Child Nutritional Status in the Malawian District of Salima: A Capability Approach

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Paper prepared for presentation at the 2nd AIEAA Conference
"Between Crisis and Development: which Role for the Bio-Economy"

6-7 June, 2013
Parma, Italy

Summary

This paper investigates the long- and short-term determinants of child nutritional status in the Malawian district of Salima. Based on monthly data from July 2004 to June 2012, the study applies the capability approach to the analysis of the impact on child nutritional status of a set of indicators representative of household food security, maternal and child care, access to and coverage of health services and health environment conditions. Two models are estimated by OLS in order to compare results based on historical series and their trend-cycle, seasonal and irregular components. Findings suggest to consider the relative response of child nutritional status to food and health in policy making, the importance of efficient and effective coordination mechanisms among stakeholders, the need for a multidimensional food security indicator, the relevance of seasonal events and climatic shocks, and the urgency to arrest the long-term cycle of food insecurity and malnutrition.

Keywords: *child nutrition, food security, health status, Malawi*

JEL Classification codes: Q18; J13; O55

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1. Introduction

This paper investigates the long- and short-term determinants of child nutritional status in the Malawian district of Salima. The empirical investigation is based on monthly data referred to the time period from July 2004 to June 2012 and follows the capability approach, integrating the food intake and health status dimensions of the issue.

The research question addressed originates from two previous analyses where economic determinants of child nutritional status in Malawi are estimated at the country and regional level (Cornia *et al*, 2012; Sassi, 2012). This paper adds an important new element to that perspective. The status of child nutrition is looked at from a multidimensional concept, affected by economic and health causes, providing a better understanding of an issue that call for urgent action.

More frequent droughts and recent economic policies introduced by the government are important factors increasing the critical condition of the nutritional status of Malawian population with children the most affected: in 2011, 48.1 per cent of children were stunted and 14 per cent severely stunted. Within the country, in the district of Salima these figures are among the highest with an incidence of children with stunting at 56.1 per cent and severely stunting at 17 per cent (Republic of Malawi, 2012). Moreover, the prevalence of underweight is only truly concerning in this district where the situation is classified as serious according to the WHO standards (World Food Programme, 2012).

Due to implementing a multidimensional approach, this study also contributes to the current debate on the "food and nutrition security" concept as opposed to that of "food security and nutrition" in which the importance of nutrition's role in food security may not receive appropriate attention, as recently underlined by the FAO (2013). In fact, hunger reduction is often seen as a function of food production and food security is frequently understood as food self-sufficiency. This understanding is a partial interpretation of the widely accepted definition of food security provided by the 1996 World Food Summit and based on the multiple dimensions of food availability, access and utilization. This concept reflects the evolution of the theoretical debate started from the elaboration of the food availability approach by Malthus (1789) to that of Sen (1981) and Drèze and Sen (1989) based on the concepts of entitlement and capability (for a summary see, Burchi and De Muro, 2012). In particular, Drèze and Sen (1989:13-14) clarify that a person's capabilities to avoid undernourishment may depend not only on food intake but also on access to health care, medical facilities, elementary education, drinking water, and sanitary facilities. They also argue the importance of other

influential factors, such as the prevalence of epidemics and disease, in relation to the extent of undernourishment. From this perspective, in the analysis of the public action aimed at combating hunger there is need to broaden the view from the command over food to other influences, including the command over other commodities that have a substantial impact on nutrition and health.

This approach, endorsed by UNICEF (1990) since 1990, recently received confirmation by the FAO (2013). The strategic document "The Director-General's Medium Term Plan 2014-17 and Programme of Work and Budget 2014-15" states that in order to ensure good nutrition, especially for young children, food access and availability has to be combined with good care and feeding practices, access to health services and health environment.

In this paper, child nutritional status is analysed in reference to these categories of determinants, namely household food security, care for mothers and children, access to and coverage of health services and health environment conditions.

The selected explanatory variables are particularly sensitive to policy changes due to the nature of the issue under investigation. As a result, this study also contributes to the debate concerning the most effectiveness policies to introduce in Malawi. This is a well known issue in the country and, in this context, a specific focus is on the appropriated time horizon for the interventions in this area (FAO, 2008). Malawi has introduced a set of measures, particularly of short-term nature for dealing with this crisis, while investment in long-term strategies remains an urgent concern. In the country and even more in a district as Salima, the policy short-term perspective must include seasonal considerations. In fact, important determinants of malnutrition, like the level of agricultural production, household income and health status of individuals, are strongly affected by seasonal events regulated by weather conditions (Sassi, 2012). Apart from the above mentioned studies by Cornia *et al* (2012) and Sassi (2012), the empirical literature concerning the determinants of child nutritional status does not take into consideration these aspects because investigations are generally based on annual data and cross-sectional analysis. This study overcomes this issue making reference to monthly data, which allow decomposing the explanatory variables of child malnutrition in the trend-cycle, seasonal and stochastic components.

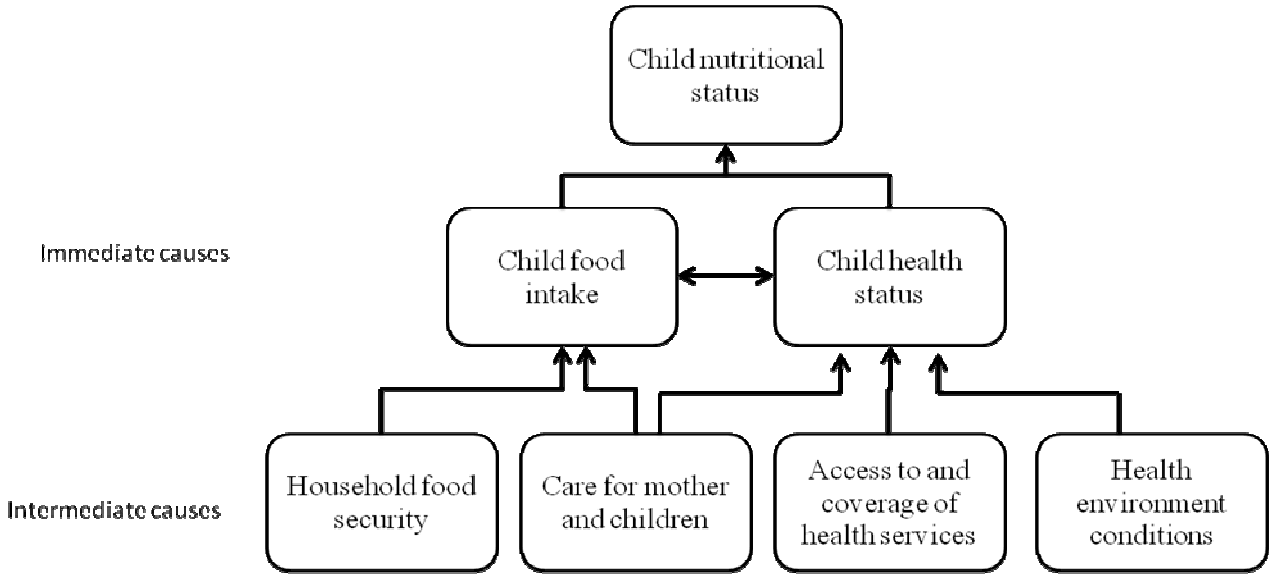
This paper is structured as follows. First, the conceptual framework of reference and the related indicators selected for the empirical investigation are presented. An important aspect adressed in this first section concerns data quality, upon which the credibility of results and of conclusions depends on. Afterwards, the empirical strategy is illustrated and followed by the presentation of and discussion of results. The paper ends by examining the main arguments and resulting conclusions.

2. CONCEPTUAL FRAMEWORK AND INDICATORS

The conceptual framework underpinning the empirical investigation is adapted from that developed by UNICEF (1990) and widely accepted internationally (Smith *et al*, 2000) and according to which three levels of causality are recognised: immediate, intermediate and underlying determinants of nutritional status. Due

to data constraints, this paper considers only the intermediate causes of child nutritional status articulated as shown by Figure 1.

Figure 1 – Conceptual framework



Source: adapted from UNICEF (1990)

More precisely, the empirical investigation focuses on factors directly affecting child food intake and health status.

Household food security is one of the intermediate causes. This involves the ability of a family to produce and acquire food, which depends on food prices, household food availability, and household income. This economic dimension, along with the access to and coverage of health services and the health environment conditions, represents the prerequisite for an adequate dietary intake and controlling common child diseases; these resources are only effective if proper maternal and child care ensures that they are employed to benefit the children (UNICEF, 1990). In fact, care represents the behavioral component of the decision making process and use of resources within the household (Reddy *et al*, 1992), involving the use of household resources for feeding children, protecting children from infection, and caring for sick children. There is also the specific role of maternal care that underlines the intergenerational causality of child nutrition. The literature suggests that malnourished women give birth to low birth weight babies, who are more likely to be malnourished themselves (Ramakrishnan *et al*, 1999; UNICEF, 2009).

In the empirical investigation, child nutritional status and the above mentioned intermediate causes are represented by the indicators listed in Table 1.

Table 1 – Elaborated indicators

Area	Indicator	Acronym
Child nutritional status	Number of underweight for age under-five years	UWG
Household food security	Maize price	MAP
	Hunger season dummy	FOI
Care for mothers and children	Live birth weighting less than 2500g out of total live new-borns	LOB
	New cases of children under five years old affected by malaria	MUF
	New cases of malnourished children under five years old	NMC
Access to and coverage of health services	Visited children under five years old affected by acute respiratory infections and non-bloody diarrhoea out of total child attending under-five clinic	DAC
	Number of Health Surveillance Assistances in post	HAS
Health Environment conditions	Number of outpatient departments' total attendance out of the number of households with access to drinkable potable water	OPH

All the indicators are on monthly basis, from July 2004 to June 2012, and all are related to the Millennium Development Goals, in particular to the first (eradicate extreme poverty and hunger), fifth (improve maternal health), sixth (combat HIB/AIDS, malaria and other diseases), and seventh (ensure environmental sustainability) goals (www.mdgs.un.org).

The adopted impact variable is the number of underweight children under-five years of age (UWG). This includes the number of underweight children from all those who had attended under-five clinics and from children 6-59 months old who had received a vitamin A dosage (Ministry of Health, Planning Department, Health Management Information Unit, 2005).

This indicator reflects not only nutrition and nourishment but also other aspects of a children's living conditions, such as infections and environmental hygiene. Its major limitation consists of the fact that it is sensitive to the degree of utilization of under-five clinic services. However, it should be noted that, in Malawi, children under-five years old are expected to attend under-five clinics for growth monitoring and related issues and that supplementing children aged 6 – 59 months with Vitamin A is the goal of a specific policy of the Ministry of Health. For this reason, the quality of this indicator is judged as adequate for the purpose of this analysis. Evidence supports this view. For example, from July 2009 to June 2010, the population of children under-five years old in Salima was 62,400 and the visits made by children attending

under-five clinics were 179,100, while vitamin A dosages given to 6-59 month old children totalled 7,600 (Ministry of Health, Planning Department, Health Management Information Unit, 2010). In 2011, the Integrated Household Survey reports that 77 per cent of children aged 6 to 59 months took part in under-five clinic programs (Republic of Malawi, 2012).

2.1. Intermediate causes

Factors affecting household food security are approximated by two indicators.

The former is retail price of maize in Malawian kwacha per kilogram (MWK) deflated by the Consumer price index (MAP). In the specifically analysed district, most food comes from own crop production, out of which about 60-70% is maize (Republic of Malawi - Salima District Assembly, 2006). The main source of livelihood is subsistence agriculture. However, a large part of the population dependents on the market for staple food and is, thus, vulnerable to price fluctuations based on supply and demand within a grain deficit area. This indicator is also policy sensitive. Maize production and prices are at the centre of the Malawi's food security policy, which in the recent years has contributed to accentuating supply shortages of maize on the domestic market and price increases (see, for example, Sassi, 2012; Cornia *et al*, 2012).

Malawi is characterised by seasonal patterns in the movement of food prices due to a heavily dependence on rain-fed agriculture: only 1 per cent of the land is under irrigation. Major maize price increases tend to occur twice a year. The first period takes place around August and September, when most of households run out of food stock from their own production, while the second occurs in February and March, during the lean season, just before the maize harvest. Major reduction in prices occur from April to June, just after harvest when most households have stored up maize from their own production (Chirwa, 2009). This peculiar pattern affects household food security with the months from December to February representing the hunger season for the majority of the people residing in the District of Salima, with poor households the most affected (Republic of Malawi - Salima District Assembly, 2006).

In the empirical investigation, a dummy variable for the hunger season (FOI) takes into consideration the seasonal lack of access to food. It is equal to 1 from December to February and to 0 throughout the other months.

The state of care for mothers and children is represented by three indicators.

The incidence of live births weighting less than 2500g out of total live new-borns (LOB) reflects not only the status of new-borns. This is also a proxy for a public health problem related to the long-term maternal situation in terms of nutrition and morbidity, antenatal care (i.e. primary health care), and possible foetal diseases (World Food Programme and Centres for Disease Control and Prevention, 2005; Molina, 2012).

New cases of children under-five years old affected by malaria (MUF) is adopted as a proxy of the level of preventive control interventions at the household level for one of the major health problems and leading causes of mortality and morbidity in Malawian children under-five years old (President's Malaria Initiative, 2012).

Finally, new cases of malnourished children under-five years of age is taken as a proxy for adequate child feeding practices in terms of dietary intake.

Access to and coverage of health services is assumed to depend on two variables. The first involves visited children under-five years of age affected by acute respiratory infections (ARI) and non-bloody diarrhoea— two of the major causes of illness and mortality among children under-five years old in Malawi— out of total children attending under-five clinics (DAC) (Ministry of Health, Planning Department, Health Management Information Unit, 2010; Republic of Malawi - Salima District Assembly, 2006). This variable represents as a proxy for the coverage of intervention on care-seeking, which is an important input into monitoring the progress towards the child survival-related MDGs and strategies (Molina, 2012).

The second adopted variable concerns the number of Health Surveillance Assistances in post (HAS). HAS represents important linkages between villages and the health system. They provide the majority of primary health care services; their responsibilities include health promotion and delivery of services for family planning, HIV, tuberculosis, malaria prevention and nutrition (Katz *et al*, 2010).

The last intermediate cause taken into consideration is the health environment conditions, which is hypothesized as represented by the number of outpatient department total attendance out of the number of households with access to drinkable potable water (OPH). This variable is adopted as a proxy for the health benefits of improved safe drinking water supplies, with this latter an MDG7 indicator.

2.2. Data source and quality

The monthly basic data between July 2004 to June 2012, from which the above mentioned indicators are elaborated, was provided by the Ministry of Health of the Government of Malawi, apart from the monthly maize prices at the district level and information on the hunger season that were collected from the FEWSNet National Representative in Malawi.

Concerning the quality of the information, it should be noted that, in Malawi, health data is gathered by the Health Care Delivery System established by the Ministry of Health as part of the implementation of the Sector Wide Approach (Ministry of Health, 2004a) alongside the MOH Programme of Work 2004 - 2010 (Ministry of Health, 2004b). Following the National Health Information Policy (Ministry of Health and Population, 2003), all public, private and Non Governmental Organizations health facilities—dispensaries, district health offices, district hospitals, and health centers— have to conduct routine passive surveillance of outpatient cases, inpatient cases, and inpatient deaths. This collected information is then transmitted to the competent District Health Office and Central Hospital. There, data is compiled and sent to the Ministry of Health central office for further compilation and analysis (Chirwa, 2011; USAID, 2012).

In spite of some limitations, this data is judged adequate for a programme planning and monitoring perspective and for the interpretation of trends (Ministry of Health, Planning Department, Health Management Information Unit, 2005; 2010).

Agricultural retail prices in Malawi kwacha per kilogram are collected by the Ministry of Agriculture at the market level on a weekly basis and aggregated, according to the simple average, on a monthly and annual

basis. The monthly maize price is from that dataset and it has been deflated with the Consumer price index, with 2000 the base year, which has been provided by the National Statistics Office (www.nso.malawi.net). The very few missing values have been estimated by the average monthly trends of the overall analysed period.

Finally, the hunger season is defined according to information provided by FEWSNet Bulletins (http://www.fews.net/Pages/country.aspx?gb=mw&l=en).

3. METHODOLOGY

The adopted empirical strategy is articulated into two steps.

The indicators shown in Table 1 have allowed testing a first model by Ordinary Least Square (OLS). It is specified as follows:

$$\ln(UWG) = c(1) + c(2) * \ln(MAP_{-2}) + c(3) * FOI + c(4) * \ln(LOB) + c(5) * \ln(MUF) + c(6) * \ln(NMC_{-1}) + c(7) * \ln(DAC_{-2}) + c(8) * \ln(HSA) + c(9) * \ln(CPH_{-1}) + \mu \quad (1)$$

where -1 and -2 indicate a lag of one and two months respectively.

The functional form and the lags have been selected according to statistical tests that measure the explanatory power of the alternative estimated regressions (Adjusted R-squared, F-statistic, Akaike information criterion, Schwarz criterion, Hannan-Quinn criterion, Durbin-Watson statistics). It should also be stressed that the introduction of NMC with one month lag solves the problem of serial correlation in the residuals, signalled by specific statistical tests (Durbin-Watson statistics, Ljung-Box *Q*-statistics for high-order serial correlation and Breusch-Godfrey Lagrange multiplier test for general, high-order, ARMA errors). What this means is that child nutritional status in one month is affected by that from the previous month.

In the second step, the empirical investigation explores if child nutritional status is the result of: long-term changes in the level of the historical series of the explanatory variables; or periodic fluctuations of constant length determined by factors such as rainfall and drought; or stochastic irregular forces resulting from short term fluctuations in the series that are neither systematic nor predictable, such as those related to unforeseen events like floods, earthquakes, wars and famines (Harvey, 1990).

To this end, all the explanatory variables in equation (1), but FOI, have been decomposed in the trend and cyclical (TC), seasonal (SF) and irregular (IR) component according to an X-12 monthly seasonal adjustment approach (Findley *et al*, 1998). The examination for each variable of the graph for trend-cycle and seasonal components and the statistics tests, such as the F-tests for seasonality, have suggested that the two effects interact to give the observed time series, according to a multiplicative model in all the cases. FOI is excluded by the decomposition procedure because it is introduced in order to control for a periodic event, the hunger season.

The decomposed variables have been substituted in Equation (1) with the definition of a second model. This takes the following form:

$$\ln(UWG)=c(1)+c(2.1)*\ln(MAP\_TC_{-2})+ c(2.2)*\ln(MAP\_SF_{-2})+ c(2.3)*\ln(MAP\_IR_{-2})+ +c(3)*FOI+ +c(4.1)*\ln(LOB\_TC) +c(4.2)*\ln(LOB\_SF) +c(4.3)*\ln(LOB\_IR)+c(5.1)*\ln(MUF\_TC)+ + c(5.2)*\ln(MUF\_SF)+ c(5.3)*\ln(MUF\_IR)+ c(6.1)*\ln(NMC\_TC_{-1})+ c(6.2)*\ln(NMC\_SF_{-1})+ +c(6.3)*\ln(NMC\_IR_{-1})+c(7.1)*\ln(DAC\_TC_{-1}) +c(7.2)*\ln(DAC\_SF_{-1})+ c(7.3)*\ln(DAC\_IR_{-1})+ +c(8.1)*\ln(HSA\_TC)+ c(8.2)*\ln(HSA\_SF)+ c(8.3)*\ln(HSA\_IR)+ c(9.1)*\ln(OPH\_TC_{-1})+ +c(9.2)*\ln(OPH\_SF_{-1})+ c(9.3)*\ln(OPH\_IR_{-1}) \quad (2)$$

As in the former model, equation (2) is estimated by OLS.

4. RESULTS

The OLS estimate of equation (1) is illustrated in Table 2.

Table 2 - OLS estimate of equation (1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	4.948	1.188	4.166	0.0001
C(2) - ln(MAP(-2))	0.152	0.058	2.645	0.0097
C(3) – FOI	0.197	0.063	3.142	0.0023
C(5) - ln(LOB)	0.399	0.079	5.080	0.0000
C(6) - ln(MUF)	0.166	0.119	1.396	0.1663
C(4) – ln(NMC(-1)	0.136	0.046	2.944	0.0042
C(7) - ln(DAC(-1))	-0.229	0.098	-2.333	0.0220
C(8) - ln(HSA)	-0.196	0.081	-2.398	0.0187
C(9) - ln(OPH(-1))	0.331	0.176	1.882	0.0632
R-squared	0.602	F-statistic		16.070
Adjusted R-squared	0.565	Prob(F-statistic)		0.000

The overall model performance is acceptable and, setting the level of the p-value at 0.10 for rejecting the null hypothesis, all the tested coefficients are non-zero, except for MUF, which is significant at the 16.63 percent level. To be more precise, the new cases of children under-five years old affected by malaria becomes statistically not significant when LOB is included in the regression. Thus, the incidence of live births weighting less than 2500g out of total live new-borns is a more proximal determinant of the number of underweight children under-five years old than MUF. In other words, in reference to the adopted sample and time period, malaria has no additional effects on child nutritional status beyond its effect through LOB.

The signs of the explanatory variables are all in keeping with the expectations.

A deterioration of household food security, due to increasing maize prices and manifestation of the hunger season; a worsening of the care services for mothers and children, expressed by a rise in the incidence of underweight birth and new cases of malnourished pre-school children; and a decline in health environment,

all work together in the increase in the number of underweight children under-five years old. Conversely, an improvement in access to and coverage of health services reduces the severity of the investigated issue.

The estimated coefficients indicate the percentage change in child nutritional status that can be expected from a one percent variation in the respective explanatory variables.

The largest impact predicted comes from a one percentage change in the live underweight birth out of total live new-borns, followed by the number of outpatient department total attendance out of the number of households with access to drinkable potable water.

The importance of LOB in clarifying the investigated phenomena is reinforced by the lagged new cases of underweight children under-five years old: the current and past levels of child malnutrition are strongly interlinked because of an intergenerational and a cumulative effect.

As far as the economic variables are concerned, it should be noted that the estimated parameter for the lagged maize price shows one of the smallest values.

Table 3 indicates how substantial the change in the maize price should be in comparison with health policy variables in order to reach a 1 percentage point reduction in the number of underweight children under-five years old, assuming the hypothesis that the other variables are constant.

Table 3 - Percentage changes in selected explanatory variables requested to reduce by 1 percent the number of underweight children under-five years old and the monthly average value of the related explanatory variable

Variable	Percentage change	Monthly average value
MAP(-2)	-6.58	35.41
LOB	-2.51	5.41
NMC(-1)	-7.35	273
DAC(-1)	4.37	24.03
HSA	5.10	236
OPH(-1)	-3.02	0.88

Values are derived by dividing 1 by the estimated coefficients, and must be read while considering the fact that the explanatory variables are measured in different units. As a result, they are not comparable. However, the monthly average value over the analysed time period, added in the final column, gives an estimate of the magnitude of the change.

Results for HAS are of specific interest. In fact, according to the objectives set by the government of Malawi, the district of Salima should have 833 HSA staff. However, currently there are 336 HSA staff members with a monthly average of 236 members throughout the analysed time period. Thus, accomplishing the goal would have a significant effect on child nutritional status with the possibility of halving the underweight children under-five years old.

4.1 Impact of variable components

Table 4 shows the parameters estimated detecting equation 2 by OLS.

Table 4 - OLS estimate of equation (2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	**7.448**	**2.192**	**3.398**	**0.0011**
C(2.1) - ln(MAP_TC(-2))	**0.108**	**0.063**	**1.710**	**0.0916**
C(2.2) - ln(MAP_SF(-2))	**0.370**	**0.185**	**1.999**	**0.0495**
C(2.3) - ln(MAP_IR(-2))	-0.131	0.120	-1.085	0.2815
C(3) – FOI	**0.171**	**0.055**	**3.114**	**0.0027**
C(5.1) - ln(LOB_TC)	**0.842**	**0.111**	**7.589**	**0.0000**
C(5.2) - ln(LOB_SC)	0.102	0.236	0.432	0.6673
C(5.3) - ln(LOB_IR)	0.053	0.098	0.541	0.5903
C(6.1) - ln(MUF_TC)	-0.205	0.206	-0.994	0.3234
C(6.2) - ln(MUF_SF)	0.176	0.154	1.143	0.2570
C(6.3) - ln(MUF_IR)	-0.137	0.207	-0.661	0.5106
C(4.1) – ln(NMC_TC(-1))	**0.217**	**0.065**	**3.347**	**0.0013**
C(4.2) – ln(NMC_SF(-1))	0.086	0.083	1.033	0.3053
C(4.3) – ln(NMC_IR(-1))	0.033	0.075	0.439	0.6623
C(7.1) - ln(DAC_TC(-1))	-0.022	0.125	-0.178	0.8591
C(7.2) - ln(DAC_SF(-1))	**-0.449**	**0.267**	**-1.681**	**0.0972**
C(7.3) - ln(DAC_IR(-1))	**-0.394**	**0.135**	**-2.924**	**0.0046**
C(8.1) - ln(HAS_TC)	**-0.336**	**0.111**	**-3.028**	**0.0034**
C(8.2) - ln(HAS_SF)	-0.468	0.537	-0.871	0.3866
C(8.3) - ln(HAS_IR)	-0.069	0.208	-0.333	0.7405
C(9.1) - ln(OPH_TC(-1))	**1.236**	**0.489**	**2.528**	**0.0137**
C(9.2) - ln(OPH_SF(-1))	0.378	0.297	1.271	0.2078
C(9.3) - ln(OPH_IR(-1))	**0.544**	**0.225**	**2.424**	**0.0179**
R-squared	0.802	F-statistic		13.111
Adjusted R-squared	0.741	Prob(F-statistic)		0.000

Key summary statistics confirm the well-fitting regression model results, underlining an improvement in the explanatory capacity with respect to the model as defined by equation 1. Introducing long- and short-term components, the adopted intermediate causes maintain their ability to explain the child nutritional status with MUF that, also in this case, remains statistically not significant.

Concerning the estimated parameters, first of all it should be noted the importance of the seasonal changes in the level of the historical series of the economic determinants of the number of underweight children under-five years old. The influence of the seasonal component of maize price is three times that of its trend-cycle and FOI reinforces this impact.

The trend-cycle is the only statistically significant component for Health Surveillance Assistances in post and for two of the hypothesized proxies of moternal and child care services, i.e. LOB and NMC. The result for these two latter variables reinforces the observation raised in commenting evidence from the estimates of equation 1. The literature underlies the negative long-term implication of child malnourishment, suggesting that adults who survive malnutrition as children are less physically and intellectually productive and suffer

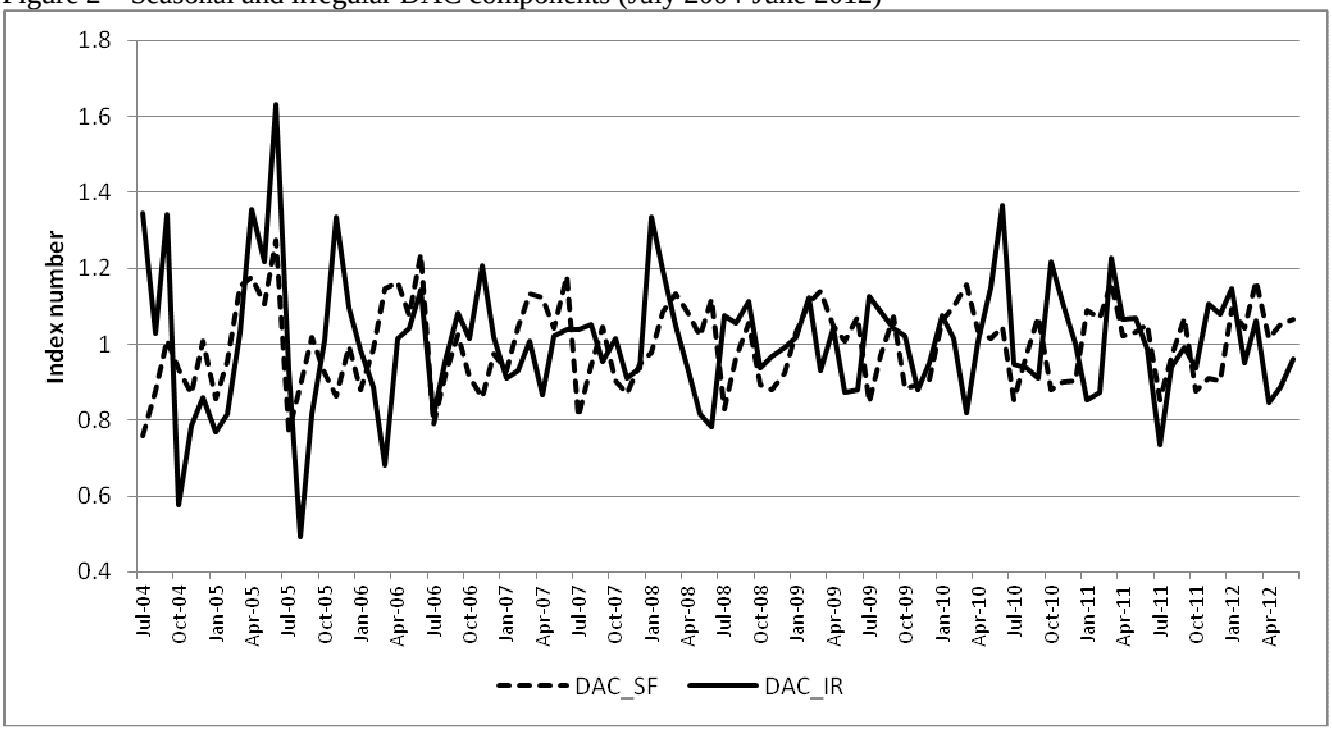
from higher levels of chronic disease and disability (UNICEF, 1998). The statistically significant trend-cycle component of LOB and NMC can be seen as explanatory of the "irreversible" negative implications of child malnutrition.

4.2. Coverage of intervention on care-seeking and health environment

The prediction capacity of the estimated parameters for the DAC components reflects the nature of the two considered infections and their relationship to child nutritional status: malnutrition makes children vulnerable to infections and each episode of infection, in turn, makes malnutrition even worse. ARI and non-bloody diarrhoea in children under-five years old have a seasonal component related to climate conditions. This explains the statistically significant explanatory capacity of the seasonal and irregular components of the adopted indicator.

Figure 2 illustrates this aspect. It represents the seasonal and irregular time series of DAC.

Figure 2 – Seasonal and irregular DAC components (July 2004-June 2012)



The seasonal component shows a pick in March, June and September, during the dry season, when there is a significant drop in temperature (Department of Climate Change and Meteorological Services, 2013). The exposure to the passage from hot to cold temperatures facilitates susceptibility to a viral infection. Children under the age of five years are badly affected by this change due to their physical vulnerability, especially those suffering from malnutrition and/or low immunity (McMichael *et al*, 2003).

The seasonal climatic effects on DAC are exacerbated by the extreme weather events that occurred in 2004 (drought), 2005 (drought), 2008 (dry spells and floods) and 2010-2011 (prolonged dry spells and floods) (Malawi National Vulnerability Assessment Committee, various years). The aspect is underlined by the

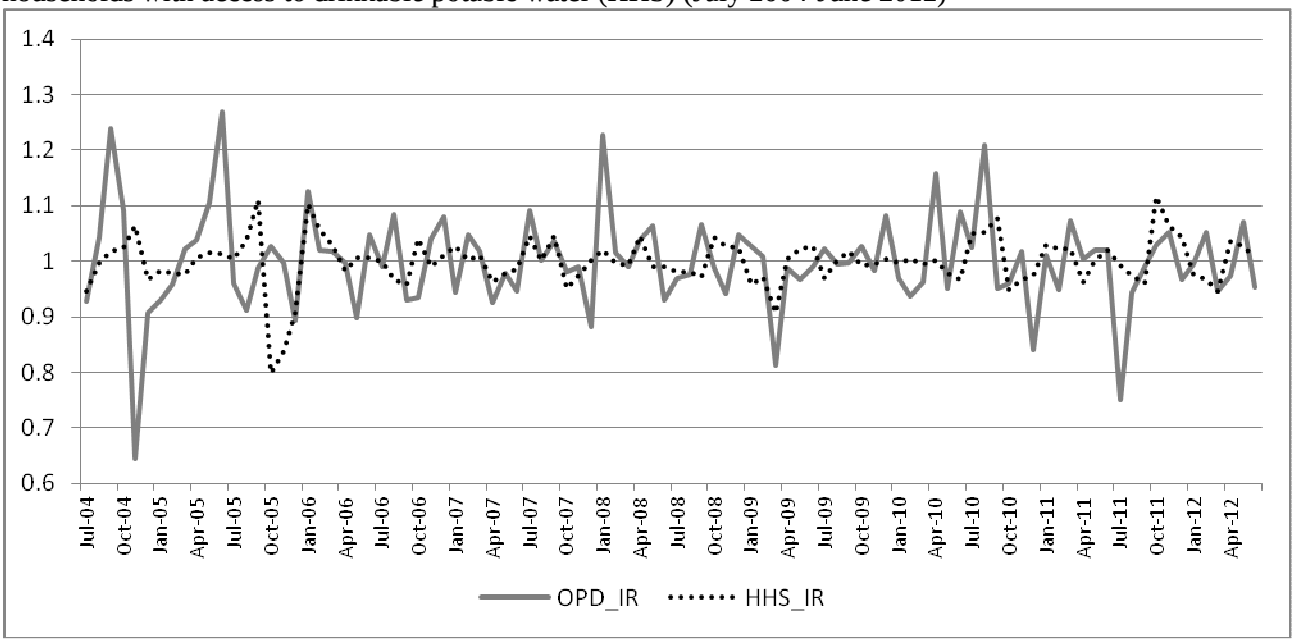
irregular component of the time series. This indicator reveals exceptional spikes not only over the hot and dry season but also during the hunger season, which is coincident with another change in weather conditions: the beginning of the hot and rainy season. This is another time of the year when vulnerability to infections increases.

According to the results of this study, improved access to under-five clinics during these critical periods prevents deterioration of child nutritional status.

The irregular component is also statistically significant for OPH, but in this case, in combination with the trend-cycle. The interpretation of the role of these two components deserves a specific attention. The sign of the coefficient of the trend-cycle results from the evolution in the number of households with access to drinkable potable water. This increase reduces the long-term component of OPH, with a positive impact on child nutritional status.

Conversely, the sign of the irregular component is affected by a substantial increase in the number of outpatient department total attendance over the above mentioned climatic emergency periods, as illustrated by Figure 3. In this case, the irregular component of OPH increases, aggravating the number of underweight children under-five years old, and reducing the potency of improvements in sanitation conditions.

Figure 3 – Irregular component: number of outpatient department total attendance (OPD) and number of households with access to drinkable potable water (HHS) (July 2004-June 2012)

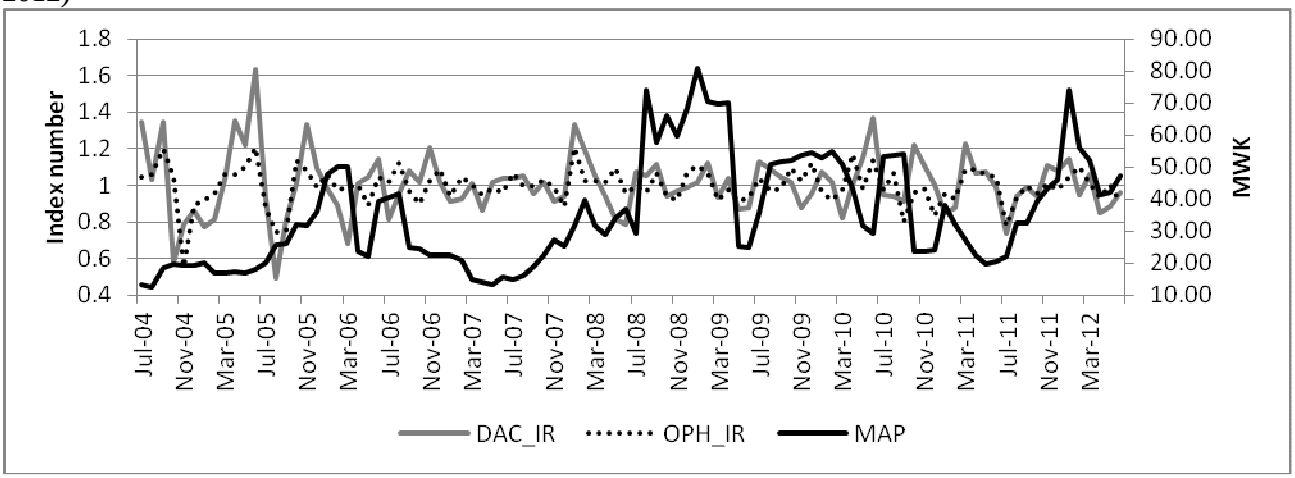


4.3 Maize price and health status

In Malawi, maize price seasonal changes are adopted as a means to interpret hunger and this aspect finds confirmation in this study for child nutritional status. Additionally, the literature considers maize price spikes as an indicator of famine due to the consequent significant level of mortality from hunger, with food shortage and political reasons considered as the determinants (see, for example, Devereux, 2012; Ellis and Manda,

2012). However, Figure 4 clearly illustrates that, in Salima, over the analysed time period, extreme maize price episodes are subsequent to a DAC and OPH stochastic shock driven by extreme climatic conditions.

Figure 4 – Maize price and irregular components of the historical series of DAC and OPH (July 2004-June 2012)



This study suggests an interpretation of "child famine" or, more precisely, of a severe deterioration of child nutritional status that is more complex than that provided by the literature on price crisis in the country and even by that referred to the inability of people to access to food, which was first emphasized by Sen (1981). According to the developed analysis, maize price, particularly its seasonal component, is only one of the contributing factors of malnutrition in children under-five years old and may be one of the last in a process starting with a health emergency during climatic shocks. These latter seems to initially affect health and afterwards the market, through the impact on agricultural production. In addition, the effect on the market is accentuated by the failure of policy response, as well documented by the literature (see also Dorward *et al*, 2008; Jayne and Tschirley, 2009; Minot, 2010).

The achieved results also indicate that improved access to under-five clinics, on its own, is not enough to counterbalance the negative effects on child nutritional status determined by the deterioration in food intake and child health status.

5. CONCLUSIONS

The developed analysis provides several key messages.

First of all, food security alone is not sufficient for improving child nutritional status in the district of Salima. The capability approach has allowed to better represent the complex nature of the investigated phenomena. A fact that, in the specific analysed case, suggests considering the relative response of child nutritional status to food and health in the policy making process in order to design a well balanced and coordinated set of interventions in both food and nutritional areas. This consideration is especially important for Malawi. Despite an institutional set up that includes a highly consultative process among some of the wide number of stakeholders working in the country at different levels and a coordinating and implementation structure with

several ministries involved (Department of Nutrition, HIV and AIDS, 2009), the food security policy is separated from the nutritional policy.

During the 2000s, Malawi lunched and implemented many plans and programs focused on agricultural development and food security. Among them, the Poverty Reduction Strategy Paper (PRSP) of 2001 recognised the link between food production and nutrition even if food security policy was still seen in isolation. An approach that was reinforced in 2007 when it was decided to split the Food and Nutritional Security Policy of 1990 into two distinct policies: the Food Security Policy and the National Nutritional Security (FAO, 2008). This choice was based on the observation that the programs and services implemented by the government did not give adequate attention to nutrition (Republic of Malawi, Office of the President and Cabinet, 2009).

In light of this separation, the achieved results reinforce the importance of efficient and effective coordination mechanisms primarily between ministries in order to guarantee food and nutrition security, as recently emphasised by the EU Commissioner Piebalgs and the FAO Director-General Graziano da Silva during the high level visit to Malawi on March 2013 (FAO Media Centre, 2013).

However, this approach should be expanded to all actors with a stake in the field. For example, the United Nation agencies specialised in food and nutritional issues work in the country and according to their mandate the FAO is focused on food security, WHO on health issues, WFP on food aid and UNICEF on care. Thus, each of them has a complementary role in improving child nutritional status in Malawi and for this reason their interventions should be jointly coordinated.

The complex nature of child undernourishment stressed by this study also suggests that the food security indicator traditionally adopted by the country should be reconsidered. In Malawi, the maize supply is the main indicator of food security with a food crisis interpreted as a situation in which maize supply falls below the minimum requirement. This indicator is criticized by part of the literature, but without any significant step towards the multidimensional feature of the problem. In fact, the proposed alternative critical indicator of food security is market maize price (see, for example, Ellis and Manda, 2012).

This aspect is of specific importance for policy purposes. The focus on maize as a political crop, due to the fact that food security is seen as dependent on that crop (Chisinga, 2012), has the consequence that maize market management is the major policy objective of the Malawian government in fighting against hanger and famine. The developed study confirms the importance of this policy while also indicating that, roughly speaking, the determinant variables showing a greater potency in reducing the number of underweight children under-five years old, in the district of Salima, are related to care services, particularly to mothers, and health environment conditions. Results also suggest the need to consider the relative response of interventions not just market oriented, but focused on child, household and community characteristics. Moreover, the decomposition of the historical series of the explanatory variables has introduced an additional element of complexity in the policy making process: the need for well-balanced long- and short-term interventions.

On this point, results confirm the literature that documents the seasonal dimension of food insecurity and child infections, contributing to the understanding of the potency of its impact. This paper also sheds light on the importance of the stochastic events in affecting child nutritional status during adverse seasons. These events exacerbate the multiplicative seasonal effects on child malnutrition, making the issue of improved child resilience to climatic variability a priority target.

Over the analysed time period, the consequences of extreme climate events have negatively affected child nutritional status, initially, through the deterioration of the state of health and care and, after few months, through worsening of market conditions aggravated by policy failures. This finding contributes to the debate on the nature of famine. Following the contribution by Sen (1981), food crises have been seen as a consequence of people inability to access food. This study supports the body of the literature that criticizes that approach, arguing that famine is a process of distinct phases rather than the result of an isolated event (see, for example, Howe, 2002) and adds to this debate the relevance of child health status.

Even if the short-term horizon represents an important investigation and policy perspective, this analysis confirms the urgency to arrest the long-term cycle of food insecurity and malnutrition. In this respect, policy focus should include fighting against female malnutrition, a condition that, in Malawi, is prevalent among women of reproductive age (World Food Programme, 2010).

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