6. Food Prices: Household Responses and Spillovers

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Interest in the analysis of the poverty impacts of trade liberalization, in general, and of food prices, in particular, has been strong in the recent literature. The pioneering work of Deaton (1989) provided a useful framework—subsequently adopted by numerous researchers—to investigate the first-order impacts of price changes. One of the major concerns with this approach, however, has been the modeling of household responses. From the introduction of the framework to date, the profession has noticed the need to improve upon the static model of the first-order approximation to allow for household responses. This need has become even more obvious with the skyrocketing of food prices of the last few years. The reason is that while the first-order approximation can provide reasonable estimates of the impacts of the moderate-to-small price changes typically generated by trade reforms, such a static model misses important effects when price changes are large, as they have been recently for food.

In this chapter, my objective is to list a number of household responses that have proved important in my own research on the topic. I will distinguish three different economic phenomena. The first is household adjustment in production and consumption. When the price of good *i* changes, households are affected both as consumers and as income earners. Consumers ordinarily will consume less of the more expensive goods and more of the cheaper ones. Producers may change their supply and input decisions, and workers may reassess their labor supply. Conceptually, these responses are fairly intuitive. Technically, their estimation requires a full set of elasticities of demand and supply that can be used to improve the approximation to the welfare impact.

The second, related, phenomenon is intra-household spillovers, whereby the change in the price of good *i* can have sizeable externalities to other activities of the household, including perhaps those that are not traded. For instance, when the price of a key cash crop increases, it may be possible for a farmer to overcome potential credit constraints and thus afford upgraded investments not only in cash cropping but also in food cropping for home consumption. The issues involved here are conceptually similar to the more standard supply and demand elasticities—they are just additional behavioral changes of the household. However, the economics, and the econometrics, needed to measure them are much more

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complicated, not least because of the need to model the factors that can generate those intra-household spillovers.

The last economic phenomenon that I want to explore is inter-household spillovers. When we think about the impacts of price changes in the Deaton model, we allow price impacts to affect only pre-shock producers and consumers. However, if a price change in good *i* affects the local demand for labor or other local non-traded goods, then there will be inter-household or, more precisely, inter-sector, spillovers with potential repercussions on the local economy, including households who were non-producers before the shock.

When prices change as much as food prices have in the recent past, measuring only first-order approximations and neglecting some of these phenomena related to household adjustment can lead to severe biases in the assessment of the poverty/welfare impacts. In this chapter, I exemplify some of these biases by looking at two case studies. One involves food prices, consumption responses (section 2), and labor market spillovers (section 3) in Mexico. The other reviews intra-household spillovers in aquaculture among Mekong farmers in Vietnam (section 4).[2] The final section briefly summarizes the findings.

CONSUMPTION RESPONSES: DEMAND ELASTICITIES IN MEXICO

Arguably, the most natural responses to begin our investigation of household adjustments are consumption responses. When prices change, consumers purchase more of the cheaper goods and less of the more expensive ones. To assess these consumption responses, one needs to estimate a system of demand elasticities. Angus Deaton wrote extensively on this, and his seminal papers provide all the necessary discussion (Deaton, 1987, 1988, 1990, and his summary in Deaton, 1997). In practice, the estimation of a full system of demand is not trivial. Tedious data preparation work is needed, and the formulas for the estimators are complicated and require special coding. The interested reader should consult Deaton's work. Here, I give a brief overview based on Porto (2008).

For simplicity, I begin with a single-good model (that is, the household consumes only one good) and later elaborate on how to extend it. The demand for this good is modeled with an equation characterizing the budget share s_{hc} spent by household h in cluster c:

$$s_{hc}=\alpha_0+\beta_0\ln x_{hc}+\gamma_0'\mathbf{z}_{hc}+\theta\ln\pi_c+f_c+u^0_{hc}, \tag{1}$$

[2] The Mexico case study is based on Porto (2008), and the Vietnam case study on Brambilla, Porto, and Tarozzi (2008).

where x_{hc} is total household expenditure, and $\mathbf{z}_{hc}$ are household demographic characteristics, such as number of members and demographic composition. π_c is a price level that is assumed to be the same for all households in cluster c; this price is unobservable. f_c is a cluster fixed effect and u^0_{hc} is a standard error term, with zero mean (for a large number of households in each cluster).

Typically, we do not observe prices π_c but rather unit values, which are part price and part quality. This is because changes in prices and in total expenditure will cause consumers to respond partly by modifying quantities and partly by modifying quality. To model unit values, I assume that

$$\ln v_{hc} = \alpha_1 + \beta_1 \ln x_{hc} + \gamma_1' \mathbf{z}_{hc} + \psi \ln \pi_c + u^1_{hc}. \tag{2}$$

Here, unit values v_{hc} are affected by prices and by household expenditure x_{hc}. The parameter ψ captures the shading of quality to price changes, and the parameter β_1 is called the "quality elasticity" or the "expenditure elasticity of quality"; β_1 would be zero if there were no quality shading, in which case ψ=1. Demographics $\mathbf{z}_{hc}$ determine unit values, too. The error term u^1_{hc} has mean zero (for a large number of h in cluster c).

The demand model in (1) is close to the AIDS model of Deaton and Muellbauer (1980), but is not a full AIDS model. In other words, equations (1) and (2) are a representation of the regression functions of budget shares and unit values. It is not possible to be sure that these functional forms are derived from some preferences (and thus that the structural preference parameters are identified), but it is enough for (trade) policy evaluation to know the demand parameters, like price elasticities, and these are identified under the linearity assumption of the model.

Equations (1) and (2) comprise the building blocks of Deaton's model. To extend the model to a full model of demand, one needs to add equations for budget shares and unit values for each of the goods actually consumed by the household. This multi-good model of demand is quite complex and, since here I am interested mainly in the conceptual issues, I refer the reader to Deaton (1997) for the details.

In short, the estimation proceeds in two stages. The identification assumption is that every household in cluster c faces the same prices. In the first stage, thus, cluster dummies absorb the unobserved prices. In the second stage, the elasticities are estimated using the information on prices contained in the residuals from the first stage. Since the model can only identify the ratio θ/ψ, a restriction is needed to separate these two coefficients. Deaton assumes group separability in consumer preferences and adopts a definition of quality whereby more expensive goods are higher quality goods (total expenditure is the product of price, quantity, and quality). In consequence, unit values are the product of price and quality and the response of unit values to prices, ψ, is one plus the quality shading term $(\varepsilon_p\beta_1/\varepsilon_x)$, which in turn depends on the quality elasticity, β_1, the price elasticity ε_p and the income elasticity, ε_x. If $\beta_1=0$ or $\varepsilon_p=0$, then there is no quality shading and $\psi=1$. When there is quality shading to prices, $\psi<1$.

To illustrate how the model works, I review results from Porto (2008), which uses data for Mexico from the Household Income and Expenditure National Surveys, ENIGH (Encuesta Nacional de Ingresos y Gastos de los Hogares). Table 6.1 reports some summary statistics for the rural modules for the 1996, 1998, and 2000 rounds. A cluster c is defined as a province-week pair: there are 720 clusters in the pooled sample, with approximately 275 in each ENIGH round. The number of households interviewed in each cluster—at least 20—is larger than typical of other surveys. There are between 3,306 and 4,684 rural households in the samples.

Table 6.1. Summary statistics: Mexico

	1996	**1998**	**2000**
Sample Sizes			
households	4,684	3,925	3,306
clusters	269	277	274
Corn			
avg. budget share	10.8	9.5	6.4
avg. log unit value	0.82	1.18	1.40
number of obs. in eq (3)	3,127	2,693	2,364
Wheat			
avg. budget share	3.5	3.1	2.4
avg. log unit value	2.24	2.38	2.54
number of obs. in eq (3)	3,415	2,816	2,491
Dairy products			
avg. budget share	3.6	3.8	3.1
avg. log unit value	2.01	2.38	2.54
number of obs. in eq (3)	2,254	1,947	1,881
Oils and fats			
avg. budget share	2.5	2.2	1.4
avg. log unit value	2.23	2.30	2.31
number of obs. in eq (3)	2,681	1,911	1,710
Meat			
avg. budget share	6.8	6.9	5.6
avg. log unit value	2.91	3.22	3.33
number of obs. in eq (3)	2,905	2,436	2,330

Fruits and vegetables avg.	12.1	13.2	9.1
avg. log unit value	1.66	2.11	2.10
number of obs. in eq (3)	4,222	3,435	2,950
Agricultural wages			
avg. (log)	6.41	6.44	6.45
share of total income	61.1	62.3	59.2
number of obs. in eq (4)	2,597	1,937	1,607
Avg. per capita expend. (log)	6.21	6.14	6.54
Household size	5.2	4.7	4.6
Males	50.2	50.1	50.1
16 yrs.	38.5	35.5	34.9
> 16 and 60 yrs.	49.4	49.7	49.8
> 60 yrs.	12.1	14.9	15.2
Years of education	3.5	3.4	3.5

Note: Based on Porto (2008). Calculations based on the Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIGH).

On the consumption side, the expenditure data cover food and non-food items. Food products, which are the focus of my investigation here, comprise corn, wheat, dairy products, oils and fats, meat, and fruits and vegetables. Following Deaton and Grimard (1992), unit values are computed using market purchases only, but budget shares are calculated using all expenditure (purchases plus home production). Fruits and vegetables, corn, and meat are the major categories of food expenses in the sample. Notice that average unit values for all these food products increased in real terms from 1996 to 2000.[3] As a result, budget shares declined over time.

Household characteristics include the size of the family, the demographic composition, and age, gender, marital status, and educational level. These are the controls that I include in the estimation of the first stage (which also includes year dummies).

Results from the standard Deaton model are reported in columns (1) and (2) of Table 6.2. I only report own-price elasticities. As expected, all the demand elasticities are negative and statistically significant. For example, in the case of corn (on which my experiments below are based), a one percent increase in price reduces the compensated demand by 0.88 percent.[4]

Table 6.2. Demand and wage elasticities in Mexico

[3] All data on expenditures and wages are expressed in 2002 constant prices using regional price deflators constructed by the Mexican statistical office. In Table 6.2, the definition of corn excludes "tortillas."

[4] There are also cross-price elasticities that measure how the consumption of all the other goods would react to changes in corn prices. See Porto (2008).

	Own-price Elasticity Deaton Model		Wage Elasticity	Own-price Elasticity Full Model	
	Uncompensated (1)	Compensated (2)	(3)	Uncompensated (4)	Compensated (5)
Corn	–0.92	–0.88	0.40	–0.65	–0.61
	(0.05)	(0.05)	(0.19)	(0.09)	(0.09)
Wheat	–1.34	–1.32	–0.28	–1.44	–1.43
	(0.09)	(0.09)	(0.19)	(0.13)	(0.13)
Dairy Products	–1.28	–1.24	–1.10	–2.29	–2.28
	(0.12)	(0.12)	(0.18)	(0.24)	(0.24)
Oils and Fats	–0.77	–0.76	–0.48	–1.07	–1.07
	(0.34)	(0.34)	(0.65)	(0.63)	(0.63)
Meat	–1.35	–1.28	–0.45	–1.46	–1.42
	(0.22)	(0.22)	(0.27)	(0.24)	(0.25)
Fruits & Vegetables	–0.90	–0.83	1.29	–0.12	–0.01
	(0.13)	(0.13)	(0.47)	(0.30)	(0.31)

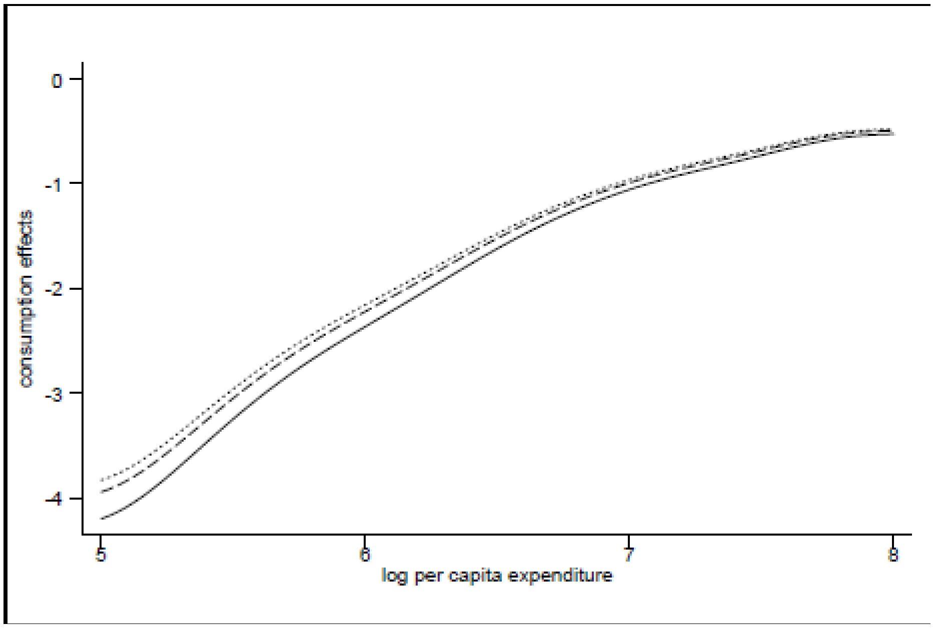
Note: Based on Porto (2008). The Deaton model is the standard model of demand as in Deaton (1987), (1988), and (1990). The full model allows for labor market responses.

CONSUMPTION ADJUSTMENTS: IMPLICATIONS

Here, I address the implications of allowing for household responses in consumption in the investigation of the welfare impact of price changes. For practical purposes, I look at the impacts of changes in the price of corn, which is one of the most important food products consumed in rural Mexico. Following the usual practice in this literature (Deaton 1989, 1997), I define the welfare effects of the price change as the compensating variation expressed as a share of total household expenditure. I work with an exogenous increase in the price of corn of 20 percent. The first-order effects of such a price increase on the consumption side (i.e. without allowing for responses at the household level) can be estimated with the product of the share of corn expenditure in total expenditure and the price change of corn. It is standard to assess distributional impacts by estimating the average welfare effects across the entire income distribution. These averages are estimated non-parametrically with locally (kernel) weighted regressions.

Figure 6.1 plots various average welfare impacts. The solid line corresponds to the first-order impact (as in Deaton 1989). Clearly, all households face consumption losses when prices rise. In the case of corn, the poor consume relatively more corn than the rich and thus they tend to suffer higher losses. For example, the losses at the bottom of the income distribution are equivalent to around 3-4 percent of household expenditure, while the losses at the top tend to be smaller than 1 percent (and actually vanish at the very top, where households consume very little corn).

Figure 6.1. Welfare effects with consumption adjustments: corn in rural Mexico



Note: Based on Porto (2008). The lines represent the average welfare effects (compensating variations) as a percentage of household expenditure. The averages are estimated with non-parametric locally weighted regression using a Gaussian kernel and a bandwidth equal to 0.5. The solid line displays the first-order effects given by the product of budget shares and the price changes. The dotted line displays first- and second-order effects using the elasticities from Deaton's model of demand, while the long-dash line is based instead on the elasticities of the full model, as discussed later in this chapter.

To account for consumption responses, I need to add the second-order impacts using the own-price elasticity estimated above. Let the household expenditure function be given by $e(\mathbf{p},u)$, for prices $\mathbf{p}$ and required utility u. When the price of corn p_c changes, a second-order Taylor expansion of e gives the following compensating variation (expressed as a share of initial expenditure):

$$cv=s_c d\ln p_c+(1/2)\varepsilon_{cc}s_c(d\ln p_c)^2, \tag{3}$$

where s_c is the budget shares and ε_{cc} is the own-price elasticity (for simplicity, cross-price effects are omitted). The average welfare effects are plotted in Figure 6.1 with a short-dotted line. It is clear that allowing for consumption responses makes the losses lower, because consumers respond to the higher corn prices by consuming less corn. Notice also that the adjustment of consumption generates larger reductions in the initial losses at the bottom of the income distribution, again because corn takes a larger share of the household budgets of the poor than of the rich.

LABOR MARKET SPILLOVERS

When the prices of agricultural goods change, the income of the household changes, especially in rural areas. To see this more formally, let a_h denote the agricultural wage income of the household. This income arises from all sorts of agricultural activities: household members may work on local farms in exchange for a wage, may work on their own farms, or may work in activities such as providing services or selling inputs to agriculture. Wages or other incomes earned in *non*-agricultural activities are denoted by i_h; for simplicity, I assume that this income i_h is exogenous. Thus, total household income x_h is given by

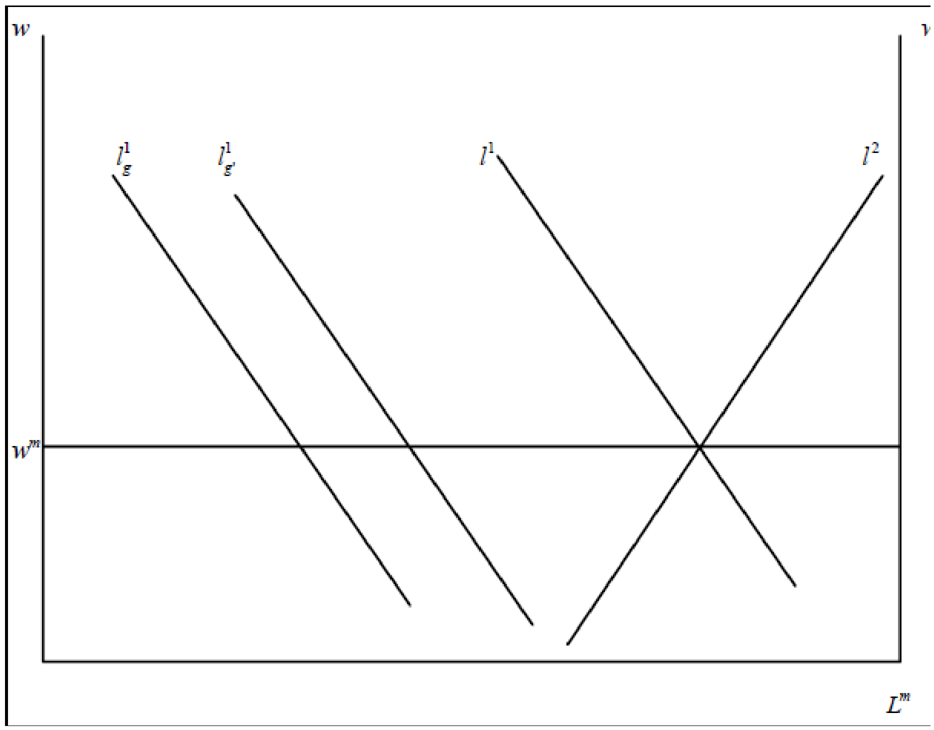
$$x_h = a_h + i_h.$$

My aim here is to discuss how a_h is affected by a change in agricultural prices. I assume that there are two types of agricultural activities: ag^1 are cropping activities; ag^2 are livestock activities such as animal husbandry or dairy production. There are three differentiated labor inputs in rural areas: agricultural labor of type 1 (for cropping, with total supply L^1); agricultural labor of type 2 (for livestock, with supply L^2); and mobile labor (for both cropping and livestock, with supply L^m). L^1 covers labor in activities that require agrarian skills—for planting, weeding, harvesting, and so forth of, say, corn, fruits, or vegetables. I assume there are many agricultural activities ag_g^1 of type 1; the common feature of these activities g is that they use L^1 intensively. Labor of type 2, similarly, works in several activities k such as animal husbandry, dairy production, or veterinary services. The activities of type 2 labor are denoted ag_k^2. Activities of both types 1 and 2 share mobile labor L^m. Notice that since labor types L^1, L^2, and L^m are differentiated inputs, their wages may differ. I also assume that there is a certain degree of labor immobility across regions. This is possible if there are relocation costs of rural labor. In the end, thus, labor supply in region c is given by L_c^1, L_c^2, and L_c^m, and agricultural wages will vary by region.

Figure 6.2 plots the equilibrium in a standard specific-factor framework. The horizontal size of the box measures L^m, the total labor supply of mobile labor. The curve labeled l^1 is the value of the marginal product of mobile labor in agricultural activities of type 1. As drawn, there are two such activities, say corn (good g) and fruits and vegetables (good g').

The curve l^2 represents the demand for mobile labor in agricultural activities of type 2. For simplicity, there is only one activity in sector 2, namely dairy products.

Figure 6.2. Rural agricultural labor markets



Note: Based on Porto (2008). The length of the horizontal box is the supply of mobile labor L^m; its wage is w^m. The curves l_g^1 and $l_{g'}^1$ represent the labor demand in activities of type 1 (which use specific labor L^1). The total demand for this specific labor is l^1. The total labor demand in activities of type 2 is l^2.

In Figure 6.2, I have purposely assumed a much larger demand for labor in activities of type 1 than in those of type 2. Accordingly, an increase in prices π_g or $\pi_{g'}$ (the prices of corn or of fruits and vegetables) would shift l^1 up, causing w^m to increase. In addition, while w^1 would increase as well, w^2 would decline. In contrast, an increase in π_k (the price of dairy products) would cause w^m and w^2 to increase, but w^1 to decline.

In consequence, the situation plotted in Figure 6.2 suggests that increases in the prices of corn or fruits and vegetables would most likely cause average wage income to increase, but that increases in the price of dairy products would most likely cause wage income to decline. It is clear that, at least in theory, anything can happen and that wage income can increase or decrease.

To estimate these labor market responses, jointly with the demand elasticities, I need to add an equation to the demand model in (1) and (2). In Porto (2008), I assume that:

$$\ln a_{hc} = \alpha_2 + \gamma_2' \mathbf{m}_{hc} + \lambda \ln \pi_c + u_{hc}^2, \tag{4}$$

where $\mathbf{m}_{hc}$ are household characteristics that affect wage agricultural income. Some elements of $\mathbf{m}_{hc}$, such as education, are different from the determinants of the budget shares and unit values. u_{hc}^2 is a standard error term. The coefficient λ measures the wage-price elasticity. The estimation is as before: in the first stage, I purge unobserved prices from budget shares, unit values, and agricultural wage income and, in the second stage, I use the price information in the residuals (together with the separability restriction) to extract the elasticities of interest.

In the estimation using the rural data for Mexico (from the ENIGH), a_h is defined as wage income in agricultural activities (farm employment) plus self-employment income earned in agriculture. It includes, first, total income from the sale of production of corn, wheat, and other crops. (Unfortunately, the data do not identify the value of sales of different crops, but just the total income from all agricultural activities). It also includes wages related to agricultural activities, including wage labor on local farms, although we do not know whether these wages are earned in corn, wheat, or dairy production. Summary statistics are in Table 6.1 above. Overall, agricultural wages as defined above account for around 60 percent of the total income of rural families. Notice that real wages did not change much from 1996 to 2000.

The wage-price elasticities λ_g are shown in column (3) of Table 6.2. The prices of corn and fruits and vegetables are positively and significantly associated with household agricultural wage income: the elasticity of the corn price is 0.40, and that of the fruits and vegetables price, 1.29. In contrast, the price of dairy products is negatively associated with agricultural income, with an elasticity of –1.10. There is no statistically significant effect of the prices of wheat, oils and fats, or meat.

The “profit effect”

When income responds to prices, the estimation of the demand system needs to be revised because the demand elasticities themselves change. To see this, denote $\mathbf{c}_h$ as the vector of household consumption. Demands are given by $\mathbf{c}^h = \mathbf{c}^h(\mathbf{p}, x^h)$. Typically, total expenditure x_h is considered exogenous (both economically and statistically). In household production models like the one above, at least part of expenditure can be endogenous. In consequence, a decline, say, in prices has two sources of income effects: the usual income effect, whereby real income increases at constant relative prices, and the change in nominal income caused by the responses of agricultural wage income. In the development literature, this effect has been labeled the "profit effect" in the work of Barnum and Squire (1979) and Singh, Squire, and Strauss (1986).

The full model in the system (1), (2), and (4) delivers demand elasticities that account for this "profit effect." The own-price elasticities are reported in columns (4) and (5) of Table 6.2 above. As before, all the own-price elasticities are negative and statistically significant. Comparing Deaton's model with the full model, there are significant differences in the own-price elasticities for corn, dairy products, and fruits and vegetables. For wheat, oils and fats, and meat, the corrections suggested here are less important. In the case of corn, the corrections of the full model decrease the estimated elasticity; in the case of dairy products, they instead drive the elasticity up to -2.29. Intuitively, an increase in the price of dairy products (which reduces consumption) reduces agricultural wage income (with an elasticity of -1.1, as shown in column (3)) and causes a negative income effect that pulls the consumption of dairy products further down. An interesting case is that of fruits and vegetables, where the profit effect renders the demand elasticity statistically insignificant. This is because the increase in the price of fruits and vegetables has a strong wage effect and thus a strong positive income effect.

Implications for the welfare impacts of price changes

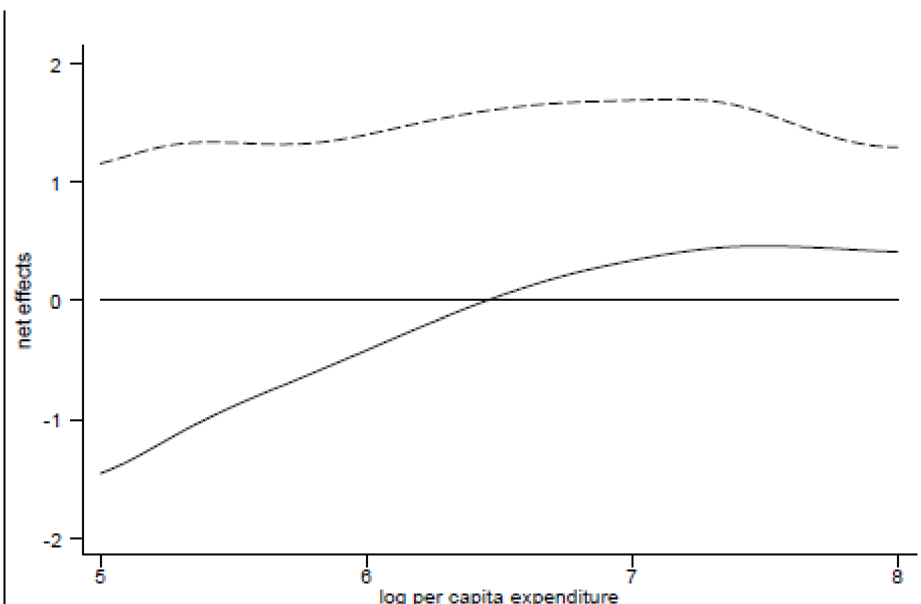
Allowing for labor market adjustments and spillovers has two implications for the welfare impacts of price changes. First, the compensated demand elasticities—and hence the impacts on welfare—may differ from those identified by the Deaton model, and second, household income adjusts as well.

The role of the correction of the demand elasticities is shown in Figure 6.1 above. There I plot, with long dashes, the average welfare effects of an increase of 20 percent in the price of corn with first- and second-order responses (using the compensated demand elasticity from the full model—that is, using the estimates from column (5) of Table 6.2). Since the compensated elasticity from the full model is smaller (in absolute value) than the elasticity from Deaton's model, losses are slightly larger (compare the long-dash line with the dotted line). On the consumption side these corrections imply only minor changes to the overall welfare impacts.

The introduction of the income effects raises a number of interesting issues. In the recent literature on food prices, it is often argued that net consumers will be hurt by higher prices while net producers will benefit. I argue here that this prediction may be misleading in a dynamic setting where households can adjust their income. In this case, if household responses are large enough, it is possible for some net consumers to become net producers and actually benefit from the price increase.

I illustrate this in Figure 6.3. I plot the static impacts of an increase in the price of corn with a solid line. This is the net consumer – net producer position calculated as the difference between expenditure shares and income shares (multiplied by the price change). Households at the bottom of the income distribution are net consumers and households at the top are net producers of corn. In consequence, a price increase hurts the poor but benefits the rich.

Figure 6.3. Welfare effects with consumption adjustment and labor market spillovers: corn in rural Mexico



Note: Based on Porto (2008). The lines represent the average welfare effects (compensating variations) as a share of household expenditure. The averages are estimated with non-parametric locally weighted regression using a Gaussian kernel and a bandwidth equal to 0.5. The solid line displays the first-order effects given by the difference between corn budget shares and corn income shares. The broken line allows for income responses and consumption responses.

To see the role of income responses, I plot the corresponding average welfare effects with a broken line. Here, consumption choices change as indicated by the own-price elasticity of the full model. In this example, the agricultural wage income of the household, including from corn production and wages from local agricultural markets, reacts to the increase in the price of corn. This response is characterized by the income shares of agricultural wages a_h and the wage-price elasticity with respect to corn prices, which was estimated at 0.4 (Table 6.2 above).

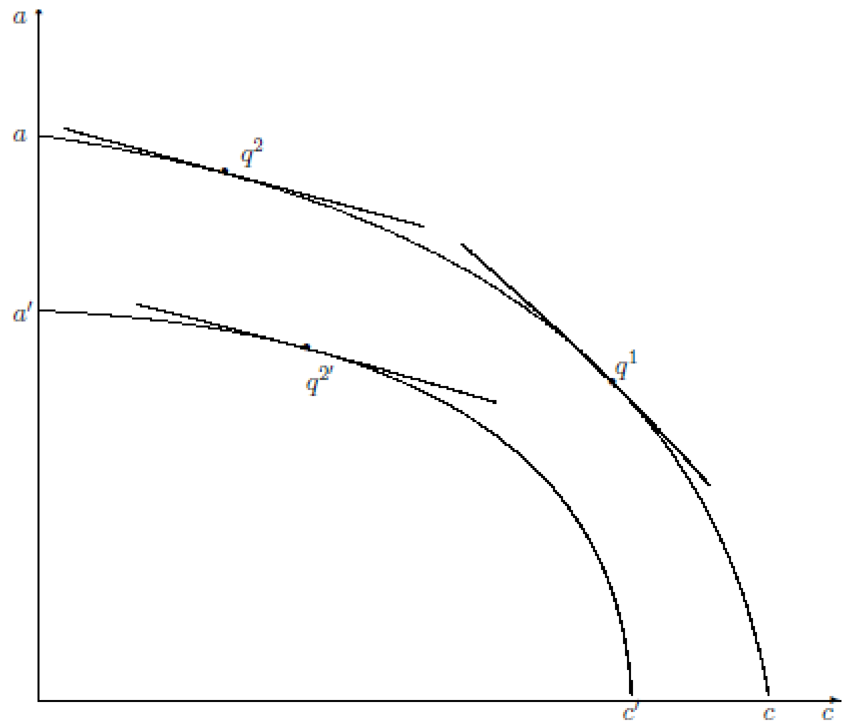
Figure 6.3 reveals that, in this scenario, an increase in corn prices would benefit households across the entire income distribution, even in the presence of sizeable consumption losses. For instance, households at the bottom of the distribution would gain around 1 percent (with consumption losses of 4 percent, their income gain is around 5 percent). The richest households would now gain around 1 percent, too (with vanishing consumption losses, the income gains are thus approximately 1 percent themselves). This is because all agricultural income and agricultural wages are responding to the price increase. Naturally, the gains will be smaller (and may become even losses for some households) when alternative definitions of wage agricultural income are used (see Porto 2008).

INTRA-HOUSEHOLD SPILLOVERS

In developing countries, there are various additional reasons (on top of consumption and labor responses) why the first-order approximation—that is, measuring welfare impacts without allowing for adjustments—may be unrealistic. Here, I want to highlight two. First, there can be sizeable costs of adjustment, which arise when the reallocation of resources from one activity to another (following a price change for instance) is costly (and involves a loss of resources). For example, know-how and other production inputs may be activity-specific, while start-up financing costs coupled with imperfections in credit markets may limit the ability to change the input allocation. Second, there may be market imperfections that generate intra-household spillovers, which occur when a change in prices affects the behavior of the household not only in that activity but also in other household activities through externalities. For instance, if cash income earned from the sale of a product is needed to finance investment, and if credit markets are imperfect, changes in prices may affect input choices and then restrict the production possibilities in one or more seasons following the price shock.

To see how these factors affect the welfare evaluation of price changes, assume that households are engaged in two economic activities, c and a, and earn incomes y^c and y^a. For simplicity, assume also that, in the initial situation, each household is endowed with fixed quantities of production factors that cannot be traded. In this case, utility maximization requires revenue maximization.[5] Figure 6.4 presents a schematic representation of the equilibrium in household production. The production possibility frontier—determined by the amount of fixed household resources—is given by the curve ca. For given prices, efficiency in production requires tangency between the relative prices and the slope of this frontier. At the initial prices p^1, the optimal production allocation is q^1.

Figure 6.4. Household production with adjustment costs and spillovers



Note: Based on Brambilla, Porto, and Tarozzi (2008). q^1 is the initial allocation. After a drop in catfish prices, q^2 would represent the first best allocation. Instead, with adjustment costs and spillovers in both aquaculture and agriculture, the equilibrium is $q^{2'}$.

In Figure 6.4, if the price of good c declines to p^2, production allocation will shift to q^2. To see these changes in the presence of spillovers, I assume that the production frontier shrinks after the decline in prices.[6] In Figure 6.4, the frontier shifts to $c'a'$ and, at changed prices p^2, the optimal allocation point q^2 is not feasible. With adjustment costs and intra-household spillovers, the equilibrium is instead at a point such as $q^{2'}$—an allocation that is characterized by declines in total income as well as in y^c and y^a.

[5] See Benjamin (1992) or Singh, Squire, and Strauss (1986) for full models of optimizing agricultural households.

[6] See Atkinson and Stern (1974) for a model where the taxation needed to provide a public good produces inefficiencies that shrink the production frontier.

To explore these intra-household spillovers, I review results from Brambilla, Porto, and Tarozzi (2008), who study the anti-dumping duties imposed by the United States on imports of catfish fillets from Vietnam in 2003.[7] They use panel data from the new Vietnam Household Living Standard Surveys (VHLSS). The first round of the VHLSS was carried out in 2001-02, before the imposition of U.S. tariffs on catfish in 2003. The second round was carried out in August 2004, after the introduction of these trade barriers.

Table 6.3 reports some key features of the data for households in the Mekong provinces that produce catfish (An Giang, Can Tho, Dong Thap, and Vinh Long) in 2002 and 2004. Panel (A) of the table shows the median level of total annual per capita income (pci) in thousand Vietnamese dong and in US PPP dollars. Income is defined as all sources of household income including earnings from agriculture (both for sale and home consumption), aquaculture, wages, livestock, silviculture, hunting, non-farm activities, and transfers. Despite the U.S. anti-dumping duty on catfish, median per capita income in the Mekong areas increased from 3,537 thousand dong in 2002 to 4,224 thousand dong in 2004. This growth rate was slightly lower than the average national-level growth rate in pci, according to VHLSS data. Panel (B) of the table reports the share of income derived from different economic activities. The main feature of these data is that the share of catfish in household income declined in the Mekong areas after the imposition of the anti-dumping duties, from 11.2 percent in 2002 to 6.8 percent in 2004.

Table 6.3. Vietnam household living standards survey: per capita income and sources of income panel sample

	2002	2004
(A) Per capita income		
in Dong	3,537	4,224
in PPP dollars	1,247	1,489
(B) Income shares		

[7] After the U.S. lifted the embargo on Vietnam in 1994, Vietnamese catfish burst into the U.S. market, which by 2002 became their main export destination and accounted for 50 percent of total production. Faced with increased competition from cheaper Vietnamese catfish, the Association of Catfish Farmers of America (CFA) initiated a successful campaign to halt catfish imports. In 2002, the CFA launched dumping allegations. In January 2003, the U.S. Department of Commerce (DoC) ruled in favor of the dumping claim of the CFA and established tariffs ranging from 37 to 64 percent on imports of frozen catfish (that is, tra and basa) from Vietnam. In July 2003, the U.S. International Trade Commission (USITC) ratified the DoC ruling. As a result, Vietnamese exports of catfish to the U.S. plummeted to the point of being almost completely shut down.

Catfish	11.2	6.8
Other aquaculture	1.0	1.0
Wages	26.7	28.1
Agriculture	42.5	43.2
sales	33.5	33.2
own	9.0	10.1
Livestock	9.5	10.4
Silviculture	0.6	0.6
Farm services	0.7	0.6
Other	7.8	9.3

Note: Based on Brambilla, Porto, and Tarozzi (2008). Calculations based on the panel sample of the Vietnam Household Living Standard Surveys, 2002 and 2004.

Brambilla, Porto, and Tarozzi (2008) exploit the U.S. anti-dumping duty intervention as a case study to test for the presence of intra-household spillovers (among other topics). Their estimation strategy relies on comparing household outcomes before and after the imposition of the duty across households with different levels of exposure to the shock. Exposure to the shock is measured using the pre-shock shares of catfish income in total income (using data from the 2002 survey round). The authors use a fixed-effects panel data model to regress various outcomes on a quadratic function of the initial shares of catfish income. Impacts are reported for households at three levels of exposure: low, at a level equal to the median share (5.5 percent); medium, at the mean level (11.2 percent); and high, for a level equal to the median share among those farmers above the sample mean (a value close to 20 percent).

The estimated impacts on total household income, per capita income, and net income (that is, total household income net of input purchases) are shown in Table 6.4. All three measures of income were negatively affected by the shock of the anti-dumping duty (the estimates being statistically significant at the 5 percent level or below). A farmer with the median pre-shock share of catfish income in total income suffered a loss of around 6.2 percent of total household income. A farmer with an average pre-shock share suffered an income loss of 11.3 percent, and a high-exposure farmer suffered even more, losing 16.9 percent. The impacts on per capita income were very similar, at 6.4, 11.7, and 17.6 percent, respectively. And the estimated impact on net income was slightly larger: 8.1 percent for low-exposure, 14.7 percent for average-exposure, and 21.7 percent for high-exposure households.

Table 6.4. Average impact of anti-dumping on household income: Mekong provinces

	Total Income	Per Capita Income	Net Income
Low-exposure	-0.062**	-0.064**	-0.081***

	(1)	(2)	(3)
	(0.031)	(0.030)	(0.030)
Mean	–0.113**	–0.117**	–0.147***
	(0.054)	(0.053)	(0.052)
High-exposure	–0.169**	–0.176**	–0.217***
	(0.078)	(0.077)	(0.074)
Observations	561	561	561
R^2 (within)	0.162	0.155	0.158

Note: Based on Brambilla, Porto, and Tarozzi (2008). Estimates of a growth equation for total household income (columns 1), per capita household income (columns 2), and net income (columns 3). Results from the quadratic model at three different levels of exposure measured by the pre-shock shares of catfish in income: the median (low exposure), the mean (average exposure), and the median share for farmers with shares above the mean (high exposure).
Robust standard errors within parenthesis: *, **, *** denote significant at the 10%, 5%, and 1% level, respectively.

Let me review now the evidence on intra-household spillovers. Brambilla and others (2008) do not test directly for those spillovers but rather explore whether the data reveal patterns of household behavior that are consistent with them (as illustrated in Figure 6.4). They begin by assessing the response of catfish income. Results are shown in column (1) of Table 6.5. The anti-dumping duty had a large impact on catfish income for households at all levels of exposure and especially for highly exposed farmers. For instance, catfish income dropped by 36.7 percent for the median farmer, by 57.7 percent for the average farmer, and by 74 percent for the highly exposed farmer. The imposition of the duty also affected the income earned in non-catfish activities: in column (2) of Table 6.5, we see that the shock caused non-catfish income to decline by 8.7 percent, 14.5 percent, and 18.5 percent for low-, average-, and high-exposure catfish farmers. The estimated impacts on non-catfish income constitute additional evidence consistent with intra-household spillovers.

Table 6.5. Intra-household spillovers: Mekong provinces

	Catfish Income	Non-catfish Income	Catfish Investment	Hours Off-farm	Agricultural Investment	Non-agric. Investment
	(1)	(2)	(3)	(4)	(5)	(6)
Low-exposure	–0.367***	–0.087**	–0.283***	–0.006	0.105*	–0.277***
	(0.042)	(0.035)	(0.058)	(0.032)	(0.065)	(0.063)
Mean	–0.577***	–0.145**	–0.464***	–0.014	0.219*	–0.456***
	(0.051)	(0.062)	(0.080)	(0.060)	(0.132)	(0.088)
High-exposure	–0.740***	–0.185***	–0.619***	–0.028	0.400*	–0.613***

	(0.047)	(0.090)	(0.086)	(0.093)	(0.224)	(0.096)
Observations	416	560	411	560	399	460
R^2 (within)	0.202	0.228	0.105	0.175	0.100	0.104

Notes: Based on Brambilla, Porto, and Tarozzi (2008). Estimates of the impacts of the US anti-dumping duty on catfish income, non-catfish income, and input choices (investment in catfish, hours worked off-farm, investment in agriculture, and investment in non-agriculture activities).
Robust standard errors within parenthesis: *, **, *** denote significant at 10%, 5%, and 1% level, respectively.

Additional support for the existence of spillovers into activities other than fish farming can be derived by inspecting the impact of the anti-dumping duty shock on input choices, both in aquaculture and in non-aquaculture activities (see Figure 6.4). Results are in columns (3)-(6) of Table 6.5.

First, in column (3) of the table, we see that investment in catfish aquaculture (that is, all types of expenditures on catfish activities such as breeding, fish food, materials, repairs and maintenance, and depreciation of fixed assets) declined significantly, by 28.3 percent for low-exposure farmers, 46.4 percent for the average farmer, and as much as 61.9 percent for high-exposure farmers. Thus the shock of the anti-dumping duty seems to have caused households to disinvest heavily in catfish farming—a finding that is consistent with the large drop in catfish income reported above. Second, in column (4), we see that hours worked for wages did not change and, in column (5), that investment in agriculture responded only marginally. Households chose not to disinvest in agriculture and to maintain the hours they worked for wages. Finally, column (6) confirms that total non-agricultural investment declined, suggesting that the shock had overall investment spillovers within the household.

CONCLUSIONS

When prices change, it is always important to know how consumers and producers will be affected, whether there will welfare gains or losses, and whether the poor will be affected more than the rich. Often, the evaluation of the impacts of price changes is done in a somewhat static setting that does not incorporate responses by economic agents. This paper has reviewed a number of instances in which such static evaluations would miss sizeable impacts of price changes. In light of the large increase in food prices observed in the recent past, these biases can be quite severe.

I explored household responses in consumption to show how allowing consumers to move away from more expensive goods can ameliorate some of the losses from higher food prices. I then looked at labor market responses to claim that labor market spillovers can actually account for a large fraction of the impacts of higher food prices, especially in rural areas that specialize in food production. The case study of rural Mexico showed how households who were net consumers before a price shock can become net producers after the shock, thus benefiting from higher prices. Finally, I turned the focus to intra-household spillovers, whereby changes in the price of one commodity can affect household behavior across the whole range of household activities. There is strong evidence supporting the presence of those spillovers in the case of catfish in Vietnam, where lower catfish prices due to the imposition of a U.S. anti-dumping duty caused income and investment to decline, not only in catfish activities but also in other activities such as agriculture and livestock.

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Figures

Tables