Understanding Household Retail Market Participation Behavior: The Interplay of Cash Transfers, Input Subsidies, and Food Purchases

Lemekezani K Chilora, Dinah T Salonga, Zione Kalumikiza and Levison Chiwaula

1. Introduction

Globally, food insecurity, undernutrition, and poverty have posed a long-lasting threat to development. This is most common among low-income countries, such as those within the sub-Saharan region, where agriculture is the hub of the economy and is dominated by smallholder farmers. Smallholder farmers constitute more than 80% of all farms in SSA and contribute up to 90% of food production in some countries (Wiggins and Keats 2013). Ironically, most of the food-insecure, malnourished and poor people are those who dominate agricultural production and reside in rural settings. This is primarily due to reduced food production resulting from agricultural production shocks, which in turn reduce household food production (Connolly-Boutin and Smit 2016).

Nevertheless, access to healthy and nutritious foods is critical in ensuring food and nutrition security (Hülsen et al., 2024). Therefore, there is a need to identify alternative means of ensuring that households have access to nutritious food. To date, two primary sources of food have been identified by various scholars: self-production and food purchase, which can significantly enhance household access to nutritious food. Following this, governments have implemented various programs to support these pathways to attaining nutritious food. For instance, the Malawi government has been implementing cash transfers and agricultural input subsidies to enhance access to food through food purchases and improve agricultural productivity.

However, current evidence has focused on how these programs improve household farm production, food security and household livelihoods, with limited attention paid to market purchases. Moreover, there is scant evidence on which households commonly purchase food groups in response to participating in these programs. For instance, Aggarwal et al. (2024), Brydon et al. (2024), and Fisher et al. (2017) suggest that social cash transfers have a positive effect on household welfare. Likewise, input subsidies have been found to enhance household welfare, positively impact labour and agricultural yields, and promote commercialisation (Khonje et al., 2022a, 2022b). Matita et al. (2024) reported positive correlations between cash transfers and household food consumption, weak joint effects of program participation, and no relationship between input subsidies and food consumption.

Although these programs have been evaluated to assess their impact on household outcomes, current evidence has focused primarily on food and nutrition outcomes. Evidence of the effect of joint programs on household market participation is limited. Nevertheless, given the negative effects of recurring agricultural production shocks across Africa, markets are now more crucial in enhancing access to nutritious food groups, such as fruits, vegetables, and animal-sourced foods. Hence, these programs must align their objectives to enable households to improve their participation in retail food markets. Moreover, household participation in food markets is crucial to improving the well-being of rural residents in developing countries like Malawi (Matita et al. 2021).

Therefore, we address the research gap by assessing the effect of joint cash transfers and input subsidies on household market participation. Thus, we attempt to address the research questions: (1) Do cash transfers and input subsidies (independent or combined) improve the households' food purchases in Malawi? (2) Does the effect of cash transfers and input subsidies (independent or combined) vary across household market participation of various food groups? (3) Does the effect of cash transfers and input subsidies (independent or combined) vary across and within male-headed households and female-headed households?

* 1. Food markets in Malawi

Food markets are the primary retail channels through which consumers can access a wide range of essential food items for a healthy diet, including vegetables, fruits, meat, fish, and other staple foods (FAO, 2023). In Malawi, retail markets offer households a diverse range of food options, available in both urban and rural areas (Hülsen et al. 2024). These markets comprise roadside stalls, traditional open-air markets, supermarkets and wholesale depots (Makoka, 2005). However, the food retail markets are commonly found on roadside stalls and traditional open-air markets.

These markets are also characterised by high sensitivity to seasonal price fluctuations, transportation costs, and supply chain inefficiencies (Chiwaula et al. 2024; Matemba, Mundende, and Milupi 2024). Hence, the government implements market interventions, such as a ban on staple food exports and the establishment of minimum farmgate prices, to alleviate some of the market challenges (Aragie et al., 2018). Additionally, digital innovations, such as mobile-based market information systems, are enhancing farmers' and traders' access to price data, enabling them to make informed decisions (Gomez and Vossenberg, 2018). However, financial constraints prevent households from participating in these markets, necessitating the need for external support instruments, such as cash transfers and subsidies, to enhance their financial capacity (Usman and Haile 2022).

1. Data and Methods
	1. Data description

We use the World Bank's Living Standard Measurement Study (LSMS) data for Malawi. The data is nationally representative with four waves spanning over a decade. These waves were collected in 2010/2011, 2013, 2016/2017, and 2019/2020. The panel survey collects data on various subjects through household, agricultural, fisheries, and community surveys. We largely use the agriculture and household questionnaires.

The agriculture questionnaire collects data on farming details, including household access to farm input subsidies. It captures data on participation in subsidies, primary access to coupons, the types of inputs accessed using the coupons and the usage of the coupons and inputs received. This wide-ranging information enables us to extend the scope of farmers' participation in the program.

Likewise, the household questionnaire gathers data on household attributes, including participation in a cash transfer program. The questionnaire also captures data on household demographic and socioeconomic factors, as well as institutional factors. Furthermore, the household questionnaire captures a roster that describes individual household member information, including gender, age, educational qualifications, and other relevant details. The roster enables us to disaggregate our analysis by gender.

* 1. Empirical and identification strategy

We employ panel regression models to assess the links between household participation in cash transfers, input subsidies, and both programs in retail food markets. We conduct our analysis on a pooled sample with an aggregate household food expenditure variable as a proxy for household participation in food retail markets (Dzanku et al., 2024). We also extend our analysis to identify how the effect of household participation in these programs varies across food groups. We adopt the food groups incorporated in the food consumption score, which are considered nutritious (WFP, 2008).

For our main econometric model, we adopt the correlated random effect model, which is considered superior to the fixed effects (FE) and random effects (RE) models. The FE model controls for all time-invariant variables and addresses omitted variable bias, producing robust estimates. However, the FE model fails to control for the effect of time-invariant covariates. It also struggles with the incidental parameters problem in nonlinear models, which affects estimation accuracy (Wooldridge, 2019).

On the other hand, the RE model assumes that unobserved heterogeneity is uncorrelated with the observed covariates. It employs generalized least squares (GLS) to address serial correlation in the composite error term, which can be more efficient than ordinary least squares (OLS) when this assumption holds. However, in empirical research, this assumption is often violated, resulting in potential inconsistencies in the RE estimator (Wooldridge, 2019).

The Correlated Random Effects (CRE) model addresses the weaknesses of both the Fixed Effects (FE) and Random Effects (RE) models by integrating the strengths of both FE and RE. The CRE incorporates time averages of time-varying covariates into the RE framework, mitigating potential correlations between unobserved effects and observed variables (Mundlak 1978). The CRE model is advantageous because it effectively handles low within-variation and avoids the incidental parameters problem associated with non-linear models when using the FE estimator, making it a suitable choice for our analysis. The basic CRE model is specified as follows:

$$Y\_{it}=α+X\_{it}δ+Z\_{i}β+\overbar{X\_{i}}θ+λ\_{t}+u\_{i} +ε\_{it} $$

Where $Y\_{it}$ denotes the outcome variable of interest (Food expenditure) of the household$ i$ in time$ t$; $X\_{it}$ are time-varying covariates of the household $i$ in time $t$; $Z\_{i}$ are time-invariant covariates; $\overbar{X\_{i}}$ denotes a vector of the time averages of the time-varying covariates for the household $i$; $λ\_{t}$ is time-fixed effects, $u\_{i}$ represents time-invariant unobserved heterogeneity, and $ε\_{it} $ is the idiosyncratic error term. Nevertheless, we still present the result of the fixed effects and random effects models in the appendix as a robustness check.

1. Results and Discussion
	1. Descriptive statistics

Table 1 provides summary statistics of the food expenditures allocated to different food groups by household’s program participation. Overall, we find that a household spends an average MK 5,914 on food items. The expenditure was higher among households that participated in both cash transfers and input subsidy programs (MK6,500) than in non-participating households (MK5,485). When disaggregated by program type, households participating in cash transfer programs had higher total food expenditures than those participating in input subsidy programs. We also find that households spend more on staples, followed by animal-sourced proteins, and the lowest expenditure was observed for fruits.

Table 1: Descriptive Statistics of Different Food Groups Expenditure by Households

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | None | Cash transfers only | Input subsidies only | Both cash transfer and input subsidies | Total |
| Total expenditure | 5485.40 | 6329.01 | 6097.61 | 6500.89 | 5914.16 |
|  | (6373.27) | (6240.13) | (8126.37) | (7216.27) | (7141.23) |
| Pulses | 367.40 | 430.21 | 365.67 | 411.79 | 378.81 |
|  | (542.35) | (568.48) | (612.71) | (518.00) | (570.00) |
| Vegetables | 664.12 | 706.75 | 666.20 | 681.43 | 671.72 |
|  | (691.44) | (632.39) | (749.57) | (723.17) | (709.85) |
| Fruits | 109.89 | 122.46 | 128.59 | 174.16 | 124.87 |
|  | (341.72) | (281.53) | (377.49) | (458.44) | (362.83) |
| Milk | 129.66 | 165.34 | 143.66 | 159.58 | 142.10 |
|  | (662.10) | (589.11) | (482.77) | (501.89) | (577.22) |
| Sugar | 408.13 | 491.69 | 410.39 | 473.33 | 425.61 |
|  | (496.76) | (482.72) | (518.02) | (475.92) | (501.70) |
| Oil | 357.67 | 412.77 | 369.28 | 419.44 | 374.84 |
|  | (514.09) | (501.96) | (548.02) | (614.67) | (536.69) |
| Staples | 1642.30 | 1909.52 | 1907.69 | 1946.85 | 1802.44 |
|  | (2179.19) | (2552.25) | (2752.42) | (2498.27) | (2481.63) |
| Animal-sourced proteins | 932.71 | 1098.91 | 1132.97 | 1195.54 | 1052.77 |
|  | (1773.31) | (1658.14) | (2115.62) | (1812.71) | (1899.14) |

Note: Figures in parentheses are standard deviations; source: author's summary from the IHPS datasets.

3.2. Econometric results

Section 3.2 presents the correlation between cash transfers, input subsidy programs, and household food expenditure. We employ the correlated random effects model to account for the correlation. We first present the findings for pooled results in Figure 1. Then we disaggregate our results by gender in Figures 2 and 3. We also control for other variables which may influence household food consumption expenditure, and detailed results are presented in Appendices 2, 3 and 4. Our results reveal varying significant correlations between household expenditure on different food groups and program participation. However, we find that the interaction of cash transfers and input subsidies is positively associated with the household expenditure on most food groups. For instance, we find that participating in both cash transfers and input subsidies is positively correlated with households' purchases of staple foods, animal-source proteins, meat, sugar, and oils. Our findings support Ruel and Alderman (2013) who suggest the need for integrated approaches to improving household consumption through the use of agricultural and social protection instruments.

On the other hand, we find that household participation in farm input subsidies is positively correlated with household expenditure on animal-sourced proteins. This is not surprising, as various scholars have revealed significant effects of farm input subsidies on maize productivity and household income (Khonje et al. 2022; Khonje et al. 2022). Suggesting that households participating in the input subsidy programs have access to staple foods, such as maize, and hence use their farm incomes to purchase other food groups, including animal-source proteins.

Similarly, a household’s participation in cash transfers only is positively correlated with its expenditure on staple foods, animal-sourced proteins, and oil. These findings agree with previous findings by other scholars. For instance, Matata et al. (2022) highlighted that cash transfers support household food expenditure beyond the staple foods to other high-value food groups such as oil and animal-sourced proteins. Likewise, Miller et al. (2011) reported that cash transfers improve household expenditure and food consumption expenditure.

Figure 1: Links between participation in programs and household food expenditure

Note: \*\*\*Significant at the 1% level; \*\*Significant at the 5% level; \*Significant at the 10% level.

* 1. Gender Intersectionality

We extend our results to assess the differences across and within gender groups. We first compared expenditure differences between males and females. The results are presented in Appendix 2. Our results suggest significant inequalities in household expenditure between male and female-headed households (Simtowe and De Groote 2021).

Furthermore, we analyse the effects of program participation within gender groups. Figure 2 presents the correlations between input subsidies, cash transfer programs, and food expenditure on food among male-headed households. Overall, we find that the total household expenditure on food among male-headed households is positively correlated with household participation in the cash transfer program and both cash transfers and input subsidies. When comparing expenditures by food item, participation in the cash transfer program has a significantly positive correlation with expenditures on animal-source protein, oils/fats, vegetables, staples, and fruits.

Figure 2: Male-headed household expenditure on food items by program participation

Note: \*\*\*Significant at the 1% level; \*\*Significant at the 5% level; \*Significant at the 10% level.

We further analysed the links between female-headed households’ participation in input subsidies and cash transfer programs and expenditure on food. The results are depicted in Figure 3 below. Interestingly, we found opposite results to those of male-headed households. Overall, participation in both programs and input subsidies only is positively correlated with household total food expenditure. When analysed by food item, we found a positive significant correlation between participation in input subsidies and expenditures on animal-source protein, sugars and staples. On the other hand, households’ participation in cash transfers is positively correlated with expenditure on staple foods.

Figure 3: Female-headed household expenditure on food items by program participation

Note: \*\*\*Significant at 1% level; \*\*significant at 5% level; \*significant at 10% level.

1. Conclusion and Policy Recommendations

In brief, the study examined the impact of cash transfers and input subsidies on household market participation in Malawi. We addressed the three specific objectives: firstly, we analysed the effect of cash transfers and input subsidies (independent or combined) on households' food purchases in Malawi. Secondly, we assessed the effect of cash transfers and input subsidies (independent or combined) on the market participation of various food groups by households. Lastly, we studied the effect of cash transfers and input subsidies (independent or combined) on expenditure across and within male-headed and female-headed households. We utilised integrated household panel survey data from 2010 to 2019, collected by the National Statistical Office in Malawi in partnership with the World Bank. The study employed panel regression models for data analysis. Specifically, we employed correlated random effect models to control for all time-invariant variables and mitigate omitted variable bias, thereby producing robust estimates.

Our results indicate that participation in both cash transfer and input subsidy programs has a positive and significant effect on total household food expenditure. Specifically, participation in cash transfers is correlated with an increase in household expenditure on oil, fats, animal-sourced protein, and staple foods. When disaggregated by gender, we found that the cash transfer program primarily increases male-headed household expenditure on food, particularly on oil, fats, sugars, vegetables, fruits, animal-sourced protein, and staple foods. On the other hand, the input subsidy program only increases total food expenditure in female-headed households that participate. Specifically, female-headed households that participated in the input subsidy program spent more on sugars, animal-sourced protein and staple foods. Overall, we found that animal-sourced protein, staples and sugars had higher expenditure.

On policy implications, we noted that both cash transfer and input subsidy programs play a vital role in contributing to household food expenditures. When combined, they have a greater impact on household food consumption than either program alone. We therefore recommend combining cash transfer and input subsidy programs to enhance nutritious food consumption. Additionally, cash transfers should complement input subsidies to increase access to staples and animal-sourced proteins. We further recommend that programs and strategies promoting nutritional education be specifically targeted at women to emphasise the importance of incorporating fruits and vegetables into their diets for optimal health and well-being.

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Appendix 1. Descriptive statistics

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | None | Cash transfers only | Input subsidies only | Both cash transfer and input subsidies | Total |
| Total expenditure | 5485.40 | 6329.01 | 6097.61 | 6500.89 | 5914.16 |
|  | (6373.27) | (6240.13) | (8126.37) | (7216.27) | (7141.23) |
| Pulses | 367.40 | 430.21 | 365.67 | 411.79 | 378.81 |
|  | (542.35) | (568.48) | (612.71) | (518.00) | (570.00) |
| Vegetables | 664.12 | 706.75 | 666.20 | 681.43 | 671.72 |
|  | (691.44) | (632.39) | (749.57) | (723.17) | (709.85) |
| Fruits | 109.89 | 122.46 | 128.59 | 174.16 | 124.87 |
|  | (341.72) | (281.53) | (377.49) | (458.44) | (362.83) |
| Milk | 129.66 | 165.34 | 143.66 | 159.58 | 142.10 |
|  | (662.10) | (589.11) | (482.77) | (501.89) | (577.22) |
| Sugar | 408.13 | 491.69 | 410.39 | 473.33 | 425.61 |
|  | (496.76) | (482.72) | (518.02) | (475.92) | (501.70) |
| Oil | 357.67 | 412.77 | 369.28 | 419.44 | 374.84 |
|  | (514.09) | (501.96) | (548.02) | (614.67) | (536.69) |
| Staples | 1642.30 | 1909.52 | 1907.69 | 1946.85 | 1802.44 |
|  | (2179.19) | (2552.25) | (2752.42) | (2498.27) | (2481.63) |
| Animal-sourced proteins | 932.71 | 1098.91 | 1132.97 | 1195.54 | 1052.77 |
|  | (1773.31) | (1658.14) | (2115.62) | (1812.71) | (1899.14) |
| Female-headed household head | 0.14 | 0.25 | 0.17 | 0.26 | 0.18 |
| (0.35) | (0.44) | (0.37) | (0.44) | (0.38) |
|  | 47.14 | 50.47 | 46.46 | 48.14 | 47.39 |
| Household head age | (14.47) | (15.18) | (14.15) | (14.73) | (14.51) |
| Household size | 3.38 | 3.19 | 3.65 | 3.30 | 3.45 |
|  | (1.47) | (1.32) | (1.65) | (1.53) | (1.53) |
| Farm size | 2.13 | 2.20 | 1.60 | 1.66 | 1.90 |
| Urban | 0.12 | 0.16 | 0.22 | 0.26 | 0.18 |
|  | (0.32) | (0.37) | (0.42) | (0.44) | (0.38) |
| Access to credit | 0.23 | 0.31 | 0.22 | 0.33 | 0.25 |
|   | (0.42) | (0.46) | (0.41) | (0.47) | (0.43) |
| Access to extension services | 0.59 | 0.74 | 0.49 | 0.51 | 0.56 |
|  | (0.49) | (0.44) | (0.50) | (0.50) | (0.50) |
| Average distance to market  | 34.73 | 31.80 | 31.75 | 28.13 | 32.61 |
|  | (19.15) | (19.43) | (20.13) | (18.21) | (19.56) |
| Drought | 0.37 | 0.40 | 0.36 | 0.35 | 0.37 |
|  | (0.48) | (0.49) | (0.48) | (0.48) | (0.48) |
| Floods | 0.19 | 0.22 | 0.13 | 0.13 | 0.16 |
|  | (0.39) | (0.41) | (0.33) | (0.33) | (0.37) |
| Rainfall | 511.60 | 612.89 | 360.68 | 437.05 | 460.77 |
|  | (413.46) | (464.43) | (361.95) | (410.22) | (410.83) |
| Temperature | 21.50 | 21.39 | 21.28 | 21.29 | 21.39 |
|  | (1.91) | (1.72) | (1.67) | (1.54) | (1.77) |
| North region | 0.10 | 0.15 | 0.10 | 0.18 | 0.11 |
|  | (0.30) | (0.35) | (0.30) | (0.38) | (0.32) |
| Central region | 0.47 | 0.41 | 0.40 | 0.26 | 0.42 |
|  | (0.50) | (0.49) | (0.49) | (0.44) | (0.49) |
| Southern region | 0.43 | 0.44 | 0.50 | 0.56 | 0.47 |
|  | (0.49) | (0.50) | (0.50) | (0.50) | (0.50) |
| Panel year 2010 | 0.13 | 0.09 | 0.26 | 0.16 | 0.18 |
|  | (0.34) | (0.28) | (0.44) | (0.37) | (0.38) |
| Panel year 2013 | 0.22 | 0.18 | 0.30 | 0.27 | 0.25 |
|  | (0.42) | (0.39) | (0.46) | (0.45) | (0.43) |
| Panel year 2016 | 0.27 | 0.26 | 0.25 | 0.30 | 0.26 |
|  | (0.44) | (0.44) | (0.43) | (0.46) | (0.44) |
| Panel year 2019 | 0.38 | 0.47 | 0.19 | 0.27 | 0.31 |
|  | (0.48) | (0.50) | (0.40) | (0.44) | (0.46) |

Appendix 2: Effect of cash transfers and input subsidies on household participation in retail food market: Mundlak approach

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Total food expenditure | Staples | Pulses | Animal-sourced proteins | Fruits | Milk | Sugar | Vegetables | Oil/fats |
| Cash transfers | 0.094\* | 0.347\*\* | 0.123 | 0.404\*\* | 0.184 | 0.125 | 0.181 | 0.089 | 0.352\*\*\* |
|  | (0.048) | (0.138) | (0.166) | (0.172) | (0.148) | (0.139) | (0.141) | (0.087) | (0.127) |
| Input subsidies | 0.034 | 0.061 | 0.053 | 0.244\*\* | -0.088 | -0.103 | 0.110 | 0.077 | 0.093 |
|  | (0.033) | (0.094) | (0.113) | (0.117) | (0.100) | (0.095) | (0.096) | (0.059) | (0.086) |
| Both cash transfer and input subsidies | 0.122\*\* | 0.348\*\* | 0.257 | 0.555\*\*\* | 0.128 | 0.145 | 0.302\*\* | 0.192\*\* | 0.466\*\*\* |
| (0.049) | (0.140) | (0.169) | (0.175) | (0.151) | (0.142) | (0.145) | (0.088) | (0.129) |
| Female household head | -0.452\*\*\* | -0.561\*\*\* | -0.065 | -1.150\*\*\* | -0.231 | -0.462\*\*\* | -0.509\*\*\* | -0.417\*\*\* | -0.626\*\*\* |
|  | (0.064) | (0.151) | (0.166) | (0.178) | (0.151) | (0.159) | (0.166) | (0.094) | (0.138) |
| Household age | -0.007\*\* | -0.019\*\*\* | -0.012 | -0.021\*\* | -0.030\*\*\* | -0.005 | -0.009 | -0.006 | -0.013\*\* |
|  | (0.003) | (0.007) | (0.008) | (0.009) | (0.007) | (0.008) | (0.008) | (0.005) | (0.007) |
| Household size | 0.077\*\*\* | 0.138\*\*\* | 0.154\*\*\* | 0.046 | 0.071\* | 0.053 | 0.040 | 0.108\*\*\* | 0.102\*\*\* |
|  | (0.013) | (0.039) | (0.047) | (0.048) | (0.042) | (0.039) | (0.040) | (0.024) | (0.036) |
| lnFarm size | 0.077\*\*\* | -0.111 | 0.002 | 0.239\*\* | -0.075 | 0.015 | 0.168\*\* | 0.117\*\* | 0.259\*\*\* |
|  | (0.027) | (0.075) | (0.089) | (0.093) | (0.080) | (0.077) | (0.078) | (0.047) | (0.069) |
| urban | 0.548\*\*\* | 1.334\*\*\* | 0.709\*\* | 0.708\*\* | 1.123\*\*\* | 0.883\*\*\* | 0.320 | 0.562\*\*\* | 1.075\*\*\* |
|  | (0.092) | (0.257) | (0.306) | (0.319) | (0.273) | (0.262) | (0.267) | (0.162) | (0.237) |
| Credit | 0.028 | 0.022 | 0.016 | 0.186 | 0.053 | 0.045 | 0.122 | -0.032 | 0.108 |
|  | (0.035) | (0.102) | (0.125) | (0.129) | (0.111) | (0.103) | (0.104) | (0.064) | (0.094) |
| Extension | 0.070\*\* | 0.124 | 0.355\*\*\* | 0.162 | 0.223\*\* | 0.009 | 0.179\* | 0.153\*\*\* | 0.045 |
|  | (0.032) | (0.093) | (0.115) | (0.118) | (0.102) | (0.094) | (0.095) | (0.059) | (0.086) |
| Distance to market | 0.001 | 0.007 | -0.014\* | -0.029\*\*\* | -0.010 | -0.013\*\* | -0.018\*\*\* | 0.002 | 0.001 |
|  | (0.002) | (0.006) | (0.007) | (0.007) | (0.006) | (0.006) | (0.006) | (0.004) | (0.005) |
| Drought | -0.065\*\* | -0.105 | 0.097 | -0.148 | 0.178\* | -0.173\* | -0.095 | -0.174\*\*\* | -0.232\*\*\* |
|  | (0.031) | (0.088) | (0.107) | (0.111) | (0.095) | (0.089) | (0.091) | (0.056) | (0.081) |
| Floods | 0.064 | 0.195 | 0.015 | 0.044 | 0.079 | -0.019 | -0.044 | -0.015 | 0.159 |
|  | (0.042) | (0.120) | (0.145) | (0.150) | (0.129) | (0.121) | (0.123) | (0.075) | (0.110) |
| Rainfall | 0.000 | 0.001\* | 0.001 | -0.000 | -0.001\* | -0.000 | 0.000 | -0.000 | 0.000 |
|  | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Temperature | 0.001 | 0.039 | 0.131 | 0.021 | -0.069 | 0.088 | -0.056 | -0.066 | -0.056 |
|  | (0.031) | (0.085) | (0.102) | (0.106) | (0.091) | (0.087) | (0.089) | (0.054) | (0.079) |
| Panel year 2013 | 1.037\*\*\* | 1.305\*\*\* | 1.465\*\*\* | 0.369\* | 0.336\*\* | 0.105 | 0.478\*\*\* | 1.309\*\*\* | 1.028\*\*\* |
|  | (0.054) | (0.157) | (0.192) | (0.198) | (0.170) | (0.158) | (0.160) | (0.099) | (0.145) |
| Panel year 2016  | 1.680\*\*\* | 2.258\*\*\* | 1.138\*\*\* | -1.300\*\*\* | 0.369\*\* | 0.394\*\* | 0.645\*\*\* | 1.780\*\*\* | 1.653\*\*\* |
|  | (0.056) | (0.163) | (0.198) | (0.205) | (0.176) | (0.164) | (0.167) | (0.103) | (0.150) |
| Panel year 2019 | 1.614\*\*\* | 1.750\*\*\* | 1.111\*\* | -1.050\*\* | 1.004\*\* | 0.717\* | 0.601 | 2.140\*\*\* | 1.992\*\*\* |
|  | (0.132) | (0.384) | (0.469) | (0.484) | (0.416) | (0.387) | (0.392) | (0.242) | (0.354) |
| Central region  | -0.020 | 0.070 | 0.131 | 0.223 | 0.319\* | 0.141 | -0.600\*\*\* | 0.065 | -0.215 |
|  | (0.078) | (0.187) | (0.207) | (0.221) | (0.187) | (0.197) | (0.204) | (0.117) | (0.171) |
| Southern Africa | -0.089 | 0.030 | -0.170 | -0.088 | 0.238 | -0.119 | -0.590\*\*\* | 0.081 | -0.070 |
|  | (0.079) | (0.188) | (0.207) | (0.222) | (0.188) | (0.198) | (0.206) | (0.117) | (0.172) |
| Mean age | -0.002 | -0.009 | -0.001 | 0.004 | 0.017\* | 0.006 | -0.008 | -0.004 | -0.008 |
|  | (0.004) | (0.009) | (0.010) | (0.011) | (0.009) | (0.010) | (0.010) | (0.006) | (0.008) |
| Mean household size | 0.030 | 0.069 | 0.119 | -0.110 | -0.125\* | -0.141\* | 0.045 | 0.046 | -0.034 |
|  | (0.028) | (0.071) | (0.082) | (0.086) | (0.073) | (0.074) | (0.077) | (0.045) | (0.066) |
| Mean rainfall | 0.000 | -0.001 | 0.000 | 0.001 | 0.001 | 0.000 | -0.000 | 0.000 | -0.000 |
|  | (0.000) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.000) | (0.001) |
| Mean temperature | 0.004 | 0.010 | 0.014 | -0.005 | 0.006 | -0.012 | 0.011 | 0.009 | 0.009 |
|  | (0.003) | (0.009) | (0.011) | (0.012) | (0.010) | (0.010) | (0.010) | (0.006) | (0.009) |
| Mean urban | 0.716\*\*\* | 0.730\*\* | 1.423\*\*\* | 2.045\*\*\* | 1.624\*\*\* | 1.738\*\*\* | 1.765\*\*\* | 0.669\*\*\* | 1.091\*\*\* |
|  | (0.122) | (0.321) | (0.372) | (0.391) | (0.334) | (0.331) | (0.340) | (0.201) | (0.295) |
| Mean credit | 0.080 | 0.344 | 0.613\*\* | -0.338 | 0.252 | -0.022 | 0.585\*\* | 0.132 | 0.297 |
|  | (0.109) | (0.265) | (0.296) | (0.315) | (0.267) | (0.278) | (0.289) | (0.166) | (0.243) |
| Mean extension | -0.080 | -0.256 | -0.670\*\* | 0.278 | -0.306 | -0.130 | -0.133 | -0.261\* | -0.152 |
|  | (0.104) | (0.252) | (0.281) | (0.299) | (0.254) | (0.265) | (0.275) | (0.158) | (0.231) |
| Mean Farm size | -0.011 | -0.010 | -0.053\* | 0.003 | -0.004 | 0.040 | 0.002 | -0.064\*\*\* | -0.015 |
|  | (0.012) | (0.028) | (0.031) | (0.034) | (0.029) | (0.030) | (0.031) | (0.018) | (0.026) |
| Mean distance markets | -0.013\*\*\* | -0.036\*\*\* | -0.005 | 0.003 | -0.004 | 0.003 | -0.009 | -0.010\*\* | -0.018\*\*\* |
|  | (0.003) | (0.007) | (0.008) | (0.009) | (0.007) | (0.007) | (0.007) | (0.004) | (0.007) |
| Constant | 6.859\*\*\* | 3.320\*\*\* | -2.994\*\*\* | 6.600\*\*\* | 2.493\*\*\* | 2.043\*\* | 4.364\*\*\* | 4.496\*\*\* | 3.720\*\*\* |
|  | (0.386) | (0.916) | (1.010) | (1.081) | (0.916) | (0.967) | (1.007) | (0.572) | (0.839) |
| Observations | 4,068 | 4,068 | 4,068 | 4,068 | 4,068 | 4,068 | 4,068 | 4,068 | 4,068 |
| Number of Households | 1,017 | 1,017 | 1,017 | 1,017 | 1,017 | 1,017 | 1,017 | 1,017 | 1,017 |

Appendix 3: Effect of cash transfers and input subsidies on household participation in retail food market among male-headed households: Mundlak approach

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Total food expenditure | Staples | Pulses | Animal-sourced proteins | Fruits | Milk | Sugar | Vegetables | Oil/fats |
| Cash transfers | 0.139\*\*\* | 0.326\*\* | 0.213 | 0.558\*\*\* | 0.321\* | 0.137 | 0.196 | 0.202\*\* | 0.322\*\* |
|  | (0.051) | (0.151) | (0.188) | (0.194) | (0.170) | (0.162) | (0.157) | (0.093) | (0.139) |
| Input subsidies | -0.016 | -0.057 | -0.012 | 0.100 | -0.128 | -0.116 | -0.008 | 0.044 | 0.035 |
|  | (0.034) | (0.098) | (0.122) | (0.126) | (0.110) | (0.106) | (0.102) | (0.061) | (0.091) |
| Both cash transfer and input subsidies | 0.090\* | 0.232 | 0.359\* | 0.519\*\*\* | 0.174 | 0.170 | 0.333\*\* | 0.136 | 0.413\*\*\* |
| (0.053) | (0.153) | (0.191) | (0.197) | (0.172) | (0.166) | (0.160) | (0.095) | (0.141) |
| Household age | -0.010\*\*\* | -0.023\*\*\* | -0.021\*\* | -0.024\*\* | -0.037\*\*\* | -0.008 | -0.018\*\* | -0.009\* | -0.018\*\* |
|  | (0.003) | (0.008) | (0.009) | (0.010) | (0.008) | (0.009) | (0.009) | (0.005) | (0.007) |
| Household size | 0.080\*\*\* | 0.125\*\*\* | 0.152\*\*\* | 0.052 | 0.111\*\* | 0.073 | 0.087\*\* | 0.100\*\*\* | 0.110\*\*\* |
|  | (0.014) | (0.041) | (0.052) | (0.053) | (0.047) | (0.045) | (0.043) | (0.026) | (0.038) |
| lnFarm size | -0.028 | -0.345\*\*\* | -0.077 | -0.020 | -0.204\*\* | -0.051 | -0.034 | -0.074 | 0.178\*\* |
|  | (0.030) | (0.089) | (0.110) | (0.114) | (0.100) | (0.096) | (0.092) | (0.055) | (0.082) |
| urban | 0.473\*\*\* | 1.186\*\*\* | 0.702\*\* | 0.597\* | 1.095\*\*\* | 1.085\*\*\* | 0.156 | 0.505\*\*\* | 0.916\*\*\* |
|  | (0.094) | (0.270) | (0.332) | (0.346) | (0.301) | (0.293) | (0.284) | (0.166) | (0.250) |
| Credit | 0.042 | 0.064 | 0.034 | 0.103 | 0.086 | 0.071 | 0.139 | 0.002 | 0.140 |
|  | (0.035) | (0.106) | (0.135) | (0.138) | (0.122) | (0.114) | (0.109) | (0.066) | (0.098) |
| Extension | 0.055\* | 0.112 | 0.267\*\* | 0.151 | 0.215\* | 0.067 | 0.201\*\* | 0.183\*\*\* | -0.006 |
|  | (0.033) | (0.099) | (0.126) | (0.128) | (0.113) | (0.106) | (0.102) | (0.062) | (0.091) |
| Distance to market | 0.002 | 0.009 | -0.012 | -0.035\*\*\* | -0.014\* | -0.014\*\* | -0.017\*\*\* | 0.004 | 0.002 |
|  | (0.002) | (0.006) | (0.008) | (0.008) | (0.007) | (0.007) | (0.006) | (0.004) | (0.006) |
| Drought | -0.059\* | -0.113 | 0.067 | -0.176 | 0.175 | -0.207\*\* | -0.080 | -0.136\*\* | -0.284\*\*\* |
|  | (0.032) | (0.094) | (0.118) | (0.122) | (0.107) | (0.101) | (0.098) | (0.059) | (0.087) |
| Floods | 0.016 | 0.118 | -0.050 | -0.011 | 0.004 | -0.064 | -0.122 | -0.053 | 0.109 |
|  | (0.043) | (0.128) | (0.160) | (0.165) | (0.144) | (0.137) | (0.132) | (0.079) | (0.118) |
| Rainfall | 0.000 | 0.001\*\* | 0.000 | 0.000 | -0.001 | -0.000 | 0.000 | 0.000 | 0.000 |
|  | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Temperature | 0.011 | 0.051 | 0.111 | 0.160 | 0.002 | 0.197\*\* | -0.008 | -0.054 | -0.038 |
|  | (0.031) | (0.090) | (0.111) | (0.115) | (0.100) | (0.098) | (0.095) | (0.055) | (0.083) |
| Panel year 2013 | 1.073\*\*\* | 1.304\*\*\* | 1.524\*\*\* | 0.372\* | 0.373\* | 0.129 | 0.708\*\*\* | 1.319\*\*\* | 1.185\*\*\* |
|  | (0.057) | (0.170) | (0.214) | (0.219) | (0.193) | (0.182) | (0.175) | (0.106) | (0.156) |
| Panel year 2016  | 1.745\*\*\* | 2.299\*\*\* | 1.299\*\*\* | -1.214\*\*\* | 0.465\*\* | 0.462\*\* | 0.892\*\*\* | 1.826\*\*\* | 1.897\*\*\* |
|  | (0.060) | (0.177) | (0.223) | (0.228) | (0.201) | (0.190) | (0.183) | (0.110) | (0.163) |
| Panel year 2019 | 1.638\*\*\* | 1.631\*\*\* | 1.324\*\* | -1.313\*\* | 0.949\*\* | 0.771\* | 0.826\* | 2.161\*\*\* | 2.335\*\*\* |
|  | (0.139) | (0.414) | (0.522) | (0.534) | (0.471) | (0.444) | (0.427) | (0.257) | (0.381) |
| Central region  | -0.021 | 0.029 | 0.235 | 0.279 | 0.359\* | 0.213 | -0.695\*\*\* | 0.064 | -0.249 |
|  | (0.077) | (0.195) | (0.221) | (0.241) | (0.202) | (0.220) | (0.217) | (0.115) | (0.182) |
| Southern region | -0.111 | -0.067 | -0.027 | -0.044 | 0.248 | -0.037 | -0.608\*\*\* | 0.070 | -0.119 |
|  | (0.079) | (0.198) | (0.223) | (0.244) | (0.205) | (0.223) | (0.221) | (0.116) | (0.184) |
| Mean age | 0.001 | -0.005 | 0.007 | 0.003 | 0.024\*\* | 0.005 | -0.002 | -0.002 | -0.003 |
|  | (0.004) | (0.010) | (0.012) | (0.013) | (0.011) | (0.011) | (0.011) | (0.006) | (0.009) |
| Mean household size | 0.007 | 0.046 | 0.165\* | -0.107 | -0.159\*\* | -0.208\*\* | -0.015 | 0.026 | -0.022 |
|  | (0.029) | (0.076) | (0.089) | (0.095) | (0.081) | (0.085) | (0.083) | (0.045) | (0.071) |
| Mean rainfall | 0.000 | -0.001 | -0.000 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | -0.000 |
|  | (0.000) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.000) | (0.001) |
| Mean temperature | 0.003 | 0.011 | 0.017 | -0.020 | -0.001 | -0.024\*\* | 0.006 | 0.007 | 0.010 |
|  | (0.004) | (0.010) | (0.012) | (0.013) | (0.011) | (0.011) | (0.010) | (0.006) | (0.009) |
| Mean urban | 0.784\*\*\* | 0.800\*\* | 1.332\*\*\* | 1.975\*\*\* | 1.612\*\*\* | 1.572\*\*\* | 1.973\*\*\* | 0.727\*\*\* | 1.164\*\*\* |
|  | (0.124) | (0.338) | (0.404) | (0.427) | (0.368) | (0.372) | (0.363) | (0.205) | (0.313) |
| Mean credit | -0.032 | 0.096 | 0.617\* | -0.304 | 0.248 | 0.132 | 0.515\* | -0.000 | 0.182 |
|  | (0.110) | (0.279) | (0.319) | (0.346) | (0.292) | (0.314) | (0.309) | (0.165) | (0.260) |
| Mean extension | -0.118 | -0.447\* | -0.850\*\*\* | 0.223 | -0.486\* | -0.409 | -0.324 | -0.325\*\* | -0.171 |
|  | (0.107) | (0.271) | (0.309) | (0.336) | (0.283) | (0.305) | (0.301) | (0.160) | (0.253) |
| Mean Farm size | 0.069\*\*\* | 0.158\*\*\* | -0.003 | 0.163\*\* | 0.084 | 0.171\*\*\* | 0.196\*\*\* | 0.068\*\* | 0.070 |
|  | (0.020) | (0.052) | (0.060) | (0.064) | (0.055) | (0.058) | (0.057) | (0.031) | (0.048) |
| Mean distance markets | -0.013\*\*\* | -0.036\*\*\* | -0.004 | 0.009 | 0.001 | 0.005 | -0.010 | -0.009\*\* | -0.021\*\*\* |
|  | (0.003) | (0.007) | (0.009) | (0.010) | (0.008) | (0.008) | (0.008) | (0.005) | (0.007) |
| Constant | 6.786\*\*\* | 3.222\*\*\* | -3.310\*\*\* | 6.936\*\*\* | 2.615\*\*\* | 2.334\*\* | 4.089\*\*\* | 4.497\*\*\* | 3.164\*\*\* |
|  | (0.391) | (0.977) | (1.101) | (1.204) | (1.011) | (1.104) | (1.093) | (0.574) | (0.911) |
| Observations | 3,407 | 3,407 | 3,407 | 3,407 | 3,407 | 3,407 | 3,407 | 3,407 | 3,407 |
| Number of Households | 854 | 854 | 854 | 854 | 854 | 854 | 854 | 854 | 854 |

Appendix 4: Effect of cash transfers and input subsidies on household participation in retail food market among female-headed households: Mundlak approach

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Variables | Total food expenditure | Staples | Pulses | Animal-sourced proteins | Fruits | Milk | Sugar | Vegetables | Oil/fats |
| Cash transfers | 0.055 | 0.691\*\* | -0.150 | 0.210 | -0.327 | 0.116 | 0.197 | -0.143 | 0.504 |
|  | (0.132) | (0.349) | (0.369) | (0.379) | (0.303) | (0.251) | (0.343) | (0.230) | (0.320) |
| Input subsidies | 0.247\*\* | 0.600\*\* | 0.283 | 0.808\*\*\* | -0.014 | -0.096 | 0.656\*\* | 0.120 | 0.375 |
|  | (0.108) | (0.283) | (0.299) | (0.307) | (0.246) | (0.204) | (0.279) | (0.187) | (0.260) |
| Both cash transfer and input subsidies | 0.257\* | 0.823\*\* | -0.032 | 0.660\* | 0.015 | 0.055 | 0.306 | 0.308 | 0.775\*\* |
| (0.134) | (0.355) | (0.375) | (0.388) | (0.307) | (0.255) | (0.349) | (0.233) | (0.327) |
| Household age | 0.005 | -0.004 | 0.022 | 0.010 | 0.005 | 0.013 | 0.029 | 0.016 | 0.010 |
|  | (0.009) | (0.019) | (0.020) | (0.019) | (0.017) | (0.014) | (0.019) | (0.014) | (0.017) |
| Household size | 0.099\*\* | 0.286\*\*\* | 0.254\*\* | 0.125 | -0.084 | -0.017 | -0.084 | 0.235\*\*\* | 0.149 |
|  | (0.041) | (0.110) | (0.116) | (0.122) | (0.095) | (0.079) | (0.108) | (0.071) | (0.102) |
| lnFarm size | 0.259\*\*\* | 0.233 | 0.123 | 0.683\*\*\* | 0.098 | -0.129 | 0.331\* | 0.364\*\*\* | 0.255 |
|  | (0.078) | (0.199) | (0.211) | (0.212) | (0.174) | (0.143) | (0.197) | (0.135) | (0.181) |
| urban | 1.038\*\*\* | 1.980\*\* | 0.899 | 1.847\*\* | 1.441\*\* | -0.054 | 1.529\*\* | 0.802 | 2.125\*\*\* |
|  | (0.317) | (0.782) | (0.826) | (0.819) | (0.688) | (0.562) | (0.772) | (0.541) | (0.706) |
| Credit | -0.076 | -0.196 | -0.156 | 0.768\*\* | -0.158 | -0.111 | 0.095 | -0.296 | -0.029 |
|  | (0.118) | (0.323) | (0.342) | (0.362) | (0.278) | (0.233) | (0.318) | (0.207) | (0.301) |
| Extension | 0.203\*\* | 0.283 | 0.772\*\*\* | 0.340 | 0.382 | -0.176 | 0.227 | 0.141 | 0.389 |
|  | (0.099) | (0.271) | (0.287) | (0.304) | (0.233) | (0.195) | (0.266) | (0.173) | (0.253) |
| Distance to market | -0.001 | -0.002 | -0.014 | 0.015 | 0.012 | -0.011 | -0.013 | -0.005 | 0.003 |
|  | (0.007) | (0.018) | (0.019) | (0.020) | (0.016) | (0.013) | (0.018) | (0.012) | (0.017) |
| Drought | -0.084 | -0.044 | 0.268 | 0.027 | 0.187 | -0.060 | -0.181 | -0.307\* | -0.024 |
|  | (0.091) | (0.245) | (0.259) | (0.270) | (0.211) | (0.176) | (0.241) | (0.159) | (0.226) |
| Floods | 0.237\* | 0.449 | 0.246 | 0.164 | 0.354 | 0.296 | 0.368 | 0.096 | 0.347 |
|  | (0.126) | (0.335) | (0.354) | (0.368) | (0.290) | (0.241) | (0.330) | (0.219) | (0.309) |
| Rainfall | -0.000 | -0.000 | 0.001 | -0.001 | -0.001 | -0.000 | -0.000 | -0.000 | 0.001 |
|  | (0.000) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Temperature | -0.087 | 0.002 | 0.200 | -0.696\*\*\* | -0.549\*\* | -0.548\*\*\* | -0.485\* | -0.153 | -0.302 |
|  | (0.101) | (0.255) | (0.270) | (0.270) | (0.223) | (0.184) | (0.252) | (0.174) | (0.232) |
| Panel year 2013 | 0.958\*\*\* | 1.516\*\*\* | 1.460\*\*\* | 0.560 | 0.319 | -0.046 | -0.236 | 1.302\*\*\* | 0.526 |
|  | (0.158) | (0.430) | (0.454) | (0.478) | (0.370) | (0.309) | (0.423) | (0.277) | (0.399) |
| Panel year 2016  | 1.508\*\*\* | 2.322\*\*\* | 0.780\* | -1.516\*\*\* | 0.184 | 0.093 | -0.025 | 1.658\*\*\* | 0.768\* |
|  | (0.159) | (0.429) | (0.454) | (0.477) | (0.370) | (0.309) | (0.422) | (0.278) | (0.398) |
| Panel year 2019 | 1.663\*\*\* | 2.994\*\*\* | 0.666 | 0.377 | 1.495 | 0.172 | 0.325 | 1.805\*\*\* | 1.238 |
|  | (0.394) | (1.064) | (1.126) | (1.180) | (0.918) | (0.766) | (1.047) | (0.689) | (0.987) |
| Central region  | 0.013 | 0.414 | -0.355 | -0.028 | 0.112 | -0.402 | -0.030 | 0.146 | 0.015 |
|  | (0.261) | (0.548) | (0.579) | (0.533) | (0.496) | (0.393) | (0.543) | (0.424) | (0.477) |
| Southern region | 0.047 | 0.552 | -0.886 | -0.211 | 0.172 | -0.639\* | -0.448 | 0.184 | 0.260 |
|  | (0.250) | (0.521) | (0.549) | (0.504) | (0.472) | (0.374) | (0.516) | (0.404) | (0.452) |
| Mean age | -0.014 | -0.028 | -0.031 | -0.019 | -0.016 | -0.009 | -0.049\*\* | -0.030\* | -0.039\*\* |
|  | (0.010) | (0.022) | (0.023) | (0.022) | (0.020) | (0.016) | (0.022) | (0.017) | (0.019) |
| Mean household size | 0.072 | 0.019 | -0.244 | -0.287 | -0.079 | 0.077 | 0.146 | -0.007 | -0.203 |
|  | (0.090) | (0.202) | (0.213) | (0.206) | (0.180) | (0.145) | (0.200) | (0.148) | (0.180) |
| Mean rainfall | -0.000 | 0.000 | 0.000 | 0.001 | 0.001 | -0.000 | -0.002 | -0.000 | -0.001 |
|  | (0.001) | (0.002) | (0.002) | (0.002) | (0.001) | (0.001) | (0.002) | (0.001) | (0.001) |
| Mean temperature | 0.009 | 0.002 | 0.000 | 0.070\*\* | 0.055\*\* | 0.053\*\*\* | 0.050\* | 0.017 | 0.026 |
|  | (0.012) | (0.028) | (0.030) | (0.029) | (0.025) | (0.020) | (0.028) | (0.020) | (0.025) |
| Mean urban | 0.478 | 0.858 | 1.664\* | 2.380\*\* | 1.438\* | 2.819\*\*\* | 0.517 | 0.720 | 0.762 |
|  | (0.416) | (0.952) | (1.005) | (0.967) | (0.848) | (0.684) | (0.941) | (0.692) | (0.846) |
| Mean credit | 0.355 | 1.061 | 0.422 | -1.546\*\* | 0.207 | -0.858 | 0.224 | 0.446 | 0.306 |
|  | (0.358) | (0.766) | (0.809) | (0.759) | (0.690) | (0.550) | (0.758) | (0.582) | (0.672) |
| Mean extension | -0.423 | -0.455 | -0.212 | -0.384 | -0.122 | 0.438 | -0.051 | -0.765 | -0.602 |
|  | (0.322) | (0.688) | (0.726) | (0.682) | (0.619) | (0.494) | (0.681) | (0.523) | (0.603) |
| Mean Farm size | -0.051\*\*\* | -0.087\*\* | -0.074\* | -0.061\* | -0.035 | -0.009 | -0.081\*\* | -0.124\*\*\* | -0.052 |
|  | (0.018) | (0.037) | (0.039) | (0.036) | (0.034) | (0.027) | (0.037) | (0.029) | (0.032) |
| Mean distance markets | -0.017\*\* | -0.032 | -0.011 | -0.042\* | -0.031\* | -0.004 | -0.024 | -0.010 | -0.011 |
|  | (0.008) | (0.021) | (0.022) | (0.022) | (0.018) | (0.015) | (0.020) | (0.014) | (0.019) |
| Constant | 6.987\*\*\* | 3.485 | -1.215 | 4.312\* | 1.809 | 1.690 | 6.215\*\* | 4.599\*\* | 5.263\*\* |
|  | (1.173) | (2.440) | (2.574) | (2.367) | (2.211) | (1.750) | (2.418) | (1.895) | (2.118) |
| Observations | 661 | 661 | 661 | 661 | 661 | 661 | 661 | 661 | 661 |
| Number of Households | 166 | 166 | 166 | 166 | 166 | 166 | 166 | 166 | 166 |

Appendix 5: Effect of cash transfers and input subsidies on household participation in retail food market among female-headed households: Fixed effects model

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Variables | Total food expenditure | Staples | Pulses | Animal-sourced proteins | Fruits | Milk | Sugar | Vegetables | Oil/fats |
| Cash transfers | 0.076 | 0.343\*\* | 0.137 | 0.273 | 0.044 | -0.059 | 0.038 | 0.018 | 0.184 |
|  | (0.051) | (0.151) | (0.187) | (0.192) | (0.166) | (0.151) | (0.153) | (0.095) | (0.140) |
| Input subsidies | 0.057 | 0.225\*\* | 0.132 | 0.254\* | 0.007 | -0.110 | 0.096 | 0.092 | 0.047 |
|  | (0.035) | (0.105) | (0.130) | (0.133) | (0.115) | (0.105) | (0.106) | (0.066) | (0.097) |
| Both cash transfer and input subsidies | 0.142\*\*\* | 0.535\*\*\* | 0.208 | 0.554\*\*\* | 0.202 | 0.169 | 0.256 | 0.220\*\* | 0.414\*\*\* |
| (0.053) | (0.156) | (0.193) | (0.198) | (0.171) | (0.156) | (0.158) | (0.098) | (0.144) |
| Female household head | -0.230 | -2.219 | 3.422\* | 1.098 | 0.102 | 0.862 | 1.870 | -0.142 | -2.066 |
| (0.513) | (1.525) | (1.886) | (1.933) | (1.669) | (1.525) | (1.545) | (0.960) | (1.408) |
| Household age | -0.007 | -0.003 | -0.007 | 0.016 | -0.007 | 0.021 | 0.000 | 0.007 | -0.015 |
|  | (0.006) | (0.016) | (0.020) | (0.021) | (0.018) | (0.016) | (0.017) | (0.010) | (0.015) |
| Household size | 0.064\*\*\* | 0.120\*\*\* | 0.125\*\* | 0.044 | 0.060 | 0.026 | 0.017 | 0.088\*\*\* | 0.073\* |
|  | (0.014) | (0.042) | (0.052) | (0.053) | (0.046) | (0.042) | (0.042) | (0.026) | (0.039) |
| lnFarm size | 0.059\* | -0.099 | 0.104 | 0.191 | -0.024 | -0.015 | 0.106 | -0.001 | 0.254\*\*\* |
|  | (0.031) | (0.092) | (0.114) | (0.116) | (0.101) | (0.092) | (0.093) | (0.058) | (0.085) |
| urban | 0.425\*\*\* | 1.189\*\*\* | 0.341 | 0.131 | 0.495 | 0.649\*\* | 0.150 | 0.420\*\* | 1.005\*\*\* |
|  | (0.104) | (0.311) | (0.384) | (0.394) | (0.340) | (0.311) | (0.315) | (0.195) | (0.287) |
| Credit | 0.020 | -0.004 | -0.027 | 0.164 | 0.056 | 0.035 | 0.128 | -0.053 | 0.093 |
|  | (0.035) | (0.104) | (0.129) | (0.132) | (0.114) | (0.104) | (0.106) | (0.066) | (0.096) |
| Extension | 0.071\*\* | 0.115 | 0.346\*\*\* | 0.171 | 0.227\*\* | 0.009 | 0.187\* | 0.171\*\*\* | 0.017 |
|  | (0.032) | (0.095) | (0.118) | (0.121) | (0.104) | (0.095) | (0.097) | (0.060) | (0.088) |
| Distance to market | 0.003 | 0.011\* | -0.011 | -0.028\*\*\* | -0.007 | -0.009 | -0.016\*\*\* | 0.005 | 0.003 |
|  | (0.002) | (0.006) | (0.008) | (0.008) | (0.007) | (0.006) | (0.006) | (0.004) | (0.006) |
| Drought | 0.002 | 0.010 | 0.256\*\* | 0.064 | 0.297\*\*\* | -0.018 | 0.030 | -0.080 | -0.151\* |
|  | (0.032) | (0.095) | (0.118) | (0.121) | (0.104) | (0.095) | (0.096) | (0.060) | (0.088) |
| Floods | 0.053 | 0.062 | -0.078 | 0.116 | 0.023 | 0.054 | -0.016 | -0.070 | 0.231\* |
|  | (0.044) | (0.130) | (0.161) | (0.165) | (0.142) | (0.130) | (0.132) | (0.082) | (0.120) |
| Rainfall | 0.000\* | 0.001\*\* | 0.001\* | -0.000 | -0.000 | -0.000 | 0.001 | -0.000 | 0.000 |
|  | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Temperature | 0.020 | 0.123 | 0.100 | -0.002 | -0.008 | 0.200\* | -0.100 | -0.028 | -0.082 |
|  | (0.035) | (0.103) | (0.128) | (0.131) | (0.113) | (0.103) | (0.105) | (0.065) | (0.096) |
| Panel year 2013 | 1.033\*\*\* | 1.290\*\*\* | 1.447\*\*\* | 0.282 | 0.278 | 0.031 | 0.396\*\* | 1.272\*\*\* | 0.987\*\*\* |
|  | (0.056) | (0.168) | (0.207) | (0.212) | (0.183) | (0.168) | (0.170) | (0.105) | (0.155) |
| Panel year 2016  | 1.669\*\*\* | 2.184\*\*\* | 1.074\*\*\* | -1.514\*\*\* | 0.224 | 0.229 | 0.531\*\*\* | 1.703\*\*\* | 1.610\*\*\* |
|  | (0.063) | (0.187) | (0.231) | (0.237) | (0.204) | (0.187) | (0.189) | (0.118) | (0.172) |
| Panel year 2019 | 1.564\*\*\* | 1.536\*\*\* | 0.917\* | -1.253\*\* | 0.661 | 0.434 | 0.227 | 2.043\*\*\* | 1.812\*\*\* |
|  | (0.139) | (0.414) | (0.512) | (0.524) | (0.453) | (0.414) | (0.419) | (0.260) | (0.382) |
| Central region  | -0.048 | 0.144 | 0.338 | -1.723\* | -1.059 | -1.308\* | 0.314 | -0.395 | 0.515 |
|  | (0.248) | (0.738) | (0.913) | (0.935) | (0.808) | (0.738) | (0.748) | (0.464) | (0.681) |
| Southern Africa | -0.299 | -0.388 | 0.352 | -2.428\*\* | -1.917\*\* | -1.482\* | -0.083 | -0.615 | 0.641 |
|  | (0.291) | (0.866) | (1.072) | (1.098) | (0.948) | (0.866) | (0.878) | (0.545) | (0.800) |
| Constant | 7.161\*\*\* | 1.747 | -0.217 | 7.090\*\* | 3.804 | -2.550 | 6.286\*\*\* | 5.231\*\*\* | 5.092\*\* |
|  | (0.776) | (2.309) | (2.856) | (2.927) | (2.527) | (2.309) | (2.339) | (1.453) | (2.132) |
| Observations | 4,068 | 4,068 | 4,068 | 4,068 | 4,068 | 4,068 | 4,068 | 4,068 | 4,068 |
| R squared | 0.490 | 0.151 | 0.068 | 0.092 | 0.010 | 0.016 | 0.039 | 0.245 | 0.157 |
| Number of households | 1,017 | 1,017 | 1,017 | 1,017 | 1,017 | 1,017 | 1,017 | 1,017 | 1,017 |

Appendix 6: Effect of cash transfers and input subsidies on household participation in retail food market among female-headed households: random effects model

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Variables | Total food expenditure | Staples | Pulses | Animal-sourced proteins | Fruits | Milk | Sugar | Vegetables | Oil/fats |
| Cash transfers | 0.107\*\* | 0.373\*\*\* | 0.153 | 0.427\*\* | 0.214 | 0.140 | 0.203 | 0.107 | 0.374\*\*\* |
|  | (0.049) | (0.138) | (0.167) | (0.172) | (0.148) | (0.140) | (0.142) | (0.087) | (0.127) |
| Input subsidies | 0.033 | 0.058 | 0.040 | 0.254\*\* | -0.086 | -0.096 | 0.103 | 0.069 | 0.087 |
|  | (0.033) | (0.094) | (0.113) | (0.117) | (0.100) | (0.095) | (0.097) | (0.059) | (0.086) |
| Both cash transfer and input subsidies | 0.134\*\*\* | 0.373\*\*\* | 0.263 | 0.590\*\*\* | 0.157 | 0.176 | 0.315\*\* | 0.194\*\* | 0.481\*\*\* |
| (0.050) | (0.141) | (0.169) | (0.176) | (0.151) | (0.142) | (0.145) | (0.089) | (0.129) |
| Female household head | -0.496\*\*\* | -0.637\*\*\* | -0.151 | -1.159\*\*\* | -0.229 | -0.468\*\*\* | -0.602\*\*\* | -0.466\*\*\* | -0.676\*\*\* |
| (0.064) | (0.150) | (0.164) | (0.176) | (0.149) | (0.158) | (0.165) | (0.094) | (0.137) |
| Household age | -0.008\*\*\* | -0.026\*\*\* | -0.015\*\*\* | -0.016\*\*\* | -0.017\*\*\* | 0.000 | -0.015\*\*\* | -0.010\*\*\* | -0.019\*\*\* |
|  | (0.002) | (0.004) | (0.004) | (0.005) | (0.004) | (0.004) | (0.004) | (0.002) | (0.004) |
| Household size | 0.091\*\*\* | 0.169\*\*\* | 0.205\*\*\* | 0.023 | 0.032 | 0.017 | 0.066\*\* | 0.129\*\*\* | 0.101\*\*\* |
|  | (0.011) | (0.031) | (0.036) | (0.037) | (0.032) | (0.031) | (0.032) | (0.019) | (0.028) |
| lnFarm size | 0.043\* | -0.158\*\* | -0.114 | 0.202\*\* | -0.140\* | -0.003 | 0.124\* | 0.023 | 0.205\*\*\* |
|  | (0.026) | (0.070) | (0.081) | (0.085) | (0.073) | (0.071) | (0.073) | (0.044) | (0.064) |
| urban | 1.044\*\*\* | 1.962\*\*\* | 1.873\*\*\* | 2.068\*\*\* | 2.323\*\*\* | 2.035\*\*\* | 1.561\*\*\* | 1.105\*\*\* | 1.904\*\*\* |
|  | (0.057) | (0.143) | (0.162) | (0.172) | (0.146) | (0.149) | (0.154) | (0.090) | (0.131) |
| Credit | 0.046 | 0.099 | 0.136 | 0.131 | 0.096 | 0.039 | 0.208\*\* | -0.001 | 0.169\* |
|  | (0.033) | (0.095) | (0.114) | (0.118) | (0.101) | (0.096) | (0.097) | (0.059) | (0.087) |
| Extension | 0.063\*\* | 0.089 | 0.250\*\* | 0.205\* | 0.180\* | -0.004 | 0.161\* | 0.120\*\* | 0.022 |
|  | (0.031) | (0.088) | (0.107) | (0.111) | (0.095) | (0.089) | (0.091) | (0.056) | (0.081) |
| Distance to market | -0.008\*\*\* | -0.019\*\*\* | -0.021\*\*\* | -0.029\*\*\* | -0.017\*\*\* | -0.014\*\*\* | -0.027\*\*\* | -0.006\*\*\* | -0.013\*\*\* |
|  | (0.001) | (0.003) | (0.004) | (0.004) | (0.003) | (0.003) | (0.004) | (0.002) | (0.003) |
| Drought | -0.076\*\* | -0.127 | 0.080 | -0.164 | 0.155 | -0.191\*\* | -0.111 | -0.186\*\*\* | -0.251\*\*\* |
|  | (0.031) | (0.089) | (0.107) | (0.111) | (0.095) | (0.089) | (0.091) | (0.056) | (0.082) |
| Floods | 0.078\* | 0.233\* | 0.043 | 0.030 | 0.081 | -0.036 | -0.028 | 0.007 | 0.181 |
|  | (0.042) | (0.120) | (0.145) | (0.150) | (0.129) | (0.121) | (0.123) | (0.075) | (0.110) |
| Rainfall | 0.000\* | 0.001\*\* | 0.001 | -0.000 | -0.001 | -0.000 | 0.000 | -0.000 | 0.000 |
|  | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Temperature | 0.011 | 0.082\*\* | 0.244\*\*\* | -0.017 | -0.020 | -0.010 | 0.020 | -0.005 | 0.002 |
|  | (0.015) | (0.036) | (0.040) | (0.043) | (0.036) | (0.038) | (0.039) | (0.023) | (0.033) |
| Panel year 2013 | 0.943\*\*\* | 1.041\*\*\* | 1.493\*\*\* | 0.300\* | 0.148 | 0.027 | 0.430\*\*\* | 1.251\*\*\* | 0.864\*\*\* |
|  | (0.047) | (0.134) | (0.162) | (0.167) | (0.144) | (0.135) | (0.138) | (0.084) | (0.123) |
| Panel year 2016  | 1.606\*\*\* | 2.042\*\*\* | 1.209\*\*\* | -1.357\*\*\* | 0.177 | 0.329\*\* | 0.640\*\*\* | 1.755\*\*\* | 1.530\*\*\* |
|  | (0.048) | (0.136) | (0.164) | (0.170) | (0.146) | (0.138) | (0.140) | (0.086) | (0.125) |
| Panel year 2019 | 1.491\*\*\* | 1.446\*\*\* | 1.177\*\*\* | -1.160\*\* | 0.701\* | 0.652\* | 0.606\* | 2.073\*\*\* | 1.836\*\*\* |
|  | (0.125) | (0.360) | (0.437) | (0.451) | (0.388) | (0.362) | (0.367) | (0.226) | (0.331) |
| Central region  | -0.023 | 0.193 | 0.013 | 0.090 | 0.197 | 0.048 | -0.655\*\*\* | 0.034 | -0.172 |
|  | (0.073) | (0.176) | (0.195) | (0.208) | (0.176) | (0.185) | (0.192) | (0.111) | (0.161) |
| Southern Africa | -0.052 | 0.157 | -0.212 | -0.178 | 0.198 | -0.217 | -0.625\*\*\* | 0.104 | -0.021 |
|  | (0.077) | (0.184) | (0.203) | (0.217) | (0.184) | (0.194) | (0.202) | (0.116) | (0.169) |
| Constant | 7.523\*\*\* | 4.089\*\*\* | -2.050\*\* | 6.951\*\*\* | 3.319\*\*\* | 1.742\*\* | 5.301\*\*\* | 5.089\*\*\* | 4.176\*\*\* |
|  | (0.316) | (0.770) | (0.859) | (0.916) | (0.778) | (0.809) | (0.838) | (0.485) | (0.707) |
| Observations | 4,068 | 4,068 | 4,068 | 4,068 | 4,068 | 4,068 | 4,068 | 4,068 | 4,068 |
| Number of households | 1,017 | 1,017 | 1,017 | 1,017 | 1,017 | 1,017 | 1,017 | 1,017 | 1,017 |