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Selected Paper No. 6426

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Selected Paper prepared for presentation at the 2015 Agricultural & Applied Economics Association and Western Agricultural Economics Association Annual Meeting, San Francisco, CA, July 26-28

The Effect of Agricultural Diversification and Commercialization on the Anthropometric Outcomes of Children: Evidence from Tanzania

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Preliminary and Incomplete Not for Citation

Abstract

This paper provides evidence of the effect of agricultural diversification and commercialization on the health of preschool children. We use a nationally representative sample of households taken from the Tanzania National Panel Survey (TNPS) to describe the correlations between agricultural diversification and commercialization on child nutrition. We find that engaging in contract farming for producing food crops has a negative effect on both nutritional stunting and wasting. Diversification only has a positive effect on child nutrition for children at the bottom of the nutritional distribution. The effect of commercialization vary by the type of crop produced and the position of children in the nutritional distribution. The results provide insight into the effects of agricultural diversification and commercialization on the household welfare.

JEL codes: I12, I15, Q12, Q18.
Keywords: nutrition, agricultural diversification, commercialization, household welfare.

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Introduction

Many developing countries have embarked on a growth strategy that focuses on increasing agricultural productivity, output diversification and commercialization. In addition to fundamental reforms that aim to create more competitive agricultural market structures, the governments of these countries have also implemented agricultural policies designed to incentivize the transition from subsistence to export agriculture (Pica-Ciamarra, 2011; Harou, 2011). The objective of this growth strategy is to alleviate poverty and to improve the overall well-being of rural households (World Bank, 2008; World Bank, 2009). While these types of strategies appear to be working in the aggregate – national measures of poverty and well-being seem to be improving – little is known about the effect of agricultural diversification and commercialization at the household level (Doward et al., 2004; Dethier and Effenberger, 2012).

This paper examines the effect of crop diversification and commercialization on the household's most vulnerable members – preschool children. Households grow crops as both a food source and to provide income. Over 2.5 billion people, world wide, are in households that generate income from agricultural activities (World Bank, 2008) with most engaging in subsistence or semi-subsistence agricultural production. As such, increasing either the agricultural productivity of these households, or the commercial viability of the crops that these households cultivate can affect child nutrition.

We focus on child nutrition because research suggests that better nutrition in early childhood can improve health, schooling, and labor outcomes in later life (Behrman, 1993; Strauss and Thomas, 1998; Martorell, 1999). Anthropometric measures such as height for age reflect cumulative nutritional deprivation especially in infancy, while weight for height measures current levels of nutritional intake. Anthropomentric measures can then be used to distinguish between children who have experienced long-term malnutrition and those whose malnutrition is more transient (Alderman, Behrman, and Hoddinott, 2005).

To explore how diversification and commercialization affect child nutrition, we use a nationally representative sample of households taken from the Tanzania National Panel Survey (TNPS). Tanzania transitioned to market-oriented policies in the mid-eighties and since 2004 the country has engaged in significant agricultural reforms. According to government assessments, diversification and agricultural productivity growth are occurring in the country at the expense of subsistence agriculture (URT, 2011). More households either switched to crops that they could take to market or they sold crops that prior to the reform were used to sustain their households. Thus, these changes may affect child nutrition in Tanzania households.

There are two channels through which farm level agricultural productivity, or commercial viability of crops produced, can affect child nutrition. First, increased productivity could result in an increase in caloric intake, even if households consume all of the crops produced. Second, alternatively, increased productivity and the commercial viability could results in households selling their crops and raising incomes that can be used to improve welfare, food security and nutritional status by purchasing more and better inputs e.g. more nutritious food, better hygiene, better housing, and health care (Von Braun and Kennedy, 1994; Maxwell and Fernando, 1989). In addition to biological factors, child health is also a function of environmental, household, and community level factors (Mosley and Chen, 1984). Poor sanitary and living conditions can result in increased disease burden for children (e.g. increase incidence of malaria, and gastrointestinal diseases). Since disease and malnutrition tend to be synergistic, if better environmental and household conditions reduce the incidence of disease, child nutritional outcomes will be also be influenced (Scrimshaw, Taylor, and Gordon, 1968).[1] While previous research has shown that there is a positive correlation between income growth and improvements in child nutrition, this finding is not definitive for all countries. As Haddad et al. (2003) notes, some countries have made large strides in improvements in child nutrition without experiencing the expected income growth, while other countries have experienced income growth without the

[1]Haddad et al. (2003) shows that a sustained increase of annual income would reduce in average the fraction of underweight children in average between 27% and 34% in Kenya, Mozambique and South Africa. Alderman, Hoogeveen, and Rossi (2006) also finds that in Kagera, a region in Tanzania, better nutrition is connected with higher income. Other evidence from the World Bank also suggests that farmers who were successfully able to diversify were most likely to transition out of poverty (World Bank, 2008).

congruent improvements in child health.

At the household level, positive income effects from the sale of commercial crops could be attenuated if households are unable to smooth their consumption or to if there is more risk involved in commercial diversification (Sen, 1982). Farming cash crops may be seasonal and households may not be able to smooth consumption during the growing season of the commercial crop. Moreover, increases in income when it comes in one lump sum may not be distributed towards the children within the household. For example Duflo and Udry (2004) find that an increase in crops cultivated by women in Cote d'Ivoire increased household food expenditures while an increase in agricultural output grown by men had mostly no impact. Preliminary evidence from Tanzania suggests that female-headed households participate less in the agricultural value chain (Anderson and Gugerty, 2012). Therefore, policies[2] that focus on improving market access may be more beneficial to male-headed households which may not necessarily use the money from commercial crops to improve household welfare. Findings such as these may be prescient, particularly in countries where female-headed households participate less in agricultural production. Beyond the household allocation decisions, from a food sustainability perspective, there may be more risk involved in commercial diversification. Unfavorable agricultural prices for commercial crops, coupled with a potential reduction of food crops could also lead to food scarcity which would also undermine household food security.

The literature on the effect of commercial agriculture on households is scant, especially when we focus specifically on child nutrition. von Braun (1995) using household data from Guatemala, Philippines, Kenya, Rwanda, Malawai and Gambia, reports no effect on the prevalence of stunting, wasting, or malnutrition. For New Guinea, Rwanda, Sierra Leone, and Zambia, the authors did find positive effects of commercialization.

[2]Policies usually focus on the improvement of production and marketing. Some examples on the former are agricultural research systems and extension services that aim to increase productivity. Examples on the latter are investments in transportation, hard and soft infrastructure for opening new market opportunities and institutional policies such as ensuring legal security as well as providing opportunities to link to integrated value chains for high value products (de Janvry and Sadoulet, 2011; Chamberlin and Jayne, 2013; Von Braun and Kennedy, 1994).

In this paper we characterize households that choose to diversify or to engage in commercial farming and compare them with those that do not. In this way we identify who is most likely to be influenced by government policies designed to increase agricultural productivity and commercialization. Second, we estimate the association between household welfare outcomes and agricultural productivity. We focus on child nutrition as a measure of welfare and we measure agricultural productivity by looking at household level crop diversification, participation in contract farming, and level of farm income.

Preliminary findings suggest that engaging in contract farming for producing food crops has a negative effect on both nutritional stunting and wasting. Diversification only has a positive effect on child nutrition for children at the bottom of the nutritional distribution. The effect of commercialization varies by the type of crop produced and the position of children in the nutritional distribution.

These results inform the general debate on the extent to which expanding and diversifying agricultural productivity affects household welfare, especially preschool children. More specifically, our findings assist the government of Tanzania with evaluating how policy instruments such as fostering contracting schemes with the private sector and their drive to diversify farm productivity will alleviate poverty.

The structure of the paper is as follows. We first present a background on Tanzania and describe the data and methods used; we then present the results and derive some conclusions.

Background Tanzania

Tanzania transitioned to market-oriented policies in the mid-eighties and since 2004 the country has engaged in significant agricultural reforms as part of the Agricultural Sector Development Programme (ASDP). As in many other developing countries, Tanzania is characterized by a dual agricultural economy (URT, 2012a) where some smallholders are able to sell their products to the markets, but most rural households produce in rudimentary conditions and mostly for subsistence. Within this framework, the objective of the ASDP is to transition the agricultural sector from subsistence to export agriculture through a variety of policies(Derksen-Schrock and Anderson, 2011). These policies have the potential to affect three quarters of the total population for whom agriculture is a source of livelihood (World Bank, 2007). The policy instruments include subsidies and initiatives to improve the links between smallholders and markets for their crops (Pica-Ciamarra et al., 2011). From 2007/8 to 2009/10 subsidies for agricultural activities in the form of fertilizers and improved seeds increased sharply(URT, 2012a). At the aggregate level these policies resulted in an increase in agricultural production of 4.2% between 2004 and 2010. In addition to traditional diversification strategies such as subsidies on seed and fertilizer, the government of Tanzania has also fostered contract farming in the private sector. Under these schemes, a private company contracts with a farmer and then the company processes and/or markets the farmer's crop. The contract may also provide the small holder with inputs and technical assistance. As a result of these initiatives agricultural diversification has also increased in Tanzania(URT, 2011).

While diversification may be occurring, government assessments in Tanzania have suggested that the pathway to agricultural productivity growth has come at the expense of subsistence agriculture (URT, 2011). Commercial agriculture has supplanted subsistence agriculture as more households either switched to crops that they could take to market or they sold crops that prior to the reform were used to sustain their households. In this case, a diversification strategy in Tanzania will only be welfare improving if the income gleaned from commercial farming is used to improve the welfare of the household. Research suggests that women invest more in welfare improving activities.

Data and Methods

To explore how diversification affects the household's well-being, we use a nationally representative sample of households taken from the Tanzania National Panel Survey (TNPS). The

TNPS collects data on agricultural output, agricultural inputs, and agricultural contractual arrangements, as well as household data such as anthropometric and educational attainment of all household members including children. Each household was visited twice. The first wave of data was collected during the 2008-09 calendar years, and the second wave was collected in 2010-11. There were 974 households with anthropometric, educational attainment and agricultural diversification measures with children under the age of 5. The final sample is unbalanced and consists of 1,271 child-year observations.[3]

Nutritional Outcomes

We focus on two anthropometric measures in this study. The first, weight for height, is sensitive to short term changes in nutrient intake and disease burden and is a relatively sensitive indicator of transitory nutritional deprivation in children under five years of age (Gibson, 2005). As outlined in Shrimpton et al. (2001), when nutrient intake falls below a child's needs their weight for height can fall below its potential growth path. The second measure, height for age measures the effect of longer term nutritional deprivation. When a child experiences persistent nutritional deprivation their height for age will also fall below its potential growth path.

To form the standardized measure we calculate the z-score for each child for both of the anthropometric outcomes. For example, the weight for height z-score expresses the child's weight for height, y_i, as its difference from the median weight for height of a reference population in 2006, y_{50}, in terms of the standard deviations of the WHO reference population σ_y. See De Onis et al. (2006) for a description of the reference population. If z_i represents the nutritional outcome of interest. The z-score is calculated as $z_i = \frac{y_i - y_{50}}{\sigma_y}$ where y_i, is the anthropometric outcome, y_{50} is the median of the WHO reference population, and σ_y is the standard deviation of the WHO reference population. The WHO reference population was chosen for this study because it may reflect more accurately the genetic and cultural variation experienced

[3]See URT (2012a) and URT (2012b) for a detailed report of the data for both waves.

by Tanzanian children.[4]

Figure 1 shows nonparametric kernel estimates of the probability density functions (PDFs) for the three anthropometric measures that we study in this paper. A close inspection of the graphs show that between 2009 and 2011 height for age Z-scores and weight for age z-scores improved but weight for height did not. These findings are reflected in the mean statistics presented in Table 1. The incidence of stunting and underweight decreased across the two year period while wasting increased from 4.4 % to 6.2 %. This can be seen by examining the left tail of the weight for height distribution.

A closer inspection of the quantiles of the anthropometric distributions presented in Figure 2 show that most of the changes occur at the upper tail of the distribution for height for age and weight for age, and at both the upper and lower tails of the distribution for weight for height Z scores.

Agricultural Measures

To understand how agricultural commercialization affects the nutritional outcomes of preschool children, we focus on household's farm income, product diversification and commercialization.

To measure product diversification we classify all crops into one of the following types: cash crops, exportable fruits and vegetables crops, and food crops. The first type includes traditional cash crops and permanent cash crops following the survey classification; the second type, exportable fruits and vegetables include those that have been exported in the period 2001-2004 (URT, 2004); the third type, food crops include staple crops and other crops that are not included in the other two groups. The list of crops for each group can be found in the Data Appendix. We aggregate all plots owned by a household and obtain a farm size measures that includes the total acres owned or cultivated by each household. We then measure the share of land used to produce each type of crop. Table 1 shows that 93.5 % of land is used to produce

[4]The z-scores were calculated using the igrowup package of Stata programs (World Health Organization and others, 2011). This package uses the WHO reference population published in 2006.

food crops in 2009. Only 5.5% was used for cash crops and 1% for export crops. These numbers were the same in 2011. A household is considered to be diversified if in addition to food crops the household also cultivates cash and or exportable crops. In Table 1 we see that 18.5% of the children in our sample came from households that were diversified. This increased to 19.3% in the 2011 survey. By examining the indicator variables for food, cash and export crops it is evident that most of the increase came from diversification. The individual shares went down so it must be that the number of households diversifying went up albeit only slightly.

Since contracting is an alternative method of encouraging households to diversify we are also interested in the prevalence of contracting. We created two indicator variables for children in household that participated in an outgrower schemes or farm contract. The first indicator is for contract farming for food crops and the second is for cash crops. None of the children households in the sample engaged in any contract farming for exportable fruits and vegetables. Approximately one percent of households engaged in contracts in 2009 and 1.5% in 2011. The percent of children within households who participated in food contracts was even smaller at .2% and only in 2011.

We use the total production per crop and prices to derive the household's farm income. In the survey households report the quantity produced (kg), the estimated value of production (T-shillings), the quantity sold (kg) and the value of the sales (T-shillings) for each crop. We derive the price per kilogram for each crop sold by using the value and quantity of sales. For those households who did not sell a given crop, we use the average price at the district level generated by using the prices derived from those households who sold the crops. We also used individual and average district prices derived from the estimated value of production to substitute for missing prices as well as average district prices collected through a community questionnaire. We use the prices and the total production per crop to calculate the total value of the production per household. We use this value as our measure of total farm income.

Commercialization and Nutritional Outcomes

We are interested in how a household's decision to diversify and to produce commercial crops in addition to traditional food crops affects the nutritional status of preschool child within the household. To cement ideas we start off by assuming that child health is a function of inputs such as food, clothing and medical care, Y, environmental factors such as disease prevalence, access to safe drinking water, availability of health care services, E, and individual observed and unobserved child characteristics, G so that,

$$H = f(Y, E, G). \tag{1}$$

Since out primary focus in this paper is on child nutrition the input Y we focus on is food. The household chooses the share of each type of crop to produce given available land. We argue that the share chosen impacts the amount of food inputs, Y, available to the household because

$$Y = f(T, C, S, N, M), \tag{2}$$

where T is the type of crops grown, C is the amount of each crop consumed, S is the amount of crops sold,N is participation in agricultural contract farming, and M is household income.[5] Substituting for Y and other inputs into the child production function in equation (1) results in a reduced form specification for child health where

$$H = f(T, C, S, N, M, E, G). \tag{3}$$

To implement the above model we assume that child health is a linear function of the above mentioned characteristics. In order to study the effect of commercialization on nutrional outcomes we first start by looking at one measure of commercialization – diversification – and classify the characteristics of households that choose to diversify and those that do not. These

[5]See Rosenzweig and Schultz (1983) and Akin et al. (1992) for child production functions of this type.

results are reported in Table 1. In terms of anthropometric measures, the prevalence of stunting, wasting and underweight was greater in households that did not diversify compared to those that did. In terms of age, sex, and rurality, children from households that diversify and those that did not were observationally equivalent. Children from households who diversified were less likely to have access to safe water, but came from wealthier households (as measured by farm size) and higher income households.

Multivariate Results

The results for three anthropometric measures of interest, height for age, weight for height, and underweight weight for age, are reported in Table 2 to Table 4. Column (1) in each table provides the OLS estimation. Huber White corrected standard errors for repeated child observations are reported. Column (2) reports the child fixed effects regression results. Columns (3) through (6) provides quantile estimations for the 20th percentile, 40th percentile, 60th percentile and 80th percentile respectively. We discuss the results by each measure of nutritional status next.

Results for Stunting

Height for age reflects long-term malnutrition and is a cumulative indicator of slow physical growth (Glewwe, Koch, and Nguyen, 2002). Diseases and the lack of sufficient dietary intake can cause stunting (low height for age). We first analyze the effect on height for age of child individual characteristics. The effect of age suggest a lag in high growth relative to the WHO reference population. This pattern is consistent with past evidence for height for age measures for developing countries (Strauss, 1990). The result may be explained by the termination of breast feeding and transition to solid foods. Estimations for the female dummy are consistently positive across specifications suggesting that female children have better height for age than male children; the effect of being female is stronger for some quantiles of the distribution; being a female is weakly significant for the 20th and 80th percentile, it is strongly significant for the

40th percentile.

The effect of environmental factors is consistent across specifications. Living in a rural area has a negative effect on height for age, specially for the bottom percentile for which the result is significant. This result may be related to the availability of health care services and disease prevalence. As explained earlier there is a synergistic relationship between disease prevalence and undernourishment. To the extent that rural areas have higher incidence of diseases like malaria for example we should expect to see the strongest effect in the lower quantiles of the nutrition distributions. As expected, access to safe water supply has an overall positive effect. The effect is strongly significant in the fixed effect specification and the bottom two percentiles regressions. Children in the bottom of the height for age distribution are likely to belong to poorer households. There is a stonger effect of safe water for children in these poorer households. The interaction between access to safe water supply with the year 2011 is not significant but it is consistently negative across specifications with the exception of the one for the 75th percentile for which the coefficient is positive. The negative coefficient may be explained by the drought that affected Tanzania in 2010/2011. Children in the top of the height for age distribution likely belong to richer households that may not be affected by the drought as they may live in areas where the water supply is more constant. The year 2011 dummy has a positive and significant effect on height for age with the exception of the top percentile estimation.

Farm size has a positive effect on stunting except for the fixed effects specification. However, the effect of farm size is only weakly significant in the 40 percentile regression. On the other hand, farm income has a positive but decreasing effect on stunting. The effect of farm income is only significant in the OLS and the 80 percentile regressions. Children in the higher quantile of the distribution benefit more from increased farm income as they may belong to wealthier households that have made long-term investment in their children nutritional intake.

The percent of land cultivated in cash or export crops and diversification do not significantly affect stunting. The dummy variable indicating whether the household sells food crops is not significant either. However, the coefficient is negative in all specifications with the exception of the quantile estimation for the bottom percentile. This result suggests that selling food crops only has a positive effect on children with the lowest height for age. In contrast, the dummy indicator for household selling cash crops has a positive coefficient in all specifications. The effect is significant on those children at the bottom of the height for age distribution. Selling export crops have a significant and negative effect on height for age in the fixed effects specification but is not significant in the other estimations.

Finally, the effect of contracting depends on whether the contract is for food crops or cash crops. These results are not surprising. Contract farming decreases ex ante the farmer's risk of finding a buyer for his crops once the production decision has been made. In addition, contract farming may provide other benefits such as technical assistance. Once the agreement is made, however, the farmer must fulfil his agreement.

having a contract for growing and selling food crops has a negative effect on height for age. The effect is significant in the OLS regression and at all quantiles reported in Table 3 with the exception of the 60th percentile. Households that engage in contract farming must comply with the contract commitments if they want to enter into future contracts with their trading partner. Failing to fulfill the contract may not only cause the farmer to lose the current buyer for future transactions but also can create a reputation of mistrust for doing business constraining future opportunities for selling crops under contracts. Therefore, a farmer producing under a contract may chose to fulfill the agreement and decrease the supply of food crops for household consumption. This may explain why we find consistently negative effect of contracting on height for age. In contrast to the results for food crops, contracting for cash crops has a positive effect on stunting in most specifications. As explained earlier cash crop could be high value crops like tobacco. Contracting on cash crops may therefore increase the household's income resulting in a positive effect on height for age.

Results for Wasting

Weight for height reflects short-term nutritional problems that can lead to weight loss (Glewwe, Koch, and Nguyen, 2002). Current disease as well, poor diet quality and low food intake currently in the household impact this measure. The child age has a similar effects as for stunting in the OLS, the fixed effects and the 80 percentile estimations. Nevertheless, older children have better weight for height for the 20th, 40th and 60th percentile, although age is only significant for the children at the bottom of the distribution. Female and male children does not have a significantly different weight for height.

Living in a rural area has a negative effect on weight for height, especially for the top two percentiles for which the effect is significant. Access to safe water supply a negative effect on weight for height. The effect is strongly significant in the OLS and the 40th percentile regressions. The interaction of access to safe water supply with the year 2011 is not significant. The year 2011 dummy has a negative and significant effect on weight for height with the exception of the top percentile estimation for which the effect is not significant. The negative effect can be explained by the the drought in Tanzania in 2010/2011. The drought has a stronger effect on those children with lower weight for height as they likely belong to households with lower incomes that cannot substitute own grown food with purchased food.

Farm size has a positive effect on weight for height. The effect is significant at the extremes of the weight for height distribution. More farm land allows for more crop production. On the other hand, farm income has a negative but increasing effect on wasting. The effect of farm income is only significant in the OLS and the 60 percentile regressions. A possible explanation may be that households are spending the farm income in goods that do not improve the current nutritional status of children. Or that the income is not being allocated to purchase food for children in the household.

The percent of land cultivated in cash crops does not significantly affect weight for height. The percent of land cultivated in export crops has a significant and negative effect on the children with the highest wasting status. These households may chose to use the land in the production of export crops substituting away from the production of food crops with high nutritional value. However, children in these households benefit from diversification as the dummy for diversification has a strong and positive effect on wasting of children on this percentile. Engaging in food crops sales has a positive effect on the short-term nutritional status of children. OLS estimate and the 40 percentile estimate are weakly significant. However, engaging on cash/export crop sales has a negative effect, although insignificant.

Contracting for food crop production only has a significant effect on wasting at the top percentiles of the nutritional distribution. The effect is negative suggesting that these households may be decreasing the supply of food crops for household consumption. As in the results for stunting contracting for cash crops has a positive effect on weight for height in all specifications. The OLS estimate is strongly significant as well as the effect on the top percentile of the wasting distribution. Although the results suggest that contract for cash crops has a positive effect on wasting of all children, those with the highest weight for height are the most benefited.

Results for Underweight

Weight for age or underweight can reflect both or either previous measures of nutritional status. We find that older children are more underweight. This result is strongly significant for all specifications and all percentiles of the nutritional distribution. furthermore there is no difference in weight for age between females and males.

The effect of environmental factors is also consistent across specifications. Living in a rural area has a negative and significant effect on weight for age for all children. A combination of lack of health care services availability and disease prevalence explains this result. Overall access to safe water supply, although not significant, has a positive effect on weight for age. The year 2011 dummy is not significant.

Farm size has a positive effect on underweight except for the fixed effects specification. The effect of farm size is strongly significant in the 20th, 40th and 60th percentile regressions but not significant in the top percentile estimation. That is, children with lower weight for age strongly benefit from farm size as they can get more calorie intake from farm production. On the other hand, farm income only has a positive but decreasing effect on underweight of children at the top of the nutritional distribution.

The percent of land cultivated in cash crops is significant and positive in the OLS regression. However, it is not significant in any of the quantile regressions. The percent of land cultivated in export crops is negative and significant for the 80th percentile estimation suggesting that children in this percentile have a negative impact from dedicating land to export crops. The diversification dummy and the indicators for household selling food or cash crops are not significant. However, selling export crops has a significant and negative effect on underweight in the fixed effect specification. This result may be explained by the effect on the lowest percentile, as the estimate is significant and negative. That is, children that have the lowest weight for age are negatively affected by the sales of export crops.

Finally, having a contract for producing food crops has a negative effect on underweight. The effect is significant in the OLS regression and in 40th and 80th quantile regressions. Again, households that engage in contract farming for food crops may be restricting own consumption of these crops to fulfill the contract. As for the previous nutritional measures, contracting for cash crops has a positive effect on underweight. The effect is weakly significant in the OLS specification but strongly significant for the fixed effects and 60th percentile specifications. Contracting for the production of cash crop such as tobacco increases the household's income which has had a significant effect on the nutrition status of the children in the 60th percentile of the weight for age distribution.

Conclusion

Agricultural diversification and commercialization can produce an increase on household incomes. Increased incomes can theoretically improve nutritional status for children in the household. However, diversification and commercialization impose additional risks

We find that children in Tanzania have a lag in height for age relative to the WHO reference population supporting previous evidence from developing countries. Access to safe water supply is important for improving height for age. Children in poorer households have a stronger effect on their nutrition from the availability of safe water supply because it provides better hydration and lower incidence of water borne diseases when transitioning from breast-feed to supplemental foods. Diversification does not have a significant effect on stunting. Selling cash crops only has a positive and significant effect on children with the lowest high for age. However, having a contract for producing and commercialize food crops has a negative effect on stunting while children in households that engage in contracting for cash crops have better measures of hight for age.

Older children have better weight for height for the 20th, 40th and 60th percentile, although age is only significant for the children at the bottom of the distribution. A year 2011 dummy has a negative and significant effect on weight for heigh that maybe explained by the drought that affected Tanzania in 2010/201. The effect was larger and significant for all percentiles of the distribution expect the top one, as they highly depend on own grown food. The percent of land cultivated in export crops has a significant and negative effect on the children with the highest wasting status while these children benefit from significantly from diversification. Engaging in food crops sales has a positive effect on the short-term nutritional status of children while contracting for food crop production only has a significant effect on wasting of the top percentile children. The effect is negative suggesting that these households may be decreasing the supply of food crops for household consumption. Moreover, contracting for cash crops has a positive effect on weight for all children but the results suggest that the children with the highest weight for height are the most benefited.

When looking at underweight, we find that older children have lower weight for age but there is no gender differences. Living in a rural area has also a negative and significant effect on weight for age for all children while overall access to safe water supply, although not significant, has a positive effect. Farm size has a strongly positive effect on underweight for the children in the 20th, 40th and 60th percentile. The percent of land cultivated in cash crops is significant and positive while the percent of land cultivated in export crops is negative and significant but only for the 80th percentile estimation suggesting that children in this percentile have a negative impact from dedicating land to export crops. We do not find any effect of diversification or commercialization of food or cash crops on underweight but selling export crops has a significant and negative effect for the children at the bottom of the distribution. Contracting for food crops has a negative effect on underweight while contracting for cash crops has a positive effect on underweight, specially for those children in the 60th percentile.

References

Akin, J., D. Guilkey, B. Popkin, W. Flieger, J. Briscoe, R. Black, and L. Adair. 1992. "A child health production function estimated from longitudinal data. Cebu Study Team." *Journal of development economics* 38:323.

Alderman, H., J.R. Behrman, and J. Hoddinott. 2005. "Nutrition, malnutrition and economic growth." *Health and economic growth: findings and policy implications*, pp. 169–94.

Alderman, H., H. Hoogeveen, and M. Rossi. 2006. "Reducing child malnutrition in Tanzania. Combined effects of income growth and program interventions." *Economics and Human Biology* 4:1–23.

Anderson, L., and M.K. Gugerty. 2012. "Tanzania National Panel Survey LSM-ISA: Gender." Working paper, EPAR Brief No. 190. Evans School of Public Affairs, University of Washington.

Behrman, J.R. 1993. "The economic rationale for investing in nutrition in developing countries." *World Development* 21:1749–1771.

Chamberlin, J., and T. Jayne. 2013. “Unpacking the Meaning of ’Market Access’: Evidence from Rural Kenya.” *World Development* 41:245–264.

de Janvry, A., and E. Sadoulet. 2011. “Agriculture for development in sub-Saharan Africa: An update.” *African Journal of Agricultural and Resource Economics*, pp. .

De Onis, M., C. Garza, A. Onyango, and R. Martorell. 2006. “WHO child growth standards.” *Acta Paediatr* 95:76–85.

Delgado, C.L. 1995. “Agricultural diversification and export promotion in sub-Saharan Africa.” *Food Policy* 20, 3:225–243.

Derksen-Schrock, K., and L. Anderson. 2011. “Tanzania: Agricultural Sector Overview. EPAR Brief No.” Working paper, Evans School of Public Affairs, University of Washington.

Duflo, E., and C. Udry. 2004. “Intra-household Resource Al- location in Cote dIvoire: Social Norms, Separate Accounts and Consumption Choices.” Unpublished, Working paper 10498, National Bureau of Economic Research.

Gibson, R.S. 2005. *Principles of nutritional assessment*. Oxford University Press.

Glewwe, P., S. Koch, and B.L. Nguyen. 2002. “Child Nutrition, Economic Growth, and the Provision of Health Care in Vietnam in the 1990s Services.” *World bank, POLICY RESEARCH WORKING PAPER*, pp. .

Haddad, L., H. Alderman, S. Appleton, L. Song, and Y. Yohannes. 2003. “Reducing child malnutrition: how far does income growth take us?” *World Bank Econonomic Review* 17:107131.

Martorell, R. 1999. “The nature of child malnutrition and its long-term implications.” *Food & Nutrition Bulletin* 20:288–292.

Maxwell, S., and A. Fernando. 1989. “Cash crops in developing countries: the issues, the facts, the policies.” *World development* 17:1677–1708.

Mosley, W.H., and L.C. Chen. 1984. "An analytical framework for the study of child survival in developing countries." *Population and development review* 10:25–45.

Pica-Ciamarra, U., D. Baker, J. Chassama, M. Fadiga, and L. Nsiima. 2011. "Linking Smallholders to Livestock Markets in Tanzania." Working paper, World Bank, FAO, AU-IBAR, ILRI, Gates Foundation.

Rosenzweig, M.R., and T.P. Schultz. 1983. "Estimating a household production function: Heterogeneity, the demand for health inputs, and their effects on birth weight." *The Journal of Political Economy*, pp. 723–746.

Scrimshaw, N.S., C.E. Taylor, and J.E. Gordon. 1968. "Interactions of nutrition and infection." *Monograph Series. World Health Organization* 57:3.

Sen, A. 1982. *Poverty and famines: an essay on entitlement and deprivation*. Oxford University Press.

Shrimpton, R., C.G. Victora, M. de Onis, R.C. Lima, M. Blössner, and G. Clugston. 2001. "Worldwide timing of growth faltering: implications for nutritional interventions." *Pediatrics* 107:e75–e75.

Strauss, J. 1990. "Households, Communities, and Preschool Children's Nutrition Outcomes: Evidence from Rural Cote d'Ivoire." *Economic Development and Cultural Change*, pp. 231260.

Strauss, J., and D. Thomas. 1998. "Health, nutrition, and economic development." *Journal of economic literature* 36:766–817.

URT. 2004. "Chapter 2: Foreign trade." http://www.kilimo.go.tz/agricultural%20statistics/Basic%20Data%202003-05/Chapter2.pdf.

—. 2011. "The Economic Survey 2010." Working paper, The Ministry of Finance, United Republic of Tanzania. Dar Es Salaam, Tanzania.

—. 2012a. "National Sample Census of Agriculture 2007/08: Smallholder Agriculture. Volume II: Crop Sector-National Report." Working paper.

—. 2012b. "Tanzania National Panel Survey Report - Wave 2, 2010 - 2011." Working paper, National Bureau of Statistics.

von Braun, J. 1995. "Agricultural commercialization:impacts on income and nutrition and implications for policy." *Food Policy* 20, 3:187–202.

Von Braun, J., and E. Kennedy, eds. 1994. *Agricultural Commercialization, Economic Development, and Nutrition*. International Food Policy Research Institute.

World Bank. 2007. "Tanzania: Sustaining and Sharing Economic Growth." Working paper, Country Economic memorandum and Poverty Asssessment, Report No. 39021-TZ.

—. 2008. "World Development Report 2008: Agriculture for Development." Working paper, World Bank.

World Health Organization and others. 2011. "WHO Anthro (version 3.2. 2, January 2011) and macros." *Geneva, Switzerland: World Health Organization*, pp. .

Appendix: Classification of crops in food, cash and exportable.

List of crops classified as food crops Maize, Paddy, Sorghum, Bulrush,Millet, Finger,Millet, Wheat, Barley, Cassava, Sweet Potatoes, Irish potatoes, Yams, Cocoyams, Onions, Ginger, Beans, Cowpeas, Green,gram Chick peas, Bambara nuts, Field peas, Sunflower, Sesame, Groundnut, Soyabeans, Caster seed, Passion Fruit, Avocado, Pomelo, Jack fruit, Durian, Bilimbi, Rambutan, Bread fruit, Malay apple, Star fruit, Custard Apple, God Fruit, Mitobo, Cabbage, Chilies, Amaranths, Pumpkins, Egg Plant, Okra, and Fiwi.

List of crops classified as exportable fruits and vegetables Banana, Mango, Papaw, Orange, Grapefruit, Grape, Mandarin, Guava, Plums, Apples, Pears, Peaches, Lime, Lemon, Plum , Peaches, Tomatoes, Spinach, Carrot , Cucumber , WaterMellon, and Cauliflower.

List of crops classified as cash crops Cotton, Tobacco, Pyrethrum, Jute, Seaweed , Sisal, Coffee, Tea, Cocoa, Rubber, Wattle, Kapok, sugar cane, Cardamom, Tamarind, Cinnamon, Nutmeg, Clove, Black Pepper, Pigeon pea, Pineapple, Palm Oil, Coconut, Cashew nut, Green-Tomato, Monkeybread, Bamboo, Firewood/fodder, Timber, Medicinal plant, and Fence tree.

Appendix of Figures and Tables

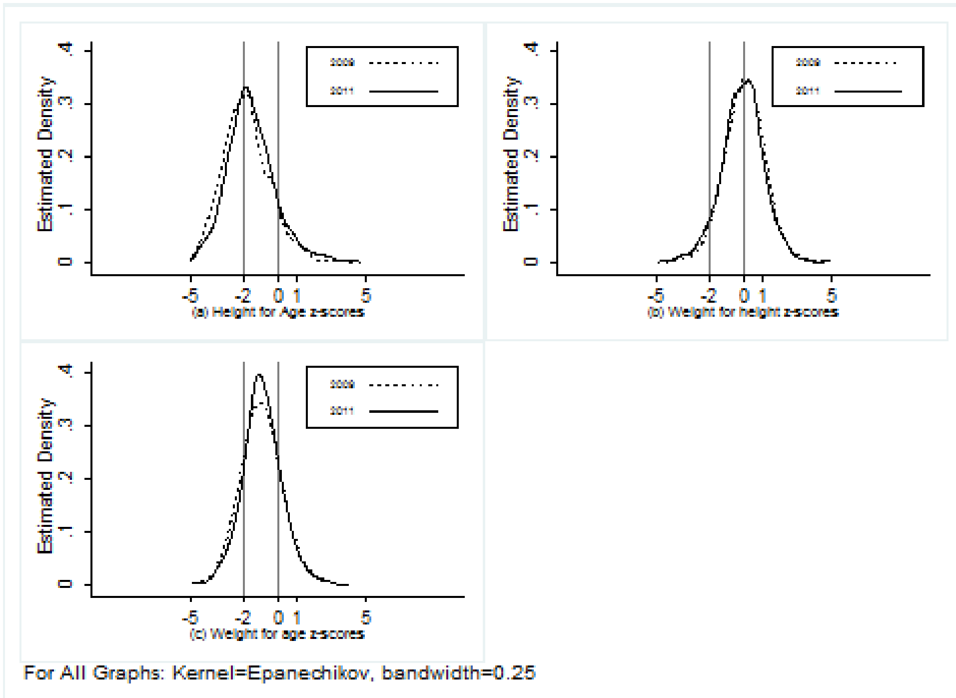

Figure 1: Anthropometric Outcomes for Preschool Children in Tanzania

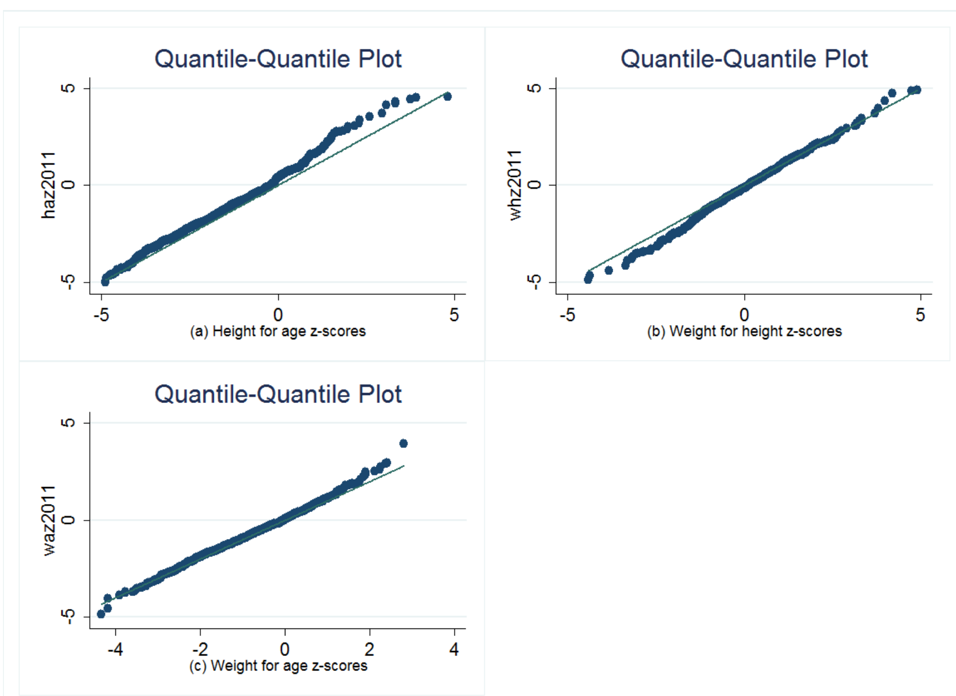

Figure 2: Quantile-Quantile Plots for Anthropometric Measures for Preschool Children in Tanzania

Table 1: Summary Statistics by indicator for diversification

	2009			2011		
	Any	No Other	Other	Any	No Other	Other
Prevalence of stunting	0.459	0.471	0.406	0.380	0.392	0.327
Prevalence of wasting	0.033	0.036	0.020	0.064	0.063	0.065
Prevalence of underweight	0.171	0.181	0.127	0.149	0.152	0.135
Height for age Z score	-1.786	-1.802	-1.712	-1.509	-1.530	-1.422
Weight for age Z score	-0.986	-1.023	-0.823	-0.915	-0.924	-0.877
Weight for height Z score	0.050	0.011	0.222	-0.087	-0.082	-0.111
Age in months	31.992	32.368	30.335	30.149	30.098	30.359
Female Child	0.526	0.528	0.518	0.509	0.522	0.453
Rural Area	0.933	0.931	0.944	0.913	0.913	0.910
Safe Water Supply	0.291	0.297	0.264	0.265	0.279	0.204
Size of farm (acres)	6.915	5.824	11.709	6.971	6.618	8.447
Farm Income in TZS 1,000,000	0.694	0.580	1.195	0.582	0.407	1.314
Indicator variable: also cultivates cash/export crops	0.185	0.000	1.000	0.193	0.000	1.000
Indicator Variable: Household Sells Food Crops	0.607	0.618	0.558	0.605	0.604	0.608
Indicator Variable: Household Sells Cash Crops	0.283	0.171	0.777	0.126	0.000	0.653
Indicator Variable: Household Sells Export Crops	0.203	0.189	0.264	0.026	0.000	0.135
% of land cultivated in cash crops	0.055	0.000	0.294	0.050	0.000	0.261
% of land cultivated in export crops	0.010	0.000	0.053	0.009	0.000	0.046
Contract for food crop	0.000	0.000	0.000	0.002	0.002	0.000
Contract for cash crop	0.017	0.007	0.061	0.015	0.000	0.078

Column headings can be interpreted as follows: Any means any type of crop cultivated; No Other means only food crops grown; Other means food and/or export or cash crops grown.

Table 2: Regression Results: Height for Age

	(1)	(2)	(3)	(4)	(5)	(6)
Age of child in months	−0.095*	−0.062*	−0.060*	−0.085*	−0.103*	−0.117*
	(0.0071)	(0.0068)	(0.0072)	(0.0068)	(0.0095)	(0.0097)
Age squared	0.001*	0.001*	0.001*	0.001*	0.001*	0.002*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)
Female Child	0.087	0.054	0.118+	0.139*	0.112	0.143+
	(0.0631)	(0.4956)	(0.0623)	(0.0569)	(0.0782)	(0.0793)
Rural Area	−0.140	−0.155	−0.262*	−0.149	−0.149	−0.014
	(0.1119)	(0.2353)	(0.1170)	(0.1079)	(0.1474)	(0.1501)
Fixed effect for year (2011)	0.238*		0.373*	0.326*	0.233*	0.149
	(0.0669)		(0.0799)	(0.0723)	(0.0999)	(0.1030)
Safe Water Supply in 2011	−0.024		−0.190	−0.122	−0.014	0.169
	(0.1193)		(0.1400)	(0.1278)	(0.1759)	(0.1795)
Safe Water Supply	0.106	0.270*	0.296*	0.199*	0.086	0.024
	(0.0908)	(0.1172)	(0.1031)	(0.0940)	(0.1300)	(0.1343)
Size of farm (acres)	0.002	−0.005	0.001	0.002+	0.001	0.000
	(0.0012)	(0.0065)	(0.0012)	(0.0012)	(0.0014)	(0.0013)
Farm Income in TZS 1,000,000	0.087*	0.025	0.027	0.012	0.058	0.114*
	(0.0434)	(0.0517)	(0.0503)	(0.0403)	(0.0521)	(0.0445)
Farm Income Squared	−0.001+	−0.000	−0.000	−0.000	−0.001	−0.002*
	(0.0007)	(0.0009)	(0.0009)	(0.0007)	(0.0010)	(0.0008)
% of land cultivated in cash crops	0.424	−0.293	−0.124	0.338	0.321	0.360
	(0.3034)	(0.4219)	(0.4239)	(0.3595)	(0.4799)	(0.4585)
% of land cultivated in export crops	0.335	0.018	−0.036	−0.301	−0.358	0.513
	(0.5257)	(0.5606)	(0.5841)	(0.4448)	(0.6462)	(0.6758)
Indicator variable:						
also cultivates cash/export crops	−0.149	0.124	0.030	−0.021	−0.070	−0.229
	(0.1266)	(0.1748)	(0.1622)	(0.1407)	(0.1886)	(0.1827)
	(0.5257)	(0.5606)	(0.5841)	(0.4448)	(0.6462)	(0.6758)
Household Sells Food Crops	−0.003	−0.010	0.073	−0.005	−0.012	−0.033
	(0.0618)	(0.0867)	(0.0676)	(0.0612)	(0.0833)	(0.0835)
Household Sells Cash Crops	0.080	0.109	0.287*	0.126	0.125	0.024
	(0.0967)	(0.1288)	(0.1157)	(0.1062)	(0.1401)	(0.1366)
Household Sells Export Crops	−0.103	−0.238+	−0.011	0.009	−0.028	−0.098
	(0.1018)	(0.1287)	(0.1172)	(0.1047)	(0.1444)	(0.1504)
Contract for food crop	−1.263*	0.000	−0.650+	−1.339*	−1.064	−2.018*
	(0.3618)	(.)	(0.3830)	(0.5633)	(0.7746)	(0.4877)
Contract for cash crop	0.139	0.370	0.265	0.007	−0.058	0.229
	(0.2677)	(0.2654)	(0.2558)	(0.2354)	(0.3196)	(0.3243)
Constant	−0.497*	−0.904*	−2.240*	−1.149*	−0.156	0.781*
	(0.1673)	(0.3627)	(0.1689)	(0.1547)	(0.2126)	(0.2188)
R-squared	0.094	−2.738				
N	2335	1064	2335	2335	2335	2335

Notes: Dependent variable is height for age relative to the WHO reference population. Regressions are presented as follows: (1) OLS regression, (2) Fixed effects regression, (3) Quantile regression (20 percentile), (4) Quantile regression (40 percentile), (5) Quantile regression (60 percentile), (6) Quantile regression (80 percentile). Huber White corrected standard errors for repeated child observations in parentheses in OLS regression. Standard errors reported in parentheses. Significance level of the estimate: + at 10% level and * at 5% level.

Table 3: Regression Results: Weight for Height

	(1)	(2)	(3)	(4)	(5)	(6)
Age of child in months	−0.001	−0.018*	0.024*	0.009	0.009	−0.011
	(0.0069)	(0.0079)	(0.0077)	(0.0075)	(0.0061)	(0.0077)
Age squared	−0.000	0.000	−0.000*	−0.000	−0.000*	0.000
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Female Child	−0.021	−0.077	0.006	0.074	−0.008	−0.030
	(0.0531)	(0.5723)	(0.0668)	(0.0634)	(0.0500)	(0.0605)
Rural Area	−0.208*	0.039	−0.123	−0.164	−0.169+	−0.251*
	(0.0945)	(0.2717)	(0.1273)	(0.1195)	(0.0946)	(0.1149)
Fixed effect for year (2011)	−0.195*		−0.228*	−0.231*	−0.128*	−0.081
	(0.0598)		(0.0855)	(0.0807)	(0.0638)	(0.0770)
Safe Water Supply in 2011	0.093		0.159	0.226	0.036	0.162
	(0.1000)		(0.1501)	(0.1425)	(0.1123)	(0.1353)
Safe Water Supply	−0.148*	−0.030	−0.134	−0.245*	−0.074	−0.134
	(0.0730)	(0.1353)	(0.1106)	(0.1047)	(0.0830)	(0.0998)
Size of farm (acres)	0.003+	0.000	0.003*	0.002	0.001	0.004+
	(0.0013)	(0.0076)	(0.0010)	(0.0011)	(0.0011)	(0.0019)
Farm Income in TZS 1,000,000	−0.085+	−0.081	−0.074	−0.041	−0.074*	−0.049
	(0.0435)	(0.0597)	(0.0505)	(0.0435)	(0.0344)	(0.0433)
Farm Income Squared	0.002*	0.001	0.001	0.001	0.001+	0.001
	(0.0007)	(0.0010)	(0.0009)	(0.0008)	(0.0006)	(0.0008)
% of land cultivated in cash crops	0.259	−0.173	−0.442	0.014	−0.014	−0.090
	(0.2907)	(0.4872)	(0.4141)	(0.3898)	(0.3105)	(0.3897)
% of land cultivated in export crops	−0.436	0.035	−1.480*	−0.917+	−0.110	−0.074
	(0.3791)	(0.6474)	(0.4055)	(0.5117)	(0.4326)	(0.4633)
Indicator variable: also cultivates cash/export crops	0.059	0.089	0.457*	0.176	0.143	−0.044
	(0.1133)	(0.2018)	(0.1564)	(0.1542)	(0.1231)	(0.1558)
Household Sells Food Crops	0.099+	0.054	0.084	0.123+	0.063	0.057
	(0.0549)	(0.1002)	(0.0723)	(0.0679)	(0.0534)	(0.0646)
Household Sells Cash Crops	−0.008	−0.120	−0.005	−0.077	−0.023	0.067
	(0.0886)	(0.1488)	(0.1236)	(0.1154)	(0.0919)	(0.1132)
Household Sells Export Crops	−0.086	−0.159	−0.170	−0.073	−0.090	−0.091
	(0.0877)	(0.1487)	(0.1221)	(0.1166)	(0.0922)	(0.1098)
Contract for food crop	−0.129	0.000	0.457	−0.242	0.013	−0.856*
	(0.3025)	(.)	(0.4112)	(0.6273)	(0.4952)	(0.3734)
Contract for cash crop	0.385*	0.464	0.398	0.303	0.318	0.587*
	(0.1808)	(0.3064)	(0.2771)	(0.2626)	(0.2029)	(0.2479)
Constant	0.352*	0.435	−1.120*	−0.149	0.518*	1.496*
	(0.1533)	(0.4189)	(0.1766)	(0.1700)	(0.1382)	(0.1734)
R-squared	0.011	−3.319				
N	2335	1064	2335	2335	2335	2335

Notes: Dependent variable is weight for height relative to the WHO reference population. Regressions are presented as follows: (1) OLS regression. (2) Fixed effects regression, (3) Quantile regression (20 percentile), (4) Quantile regression (40 percentile), (5) Quantile regression (60 percentile), (6) Quantile regression (80 percentile). Huber White corrected standard errors for repeated child observations in parentheses in OLS regression. Standard errors reported in parentheses. Significance level of the estimate: + at 10% level and * at 5% level.

Table 4: Regression Results: Weight for Age

Dependent variable: waz06	(1)	(2)	(3)	(4)	(5)	(6)
Age of child in months	−0.041*	−0.037*	−0.036*	−0.035*	−0.045*	−0.047*
	(0.0054)	(0.0056)	(0.0081)	(0.0067)	(0.0062)	(0.0080)
Age squared	0.000*	0.000*	0.001*	0.000*	0.001*	0.000*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Female Child	0.010	−0.053	−0.022	−0.007	0.034	−0.006
	(0.0498)	(0.4043)	(0.0696)	(0.0566)	(0.0513)	(0.0643)
Rural Area	−0.239*	−0.063	−0.336*	−0.292*	−0.314*	−0.205+
	(0.0928)	(0.1919)	(0.1331)	(0.1060)	(0.0962)	(0.1173)
Fixed effect for year (2011)	0.014		0.125	−0.006	−0.009	−0.011
	(0.0505)		(0.0878)	(0.0720)	(0.0656)	(0.0835)
Safe Water Supply in 2011	0.049		−0.122	0.102	0.051	0.233
	(0.0904)		(0.1567)	(0.1275)	(0.1154)	(0.1449)
Safe Water Supply	−0.033	0.127	0.142	−0.059	−0.021	−0.176
	(0.0701)	(0.0956)	(0.1144)	(0.0937)	(0.0855)	(0.1074)
Size of farm (acres)	0.003*	−0.004	0.003*	0.002*	0.003*	0.001
	(0.0009)	(0.0053)	(0.0011)	(0.0010)	(0.0013)	(0.0013)
Farm Income in TZS 1,000,000	−0.013	−0.049	−0.046	−0.057	−0.016	0.077*
	(0.0351)	(0.0422)	(0.0534)	(0.0384)	(0.0321)	(0.0364)
Farm Income Squared	0.000	0.001	0.001	0.001+	0.000	−0.001*
	(0.0006)	(0.0007)	(0.0009)	(0.0007)	(0.0006)	(0.0006)
% of land cultivated in cash crops	0.454+	−0.320	0.308	0.362	0.149	0.166
	(0.2622)	(0.3441)	(0.4391)	(0.3636)	(0.3219)	(0.3930)
% of land cultivated in export crops	−0.087	0.024	−0.070	−0.024	−0.733+	−0.644
	(0.4438)	(0.4573)	(0.5424)	(0.5073)	(0.4112)	(0.5567)
Indicator variable: also cultivates cash/export crops	−0.051	0.122	−0.016	0.029	0.120	0.032
	(0.1037)	(0.1426)	(0.1639)	(0.1402)	(0.1252)	(0.1561)
Household Sells Food Crops	0.064	0.035	0.071	0.078	−0.031	−0.012
	(0.0489)	(0.0708)	(0.0757)	(0.0608)	(0.0545)	(0.0680)
Household Sells Cash Crops	0.046	0.019	0.167	0.039	−0.047	−0.026
	(0.0793)	(0.1051)	(0.1288)	(0.1050)	(0.0929)	(0.1111)
Household Sells Export Crops	−0.107	−0.216*	−0.215+	−0.029	0.054	−0.037
	(0.0868)	(0.1050)	(0.1288)	(0.1045)	(0.0953)	(0.1187)
Contract for food crop	−0.814*	0.000	−0.330	−0.945+	−0.641	−1.428*
	(0.2929)	(.)	(0.4295)	(0.5609)	(0.5091)	(0.3959)
Contract for cash crop	0.309+	0.488*	0.171	0.262	0.476*	0.351
	(0.1744)	(0.2165)	(0.2890)	(0.2352)	(0.2100)	(0.2594)
Constant	−0.129	−0.268	−1.156*	−0.434*	0.286*	0.979*
	(0.1322)	(0.2959)	(0.1873)	(0.1518)	(0.1408)	(0.1766)
R-squared	0.051	−3.006				
N	2335	1064	2335	2335	2335	2335

Notes: Dependent variable is weight for age relative to the WHO reference population. Regressions are presented as follows: (1) OLS regression. (2) Fixed effects regression, (3) Quantile regression (20 percentile), (4) Quantile regression (40 percentile), (5) Quantile regression (60 percentile), (6) Quantile regression (80 percentile). Huber White corrected standard errors for repeated child observations in parentheses in OLS regression. Standard errors reported in parentheses. Significance level of the estimate: + at 10% level and * at 5% level.