaches interact with each other, as farm-level impacts are only achievable as long as action is taken collectively. For instance, the use of improved seeds is only sustainable if farmers, cooperatives and public agricultural research centres are connected in a sound durum wheat seed production cycle. Moreover, since the quality of durum wheat is measured at the cooperative/area level, individual farmers are only incentivised to invest in qualitative activities – such as better training, higher quality seeds and more fertiliser – if other members of the cooperative do likewise.

Direct access to national markets, especially through cooperatives, is expected to increase the bargaining power of farmers. Moreover, the alternative marketing channels that are made available through cooperatives may induce competition, as other intermediaries might be compelled to offer competitive prices. Perhaps more importantly, the transformations associated with having better access to national markets might allow smallholders to produce higher value crops, which will in turn allow farmers to retain a greater share of the added value. These induced changes in the production and market system are expected to increase farmers' wheat revenues by increasing the prices and/or quantity that is produced and sold. Household income may rise as long as additional costs are lower than the revenue increases. Through an increase in household income, the project might then improve other dimensions of farmers' wellbeing, such as food security, education and health (see Figure 1).

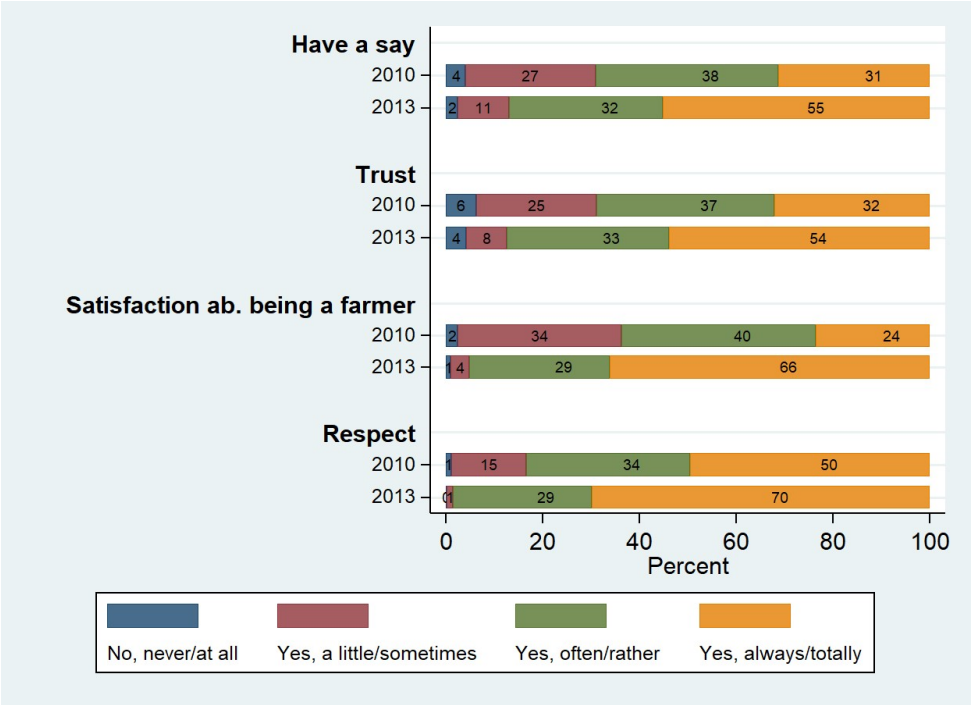
Insert Figure 1. AVCPO impact framework

Regardless, the transformations brought about by the AVCPO may potentially introduce undesired effects. For instance, more profitable crops might encourage less sustainable forms of land use (e.g. reduced crop rotation) or crowd out traditional crops (e.g. emmer wheat, teff or barley). Another point worth mentioning is the possibility that factors beyond the AVCPO's control may influence its effectiveness, particularly natural disasters such as drought or floods. The political stability of the area and ethnic tensions might also undermine the AVCPO's efforts to establish a positive business climate and forge sound cross-level interactions between stakeholders. Price instability in the international and national grain markets could also hinder the AVCPO's efforts, as Ethiopia is still heavily reliant on foreign imports of both grain and fertilisers.

3.2. Outcome variables

At the household level we construct a number of outcome variables as proxies of smallholders' vertical (trust toward cooperatives) and horizontal (feeling respected by other community members and satisfaction as being a farmer) trust as well as of their ability\opportunity to be involved in collective action (opportunity to have a say within the cooperative).. The first category reflects the relationship between a farmer and its reference cooperative and embed farmers social empowerment and trust towards the cooperative. The second categories proxy the farmers subjective wellbeing and the relations between farmers within the same local community and includes farmers satisfaction and respect within the community. All the variables are categorical variables where the interviewee is required to answer on 4 points scale

Figure 1. Frequency distribution of answers to the key questions for the analys



Source: Authors elaboration

4. Methodology

4.1. Binary treatment analysis

Treatment is based on (i) the willingness of farmers to be part in at least one of the AVCPO activities, which consisted in training, storage facilities and purchase of high-quality durum wheat seeds, and (ii) agreement on cultivating durum wheat. Since farmers can choose to join one or more of these activities, therefore the probability of joining the program is largely influenced by observable and, to a higher extent, hidden characteristics. Among them, factors like the management capacity, perception towards risks may affect the willingness to accept to be treated. We address such treatment endogeneity following the procedure already employed by Biggeri et al. (2018), that consists in three different strategies.

The **first strategy** is represented by an instrumental variables (IV) approach. Such method is in tune with the existing literature on the impact of interventions on a number of outcomes in smallholders involvement in agro-industrial chains or contract farming schemes (e.g. Maertens and Swinnen, 2009, Bellemare, 2012; Yirga et al., 2016).

The instrumental variables model is defined as follows:

$$(1a)\ \ Y = D\beta + X\gamma + \varepsilon$$
$$(2a)\ \ D = Z\pi + v$$

where **Y** is our outcome variable (*haveasay, trust, fsatisfaction, respect*), **D** is the endogenous treatment variable and **X** is a vector of household demographic characteristics, asset ownership, and shocks covariates. **Z** is the instrument(s) that is related to the endogenous treatment but not directly to the outcome Y. A two stage least squares procedure returns unbiased estimate of β as long as the instrument (Z) is correlated with D (strong/relevant) (Angrist and Imbens, 1995). Through IV and a local average treatment effect (LATE), only the impact for those units whose treatment status would change D in case of an exogenous change in the value of the instrument Z is estimated. Given this framework, membership of an AVCPO cooperative is a plausible candidate for an IV. Given that the compliance rate is 66.7%, the strength of the instrument should not be a problem.

The **second strategy** is represented by a PSM + IV analysis. This combined two-step procedure uses pre-treatment variables in order to perform a PSM estimation with a neighbour matching without replacement on the intention to treat (i.e. Z in Eq. (1)) as treatment variable. In this way we manage pre-project unbalances of key variables. Once non-matched observations are dropped, we perform the econometric estimates on the resulting sub-sample. Observations drop to 603 units: 161 treated and 442 control (including 90 non-compliers living in AVCPO cooperatives).

A **third alternative** way to deal with a strong but potentially endogenous instrument is the one elaborated by Frölich (2007) and operationalised by Frölich and Melly (2010) who proposed a fully nonparametric estimator for the estimation of LATE with covariates: the instrument is supposed to satisfy the exclusion restriction only conditioning on a set of covariates X.
Let $\bar{\beta}$ being the LATE estimate. Considering the conditional mean functions:

$$(3)\ \ m_z(x) = E[Y|X = x;\ \ Z = z]$$
$$(4)\ \mu_z(x) = E[D|X = x; Z = z]$$

the proposed way to get $\bar{\beta}$ (i.e. the ratio between two matching indicators):

$$(5)\ \bar{\beta} = \frac{\sum_i m_1(X_i) - m_0(X_i)}{\sum_i \mu_1(X_i) - \mu_0(X_i)}$$

4.2. Continuous treatment analysis

In such a setting what matters is not only the binary treatment status of observations, but also the rate of exposure (or dose) experienced. In this paper, we are also interested in studying the impact of the program involvement degree on the outcome variables previously analysed. To this end, we draw upon the impact evaluation literature related with treatment effects analysis (Imbens and Wooldridge 2009), and more specifically on that estimating dose-response models (Hirano and Imbens 2004; Bia and Mattei 2008; Cerulli 2015). Dose-response models are well suited in socio-economic contexts where a 'cause' takes the form of a continuous exposure to a certain treatment. Such models are also in tune with cash transfers analysis in developing economies, where dose-response functions are applied to assess the impact of transfers on households well-being, food security and labour supply (Tiwari et al. 2016).

The treatment level is represented by the self-reported involvement in the project activities (training, adoption of processing facilities, storage facilities, durum wheat seed selected varieties and participation within the durum wheat value chain). Participation in the durum wheat value chain is switched on if farmers sell part of the production through the cooperative. The continuous treatment follows the scheme reported in table 1. Following the continuous treatment approach developed by Cerulli (2015) we define a relative dose response function (DRF) to identify the average difference in outcomes between a group of treated subjects that received a given level of treatment and what would have been observed had they not received any treatment. In the continuous treatment setup the average difference in the outcome of the treated and the controls, given their observed characteristics, is allowed to vary by an arbitrary function of the flexible function of treatment level. Intuitively, the DRF is obtained by first estimating the average outcome of the treated as a function of the continuous treatment t given a set of controls and then subtracting the estimated average outcome for the controls which does not depend on t.

Table 1. Continuous treatment definition

CT	Freq.	%	Description
0	352	47.7	Not-AVCPO member*/
1	113	15.3	AVCPO member not cultivating DW plot
2	63	8.5	AVCPO member cultivating DW PLOT & not involved in any activity except TRAINING
3	62	8.4	AVCPO member cultivating DW PLOT & involved in PROC/STOR/SEEDS adoption
4	67	9.1	AVCPO member cultivating DW PLOT & not involved in any activity but involved in DW value chain
5	81	10.9	AVCPO member cultivating DW PLOT & involved in PROC/STOR/SEEDS & involved in DW value chain
738	100		

5. Results (zero draft to be improved)

Results from the binary treatment analysis are presented in Table 2, Table 3 and Table 4. We run the analysis over the full sample (**Full**) and we check its robustness against alternative sample sizes: the first alternative specification includes only those households who report in 2010 a score < 4 (**No4**) in the outcome of interest; the second alternative specification is run on a subsample of households reporting a score of <4 in both 2010 and 2013 (**No44**). The results suggest that the project has not had a positive impact on what has been defined as "vertical trust" and farmers ability to participate to decision making processes within the cooperative. The results shows also that farmers treated are more satisfied of their work and feel more respected within the community (i.e. our proxies of horizontal trust). There are several possible explanations of these results. First, problems concerning the trust among farmers and cooperatives as well as issues about farmers' participation might be linked to the top-down structure of Ethiopian cooperatives system still characterized by a strong state control. It is interesting to notice that this kind of topic emerged during a qualitative evaluation of AVCPO project (Biggeri, Ciani and Ferrannini 2016). On the other hand, data were collected after two harvesting seasons and the first harvesting season was a start-up of the project. Moreover key cooperative level facilities were still not available (e.g. renewed storage facilities, installed seed grading machines). These newly provided facilities were potentially able to mobilize the interest of the communities toward cooperatives and to strengthen vertical linkages. Table 5 presents the results of an heterogeneity analysis aimed at identifying heterogeneous effects linked to fam size. The analysis shows that AVCPO have more or less the same impact on land-rich and land-poor farmers. The results from binary treatment analysis can be visually confirmed by the Dose Response Functions (DRF). In Fig. 2 to 5, we present for the horizontal cohesion variables (vertical not significant) the DRF describing the impact on farming satisfaction and respect within community for different levels of involvement in AVCPO activities at 10% significance. In both cases the charts exhibit an increasing pattern of impacts. Higher involvement in the project leads to higher impacts on farmers social quality. Overall, our findings point to the effectiveness of the project. Before replicating or scaling up this intervention, however, it is necessary to understand how to better involve poorer farmers and which adjustments are needed if the areas selected have a lower potential than Bale Zone.

Table 2. IV on Full, No4, No44 samples

Sample	Model	Dependent Variable	b	t	N	R2	ARW	KP
Panel 1: Have a say								
Full	IVREG	Have a say	0.08	[0.53]	738	0.57	0.60	0.00
No4	IVREG	Have a say	-0.02	[-0.07]	507	0.62	0.94	0.00
No44	IVREG	Have a say	-0.01	[-0.07]	516	0.61	0.94	0.00
Panel 2: Trust								
Full	IVREG	Trust	0.03	[0.12]	738	0.53	0.91	0.00
No4	IVREG	Trust	0.02	[0.09]	501	0.60	0.93	0.00
No44	IVREG	Trust	-0.00	[-0.02]	525	0.59	0.99	0.00
Panel 3: Satisfaction								
Full	IVREG	Satisfaction	0.67***	[3.89]	738	0.75	0.00	0.00
No4	IVREG	Satisfaction	0.64***	[3.08]	564	0.79	0.00	0.00
No44	IVREG	Satisfaction	0.69***	[3.14]	569	0.78	0.00	0.00
Panel 4: Respect								
Full	IVREG	Respect	0.32***	[2.80]	738	0.68	0.00	0.00
No4	IVREG	Respect	0.36*	[1.73]	369	0.74	0.08	0.00
No44	IVREG	Respect	0.47**	[2.17]	381	0.72	0.03	0.00

*, **, *** indicates significant effects at the 1%, 5%, and 10% level, respectively. t-tests in brackets.
Note: Authors elaboration

Table 3. IV+PSM. Full

PSM + IV	b	t	N	R2	KP
Have a say	0.10	[0.65]	604	0.58	0.00
Trust	-0.01	[-0.03]	605	0.56	0.00
Farming Satisfaction	0.69***	[3.94]	603	0.74	0.00
Respect within community	0.31***	[2.78]	606	0.70	0.00

*, **, *** indicates significant effects at the 1%, 5%, and 10% level, respectively. t-tests in brackets.
Note: Authors elaboration

Table 4. LATE. Full

LATE	b	t
Have a say	0.08	[0.50]
Trust	0.02	[0.09]
Farming Satisfaction	0.68***	[3.74]
Respect within community	0.32**	[2.57]

*, **, *** indicates significant effects at the 1%, 5%, and 10% level, respectively. t-tests in brackets.
Note: Authors elaboration

Table 5. Heterogeneity IV+PSM+LATE. Full Sample

Farm size						**LATE**	
	b	**t**	**N**	**R2**	**KP**	**b**	**t**
Have a say							
0-2 ha	-0.12	[-0.32]	178.00	0.62	0.00	0.01	[0.03]
2-4 ha	-0.17	[-0.60]	221.00	0.61	0.00	-0.13	[-0.50]
4+ ha	0.38*	[1.80]	205.00	0.60	0.00	0.24	[1.10]
Trust							
0-2 ha	0.71	[1.53]	181.00	0.61	0.00	0.75	[1.64]
2-4 ha	-0.59*	[-1.78]	221.00	0.61	0.00	-0.46	[-1.26]
4+ ha	0.12	[0.49]	203.00	0.59	0.00	0.08	[0.33]
Farming Satisfaction							
0-2 ha	0.76**	[1.97]	181.00	0.74	0.00	0.67**	[2.24]
2-4 ha	0.06	[0.20]	224.00	0.77	0.00	0.06	[0.22]
4+ ha	1.27***	[5.39]	198.00	0.81	0.00	1.42***	[5.87]
Respect within community							
0-2 ha	0.19	[0.58]	180.00	0.73	0.00	0.21	[0.70]
2-4 ha	0.26	[1.52]	219.00	0.72	0.00	0.19	[1.14]
4+ ha	0.54***	[3.50]	207.00	0.74	0.00	0.58***	[3.42]

*, **, *** indicates significant effects at the 1%, 5%, and 10% level, respectively. t-tests in brackets.
Note: Authors elaboration

Figure 2 and 3. Dose-Response Function - Farming Satisfaction and Respect within community

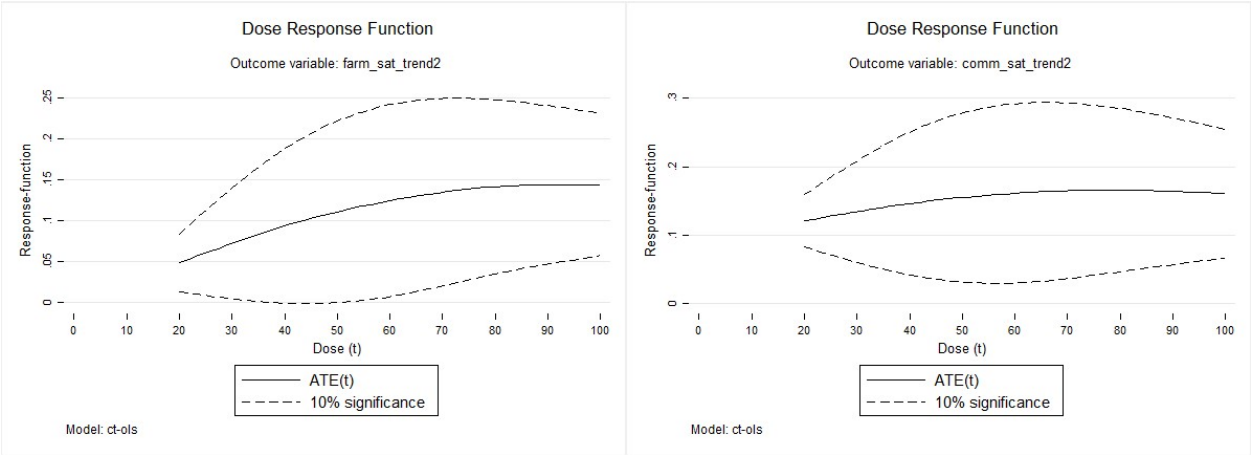
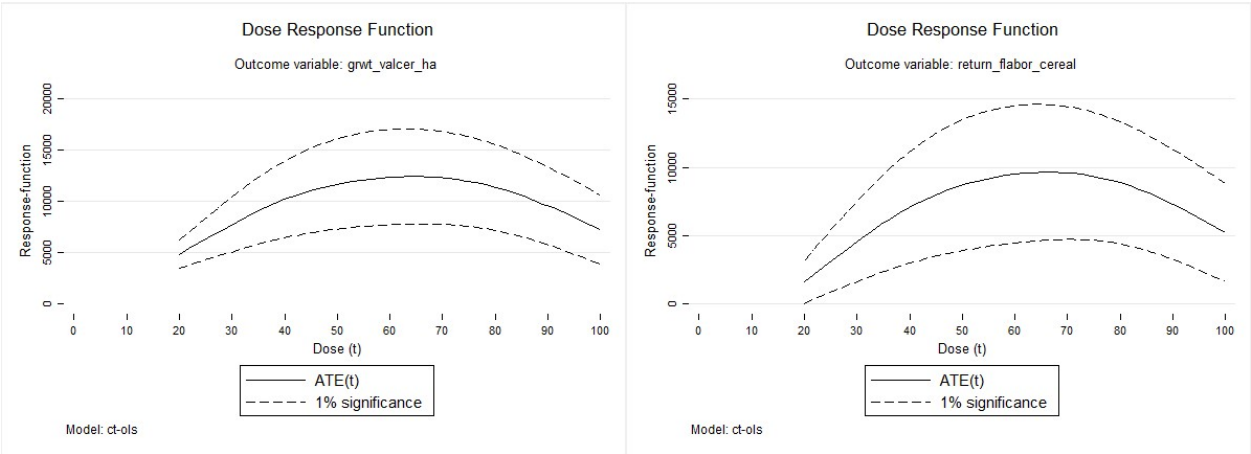


Figure 4 and 5. Dose-Response Function – Growth Val Cer/ha - Return from labour cereal



6. Conclusions

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