**Review for Domestic versus export-led agricultural transformation: evidence from Uganda’s dairy value chain**

The paper is interesting and general well written. One contribution I find most compelling is the evidence provided on how the rise of modern value chain actors in the midstream of food value chains (e.g. traders, milk collection centers and processors) is enabling smallholder farmers to upgrade their practices and increase their productivity both by changing the incentives they face as well as providing them the support services to do this. However, I have a few comments and suggestions for the authors.

General

1. After reading the paper, I am a little unsure that the authors title (and some of the motivation provided) adequately captures what they have done. It looks to me like the paper is really demonstrating that the growth and modernization of the dairy sector in Uganda (driven by both local demand and FDI and the subsequent rise of processors demanding for large quantities of milk and milk of a certain quality) is inducing a change in the organization of actors upstream and midstream with the behavior of farmers and role played by traders and collection centers. I am not quite convinced that this is driven by the export sector per say versus just modernization and more activity in the sector. It looks to me like modernization may be more evident in the southwest milk shed (which could be for several reasons including but not only the more export orientation) vs. the central milk shed that is said to be more local market oriented but I feel the final outcomes in terms of the innovations are occurring in both just at different rates as one would expect since we know that the transformation in food systems starts in richer countries and/or richer, more dynamic areas of countries and then spreads out with time. A lot of the descriptive statistics on the structure of the dairy value chain, the provision of services by milk collection centers and the growth in the MCC, and the change in level of exotic breed in both milk sheds all seem to indicate that things are changing quickly in both milk sheds. Thus I think the authors should reconsider their title and part of their motivation or do more to convince the reader that what they are finding is driven by exports and not just growth in an industry. The authors’ discussion and results in section confirm this.

*This point is well taken. The original study set out to compare the evolution of export-led dairy value chains to domestic value chains, with the expectation to find a modern and a traditional value chain side-by-side. However, upon analysis of the data, we see that also in areas where we expected to find a traditionally organized sub-sector, some actors were involved in fairly modern value chains. Furthermore, we indeed found that value chain upgrading also takes place in both domestic and export-oriented value chains, with the export-led area leading the way. This may indicate spillover of FDI and export-led value chains to domestic value chains.*

*It seems that the title and motivation of the paper still reflected the original hypothesis that two isolated value chains would co-exist in Uganda, one dynamic and one where little of no innovation takes place. We have rewritten the paper in various places to make sure that the motivation (and conclusion) is now in line with the findings. In particular, instead of trying to convince the reader that what we find is driven by exports we now emphasize more how FDI facilitates upgrading in export led value chains, and that local value chains also benefit from FDI through learning and spillover effects. We also changed the title as recommended by the reviewer. It now reads:* *“Leading the way - FDI and the acceleration of dairy value chain upgrading in Uganda”.*

2. The one area where I do see some potential to distinguish between the local and the export might be in the area of quality. If there are different quality standards and enforcement for export products versus those for local consumption (that can be proven), that might be an area to make that point... but I do not see it yet.

*In general, we were surprised to find that quality does not receive a lot of attention in Ugandan dairy value chains (both local and export-led supply chains). For instance, we did not find evidence of price premia based on eg. fat content or other quality related attributes.*

*At the same time, we do see differences with respect to milk sanitation. In section 4.5, we document how the use of proper milk containers is common in the Southwest that caters for export. In the central milk shed, farmers often use plastic containers and traders use jerry cans, which is not recommended. We also learned from key informants that the DDA inspectors are much more vigilant in the South West.*

*Changes made to the text: We have rewritten section 4.5 to include that we do not find price premia for quality. We also indicate that in Uganda, quality seems to be viewed particularly in terms of milk sanitation. We point out that also here, it seems that the SW is leading the way in terms of technology adoption to maintain milk sanitary standards.*

3. Do the authors have information on volume of sales to processors that export in the two districts? That could be useful information to look at to explore the effect that has (conditional on other district characteristics) on the adoption of practices that are more important for the export market such as milk cans (if I understand correctly) by farmers and motorbikes by traders and would be a bit more amenable to interpretation as an effect of an export led transformation versus just growth in an industry.

*Unfortunately, we do not have information on what processor traders or farmers sold their produce too. However, most of the processors that supply the export market are located in Mbarara, the largest town in the South Western milk shed. So, our original identification strategy was to just compare value chains between milk sheds to capture these differences. However, we have now toned down the role of exports as sole driver technology adoption.*

More specific comments

1 It would be helpful if somewhere before the last paragraph on page 3 where the authors being to tell us what they find (....that milk centers are central to value chain upgrading,) the authors explicitly state what this paper is looking at?

*Thanks for this suggestion. We have rewritten the introduction to make sure we first explain what this study originally set out to do before we summarize the conclusions.*

*Changes made to the text: The following paragraph was rewritten before we give a preview of the results:*

*In this paper, we set out to document the likely technological and institutional innovations that are associated with value chain upgrading. However, value chain transformation is an endogenous process with causality running in both directions. As such, it is not always clear what innovations are the cause and what innovations are the result of modern value chain development. Nevertheless, we argue that the co-existence of both export-led and domestic market-led value chains for the same commodity in a single country provides an interesting case, and hope to shed some light on critical innovations by comparing technological, institutional and organizational features in these two locations. Generally, studies on value chain transformation in developing countries analyze either export-led chains for commodities with little or no local market [*[*maertens2009trade*](#LyXCite-maertens2009trade)*,* [*maertens2009horticulture*](#LyXCite-maertens2009horticulture)*,* [*minten2009global*](#LyXCite-minten2009global)*] or domestic chains [*[*minten2016feeding*](#LyXCite-minten2016feeding)*,* [*JANSSEN2019327*](#LyXCite-JANSSEN2019327)*]. This makes it difficult to identify which innovations are most important in both driving and enabling value chain upgrading, as the context may be too dissimilar. In this study, we will compare value chains from the southwestern milk shed to value chains from the central milk shed and document differences in key technological and institutional dynamics. At the same time, we acknowledge the limits of using exposure of value chain actors to FDI in the vicinity as a proxy for value chain transformation. Indeed, there may be dairy farmers located in the southwestern milk shed that supply only to the local market, just as well as there are likely to be traders operating in the central milk shed that ship to processors that export. We thus also present an alternative analysis where the focus is more on integration in modern value chains.*

2. To convince a reader that these milk sheds are very similar except in terms of the export orientation, it would also be important for the authors to provide some more general descriptive statistics about the two milk sheds. This could include information on level of infrastructure (e.g. electricity access (important decision for location of firms), number of schools, hospitals, Income, Population, land size (given the discussion about intensive and extensive livestock rearing) poverty rate etc.

*This is an interesting suggestion, but it seemed to be harder than we initially thought to get suitable data.*

*The primary source for the kind of data would be the Uganda National Household Survey. However, this data is only representative up to the sub-regional level (grouping several districts). The southwestern milk shed and the central milk shed are part of different sub-regions (southwestern milk shed is part of Ankole sub-region, central milk shed is part of central 1 sub-region). Our initial idea was to present some general descriptive statistics for these two sub-regions. However, the sub-regions comprise many more districts than the ones we included in our study (which were specific for the sub-sector), and so we suspect that sub-region averages are not very representative of the districts we have included. For instance, the Ankole sub-region statistics seems to be affected by the fact that Mbarara, the second largest city in the country, is part of this sub-region. We also considered data on public service delivery (to get an idea of access to schools, hospitals, or roads as suggested by the reviewer) that was collected as part of a national impact evaluation of a governance project (*[*https://www.ifpri.org/publication/state-public-service-delivery-uganda-report-baseline-survey*](https://www.ifpri.org/publication/state-public-service-delivery-uganda-report-baseline-survey)*), but we found that also here too few observations were available from the areas that were included in our study. Rather than providing a table with statistics that we deemed not representative for our study area, we thus decided not to include such a table.*

*We did include some more descriptive characteristics that we collected in our survey. While for most of the statistics we do indeed find that there is no significant difference between the two sheds, we do find some differences related to road infrastructure. This thus leads us to further caution against a causal interpretation.*

*Changes made to the text: We have added the following paragraph at the beginning of the comparison between the two milk sheds:*

*We start by comparing actors located and operating in the export oriented southwestern milk shed to the central milk shed to assess the importance of various innovations in modernizing the dairy value chain. As mentioned above, the two milk sheds are both located in the cattle belt and share the same agro-ecology. According to the DDA, they are also very similar in aggregate production: the southwestern milk shed produces 25 percent of all milk, while this is 24 percent for the central milk shed. Our own data also suggest that farmer typology is similar in both sheds: the average farmer has about 30 cows and has access to about 45 acres of land. However, we do not have accurate data on differences in infrastructure between the two sheds. In fact, some data we collected in our survey that may be useful to get a sense of differences in infrastructure suggests there may be some. For instance, we find that the average distance from a household to the nearest all weather road is significantly higher in the central milk shed than in the southwestern milk shed. Therefore, it bears repeating that the innovations we document below may also be the consequence of differences in infrastructure (or any other unobserved confounder) between the two milk sheds.*

3. In section 3, could the authors include a table that shows the share of sales by farmers’ traders and MCCs that goes to the different market channels? I think it would be easier to see the message about who they sell to in a simple table and where possible see whether any observed differences are statistically significant.

*Thanks for this suggestion. We have added this table as requested (Table 2). We have also rewritten section 3 on the structure of the value chain in light of the addition of this table and the fact that figure 4 was removed (see next comment).*

*Changes made to the text: We refer to section 3 for the table and the description in the text.*

4. I found figure 4 difficult to follow. Could the authors put a simple set of bar charts (or pie chart) that communicate the main point in the figure (how the milk at the various centers moves through the different actors) while making keeping this for the interactive file? From the text, it looks like production/sales are much higher in the southwest milk shed but that traders and milk collection centers are the key markets for both milk sheds but I don’t see that clearly from Figure 4.

*With the addition of the table from comment 3 above, figure 4 becomes redundant. We still refer to the online interactive figure in a footnote. The structure of the value chain is now described in the text with reference to the new table.*

*Changes made to the text: We refer to section 3.*

5. For the regressions, the authors mention in their discussion of table 4 that they control for district characteristics. They mention that the full regressions are in the appendix. I think this is really important as district characteristics (infrastructure, market opportunities) are likely to be important in the location decision of these processing centers and whether these services explored in table 4 are available for farmers. However, when I look at the tables in the Appendix; Tables A1-A3, I do not see any controls for district.

*We did include fixed effects for the districts but did not include the coefficient estimates in the table due to space considerations (there were a total of 5 districts).*

*Changes made to the text: We have added a footnote to the tables indicating that fixed effects are included in the regression but not shown.*

6. Did the authors explore if integration to a modern value chain interacted with some indicator of the district level (magnitude) of dairy export or milk shed (conditional on other district controls) mattered? That might help to demonstrate the role of export orientation.

*This is an excellent suggestion. We tried regressions where we estimate full interaction between an indicator or the milk shed (as used in the descriptive part comparing the center and the southwest) and the indicator of being integrated a modern value chain (as used in the econometric analysis). However, we did not find that, generally, the interaction was significantly different from zero, and often also the main effects became insignificant. While part of this may be due to a lack of statistical power (especially for the analysis of traders and milk collection centers), this also suggests that integration into modern value chains and export orientation are to some extent proxies of the same latent variable.*

*In short, the above is yet more evidence that, as the reviewer suggests in the first comment, we can not claim that FDI alone is driving innovations, but that innovation is correlated to more general processes related to overall growth in the sector. We feel that the way the manuscript was rewritten now reflects this, and so we decided to keep the two sections (on section comparing locations and one looking at integration into modern value chain) side by side.*

7. For the propensity score matching, though it is not the main specification for the paper, it would be helpful for the authors to confirm (and then mention) if the analysis minimized incidence of bad matches by using observations that lie within the common support, that results are robust to the common matching procedures and possibly that you confirmed they are robust to some degree of hidden bias due to an unobserved confounder using the Rosenbaum estimates.

*We use calipher matching, which should reduce the incidence of bad matches (at the cost of reducing degrees of freedom). At the same time, as mentioned by the reviewer, the matching models are not the main specification; especially in the reworked version of the manuscript, we are very explicit in the fact that this is mainly an exploratory analysis. The robustness tests suggested by the reviewer are mostly related to detecting bias in the context of a confirmatory analysis. As we are trying to caution against causal interpretations of our work, we think that an extensive appendix comparing different matching procedures and calculating Rosenbaum bounds would be somewhat counter-intuitive.*

8. Also, for the propensity score estimations and regressions, did you also explore separate analysis for each milk shed? If the results are maintained in a separate analysis for each milk shed, it would likely indicate that the results are really about just modernization of the value chain versus exports. This or other ways to convince the reader that it is really appropriate to consider these findings as indicative of differences due to export orientation is still needed.

*This is again a good suggestion to differentiate between FDI or modernization as the drivers of modernization. In fact, it is similar to the suggestion that the reviewer makes in comment 6: a model that is (fully) interacted with an indicator for the milk shed will be equivalent to running separate regressions for the two milk sheds. As such, we expect the same results (and same issues such as low statistical power) as when we ran the interacted model.*

9. For the trader analysis, do you have information about whether traders provide assistance to farmers in form of credit, supply of the milk cans or other service? It would be interesting to see if that might also vary among those integrated into the modern value chains versus traditional. This could be an innovation geared to ensure the quality of milk provided as well and contribute to the literature on the role that traders play in modern food value chains.

*Our data suggests that very few traders provide services to farmers. In general, these traders are very small (one person businesses) and use little capital. The average trader will have a bicycle or a motorbike and a few jerry cans of milk cans. These petty traders do not seem to have the capacity to provide services. Milk collection centers seem to be better suited to provide some of the missing services.*

10. For the conclusion (and results) on things like value chain financing, again I do not see the conclusion being that value chain financing is more prevalent in export led value chains but rather that value chain financing likely becomes more formal and available the more modern a value chain is. This is a general comment on a lot of the results as presented so far.

*As mentioned in response to the first comment, we agree that we may have presented the impact of FDI too strongly in light of the evidence. We have rewritten the paper with this in mind.*

Data and sampling

1. Are milk collection centers required by law to register with the DDA? Is there something you can say to increase the reader’s confidence in this list that served as your sampling frame?

*Yes, milk collection centers are fairly formal structures that are required to be registered with the DDA. This is because milk collection centers are inspected by DDA officials in a regular basis. When we were doing the survey, the DDA was also in the process of getting the GPS coordinates of all milk collection centers in Uganda. We are thus confident that our sampling frame was adequate.*

*Changes made to the text: The following was added as a footnote to the text:* *Milk collection centers are fairly formal structures that are required to be registered with the DDA. This is because milk collection centers are inspected by DDA officials on a regular basis.*

2. For how long did enumerators interview the nth trader that came to deliver milk to a center? Did N vary by collection center or district or sub county? If not, why note tell us what N is and why the selected N was appropriate in this context. I am also guessing this approach was done for each of the selected milk collection centers. It would be helpful to be clear about this and to also acknowledge limitations of the approach use or at least better justify it in the text.

*In each milk collection center, about 7 traders were selected. The n was chosen in proportion to the size of the milk collection center. In other words, if the milk collection center was supplied by only 14 traders, every second trader that arrived was interviewed. If the milk collection center was supplied by 200 traders, we interviewed one in 28 traders.*

*Changes made to the text: The following footnote was added:*

*In each milk collection center, about seven traders were selected. To do so, an interviewer went to the milk collection center early in the morning before it opened and collected information on the total number of traders that supply the center on an average day. From this, “n” was determined as the total number of traders divided by seven. However, sampling traders is hard due to their mobile nature and we agree that our approach has its weaknesses relative to other sampling strategies. The most important drawback is probably the fact that our method would lead to an overestimate of the role and importance of traders that supply milk collection centers (as opposed to traders that supply processors directly, milk-shops,...).*

Minor Details:

1. Please provide necessary sources for the claims and cited evidence of transformation in Uganda’s dairy value chain in the introduction ( p2)

*While it is widely agreed that the sub-sector witnessed (and continues to witness) substantial transformation, this is harder to document (especially using peer reviewed material). This is due to the fact that dairy was not considered a priority sector for export. However, in the popular press, there are many articles that document the massive change that happened. Here are just a few:*

[*https://www.monitor.co.ug/Business/Prosper/Firms-investment-milk-processing-Fresh-Dairy-Pearl-Dairy/688616-4039470-13jqiiv/index.html*](https://www.monitor.co.ug/Business/Prosper/Firms-investment-milk-processing-Fresh-Dairy-Pearl-Dairy/688616-4039470-13jqiiv/index.html)

[*https://www.monitor.co.ug/Business/Commodities/Uganda-milk-exports-make-good-inroads-Kenya/688610-4539882-tkane4z/index.html*](https://www.monitor.co.ug/Business/Commodities/Uganda-milk-exports-make-good-inroads-Kenya/688610-4539882-tkane4z/index.html)

[*https://www.newvision.co.ug/new\_vision/news/1002537/dairy-sector-attracts-investors*](https://www.newvision.co.ug/new_vision/news/1002537/dairy-sector-attracts-investors)

[*https://www.foodbusinessafrica.com/2019/02/02/ugandan-milk-processor-vital-tomosi-commissions-us15m-processing-factory/*](https://www.foodbusinessafrica.com/2019/02/02/ugandan-milk-processor-vital-tomosi-commissions-us15m-processing-factory/)

[*https://www.softpower.ug/museveni-opens-milk-processing-plant-in-kiruhura/*](https://www.softpower.ug/museveni-opens-milk-processing-plant-in-kiruhura/)

*There is also a considerable gray literature consisting of reports and investment guides, but the quality varies.*

*Changes made to the text: The following footnote has been added. We refer to one news article and two of the more credible studies:*

*However, these changes have mostly gone unnoticed. The dairy sub-sector in Uganda was traditionally not considered a strategic sector. As a result, in the Bank of Uganda's statistics, dairy exports are amalgamated into a category together with other non-traditional exports, obscuring the evolution of the sector. Practitioners in the sector have been trying to get the attention of politicians through the local press (eg. Van Klinken, 2019) and the research community also started to be interested in the evolution in the sector (eg. Omondi et al., 2017; Mbowa, 2019).*

2. Table 1: Top 5 exporters?- sum is 101 not 100 and sum on column 2 also is 131

*OK, that was a rounding error – corrected*

3. Cross bred cows are longer in milk production than local cows? Than is missing on page 19

*Corrected*

4. For organization and flow, in section 5, when presenting the results, an in the table, it might be helpful to discuss/present results for technology adoption ( feeding practices milk cans etc.) versus access to services such as value chain financing and cooperative membership)

*Thanks for this suggestion. However, we when trying to follow this suggestion, we were often unsure whether to categorize a particular innovation as a technology or service (eg is it the provision of cans as a service or the use of cans as a technology). Hence, the result seemed to be somewhat arbitrary and we decided to keep the original organization of the paper.*

5. Table A1. Regressions for farmers not just farmer ( s is missing)

*OK, this has been corrected.*

6. Table A1-A4). Could the authors define what access to finance means for this study? Is it that they took a loan in the last year or .…

*We define credit as having obtained a loan for investment in dairy business activities in the last year. We have clarified this in the paper.*

7. There are several areas in the paper; in some of the tables (and also in the text) where things could be more clearly labelled or more explicitly defined. So the authors should check this as they revise.

*Thanks for this suggestion, we have tried to make definitions more explicit and labels clearer.*

Reviewer 2:

This paper discusses the development of a modern value chain in the dairy sector in Uganda. It further compares farmers that serve local and export value chains with those that do not participate in value chains in terms of the access/usage of technological innovations. The main contribution of the paper is that it presents and discusses the results of a stack data collection, which is a very innovative approach to measure trends and innovations throughout the value chain. It requires collecting data at different levels of the value chain, not just producers, and is therefore challenging. I think these type of studies (based on stacked surveys of value chain agents) are important for a better understanding of how value chains are organized in developing countries, and the paper makes a real contribution here. The data is original, and the topic is important for the current policy discussion on how to promote agricultural transformation in Africa.

The paper is also well-written, the authors do a very careful interpretation of the data, and draw clear conclusions.

Here are the comments I have on the paper:

1. I find the literature review to be missing some key papers, especially related to the milk sector. As the paper finds that cooperatives are very important in the milk value chain, there is no reference to the literature that has been written on dairy cooperatives. To mention a few, see :

* Chagwiza, Clarietta, Roldan Muradian, and Ruerd Ruben. 2016. “Cooperative Membership and Dairy Performance among Smallholders in Ethiopia.” Food Policy 59 (February): 165–73. <https://doi.org/10.1016/j.foodpol.2016.01.008>.
* Kilelu, Catherine, Laurens Klerkx, Amos Omore, Isabelle Baltenweck, Cees Leeuwis, and Julius Githinji. 2017. “Value Chain Upgrading and the Inclusion of Smallholders in Markets: Reflections on Contributions of Multi-Stakeholder Processes in Dairy Development in Tanzania.” The European Journal of Development Research, January. https://doi.org/10.1057/s41287-016-0074-z.
* Kilelu, Catherine W., Laurens Klerkx, and Cees Leeuwis. 2017. “Supporting Smallholder Commercialisation By Enhancing Integrated Coordination In Agrifood Value Chains: Experiences With Dairy Hubs In Kenya.” Experimental Agriculture 53 (02): 269–87. <https://doi.org/10.1017/S0014479716000375>.

*Thanks for this suggestion. We have included these and some more references in the paper.*

1. I struggle a bit in understanding what innovations are the cause and what innovations are the result of modern value chain development in the dairy sector of Uganda. This is acknowledged by the authors though in the paper, but I think it also affects how the story is told (and the paper structured). Up to the descriptive part of the paper, the proliferation of milk collection centers is mentioned as the most important change towards modern value chain development. Underlying drivers are improved service provision and especially the organization of milk collection centers (mcc) as cooperatives. However, this conclusion is not supported by the empirical part of the paper, where participation in modern value chains by farmers does not increase their assistance received from buyers and cooperative membership.
   * First, integration into the modern value chain is identified by selling regularly to mcc. So one of the innovations (driver) is used as measure of modern value chain participation (outcome). But then one of the innovations (selling to mcc which is a driver) is used to identify participation in value chains and to measure differences in other innovations (outcomes). That confuses me a bit.

*Thanks for this. We agree that the way this was presented in the original manuscript was potentially confusing. However, as mentioned in the introduction, “innovations” in the value chain are endogenous, and so it is difficult to determine which innovations should be categorized as drivers of value chain upgrading and which innovations should be considered the result of value chain upgrading. Some of this confusion is also related to the terminology. For instance, value chain upgrading itself can be understood as the adoption of innovations.*

*We have tried to make this clearer in the following ways:*

*First, it should be noted that we avoid terms that imply a causal direction (driver or outcome) unless such an interpretation is warranted. For instance, the “drivers” for the broad changes in the sector are laid out in the second section. These drivers are the increase in demand (both internal and global demand) and the liberalization and privatization efforts from the government.*

*Second, as a response to the first reviewer who noted that the title, motivation and conclusion was not always supported by the findings/data, we have rewritten the manuscript to bring in much more nuance. In particular, we are now clearer in pointing out in the motivation that we do not aspire to identify the drivers of value chain upgrading, nor test whether this upgrading is caused by FDI. Instead, we provide a descriptive account of transforming value chains, and this is done (1) in a descriptive part by comparing two different milk shed and (2) by an econometric analysis that focuses more in the integration of value chain actors into modern value chains. In other words, we now present the descriptive and econometric part as two alternative ways to describe the modernization in the dairy supply chains.*

* + I also struggle with linking the findings from the descriptive part and the econometric analysis. While the descriptive figures in section 4.1 point to the importance of the mcc expansion & institution organization, the matching results in table 4 show that there is no difference in cooperative membership between farmers integrated in the modern value chain, and those not. In addition, most of the services given by buyers are not significantly higher for farmers integrated into modern value chains. This undermines the descriptive story.

*Referring to the previous comment, the fact that we consider the descriptive part and the econometric part now as alternative ways to describe modernization in the dairy supply chains also means that findings may differ. For instance, it may be that a cooperative organization of milk collection centers are important for export led supply chains, but that this organizational form is less critical in modern supply chains.*

* + The story that I take away from column 4 of table 4 is that farmers integrated in modern value chains are more likely to have crossbred cows, use water dams, and use cans. So participation in value chains promotes technology uptake.

*This is correct. But in the manuscript we are careful in attributing this effect to participation in modern value chains. There may be a bunch of other (potentially unobservable) attributes that are correlated to technology uptake.*

* + Hence, I would be more careful in how to link the findings from the econometric analysis with the conclusions drawn earlier in the paper based on the descriptive figures/Tables. More nuance is needed. For example, even though regression results follow later, I think it is useful to test and mention in the text whether the differences in figure 6 in service provided are significant between the central and southwest location (as is done for figure 7).

*The above concerns are similar to the concerns made by reviewer 1. Also here, the reviewer feels some of the conclusions are too strong and not supported by the empirical analysis, which calls for more nuance. This is because the study set out with clear hypotheses we wanted to test, and this language is still seeping through in the manuscript. We have rewritten the entire manuscript to be more careful and nuanced in our conclusion.*

*We have also looked at the significance of the differences mentioned in figure 6. Most of these differences are not significant. However, this is probably also due to low sample size.*

*We have added to the text that apart from the supply of milk cans, these differences are not statistically significant.*

1. Related to the previous point. I certainly appreciate that the authors try to underpin the graphical representation of the data using robust estimation methods (most notably the matching results). However, the results only provide robust evidence of the effect of participation in modern value chains for producers. While sample sizes are an issue for traders and cooperatives, the fact that the authors do not find statistically significant effects in Table 5 and 6 undermine the conclusions taken by the authors based on the graphs earlier. Hence, I would be more careful in the interpretation of the results (by at least mentioning that there is no empirical evidence for the trends observed, but that sample sizes are an issue).

*We have followed this suggestion and have rewritten the conclusion pointing out that at the level of the mccs and traders, observed trends are not supported by the data, but that sample size may be an issue.*

1. Even if we stick to the claim by the authors that the main innovation in the dairy sector in Uganda is the organization of different value chain agents into cooperatives, I struggle with the main take away of the paper. While this is an interesting finding, cooperative activity does not seem to be main element hypothesized by the authors (of how value chain access affects agricultural transformation), which is commercial interaction with modern buyers. However, to me, both channels do not equate, as cooperative activity (horizontal organization) is not really commercialization (vertical organization/integration). The story of the paper could thus equally be that participation in cooperatives is driving changes in innovations, not the proliferation of mcc. What would happen to the results in table 4 if one controls for cooperative membership (rather than considering it as an outcome variable)?

*It was not our intention to claim that cooperatives are the main innovation in the dairy sector. The message we wanted to convey is that milk collection centers are important for the value chain, and that it seems these milk collection centers are often organized as cooperatives, particularly in the southwest, which may be an appropriate organizational form.*

*For instance, in the introduction we state:*

*Many milk collection centers are cooperatives, which may be an effective organizational form to safeguard collective reputation in cases where traceability is hard and provide loyalty when side-selling is an attractive option.*

*The latter is derived from theory, but not substantiated with data.*

*Indeed, the fact that we do not find an effect of integration into modern value chains on farmer cooperative membership is due to the fact that the cooperative membership effect is conflated with the milk shed. In the SW, the cooperative movement is very strong, while this does not seem to be the case in the central milk shed. Therefore, the inclusion of district fixed effects renders the coefficient on modern value chain inclusion insignificant in column (3). This is also indicated in the manuscript:*

*“However, the difference becomes insignificant once we include controls or match on observables. Most likely, the observed difference in column 2 is explained by the fact that cooperatives are much more prevalent in the southwestern milk shed.”*

*Changes made to the text: We have made an effort to make it clearer that the cooperative organizational form is not the key innovation.*

1. Can the authors provide some intuition why in Figure 1 there is a drop in liquid milk consumption in rural areas (while it stagnated in urban areas)?

*Not really. In fact, we think this is probably just noise. The figure is based on data from the Uganda National Household Survey. The UNHS is considered the most credible source for estimating consumption expenditure. However, as dairy consumption is very low in many parts of Uganda, there may simply be too few non-zero observations.*

*It seems that estimating per capita dairy consumption is harder than expected. In the grew literature and in the popular press, figures quoted often differ widely and sources are not provided. For instance, one of the figures mostly quoted is 62 liters per capita in 2017 (up from 25 liters in 1986) and is attributed to the DDA. However, it is not clear how the DDA estimated this.*

*We added the following paragraph:*

*More in general, providing reliable estimates of local dairy consumption is not straightforward. While the UNHS is arguable the most credible source when estimating consumption expenditure, dairy consumption in Uganda is very low, with the vast majority of households reporting no consumption of milk in the last 7 days, which is the consumption recall period in the UNHS. Per capita consumption estimates quoted in the popular press or estimated in case studies often differ widely, with sources not always well documented. For instance, one of the figures mostly quoted is 62 liters per capita in 2017 (up from 25 liters in 1986) and is attributed to the DDA. However, it is not clear how this was estimated and what data source was used.*

1. Section 2.1: are there important supply side changes that happened in this period? For example, new research on improved genetic material, substantial investments in rural roads etc.

*As mentioned before, the study set out with clear hypotheses we wanted to test, and this language is still seeping through in the manuscript. In the original manuscript, we may have been too quick in assuming that the only difference between the two milk sheds were related to FDI. Indeed, one may wonder about other supply side changes that happened in this period and/or that differ between the two sheds.*

*The first reviewer also suggested to include a table with some descriptives, such as road networks etc., to alleviate some of these concerns (See specific comment 2). However, as we explain there, we do not have access to appropriate data to look at most of these other potential (observable or non-observable) confounders. We did collect some information on access to roads, and there seems to be some difference between the two sheds. We thus repeat that one should be cautious when interpreting the comparisons.*

*We have added the following paragraph at the beginning of the comparison between the two milk sheds:*

*We start by comparing actors located and operating in the export oriented southwestern milk shed to the central milk shed to assess the importance of various innovations in modernizing the dairy value chain. As mentioned above, the two milk sheds are both located in the cattle belt and share the same agro-ecology. According to the DDA, they are also very similar in aggregate production: the southwestern milk shed produces 25 percent of all milk, while this is 24 percent for the central milk shed. Our data also suggest that farmer typology is similar in both sheds: the average farmer has about 30 cows and has access to about 45 acres of land. However, we do not have accurate data on differences in infrastructure between the two sheds. In fact, some data we collected in our survey that may be useful to get a sense of differences in infrastructure suggests there may be some differences. For instance, we find that the average distance from a household to the nearest all weather road is significantly higher in the central milk shed than in the southwestern milk shed. Therefore, it bears repeating that the innovations we document below may also be the consequence of differences in infrastructure (or any other unobserved confounder) between the two milk sheds.*

1. Sampling was done based on the list of all households within the village, and hence was not restricted to dairy farmers or cooperative members. How many of these random farmers are dairy farmers, and how important is dairy for their income? Other information on these farmers could be useful, e.g. what is the share of milk that they sell?

*In fact, we only sampled milk producers in this study.*

*We added the following footnote: Most households in these areas own cattle. However, in case the randomly selected farmer in the list did not own dairy animals, the next household on the list was selected.*

1. On the definition of participation in modern value chains as explained in Section 5:
   * How is indirect selling by farmers to collection centers via traders captured in the data? is it asked where the milk is likely to end up?

*Yes, we asked separate questions depending on where the trader is taking the milk (eg traders that take milk to milk collection centers, traders that take milk to processors, etc.). This was added as a footnote.*

* + It is mentioned that only 40% have access to the modern value chain, but from Figure 4, this share seems higher?

*This may be because integration into a modern value chain was defined by selling to a milk collection center every day in the last 7 days. This was done because we wanted to differentiate between commercially oriented farmers that produce for the market on a daily basis and farmers that mainly produce for own consumption but may sporadically sell to mccs if they have a surplus.*

*We have added this more explicitly to the text.*

* + Regarding the definition for traders, what is the time period of delivery? Every week/month, or?

*For the definition of traders, we start by asking how much milk is collected from farmers on an average day during last dry season (dec 2017 – feb2018). We then probed for the share of milk that is delivered to different outlets on an average day during the on an average day during last dry season (dec 2017 – feb2018). Farmers that supply 100 percent of collected milk to milk collection centers or processors were defined as being integrated into modern dairy value chains.*

*We have now explained this in the text.*

1. Some editorial comments:
   * Need to explain some abbreviations in the text: UNHS p5, mcc p 13,

*This has been explained.*