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Are smallholder farmers better or worse off from an increase in the international price of cereals?

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ABSTRACT

The effect of agricultural price shocks on household welfare in low-income countries is a major concern for policymakers attempting to reduce poverty rates. This study estimates the impact of an increase in the world cereal price on rural households in Burkina Faso in an agricultural household model framework. We account for imperfect transmission of global prices to local prices as well as supply and demand response of rural households to price signals. The increase in price during the period from 2006 to 2014 is translated to welfare improvement ranging from 0.02 percent for 2006 to 0.06 percent for 2011 for farmers in Burkina Faso.

1. Introduction

In 2008 and 2009, steep increases in international food prices raised concerns about negative welfare impacts on, and the overall poverty rates of, populations in low-income countries. From mid-2007 until mid-2008, the global prices of major cereals increased up to 130 percent with most of these increases passed on to domestic markets (Ivanic and Martin, 2014; Baquedano and Liefert, 2014). Such dramatic changes in food prices may increase poverty rates in developing countries, especially poor ones, where consumers spend most of their income on food and also heavily rely on agricultural production to earn a living (Headey, 2016). In addition, price shocks and the resultant social unrest could sharply increase political instability (Bellemare, 2015). In general, the literature uses three major methods to assess the effect of cereal price increases on household welfare. These are the net benefit ratio (NBR), econometric-based methods and computable general equilibrium models (CGE).

The approach of Deaton's elasticity of the cost of living with respect to the price of a staple good, also known as the net benefit ratio, is an important starting point for evaluating the welfare effect of a price change (Deaton, 1989). As pointed out by Headey (2016), most studies based on the NBR reached consistent conclusions of negative welfare impacts of food price increases since the poor are net consumers of staples (Ivanic and Martin, 2008; De Hoyos and Medvedev, 2011; Ivanic et al., 2012; Badolo and Traore, 2015). However, several critiques of these results have emerged. Recent studies indicate that consumption and production data based upon short-term recall and used to extrapolate to annual estimates suffer from significant downward biases compared to consumption-plus-sales diary methods (Beegle et al., 2016; Deininger et al., 2012).

Another drawback of the NBR approach is the assumption of no behavioral or market response to higher food prices (Headey, 2016). However, rural household engagement in farming provides scope to adjust production during and between cropping seasons in response to higher food prices (Headey and Fan, 2010, 2008; Magrini et al., 2017a, 2017b). Studies in Madagascar, Malawi, Zambia and Niger have found long-run reductions in poverty and food insecurity following price increases (Headey, 2016; Van Campenhout et al., 2013; Jacoby, 2016; Headey, 2011). Other studies have estimated the impact of price volatility on welfare (Bellemare et al., 2013; McBride, 2015; Magrini et al., 2017a). Previous literature did not relate household welfare to a world price shock in a way that underscores the role played by world price transmission to domestic markets.

The main objective of this paper was to highlight the theoretical and empirical relationship between world price shocks and household welfare for those individuals living in rural areas by taking price transmission into consideration. Based on both the agricultural household model and the law of one price, we extended Deaton's method to account for imperfect price transmission of global prices to local producer and consumer prices. We applied our model to rural households in Burkina Faso using a three-year nationally representative panel survey on expenditures collected using the consumption-plus-sales method. The study considered six major food commodities produced and consumed in rural areas including: pearl millet, maize, rice,

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sorghum, peanuts and cowpea. Together these commodities occupy more than 80 percent of the cultivated area of food crops in Burkina Faso (MASA, 2004)[1].

Our major contribution was to combine welfare analysis and price transmission literatures to identify household welfare implications of world price shocks. We also examined data collection differences of the NBR by using our own consumption-plus-sales survey method to estimate household annual consumption as opposed to recall-based approaches (Deininger et al., 2012). Finally, we accounted for behavioral responses in household demand and supply when evaluating the welfare effects of price changes.

Under conditions of price certainty, we found that increases in world prices were associated with an improvement in rural household welfare. This was because the positive producer effect outweighed the negative consumer effect. The increase in price during the period from 2006 to 2014 translated into welfare improvement ranging from 0.02 percent in 2006 (the lowest improvement) to 0.06 percent in 2011 (the highest improvement) of the total purchases. The shocks generated positive welfare impacts for most of the crops, except sorghum and rice. Furthermore, consistent with Baquedano and Liefert (2014), we found that world cereal prices changes are transmitted to consumers and producer prices for almost all the commodities considered in this study. Finally, households had statistically significant behavioral responses to price signals on both the demand and supply sides for the majority of crops.

The remainder of the paper includes information about our conceptual framework, which was based on an agricultural household model to derive the relationship between household welfare and world cereal price changes. Our empirical strategy estimated the welfare effect, including identification of our demand, supply and price transmission elasticities. The three last sections respectively describe our data, the major findings and policy implications.

2. Conceptual framework

Consider the classic model of agricultural households (Singh et al., 1986; Deaton, 1989). In each production cycle, households are assumed to maximize their living standard (utility) over agricultural staples, purchased market goods and leisure. Given a farm production technology and an income constraint, the household standard of living is represented as follows:

$$u_h = \psi(w \times T + A + \pi h(v, w, p^p(p^w)), p^c(p^w)) \quad (1)$$

where the utility of household h (u_h) is determined by its income (I), composed of the value of its available total time ($WageRate(w) * TotalTime(T)$), the $transfer(A)$ received, profit (π_h) from farming or other family businesses, the consumer price (p_c), and the world price (p_w). Farm profit depends on input prices (v), the wage rate (w), producers' price (p_p) and the world price. Thus, a price shock will have two effects: first, the change of household welfare through consumption, and second, through production. On the production side, the welfare change is a function of household marginal utility of income ($\frac{\partial\psi}{\partial I}$), sales of home-produced goods or commodities (y_i), and the transmission elasticity of world price to the producer price (ε_{ip^w,p^p}). On the consumption side, the welfare change following an international price increase depends on the marginal utility of income ($\frac{\partial\psi}{\partial I}$), purchases ($q_i$), and the transmission elasticity of the world price to the consumer price (ε_{ip^w,p^c}). The effect of a change in the world price of commodity i on household utility[2] is represented by:

$$\frac{\partial u_h}{\partial p^w} = \frac{\partial\psi}{\partial I} y_i \varepsilon_{ip^w,p^p} - \frac{\partial\psi}{\partial I} q_i \varepsilon_{ip^w,p^c} \quad (2)$$

[1] Minist`ere de l'Agriculture et de la Śecurit́e alimentaire (MASA)

[2] See derivations in the appendix.

As with the standard agricultural household model, the net effect could either be positive or negative. Our model focused on the bias that can be introduced when differential price transmission elasticities exists ($\varepsilon_{ip^w,p^p} \neq \varepsilon_{ip^w,p^c}$). The welfare effect is trivial if and only if the world price is fully transmitted to producer and consumer prices ($\varepsilon_{ip^w,p^p} = \varepsilon_{ip^w,p^c}$=1), or equally transmitted ($\varepsilon_{ip^w,p^p} = \varepsilon_{ip^w,p^c}$) or there is no temporal difference in marketing decisions. Using $\frac{\partial u_h}{\partial p^w} = (y_i - q_i)\frac{\partial\psi}{\partial I}$ as a measure of the world price change welfare effect is equivalent to assuming full price transmission to producer and consumer prices, which is empirically implausible under many circumstances. Therefore, the status of household h as a net buyer or net seller is the only driver of the welfare effect following a world price shock.

In addition to relaxing the assumption that price transmission is equal for consumer and producer prices, we also accounted for supply and demand responses when estimating the welfare impact of a change in world price. We approximated the change in consumer welfare using Compensating Variation (CV), defined as a change in the household expenditure (Irvine and Sims, 1998). Following Irvine and Sims (1998) and Martin and Alston (1997), the change in producer welfare (PW) is derived as a change in the profit function (π). As a result, the net welfare change is represented as:

$$welfare = e(p^c(p_0^w), u_0) - e(p^c(p_1^w), u_0) + \pi(p^p(p_0^w), u_0, z_0) - (p^c(p_1^w), u_0, z_0) \quad (3)$$

where e(.) is the household expenditure function, and p_0^w and p_1^w are the levels of world cereal price before and after a price shock. Household utility before the price change is u_0. We assumed that labor is perfectly inelastic in the short-run causing input price stickiness.

3. Empirical strategy

Following Irvine and Sims (1998) and Martin and Alston (1997), second-order Taylor series approximations of the expenditure and profit functions were used to approximate Eq. (3)[3]. The following equations are used to estimate welfare impacts:

$$CV \cong -\sum_{i=1}^{n} q_i p_i^c \varepsilon_{ip^w,p^c}(\zeta_{p^w}) - \frac{1}{2}\sum_{i=1}^{n} q_i p_i^c \eta_{ii} \varepsilon^2_{ip^w,p^c}(\zeta_{p^w})^2 \quad (4)$$

$$PW \cong \sum_{i=1}^{n} y_i p_i^p \varepsilon_{ip^w,p^p}(\zeta_{p^w}) + \frac{1}{2}\sum_{i=1}^{n} y_i p_i^p \gamma_{ii} \varepsilon^2_{ip^w,p^p}(\zeta_{p^w})^2 \quad (5)$$

with ζ_{p^w} being the relative exogenous price shock[4] in cereal world price, and η_{ii} and γ_{ii} the Marshallian demand and supply elasticity of commodity i, respectively. The price at which households buy and sell crops may be different, mainly due to marketing differences between purchases and sales. In fact, most crops' sales are conducted during the harvest period when there is an excess of supply. Purchases occur during the lean season for farm households that are net buyers. As a result, production and consumption were considered as different activities and non-separable. Furthermore, y_i and q_i were estimated respectively as the country-level total quantities purchased and sold of all commodities. Our model imposed no cross-price effects, as discussed in the next section. Approximations of market demand (y_i) and supply quantities (q_i) could be considered to better capture household decisions on food market participation[5]. The survey collected household-level data on quantities of these variables each year in the local unit of measurement.

[3] See derivations in the appendix A

[4] The relative exogenous price shock stands for the percentage change in FAO cereal price index relative to the base 2002–2004.

[5] y_i and q_i are the weighted total of quantity purchased and sold. The weight is attributed to each household to ensure the sample represents the rural population.