

Raising Food Prices and Welfare Change: A Simple Calibration

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Abstract:

This paper proposes a simple and straightforward method which only requires the information of expenditure share and the compensated own price elasticity to calibrate ex ante consumer welfare change due to price change, while specific price information is not required. It is applied to calculate the welfare loss due to recent food price inflation, and find that recent food price inflation after Jan. 2009 in the world causes 22%, 14% and 9% welfare loss respectively for low-, middle- and high- income countries.

Key Words: Compensating Variation, Food Price, Welfare Loss, Low-Income Countries.

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Introduction

Recent food price inflation has significant negative impact on household welfare, particularly for the poor households (Ferreira et al. 2013; Meyer and Yu 2013). The prevalent method to calculate consumer welfare change in response to price change is the Hicksian Compensating Variation (CV), which assumes expenditure is constant. The main stream of the current literature uses the first-order approximation (Ferreira et al. 2013; Deaton and Muellbauer 1980 pp.186) or the so-called exact welfare measure (Hausman 1981) which is derived from integrating the Marshallian demand function, to calculate CV. The method of first-order approximation suffers from serious bias if the income effect is very large, whilst the method of exact welfare measure involves complicated integration and may also entail substantial bias if the demand function is not correctly specified. Even though Friedman and Levinsohn (2002) and Robles and Torero (2010) provide second order approximations for CV, they require price information for specific products, and hence are ad hoc. From the policy perspective, it is important to know the welfare impact in advance, so that some simple calibrations would be very appealing.

This paper simplifies the second-order approximation by Friedman and Levinsohn (2002), and proposes a much straightforward method to calculate the welfare impact of price changes. It only requires the information for expenditure share (Engel index for the case of food) and compensated own price elasticity to calibrate ex ante welfare change due to price change. Such a method can provide precautionary policy to offset negative impact of price change promptly.

Methodology

Suppose the price for good i changes from p_i^0 to p_i^1 , then the compensating variation is defined as

$$CV = E(p^1, u^0) - E(p^0, u^0) \quad (1)$$

where p , u , and $E(\bullet)$ respectively denote price vector for m goods, utility, and expenditure function; The superscript $j, (j = 0, 1)$, denotes time: $j = 0$ and $j = 1$ respectively for before and after price change. CV can be normalized by expenditure as

$$M = \frac{CV}{E(p^0, u^0)} \quad (2)$$

M in equation (2) can be explained as the proportion of addition expenditure entailed by price change to the expenditure before price change in order to keep the welfare constant. Following Friedman and Levinsohn (2002) and Robles and Torero (2010), $E(p^1, u^0)$ can be approximated as

$$E(p^1, u^0) \approx E(p^0, u^0) + \sum q_k^0 \Delta p_k + \frac{1}{2} \sum \sum s_{kj}^0 \Delta p_k \Delta p_j \quad (3)$$

where $s_{kj}^0 = \frac{\partial^2 C(p^0, u^0)}{\partial p_k \partial p_j} = \frac{\partial h_k^0}{\partial p_j}$ by Shephard's Lemma, and h_k^0 is the Hicksian demand for Good

k . Then we have,

$$CV \approx \sum q_k^0 \Delta p_k + \frac{1}{2} \sum \sum s_{kj}^0 \Delta p_k \Delta p_j. \quad (4)$$

If p^1 is fairly close to p^0 , or if p^1 is almost proportional to p^0 , or if substitution is limited, the second order term will be small, and the bias for the first-order approximation is small (Deaton and Muellbauer 1980 pp.174).

In practice, policy makers usually concern about the impact of price change for a specific good or a group of goods, such as food group. Suppose the price for group i (e.g. food) changes, while the prices for other goods are fixed. By Equation (4), we have

$$CV \approx q_i^0 \Delta p_i + \frac{1}{2} \frac{\partial h_i^0}{\partial p_i} (\Delta p_i)^2 \quad (5)$$

Define $\frac{\Delta p_i}{p_i^0} = G_{p_i}$ as the price growth rate. Combining equations (2) and (5) yields

$$M = w_i [G_{p_i} + \frac{1}{2} \varepsilon_{ip} G_{p_i}^2] \quad (6)$$

where $w_i = \frac{h_i^0 p_i^0}{E(p^0, u^0)}$ is the expenditure share for good i before price change, and $\varepsilon_{ip} = \frac{\partial h_i^0}{\partial p_i} \frac{p_i^0}{h_i^0}$

is the compensated own price elasticity (Proof can be seen in Appendix 1).

Different from Friedman and Levinsohn (2002) and Robles and Torero (2010), Equation (4) provides a simple calibration for welfare change in response to price change for good i , but it only requires the information for budget share w_i and compensated price elasticity ε_{ip} , which are often available in the literature. We then can ex ante calibrate the welfare change, and provide precautionary policy to offset negative impact of price change promptly.

In the case of food price change, w_i is simply the Engel Index. Obviously, Equation (6) indicates that welfare loss due to high food prices is positively correlated with Engel Index when

the absolute value of price elasticity and price growth rate are small. As the poor usually have higher Engel index, the loss of welfare would be greater.

Application and Discussion

Recently, food price inflation has attracted a lot of attention (Ferreira et al. 2013, Robles and Torero 2010) from a policy perspective. As shown in Figure 1, the world has experienced two food crises in the past decade: one in 2008, and the other one after 2009. For the recent food crisis, food price has increased by almost 50% compared with the data in January 2009. High food price can inevitably impact consumer welfare, and the number can be easily calibrated by Equation (6).

The current literature has provided ample information about food budget shares (or Engel index) and own price elasticities. The largest database for cross-national comparable budget share information would be the International Comparison Program (ICP) (World Bank 2008)¹. Then USDA estimated income and price elasticities, including compensated own price elasticities needed in this study by using the 2005 ICP data² (Muhammad et al. 2011). Given the budget share and compensated own price elasticities, we can calculate the welfare loss in different scenarios for different countries. We only report the aggregate results for low-, middle- and high-income countries in Table 1.

Table 1 indicates that when food price grows by 50%, which occurred after Jan. 2009 in the world, 22%, 14% and 9% of the incomes are needed to compensate the welfare loss respectively for low-, middle- and high- income countries. The numbers are quite huge.

Finally, it should be mentioned that the method is based on the second-order approximation, so that there might be some bias when the price growth rate is high.

¹ The most recent ICP program was set up in 2011, but only 2005 ICP data is available at : http://siteresources.worldbank.org/ICPINT/Resources/270056-1255977254560/6483625-1337016259587/2005ICPReport_FinalwithNewAppG.pdf

² Available at: <http://www.ers.usda.gov/data-products/international-food-consumption-patterns.aspx>

Appendix 1:

Proof of Equation (6).

Combining equations (2) and (5) yields

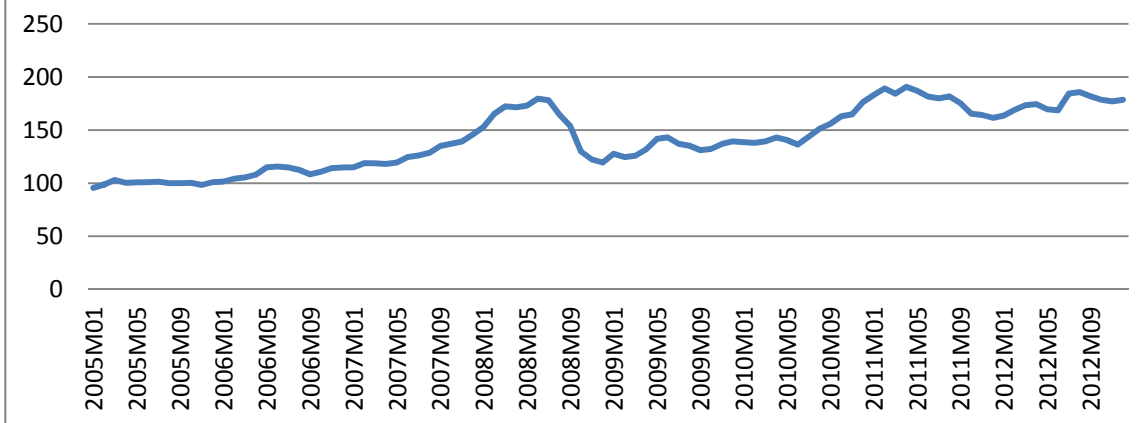
$$\begin{aligned} M &= \frac{1}{E(p^0, u^0)} [q_i^0 \Delta p_i + \frac{1}{2} \frac{\partial h_i^0}{\partial p_i} (\Delta p_i)^2] \\ &= \frac{h_i^0 p_i^0}{E(p^0, u^0)} [\frac{\Delta p_i}{p_i^0} + \frac{1}{2} \frac{\partial h_i^0}{\partial p_i} \frac{p_i^0}{h_i^0} (\frac{\Delta p_i}{p_i^0})^2] \\ &= w_i [G_{p_i} + \frac{1}{2} \varepsilon_{ip} G_{p_i}^2] \end{aligned}$$

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Figure 1, World Food Price Index

(Jan. 2005-Dec. 2012, and 2005=100)



Source: IMF Primary Commodity Prices

<http://www.imf.org/external/np/res/commod/index.aspx>

Table 1, Welfare changes (M) in response to food price change with difference scenarios

	Budget share for Food, Beverages & tobacco	Compensated Own Price Elasticities	Welfare Change for Different Scenarios of Price Change Rates				
			10%	20%	30%	40%	50%
Low-income	0.485	-0.345	0.05	0.09	0.14	0.18	0.22
Middle-income	0.311	-0.379	0.03	0.06	0.09	0.11	0.14
High-income	0.204	-0.323	0.02	0.04	0.06	0.08	0.09

Note:

Low-income countries represent those with real per capita income less than 15 percent of the U.S. level; middle-income countries are those with real per capita income between 15 and 45 percent of the U.S. level, and high-income countries with have per capita income equal to or greater than 45 percent of the U.S. level. Budget share and price elasticities are reported in Muhammad et al. (2011).