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The fate of Zimbabwe's children:
Insights from changes in nutrition outcomes, 1999 - 2006

by

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About the Author(s) and Acknowledgments

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The fate of Zimbabwe's children: Insights from changes in nutrition outcomes, 1999-2006

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Abstract

The economic situation in Zimbabwe deteriorated significantly between 2000 and 2009. However, little empirical effort has been directed towards analysing changes in outcomes at micro levels during this challenging period. This paper therefore investigates changes in welfare during this period, with specific reference to child health outcomes. In addition to using height and weight for age as proxies for welfare, the analysis further overcomes the absence of consumption data expenditure by using a food variety score to proxy for access to food and an asset index based on principal component analysis to provide an alternative for economic ranking. Results from a comparative analysis of the 1999 and 2005/6 DHS data show that average height and weight for age z-scores for children aged 5 years or under worsened by 19% and 16% respectively while food consumption declined by 34%. These declines were across the entire wealth distribution but were more pronounced among children in middle quartile and the poorest households, but least for the rich. Multivariate regressions of height and weight for age show that a large part of their decline between 1999 and 2005/06 is explained by the deterioration in access to food over this period. Oaxaca-Blinder decompositions show that deterioration in access to food explains half the overall decline in mean height for age.

KEYWORDS: Zimbabwe, Africa, Nutrition, Stunting, Food Variety Score, Diet Diversity Score, Height for age, Weight for age

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1 Introduction

The Zimbabwean per capita income shrunk at an annual average rate of 5.7% between 2000 and 2008, implying a decline in GDP per capita of more than 60% during this period (World Bank, 2010). Inflation rose to reach 200 million in 2008 when the last estimates before dollarization were released (CSO, 2008). Food shortages became widespread in specific periods while service delivery crumbled. While the macroeconomic trends are well known, little empirical investigation has been directed at tracking socioeconomic outcomes at a micro level to quantify changes in aspects that are intrinsically important for human life. For this reason, this paper seeks to investigate the changes in child health outcomes in Zimbabwe to make a quantitative assessment of the change in welfare during this period.

The absence of household survey data with consumption expenditure before 2009 might have limited opportunities for a quantitative investigation in changes in welfare at a micro level. The only household survey with expenditure data between 1999 and 2008 was in 2001 when the economic situation was beginning to change. Even if household consumption expenditure data were available, the high rates of inflation post 1999 would have rendered any consumption expenditure data collected incomparable across households interviewed in separate weeks within the same survey. Therefore, the paper provides an alternative to assessing welfare changes when expenditure data is not usable or available by using a food variety score as an alternative proxy for consumption and children's height and weight for age as preferred measures of welfare. Variations of the food variety score are known to be highly correlated with nutritional intake in developing countries (see Hatloy et al. 1998, Steyn et al. 2006, Moursi et al. 2008). The anthropometric measures are objectively measured and directly measure capability deprivation (see Wagstaff, at.al. 2003, Pradhan, Sahn & Younger 2003, Sahn & Younger 2005), unlike expenditure whose measurement is subject to errors and is only instrumentally important in human welfare.

The particular focus on health outcomes is further motivated by three major reasons. Firstly, health is a direct measure of well-being and functionings (Sahn & Younger 2005, Sahn & Stifel 2003). Unlike income or expenditure, health outcomes adequately capture the notion of poverty as deprivation of capabilities or failure of certain functionings (Sen 1987). Secondly, health achievements largely influence people's ability to exercise most other freedoms and capabilities. Stunted infants have lower brain development and lower rates of human capital accumulation for example. Last but not least, analysis of health outcomes is materially relevant if caused by changes in economic policy (Sen 2002) as arguably the case with Zimbabwe post 1999.

A comparative analysis of the 1999 and 2005/06 DHS data for Zimbabwe points to a significant deterioration in welfare over this period. The average number of food items consumed by children declined by 34%. The decline occurred across all wealth quartiles but it was greater for children living in households in the poorest and middle wealth quartiles and least for children in the richest quartile. Both means of height for age and weight for age declined significantly. Mean height for age declined by 19%. Its decline was greatest in the middle quartiles. Mean weight for age declined by 16% with the highest decline occurring among the poorest and second poorest wealth quartiles. The analysis rules out demographic changes or increases in the burden of disease as potential causes for the decline in height and weight for age because they did not change significantly and in some cases actually improved.

A large portion of the decline in mean height for age and weight for age is instead explained by the decline in food consumption after the year 1999. The coefficient of the food variety score is positive and significant in both height and weight for age regressions in 1999 and 2005/06. Its magnitude implies the decline in mean food consumption reduced means of height and weight for age by 37% and 59% of their average changes. One possible explanation for this deterioration in access to food is that distortive economic policies created shortages which inhibited access to basic commodities for the poor while rent seeking opportunities they generated redistributed resources in favor of the wealthy and the well connected.

This paper is organized as follows: Sections two and three empirically assess changes in food consumption and health outcomes after the economic decline that started in the year 2000. Section 2 introduces the data and focuses on measurement of changes in food consumption and health outcomes. Section 3 then investigates the contribution of changes in food consumption on changes in health outcomes. Section 4 discusses the findings of the analysis and section 5 concludes the paper.

2 Measuring changes in food consumption, wealth and health outcomes after the policy shift

The economic situation in Zimbabwe started unraveling in 2000. The year 1999 is therefore taken as a point of reference to analyse changes in food consumption and child health outcomes from their 1999 levels. However, such a comparative analysis requires using comparable 1999 and post 1999 samples so that real changes instead of measurement changes are captured and caution must be taken in any attempt to attribute causal relationships to any of the observed changes.

2.1 Data and measurement of variables

DHS data for the 1999 and 2005/06 surveys is used for the analysis. From each survey, only children aged 5 years and under are selected. This gives sample sizes of 3892 from the 1999 DHS and 5943 from the 2005/06 DHS. Restricting the sample to 5 year olds or less ensures that only children born after 1999 are included in the 2005/06 sample. This facilitates a distinct comparison of health outcomes for the two periods. Measures from the 1999 DHS data reflect the state of outcomes just before the economic situation deteriorated while outcomes from the 2005/06 DHS data will reflect the state of outcomes five years into the economic decline.

However, this comparative analysis is valid only if the two samples are comparable or if differences can be controlled for, as is the case with these samples. The DHS data was collected consistently for the two surveys while summary statistics presented in Table A1 in the appendix show similar geographic and demographic compositions in the two samples. The age profile of the households and fertility rates are similar across the two samples. For example, in 2005 about 12% of household members in urban areas are aged between 5-9 while the same cohort in 1999, constituted 13%. Other similarities can be observed in the household proportions of 0 - 4 age in both rural (15% in 2005/06 against 14% in 1999) and urban areas (12% in 2005/06 against 13% in 1999) The 15 - 49 fertility rate in 2005 is 3.8 which is close to the 1999 rate of 4. Equally similar are crude birth rates which at 31 births per 1000 population are equal and the general fertility rate which only differs by 3 live births per 1000 females (137 in 2005/06 sample vs 141 in the 1999 sample). The mean number of children ever born and mean children living are within the same range. These similarities permit a comparative analysis using these two surveys.

Measures for child health outcomes

The assessment of changes in health outcomes is based on height for age z-scores (HAZ) and weight for age z-scores (WAZ) using WHO growth standards. Anthropometric measures are widely used and preferred because of their objectivity (see Wagstaff, at.al. 2003, Pradhan, Sahn & Younger 2003, Sahn & Younger 2005). They do not have self reporting errors while measurement errors are likely to be random. Children's HAZ and WAZ have an additional advantage in that the distribution of healthy children's height is invariant to ethnic and racial differences (Habitch et al. 1974), unlike that of adults which is also sensitive to childhood health shocks.

The mean HAZ and WAZ are respectively -1.17 and -0.61 in 1999 and -1.36 and -0.69 in 2005/06. A negative/positive z-score implies that a child is below/above the median of the distribution of healthy children. Therefore, negative mean HAZ and WAZ indicate that Zimbabwean children are below the reference child growth standards on average. The averages for 2005/06 are statistically significantly lower than corresponding averages in 1999. Using -2 standard deviations as the height/weight poverty line, the prevalence of stunting increased from 32.6% in 1999 to 34.1% in 2005/06 and the prevalence of underweight children increased from 12.1% to 13.9%. These statistics show worsening health among children in Zimbabwe.

Food consumption index

Consumption expenditure is not captured in DHS data. Therefore, a food variety score shall be used as a proxy of food consumption. The score is constructed by summing up 11 food items consumed by the child, basing on responses to questions on consumption of specific food items in the DHS. Among selected food items are consumption of legumes, vegetables, meat, vitamin A fruits, other fruits, grains, cereals and milk products. The constructed food variety score for 1999 has a mean of 3.41, mode of 4 and lower and upper quartiles of 2 and 5 respectively. In 2005/06 the mean is 2.24, mode is 1 and lower and upper quartiles are 1 and 3 respectively. These are lower than the corresponding food consumption mean and quartiles for 1999. A weakness of using this proxy is that DHS food consumption data is recall rather than concurrent data. This could overstate changes in the index across time if recall periods differ substantially, which is not the case in this study. Nevertheless, the fact should be kept in mind when analyzing the data.

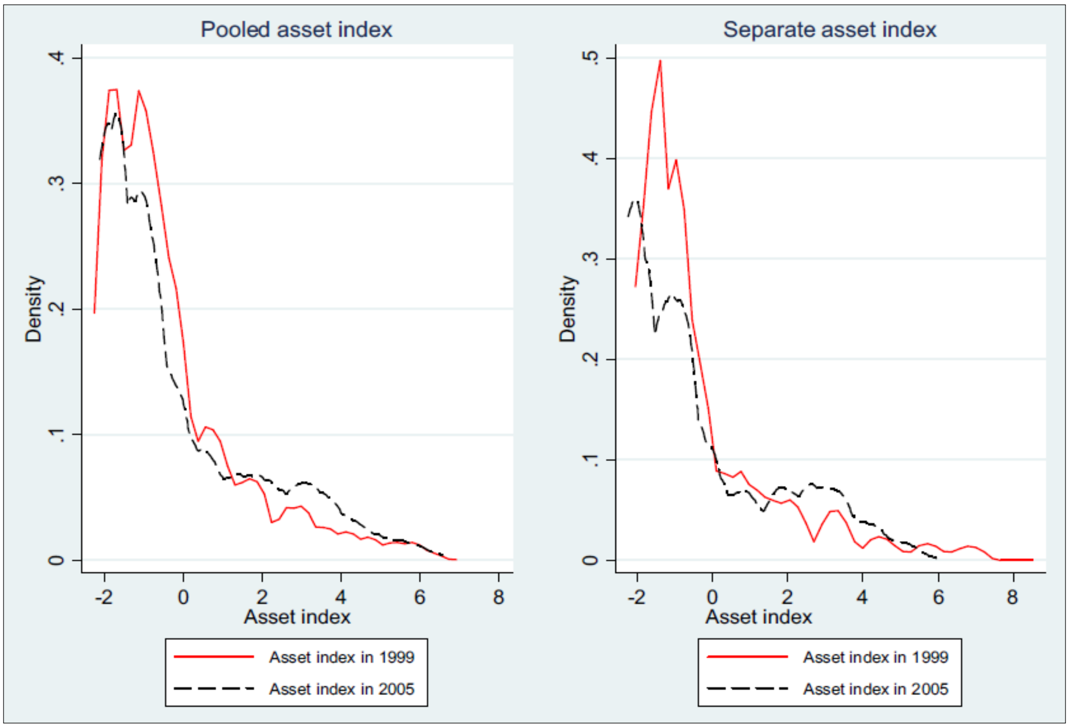
Variations of similarly constructed measures, namely the dietary diversity index and the food variety index, have been widely used in the literature and found to be positively correlated with greater intake of nutrients in developing countries (see Hatloy et al. 1998, Steyn et al. 2006, Moursi et al. 2008). Using DHS data from 11 developing countries including Zimbabwe, Arimond & Ruel (2004) found a positive association between the dietary diversity index and HAZ even after controlling for socioeconomic status. They concluded that the index has an effect on HAZ that is independent of wealth. Their results show that changes in the index had the greatest impact on mean HAZ among children in Zimbabwe. This provides a rationale for using this index in this analysis.

Measuring wealth from asset ownership variables

This analysis will make comparisons in changes in HAZ and WAZ at different points of the wealth distribution but this would require income or expenditure information which is not available from the DHS. The DHS contains information on asset ownership however. Thus following past literature (Vyas & Kumaranayake 2006, McKenzie 2005, Filmer & Pritchett 2001), this information is used to extract a proxy for wealth using principal component analysis (PCA). In this case, the first principal component extracted from asset ownership variables is used to proxy for household wealth. Filmer & Pritchett (2001) used data for Pakistan, Indonesia and Nepal, to show that an asset index derived from PCA produces internally coherent results that are consistent with those based on expenditure data. More support for use of the asset based index is provided by Sahn & Stifel (2003) who also find that an asset index derived from PCA is a good predictor of stunting among children.

Assets used to compute this index include durables like television, radio, refrigerator, motorcycle/scooter, oxcart and car. These are combined with housing characteristics like the type of the main floor material, the type of fuel used for cooking, ownership of bed nets, whether the household shares a toilet with other households and number of households the toilet is shared with. From these, two indices are computed. The first asset index is computed with pooled data over the two surveys so that the same metric of welfare is used in both years. This pooling imposes equal weighting of assets in the two periods. However, technology and economic development introduce new assets and change the importance of some of the existing assets. Therefore, a year specific asset index is also computed but using common assets over the two samples. Unless stated, this is the principal index used in the analysis in this paper while the pooled index is used for robustness checks. Figure 1 shows the distribution of the year specific index over the two periods. A tabulation of asset ownership by asset index quartile presented in Table A2 shows the internal coherence of the computed index.

Figure 1. The distribution of the asset indices over the two samples



2.2 Results

Figures 2 and 3 show the cumulative distributions of HAZ and WAZ in 1999 and 2005/06. Both graphs show a first order stochastic dominance of the distributions of height and weight for in 1999 when compared to 2005/06. This indicates an unambiguous decline in these outcomes across the board in 2005/06. It implies a decline in welfare in 2005/06. The deterioration is more apparent for height for age.

Figure 2. The distribution of the food indices over the two samples

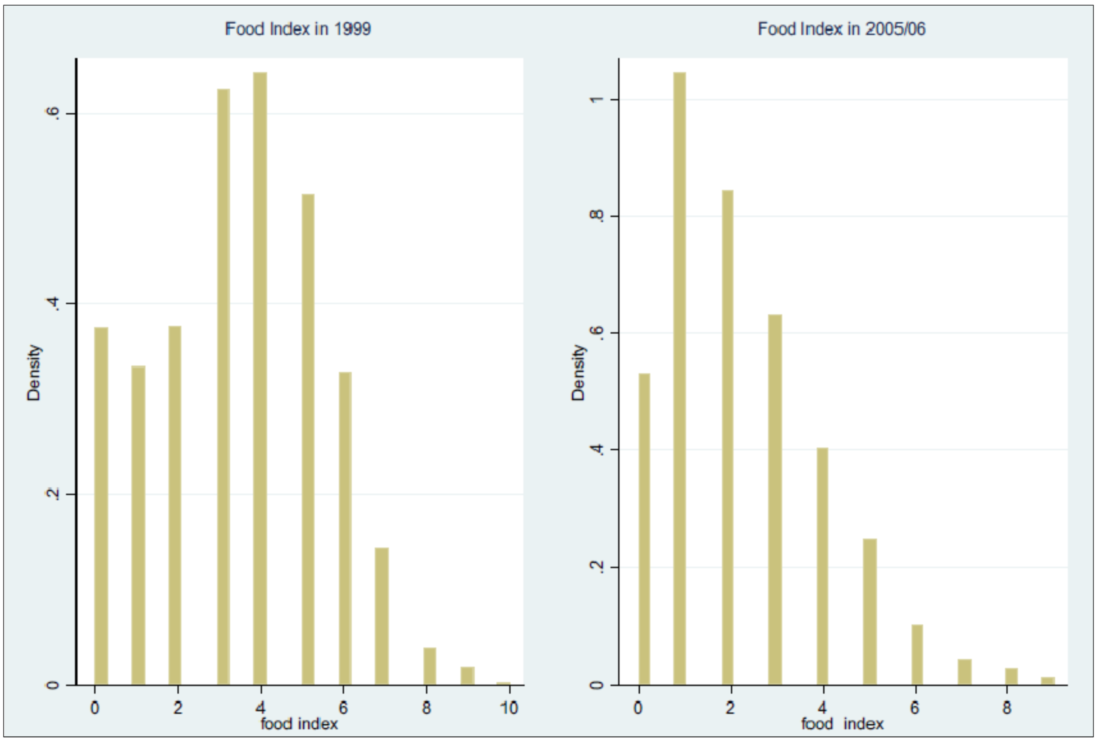


Figure 3. Comparison of height for age, 1999 and 2005/06

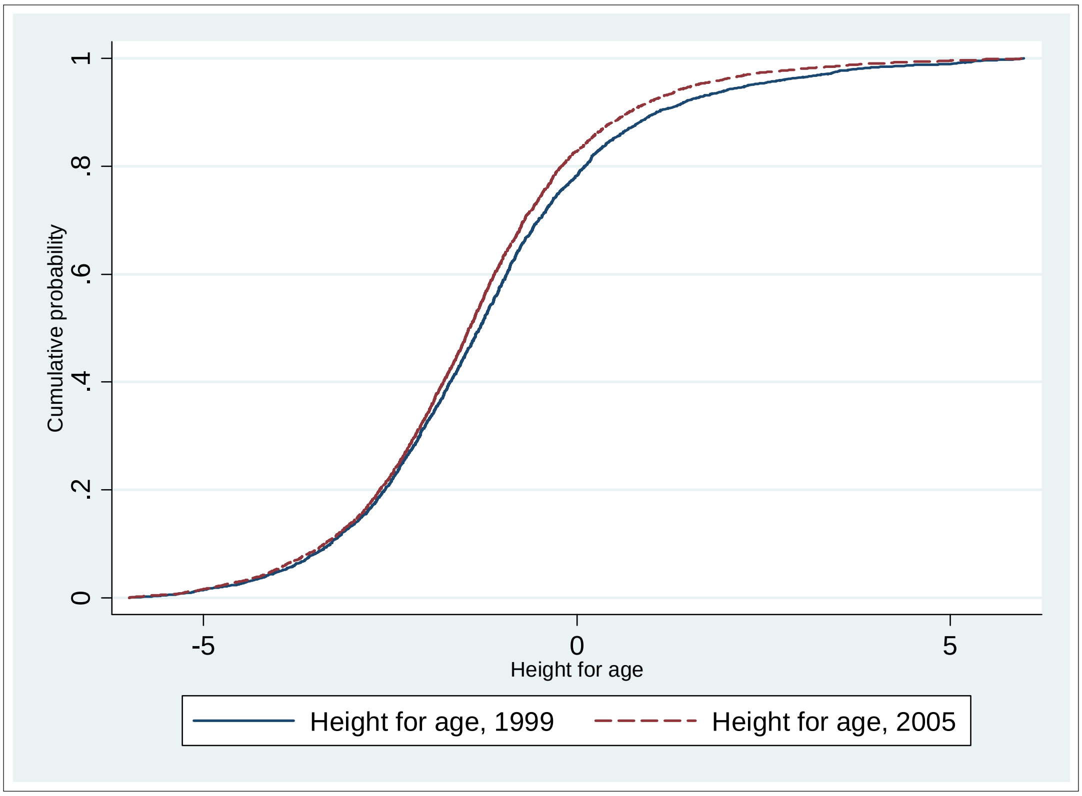


Table 1 presents means of the food variety score, HAZ and WAZ by asset quartiles. Food consumption declined from an average of 3.41 items in 1999 to 2.24 items in 2005/06. This translates to a 34.1% decline in items consumed. This decline cuts across all asset quartiles but was substantially lower for children in the richest quartile, both in absolute and proportionate terms. Those in the middle quartiles experienced the largest declines. In both samples, children in richer asset quartiles consumed more food items than children in poorer quartiles. Thus the impact of the decline in food consumption should be more severe on the poorer children. Asset quartiles were held at their 1999 values for calculating means for 2005/06 sample. Similar patterns are observed when the 2005/06 asset quartiles are used.

Table 1. Means of food index, HAZ and WAZ by asset quartiles

	Food Index			HAZ			WAZ		
Asset Range	1999	2005	%Δ	1999	2005	%Δ	1999	2005	%Δ
poorest 25 %	2.76	1.67	-39.49	-1.38	-1.49	-7.79	-0.83	-0.95	-14.46
26 - 50 %	3.15	2.04	-35.24	-1.18	-1.36	-15.25	-0.69	-0.81	-17.39
51 - 75 %	3.55	2.21	-37.75	-1.09	-1.41	-29.36	-0.55	-0.60	-9.09
richest 25%	4.23	3.23	-23.64	-0.97	-1.16	-19.59	-0.32	-0.36	-12.50
All	3.41	2.24	-34.12	-1.17	-1.36	-16.52	-0.61	-0.69	-13.11

Stunting and wasting increased, mirroring changes in food consumption. Mean HAZ and WAZ declined between 1999 and 2005/06 for all levels of wealth. Mean HAZ declined by 16.5% from -1.17 to -1.36 standard deviations from the median of the reference healthy children. Mean WAZ declined by 13.1% from -0.61 to -0.70. Generally, mean HAZ and WAZ remained higher for children in richer quartiles. The only exception is mean HAZ in the 3rd asset quartile which was lower than mean HAZ in the 2nd quartile in 2005/06. Mean HAZ in this quartile had the largest decline both in absolute terms (decline by 0.32) and relative terms (decline of 29.3%). Mean food consumption for this quartile had the largest absolute decline too. The lowest decline was in mean HAZ of the poorest quartiles. At -1.38 in 1999, the scope for a decline in mean HAZ was relatively lower for the poorest quartiles when compared to the highest quartiles.

3 Empirical assessment of the impact of changes in food consumption on health outcomes

A neo-materialism interpretation of health differences attributes them to differences in individual
resources, among them food availability (Lynch et al, 2000). Indeed, the observed changes in HAZ and WAZ mirror changes in food consumption. The third wealth quartile had the largest absolute declines in both mean HAZ and the food variety score for example.

However due to the presence of confounding factors, the declines in HAZ and WAZ may not be wholly attributable to the reduction in the consumption of food. Deterioration in other determinants of health also reduces the mean HAZ and WAZ while improvements have the opposite effect. A multivariate analysis of the determinants of health outcomes in this section sheds more light on the impact of declining food consumption on health outcomes.

3.1 Measuring the impact of food consumption on health outcomes

The impact of a decline in food consumption on health outcomes can be analyzed using the regression in equation (1). *Hi* is a measure of child *i*'s health outcome, *FVS* is the food variety score and β_0 is the impact of food consumption on the health outcome. Other determinants of the health outcome are denoted by a *K × 1* matrix ***X*** while ϵ_i denotes the disturbance term. This regression is based on a standard specification that includes community, household and child specific determinants of health (e.g. Lavy et al. 1996, Ponce et al. 1998, Case et al. 2002).

$$H_i = \alpha + \beta_0 FVS_i + \sum_k \beta_k x_{ki} + \epsilon_i \qquad (1)$$

Community effects include dummies for rural-urban classification, access to sanitation and access to safe water. A household is considered to have access to sanitation if it has either a flush toilet, blair toilet or pit latrine. It has access to safe water if it has access to treated pipe water, boreholes or protected wells. Household variables include household size, the number of under 5 years old children and the household head's age, years of education and gender (female household head takes a value of 1). Child specific variables include age in months, age squared, gender (girl child takes a value of 1), mother's years of education and breast-feeding duration. Other child specific variables are illness dummies like whether a child had diarrhea, fever or coughed during the previous two weeks and the interaction of the food consumption index and whether the baby was breastfeeding. The size of the child at birth is controlled for using a dummy taking a value of one if the baby was born smaller than average based on the mother' recall of the size of the child size at birth. Summary statistics of these variables are presented in Table 2 below.

Table 2. Changes in means of determinants of HAZ and WAZ

Variable	All children			Estimation sample		
	1999	2005	Change	1999	2005	Change
Food consumption	3.41	2.24	**-1.16**	3.48	2.31	**-1.17**
Lives in rural area	0.77	0.75	**-0.02**	0.75	0.77	**0.03**
Has sanitation	0.63	0.60	**-0.03**	0.64	0.59	**-0.05**
Has safe water	0.76	0.70	**-0.06**	0.77	0.69	**-0.08**
No of children	1.75	1.81	**0.06**	1.73	1.92	**0.19**
Household size	6.17	6.15	-0.02	6.10	6.14	0.08
Female headed household	0.37	0.35	-0.02	0.35	0.33	-0.01
Household head age	42.21	42.34	0.13	40.14	39.54	-0.60
Household head years of education	6.46	6.85	**0.39**	7.03	7.24	**0.21**
Mothers' years education	4.43	4.28	**-0.15**	4.41	4.30	-0.11
Age in months	29.61	30.02	0.40	27.78	22.93	**-4.85**
Gender (female=1)	0.50	0.50	0.00	0.50	0.51	0.01
Was born small	0.16	0.15	-0.01	0.16	0.15	0.00
Breastfeeding duration	15.96	15.31	**-0.65**	15.77	14.28	**-1.48**
Has diarrhea	0.14	0.13	-0.01	0.14	0.14	0.00
Has fever	0.26	0.08	**-0.17**	0.40	0.23	**-0.17**
Coughs	0.40	0.22	**-0.18**	0.26	0.08	**-0.18**

Notes: *Changes in bold are statistically significant at 5% level of significance.*

Selection issues

Some child specific variables are only captured for children who live in the same household with their mothers. There is no information on consumption, breast-feeding and illness for children who do not live with their mothers. As noted in Case et al. (2002) and Case, Paxson & Ableidinger (2004), expenditures on healthy food items are lower for children not living with their mothers. This may translate to higher prevalence of stunting and underweight among these children as evidenced by statistically significant lower means of HAZ and WAZ for children not living with their mothers in all but height for age in 2005/06.

To avoid potential selection bias, the regression in equation (1) is estimated using the Heckman selection procedure based on mother presence in a household. A father presence dummy taking a value of one if a father is dead or existence is not known and a value of zero otherwise is constructed and used as the excluded variable. The use of father presence assumes that a father's non-existence influences the likelihood of staying with a relative in two ways. Either both parents of the child are deceased or that single mothers without support of the child's father are forced to leave the household and find work. Furthermore, a father's presence is presumed to affect child nutrition only through provision of resources. Once food consumption is controlled for, father presence should not be significant.

3.2 Results

Results from the regression of HAZ and WAZ on their determinants are shown in Table A3. In all regressions, the father alive dummy is a significant predictor of a mother's presence in the household. Mothers of children whose fathers are alive or their existence is known are more likely to be members of their children's households. The father alive dummy was included in OLS regressions of HAZ and WAZ for only children whose mothers are present in their households. Its coefficient lost significance in all regressions once food consumption is controlled for. This result is consistent with the notion that father presence's effect on HAZ and WAZ works through access to resources and ceases to be important once this is controlled for.

Table 3 presents the impact of food consumption and other selected variables on HAZ and WAZ. The coefficient of the food variety score is positive and significant in all regressions. For HAZ, the coefficient is around 0.06 in both years, implying that a reduction in mean food variety score from the 1999 to the 2005 level reduced mean HAZ by 0.07. This is 37% of the overall decline in mean HAZ for the entire sample. The coefficient of the food variety score in the WAZ regression is 0.046 in 1999 and 0.061 in 2005. Thus the decline in mean food variety score contributed to at least 59% of the decline in the mean of WAZ. The decline in food consumption significantly contributed to worsening health outcomes among children in Zimbabwe.

Table 3. The impact of selected variables on HAZ and WAZ

	HAZ		*WAZ*	
Variable	1999	2005	1999	2005
Food index	0.0611***	0.0605***	0.0457***	0.0613***
	(0.0226)	(0.0228)	(0.0154)	(0.0173)
Was born small	-0.428***	-0.350***	-0.464***	-0.514***
	(0.0988)	(0.0864)	(0.0667)	(0.0652)
Has diarrhea	-0.277**	-0.219**	-0.119	-0.252***
	(0.109)	(0.0927)	(0.0727)	(0.0696)
Household head's education	0.0290**	0.00386	0.0291***	0.0295***
	(0.0125)	(0.0120)	(0.00834)	(0.00903)

**** p<0.01, ** p<0.05, * p<0.1, Standard errors in parentheses*

Children suffering from diarrhea have lower HAZ and WAZ on average. The coefficient of diarrhea is negative and significant for WAZ in 2005/06 and HAZ in both years. Diarrhea has an immediate effect on WAZ since it captures short term health shocks hence its significant impact. Its significant impact on HAZ indicates that diarrhea is also capturing long term or recurring illness e.g. illness due to HIV/AIDS. Other illness variables like coughing have an insignificant impact on HAZ and WAZ across all regressions.

The household head's years of education has a significant positive impact on HAZ and WAZ in all regressions expect for HAZ in 2005/06. Since 75 percent of the household heads had at least 5 years of education in 2005 compared to 3 years in 1999, this improvement should have significantly increased health outcomes in 2005/06. However, the collapse of the coefficient of education in the HAZ regression for 2005/06 indicates the changing economic environment reduced external returns to education as the middle class collapsed. The impact implied by the household head's education coefficient is indeed smaller than that of the food variety score. Therefore, the effect of improved education was more than offset by the effect of declining access to food especially for the middle class. The collapse in the impact of education is thus consistent with the large drop in HAZ and mean food variety score for the middle wealth quartiles.

The data show that children living in the same household had an identical food variety score most of the time which raises the possibility of cluster effects. Heckman regression results with clustered standard errors allowing for intra household correlation give similar results to those presented above (see Table A4). The regressions were also estimated using ordinary least squares on those children living with their mothers only, since these are the only children for which food consumption and illness variables are observed. The coefficient of the food variety score remains significant in all four regressions in both the Heckman regressions with clustered variances and the OLS regressions. The conclusion that the decline in food consumption worsened stunting and underweight remains unchanged.

A decomposition of the sources of changes in mean HAZ confirms the importance of declining access to food in explaining increases in stunting. A threefold Oaxaca-Blinder decomposition of the change in mean HAZ shows that the magnitude of the impact of the decline in levels of food consumption explains almost 51 percent of the overall difference in mean HAZ (see Table 4). This effect is statistically significant at 5% level of significance. The effect of food is almost entirely through the endowment effect as its coefficient is the same in both 1999 and 2005/06. With the exception of access to safe water and breast feeding duration, the decomposition shows that no other policy variable has an endowment effect that is statistically significant in explaining the change in mean HAZ. A similar result is observed for the decomposition of changes in mean WAZ. The endowment effect of the food variety score' is 0.07 which is 120 % of the overall change in mean WAZ, although its coefficient effect (-0.035) reduces the effect of declining food consumption on mean WAZ.

Table 4: Oaxaca decomposition of the difference in mean HAZ (1999 -2005/05)

Overall Decomposition	Mean in 1999	Mean in 2005	Difference	Endownment	Coefficient	Interaction
coefficients	-1.478	-1.618	0.139	-0.114	0.207	0.047
P-value			0.016	0.003	0.001	0.289
			Detailed Decomposition			
	Endownment Effect		*Coefficient Effect*		*Interaction Effect*	
Variable	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Has sanitation	-0.001	0.888	0.075	0.293	0.007	0.308
Has safe water	-0.010	0.095	0.159	0.072	0.018	0.083
Household head's education	-0.001	0.727	0.180	0.141	-0.005	0.229
Age in months	-0.709	0.000	0.341	0.422	0.072	0.423
Age squared	0.523	0.000	-0.128	0.519	-0.048	0.519
Was born small	-0.001	0.777	-0.012	0.528	0.000	0.796
Breast feeding duration	0.021	0.064	-0.170	0.361	-0.018	0.365
Food variety score	**0.071**	**0.012**	**0.001**	**0.986**	**0.001**	**0.986**
Has diarrhea	0.001	0.763	-0.008	0.679	0.000	0.806
Has fever	0.000	0.990	0.004	0.703	0.010	0.703
Coughs	-0.009	0.447	0.006	0.805	0.004	0.805

4 Discussion

Empirical findings from the analysis have established that food consumption declined while stunting and underweight increased across all points of the wealth distribution after 1999. These trends show a real deterioration in child health outcomes and hence welfare post 1999. While this paper does not seek to make a causal attribution for this decline, this section explores potential explanations for the observed trends.

Since the methodology for DHS are consistent across time, observed declines in HAZ and WAZ reflect real changes in welfare rather that sampling or measurement differences. The discussion on data comparability indeed confirmed this. Key demographic characteristics are the same in the two periods. The probability of survival for children born small was nevertheless higher, potentially reducing mean HAZ and WAZ if the 2005/06 sample has more children who were born small. However, the proportion of children born small in the 2005/06 sample is actually a percentage point lower than 1999 and this difference is statistically insignificant. Therefore, demographic changes do not explain changes in HAZ and WAZ.

From the regressions, diseases like diarrhea lower HAZ and WAZ. Thus a higher burden of diseases, especially HIV and AIDS and diarrhea, post 1999 would help explain the decline in

HAZ and WAZ. Observed trends suggest this is not the case. The change in the proportion of children who reported having diarrhea within two weeks of the interview is statistically insignificant while that of children reporting having a cough or fever was in fact significantly lower in 2005/06 than 1999 (see summary statistics in Table 2). Indeed the Oaxaca-Blinder decomposition in Table 4 shows a negligible impact of the burden of disease in explaining the change in mean HAZ. Furthermore, HIV/AIDS prevalence has been declining (see UNGASS 2008, Mugurungi et al. 2008). Even the most pessimistic projections show a flattening of the trend after 1994 (Mugurungi, Gregson,McNaghten, Dube & Grassly 2008). These trends were compiled using the most recent technique in HIV prevalence (EPP) hence statistical methodology cannot be attributed to the decline. The report by UNAIDS (2005), which sought a thorough investigation of whether the declines are real or artificial, confirmed that HIV/AIDS declined even after taking migration and other factors into account. This decline should have induced an increase rather than decline in HAZ and WAZ.

The summary statistics in Table 2 show a significant deterioration in socio-economic conditions post 1999, with the exception of the household head's level of education. This could have driven the decline in HAZ and WAZ. However, based on regressions in the previous section, only food consumption and the household head's level of education are shown have a robust impact on HAZ and WAZ. While the household head's level of education improved and has a positive effect, access to food declined by a greater magnitude and its impact greater impact than that of education. Furthermore, the impact of household education on HAZ collapses in 2005/06 indicating a decline in the socio-economic returns to education as the middle class suffered a decline in access to food.

The decline in access to food stands out as the important explanation of the decline in mean HAZ and WAZ post 1999. Indeed, decompositions of the changes in mean HAZ and WAZ show that the deterioration in access to food is, among all other socio-economic variables, the most important factor in explaining the variation in mean HAZ and WAZ. While its endowment effect is large (more than 50% of the change in means) and statistically significant, the effect of other factors like sanitation and education is both small in magnitude and statistically insignificant in explaining the change in mean HAZ and WAZ.

A popular hypothesis for the decline in access to food is that the land redistribution policy reduced the production of food in the country or that the post 1999 period had more droughts. These two hypotheses have little empirical support however. Food production trends prior to 2005 mirrored the pre 1999 trends with two severe droughts at the mid points of 5 year period either side of 1999 (FAO & WFP 2003, FAO 2004, African Development Bank 2007) hence droughts cannot be the main driver. This is illustrated in figure 5. The land redistribution led to a significant decline in the production of commercial cash crops like tobacco. Yields in maize production declined too but this was offset by increased acreage. Thus overall food production did not change although its distribution could have changed.

A possible explanation for poor access to food post 1999 is the high level of market distortions that characterized the post 1999 period. These led to asymmetric access to controlled commodities favoring the wealthy and the well connected (see Chikukwa 2004). In addition, market distortions created exclusive rents which allowed rent seekers, chiefly the elite (RBZ 2006), to increase their wealth and general command over resources. They were able to maintain or even increase their consumption while everyone else reduced theirs. The economic contraction in Zimbabwe also disproportionately harmed the ordinary citizen (IMF, 2005, Clemens & Moss 2005) while rent seekers were cushioned from the economic decline. This allowed rent seekers to sustain their levels of consumption when ordinary households were reducing theirs. The analysis in this paper is however not sufficient to establish a causal link between the economic policy. It does however, establish the point that children' health outcomes significantly deteriorated owing to poor access to food post 1999.

4 Conclusion

The economic situation in Zimbabwe unraveled after 1999. A comparative analysis of child health outcomes in this paper points to a significant deterioration in welfare post 1999. Results show that food consumption among children in all wealth groups declined along with their mean HAZ and WAZ. The average number of items consumed, mean HAZ and mean WAZ declined. The biggest declines were on outcomes for children living in poor and middle class households while children in richer households were the least affected. The decline in food consumption significantly contributed to the decline in means of HAZ and WAZ respectively. This deterioration in access to food explains the largest part of the declines in HAZ and WAZ. The redistributive nature of the prevailing economic environment post 1999 is likely to have contributed to this decline in access to food, especially among poor households. The collapse in the impact of education on stunting in 2005/06 also indicates a decline in the external returns to education in an environment where the middle class experienced the largest relative declines in access to food.

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Appendix of Tables

Table A1. Descriptive statistics: Composition of DHS samples for 1999 and 2005/6

Variable		1999	2005
Sample size		3892	5943
Mother is alive		98.48	97.59
Mother not in household		14.52	15.3
Total fertility rate (women aged 15-49 years)		4	3.8
General fertility rate (per 1000)		141	137
Crude birth rate per 100		31	31
Mean age of mothers		27.9	27.7
Infant mortality per 1000 births		59.9	65
Infant mortality among children Born smaller than average (per 1000 births)		118.8	83
Residential composition (%)	urban	23.43	25.03
	rural	76.57	74.97
Gender composition (%)	male	50.41	50.12
	female	49.59	49.88
Household Head Gender (percentage of households)	male	63.28	65.21
	female	36.72	34.79
Composition by residence and age	Urban (0-4 years)	12.9	11.9
	Rural (0-4 years)	14	15.2
	Urban (5-9 years)	10.5	11.0
	Rural (5-9 years)	16.6	15.7
Household head age (percentage of households)	below 18	0.73	0.3
	19-29	24.06	23.08
	30-39	26.86	30.37
	40-49	18.29	14.94
	50-59	13.38	14.83
	60+	16.58	165.48
Relation to household head (proportion of children)	son/daughter	64.72	63.28
	grandchild	26.77	28.06
	other	8.48	8.65
Relation structure (percentage of households)	1 adult	11.87	11.68
	2 adults, opposite sex	34.89	34.69
	2 adults same sex	4.75	5.47
	3+ related adults	42.39	43.72
	unrelated adults	6.09	4.42

Table A2. Housing characteristics and ownership of durable assets by asset index quartiles (in percentages)

	1999				2005/06			
Variable Description	Poorest	Second	Middle	Richest	Poorest	Second	Middle	Richest
Car or truck	0.00	0.00	1.01	23.56	0.00	0.29	3.84	21.59
Telephone	0.00	0.00	0.32	22.04	0.00	0.00	1.13	32.15
Refrigerator	0.00	0.00	0.76	48.32	0.00	0.00	3.84	69.10
Bicycle	9.09	23.18	31.12	22.86	13.53	21.86	35.01	33.49
Motorcycle	0.00	0.00	0.44	2.28	0.00	0.34	1.4	2.90
Radio	11.93	24.22	71.55	90.75	0.00	24.35	77.02	92.99
Share toilet	49.75	46.26	61.43	53.33	31.98	39.28	44.26	31.51
Earth floor	100.00	25.54	2.73	0.13	100.00	26.10	4.66	1.33
Cement floor	0.00	74.46	96.63	78.39	0.00	73.90	94.30	86.09
Ceramic tiles	0.00	0.00	0.06	3.74	0.00	0.00	0.72	7.11
Carpeted floor	0.00	0.00	0.51	14.32	0.00	0.00	0.72	7.11

Table A3. Results: Determinants of HAZ and WAZ

	1999		2005		1999		2005	
VARIABLES	HAZ	selection	HAZ	selection	WAZ	selection	WAZ	selection
Rural household	0.0930	0.184**	-0.224**	0.0593	-0.101	0.174**	-0.156**	0.0866
	(0.110)	(0.0814)	(0.0978)	(0.0764)	(0.0693)	(0.0850)	(0.0711)	(0.0779)
Sanitation	0.123	0.0124	-0.0106	-0.118*	0.0664	0.0519	0.149***	-0.108*
	(0.0928)	(0.0649)	(0.0776)	(0.0608)	(0.0593)	(0.0679)	(0.0569)	(0.0621)
Has safe water	0.0981	0.0315	-0.131*	-0.0738	0.0656	0.0258	-0.0036	-0.0307
	(0.0996)	(0.0699)	(0.0782)	(0.0622)	(0.0639)	(0.0732)	(0.0574)	(0.0634)
No. of children	-0.0889	-0.0621	-0.0811	0.387***	-0.181**	-0.0410	-0.234***	0.451***
	(0.137)	(0.0931)	(0.122)	(0.0912)	(0.0900)	(0.0987)	(0.0895)	(0.0931)
No. of children squared	-0.0058	0.0001	-0.00115	-0.072***	0.0339*	-0.0084	0.0299*	-0.0858***
	(0.0281)	(0.0186)	(0.0243)	(0.0179)	(0.0188)	(0.0201)	(0.0179)	(0.0182)
Household size	0.0094	0.0194	0.0033	0.0225*	-0.0134	0.0326**	0.0107	0.0288**
	(0.0197)	(0.0134)	(0.0175)	(0.0129)	(0.0127)	(0.0142)	(0.0127)	(0.0129)
Household head sex	-0.256***	-0.341***	-0.127*	-0.340***	-0.0950*	-0.372***	0.000312	-0.368***
	(0.0866)	(0.0601)	(0.0730)	(0.0560)	(0.0560)	(0.0627)	(0.0538)	(0.0569)
Household head age	-0.0194	-0.069***	-0.027**	-	0.0165	-0.076***	-0.0056	-0.0979***
	(0.0162)	(0.0113)	(0.0131)	(0.0097)	(0.0104)	(0.0118)	(0.00974)	(0.00992)
Household head age squared	$8.5x10^{-5}$	0.0004***	0.0001	0.0006***	-0.0002**	0.0004**	$-1.0 x10^{-5}$	0.0006***
	(0.0002)	(0.0001)	(0.0001)	$(9.2x10^{-5})$	(0.0001)	(0.0001)	$(9.6 x10^{-5})$	$(9.5 x10^{-5})$
Household head education	0.0291**		0.0039		0.0291***		0.0295***	
	(0.0125)		(0.0120)		(0.0083)		(0.0090)	
Mother's education	0.0265		0.0111		0.0090		0.0076	
	(0.0177)		(0.0164)		(0.0121)		(0.0123)	
Age in months	-0.132***	-0.094***	-0.148***	-0.104***	-0.054***	-0.093***	-0.0761***	-0.103***
	(0.0123)	(0.0096)	(0.0102)	(0.0084)	(0.0080)	(0.0098)	(0.0076)	(0.0085)
Age squared	0.0026***	0.0010***	0.0018***	0.0010***	0.0006***	0.0010***	0.0009***	0.0010***
	(0.0002)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Gender	0.258***		0.206***		0.201***		0.142***	
	(0.0709)		(0.0623)		(0.0479)		(0.0469)	
Was born small	-0.428***		-0.350***		-0.464***		-0.514***	
	(0.0998)		(0.0864)		(0.0667)		(0.0652)	
Breastfeeding	0.0024		0.0145**		-0.0094*		0.0018	
	(0.0074)		(0.0059)		(0.0048)		(0.0044)	
Food*Breastfeeding	0.0009		-0.103***		-0.0084		-0.0368*	
	(0.0263)		(0.0274)		(0.0172)		(0.0202)	

Food Variety Score	0.0611***		0.0605***		0.0457***		0.0613***	
	(0.0226)		(0.0228)		(0.0154)		(0.0173)	
Has diarrhea	-0.277**		-0.219**		-0.119		-0.252***	
	(0.109)		(0.0927)		(0.0727)		(0.0696)	
Coughs	-0.0288		-0.0556		-0.0362		0.0174	
	(0.0795)		(0.0783)		(0.0536)		(0.0592)	
Father is alive		0.409***		0.479***		0.508***		0.487***
		(0.0854)		(0.0800)		(0.0956)		(0.0861)
Mother is alive		0.645***		1.014***		0.640***		1.022***
		(0.113)		(0.103)		(0.113)		(0.103)
Constant	0.425	3.813***	1.308***	4.013***	-0.0228	3.916***	0.467*	3.948***
	(0.449)	(0.357)	(0.374)	(0.327)	(0.292)	(0.376)	(0.277)	(0.332)
Lambda	1.667		1.340		0.775		0.783	
	(0.062)		(0.076)		(0.085)		(0.079)	
rho	0.837		0.743		0.613		0.587	
	(0.021)		(0.034)		(0.059)		(0.053)	

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

Table A4. Results with clustered standard errors: Determinants of HAZ and WAZ

	HAZ		WAZ	
VARIABLES	**1999**	**2005**	**1999**	**2005**
Rural	0.0930	-0.2241**	-0.1014	-0.1561**
	(0.1150)	(0.1038)	(0.0718)	(0.0780)
Sanitation	0.1226	-0.0106	0.0664	0.1491**
	(0.1022)	(0.0820)	(0.0641)	(0.0614)
Safe water	0.0981	-0.1313	0.0656	-0.0036
	(0.1112)	(0.0824)	(0.0695)	(0.0617)
No. of children	-0.0889	-0.0811	-0.1808*	-0.2339***
	(0.1572)	(0.1293)	(0.0991)	(0.0893)
No. of children squared	-0.0058	-0.0011	0.0339	0.0299
	(0.0337)	(0.0259)	(0.0209)	(0.0182)
Household size	0.0094	0.0033	-0.0134	0.0107
	(0.0197)	(0.0179)	(0.0135)	(0.0137)
Household head gender	-0.2556***	-0.1273	-0.0950	0.0003
	(0.0944)	(0.0780)	(0.0598)	(0.0587)
Household head age	-0.0194	-0.0270*	0.0165	-0.0056
	(0.0174)	(0.0146)	(0.0107)	(0.0104)
Household head age2	0.0001	0.0001	-0.0002**	-0.0000
	(0.0002)	(0.0001)	(0.0001)	(0.0001)
Household head education	0.0291**	0.0039	0.0291***	0.0295***
	(0.0131)	(0.0121)	(0.0092)	(0.0094)
Mothers' education	0.0265	0.0111	0.0090	0.0076
	(0.0194)	(0.0173)	(0.0127)	(0.0137)
Age in months	-0.1322***	-0.1477***	-0.0545***	-0.0761***
	(0.0144)	(0.0118)	(0.0088)	(0.0075)
Age squared	0.0016***	0.0018***	0.0006***	0.0009***
	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Gender	0.2578***	0.2065***	0.2006***	0.1423***
	(0.0700)	(0.0628)	(0.0480)	(0.0475)
Was born small	-0.4282***	-0.3505***	-0.4638***	-0.5135***
	(0.0945)	(0.0867)	(0.0689)	(0.0670)
Breastfeeding duration	0.0024	0.0145*	-0.0094	0.0018
	(0.0106)	(0.0074)	(0.0059)	(0.0043)
Food*Breastfeeding	0.0009	-0.1025***	-0.0084	-0.0368*
	(0.0297)	(0.0303)	(0.0175)	(0.0205)
Food consumption index	0.0611***	0.0605**	0.0457***	0.0613***
	(0.0235)	(0.0251)	(0.0155)	(0.0173)
Has diarrhea	-0.2774**	-0.2195**	-0.1193	-0.2517***
	(0.1095)	(0.0933)	(0.0745)	(0.0728)
Has fever	0.0536	-0.0043	-0.2285***	-0.2355**
	(0.0950)	(0.1141)	(0.0606)	(0.0940)
Coughs	-0.0288	-0.0556	-0.0362	0.0174
	(0.0805)	(0.0756)	(0.0541)	(0.0588)
Constant	0.6804	1.4355***	0.0722	0.4662
	(0.4968)	(0.4114)	(0.3167)	(0.2994)
lambda	0.6804	1.4355***	0.0722	0.4662

	(0.4968)	(0.4114)	(0.3167)	(0.2994)
rho	0.6804	1.4355***	0.0722	0.4662
	(0.4968)	(0.4114)	(0.3167)	(0.2994)
Observations	2945	3723	3043	3876

NB: Selection equations are not presented in the table, robust standard errors in parentheses

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

Figures

Figure 4. Comparison of weight for age, 1999 and 2005/06

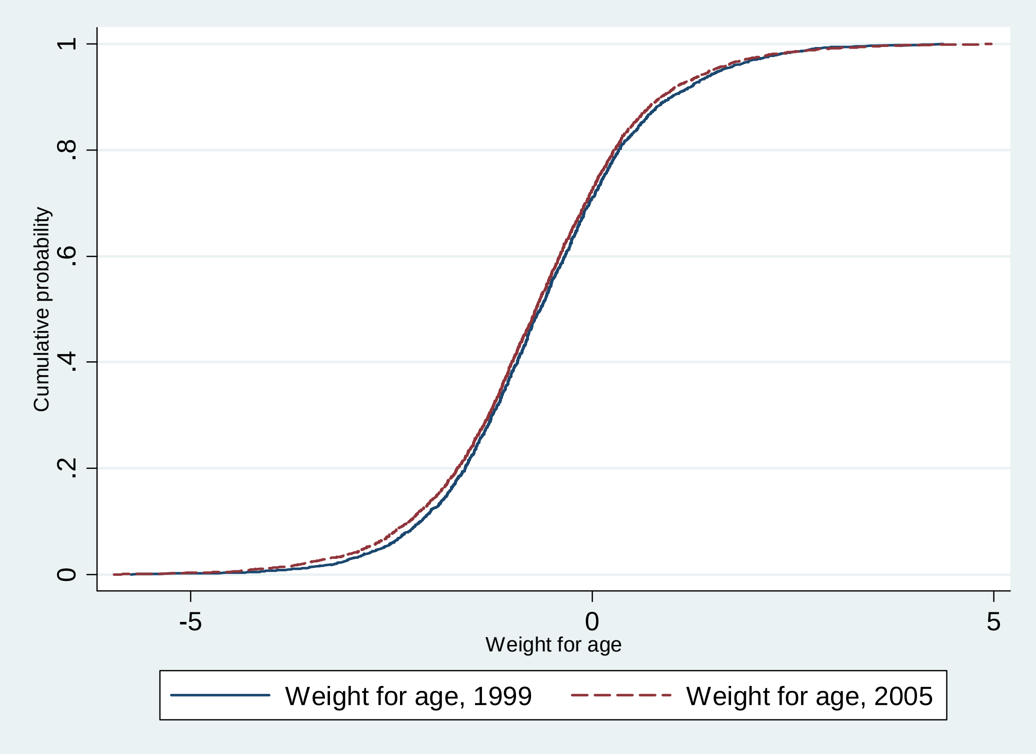
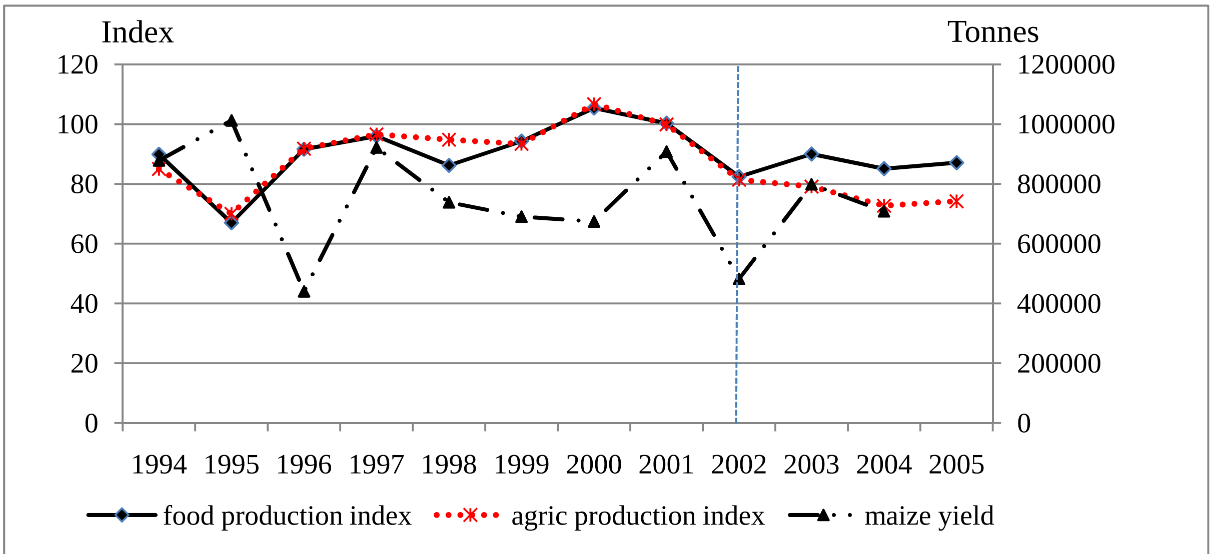


Figure 5. Trends in agriculture production in Zimbabwe: 1994 - 2005



Source: FAO/WFP , (various) and AfDB, 2007

southern africa labour and development research unit

The Southern Africa Labour and Development Research Unit (SALDRU) conducts research directed at improving the well-being of South Africa's poor. It was established in 1975. Over the next two decades the unit's research played a central role in documenting the human costs of apartheid. Key projects from this period included the Farm Labour Conference (1976), the Economics of Health Care Conference (1978), and the Second Carnegie Enquiry into Poverty and Development in South Africa (1983-86). At the urging of the African National Congress, from 1992-1994 SALDRU and the World Bank coordinated the Project for Statistics on Living Standards and Development (PSLSD). This project provide baseline data for the implementation of post-apartheid socio-economic policies through South Africa's first non-racial national sample survey.

In the post-apartheid period, SALDRU has continued to gather data and conduct research directed at informing and assessing anti-poverty policy. In line with its historical contribution, SALDRU's researchers continue to conduct research detailing changing patterns of well-being in South Africa and assessing the impact of government policy on the poor. Current research work falls into the following research themes: post-apartheid poverty; employment and migration dynamics; family support structures in an era of rapid social change; public works and public infrastructure programmes, financial strategies of the poor; common property resources and the poor. Key survey projects include the Langeberg Integrated Family Survey (1999), the Khayelitsha/Mitchell's Plain Survey (2000), the ongoing Cape Area Panel Study (2001-) and the Financial Diaries Project.

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