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Simulating economic growth effects on food and nutrition security in Yemen: A new macro–micro modeling approach

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ABSTRACT

This paper presents an innovative approach for estimating changes in a country's food and nutrition security subject to economic growth and related income distribution over time. Specifically, we combine a dynamic computable general equilibrium model with household- and individual-level regression models and apply this macro–micro approach to assess the effects of Yemen's crisis-induced economic recession in 2011/12, together with two alternative transition scenarios from 2013 to 2020. Our results strongly suggest that not only more rapid, but also broader based economic growth will be needed for a quick return to pre-crisis food and nutrition security levels in Yemen. In addition to broader based growth that benefits the poor, targeted measures for improving nutrition such as integrated childcare programs and awareness campaigns related to family planning, female education, and qat consumption are needed.

1. Introduction

There is broad consensus that economic growth is a precondition for poverty reduction (e.g., Christiaensen et al., 2003; Deaton, 2005; Dollar and Kraay, 2002; Ravallion and Chen, 1997). Yet, the role of economic growth for food and nutrition security is less clear, and only few recent studies have attempted to estimate the effects of economic growth on people's nutritional status.[1] Results from cross-country regressions suggest that generally economic growth is a strong predictor of nutritional performance and contributes to reducing child undernutrition (e.g., Haddad et al., 2003; Headey, 2013; Smith and Haddad, 2002), although to a lesser extent than growth contributes to income poverty reduction (Headey, 2013). However, there is also evidence that economic growth and nutrition outcomes are only weakly associated in some world regions, and that some countries even face a growth-nutrition disconnect. For example, Breisinger et al. (2012) find that, unlike in other regions, growth in per capita gross domestic product (GDP) in Arab countries did not translate into significantly reduced child undernutrition in recent decades. In Egypt, for example, the prevalence rate of child stunting (i.e. chronic child undernutrition) has in fact increased from 23% in 2000 to 31% in 2011 (El-Zanathy and Way, 2009; WFP, 2013), despite an average annual growth rate of 4.6% during this period (World Bank, 2014).

However, most country-specific cross-sectional studies do find a positive relationship between household consumption expenditures (used as a proxy indicator of household income) and household food security indicators as well as household members' nutritional status. Calorie and micronutrient consumption has been found to significantly increase with household expenditures in Mexico (Skoufias et al., 2009), Malawi (Ecker and Qaim, 2011), and Tanzania (Abdulai and Aubert, 2004), for example. And, child height-for-age, which identifies child stunting, has been found to significantly increase with household expenditure in Ethiopia (Christiaensen and Alderman, 2004) and Tanzania (Alderman et al., 2006), for example, particularly when combined with interventions related to human capital formation.

Yet, evidence on the inter-temporal responses of food and nutrition security indicators to changes in household expenditures has been limited because of the general scarcity of longitudinal data. Quantitative evidence is particularly sparse for the longer-term relationship between household income growth and individual nutrition outcomes, because most nutrition surveys focus on specific age groups such as children below five years of age and do not follow up once the individuals grow out of the considered age period. In addition, most surveys cover

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[1] "Food and nutrition security exists when all people at all times have physical, social and economic access to food of sufficient quantity and quality in terms of variety, diversity, nutrient content and safety to meet their dietary needs and food preferences for an active and healthy life, coupled with a sanitary environment, adequate health, education and care" (CFS 2012, p. 8).

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time periods too short to adequately capture economic growth-nutrition effects or are simply not designed for panel data collection. If they are designed for panel data collection, they often do not collect data on household incomes such as the common Demographic and Health Survey (DHS). Nonetheless, available studies from the literature on the impact of economic shocks generally confirm the food security-income and child nutrition-income associations at the household and individual level found in cross-sectional studies (Headey, 2013). They also reveal critical, short-term substitution and distribution effects in food consumption as mechanisms to cope with shocks, which can have long-term nutritional consequences. For example, Block et al. (2004) show that households in rural Java considerably reduced their consumption of high-quality food in response to the experienced income losses during the 1997/98 Indonesian financial crisis. As a consequence of reduced food consumption, mothers' body-mass-index deteriorated during the crisis but quickly returned to pre-crisis levels afterwards. In contrast, child weight-for-age, which identifies underweight and captures both acute and chronic undernutrition, remained constant throughout the crisis possibly as a result of mothers buffering children's calorie intake. During the two years following the crisis year, though, the prevalence rate of child underweight increased from 27% to 30% (Block et al., 2004).

Overall, this brief literature review shows that, if economic growth trickles down and raises household incomes among food-insecure and undernourished population groups rather than just average national income, it is likely to improve household food security and individual nutrition. Hence, the extent to which economic growth improves food and nutrition security depends on country-specific factors, including the structure of the economy, the distribution of national income, and households' income and expenditure patterns. The nutrition literature (e.g., Bhutta et al., 2008; Ruel et al., 2013; UNICEF, 1990) also points to household food security as one important determinant of individuals' nutritional status, along with the importance of health services and the individual health environment as well as the care provided to the individual, all of which are particularly critical for the nutrition of young children. Since the food intake, the health status, and the care received is individual-specific, the intra-household distribution of the available resources matters for nutrition outcomes. Thus, estimating the effects of economic growth and simulating the effects of alternative growth and/or recession scenarios on food and nutrition security requires a comprehensive analytical framework.

This paper develops such a framework for application at the country-level. It links a dynamic computable general equilibrium model (DCGE) to an econometrically estimated food and nutrition security model and combines the estimates from both models for forward-looking simulations. DCGE models are among the most comprehensive tools for assessing the linkages between economic growth and household welfare as measured by incomes and expenditures (e.g., Bourguignon et al., 1991; Breisinger et al., 2009; Diao and Thurlow, 2012; Hertel et al., 2004). They map the interactions of agents in an economy and include many of the transmission channels that link economic growth to household expenditures such as production, consumption, labor markets, and the public sector. DCGE models thus provide consistent estimates of how economic growth translates into household expenditures, and—combined with household/individual-level models of food and nutrition security—they can also capture the direct and indirect effects of economic growth on household food security and people's nutrition. Applying such a combined macro–micro modeling framework as an impact assessment tool to a specific country context can help in addressing important policy questions. These questions may refer to the potential impact of economic crises on the prevalence of calorie deficiency ("hunger") and chronic child undernutrition. Or, for example in the context of the post-Millennium Development Goals agenda, it can provide evidence on the size and targeting of additional measures needed to meet country-specific food and nutrition security goals.

Methodologically, this paper contributes to the literature on DCGE-microsimulations. Following Debowicz and Golan (2014) classification, it adds to the class of layered non-behavioral approaches that keep the macro model and the microsimulation as separate entities and link them through some sort of communication between them. More specifically, we use a top-down approach, in which the macro model informs the microsimulation through the link of household consumption expenditures, which are endogenous in a CGE model and exogenous in the regressions of the food and nutrition security model. Previous applications of this approach have been limited to analyses of income poverty and inequality (e.g., Boccanfuso et al., 2008; Vos and Sanchez, 2010). We expand this strand of the literature by linking a DCGE model to a microsimulation, which utilizes parameters consistently estimated from regressions of household calorie consumption and child nutrition. This macro–micro approach provides estimates of changes in calorie deficiency and child stunting in Yemen under different economic growth scenarios. According to the best of our knowledge, this paper is the first study that combines a DCGE model with a microsimulation for nutrition outcomes to date. Existing similar studies such as by Ecker et al. (2011) for Malawi and Yemen, Pauw and Thurlow (2011) for Tanzania, and Wiebelt et al. (2013) for Yemen look only at household-level calorie and micronutrient consumption/deficiency. In addition, compared to this study, the previous studies fall short in aligning the disaggregation of the household accounts in the DCGE model with the estimation function of the regression or simply use aggregated parameter estimates from other sources.

Empirically, this paper contributes to the debate on the potential of economic growth and the role of complementary interventions for reducing food and nutrition insecurity in Yemen—a middle-income country in political transition and with extreme prevalence rates of household food insecurity and chronic child undernutrition (Breisinger et al., 2012; WFP, 2012). Due to the Arab awakening and the ensuing crisis in Yemen, the International Monetary Fund estimates that GDP shrank by about 10% in 2011 (IMF, 2012), and, as a result, poverty is estimated to have risen to 54% at the end of 2011, up from 42% in 2009 (World Bank et al., 2012). Improving food and nutrition security is very high on the new government's agenda. Yemen has developed a National Food Security Strategy and the topic also features prominently in the country's Transitional Program for Stabilization and Development and the international partners' Joint Social and Economic Impact Assessment (MOPIC, 2010, 2012; World Bank et al., 2012).

The paper is organized as follows. Section 2 describes the methodology underlying our macro–micro modeling framework. Section 3 discusses Yemen's economic structure and food and nutrition security situation. Section 4 presents the economic growth scenarios and their effects on food and nutrition security in Yemen. Section 5 presents the results of a sensitivity analysis and Section 6 concludes.

2. Methodology

To estimate and predict the effects of economic growth on food and nutrition security, we combine an economy-wide model—the "macro model"—with a household/individual-level model—the "micro model"—and use the model estimates for forward-looking (micro)simulations. Based on assumptions on sector-level growth potentials, the DCGE model produces consistent futures for, among others, total GDP growth and changes in household expenditure. The food and nutrition security model provides estimates of changes in household food security and individual nutrition subject to changes in household consumption expenditures, while controlling for other factors. Hence, the macro model links to the micro model via household expenditures. Projected changes in average expenditures of specific household groups from the DCGE model and econometrically estimated parameters of the responses of household food security and individual nutrition from the