Module 2
The microeconomic approach
1 Introduction

This module analyses the gender effects of trade policies and shocks using household survey data. The approach follows the two-step methodology that characterizes recent trade and poverty literature. The first step studies how trade policies and trade shocks affect prices of goods and factor remuneration in the domestic economy. The second step uses household survey data to assess the welfare impact of those price changes.

Trade policies have diverse effects on individuals and households: some may benefit from trade liberalization or facilitation, others may suffer, and yet others may not be affected. The results depend mainly on two factors:

• The influence that trade policies and trade shocks have on domestic prices of goods and factors of production; and
• The degree of exposure that individuals have to the various goods and factors of production.

As we will see below, trade policies and shocks have three main effects on households:

• Consumption effect – the effect on the price of goods consumed by the households directly (traded goods) and indirectly (non-traded goods);
• Income effect – the effect on household income, including labour wages, earnings from the sales of agricultural products or any other goods, and other forms of income;
• Revenue effect – the effect on the generation and distribution of government revenues that may indirectly affect household welfare through government transfers and the provision of public goods.

This module will not consider the revenue effect but will rather focus on the first two effects. For methodological reasons, we will split the income effect into two components, the production effect and the labour income effect. We will explain the difference later on.

As we will show, once the welfare impact has been estimated for each household, we can aggregate it by the relevant dimension — geography, gender, or income level — to identify “winners” and “losers” from trade policy. In this module, we focus on the gender dimension.

Section 2 of this module provides a brief literature review of studies that have applied the microeconomic approach presented here as well as a list of types of microeconomic studies. Sections 3 and 4 provide the intuition behind the methodology, leaving the more technical presentation for the interested reader in the two annexes, A and B, at the end of this module. Section 5 offers the basics on non-parametric regression techniques, which are commonly applied to explore how trade-led price changes can influence household welfare. In the hands-on application in Section 6, we then explain step by step how to replicate in Stata the estimations from an UNCTAD (2011) study on gender and trade in Cape Verde. Section 7 presents concluding remarks.

At the end of this module, students should be able to:

• Describe the microeconomic approach relating changes in trade policy and/or shocks to changes in household welfare;
• Review and summarize the literature using the microeconomic approach to disentangle the effects of trade on gender;
• Understand the mechanisms linking changes in trade policy and/or shocks with changes in consumer and producer prices — i.e. the pass-through effect;
• Split the effects of trade on household welfare into three components: (a) the consumption effect, (b) the production effect, and (c) the labour income effect;
• Understand how the microeconomic approach can be used to analyse the relationship between trade and gender;
• Understand non-parametric estimation tools;
• Replicate, using Stata, the 2011 UNCTAD study on trade and gender in Cape Verde.

2 Review of the literature

The aim of this section is to discuss a series of papers that have used the microeconomic approach described in this module. The section will focus mostly on the trade and poverty literature with a gender dimension, for example, focusing on the impact of trade on female-headed households (see the hands-on application in Section 6). In this regard, it should be noted that this literature review is mostly concerned with providing a non-exhaustive collection of papers linking trade policy with welfare at the household and individual levels. At the end of the section, several studies on trade and gender are cited that have not necessarily employed the methodology presented in this module, thereby illustrating the existence of alternative microeconomic empirical approaches.

One of the most influential papers in the trade and poverty literature is Porto (2006), which
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extends Deaton (1989a) to study the impact of international trade on household welfare. The work of Porto (2006) is innovative because it considers the impact of international trade liberalization both on household consumption and wages. In this respect, it represents a general equilibrium analysis. As such, it simultaneously explores more than one channel of interaction between trade and poverty – i.e., the consumption channel and the labour market channel. It is thus different from earlier partial equilibrium analyses that considered only one sector of the economy (for instance, labour markets) at a time (Goldberg and Pavcnik, 2007). Porto (2006) identifies two stages that link changes in trade policy with changes in household welfare: First, trade reforms cause direct changes in the prices of consumption goods; and second, these price changes affect households both as consumers (because households purchase consumption goods) and as income earners (because changes in the prices of goods affect the wages of workers living in the household).31

Porto (2006) applies his theoretical framework to study the distributional effects of the Southern Cone Common Market (MERCOSUR) on household welfare in Argentina. For this purpose, he employs household level data as well as data on the intra-zone tariffs applied to MERCOSUR members. The findings suggest that the MERCOSUR agreement had a pro-poor distributional effect and that trade liberalization was not responsible for the increase in poverty and income inequality experienced in Argentina throughout the 1990s.

Empirical studies employing Porto’s framework have mushroomed over the years.32 For example, Nicita (2009), Marchand (2012), and Borraz et al. (2012) analyse the cases of Mexico, India, and Paraguay and Uruguay, respectively. Their contribution is to adapt Porto’s price transmission mechanisms from tariffs to prices by allowing trade costs (proxied by distance from borders), domestic producer prices, and exchange rates to influence prices of goods as well. In this scenario, there are more data requirements that cannot always be met, especially for developing countries. Despite analysing two very different regions of the world, Nicita (2009) and Marchand (2011) arrive at a similar conclusion: the distributional effects of trade liberalization on household welfare depend on the region where the individuals live, their consumption basket, and the factors of production owned (whether skilled or unskilled labour). Borraz et al. (2012) analyse the distributional implications of MERCOSUR on household welfare in Uruguay and Paraguay and also account for poverty and inequality effects separately. They find that preferential trade liberalization affected households in Paraguay and Uruguay differently, thereby suggesting that trade has different effects across countries as well. In sum, there is still no agreement on the welfare effects of trade liberalization at the microeconomic level, and there is scope for further research in this direction.

Despite its validity, the microeconomic approach introduced here represents only one of the existing ways to analyse the link between trade and gender. When it comes to exploring the gender implications of trade, one strand of literature focuses on intra-household dynamics. The basic assumption is that households are heterogeneous units comprised of men and women who differ in their control over resources and consumption preferences. By affecting prices and wages, trade may bring changes to the allocation of resources among members of the household and ultimately to the well-being of the household as a whole. This theoretical framework has been applied in a series of papers included in Bussolo and De Hoyos (2008). For example, by focusing on the case of Senegal, Bussolo et al. (2008) test the idea that in developing countries’ rural households, education spending, mostly controlled by women, can be affected by a trade-related increase in the prices of export crops, from which men benefit the most. The findings support this hypothesis: men’s income share increases relative to women’s share, with negative though limited repercussions on the amount of education spending for children. De Hoyos (2008) focuses instead on the implications of trade for female wages. In particular, the study looks at better working opportunities for women, including lower gender wage gaps, offered by the maquila sector of Honduras that has developed and grown thanks to the liberalization policies implemented by the country since the early 2000s. The study also tries to explore the link between women’s improved working conditions and poverty by simulating the level of poverty that Honduras would have reached if the maquila had not existed. The results show that in this scenario poverty levels would have been 1.5 percentage points higher.

In conclusion, what we want to say is that although this module focuses on a particular type of microeconomic approach, it is not the only approach. The aim of this brief literature review is to stimulate your interest and enrich your knowledge about the multiple approaches you can use to study the linkages between trade and gender at the microeconomic level.
3 From trade policy to prices

Going back to the two-step methodology introduced by the trade and poverty literature, this section explains the first step in detail. The key idea is that domestic and international prices are linked and that trade policy and trade shocks will therefore have an effect on domestic prices and factor remuneration. According to Brambilla and Porto (2009), standard models of international trade assume competitive markets (with homogeneous goods) and frictionless trade. In this scenario, markets are integrated and the law of one price holds. Domestic prices are equal to international prices converted into the local currency. That is, if a product costs $5 abroad and the exchange rate in your country is two units of the local currency for each unit of the foreign currency ($), then the product should cost 10 units in local currency. Of course this is a very simple model, as it does not consider transportation and distribution costs, or the fact that the price of the good may also be affected by trade policy instruments (such as tariffs). In this case, if $p_i$ is the domestic price of an imported good, $p_i^*$ is the international price, $e_i$ is the exchange rate, $\tau_i$ is the sum of international transaction costs (i.e. transportation), and $\gamma_i$ is the tariff rate applied to good $i$, then we may write:

$$p_i = p_i^* e_i (1 + \tau_i) (1 + \gamma_i) + \gamma_i$$

(1)

where $\gamma_i$ represents internal transportation, resale, marketing, and distribution costs. If good $i$ is exported, then equation (1) becomes:

$$p_i = p_i^* e_i (1 - \tau_i) (1 - \gamma_i) - \gamma_i$$

(2)

where $\gamma_i$ is the export tax if different from zero.

Let us assume for simplicity that internal costs $\gamma_i$ are zero so we can focus on the response of domestic prices to changes in international prices, exchange rates, national trade policies, international trade policies, and transaction costs. Clearly, if these equations hold, then a proportional change in the exchange rate $e_i$, in the international price $p_i^*$, or in the tariff rate $\tau_i$ (or rather $(1 + \tau_i)$) will be fully transmitted to domestic prices. This can be formally derived from the log-linearized version of equation (1), where we have excluded internal costs $\gamma_i$:

$$\ln p_i = \ln p_i^* + \ln e_i + \ln (1 + \tau_i) + \ln (1 + \gamma_i)$$

(3)

The derivative of $\ln p_i$ with respect to any determinant of the price (e.g. $\ln e_i$) is equal to one. This derivative corresponds to the elasticity of domestic prices with respect to the determinants of this elasticity. This implies that any relative change on the right-hand side of the expression would be fully transmitted to domestic prices. We call this perfect pass-through. However, there is strong evidence against this prediction, especially for exchange rates. Most studies consistently reject the law of one price for a variety of products and countries. There are many reasons why the law of one price may fail, some of which are presented by Feenstra (1989) and Nicita (2009). When the relative change in the domestic price of a good is lower than the relative change in international prices, tariffs, or exchange rates, we say that there is imperfect pass-through. For instance, if the international price increases by 10 per cent but the local price only increases by 5 per cent, keeping everything else (tariffs, transportation costs, and exchange rate) constant, the pass-through is 50 per cent. Sometimes prices take time to adjust following a shock because there are signed contracts, accumulated stocks, and other market frictions. For that reason, the pass-through is often lower in the short run than in the long run, and this should be taken into account when analysing the effects of trade policies.

Even though pricing equations (1) and (2) do not provide an accurate framework for measuring and estimating pass-through effects, they are useful to conceptually show different effects of price changes. For instance, it is often observed that governments react to exogenous changes in international prices by changing tariffs and export taxes (and sometimes also by altering the exchange rate via devaluations). In some instances, when the price of food imports increases, governments may reduce tariffs to alleviate the increase in domestic prices. In some exporting countries, the government’s response to skyrocketing commodity prices has been to increase export taxes. Increasing export taxes reduces the incentives for national producers to export, which increases the supply of the good in the domestic market and consequently decreases the domestic price of the good. Since food products represent consumption goods, such policies can be supported on distributional grounds. Export taxes are also a good source of public revenue, especially in the context of increasing international prices, which provides additional motivation for their implementation (UNCTAD, 2012).

There are several methodological approaches and models to study price changes assuming both perfect and imperfect pass-through. These studies are beyond the objective of this module, but we have included a reference to them in Annex A for the interested readers.
4 From prices to welfare impact

A useful way to study how trade affects household welfare is by noting that trade affects the prices faced by producers and consumers. In consequence, we can investigate the trade-welfare link by tracing how trade policy affects prices and, in turn, how prices affect welfare (Porto, 2006; Nicita, 2009). The previous section examined how trade affects prices. Here we focus on the second step of the two-step methodology discussed so far and look at how price changes translate into welfare effects.

The consumer and producer surplus measures covered in introductory microeconomics courses are useful to illustrate how price changes affect welfare. Consider all households consuming a good $i$ whose initial price $p_i$ changes. We can estimate the impact on consumer surplus by multiplying the amount of the price change by the quantity consumed by all households before (or after) the price shock. In the case of a price increase of good $i$, this would be an approximation of the loss in consumer surplus because each household has to pay a higher price for each unit it consumes. This loss would correspond to the shaded area in panel (a) of Figure 3. Conversely, if households produce and sell the good and its price increases, then all producing household will be better off as they will receive a higher price for each unit they sells in the market. In this case, the change in the producer surplus would be positive, and it can be approximated by the price differential multiplied by the production level before (or after) the shock that generated the price change (panel (b) in Figure 3).

**Figure 3**

*Impact of a price increase ($p_0 \rightarrow p_1$) on consumption and production*

(a) Consumer welfare loss from a price increase

(b) Producer welfare gain from a price increase

Source: UNCTAD (2012).

Note: $p_i$ is the initial price which increases to $p_1$ after an exogenous price shock.
To evaluate the overall impact of the price change on household welfare, we need to consider the changes in both the consumer and producer surpluses. If the household is a net producer of the good (i.e., its production exceeds consumption), the loss in the consumer surplus is lower than the gain in the producer surplus and the welfare of the household will increase. On the other hand, if the price of the good increases and the household is a net consumer (i.e., its consumption exceeds production), the welfare of the household will decrease.\footnote{If a household is a net consumer of the good (consumption > production), the loss of welfare after the price increase can be approximated by:}

\[
\Delta W = - \Delta p \left( c_0 - q_0 \right) \quad (4)
\]

or

\[
\Delta W = - \Delta p \left( c_1 - q_1 \right) \quad (5)
\]

Panel (a) in Figure 4 shows the loss for the net consumer.

In the case of a net producer household (production > consumption), the impact of a price change on welfare will be positive and can be approximated by:

\[
\Delta W = \Delta p \left( q_0 - c_0 \right) \quad (6)
\]

or

\[
\Delta W = \Delta p \left( q_1 - c_1 \right) \quad (7)
\]

Panel (b) in Figure 4 shows the gain for the net producer.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure4}
\caption{Loss and gain from price increase of good $i$}
\end{figure}

(a) Welfare loss from a price increase for a net consumer ($c_0 > q_0$ or $c_1 > q_1$)

(b) Welfare gain from a price increase for a net producer ($q_0 > c_0$ or $q_1 > c_1$)

Source: UNCTAD (2012).
Unfortunately, in most surveys the quantities households consume and produce are not observed and therefore it is not possible to use this type of intuitive approximation in practical applications. As discussed below, this can be overcome by using consumption expenditure shares and production income shares, information that is often available in household surveys. Aside from this difficulty, this simple approximation does not take into account possible labour market changes following the price change. It also does not consider the general equilibrium effects that can affect the price of non-traded goods as a response to changes in the price of traded goods. We will look at these issues now.

Figure 5 provides us with the basic intuition of the transmission of a traded good price increase to prices of non-traded goods and the labour market equilibrium. In panel (a), we have a representation of the labour demand curve (which decreases as the wage level rises) and the labour supply curve (which increases as the wage level rises; their intersection determines the equilibrium wage paid to the workers. Assuming an exogenous price increase of a traded good \( p_i \rightarrow p_i' \), companies selling that good would like to sell more of it. Consequently, at each level of wage, the labour demand from firms will increase, shifting the demand curve upwards \( D_i \rightarrow D_i' \). As a result, there will be a new equilibrium in this market, with higher wages \( w_e \rightarrow w_e' \) and more labour employed \( L_e \rightarrow L_e' \) in the economy.

This change in a particular market will have spillover effects on other markets. For instance, this could be the case because the traded goods are an input in the production of non-traded goods. It could also be the case that following an increase in the wages paid to workers in traded sectors, the firms in the non-traded goods sectors would have to increase the wages paid to their employees in order to keep them. In panel (b) of Figure 5, we observe the effect of this wage increase on non-traded goods. The wage increase implies a higher production cost of non-traded goods, causing the supply curve for the non-traded goods to move to the left \( S_o \rightarrow S_o' \). Finally, we observe that the equilibrium price of the non-traded goods increases \( p_k \uparrow \) and the quantity sold in the market decreases \( q_k \downarrow \).

*Figure 5*

**Effect of a price increase on labour market equilibrium and prices of non-traded goods**

(a) Effect on labour market equilibrium

(b) Effect on prices of non-traded goods

Source: UNCTAD (2012).
The welfare effect will now depend not only on how trade affects the price of the goods the household consumes and produces, but also on the effect of trade on labour income. As mentioned previously, we rarely observe the quantities of a good a household buys or sells in the household surveys. However, we often have information on budget shares and income shares. We know what percentage of total household expenditures a household spends on a good \( i \). We also often know from the household surveys about the source of income of the household, that is, what percentage of the total income of the household comes from selling good \( i \) or from selling its labour in exchange for wages. Therefore, we can approximate the welfare impact of a trade policy or shock by estimating three effects:

\[
\begin{align*}
\text{Consumption effect for household } h &= -\left( \text{Share of good } i \text{ in total expenses of household } h \right) \cdot \left( \text{Change in the price of good } i \right) \\
\text{Production effect for household } h &= -\left( \text{Share of income household } h \text{ gets from selling good } i \right) \cdot \left( \text{Change in the price of good } i \right) \\
\text{Labour income effect for household } h &= -\left( \text{Share of income household } h \text{ gets from selling its labour } \right) \cdot \left( \text{Change in the wage perceived by household } h \right)
\end{align*}
\]

Finally, the total welfare effect for the household is the combination of the three effects:

\[
\text{Welfare effect} = \text{Consumption effect} + \text{Production effect} + \text{Labour income effect}
\]

Annex B presents a detailed derivation of this result.

5 Methodological approach: Non-parametric regressions

Most of the papers in the trade and gender literature that use the microeconomic approach follow the standard two-step approach of the trade and poverty literature presented above and in Annex B. However, the 2011 UNCTAD study that we will review below skips the first step. Rather than trying to answer how trade liberalization would increase or reduce prices and household income, the paper just assumes those changes and tries to estimate the welfare impact at the household level and determine if that impact is different, depending on the gender of the household head and the number and share of women in the household.

The second step of the approach is based on non-parametric analysis. Non-parametric methods let the data show the “shape” of the relationship between the \( y \) and the \( x \) variables without any parameters that would, for instance, appear in linear regression analysis. The UNCTAD study uses non-parametric methods to estimate densities (Figures 2–5 in the paper) and regressions (Figures 6–15 in the paper). We provide the intuition behind both the non-parametric densities and regressions and briefly explain how to estimate them using Stata.

5.1 Basic idea of density estimations

Suppose you have a large number of observations on a variable \( x \) and you would like to “draw a picture” of the density function of \( x \). The simplest method is to divide the range of \( x \) into a small number of intervals and count the number of times \( x \) is observed in each interval—basically, to use a histogram. You need to choose the number of “bins” (number of columns) into which you will split the data. If you choose too few, you will not capture the shape of the distribution very well. On the other hand, choosing too many will make the distribution too erratic due to the small number of points in each bin. The larger the sample, the more scope for using smaller bins (Cameron and Trivedi, 2005).

There are two problems with histograms. First, for a given number of bins, moving their exact location (boundary points) can change the figure. Second, from the technical point of view, the density function produced is a step function and the derivative either equals zero or is not defined (at the cut-off point for two bins). This represents a problem if we are trying to maximize a likelihood function that is characterized by a step function of the distribution. The first problem with histograms—i.e. the arbitrariness in the location of the bin cut-off points—can be avoided by having a “moving” bin that is defined for every possible value of \( x \). The second problem of discontinuities in the estimated ("empirical") density function can also be avoided by using kernel
estimation (Glewwe, 2013). For continuous data taking many values, kernel density plots are preferable to histograms, as they result in a smooth curve that directly connects the midpoints of a series of histograms rather than forming the histogram step function.

Figure 6 shows graphically the difference between a histogram and its non-parametric estimation using kernel densities for numbers generated randomly from a given distribution. You can easily see that the non-parametric estimation is smoother.

Figure 6

Histogram and kernel density function

Source: UNCTAD Secretariat.

In Stata, the command for kernel densities is `kdensity`. It has different options:

- `bwidth(#)` specifies the half-width of kernel, i.e. the width of the density window around each point;
- `generate (newvar_x newvar_d)` stores the estimation points in `newvar_x` and the density estimate in `newvar_d`;
- `n(#)` indicates the number of points at which the density estimate should be evaluated; if not specified, the default is min(N,50) with N the number of observations;
- `at(var_x)` estimates a density using the values specified by `var_x`;
- `nograph` suppresses the graph.

We will use some of these options in our Stata estimation below.

5.2 Intuition behind non-parametric regressions

Suppose you want to regress a variable $y$ on a single explanatory variable $x$, without using any functional form on the relationship (e.g. without imposing the functional form of the relationship). This is not the same as looking at a density estimate of a bivariate distribution; a plot of a bivariate distribution has not yet defined one variable as the dependent variable and the other as the independent variable. With regressions, we are ultimately interested in the expectation of $y$ conditional on $x$. Assuming away problems of endogeneity of $x$, measurement error, etc., the relationship that we are interested in estimating is the expectation of $y$ conditional on $x$: $E[y|x]$. The relation of interest is:

$$y_i = m(x_i) + \epsilon_i, \quad i = 1, 2, \ldots N \quad (8)$$

where $\epsilon_i \sim i.i.d \left(0, \sigma^2 \right)$. The functional form of $m(.)$ is unknown and we will not approximate it using some parametric functional form. Kernel regressions are weighted average estimators that use kernel functions as weights. Technically, a kernel regression estimator is a local constant regression because it sets $m(x)$ equal to a constant in the very small “neighbourhood” of $x$ (Glewwe, 2013).

Figure 7 is an example of a graph generated by the non-parametric regression of the share of income that households in Ghana earn from selling cocoa (vertical axis) on the logarithm of the household per capita consumption (horizontal axis). The non-parametric regression will be useful to assess the effect of a price change in cocoa. As cocoa is a cash crop that in most cases is not consumed by Ghanaian households, the consumption effect is nil. The figure shows that the share of income coming from cocoa in Ghana increases with the level of income. It also shows the non-parametric regressions conditional on the location of the household (rural or urban areas) – we can see that rural households have a larger share of their income coming from cocoa than urban households.
Several methods can be applied for non-parametric regressions. In Stata, two commands are used: `lpoly` and `lowess`. In the paper which we will review below, the author uses `lpoly` that performs a kernel-weighted local polynomial regression of $y$ on $x$ and displays a graph of the smoothed values. See the command `help lpoly` in Stata (`help lpoly`) for a more extensive and complete explanation about smooth regression and local weighted regressions.

### 6 Hands-on application: “Who is benefiting from trade liberalization in Cape Verde? A gender perspective” (UNCTAD, 2011)  

#### 6.1 Context and overview

The objective of this study developed by UNCTAD’s Trade, Gender and Development Section is to explore whether there are any differential effects of trade policy on men and women and, in particular, to analyse whether there is a gender bias in the potential gains from trade in Cape Verde. A small and open country, Cape Verde is largely dependent on imports, remittances, and tourism. The export sector is small and limited to primary and low technology-intensive goods. In general, the country has a very large deficit in its balance of trade. A portion of this deficit is financed by tourism and travel receipts (19.5 per cent of GDP in 2008), and remittances from emigrants (8.5 per cent of GDP in 2008). Based on its analysis and results, the study also provides some policy recommendations.

The preparation of the study involved the following methodological steps:

- Preparation of a country profile that included identifying vulnerable groups and key economic sectors, with special emphasis on women;
- Description of the trade sectors, which identified major imports and exports, partners, trade agreements, and markets;
- Assessment of some of the effects of trade liberalization on household welfare (with a focus on gender issues), including an assessment of whether the effects depend on the location of the household (if located on an island or not), and an analysis of the effects from food prices, remittances, and tourism;
- Drafting of a set of policy recommendations.

This section focuses on the third step, i.e. the assessment of some of the effects of trade liberalization on household welfare using the microeconomic approach. In particular, we look at the effects of trade on some gender outcomes. The study follows the two-step methodology used in the trade and poverty literature described above. However, it does not cover the first step in detail, i.e. it does not look at the impact of trade liberalization on changes in food prices, tourism receipts, or remittances, but just assumes these changes. Given these assumptions, it then tries to estimate their welfare impact at the household level in Cape Verde, following the second step of the analysis. Table 4 provides a summary of the country case study of Cape Verde.
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Objective

The objective of the study is to analyse some of the effects of trade liberalization on household welfare in Cape Verde, with a focus on gender issues. It looks at the effects stemming from:

- Changes in food prices: Cape Verde is highly dependent on food imports (80 per cent of the food it consumes is imported). In particular, the study simulates (a) an increase in international food prices; and (b) trade policy changes, including the phasing out of the Everything But Arms Initiative (duty-free access to the European Union) on 1 January 2012 and subsequent implementation (although negotiations are still ongoing) of the Economic Partnership Agreement (duty-free access to the European Union but on the basis of reciprocity).
- Increase in income from remittances from the Cape Verdean diaspora.
- Expansion of the tourism subsectors (hotels and restaurants, trade and transport), given the potential of the tourism sector for economic empowerment of women.

Methodology

- Two-step approach: (a) assumed induced price and income changes; (b) used price and income changes and household data to study the trade impact on household welfare.
- Non-parametric estimation techniques to describe the effects of changes in food prices, remittances and tourism, conditional on the level of income, the geographical area where the household is located, and the gender of the head of the household.

Equation estimated

In non-parametric methods, we do not estimate equations, as there are no parameters to estimate. Results are displayed in terms of graphs and/or summary tables.

Dependent and independent variables

The dependent variables are:

- The share of consumption spent on food (share_food)
- The share of income coming from remittances (part_rem)
- The gains coming from the simulated increase in remittances (gain)
- The gains coming from the simulated increases (three scenarios) in expenditure related to the tourism sector (gain1, gain2, and gain3)

The independent variables are:

- The log per capita expenditure of the household (logpce)
- The area, rural or urban, where the household is located (area)
- The location (which island) of the household (ilha)
- The gender of the household head (female_head)
- The proportion and number of women in a household (female and sfemale)

Results

- The price effects will be more strongly felt in rural areas than in urban areas but the gender differentiated effects from food price changes would only be marginal.
- In general, a drop in food prices will have a pro-poor effect, while higher food prices will have an anti-poor bias.
- The simulated increases in remittances and income from tourism seem to favour female-headed households. Female-headed households located in rural areas benefit in particular from increases in remittances, while those located in urban areas gain more from increases in income related to tourism.
- While the reduction of prices has a pro-poor impact, the increase in remittances and income from tourism would benefit mostly middle- and high-income families.


6.2 Data sources

The data for the analysis are already saved in Stata format (graphs.dta). There are two main sources of data:

- Cape Verde’s 2002 Household Expenditure and Income Survey (Inquérito Às Despesas e Receitas Familiares – IDRF);
- Cape Verde’s 2007 Questionnaire on Basic Welfare Indicators (Questionário Unificado de Indicadores Básicos de Bem Estar).

Detailed information regarding the methodology and questionnaires used in these two surveys can be found on the website of the Cape Verdean National Institute of Statistics.43 When we go through the methodology step by step, we will also discuss the content of the different variables.

The IDRF does not contain data that allow for identifying net producers and net consumers of food. However, considering that Cape Verde imports 80 per cent of the food it consumes, it seems reasonable to assume that most households consume imported food.

6.3 Step-by-step explanation of how to do the estimations in Stata

We will now show you how to estimate the kernel densities and non-parametric regressions of the Cape Verde study in Stata. To do that, we will describe each of the steps and commands in the do-file that is provided with this teach-
As explained in the previous module, although it is possible to use Stata interactively, in this and the following modules we will work with do-files. The advantage of writing a do-file is that you do not have to type the same commands again and again. You can run your programme as many times as you wish and correct typos or wrong commands.45

Before going through the steps in the Stata do-file, we strongly recommend that you read the UNCTAD (2011) study.

Step 1: Open the database and explore the variables

The first step is to ask Stata to clean any result and data that may be in the memory and set an appropriate memory space level to work with. The commands are as follows:

\begin{verbatim}
clear matrix
clear
set mem 100m
\end{verbatim}

We then tell Stata in which folder in the computer we will be working. You need to upload the data file (dta file) to the computer first, and it is also where Stata will save the outputs by default. The command will appear as follows:

\begin{verbatim}
cd "c:\...\...\..."
\end{verbatim}

Note that you need to specify the disk (“c” here), the folder, subfolders, etc. In sum, you need to specify the folder path. Note that we use “” to indicate the whole path.

We now need to tell Stata what database we will use in the analysis:

\begin{verbatim}
use "Data\graphs.dta", clear
\end{verbatim}

Often we use different data files, and it is convenient to work with macros that allow us to call them separately.46 The command to define a local macro is local. We can tell Stata to create one and then to use it. The database we will use for the analysis (graphs.dta) is located in the subfolder Data that is inside the folder we specified above with the command cd. The command to create a local macro is the following:

\begin{verbatim}
local base_in_1 ="Data\graphs.dta"
\end{verbatim}

We then tell Stata to use the dataset:

\begin{verbatim}
use "`base_in_1'", clear
\end{verbatim}

Now you have the data uploaded, and you can see the name of all file variables in the variables window. What does each variable contain? We can use the command describe to take a first look at the data. As you will see from the output of the command, most of the labels are in English but a few of them are in Portuguese, so we explain them below:

- \textbf{Actividad} is the economic sector where the individual works;
- \textbf{Ilha} is the island where the household is located;
- \textbf{des_indi} is the per capita expenditure of the household;
- \textbf{area} takes two values: 1 corresponds to urban households, 2 corresponds to rural households;
- \textbf{pens_est} corresponds to the amount of foreign pensions received;
- \textbf{rem_emig} corresponds to the amount of remittances received.

Step 2: Describe the income distribution using kernel densities

We will use a kernel density function to describe the distribution of the log of per capita expenditure for all households, all urban households, all rural households (one graph combining the three), by island, and by the gender of the household head. This corresponds to Figures 2–5 in the UNCTAD (2011) study.

Note that the data do not contain the logarithm of per capita expenditure but the per capita expenditure (des_indi). We can create the logarithm of per capita expenditure using the command gen:

\begin{verbatim}
gen logpce = log(des_indi)
\end{verbatim}

There are some variables and labels we will use repeatedly in the graphs, so it would be convenient to define them. In particular, we will often split the household data by area (rural vs. urban households). Let us make a value label called area1 to label the values of the variable area.

This is a two-step process in which you first define the label and then assign the label to the variable. The command label define creates the value label called area1 that associates 1 with an urban household and 2 with a rural household.

\begin{verbatim}
label define area1 1 "Urban" 2 "Rural"
\end{verbatim}

The command label values associates the variable area with the label area1.

\begin{verbatim}
label values area area1
\end{verbatim}
If we use the command `describe`, we can see that the variable `area` has a value label called `areal` assigned to it.

We are now ready to produce our kernel densities of log of per capita expenditure for the whole population and its different subsamples. We will use the command `kdensity` to produce the kernel densities and the command `twoway` to produce a graph. We could first produce the densities, save the outputs, and then build the graphs using those outputs, or combine everything in one single programme sentence. We will use the latter option as it is faster.

The Stata command to reproduce Figure 2 in the UNCTAD (2011) study is:

```
twoway (kdensity logpce[w=pondera], legend(lab(1 "National")))
    (kdensity logpce [w=pondera] if area== 1, lpattern(dash) legend(lab(2 "Urban")))
    (kdensity logpce [w=pondera] if area== 2, lpattern(dash_dot) legend(lab(3 "Rural"))),
    ytitle(Density) xtitle(Log per capita expenditure)
```

Note that we estimate kernel densities for all households (`kdensity logpce [w=pondera]`), and then for those in urban areas (`kdensity logpce [w=pondera] if area== 1`) and those in rural areas (`kdensity logpce [w=pondera] if area== 2`). When producing the density estimations, we ask Stata to give each household a different weight (`w=pondera`) because of the representativeness of each household in the population.

We use the command `twoway` to plot the three densities on a single graph. For each density, we specify its legend (national, urban and rural) and the type of line pattern (`lpattern`) (solid (which is the default), `dash`, and `dash_dot`). The syntax of the command `twoway` requires each set of line variables and its associated parameters to be included in a pair of parentheses. We can also specify the title of the y and x axes using `ytitle` and `xtitle`, respectively.

The output of the command is shown in Figure 8 (Figure 2 in the study).

```
Figure 8
Distribution of income for national, urban and rural households
```

Figure 8 shows the distribution of the log of per capita expenditure in Cape Verde for all households, urban households, and rural households. The distribution is somewhat similar to a normal distribution, with the urban density shifted to the right as urban households tend to be wealthier than rural ones.

We can split the population not only by area (urban and rural) but also by gender of the head of the household and obtain Figure 9 (Figure 3 in the study). The Stata command is similar to the previous one:

```
twoway (kdensity logpce [w=pondera]
    if female_head==1 , legend(lab(1 "Female-headed")))
    (kdensity logpce [w=pondera] if female_head== 0,
    lpattern(dash) legend(lab(2 "Male-headed"))), by(area)
    ytitle(Density) xtitle(Log per capita expenditure)
```
The microeconomic approach

Figure 9 compares the income distribution among urban and rural female- and male-headed households. There is a left shift of the female-headed income distribution relative to the male-headed income distribution, in particular in urban areas. Therefore, the data show that, on average, female-headed households tend to be poorer than their male counterparts.

We can also produce a similar figure, shown here as Figure 10 (Figure 4 in the study), by island and area using:

```
graph twoway (kdensity logpce [w=pondera] if area == 1, legend(lab(1 "Urban"))) (kdensity logpce [w=pondera] if area == 2,lpattern(dash) legend(lab(2 "Rural"))), ytitle("Density",size(small)) xtitle("Log per capita expenditure",size(small)) by(ilha, cols(3)) legend(size(small))
```

By specifying `cols(3)` in the `by` option, we are telling Stata to display the panels in three columns.

Finally, Figure 11 (Figure 5 in the study) shows the distribution of income for each household by the gender of the head of the household. The syntax of the Stata command is similar:

```
graph twoway (kdensity logpce [w=pondera] if female_head==1 , legend(lab(1 "Female-headed")))
(kdensity logpce [w=pondera] if female_head== 0,lpattern(dash) legend(lab(2 "Male-headed"))),
ytitle("Density",size(vsmall))
xtitle("Log per capita expenditure",size(vsmall)) legend (size(vsmall)) by(ilha, cols(3) rescale)
ylabel(), labsize(vsmall))
xlabel(), labsize(vsmall))
```

In this case, we add rescale to the by option to allow the x and y axes to be different for each group. Also, the ylabel and xlabel options are added to the command graph twoway to indicate the size of the values on the y axis and x axis.

The figures by island and gender of the household head show that there are fewer disparities in the distribution of income for male- and female-headed households in Sal and Santiago. São Vicente and São Nicolau show a higher mode for men. In contrast, the mode seems higher for women in São Antão. Boa Vista, Brava, and Fogo show a greater dispersion for the log of per capita expenditure of female-headed households than of male-headed households.

**Step 3: Create graphs of the non-parametric regression of log of per capita income, food, and remittances shares**

In this step, the study analyses the relationship between two variables through figures derived from non-parametric regressions. The aim is to relate the level of livelihood to the consumption of food and the income from remittances. This allows us to see how changes in food prices or remittances affect different "types" of households.

Non-parametric regressions fit a local relationship between two variables, y and x. By “local” we mean that separate fitted relationships are obtained at different values of the explanatory variable, x. Two commands can be used to do this in Stata: `lpoly` and `lowess`. There are several other methods for running this type of analysis, but we will not discuss them in this material. Here, we will exclusively use `lpoly`, which performs a kernel-weighted local polynomial regression of y on x and displays a graph of the smoothed values with (optional) confidence bands.

Figure 12 (Figure 6 in the study) shows the non-parametric regressions of the share of food (how
much a household in Cape Verde spends on food (as a proportion of its total expenses) on the level of livelihood of the family (proxied by the log of per capita expenditure of the household). The figure has three different panels, one for the whole sample, one for households in urban areas, and one for households in rural areas. In each panel, we are interested in knowing, for each level of income, how much a family with a female household head spends on food compared to how much a male-headed household spends.

The command to create the figure is once again `twoway` and therefore we do not need to explain its syntax. This time, however, each line will not be a density function but a non-parametric regression. We then replace the command `kdensity` with `lpoly`. We regress `share_food` on `logpce`, recognizing once again that each observation in the sample has a different weight in the population by including the option `[w=pondera]`, and we perform the regressions for female-headed households (if `female_head==1`) and male-headed households (if `female_head==0`). We also want to eliminate possible outliers, so we remove the first and last observation in the sample (`logpce <16 & logpce>= 9`).

The Stata command for all households is:

```stata
twoway (lpoly share_food logpce [w=pondera] if female_head==1 & logpce <16 & logpce>= 9, legend(lab(1 "Female-headed")) (lpoly share_food logpce [w=pondera] if female_head== 0 & logpce <16 & logpce>= 9, lpattern(dash) legend(lab(2 "Male-headed"))), ytitle(Share of food (ratio)) xtitle(Log per capita expenditure)
```

The Stata command for urban households only is:

```stata
twoway (lpoly share_food logpce [w=pondera] if female_head==1 & area ==1 & logpce <16 & logpce>= 9, legend(lab(1 "Female-headed")) (lpoly share_food logpce [w=pondera] if female_head== 0 & area ==2 & logpce <16 & logpce>= 9, lpattern(dash) legend(lab(2 "Male-headed"))), ytitle(Share of food (ratio)) xtitle(Log per capita expenditure)
```

The Stata command for rural households only is:

```stata
twoway (lpoly share_food logpce [w=pondera] if female_head==1 & area ==2 & logpce <14 & logpce>= 9, legend(lab(1 "Female-headed")) (lpoly share_food logpce [w=pondera] if female_head== 0 & area ==2 & logpce <14 & logpce>= 9, lpattern(dash) legend(lab(2 "Male-headed"))), ytitle(Share of food (ratio)) xtitle(Log per capita expenditure)
```

The outputs of these three commands are the non-parametric regressions panels in Figure 12. These regressions estimate the average food share at different levels of expenditure. The food budget share at the left tail of the income distribution is approximately 45 per cent (in both urban and rural areas). In rural areas, there are some differences between female-headed and male-headed households in the share spent on food. As expected and in accordance with Engel’s law, the share spent on food declines with the increase in the level of household well-being. It follows that lower food prices will have a pro-poor bias, while higher food prices will have an anti-poor bias when considering the consumption effect on welfare.
The microeconomic approach

module

Log per capita expenditure

Share of food and level of livelihood

(b) Urban

(c) Rural


As the study notes, “Looking at the difference between female- and male-headed households does not necessarily capture all the impacts on women. [...] Women living in male-headed households can also benefit from lower food prices. This is explored by examining the relationship between the food share on the one hand and the total number of females in the household or alternatively the share of females in the household on the other.” UNCTAD (2011: 40).

To this end, we need to create the variables capturing the number of females in a household and the proportion of women in a household. To do that, we create an auxiliary variable aux that takes the value 1 if the member of the household is a woman and 0 otherwise. We then create a new variable female with the command egen to count how many women live in that particular household (houseid). The syntax of the command is egen <new variable> = function(<expression(s)> or <variable(s)>), by (variables)). The functions actually determine what the command egen will do. There are many functions, all described in the manual. We also need to create a variable sfemale indicating the share of women in a household. The Stata commands are as follow:

gen aux = 1 if male == 0
gen female = sum(aux), by(houseid)
drop aux
gen sfemale = female / hsize

The variable hsize stands for the number of household members. As before, non-parametric regressions are estimated and reported in Figure 13 (Figure 7 in the study) according to the area where the household is located. The Stata commands are similar to the ones used before. Specifically, for plotting the relationship between the share of food and the number of females living in a household we use the following command:

twoway (lpoly share_food female [w=pondera] if head == 1 & female<11, msymbol(none) legend(lab(1 "National"))) (lpoly share_food female [w=pondera] if head == 1 & area == 2 & female<11, lpattern(dash) msymbol(none) legend(lab(2 "Rural"))) (lpoly
The microeconomic approach

For plotting the relationship between the share of food and the share of females living in a household, we use the following command:

```
twoway (lpoly share_food sfemale [w=pondera] if head == 1 & area == 1 & female<11, lpattern(dash_dot) msymbol(none) legend(lab(3 "Urban"))), ytitle(Share of food (ratio)) xtitle(Share of females (ratio))
```

The option `msymbol` indicates the marker symbol that should be used in the figure.

![Figure 13](image)

<table>
<thead>
<tr>
<th>Share of food and women in the household</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Share of food and number of women in the household</td>
</tr>
<tr>
<td>National</td>
</tr>
<tr>
<td>National</td>
</tr>
<tr>
<td>National</td>
</tr>
<tr>
<td>National</td>
</tr>
</tbody>
</table>

What we can see from the results in Figure 13 is that, in principle, households with more women tend to allocate a slightly higher share of their expenditure to purchase food, especially in rural areas, and thus these households will enjoy higher gains from lower food prices. Note, however, that there are few differences in food shares for different gender structures (share of females) in Cape Verdean households.
The study then follows the same methodology to estimate the relationship between the share of income the household gets from remittances and the level of expenditure, again by area and by gender of the household head. The analysis is also carried out for the number and share of females in the household. The structure of the Stata command is very similar to the one used before. In particular, at the national level, the command to plot the figure is the following:

```
twoway (lpoly part_rem logpce [w=pondera] if head == 1 & female_head == 1, msymbol(none) legend(lab(1 "Female-headed"))) (lpoly part_rem logpce [w=pondera] if head == 1 & female_head == 0, lpattern(dash) msymbol(none) legend(lab(2 "Male-headed"))), ytitle(Share of remittances (ratio)) xtitle(Log per capita expenditure)
```

Panel (a) in Figure 14 (Figure 9 in the study) presents the non-parametric regressions at the national level and shows that the share of remittances in total income is always higher for female-headed than for male-headed households, except for very poor households. For females, the share increases sharply with the level of livelihood until reaching values higher than 15 per cent of total income, then decreasing to less than 5 per cent of total income.

To plot the figure for households living in urban areas only, the command is the following:

```
twoway (lpoly part_rem logpce [w=pondera] if head == 1 & female_head == 1 & area == 1, msymbol(none) legend(lab(l "Female-headed"))) (lpoly part_rem logpce [w=pondera] if head == 1 & female_head == 0 & area == 1, lpattern(dash) msymbol(none) legend(lab(2 "Male-headed"))), ytitle(Share of remittances (ratio)) xtitle(Log per capita expenditure)
```

Panel (b) shows that in urban areas the share of remittances is higher for female-headed households at the left (poorest) tail of the distribution and in the middle, but the shares seem to converge at the richest tail.

To plot the figure for households living in rural areas only, the command is the following:

```
twoway (lpoly part_rem logpce [w=pondera] if head == 1 & female_head == 1 & area == 2, msymbol(none) legend(lab(1 "Female-headed"))) (lpoly part_rem logpce [w=pondera] if head == 1 & female_head == 0 & area == 2, lpattern(dash) msymbol(none) legend(lab(2 "Male-headed"))), ytitle(Share of remittances (ratio)) xtitle(Log per capita expenditure)
```

As shown in panel (c), in rural areas the share of remittances in total income is low for the poorest households but increases sharply as the level of income increases. This analysis reveals that remittances are an important source of income, and more so for female-headed households than for male-headed households, reaching more than 30 per cent of the income of the richest rural households.
Finally, the study plots the relationship between the share of remittances in total income and the number of females living in the household, and the share of females in the total number of household members according to the area where the household is located (Figure 10 in the study, not displayed here). The code lines are, respectively:

```
twoway (lpoly part_rem female [w=pondera] if head == 1 & female<11, msymbol(none) legend(lab(1 "National"))) (lpoly part_rem female [w=pondera] if head == 1 & area == 1 & female<11, lpattern(dash) msymbol(none) legend(lab(2 "Urban"))) (lpoly part_rem sfemale [w=pondera] if head == 1 & area == 2, lpattern(dash_dot) msymbol(none) legend(lab(3 "Rural"))), ytitle(Share of remittances (ratio)) xtitle(Share of females (ratio))
```

**Step 4: Plot welfare gains in simulated scenarios**

Our last task is to study the welfare effects of different scenarios. The first simulation is an increase of 20 per cent in remittances. We want to see how this would affect household per capita income for different types of households. We will need to create a few new variables. First, we cre-
ate the log of per capita income using the same command `gen` we employed to create the logarithm of per capita expenditure (`logpce`):

```
gen lipcf = log(ipcf)
```

Second, we generate a variable that would be the new household per capita income simulated, that is, the initial income plus an increase of 20 per cent of the part of the income that comes from remittances:

```
gen ipcf_sim = ipcf + 0.2 * part_rem * ipcf
```

Third, we create the logarithm of the simulated income in the following way:

```
gen lipcf_sim = log(ipcf_sim)
```

Finally, we generate a new variable `gain` as the difference between the simulated and the original income, as follows:

```
gen gain = lipcf_sim - lipcf
```

We are now ready to create Figure 15 (Figure 12 in the study) using the command `twoway` and the same syntax as before. We are also eliminating potential outliers by restricting the analysis to households with a logarithm of per capita expenditure below 15. The code is the following:

```
graph twoway (lpoly gain logpce [w=pondera] if female_head == 1 & logpce <15 , legend(lab(1 "Female-headed"))) (lpoly gain logpce [w=pondera] if female_head == 0 & logpce <15 , lpattern(dash) legend (lab(2 "Male-headed"))), ytitle("Gain (ratio)", size(vsmall)) xtitle("Log per capita expenditure", size(small)) legend(size(small)) by(area, cols(2)) ylabel(, labsize(small)) xlabel(, labsize(small))
```

As shown in Figure 15, the effect would be significant, in particular for female-headed households both in urban and rural areas. While the effect is more or less constant in urban areas, it increases according to the level of income in rural areas.

We now move to the analysis of the gains from an increase in tourism. This simulation is more complex than the previous one because tourism generates income not only for those who work directly in this sector but also for those who provide services such as transport and communications, or who work in the retail sector. Therefore, we should consider simulations with both direct and indirect effects of tourism on workers in Cape Verde. We will follow four steps to do these estimations.

**Step 1:** We generate a new dataset that contains the original dataset twice. This is done by attaching the dataset to the original dataset again. We generate a variable called `case` and give it the value 1 for all households in the original dataset, and in the repeated dataset we assign the values 2 for households in rural areas and 3 for households in urban areas to the variable `case`.
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Step 2: We define labels also for graphical reasons as follows:

```
label define case1 1 "National" 2 "Rural" 3 "Urban"
label values case case1
label define female 0 "Male-headed" 1 "Female-headed"
label values female female
```

Step 3: We define the variables of interest using the command gen as follows:

```
gen pce = des_indi
gen lpce = log(pce)
```

We generate variables recording the activity of the household head for tourism, retail trade (commerce), and transport and communications. The variable `actividad` in the data records the economic sector, with 7 being tourism, 6 retail trade (trade), and 9 transport and communications (transport).

* Tourism

```
gen aux_head_tourism = 0
replace aux_head_tourism = 1 if actividad == 7 & head == 1
egen head_tourism =
    sum(aux_head_tourism), by(houseid)
replace head_tourism = 1 if head_tourism == 2
```

* Trade

```
gen aux_head_trade = 0
replace aux_head_trade = 1 if actividad == 6 & head == 1
egen head_trade =
    sum(aux_head_trade), by(houseid)
replace head_trade = 1 if head_trade == 2
```

* Transport

```
gen aux_head_transport = 0
replace aux_head_transport = 1 if actividad == 9 & head == 1
egen head_transport =
    sum(aux_head_transport), by(houseid)
replace head_transport = 1 if head_transport == 2
```

Step 4: As you can see in the study, the idea is to simulate the welfare effects of an increase in income from tourism and related activities (retail trade, and transport and communications). In particular, the country case study proposes different scenarios (cases).

Case 1: Tourism 30 per cent (called Tourism in the labels of the figures)

30 per cent increase in per capita expenditure (`pce`) of households with the head employed in tourism. The code to build the variable corresponding to the gain obtained by households in this first case (`gain1`) is the following:

```
gen pce_sim1 = pce
replace pce_sim1 = pce * 1.3 if head_tourism == 1
gen lpce_sim1 = log(pce_sim1)
gen gain1 = lpce_sim1 - lpce
```

Case 2: Tourism 30 per cent and trade 10 per cent

10 per cent increase in `pce` of households with the head employed in retail trade. The code to build the variable corresponding to the gain obtained by households in this second case (`gain2`) is the following:

```
gen pce_sim2 = pce_sim1
replace pce_sim2 = pce_sim2 * 1.10 if head_trade == 1
gen lpce_sim2 = log(pce_sim2)
gen gain2 = lpce_sim2 - lpce
```

Case 3: Tourism 30 per cent, trade 10 per cent, and transport 10 per cent

10 per cent increase in `pce` of households with the head employed in transport and communications. The code to build the variable corresponding to the gain enjoyed by households in this third (`gain3`) case is the following:

```
gen pce_sim3 = pce_sim2
replace pce_sim3 = pce_sim3 * 1.10 if head_transport == 1
gen lpce_sim3 = log(pce_sim3)
gen gain3 = lpce_sim3 - lpce
```
We are now ready to generate Figures 16 and 17 (Figures 13 and 14 in the study). For Figure 16 (Figure 13 in the study), we calculate the gains for each of the three cases described above. We are also interested in finding out whether there are any differences in the distribution of gains between rural and urban households. The Stata command to perform these simulations is similar to those presented before:

```stata
graph twoway (lpoly gain1 lpce [w=pondera] if lpce<15, legend(lab(1 "Tourism"))) (lpoly gain2 lpce [w=pondera] if lpce<15, lpattern(dash) legend(lab(2 "Tourism and Trade"))) (lpoly gain3 lpce [w=pondera] if lpce<15, lpattern(dash_dot) legend(lab(3 "Tourism, Trade and Transport"))) , ytitle("Gain (ratio)",size(vsmall)) xtitle("Log per capita expenditure",size(vsmall)) legend(size(vsmall)) by(case, cols(3)) ylabel(,labelsize(vsmall)) xlabel(,labelsize(vsmall))
```

To eliminate any outliers, we only consider households with a logarithm of per capita expenditure smaller than 15.

The results in Figure 16 show that the gains mostly increase with the level of livelihood and are larger in urban than in rural areas. The panels also show that the effects can be important when we take into account both the direct and indirect effects of tourism.

Figure 17 (Figure 14 in the study) explores whether the expected gains are different depending on the gender of the household head (we find that they are larger for female-headed households). For that reason, we run the non-parametric regression for the whole sample (case==1) by gender of the head of the household (by female_head). The Stata command is as follows:

```stata
graph twoway (lpoly gain1 lpce [w=pondera] if case == 1 & lpce<15, legend(lab(1 "Tourism"))) (lpoly gain2 lpce [w=pondera] if case == 1 & lpce<15, lpattern(dash) legend(lab(2 "Tourism and Trade"))) (lpoly gain3 lpce [w=pondera] if case == 1 & lpce<15, lpattern(dash_dot) legend(lab(3 "Tourism, Trade and Transport"))) , ytitle("Gain (ratio)",size(vsmall)) xtitle("Log per capita expenditure",size(vsmall)) legend(size(vsmall)) by(female_head, cols(2)) ylabel(,labelsize(smallest)) xlabel(,labelsize(smallest))
```

Welfare gains from tourism by gender of the household head

Figures 15 (a) and 15 (b) in the study (not displayed here) run the same non-parametric regressions of the gains by gender of the household head and for urban and rural areas, as follows:

```stata
graph twoway (lpoly gain1 lpce [w=pondera] if case == 1 & lpce<15 & area == 1, legend(lab(1 "Tourism"))) (lpoly gain2 lpce [w=pondera] if case == 1 & lpce<15 & area == 1, lpattern(dash) legend(lab(2 "Tourism and Trade"))) (lpoly gain3 lpce [w=pondera] if case == 1 & lpce<15 & area == 1, legend(lab(3 "Tourism, Trade and Transport"))) , ytitle("Gain (ratio)"), xtitle("Log per capita expenditure"), yscale(range(0 0.6)) ytitle(size(small)) xtitle(size(small)) legend(size(small)) by(female_head, cols(2)) ylabel(labsize(small)) xlabel(labsize(small))
```

```stata
graph twoway (lpoly gain1 lpce [w=pondera] if case == 1 & lpce<15 & area == 2, legend(lab(1 "Tourism"))) (lpoly gain2 lpce [w=pondera] if case == 1 & lpce<15 & area == 2, lpattern(dash) legend(lab(2 "Tourism and Trade"))) (lpoly gain3 lpce [w=pondera] if case == 1 & lpce<15 & area == 2, legend(lab(3 "Tourism, Trade and Transport"))) , ytitle("Gain (ratio)"), xtitle("Log per capita expenditure"), yscale(range(0 0.6)) ytitle(size(small)) xtitle(size(small)) legend(size(small)) by(female_head, cols(2)) ylabel(labsize(small)) xlabel(labsize(small))
```


6.4 Discussion of findings and limitations of the analysis

By focusing on the second step of the two-step methodology (see Section 3 of this module), this study uses the microeconomic approach to analyse the potential welfare impact of further trade liberalization in Cape Verde. The study looks both at the household consumption impact of trade-induced changes in the prices of goods and the employment/income changes from the potential increase in remittances and tourism. The simulations find that the price effects would be more strongly felt in rural than in urban areas, but that the differences between male- and female-headed households from food price changes would only be marginal. On the other hand, the simulated increase in remittances and income from tourism seems to favour female-headed households. Female-headed households located in rural areas would benefit in particular from increases in remittances, while those located in urban areas would gain more from increased income from tourism. While the reduction of prices has a pro-poor impact, the increase in remittances and tourism would benefit mostly middle- and high-income families.

One limitation of this analysis is that it does not estimate the effects that trade liberalization would have on food prices, remittances, and tourism. The analysis assumes those changes and then studies the welfare impact, leaving open the question of the amount of gains there are for Cape Verde, which is an important question for policymakers. Another limitation of the analysis is that, due to the lack of data, it is limited to a comparison between female- and male-headed households.
households, thus overlooking any potential intra-household reallocation effect. Male-headed households often have females living in the household, and it is therefore important to see how a trade shock affects the distribution of tasks within the household (e.g., whether domestic household activities are distributed fairly between males and females) and resources among various competing categories of expenditure (e.g., how much the household spends on food and on education).

### 7 Conclusions

This module has introduced the microeconomic approach (household and market channel) to study the welfare effect of trade policy at the household level and identify different gender outcomes. The approach follows the trade and poverty literature, where we first estimate the effects of trade on domestic prices and remuneration and then use those changes to estimate the welfare impact at the household level. For this purpose, this module uses information collected by household surveys. As these surveys often contain information about the gender of the household head and other members of the family, we can use this information to depict potential gender-differentiated effects. In the application we reviewed, the emphasis is on the effects of trade on earnings and expenditure, but a similar methodological approach could be used, for instance, to estimate health and education outcomes of trade policy.

The methodology reviewed in this module uses a specific definition of trade that refers to trade policy or reform and trade facilitation, as explained in Box 1 of Module 1 of this volume. The methodology can be used to analyse welfare effects of bilateral, regional, or multilateral trade agreements. Trade policy and reform can be measured, for example, by changes in tariffs. We reviewed the main sources of trade data in Module 1 of this volume. Additionally, we can analyse more general trade costs such as those linked to trade procedures, transportation, availability of infrastructure, and access to credit or inputs. When data are available, this methodology also makes it possible to study price transmission issues, including those related to market structure and competition that may have an effect on the degree of pass-through of international prices to domestic prices. The analysis can be applied both *ex ante* and *ex post*. In *ex-post* analysis, we compare various outcomes (wages, incomes, employment, expenditures, etc.) before and after episodes of trade liberalization or reform. We can sometimes distinguish those effects by the gender of the individual or the head of the household, but that often depends on the content of the dataset. In *ex-ante* analysis, we work with a two-step methodology, examining first the likely transmission effects from trade to prices, and then the effects from prices to households and/or firms. As described in Module 1, there are various open-source tools you can employ to conduct an *ex-ante* analysis. Again, how much we can say about differential gender effects may depend on the available data.

The method used in this module is based on non-parametric econometric techniques. The advantage of non-parametric analysis compared to the more traditional regression analysis is that you do not have to make any assumption regarding the relationship between the independent variable and the dependent variable. In other words, you let the data choose the best shape of the functional form. Additionally, in welfare analysis, the non-parametric approach allows you to look at the distributional impact of trade policy along the entire income distribution of households. Trade policy usually has different indirect effects on rich and poor households, since they have different consumption baskets and sources of income. For example, the case study of Cape Verde shows that, overall, the share of household income spent on food declines with the increase in the level of household well-being.
ANNEX

Annex A  Modelling price changes

This annex presents three ways of modelling ex-ante price changes: (a) econometric estimation within a model (homogeneous goods); (b) simulation models (heterogeneous goods across countries); and (c) CGE models.

A1 Econometric estimation within a model

The first methodology to study price changes in an open economy setting was the model by Hoekman et al. (2005). These authors combined a simple structural model with parameter estimation. The model is used to estimate the welfare effects of the Doha Round of multilateral trade negotiations: it has a multi-country and multi-product setting and allows for estimations of changes in prices of more than 5,000 products. Based on estimates of demand and supply elasticities, the authors use their structural model to solve for equilibrium prices of agricultural products following a change in tariff rates.

The import demand and export supply functions are given by \( m_c, \left(p_c, Z^c_x \right) \) and \( x_c, \left(p^*_c, Z^c_x \right) \), where \( m_c \) and \( x_c \) are the import demand and supply vectors, respectively, for country \( c \) across all goods; \( p_c \) is the domestic price vector of imported goods in country \( c \); \( p^*_c \) is the vector of world prices; and \( Z^c_x \) represent matrices of exogenous variables that determine imports and exports, respectively, in country \( c \). Each good \( g \) is homogeneous across all countries, but within each country, it is an imperfect substitute for all other traded goods.

World markets for each good clear so that \( \sum_c m_c (p_c, Z^c_x) - \sum_c x_c (p^*_c, Z^c_x) = 0 \) and the solution with respect to \( p^*_c \) yields equilibrium world prices. To see how this works, assume that all world and domestics markets are perfectly competitive so that \( p_i = p^*_c \tau_c \), where \( \tau_c \) is a vector of all goods of the form \( \tau_{c,g} = (1 + t_{c,g}) \), in which \( t_{c,g} \) is the level of protection in country \( c \) for good \( g \). We obtain world prices \( p^*_c \) by solving:

\[
\hat{p}_c = \left[ \sum_g E \tau = \sum_g E \tau \right]^{-1} \sum_g E \tau \hat{c}_g
\]  

(A1)

where \( E \tau \) and \( E \hat{c}_g \) are square matrices in which elements are equal to the elasticity of import supply and demand (respectively) in country \( c \), multiplied by the share in world trade of each country’s imports of good \( g \). We can use equation (A1) to estimate the price effects of any change in trade protection in the local economy or abroad.

Balat et al. (2007) use this methodology to estimate the effects of the Doha Round on Zambia. They follow the two-step methodology of the trade and poverty literature. In the first step, they look at price changes resulting from the implementation of the Doha Round agreement for the main crops produced and consumed in Zambia. They find that cotton prices will increase by 3.5 per cent, hybrid maize prices will increase by almost 4 per cent, and tobacco prices will increase by 1.3 per cent. They find modest price reductions in vegetables and groundnuts. In the second step, given these price changes, the authors explore the net effect of trade liberalization at the household level, using Zambia’s 1998 Living Conditions Monitoring Survey.

The average budget share spent on food consumption is high, with poor households dedicating more than 70 per cent and non-poor households almost 60 per cent of their budget to food (see Table 5). The estimated price increases from the Doha Round agreement would therefore certainly have a negative impact on consumers. However, the overall effect needs to be carefully assessed, as most households are both consumers and producers of agricultural goods. Therefore, it is also important to consider the production effect, which in the case of Zambia will operate through the 10 per cent (5 per cent) of income derived from sales of poor (non-poor) households (see shares of food and non-food crop sales in Table 6).

Finally, the authors calculate the net welfare effect of price increases (Table 7). The consumption effect is negative for every decile, particularly for the poorest households, given that a large share of their expenditure is spent on food. The income effect is positive, but not strong enough to overcome the negative impact on consumption (except for households in the sixth decile). It appears therefore, that the Doha agreement would have on average a negative welfare effect in Zambia.
An additional modelling framework that can be used to study price changes is the GSIM developed by Francois and Hall (2009). The authors build a partial equilibrium framework of global trade policy changes at the industry level. This model can be used for the analysis of global, regional, and unilateral trade policy changes. One of the differences from the previous model is that here the authors assume imperfect substitutability across goods.

Porto (2007) uses the GSIM methodology to study the effects of the Central America-Dominican Republic-United States Free Trade Agreement (CAFTA) in Guatemala. The paper uses the two-stage approach. First, the model is used to estimate the effect of CAFTA on prices of several products. For instance, the author finds that following the agreement, yellow maize prices would decrease by 19 per cent, while prices of white maize would decrease by 38 per cent and prices of chicken by 18.6 per cent. In the second stage, the author uses the estimated price changes put of bilateral trade volumes for key partners in the agreement and the rest of the world, together with key export supply elasticities, import demand elasticities, and elasticities of substitution.
and household data for Guatemala to study the welfare changes. Food is the most important expenditure for all Guatemalan households, and the average food budget share is particularly high for poor and indigenous households (almost half of the budget, as shown in Table 8). Here, price decreases of food staples would be positive for consumers, but again, the net effect would also depend on the income effect, as some households are producers of agricultural goods.

Table 8

<table>
<thead>
<tr>
<th>Household budget item</th>
<th>Total</th>
<th>Poor</th>
<th>Non-poor</th>
<th>Total</th>
<th>Poor</th>
<th>Non-poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>35.3</td>
<td>45.4</td>
<td>26.7</td>
<td>42.4</td>
<td>47.0</td>
<td>32.8</td>
</tr>
<tr>
<td>Clothing</td>
<td>12.7</td>
<td>13.4</td>
<td>12.1</td>
<td>14.7</td>
<td>15.2</td>
<td>13.8</td>
</tr>
<tr>
<td>Alcohol &amp; tobacco</td>
<td>0.04</td>
<td>0.06</td>
<td>0.02</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Personal goods</td>
<td>21.2</td>
<td>19.4</td>
<td>22.8</td>
<td>19.7</td>
<td>18.8</td>
<td>21.6</td>
</tr>
<tr>
<td>Housing</td>
<td>3.3</td>
<td>1.9</td>
<td>4.6</td>
<td>2.1</td>
<td>1.8</td>
<td>2.7</td>
</tr>
<tr>
<td>Education</td>
<td>3.8</td>
<td>2.9</td>
<td>4.6</td>
<td>2.7</td>
<td>2.3</td>
<td>3.4</td>
</tr>
<tr>
<td>Health</td>
<td>5.5</td>
<td>4.0</td>
<td>6.8</td>
<td>4.1</td>
<td>3.4</td>
<td>5.6</td>
</tr>
<tr>
<td>Transport</td>
<td>10.5</td>
<td>6.0</td>
<td>14.3</td>
<td>7.9</td>
<td>5.4</td>
<td>13.1</td>
</tr>
<tr>
<td>Remittances</td>
<td>0.28</td>
<td>0.07</td>
<td>0.45</td>
<td>0.13</td>
<td>0.03</td>
<td>0.34</td>
</tr>
<tr>
<td>Other</td>
<td>7.3</td>
<td>6.9</td>
<td>7.7</td>
<td>6.3</td>
<td>6.1</td>
<td>6.8</td>
</tr>
</tbody>
</table>


Table 9 shows that own production is an important source of income for indigenous people (31 per cent of income) and the effect of price decreases will operate through sales of food crops by households. This negative production effect should in principle be a source of concern. However, as seen in Table 10, the net effect would be positive on average for all households, because the positive consumption effect would be larger than the negative production effect across all levels of income. In conclusion, according to this analysis, the CAFTA agreement is expected to have a positive effect on the welfare of Guatemalan households.

Table 9

<table>
<thead>
<tr>
<th>Income source</th>
<th>Total</th>
<th>Poor</th>
<th>Non-poor</th>
<th>Total</th>
<th>Poor</th>
<th>Non-poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own production</td>
<td>18.1</td>
<td>30.1</td>
<td>7.9</td>
<td>10.8</td>
<td>36.6</td>
<td>18.6</td>
</tr>
<tr>
<td>Sales of food crops</td>
<td>7.1</td>
<td>10.3</td>
<td>4.3</td>
<td>10.3</td>
<td>11.3</td>
<td>8.0</td>
</tr>
<tr>
<td>Sales of non-food crops</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Livestock and poultry</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Wages</td>
<td>45.2</td>
<td>39.0</td>
<td>50.5</td>
<td>34.6</td>
<td>32.7</td>
<td>38.5</td>
</tr>
<tr>
<td>Income non-farm</td>
<td>18.2</td>
<td>13.9</td>
<td>21.9</td>
<td>16.6</td>
<td>13.8</td>
<td>22.5</td>
</tr>
<tr>
<td>Remittances</td>
<td>5.1</td>
<td>3.2</td>
<td>6.7</td>
<td>3.9</td>
<td>3.0</td>
<td>5.7</td>
</tr>
<tr>
<td>Other sources</td>
<td>5.2</td>
<td>2.4</td>
<td>7.6</td>
<td>2.9</td>
<td>1.7</td>
<td>5.3</td>
</tr>
</tbody>
</table>


Table 10

<table>
<thead>
<tr>
<th>Income decile</th>
<th>Vegetables</th>
<th>Cereals</th>
<th>Fruits</th>
<th>Total</th>
<th>Maize</th>
<th>Total</th>
<th>Net total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.17</td>
<td>2.92</td>
<td>1.16</td>
<td>5.23</td>
<td>-3.52</td>
<td>-3.41</td>
<td>1.82</td>
</tr>
<tr>
<td>2</td>
<td>0.58</td>
<td>4.38</td>
<td>1.09</td>
<td>6.05</td>
<td>-4.38</td>
<td>-4.24</td>
<td>1.81</td>
</tr>
<tr>
<td>3</td>
<td>0.43</td>
<td>4.19</td>
<td>1.23</td>
<td>5.85</td>
<td>-4.17</td>
<td>-4.1</td>
<td>1.75</td>
</tr>
<tr>
<td>4</td>
<td>0.42</td>
<td>4.35</td>
<td>1.1</td>
<td>5.87</td>
<td>-4.62</td>
<td>-4.56</td>
<td>1.31</td>
</tr>
<tr>
<td>5</td>
<td>0.37</td>
<td>3.82</td>
<td>0.9</td>
<td>5.09</td>
<td>-3.62</td>
<td>-3.49</td>
<td>1.6</td>
</tr>
<tr>
<td>6</td>
<td>0.33</td>
<td>4.03</td>
<td>1.05</td>
<td>5.41</td>
<td>-4.06</td>
<td>-3.92</td>
<td>1.49</td>
</tr>
<tr>
<td>7</td>
<td>0.33</td>
<td>4.07</td>
<td>0.87</td>
<td>5.27</td>
<td>-4.24</td>
<td>-4.08</td>
<td>1.19</td>
</tr>
<tr>
<td>8</td>
<td>0.27</td>
<td>3.47</td>
<td>0.95</td>
<td>4.69</td>
<td>-3.39</td>
<td>-3.33</td>
<td>1.36</td>
</tr>
<tr>
<td>9</td>
<td>0.28</td>
<td>2.33</td>
<td>0.7</td>
<td>3.31</td>
<td>-2.66</td>
<td>-2.57</td>
<td>0.74</td>
</tr>
<tr>
<td>10</td>
<td>0.07</td>
<td>3.66</td>
<td>0.19</td>
<td>3.92</td>
<td>-3.27</td>
<td>-3.16</td>
<td>0.76</td>
</tr>
<tr>
<td>Total</td>
<td>0.425</td>
<td>3.722</td>
<td>0.922</td>
<td>5.069</td>
<td>-3.793</td>
<td>-3.686</td>
<td>1.383</td>
</tr>
</tbody>
</table>

A3 Computable general equilibrium model

Finally, another modelling alternative is the CGE model. CGE models are built to represent a given economy (region, country, group of countries) and assume optimizing behaviour by agents (firms, consumers). They not only apply market-clearing conditions as in the previous models – i.e. partial equilibrium models – but also deal with government and household budget constraints, labour market decisions, profit maximization, and other features. Data are used to infer (“calibrate” in technical terms) the parameters of the model in order to obtain an accurate representation of the economy under study. Concerning resulting price changes, a key feature of CGE models is that these results embody not only the direct price effects of the trade policy change, but also “second-round” indirect effects on the prices of non-traded goods and on factor returns, including effects operating through the government’s budget constraint. The solution of the model and its comparative statics provide predictions of the change in variables, such as prices, output, and economic welfare resulting from a change in a tariff, for instance. These price changes can then be used with household survey data to analyse the welfare impact of trade shocks.

An example of this type of methodology is Chen and Ravallion (2004). This paper evaluates the welfare effects of price changes in goods and factors following the accession of China to the WTO, using the GTAP model. Table 11 shows the price changes reported by the model over the period 2001–2007. With those price changes, the authors estimate the net income effect and the net welfare effect on households in rural and urban areas. As columns 5 and 6 of Table 11 show, the welfare effects are mostly negative for the rural population and mostly positive for the urban population. This suggests that trade policy has a diverse impact according to the household type and region, associated with differences in consumer behaviour and income sources.

### Table 11

<table>
<thead>
<tr>
<th>Expenditures</th>
<th>Wholesale prices</th>
<th>Consumer prices</th>
<th>Rural Net revenue</th>
<th>Mean welfare change</th>
<th>Urban Net revenue</th>
<th>Mean welfare change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per cent change</td>
<td>Per cent change</td>
<td>Renminbi</td>
<td>Renminbi</td>
<td>Renminbi</td>
<td>Renminbi</td>
</tr>
<tr>
<td>Rice</td>
<td>-1.4</td>
<td>0.7</td>
<td>73.66</td>
<td>-1.39</td>
<td>-109.33</td>
<td>-0.75</td>
</tr>
<tr>
<td>Wheat</td>
<td>-1.5</td>
<td>0.7</td>
<td>40.86</td>
<td>-0.92</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Feed grains</td>
<td>-3.7</td>
<td>2.1</td>
<td>117.04</td>
<td>-4.90</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Vegetable and fruits</td>
<td>-2.6</td>
<td>-0.6</td>
<td>123.41</td>
<td>-4.02</td>
<td>-378.69</td>
<td>2.24</td>
</tr>
<tr>
<td>Oilsed</td>
<td>-5.7</td>
<td>-5.9</td>
<td>37.05</td>
<td>-2.10</td>
<td>-1.04</td>
<td>0.06</td>
</tr>
<tr>
<td>Sugar</td>
<td>-2.8</td>
<td>-3.5</td>
<td>13.74</td>
<td>-0.34</td>
<td>-174.06</td>
<td>6.01</td>
</tr>
<tr>
<td>Plant-based fibers</td>
<td>1.6</td>
<td>4.1</td>
<td>36.84</td>
<td>0.56</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Livestock &amp; meat</td>
<td>-1.5</td>
<td>0.7</td>
<td>194.62</td>
<td>-5.21</td>
<td>-500.65</td>
<td>-3.40</td>
</tr>
<tr>
<td>Dairy</td>
<td>-2.4</td>
<td>-0.5</td>
<td>2.50</td>
<td>-0.09</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other food</td>
<td>-3.1</td>
<td>-2.7</td>
<td>-81.60</td>
<td>2.04</td>
<td>-343.13</td>
<td>9.32</td>
</tr>
<tr>
<td>Beverages and tobacco</td>
<td>-5.6</td>
<td>-7.7</td>
<td>-72.98</td>
<td>5.62</td>
<td>-1972</td>
<td>15.09</td>
</tr>
<tr>
<td>Extractive industries</td>
<td>-0.4</td>
<td>1.7</td>
<td>17.99</td>
<td>-0.86</td>
<td>-173.03</td>
<td>-2.92</td>
</tr>
<tr>
<td>Textiles</td>
<td>-0.2</td>
<td>1.5</td>
<td>-11.08</td>
<td>0.17</td>
<td>-53.5</td>
<td>0.82</td>
</tr>
<tr>
<td>Apparel</td>
<td>2.6</td>
<td>0.8</td>
<td>-64.13</td>
<td>-0.51</td>
<td>-394.3</td>
<td>-2.98</td>
</tr>
<tr>
<td>Light manufacturing</td>
<td>-0.6</td>
<td>0.5</td>
<td>-16.15</td>
<td>-0.08</td>
<td>-82.96</td>
<td>-0.43</td>
</tr>
<tr>
<td>Petrochemical industry</td>
<td>-1.1</td>
<td>0.8</td>
<td>-325.39</td>
<td>-2.60</td>
<td>-398.23</td>
<td>-3.19</td>
</tr>
<tr>
<td>Metals</td>
<td>-0.6</td>
<td>1.3</td>
<td>-15.30</td>
<td>-0.20</td>
<td>-24.02</td>
<td>-0.31</td>
</tr>
<tr>
<td>Autos</td>
<td>-3.8</td>
<td>-4</td>
<td>-52.27</td>
<td>2.09</td>
<td>-377.63</td>
<td>1.52</td>
</tr>
<tr>
<td>Electronics</td>
<td>-1.2</td>
<td>-1.4</td>
<td>-24.27</td>
<td>0.34</td>
<td>-162.69</td>
<td>2.20</td>
</tr>
<tr>
<td>Other manufactures</td>
<td>-0.8</td>
<td>0.8</td>
<td>-264.61</td>
<td>-2.12</td>
<td>-431.16</td>
<td>-3.46</td>
</tr>
<tr>
<td>Trade and transport</td>
<td>-0.4</td>
<td>1.7</td>
<td>-18.70</td>
<td>-0.32</td>
<td>-110.53</td>
<td>-1.85</td>
</tr>
<tr>
<td>Construction</td>
<td>-0.4</td>
<td>1.7</td>
<td>0</td>
<td>0</td>
<td>-311.0</td>
<td>-0.52</td>
</tr>
<tr>
<td>Communication</td>
<td>-0.4</td>
<td>1.7</td>
<td>-16.72</td>
<td>-0.28</td>
<td>-152.04</td>
<td>-2.54</td>
</tr>
<tr>
<td>Commercial services</td>
<td>-1.1</td>
<td>0.9</td>
<td>-61.37</td>
<td>-0.55</td>
<td>-533.33</td>
<td>-4.72</td>
</tr>
<tr>
<td>Other services</td>
<td>-0.7</td>
<td>1.3</td>
<td>-434.45</td>
<td>-5.39</td>
<td>-680.99</td>
<td>-8.76</td>
</tr>
</tbody>
</table>
The microeconomic approach

2

The first panel of Table 12 summarizes the aggregate welfare impact of China joining the WTO over the time frames covering 1995–2001 and 2001–2007. In the short run (1995–2001), this trade reform has a positive impact on all Chinese households (a gain of 55.49 renminbi per capita). However, in the long run (2001–2007), the negative effect on rural households (–18.07 renminbi per capita) makes the aggregate effect at the national level slightly negative (–1.54 renminbi per capita during this time period). The second panel shows the changes in inequality measured by the Gini index with respect to the baseline. Inequality increases in all areas, yet mainly in rural areas (from 33.90 to 34.06 per cent). A similar conclusion can be drawn for the poverty indices for which all estimates show an increase of overall poverty in China.

<table>
<thead>
<tr>
<th>Item</th>
<th>Rural</th>
<th>Urban</th>
<th>National</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mean gains (renminbi per capita)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995–2001</td>
<td>34.47</td>
<td>94.94</td>
<td>55.49</td>
</tr>
<tr>
<td>2001–2007</td>
<td>–18.07</td>
<td>29.45</td>
<td>–1.54</td>
</tr>
<tr>
<td>2. Inequality effects (Gini index, per cent)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline, 1999</td>
<td>33.95</td>
<td>29.72</td>
<td>39.31</td>
</tr>
<tr>
<td>Simulated: Less gains 1995–2001</td>
<td>33.90</td>
<td>29.68</td>
<td>39.27</td>
</tr>
<tr>
<td>Simulated: Plus gains 2001–2007</td>
<td>34.06</td>
<td>29.65</td>
<td>39.35</td>
</tr>
<tr>
<td>3. Poverty effects (headcount index, per cent)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Official poverty line</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Baseline (1999)</td>
<td>4.38</td>
<td>0.08</td>
<td>2.92</td>
</tr>
<tr>
<td>Simulated: Less gains 1995–2001</td>
<td>4.56</td>
<td>0.08</td>
<td>3.04</td>
</tr>
<tr>
<td>Simulated: Plus gains 2001–2007</td>
<td>4.57</td>
<td>0.07</td>
<td>3.04</td>
</tr>
<tr>
<td>$1/day (1993 purchasing power parity)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline (1999)</td>
<td>10.51</td>
<td>0.29</td>
<td>7.04</td>
</tr>
<tr>
<td>Simulated: Less gains 1995–2001</td>
<td>10.88</td>
<td>0.28</td>
<td>7.28</td>
</tr>
<tr>
<td>Simulated: Plus gains 2001–2007</td>
<td>10.81</td>
<td>0.28</td>
<td>7.23</td>
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<tr>
<td>$3/day (1993 purchasing power parity)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline (1999)</td>
<td>45.18</td>
<td>4.07</td>
<td>31.20</td>
</tr>
<tr>
<td>Simulated: Less gains 1995–2001</td>
<td>46.10</td>
<td>4.27</td>
<td>31.88</td>
</tr>
</tbody>
</table>

Source: Chen and Ravallion (2004).
Annex B  Formal derivation of the first-order welfare effect

This annex aims to formally derive the first-order welfare effect that we presented intuitively in Section 3 of this module. The framework builds on standard agricultural household models, as in Singh et al. (1986), which we will modify to take into account that most urban households in middle-income countries are wage earners and do not produce agricultural goods. The unit of analysis is the household, denoted by \( h \). To measure welfare changes, we begin by adopting the indirect utility function approach, as in Deaton (1997). We will later derive the same result using the expenditure function (as in Dixit and Norman, 1980) where we will incorporate the effects of total expenditure on various goods and services, and total income from various production activities. In order to be able to apply the framework to the data, we need some manipulation of equation (B6). In short, multiply and divide by \( p_i \) and by total household income \( y^h \) to get:

\[
\frac{\partial V^h}{\partial p_i} = \frac{\partial V^h}{\partial y^h} \left( q^h - c^h \right) \frac{p_i}{y^h} \quad (B6.1)
\]

Furthermore, multiply each side of equation (B6.1) by \( y^h \), as follows:

\[
\frac{\partial V^h}{\partial p_i} \cdot y^h = \frac{\partial V^h}{\partial y^h} \left( q^h - c^h \right) \frac{p_i}{y^h} \quad y^h \quad (B6.2)
\]

to get, after applying the properties of logarithms:

\[
\frac{\partial V^h}{\partial \ln p_i} = \frac{\partial V^h}{\partial \ln y^h} \left( \Phi^h - s^h \right) \quad (B7)
\]

The left-hand side is the object we are trying to measure. On the right-hand side, \( \left( \partial V^h \right) / \left( \partial \ln y^h \right) \) is the marginal utility of money to household \( h \); \( \Phi^h \) is the share of household income derived from the production of goods \( i \) equal to \( q^h / y^h \); and \( s^h \) is the budget share spent on good \( i \) equal to \( c^h / (p_i / y^h) \). In Deaton (1989b, 1997), the quantity \( \Phi^h - s^h \) is the net benefit ratio, which is what we care about with regard to policy implications. In fact, \( \Phi^h - s^h \) is the money equivalent of the losses or gains for different individuals. The benefit ratios are easily retrieved from the household surveys. Note that \( \left( \partial V^h \right) / \left( \partial \ln y^h \right) \) is the private marginal utility of income, which is not the focus of our analysis. Instead, we care about the social marginal utility of money, which informs us about the amount of resources the social planner needs to transfer to household \( h \).

We can now turn to the interpretation of this equation. Households are affected both on the consumption and income sides. On the consumption side, consumers are worse off if prices go up and better off if prices go down. In a first-order
approximation, these effects can be measured with budget shares, $s$. On the income side, there is also a direct impact on profits if the household produces goods $i$, which depends on the share of income derived from these goods, $\theta_i$. In rural economies, this source of income can account for a large portion of total income. In more urbanized economies with more developed labour markets (as in many countries in Latin America or Asia), the role of the direct production of (agricultural) goods tends to be much less important and may be treated as zero. When we do not consider labour income, the total effect of a price change will depend on whether the household is a net consumer or a net producer of the goods under study.

In a small open economy that faces exogenous commodity prices (determined in international markets), wages will respond to changes in those prices mainly because the demand for labour depends on prices (labour supply can be affected by prices as well, but we defer this discussion for the moment). Changes in relative product prices cause some sectors to expand and others to contract. If sectors use factors of production in different proportions, then the relative demand for factors (including skilled labour, unskilled labour, and capital) will change. Even with a fixed labour supply, wages will adjust. If the labour supply reacts as well, an additional channel emerges. In practice, the link between wages and prices depends on the way product prices affect factor demand and supply, and the way changes in factor demand and supply transmit to wages. It is possible to imagine situations where wages would not react to a change in a given price, or situations where wages would increase or decrease. The prices of non-traded goods can also be affected. In the simplest mechanisms, a change in the price of traded goods affects factor prices, as discussed above, and this, in turn, affects the cost of production of non-traded goods. As a result, the prices of these goods may change as well. How these prices (including wages) respond to trade policy is an empirical question.

It is relatively simple to amend the theoretical framework to account for these responses. We begin with wage adjustments. To illustrate them, we work with the expenditure function approach as in Dixit and Norman (1980). As before, the unit of analysis is the household, denoted by $h$. In equilibrium, household expenditure (including savings) has to be financed with household income (including transfers).

$$e_h(p, u^h, x^h) = \sum_i \pi_i w^m + \sum_i \pi_i \phi(p, \phi) + T^h + x^h \quad (B8)$$

The expenditure function $e(\cdot)$ of household $h$ on the left-hand side of equation (B8) is defined as the minimum expenditure needed to achieve a given level of household utility $u^h$. It depends on a vector of prices of consumption goods, $p$, on the level of utility $u^h$ the household wishes to achieve, and on other household characteristics, $x^h$ (such as household composition).

Income comprises the sum of the wages of all working members $m$, $(w^m)$, and the sum of the profits $\pi$, made in different economic activities $i$. Profits include, for instance, the net income from agricultural production or farm enterprises. They depend on prices, technical change, and key household characteristics (summarized by $\phi$). Note that profits are defined as sales net of purchases of inputs so that some of the effects caused by protection on inputs or intermediate goods can be captured by $\pi_i$. In equation (B8), $T^h$ measures transfers (public or private), savings, and other unmeasured factor returns. Finally, we add exogenous income $x_0^h$ for technical reasons.

It is evident from equation (B8) that household welfare depends on equilibrium variables such as prices and wages (that affect household choices) and also on household endowments. For instance, household consumption depends on the prices of consumer goods and household income depends on the labour endowment (skilled, unskilled), the wage rate, and the prices of key outputs. It follows that changes in commodity prices affect welfare directly via consumption and production decisions, and that these effects are heterogeneous insofar as they depend on household choices and endowments.

The first-order impact of changes in the price of good $i$ can be derived by differentiating equation (B8) (while keeping utility constant and adjusting $x^h$) and following a similar procedure to the one above in the case of the indirect utility function. Specifically, the terms of equation (B8) are re-arranged as follows:

$$x^h_0 = e^h(\cdot) - \sum_i \pi^h_i (p, \phi) - T^h \quad (B8.1)$$

Assuming $T^h$ constant or equal to zero, the differentiation for an exogenous change in the prices of consumption goods $i$ $(p_i)$ yields:

$$dx^h_0 = \frac{\partial e^h(\cdot)}{\partial p_i} dp_i - \sum_i \frac{\partial \pi^h_i (p, \phi)}{\partial p} dp_i - \frac{\partial T^h}{\partial p} \quad (B8.2)$$

Dividing all terms by $e^h(\cdot)$ and manipulating the right-hand side of equation (B8.2), it follows that:
\[
\frac{dx_h^i}{e^h} = \frac{\partial e^h}{\partial p_i} \frac{dp_i}{p_i} + \frac{\partial p_i}{\partial p_i} \frac{dp_i}{p_i} - \frac{\partial w^m_i}{\partial p_i} \frac{dp_i}{p_i} - \frac{\partial w^m_i}{\partial e^h} \frac{dp_i}{p_i} - \frac{\partial \pi_i}{\partial p_i} \frac{dp_i}{p_i} + \frac{\partial \pi_i}{\partial e^h} \frac{dp_i}{p_i} \] (B8.3)

The right-hand side of equation (B8.3) is composed of three terms. First, the consumption effect for good \( i \), represented by:

\[
\frac{\partial e^h}{\partial p_i} \frac{dp_i}{p_i} = s_h^i \frac{dp_i}{p_i} \] (B8.4)

where \( s_h^i \) represents the budget share of household \( h \) spent on good \( i \) and derives from Shepard's lemma, according to which \( \frac{\partial e^h}{\partial p_i} / \partial p_i \) is equal to the demand of household \( h \) for good \( i (x^h_i) \).

Second, the labour income effect, equal to:

\[
\left[ \sum_m \frac{\partial w^m_i}{\partial p_i} \frac{dp_i}{p_i} \right] \frac{dp_i}{p_i} = \left[ \sum_m \epsilon w^m \theta^m \right] \frac{dp_i}{p_i} \] (B8.5)

where \( \epsilon w^m \) is the elasticity of the wage earned by household member \( m \) with respect to \( p_i \), and \( \theta^m \) is the share of wage income of the household member \( m \) in total household expenditure \( e^h \).

Finally, the third term on the right-hand side of equation (B8.3) is equal to:

\[
\left[ \frac{\partial \pi_i}{\partial p_i} \right] \frac{dp_i}{p_i} = \phi^h \frac{dp_i}{p_i} \] (B8.6)

with \( \phi^h \) representing the share of household income from the production of good \( i \), derived from Hotelling's lemma (see equation (B8.4) above).

Substituting \( s_h^i, \phi^h \) and the labour income effect in equation (B8.3), it follows that:

\[
\frac{dx_h^i}{e^h} = s_h^i \phi^h - \sum_m \theta^m \epsilon w^m \frac{dp_i}{p_i} \] (B8.7)

where \( dp_i/p_i \) can also be written as \( dln p^h_i \) for the properties of logarithms. Multiplying each term of equation (B8.4) by \(-\epsilon \) yields:

\[
-\frac{dx_h^i}{e^h} = -s_h^i + \phi^h - \sum_m \theta^m \epsilon w^m dln p^h_i \] (B8.8)

which finally results in:

\[
-\frac{dx_h^i}{e^h} = (\phi^h - s_h^i) dln p^h_i + \sum_m \theta^m \epsilon w^m dln p^h_i \]

\[= cv^h \] (B9)

where \( cv^h = -dx_h^i/e^h \) is a measure of the compensating variation (as a share of initial expenditure) at the household level associated with a change in the \( i^{th} \) price. The compensating variation is the revenue that the social planner needs to transfer to households to compensate them for the price change. If a household loses from a price increase, the compensating transfer of income from the planner is \(-dx_h^i/e^h \) and the compensating variation \( cv^h \) is negative (i.e. a deficit for the planner). Instead, if the household benefits from a price increase, the compensating variation is positive because it actually represents a transfer from the household to the planner (so that \( dx_h^i/e^h \) is negative).

Equation (B9) summarizes the first-order effects of a price change. The first term on the right-hand side re-establishes the net consumer/net producer result, as described in Section 3 of this module. Additionally, price changes affect wages. This channel is described by the second term on the right-hand side of equation (B9). The mechanisms are in principle simple. When there is a price change, demand for different types of labour (and also labour supply) can change, thus affecting equilibrium wages. In equation (B9), these responses are captured by the elasticities \( \epsilon w^m \), which vary from one household member to another provided different members are endowed with different skills (unskilled, semi-skilled, or skilled labour) – also known as skill wage premiums – or if they work in different sectors – also known as industry wage premiums. These effects on labour income depend on the share of income contributed by the wages of different members, \( \theta^m \). Clearly, if countries differ in technologies, endowments, or labour regulations, the responses of equilibrium wages to prices can be heterogeneous across different economies.

In the presence of wage adjustments, the standard net consumer/net producer proposition needs to be modified. Consider the case where a household consumes a product but does not produce it at all, yet its members earn an income from selling labour. Omitting wages, this household is a net consumer and could thus be hurt by a price increase. But if wages respond positively to prices, the final welfare effect may not necessarily entail a loss.
REFERENCES


