

CHAPTER 6: Analyzing the distributional effects of trade policies

TABLE OF CONTENTS

A. Overview and learning objectives	211
B. Analytical tools	212
1. General equilibrium transmission of tariff changes	212
2. Simple model linking trade policy to household welfare	214
3. Empirics	215
C. Data	218
1. Survey data	218
2. Trade policy data	220
D. Applications	221
1. Calculating the effect of change in tariffs on consumption and agricultural sales	221
2. Measuring the impact of tariffs at the household level	227
E. Exercise	229
Assessing the progressivity of trade taxes	229
Endnotes	231
References	232

LIST OF FIGURES

Figure 6.1.	Trade policies and households' welfare	212
Figure 6.2.	Consumption effect by per capita expenditures (log)	223
Figure 6.3.	Income effect by per capita expenditures (log)	224
Figure 6.4.	Share of income from subsistence activities and wages	224
Figure 6.5.	Overall effect by regions	225
Figure 6.6.	Tariff on consumption	229

LIST OF TABLES

Table 6.1.	Income, consumption and overall effects by deciles	226
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LIST OF BOXES

Box 6.1.	Design of surveys	219
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A. Overview and learning objectives

This chapter provides an overview of the measurement of the distributional effects of trade policies on social welfare, in particular on inequality and poverty. The economic literature has emphasized open trade policies' positive impact on economic growth and development for many years. While these results generally hold when measured on average, empirical evidence suggests that trade liberalization is unlikely to produce beneficial results across all households. In practice, trade policies generally have strong redistributive impacts, often benefiting some individuals while penalizing others.

Trade policies impact individuals because of two main factors. First, the impact of a trade policy depends on the extent to which the policy influences domestic prices. For example, the existence of administrated prices (or fixed wages) has the effect of isolating economic sectors (and individuals) from many price shocks such as those originating from trade policies. Similarly, weak infrastructure, high transportation costs and poorly developed or uncompetitive markets may dampen the effect of trade policies in remote areas. Second, the redistributive effects of trade policies trickle down to households and individuals depending on how those households' fortunes are tied to specific factors of production or to specific economic sectors. For example, reducing trade barriers may put pressure on the wages of workers in import-competing sectors while benefiting workers whose skills are sought by the export-oriented sectors. Similarly, imposing tariffs on food items would disproportionately affect poor households (because they spend a larger share on their income on food items), while only minimally taxing high-income individuals.

This chapter provides a brief overview of some quantitative methods that will enable analysts to give answers to some simple policy questions — namely, what is the redistributive impact of the existing trade policy and does the current structure of a country's tariff penalize some segments of the population relative to others? It also illustrates the framework for assessing the general equilibrium effects of trade policy reforms.

The learning objective of this chapter is to provide an overview of:

- how to think about the transmission of trade shocks to individual households in simple terms
- what needs to be estimated and what are the data requirements for analyzing the distributional effects of trade reforms
- what statistical techniques are required when dealing with household survey data
- how to assess the impact of trade policies on population groups
- how to assess the regressiveness or progressivity of trade taxes.

The relationship between trade policy and social welfare is clearly much more complex than what is discussed in this chapter. Its analysis also requires more advanced econometrics and modelling techniques than are appropriate to the purpose of this chapter. The interested reader is encouraged to read the relevant literature, especially Chapter 5 in Deaton (1997), the papers in Harrison (2007) and those of Winters (2002), Porto (2003) and Nicita (2007).

The rest of this chapter is organized as follows: first, the chapter describes some of the analytical tools in analyzing trade and poverty; second, it discusses the data; and finally, it presents some applications and exercises.

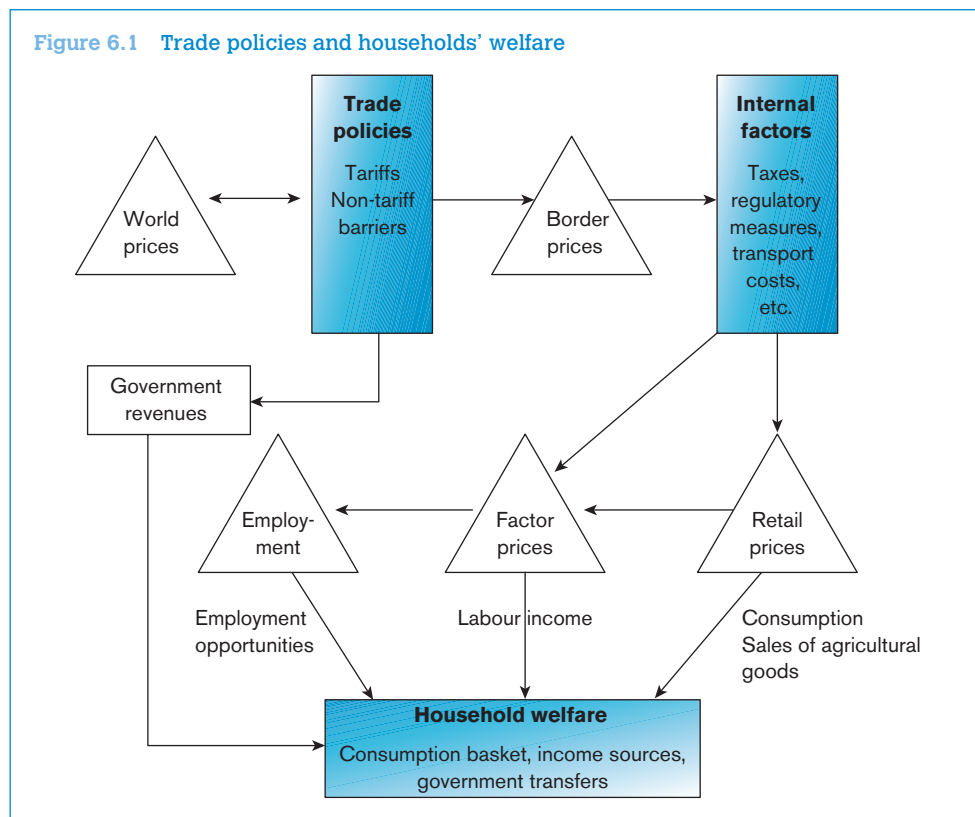
B. Analytical tools

1. General equilibrium transmission of tariff changes

The textbook treatment of trade policy is usually cast in terms of its aggregate welfare effects. However, policymakers are often also interested in its *distributional* effects, i.e. in how the impact of a trade reform differs across the various segments of the population. The general framework describing the effects of trade policies on household welfare is illustrated by Winters (2002) and reproduced in Figure 6.1.

Trade policies affect the domestic economy by their impact on domestic prices of goods and factors and by affecting government revenues. A change in a tariff translates into a change in the border price of traded goods. This change affects domestic prices (retail and factor prices) to a variable extent, generally referred to as "pass-through". The magnitude of the pass-through is determined by factors that influence the extent to which trade policies can affect domestic prices. Domestic policies, institutions, geography, market competitiveness and infrastructures all have an important role in the extent to which trade policies affect domestic markets. Because these factors are specific to each country, similar trade policies can produce dissimilar outcomes

Figure 6.1 Trade policies and households' welfare



in different countries. Moreover, these factors can also be different within the domestic economy. For example, the effects of trade policies on prices are often different across geographic areas.

In summary, the effect of trade policies on households and individuals is schematized through three links:

- the *consumption effect*: the effect of trade policies on the prices of goods consumed by the household
- the *income effect*: the effect of trade policies on the income of the household (wages, sales of products and employment opportunities)
- the *revenue effect*: the effect of trade policies on government revenues and indirectly on households via government transfers.

Analysis of the distributional effect of trade policy often starts by estimating its effect on consumption. An advantage in the analysis of consumption effects is the data requirement. Disaggregated consumption data are generally widely available in most household surveys. However, consumption data are not sufficient to capture the impact of trade policies. Consumption effects are generally positive in the case of trade liberalization since tariff reduction will reduce the price of foreign goods, thereby increasing households' purchasing power.

Both from a poverty and a distributional perspective, the income effect is generally more important. However, analyzing the effects of trade policy on factor endowments and labour markets is more difficult. In practice, one would need to link policy-driven changes in prices to wages and employment opportunities. Proper econometric identification is often problematic, and economic models linking trade policy and labour returns do not provide much guidance. Economic models rely on several large assumptions such as full employment and perfect competition and thus they are seldom confirmed by empirical observations. Moreover, the effect of trade policies on labour markets depends greatly on the pre-existing structure of protection and on market distortions that will have to be taken into account in the analysis. Still, regardless of the sophistication of the analysis, empirical studies find that trade liberalization is often associated with a rise in the skill premium, changes in industry wage premiums and increases in employment opportunities for individuals. These are general findings, however. Given each country's different economic and social environment, the effects could be quite diverse for any given country. In practice, the effects of trade policy on labour markets cannot be generalized but should be estimated through microeconomic models accounting for countries' idiosyncrasies.

The revenue effect is often more difficult to quantify due to lack of available data on government transfers at the household level. Moreover, to the extent that changes in revenues are proportionally distributed to individuals, their impact on inequality is negligible and thus can be ignored. Still, the revenue effect should be considered (and analyzed) when a large share of government revenues depends on trade policy and when government transfers are targeted on anti-poverty programmes. In such cases, trade policy-driven changes in government revenues could have a substantial impact on these programmes and thus indirectly on welfare and inequality. This chapter's analysis focuses on the income and consumption effects. The rest of the chapter does not analyze the revenue effect, so the interested reader should refer to Deaton (1997).

2. Simple model linking trade policy to household welfare

The empirical analysis of the effects of trade policy on social welfare relies on a relatively simple model (Porto, 2003, 2004). Consider a small open economy that produces and consumes two goods: a traded one with price p_T and a non-traded one with price p_N . Let $e(\mathbf{p}, u)$ be the household's expenditure function.¹ Let w be the wage earned by a single-person household, τ the tariff on the traded good and p^* the traded good's international price.

The model's four basic equations are an income-expenditure identity, a wage equation, a non-traded good pricing equation (implicitly based on a zero-profit condition) and a pass-through equation. That is,²

$$\underbrace{e(p_T, p_N, u)}_{\text{Expenditure}} = \underbrace{t + w}_{\text{Income}} \quad (6.1)$$

$$w = \underbrace{w(p_T)}_{\text{Stolper-Samuelson effect}} \quad (6.2)$$

$$p_N = \underbrace{p_N(w)}_{\text{zero-profit cond.}} \quad (6.3)$$

$$p_T = \underbrace{p_T(p^*, \tau)}_{\text{pass-through}} \quad (6.4)$$

In practical calculations the researcher does not need to know what forms the functions (6.2) to (6.4) take: the data will inform. Differentiating totally (6.1)–(6.4) and substituting (6.2) into (6.1), the change in real income consequent to a change in tariff is:

$$\frac{\Delta t}{e} = (s_T + s_N \eta_{N,T} - \mu_{w,T}) \zeta \Delta \tau \quad (6.5)$$

where $\eta_{N,T}$ and $\mu_{w,T}$ are the elasticities of the non-traded good's price and of the wage to the traded good's price respectively, s_T and s_N are the traded and non-traded goods' shares in the household expenditure and $\zeta \leq 1$ is the pass-through parameter. In practice, (6.5) takes on a more complicated form because there are several traded goods, non-traded goods and sources of labour income. The change in real income is also referred to as “compensating variation” — the amount of money a household would need to keep its purchasing power intact.³

A useful way of thinking about how households are affected by trade policies is in terms of the farm household model. The farm household produces goods and services, sells its labour, and consumes. In this setup, an increase in the price of an item (or factor of production) that the household is a net seller of increases the household's real income, while a decrease in this price reduces that income.

In practice, household utility u_h can be expressed as a function of a vector of prices faced by the household and the household's income, which includes the income from farm activity and non-farm

activity (Singh et al., 1986). The change in utility Δu_{hr} of household h in region r depends on the changes in local prices (of goods and factors) and on the household's specific labour income, agricultural production and consumption. In practice, as households are generally consumers, producers and wage earners at the same time, the change in utility for each household h residing in region r can be simply calculated as:

$$\Delta u_{hr} = \sum_{sk} L_{sk}^{labour} \Delta w_{sr} + \sum_T (s_T^{Prod} - s_T^{Consum}) \Delta p_{Tr} + \sum_N (s_N^{Prod} - s_N^{Consum}) \Delta p_{Nr} \quad (6.6)$$

where s^{Consum} is the share of income spent on good g by household h ; s^{Prod} is the share of income of household h obtained by selling each traded (T) and non-traded (NT) goods at their respective price p_{Tr} and p_{Nr} . The difference $s_T^{Prod} - s_T^{Consum}$ can be thought of as the net exposure of the household to the change in price of that particular good. L_{sk}^{labour} is the share of income of the household h obtained by selling (skilled and/or unskilled, denoted by sk) labour. Finally, changes in prices (Δp_{Tr} , Δp_{Nr}) and wages (w_{sr}) in region r are expressed in percentage terms and are estimated in equations (6.2), (6.3) and (6.4). Social welfare is simply the sum of the welfare of all households (each weighting according to its number of individuals). Ultimately, the exposure of the households (and individuals) to price and wage changes depends on the structure of their income and the allocation of expenditures. Equation (6.6) provides the change in utility and would need to be calculated for each household.

This simple model does not take into account second-order effects, i.e. the fact that trade policies are likely to affect not only prices but also consumption and production decisions as well as the amount of labour offered by the households. To measure second-order effects properly is complex and requires a great deal of data on households' behaviours. Thus, second-order effects are generally not included in the analysis. The effects we are discussing here are so-called "first-order effects" (or "short-run effects") since we do not allow for any change in the allocation of resources of the households.⁴

3. Empirics

The analysis of the effects that trade liberalization has on welfare is generally conducted in two exercises requiring two different sets of data. The first exercise is the estimation of the changes in the prices of goods and factor returns resulting from trade liberalization. This is the estimation (or assumption) of the magnitude of pass-through from international to domestic prices (of traded and non-traded goods) and from domestic prices to wages. The second exercise consists of two steps. In the first step, the income sources and consumption baskets of each household are carefully disaggregated to construct budget and income shares. In the final step, the changes in the prices of goods and factors are mapped onto each household's budget and income shares to produce an estimate of the changes in the welfare of the households.

The first exercise starts with an estimation of the effect of trade policy on the prices of traded goods (equation (6.4)). Particularly in developing countries, domestic markets are often segmented and price transmission mechanisms are often different across various domestic markets. For example, trade policy may have a much larger impact in areas where markets are more competitive (near the border or in large cities) than in remote areas where isolation and remoteness can dampen any

price effect or in places or sectors where overall competition is lower. It is therefore preferable, when possible, to estimate changes in domestic prices at the regional level.

The measurement of the effects of trade on domestic markets is generally based on econometric estimation using time series data. The econometric approach aims to isolate the movement in prices due exclusively to changes in trade policy and requires a great deal of information on prices, domestic production and economic policies. Unfortunately, the data for properly estimating such effects (especially at the regional level) is often not available; thus analysts are obliged to simplify their assumptions.⁵ For example, due to lack of data, researchers may be constrained to estimate an average pass-through for the country as a whole rather than for the different regional markets. More commonly, the extent of the pass-through of a change in trade policies into domestic prices is often not estimated but assumed. Often the pass-through of trade policies to prices is assumed to be full, so that a 10 per cent reduction in the tariff of an imported good would reduce the domestic price of that good by 10 per cent. In some cases, the analysis makes use of existing estimates of pass-through coefficients. For example, if previous studies have estimated an imperfect pass-through of 40 per cent, this will imply that a 10 per cent increase in the tariff will affect domestic prices by only 4 per cent. The interested reader can find more details on how to estimate pass-through equations in Feenstra (1989), Goldberg and Knetter (1997), Campa and Goldberg (2002) and Nicita (2009).⁶

Having estimated (or assumed) the pass-through of trade policies to domestic prices, the second step consists in estimating the relationship between the price of traded and non-traded goods (equation (6.3)), and between prices and wages (equation (6.2)). In practice, this estimation is based on the long-term relationship between the variables of interest (prices and wages) and often makes use of time series econometrics (see Robertson, 2004 for a discussion). As in the case of the pass-through, the estimation may be hindered by the paucity of data. When the estimation is not possible, the analyst would have to make some simplifying assumption (or to rely on previous estimates of the elasticities between prices and wages). For example, prices of non-traded goods may be assumed to vary only to a fraction of the prices of trade goods, while wages may be assumed to vary in proportion to the overall changes in prices (and thus being not influential in terms of purchasing power). As trade policies have redistributive effects, the analyst should try to identify the relationships between prices and wages according to assumptions on the working of the labour markets. There are several possible assumptions on segmentation of the labour markets: which one is more plausible depends on the country being analyzed. In most cases the labour market is assumed to be segmented by skills, with workers able to move freely across economic sectors. Other approaches assume a segmentation of the labour markets across sectors (i.e. worker skills are sector specific), or segmentation may be assumed across geographic areas (i.e. no internal migration of workers). Further complications arise when modelling labour markets in developing countries where there is a large pool of reserve labour (unemployed or semi-employed). In such cases, wages may be insensitive to prices as wages are kept at subsistence levels (Nicita, 2008).

Having estimated (or assumed) the reaction of prices and wages to changes in trade policies, the analysis now moves to calculate their impact on each household. Equation (6.6) shows us how to measure the change in utility for each household resulting from a change in trade policy. The components of equation (6.6) are:

1. Δp_{Tr} is the percentage change in prices for each traded good in region r . This is obtained by estimating a pass-through model or by assuming a uniform price change proportional to the change in tariff. That is, $\Delta p_{Tr} = \xi \Delta \tau_{Tr}$ where $\Delta \tau_{Tr}$ is the change in tariff for good T obtained from trade policy data, and ξ is the pass-through coefficient. This can be estimated econometrically or assumed to be a fixed value between 0 and 1. As a rule of thumb the pass-thru can be assumed to be 40 percent for rural areas and 60 percent for urban areas.
2. Δp_{nr} is the percentage change in prices for non-traded goods in region r . This is estimated econometrically according to (6.3).
3. Δw_{sr} is the change in wages for each skill, or economic sector, s , in region r .⁷ This is estimated econometrically according to (6.2). This is often estimated using a Mincer-type equation. That is, labour returns are estimated by skills (or even by economic sector) as a function of prices of traded goods (or tariffs) controlling for a series of individual characteristics.
4. s_T^{Consum} is the share of income spent on each traded good T by household h ; s_T^{Prod} the shares of household income from the sales of products (generally agricultural). s_T^{Prod} is the share of sales of traded goods in total income. This information comes from household surveys. In general, traded goods are considered those to which tariffs are applied. That is, physical goods that can enter the domestic market from abroad.
5. s_N^{Consum} is the share of income spent on non-traded goods N by household h . This is also observable in the household survey data. Non-traded goods are usually lumped together to form a single group. In practice, the share of non-traded goods is often approximated by the share of household expenditures in services as these are generally considered non-tradables. Moreover, s_N^{Prod} (sales of non-traded goods) is often assumed to be zero, as data on households' direct sales of services is generally not available from household surveys. In the data, sales of services are often comprised in "returns from own enterprises" and assumed to follow labour returns (wages).
6. Δu_{hr} is the change in utility of the household h measured as change in real income or compensating variation (CV) — the compensation that would be needed for a given household to maintain its real income unchanged, expressed here relative to the household's expenditure.

The resulting compensating variation, calculated for each household, can then be displayed in a graph in which households are sorted by the variable of interests (income, gender, region, age, etc.).⁸ For example, the relationship between the compensating variation and the level of income tells us whether trade reform benefits and costs are correlated with household income.

Depending on the assumptions taken in estimating the effect of trade policies on prices and wages, it is important to check the robustness of the results. Assumptions should be taken on the basis of a priori knowledge of the functioning of markets, and should be justified in the discussion of the analysis. However, assumptions may severely affect the results. It is therefore important to test whether some of the assumptions have a large impact on the overall results. To check robustness of results, the easiest method is to provide different estimates according to different assumptions. For example, if the pass-through of trade policy to domestic prices was assumed to be full, it would be necessary to check the consistency of the results when pass-through is assumed to be lower, say 0.5. Similarly, several welfare estimates should be calculated for assumptions on wages. For example, estimates should be calculated for sticky wages as well as for wages that follow changes in prices completely.

C. Data

1. Survey data

The data needs of studies dealing with distributional effects are frequently filled through surveys (household surveys, labour surveys and firm-level surveys). Survey data are often collected for reasons that are different from that of analyzing the effect of trade policies and thus may not contain the relevant information required for an exhaustive analysis. It is therefore important first to scrutinize a household survey in order to determine whether it contains the relevant information for the analysis. The analysis of household surveys can be a daunting task for the inexperienced analyst. A comprehensive book on the topic is provided by Deaton (1997).

Note that surveys are quite heterogeneous. In practice, every survey has its peculiarities and survey structures vary greatly across countries as well as across time. Even repeated surveys (that is, multiple rounds of surveys done for the same purpose in the same country) can be different, since survey methodologies have evolved. Moreover, surveys are conducted for reasons that can vary both across countries and across time. Before initiating the analysis, it is important to familiarize yourself with the survey's structure, its original purpose, its limitation and its coverage. When using multiple surveys, it is also important to verify any incompatibilities and to ascertain to what extent they can be used for panel estimation or for comparison purposes.

Most of the household surveys collect the type of information required for household-level trade policy analysis. However, not all surveys are well suited for this purpose and, in many cases, the depth of analysis depends very much on the richness and quality of the data. To be appropriate for the analysis of distributional effects of trade policy a survey should include, besides information on consumption, information on the income shares each household derives from the sale of labour and/or the sale of agricultural products. Since trade policy impacts products and economic sectors differently, the more disaggregate the data are in the survey, the better it is suited for distributional analysis of trade policy. Household survey data should also provide information on subsistence activities, i.e. the amount of produced goods (usually agriculture) consumed within the household. Although subsistence activities are not directly affected by trade policy, they will have to be included as part of total household income and expenditures when income and budget shares are calculated since they contribute to the well-being of the household.

Survey data are based on the concept of a representative sample since they are collected only from a sub-sample of the represented population. Still, by using appropriate statistical techniques it is possible to infer the behaviour of the population it represents. A clear summary of the techniques required in the analysis of survey data is provided by Deaton (1997). In practice, analysis of survey data is facilitated by statistical software packages. Survey data are constructed in a way so that inferences drawn from them (through descriptive statistics or regressions) can be directly applied to the whole population. Surveys can be designed as clustered and/or stratified, as explained in the Box 6.1.

Box 6.1 Design of surveys

Survey data are based on the concept of a representative sample since they are collected only from a sub-sample of the represented population. In a *stratified* sample, a heterogeneous population is first divided into homogenous groups on the basis of a certain trait (geographical units, ethnic affiliation, rural/urban environment). Households within each group are then randomly selected to be part of the sample. The result is not one random sample drawn from the whole population but rather a collection of random samples, one for each group. It is as if we were dealing with several populations, heterogeneous across but homogenous within, instead of a single homogenous one, and designing sub-samples accordingly. The advantage of stratification is that it increases the precision of estimates and statistics. It also enables users to generate statistics and inferences for population subgroups (the strata), ensuring that there will be enough observations in each subgroup to do so.

In a *clustered* sample, by contrast, the population is first divided into groups that are *similar*: each cluster should be a small-scale replica of the total population. The surveyor then randomly selects some clusters to be in the sample. In a further stage, in each cluster, households are randomly selected to be in the sample. The advantage of clustering is that it reduces the cost of implementing the survey.

A sample that is both stratified and clustered is called a three-stage sample design:

- first, the population is partitioned into strata
- second, in each stratum, clusters are formed and some of them selected at random
- third, in each selected cluster, households are selected at random.

A large number of commands in STATA are dedicated to the use of survey data. This vastly simplifies the work of the statistician, who simply needs to indicate survey design once; STATA then takes care of the appropriate modifications to the most common formulae. A list of STATA survey commands is easily accessible by typing “help survey”. Particular attention needs to be given to weights (or the “expansion factor”). STATA allows four different types of weights (frequency, probability, analytical and importance weights). Specifying the appropriate weight is important for obtaining the correct standard error. Most surveys use probability (or sampling) weights (pweight). These can be interpreted as the number of population units represented by that particular observation.

Understanding the survey's design becomes important once you want to draw statistical inferences from it, whether these are regressions or descriptive statistics. Results will be biased if the survey's structure is not taken into account. The reason is that when households are not randomly selected from the whole population, each household in the sample “represents” a different number of samples in the population. Some types of households will be over-represented and some under-represented.

How is this source of bias corrected in practice? The answer is to give each household (or individual) in the sample a weight that represents the number of households (individuals) it truly represents. A typical survey therefore assigns a weight to each household, which is inversely proportional to the probability of the household to be in the sample (if a household of a certain type has a *high* probability of being in the sample, that type is likely to be over-represented, which calls for a *small* weight). These weights are provided with the survey data.

In practice, statistical packages greatly simplify the analysis of survey data and everything that the analyst needs to understand when identifying the variables indicating the strata, the clusters (often referred to as primary sampling unit) and the weights. This information is often embedded in the survey and should be clearly explained in the documentation accompanying the dataset. Once the researcher has positively identified the variables indicating any strata, clusters and sampling weight, these are entered in the software package.

In summary, STATA greatly facilitates the analysis by providing a set of common econometric and statistical routines that take into account the design of the survey so as to obtain results that will fit for the whole population. Survey data and design has to be understood, scrutinized and then analyzed with the proper statistical and econometric techniques. That is, the task of drawing inferences from survey data always requires human skills and knowledge with the possibility of misinterpreting the data and the results.

Household survey data are generally the property of the respective governments. In some cases, the data can be accessed only by submitting a formal request to the competent statistical offices. In other cases, the use of survey data does not require any permission or permission is automatically granted. There are two websites that are very helpful in obtaining survey data, both managed by the World Bank: <http://www.internationalsurveynetwork.org> and <http://go.worldbank.org/ZTOE0XCJ20>. These websites provide information on the availability and access of various types of surveys.

2. Trade policy data

The trade data needed to study the effects of trade policies are of two types: trade data and trade policy data. A good discussion of trade and trade policy data is provided by Nicita and Olarreaga (2007).

Trade data consist of trade flows and it is important to understand which goods are being imported and which are not. Trade policy data consist of information regarding the trade policy that is the subject of the analysis. In general these data consist of tariffs, since the analysis is often limited to traditional trade policies such as tariffs and specific duties.⁹ However, non-tariff measures (i.e. standards, quotas, anti-competitive measures, etc.) and any trade-related costs can also be analyzed. As explained in Chapter 2, the pre-requisite is first to convert the information about particular non-tariff measures or trade costs into *ad valorem* equivalents, i.e. how much (in percentage terms) a determined non-tariff measure (or any other trade costs) affects the price of a product. Estimating *ad valorem* equivalents is not an easy task and requires a considerable amount of data.¹⁰

As discussed in Chapters 1 and 2, detailed trade and trade policy data (tariffs and trade flows) can be obtained from different sources such as government websites, UNCTAD TRAINS or the UN COMTRADE databases. An easy way to access these data is to use the World Integrated Trade Solution (WITS): <http://wits.worldbank.org>.

One challenge when working with different datasets is to merge the data into a single file. Survey data and trade policy data need to be harmonized, since they do not come under the same classification. While trade policy data generally follow the Harmonized System (HS) classification, survey data follow a classification peculiar to their needs. In practice, tariff changes will need to be aggregated into broader categories that can be matched with expenditure and income categories in the household survey. At a minimum, the aggregation should use imports as weights so as to give more importance to sub-products that are most traded. For a better aggregation, one should use both trade flows and import demand elasticities (see Kee et al., 2009 for details). Another aggregation issue is likely to arise when estimating wage-price and non-traded elasticities. For example, depending on the assumptions taken, there would be a need to aggregate the data into traded or non-traded goods, broad economic sectors, skilled and unskilled and so on.

D. Applications

1. Calculating the effect of change in tariffs on consumption and agricultural sales

Here we present a simple method of calculating the effect of a tariff reduction on households. The analysis is based on data for Ethiopia. The purpose of this exercise is to illustrate in some detail the mechanics of working with trade policy and household survey data. The exercise is divided into two steps. In the first step we will calculate the change in domestic prices due to the tariff reduction. In the second step we will assess the impact of the change in prices on the consumption baskets of households as well as on the income from agricultural sales. For tractability, the analysis adopts some simplifications. First, we assume a perfect price pass-through. That is the domestic price given by the world price multiplied by $1 + \text{tariff}$. Second, we abstract from effects on the labour market. Finally, as we are only interested in point estimates, we do not consider the sampling structure of the household surveys. The STATA code for this application is detailed step by step in the file `DE_Application(Ethiopia).do` that can be found in the subfolder `Chapter6\Applications\` (all other do files relevant for this application can be found here too). Then we provide some discussion and some possible extensions.

The analysis first calculates the change in prices resulting from a change in tariff. This is based on trade policy data and it is detailed in the first few commands in the `Ethiopia.do` file. Trade policy data (in the file `Chapter6\Datasets\tariff_9501.dta`) consists of tariffs in 1995 and 2001. Trade policy data follows the HS classification at the six-digit level for a total of about 5,400 different products. The trade policy data file also contains the concordance (the variable is labelled "type") between the HS six-digit classification and the product groups important for Ethiopian households. The change in price is simply calculated as the percentage change in tariff between 1995 and 2001, taking into account that the domestic

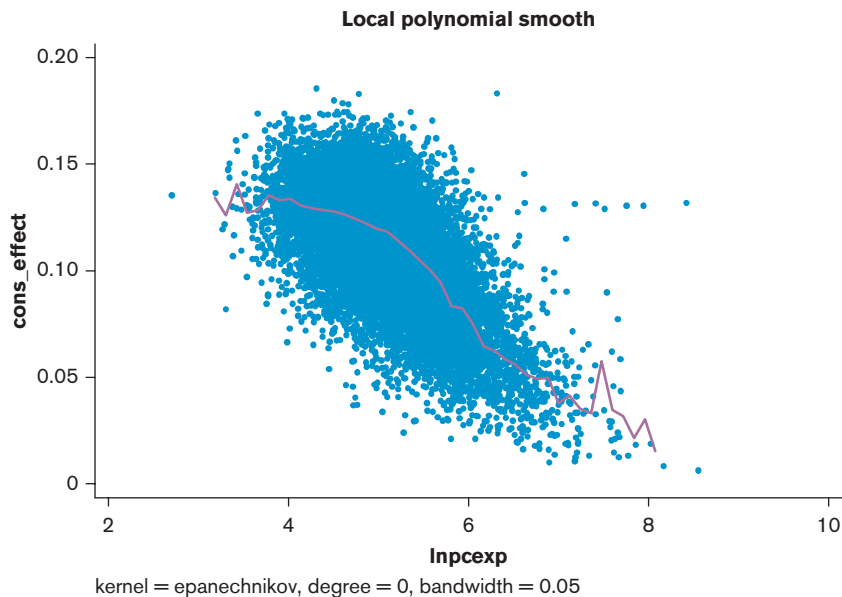
price is given by the world price multiplied by $1 + \text{tariff}$. The change in price at the product level is then saved in the file `deltaprice.dta`.

An extension to the analysis could assume a different price pass-through. This could be assumed uniform across the country, say 0.6 (this can be simply implemented by multiplying the observed change in tariff between 1995 and 2001 by 0.6 and then recalculating the change in domestic prices). Alternatively, an option would be to use pre-estimated pass-through coefficients at the regional level, i.e. the price transmission is assumed to vary across regions (kilil in the case of Ethiopia). These are provided in the file `passthru_coeff.dta`. A further extension could entitle the estimation of pass-through coefficients for different products, say agriculture and manufacturing, or mainly imported and exported goods.

The second step of the analysis uses the data from the Ethiopia households survey (`Ethiopia_hhsurvey.dta`). These data have been already cleaned and formatted for the analysis. The data file contains three main sets of variables. First, the identification variables which provide some characteristics of the household: location, household head's gender, the number of people living in the households, etc. Second, a set of variables detailing the expenditures of the households aggregated in 18 categories. And third, a set of variables detailing the sources of income of the households aggregated in 13 categories. The data file also contains information on survey design (weights and strata). Note that the dataset contains only part of the data in the official Ethiopia households survey. The original file contains more information than those provided in the file.

The first point of this second step is to divide the households according to their purchasing power. This is generally done by using expenditures or alternatively per capita income. In the STATA do file, this is done first by summing up all expenditure categories with the inclusion of subsistence activities. We can call this variable `totexpend_hh`. Note that it is important to add subsistence activities as these contribute to the well-being of the household. These are generally cumbersome to calculate since subsistence activities do not have a manifest monetary price, so some reference price has to be used. The data file already contains a variable that provides the monetary equivalent (calculated at market prices) of all products produced and consumed by the household. The total expenditure of the households then needs to be divided by the number of household members so as to obtain per capita expenditures. This can be done by simply dividing by the number of people living in the household or, more properly, by using equivalence scales. Equivalence scales take into account the economies of scale that occur in the households. For example, children or elderly could have fewer expenses than adults, so that for maintaining a given living standard a family with a large number of children does not need the same level of consumption as a family of the same size but with a large number of adults. Deaton (1997) treats this argument at length. The do file also splits households across per capita expenditure deciles; this is useful especially for producing summary statistics and graphs. This is done by using the `"xtile"` command in STATA.

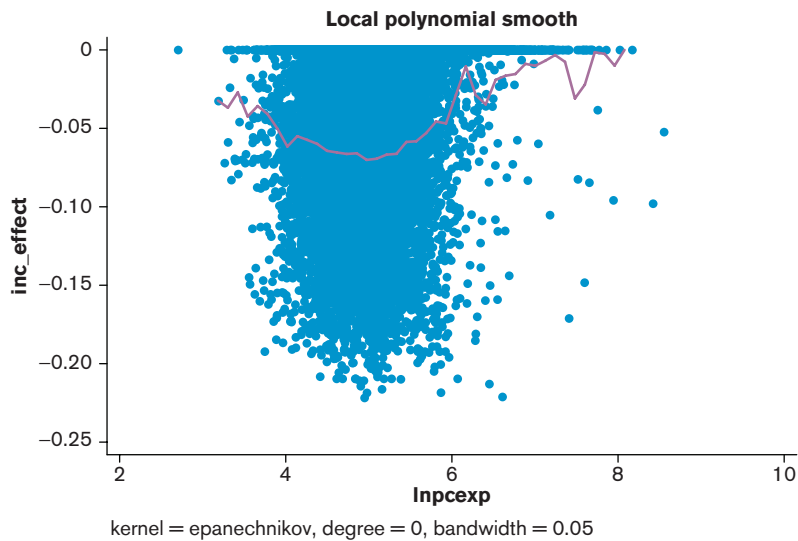
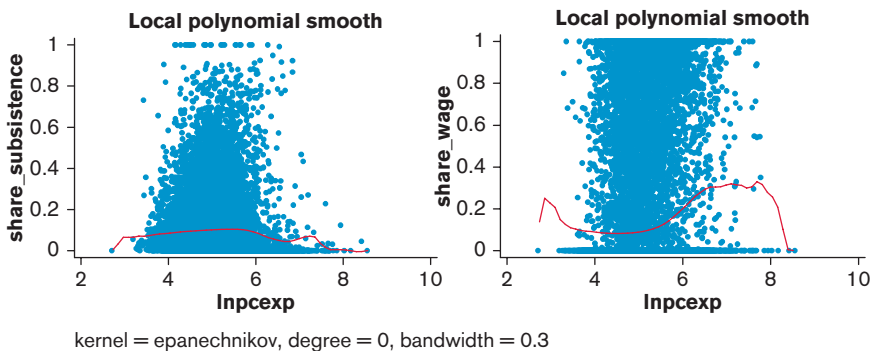
The next step is to focus on consumption effects so as to compute changes in the cost of the expenditure basket of each household due to the change in trade policy. This is done by merging the household survey data on consumption with the price change calculated in step 1, and then

Figure 6.2 Consumption effect by per capita expenditures (log)

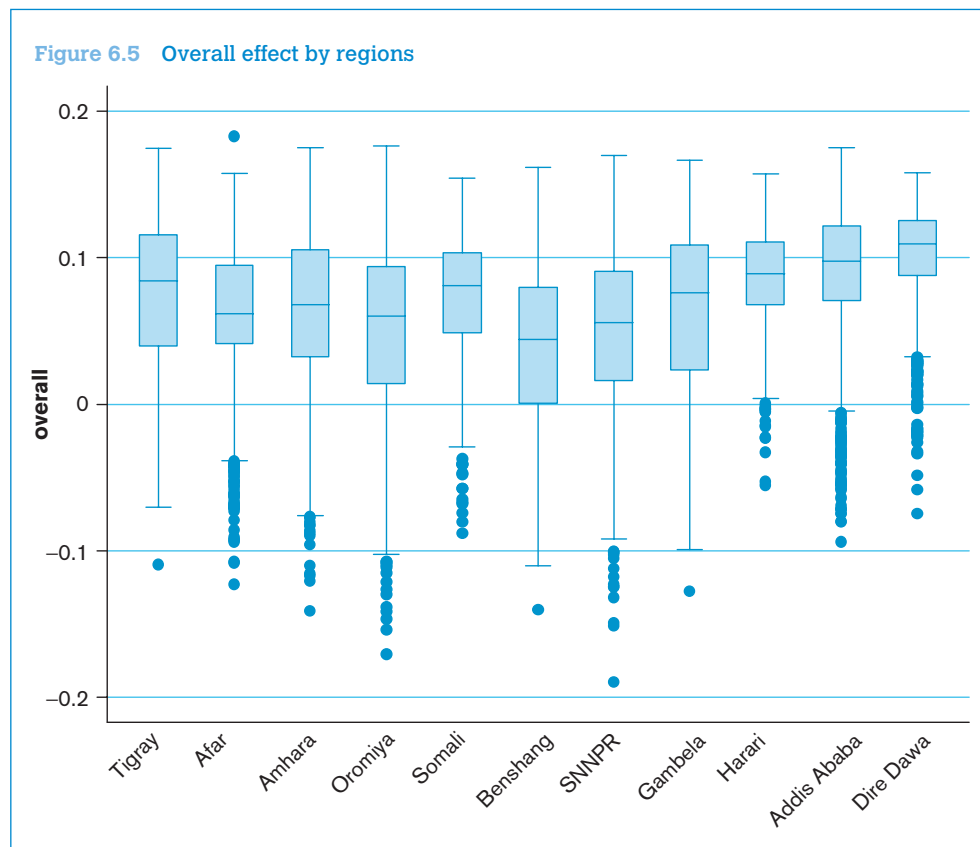
recalculating the new cost of the expenditure basket for each household. The gain or loss for each household will be given simply by the difference between the old and the new cost of the expenditure basket. This statistic is generally reported in percentage terms. In practice, a decline in the import tariff will reduce the price of the good in the domestic market, so it will have a positive effect on the purchasing power of households because the household budget will allow purchase of more of the goods for which the tariff has declined. The effect on consumption (the percentage change in the cost of the consumption basket) is then plotted against the log of per capita expenditures so as to analyse possible differences across household distributions. The data are plotted using the “lpoly” command and illustrated in Figure 6.2.

The plot indicates the effect of the tariff reduction inversely correlated with household expenditure; thus the reduction of the tariff has benefited the poor proportionally more. This plot is informative for poverty purposes but it is only one way of presenting the results. In practice, the results could be calculated and presented for households divided according to any other characteristic (location, gender, size, etc.).

The income effect is similarly calculated. The various goods produced by households are merged with the change in their respective prices and then the percentage change in the value of agricultural income is calculated. As subsistence activities are assumed not to be affected by trade policy, it is important to include them in total income. The income effect is plotted against the log of per capita expenditure in Figure 6.3.

Figure 6.3 Income effect by per capita expenditures (log)**Figure 6.4** Share of income from subsistence activities and wages

The reduction in tariff will translate into more competition from foreign products, and thus into lower domestic prices, which then translate into lower income for households producing agricultural products. Regarding the distribution of the income effect, the plot in Figure 6.3 suggests two points. First, the income effect of agricultural sales is mostly zero for richer households. This is due to the fact that agricultural sales do not play a large role in the income of richer households. Second, the larger effects are for households in the middle of the distribution. This may be due to poorer households being landless or, more likely, disproportionately engaging in subsistence activities and thus their income is unaffected by changes in prices. For richer



households, the lack of effects is most likely due to the fact that agricultural sales represent a small part of their total income. Another explanation might be that tariffs on products produced by the poor have not changed as dramatically as those produced by households in the middle of the income distribution. Some of these hypotheses can be roughly verified by plotting the share of income originating from subsistence activities and from wages. These plots are presented in Figure 6.4.

Figure 6.4 suggests that, with the exception of the first data point on the left side of the distribution and for richer households, income from subsistence activities does not substantially vary across households. On the contrary, income from wages presents a bipolar distribution. Wages are important for both the poorest and the richer households. This allows us to conclude that the main reason behind the weak income effects in Figure 6.3 is the fact that a substantial share of the income of poor households as well as of richer households is from wages, which in the analysis so far have been assumed to be unaffected by trade policy. This issue may lead us to analyze the effect of trade policies on wages. Unfortunately, as discussed above, this is a complex exercise which requires a time series of data linking prices

to wages (Robertson, 2004). This exercise would also require some assumptions on the functioning of the labour markets (say, if labour markets are segmented by skill, industries, regions, etc.). In practice, some insights may be obtained by regressing a Mincer equation (wages on individual characteristics and prices) with time series data so as to try to isolate properly the effect of tariff changes on wages (see Nicita, 2008 and 2009, and Ural Marchand, 2012 for a few applications).

The last part of the analysis consists in calculating the overall effects of trade policy. This is simply done by summing up income and consumption effect. For this exercise, the results are presented in terms of deciles, i.e. the consumption, income and overall effect on households divided according to their level of expenditures. Table 6.1 provides the results.

Table 6.1 indicates two points. First, results are positive overall: the benefit of a cheaper consumption basket outweighs the cost of lower prices of agricultural sales. Second, effects are larger for poorer households. This implies that the tariff changes have benefited poor households proportionally more than richer households and thus that the change in trade policy has been pro-poor. Note that these are averages by deciles and so it is still possible that single households might lose from the tariff reduction. This can be shown in several ways; for illustrative purpose here we also can plot the results by regions (kilil) – see Figure 6.5.

The box plot shows the distribution of the overall effects across 11 Ethiopian regions (kilil). The boxes in the figure display the 25th, 50th and 75th percentile, the lines extend to the 5th and 95th percentiles and dots represent outliers. The figure suggests that the overall effects are similar across regions. However, the effects are slightly more positive in the regions with a larger share of urban population (Addis and Dire Dawa). For these regions, there are very few households that will lose from the tariff change. Regions with the largest number of households that will lose from the effect of tariff change are Oromiya, Benshang and SNNPR, with a negative overall result for about 20 per cent of households. The next step would be to identify these households more precisely, analyze their means of living and try to devise complementary policy to alleviate the trade policy costs that fall on these households. This is clearly beyond the purpose of this illustrative exercise.

Table 6.1 Income, consumption and overall effects by deciles

<i>decile</i>	<i>inc_effect</i>	<i>cons_effect</i>	<i>overall_effect</i>
1	−0.051	0.137	0.086
2	−0.057	0.135	0.077
3	−0.061	0.133	0.072
4	−0.061	0.130	0.069
5	−0.057	0.128	0.071
6	−0.063	0.124	0.060
7	−0.071	0.123	0.052
8	−0.065	0.117	0.052
9	−0.046	0.108	0.062
10	−0.023	0.072	0.050

2. Measuring the impact of tariffs at the household level

Whether a given trade policy has a regressive or “anti-poor” bias, i.e. whether it penalizes poor households more than rich ones, is an important policy question in the context of trade reform. In general, various tools can be used to quantify the effects of trade barriers on domestic residents’ incomes. Here we abstract from effects on the labour market and limit ourselves to a tool that is simple to use — although its data requirements can be non-trivial — but nevertheless provides a clear answer to the question of progressivity/regressivity.¹¹

Consider for instance a simplified version of equation (6.6), where a farm household consumes n products indexed by k , and let $s_{h,k}^{Consum}$ stand for the share of good k in the household’s expenditure.¹²

Suppose that the farming household also produces those n products for either self-consumption or for sale (we will show later in this section that extending the analysis to the case where goods produced and consumed are not the same is straightforward). Let $s_{h,k}^{Prod}$ be the share of good k in the household’s income. By income, we mean “full income” including self-subsistence activities evaluated at market prices.¹³ Again, the share of some goods — i.e. crops in the context of a farming household — in household income may rise with income, say because growing that crop requires access to credit, some degree of training or other factors typically correlated with income; or it may fall. The former case will apply when the income elasticity of the crop in question is higher than one, the latter when it is lower than one. Thus, there are “necessities” and “luxuries” on the production side, although the terminology is not very telling here.

From the above discussion it should be clear that tariffs on goods produced by households *protect* (benefit) them whereas tariffs on consumption goods *tax* them. In practice, if the tariff structure protects the goods *produced* by rich households disproportionately (relative to those produced by non-rich households), these tariffs are pro-rich (i.e. high tariffs on crops grown predominantly by large and high-income farmers, and low tariffs on products produced by poor, small-scale farmers). On the other hand, if tariffs are relatively higher on goods *consumed* by the rich, these tariffs are pro-poor (e.g. high tariffs on luxury goods).

Formally, one can construct a production-weighted average tariff for each household as

$$\bar{\tau}_h^{Prod} = \sum_k s_{h,k}^{Prod} \tau_k \quad (6.7)$$

where τ_k is the tariff on good k , and a consumption-weighted average tariff as

$$\bar{\tau}_h^{Consum} = \sum_k s_{h,k}^{Consum} \tau_k \quad (6.8)$$

The net effect of the tariff structure on household h ($\bar{\tau}_h$) is then the difference between the two:

$$\bar{\tau}_h = \sum_k (s_{h,k}^{Consum} - s_{h,k}^{Prod}) \tau_k \quad (6.9)$$

Note that the sets of goods produced and consumed need not overlap; for instance, an urban, salaried household would simply have zero production weights on all goods, i.e. for some goods $s_{h,k}^{Prod} = 0$ while for others $s_{h,k}^{Consum} = 0$. Finally, note that the effect of trade reform would be assessed in this framework by replacing tariff levels τ_k by tariff changes $\Delta \tau_k$.

All three (consumption effect, production effect and net effect) can be plotted against income levels in order to get a picture of the regressive or progressive nature of tariffs. One way of doing this might be simply to regress $\bar{\tau}_h$ on income levels. However, nothing guarantees that the relationship between the two will be linear or even monotone, as it may well have one or several turning points. As an alternative to linear or polynomial regression, you may fit what is known as a “smoother” regression, which essentially runs a different regression for each observation, using a sub-sample centred on that observation.¹⁴

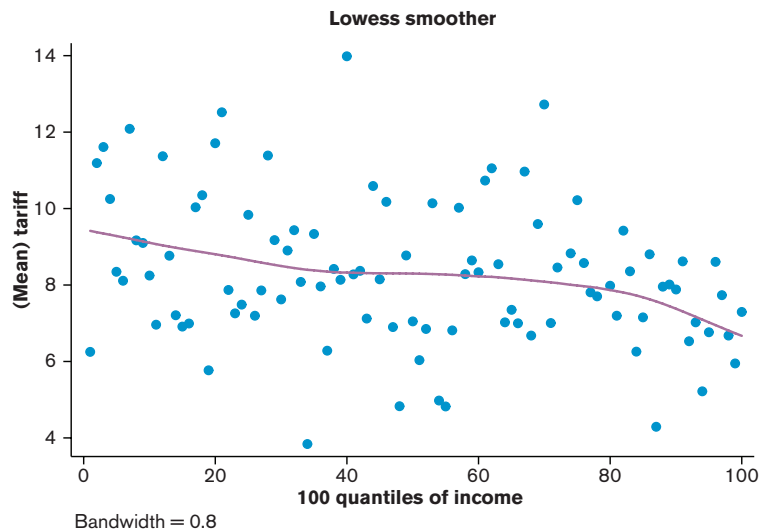
A “smoother” regression is a non-parametric regression technique designed to generate a fitted curve that imposes no *a priori* functional form (linear, quadratic or other) on the relationship between two variables X and Y . It is thus a useful exploratory tool for detecting highly nonlinear relationships. This can be done, but only in the case of a large sample (such as the one originating by survey data), by performing a so-called LOWESS smoother (for LOcally WEighted Scatterplot Smoothing). In short, the value of the regression function for each point is estimated only by using a subset of the data. Moreover, the estimation is performed by using weighted least squares, giving more weight to observations near the point for which a response is being estimated and less weight to observations further away. The value of the regression function for the point is then obtained by evaluating the local polynomial using the explanatory variable values for that data point.

The result is a “regression curve” on which no particular shape is imposed and which can therefore have as many turning points as needed to fit the data. In addition, for readability, households can be grouped into centiles and the smoother regression is run on the average incomes of the centiles rather than on individual household incomes. This is done by employing STATA's `xtile` command using appropriate *weights*. If *tariff* is the consumption-weighted tariff, the mean by centile of the income distribution is obtained by:¹⁵

```
use "EPM.dta", clear
collapse income tariff [w=prod_exp] , by ( strata_id comm_id weights)
xtile centile = income [w=weights], nquantiles(100)
collapse tariff [w=weights] , by ( centile)
lowess tariff centile
```

Note that this procedure reports the results at the household level. More commonly, for poverty and inequality purposes, results are to be reported at the individual level, i.e. larger households should be given more weight. Individual-level results can be obtained by multiplying the weights by number

Figure 6.6 Tariff on consumption



of individuals or by using multipliers depending on equivalence scales so as to capture economies of scale within the household (see Deaton, 1997 for more details).

Figure 6.6 shows the Lowess smoother for Madagascar based on an extraction from Madagascar's 2001 household survey. The downward trend indicates that the tariff structure is regressive (it taxes poor households more than rich households), at least for what regards consumption. While the poor households are taxed almost 10 per cent, the richer households are taxed about 7 per cent. Clearly this is only part of the analysis; the overall tariff structure of Madagascar could still be progressive (more favourable to the poor) to the extent that income sources of the poor enjoy higher tariff protection than those of richer households.

E. Exercise

Assessing the progressivity of trade taxes

The household survey used in the practical exercise is Madagascar's 2001 *Enquête Permanente des Ménages*. The population was stratified into groups according to the environment (urban/rural) and to the district. With six districts, the number of strata is 12 (you can verify this by using the survey description command *sydes*). Then, in each stratum, clusters were defined according to communities. Among them, some were selected with a probability proportional to the community's size. Finally, in each selected community, households were randomly selected.

In the database used in the practical exercise, the strata are identified by the variable *strata_id*, the clusters by *id_comm* and the sampling weights by *weights*. The command to specify the survey structure is then:

```
svyset id_comm [pweight=weights], strata(strata_id)
```

Use the datafile EMS.dta provided in the folder Chapter 6\Exercises. It is an extraction from Madagascar's 2001 *Enquête Permanente des Ménages* (EPM). A STATA do file explains the commands involved in each step (DE_Exercise(Madagascar).do).

1. Using the *svydes* command, answer the following questions:
 - a. What is the total number of strata, units (communities in the database) and households in the sample? What type of sample is this?
 - b. What is the average number of households per unit (community)?
 - c. In which stratum is the smallest unit (community)? How many households are in it?
2. Without taking account of the survey's design, assess the progressivity or regressivity of Madagascar's tariff structure on the consumption side. The steps are as follows:
 - a. Calculate the weighted-average tariff for each household; call it *c_tariff*.
 - b. Generate centiles of the income distribution in the sample.
 - c. Calculate the average of this consumption-weighted tariff for each centile using the command *collapse c_tariff, by(centile)*.
 - d. Regress this centile average on income using STATA's *lowess* command, using a bandwidth of 0.8.
 - e. In view of the smoother regression curve, is Madagascar's tariff structure progressive or regressive on the consumption side?
3. Redo Question 2 but taking into account the survey's design. What do you observe?
4. Using the household expenditure data, determine which of the 81 goods in the database are necessities (income elasticity lower than one) and which ones are luxuries (income elasticity above one).
 [Hint: Calculate average product weights by centiles and perform a simple regression of product weights on centiles for each product.]
5. Using your findings from Questions 2–3 and from Question 4, suggest a trade-policy reform. Assuming a budget-neutral tariff reform designed to bring more equity in the system, on what products would you suggest raising tariffs? On which ones would you suggest cutting them?

Endnotes

1. The expenditure function gives the minimum expenditure needed to attain a level of utility u given prices p . Its derivative with respect to the price of each good, by Shephard's lemma, is the household's consumption of that good.
2. In the equations below, we will abuse notation by using the same letter to designate a variable (say, w) and the function that determines it from its argument (say, p_j).
3. Imagine that a benevolent government were to pay losing households the amount they lost as a result of the trade shock and to tax winning households by the amount they won. This "transfer" would thus be a positive number in the budget constraint of losing households and a negative one in that of winning households.
4. See Porto (2003) and the references therein for a discussion of that assumption's implications. In practice, second-order effects are taken into account for case studies confined to few markets and sectors, and only when large effects are expected. Nicita (2008) provides an empirical methodology for assessing the effect of employment changes on households' welfare.
5. Household surveys are collected on a regular basis and thus they can provide some information on trends in prices of goods of importance to the households. Time series on prices (often at the local level) can be extracted from household surveys. Surveys collect information on purchases, and proxies of prices can be obtained by dividing expenditures by quantities. These unit values would have to be corrected for quality and aggregated in cohorts so as to reduce measurement errors (see Deaton, 1997).
6. See also Nicita (2007) for a simpler calculation of regional pass-through.
7. Generally, wage responses to prices are estimated for skilled and unskilled (often based on years of education, with workers having less than nine years of education considered to be unskilled). Skills can also be assumed to be sector specific; thus the estimation can be performed segmenting the labour markets by economic sector instead of skill.
8. With a sample of several thousand households this graph is likely to be unclear, so observations can be averaged by groups (based on income, gender, region, etc.).
9. Specific duties (i.e. \$10 per metric ton) would need to be converted in *ad valorem* equivalents (i.e. 8% tariff). AVEs can be calculated with an algebraic formula where the key parameter is the price of the good. Users can query WITS to perform this calculation.
10. See Kee et al. (2009) for estimating *ad valorem* equivalents of non-tariff barriers.
11. A progressive tax is one whose average rate goes up with income, and conversely for a regressive tax.
12. Those shares are themselves likely to vary with income levels (goods are "necessities" if their budget shares go down with income, i.e. if their income elasticity is less than one, and "luxuries" otherwise).
13. Evaluating the monetary equivalent of the food crop output can be done using producer or (typically higher) consumer prices. The logic for using the former is that if the food crop was sold instead of consumed it would be sold at producer prices. The logic for using the latter is that if the food crop was purchased instead of grown it would be purchased at consumer prices. So which one to use is a matter of judgment and data availability. What is important is that the analyst makes his/her choices clear in the writing.
14. Although it sounds complicated, this procedure is in practice very simple because it is pre-programmed as the "lowess" and "lpoly" command in STATA.
15. As we are not interested about standard errors this example does not use the "svy" STATA commands. See the practical exercise for a similar exercise using svy commands.

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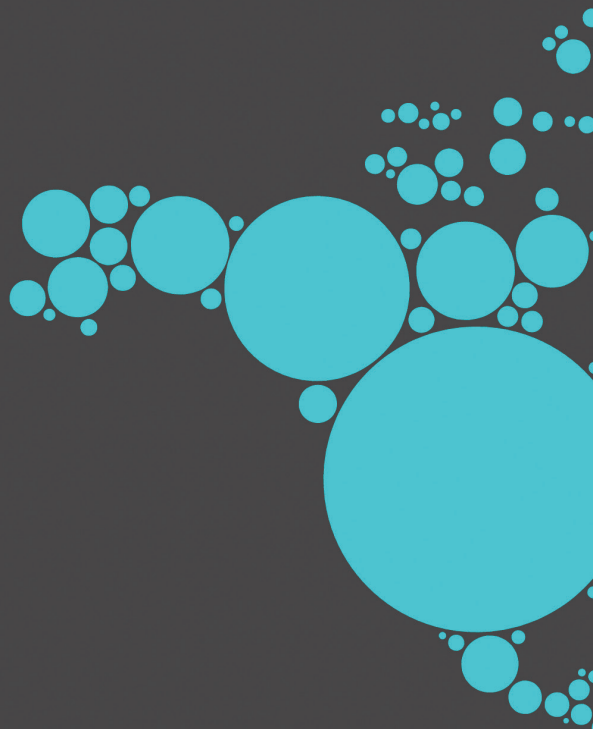
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ISBN-13: 978-92-1-112855-0
e-ISBN-13: 978-92-1-055690-3
United Nations publication
Sales No.: E.12.II.D.12

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