

**TRADE REFORMS AND FOOD SECURITY PROJECT  
 FNPP/GLO/001/NET – 01**

**Methodological Approaches**

**1. Price decomposition**

The question asked here is whether, and to what extent, it is the reform process that explains the evolution of market prices (producer, consumer or wholesale) of tradables in the post reform period, or there are other forces at work. In reality, domestic prices are influenced by a number of factors, notably world prices, exchange rates, tariffs, domestic marketing margins and so on. It is useful to know the percentage contribution of these various factors to changes in market prices so that some informed conclusion may be drawn about the relationship with the reform process.

One way to go about this, as the first step in the price analysis, is to use a technique to decompose the contributions to price changes. The technique is simple and works as follows.

Assume that the domestic price of a product, for some period “0”, is determined as in equation (1):

$$P_d^0 = P_w^0 * E^0 * t^0 * c^0 \dots\dots\dots (1)$$

where  $P_d$  is domestic price (e.g. at farm level),  $P_w$  is world price,  $E$  is exchange rate,  $t$  (or  $(1+t)$  to be exact) represents *ad valorem* tariff and  $c$  (or  $(1+c)$  to be exact) represents other (proportional) costs (e.g. transport and marketing costs). Similar relationship is defined for some other period (period “1”) as in equation (2):

$$P_d^1 = P_w^1 * E^1 * (1 + t^1) * (1+c^1) \dots\dots\dots (2)$$

Taking logs (ln) of both equations and subtracting (1) from (2), one obtains equation (3):

$$(\ln P_d^1 - \ln P_d^0) = (\ln P_w^1 - \ln P_w^0) + (\ln E^1 - \ln E^0) + (\ln t^1 - \ln t^0) + (\ln c^1 - \ln c^0) \dots\dots\dots (3)$$

Since the first-order difference of logs gives (approximate) percentage change (after multiplying by 100), the change in the domestic price is decomposed in a way that the contributions of the four factors sum to 100%. The data for the first three variables are often easily available; it is only in the last two cases that researchers will face data problems. In view of this, many analysts simply combine the last two terms and conduct the decomposition – which is also useful in that this term represents the effect of domestic factors (policies and others).

**2. Price transmission analysis**

In some way, price decomposition is also a study of price transmission because it shows the relationship between the world and domestic prices. But there is a separate, and large, literature on price transmission in the context of market integration.<sup>1</sup> The purpose of price transmission analysis is to determine the degree of integration of two or more markets, notably the world and domestic markets and spatially separated markets within a country. One of the effects of policy reforms is to increase the degree of market integration. For example, changes in world market

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<sup>1</sup> Some references on this subject include Colman (1992, 1995), Lloyd et al. (1997) and Sharma (2002).

prices would be strongly reflected in domestic prices following the removal of quantitative controls on trade and with tariff-only import or export regimes (in *ad valorem* forms). Similarly, competitive procurement and free internal trade following the removal of the monopoly right of marketing boards should result into much stronger transmission of price signals across domestic markets. It is for these reasons that price transmission studies are widely undertaken to study market performance and integration, as well as to evaluate the impact of reforms (in the pre- and post-reform framework).

Both the TRFS project and FAO/World Bank study plan to use this technique, for quantifying both the world-to-domestic (farm level) and inter-market transmission of price signals. The econometrics of price transmission analysis is well developed and there are many applications to learn from. Like all econometric methods, the technique is very data demanding, in terms of monthly prices in two or more markets, as well as additional information to interpret the results (e.g. policies that damp or magnify the transmission, marketing and transport costs etc.).

### **3. Analysis of marketing, transport and other margins**

This is yet an additional important “tool kit” in the analysis of prices or incentives. Economic reforms should reduce the cost of doing business, or margins facing economic agents. Thus, margins are an important intermediate impact indicators in themselves. They are also indispensable statistics for other related analysis: to explain the (often low) share of consumer price (or world price) received by producers; to explain the price transmission results; incentives to export; and to examine differential terms of trade (on outputs, foods purchased and input prices) facing small and large farmers. In other words, a good idea of changing margins over time and across locations is a must for any study on trade liberalization and food security.

All the studies will measure these margins, at various places, e.g. border to wholesale markets (major towns) and all the way to the farm level. The analysis of margins plays an important role because many studies have shown that smaller farmers invariably face much higher margins (and transaction costs) than larger farmers, and this explains a great deal of their differential participation in commercialization.

### **4. Supply response to incentives and other factors**

In the sequence of the research being discussed here, the analysis of supply response comes after that of the analysis of the incentives regime and before the quantification of the outcome indicators. Supply response is about how producers (and consumers) respond to changes in product and factor prices, in technology and in access to other constraining factors of production. It is mostly the case that different producers (and consumers) will respond differently to similar incentives depending on other factors (constraints). Thus, this is a key building block in the study of economic reform and food security. The main purpose is to understand why or why not there was a response.

The TRFS studies will attempt to estimate these responses. Efforts will be made to quantify the response, i.e. measure supply response elasticities, for major commodities at various levels, e.g. typical household, village, region and in the aggregate. Despite the importance, estimating supply responses in a robust manner has always been a difficult task, largely due to lack of suitable data.<sup>2</sup> Good quality survey data is essential for measuring the response by farmers. Even where the quantification of elasticities using econometrics is not feasible, insights should be gained through other techniques. Interviews with farmers, key informants and extension workers often reveal if farmers did respond to incentives following some reform, whether the

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<sup>2</sup> Examples of some recent estimates for some African countries are Abrar et al (2002) and McKay (1998). These analyses use data from large scale household surveys.

response was weak or strong, and what non-price factors<sup>3</sup> were important for facilitating the response. Where there was no response, these surveys should point to constraints limiting the response.<sup>4</sup>

### 5. *Quantifying the outcome – impact on income and food security*

Once relative prices of inputs and outputs and other factors of production are determined (or analysed), the next step is to compute the ultimate impact, e.g. changes in income, welfare, food security etc. The most commonly used framework comes from *agricultural household models*. These can be simple accounting frameworks to record all incomes and expenditures (consumption) of a household in one place in order to compute the net change – in which case they can hardly be called models – or could incorporate quantity responses to price changes, in which case these could be called “models”. The former may be called “first-round impact” (only the impact of price changes) and the latter “second-round (or complete) impact”.

Applications based on this approach to quantify the impact of reform on poverty are numerous. The following framework is somewhat simplified, but adequate enough for most cases.

For a selected household type, and a given period, the full income and consumption expenditures are defined as in equations (4) and (5).

$$\text{Income: } Y = (\sum p_j^o q_j^o - \sum p_k^i q_k^i) + w.L + T \dots\dots\dots (4)$$

where the first term within the bracket is value added (income) from own production (the p’s indicating prices and q’s indicating quantities, the superscript “o” for output and subscript “j” for commodities produced). The “w.L” term is to measure labour income (wage rate times employment) and T is transfers received by the household (e.g. from government, pension, remittance etc.).

$$\text{Consumption expenditure: } C = (\sum p_j^c q_j^c) \dots\dots\dots (5)$$

with variables as above (the superscript “c” standing for consumption).

The purpose is to measure a change over two periods. Where survey data are available for two periods, the Y and C in equations (4) and (5) are measured for two periods. Where this is not possible, analysts have measured the impact of price changes (induced by policy reforms, as estimated in the previous steps, or shocks) assuming that quantities do not change. This is the short-run effect, also called “first-round” effects. This is done by assuming that quantities do not change. Using the change operator Δ, equations (6) and (7) are used for this purpose:

$$\Delta Y = (\sum \Delta p_j^o q_j^o - \sum \Delta p_k^i q_k^i) + \Delta w.L + \Delta T \dots\dots\dots (6)$$

Similarly, the change in consumption assuming that consumed quantities remain fixed is:

$$\Delta C = (\sum \Delta p_j^c q_j^c) \dots\dots\dots (7)$$

A first-order approximation of the change in money metric utility, or welfare  $W^5$ , resulting from changes in prices (including wage rates) is given by expression (8):

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<sup>3</sup> Often these are access to suitable land, irrigation, inputs (credit, fertilizers), markets etc.  
<sup>4</sup> One technique that has been used in the past to study supply response to prices and other constraints at the farm level is to use liner programming methods. This would be “what if” type of analysis, rather than quantifying past responses; but could be useful for insights about how farmers would have responded.  
<sup>5</sup> Most poverty-focussed studies measure welfare in income terms. In food security-oriented studies, there is a justification for extending the analysis to quantify the impact in terms of food consumption, e.g. by

$$\Delta W = \Delta Y - \Delta C \dots\dots\dots (8)$$

With this framework, it is possible to analyse the impact of changes in many variables, e.g. output prices, food prices, input prices, wage rates, transfers etc. In particular, the focus of many studies has been on the impact of a change in food prices. This is because an increase in food prices not only leads to higher income but also higher consumption expenditure. The net gain will depend on the net position of the household (net seller or net buyer) and the weights (income and consumption shares).

Many studies also “imbed” quantity responses, i.e. price and income elasticities of supply and demand, in equations (4)-(8) in order to derive expressions that permit the analysis of “second-round” effects also.<sup>6</sup> The model is also widely used for *ex ante* simulation studies, under a variety of assumptions about markets, e.g. complete and fully functioning markets, missing markets, or imperfect markets.

The identification of “typical” households is often critical in this part of the research. The TRFS project, for example, asks researchers to consider the following categories to select households (in addition to non-farm rural household). Similar guidelines are given in the FAO/World Bank study.

- By degree of commercialisation (subsistence, pre-commercial, commercial)
- By types of main products (export crops, import crops, non tradables)
- By organisation of farming (owner operated, cooperative, contract farming, sharecropping, plantation)
- By mode of market access (e.g. how output and credit markets are accessed)
- By scale of resources access (particularly land).

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measuring food energy (kilocalories) and protein. Several studies on agricultural commercialization in von Braun and Kennedy (1994) extend the analysis from incomes/expenditures to food energy.

<sup>6</sup> There are numerous references on agricultural household models and their applications to cite here. Two widely quoted references are Barnum et al. (1979) and Singh et al. (1986). A good exposition of the theory and application is in Chapter 6 of Sadoulet and de Janvry (1995). Sahn and Sarris (1991) apply similar method in their study of five countries in Africa (they trace welfare changes for 15 years, 1975-89). The Ethiopian study of Dercon (2001) uses similar technique. Minot and Goletti (2000) apply the method in their study of the impact on poverty of Vietnam’s rice market liberalization.