

Using Survey Data to Assess the Distributional Effects of Trade Policy*

Guido G. Porto[†]
Development Research Group
The World Bank

April 2003

*I wish to warmly thank Angus Deaton and Gene Grossman for their comments, insights and continuous support. I thank Alicia Menendez and Marcelo Olarreaga for comments and unconditional help. My special thanks go to Irene Brambilla. Errors are my sole responsibility.

[†]Correspondence: The World Bank, MailStop MC3-303, 1818 H Street NW, Washington, DC 20433.
email: gporto@worldbank.org

Using Survey Data to Assess the Distributional Effects of Trade Policies
Non-Technical Summary

Guido G. Porto

The purpose of this paper is to develop and apply a methodology to empirically explore the effects of trade policies on the distribution of income and poverty in developing countries. The methodology used here is based on two links, one connecting trade policies to prices and another connecting prices to household welfare. In the first link, trade reforms in small open economies cause the relative prices of traded goods to change. In the second link, these price changes affect households as consumers and as income earners. In fact, there are general equilibrium consumption effects, as households pay different prices for traded and non-traded goods, and general equilibrium labor income effects, as factor demand and wages adjust.

The change in the price of traded goods is taken from the exogenous policy shift. I also develop methodology that allows one to estimate the change in the wages and the change in the price of non-traded goods based on the exogenous change in the price of traded goods. I then estimate the change in consumer welfare, measured as compensating variation, given the changes in prices of traded goods, non-traded goods and wages.

I apply the methodology to the study of the distributional effects of Mercosur on Argentine families. The main finding of the paper is that Mercosur benefits the average Argentine household across the entire income distribution. There is evidence of a pro-poor bias of the regional trade agreement: on average, poor households gain more from the reform than middle-income households, whereas the impacts on rich families are positive but not statistically significant. The reason behind these results is that Argentine trade policy protected the rich over the poor, prior to the reform, and granted some protection to the poor, after the reform. As a result, the relative pre-Mercosur tariff on the goods investigated in this paper is higher on relatively skill-intensive goods. This means that tariff removals would tend to benefit the poor over the rich. These findings indicate that trade reforms may actually help improve the distribution of income and reduce poverty in the country.

1 Introduction

The purpose of this paper is to develop a methodology to empirically explore the effects of trade policies on the distribution of income and poverty in developing countries. As opposed to most previous work in the trade literature, which looks at aggregate measures of performance, I use survey data to econometrically assess the general equilibrium effects of trade reforms. The paper thus substantially extends the existing literature that studies trade liberalization with household data in partial equilibrium (Deaton, 1989a; Friedman and Levinsohn, 2003; Edmonds and Pavcnick, 2003).

The methodology used here is based on two links, one connecting trade policies to prices and another connecting prices to household welfare. In the first link, trade reforms in small open economies cause the prices of traded goods to change. In the second link, these price changes affect households as consumers and as income earners. In fact, there are general equilibrium consumption effects, as households pay different prices for traded and non-traded goods, and general equilibrium labor income effects, as factor demand and wages adjust. To measure these welfare impacts, I estimate compensating variations at the household level.

I show that household budget shares approximate the compensating variation originated in the changes in the prices of consumer goods (Deaton, 1989a, 1989b). In addition, I develop methods to estimate the responses of the prices of non-traded goods and wages. To measure the endogenous responses of the prices of non-traded goods, I use time series data to regress the prices of non-traded goods on the exogenous prices of traded goods. To measure the general equilibrium reaction of wages, I estimate wage price-elasticities by using an earnings regression scheme that incorporates the price of traded goods as exogenous regressors. My method adapts and extends techniques used in demand analysis to the labor market analysis.

The distributional analysis is based on the estimation of the average compensating variations at different levels of per capita household expenditure. The welfare analysis

is thus performed *across the entire distribution of income*. The individual consumption effects of traded goods, the individual consumption effects of non-traded goods and the individual labor income effects are smoothed with non-parametric, locally weighted Fan (1992) regressions.¹

I apply the methodology to the study of the distributional effects of Mercosur on Argentine families. The experience of Argentina is convenient because it combines enough available data with a changing trade regime during the 1990s. Argentina therefore provides a rich environment, in terms of changes in exogenous parameters and of responses of endogenous variables, to analyze the extent to what individual welfare is affected by trade reforms and to find magnitudes for some of these effects. In addition, since Argentina witnessed an increase in income inequality during the 1990s, I can use the methodology to carry out a comparative distributional analysis of trade policies vis-à-vis other simultaneous reforms.²

The main finding of the paper is that Mercosur benefits the average Argentine household across the entire income distribution. There is evidence of a pro-poor bias of the regional trade agreement: on average, poor households gain more from the reform than middle-income households, whereas the impacts on rich families are positive but not statistically significant.

These results indicate that trade reforms may actually help improve the distribution of

¹The methods used in this paper differ from the Computable General Equilibrium literature in various ways. CGE models may lead to conclusions that are embedded in assumptions on functional forms rather than being derived from the data (Deaton, 1987; 1999). At the same time, welfare conclusions can be sensitive to small changes in those assumptions (Deaton, 1981). In contrast, my work emphasizes the use of econometric techniques that place few restrictions on estimable parameters, allowing for a much bigger, and better, role for econometric measurement as opposed to assumptions. It will sometimes be necessary to make compromises between a non-parametric analysis and a more restrictive strategy: some parameterization will be needed and even some computation as in the CGE modeling will be unavoidable. My aim is to merge as much econometric measurement with as few theoretical assumptions as possible, in an attempt to provide an analysis with a different flavor from most current research on trade policy.

²The Gini coefficient for household per capita income grew from 0.438 in 1992 to 0.480 in 1997. Raising inequality in Argentina has been very well-documented, in terms of Gini coefficients, Lorenz curves and other relevant instruments (Gasparini, 1999). Financial reforms, economic deregulation and privatization are some of the policy reforms adopted by Argentina.

income and reduce poverty in the country.

The paper is organized as follows. In section 2, I introduce a simple general equilibrium trade model of a small open economy to characterize the impacts of trade reforms on prices and to derive measures of the compensating variations at the household level. Section 3 develops the empirical techniques used to estimate these compensating variations and implements the methodology on Argentine data. Section 4 concludes.

2 The Model

I begin by deriving the set of theoretical distributional effects caused by trade policies that are estimated in this paper. I adapt the small open economy models of Dixit and Norman (1980) and Woodland (1982) to a multi-household context. It is assumed that, for each family, expenditure on consumption goods is equal to income (factor earnings plus transfers).³

That is,

$$(1) \quad e^j(\mathbf{p}_T, \mathbf{p}_{NT}, u^j) = x_0^j + \sum_m w_m^j + k^j + \psi^j.$$

The expenditure function of household j , $e^j(\cdot)$, depends on the vector of prices of traded goods (\mathbf{p}_T), the vector of prices of non-traded goods (\mathbf{p}_{NT}), and required utility u^j . Household income comprises exogenous income, x_0^j , the sum of the labor income of each member m , w_m^j , capital income, k^j , and government transfers, ψ^j .

A small open economy faces an exogenous international price p_i^* for traded good i , so that the domestic price p_i is given by

$$(2) \quad p_i = p_i^*(1 + \tau_i),$$

³I do not consider the impacts of trade on savings.

where τ_i is the trade tariff. There are constant returns to scale in the production of these goods and firms participate in competitive markets. Thus, for each good i , price is equal to unit production cost

$$(3) \quad p_i = c_i(\mathbf{w}),$$

where $c_i(\cdot)$ is the unit cost function and \mathbf{w} is the vector of factor prices. The system of equations in (3) characterizes the general equilibrium relationship between the prices of traded goods and the prices of production factors. As product prices change, some sectors expand while some others contract. This causes changes in relative factor demands, depending upon the relative factor intensities used in different sectors. As a result, wages adjust. In a two-good, two-factor model, this relationship is described by the Stolper-Samuelson theorem: an increase in the price of a good causes an increase in the return to the factor intensively used in its production (and a decline in the return to the other factor). However, the association between prices and factor returns is more general and multidimensional models only deliver correlations among prices of goods and prices of factors (Dixit and Norman, 1980; Helpman, 1984).⁴

If there are at least as many traded goods as factors, then the system of equations in (3) fully determines the prices of the factors of production, \mathbf{w} , as a function of the vector of prices of traded goods, \mathbf{p}_T . This assumption is adopted in this paper.

The equilibrium prices of non-traded goods are derived from the demand-supply equality in domestic markets. That is,

$$(4) \quad \sum_j \frac{\partial}{\partial p_k} e^j(\mathbf{p}_T, \mathbf{p}_{NT}, u^j) = \frac{\partial}{\partial p_k} r(\mathbf{p}_T, \mathbf{p}_{NT}, \mathbf{v}),$$

⁴This means that, with many goods and factors, Stolper-Samuelson effects are not necessarily expected.

where k denotes a non-traded good, $r(\cdot)$ stands for the GDP function of the economy and \mathbf{v} for a vector of factor endowments (Dixit and Norman, 1980). In (4), the demand for a non-traded good k is given by the derivative of the expenditure function with respect to the price of that good (Shepard's Lemma), whereas its supply is given by the own-price derivative of the GDP function (Hotelling's Lemma). Given the factor endowments and the prices of traded goods, the equilibrium prices of the non-traded goods are endogenously determined by the functions⁵

$$(5) \quad p_k = p_k(\mathbf{p}_T, \mathbf{v}).$$

If there are at least as many traded goods as factors, the exogenous prices of all the traded goods uniquely determine the vector of factor prices and these, in turn, uniquely determine the prices of the non-traded goods through the zero-profit conditions in these sectors. In this case, neither factor endowments nor demand conditions affect equilibrium prices of non-traded goods. This means that, in general equilibrium, there will be an aggregate relationship between the prices of non-traded goods and the prices of traded goods, as follows

$$(6) \quad p_k = p_k(\mathbf{p}_T).$$

The welfare evaluation of trade policies comprises two steps: the effects of trade reforms on prices, and the effects of price changes on household welfare. In the first step, the parameters used to identify trade policy reforms are given by the vector of import tariffs $\boldsymbol{\tau}$. These tariff reforms cause movements in the domestic prices of the traded goods, according to equation (2). In the second step, there are a couple of general equilibrium responses triggered by

⁵Notice that, more generally, I can write $p_k = p_k(\mathbf{p}_T, \mathbf{v}, \boldsymbol{\chi})$, where $\boldsymbol{\chi}$ stands for preference shifters, income distribution or other variables.

these price changes: the changes in factor prices given by equations (3), particularly wages for workers with varying skills, and the induced impacts on the prices of non-traded goods given by equation (6). The welfare impacts caused by the changes in the consumer prices of traded and non-traded goods are called *consumption effects*. The welfare impacts caused by the changes in wages are called *labor income effects*.

The changes in household welfare are computed with measures of compensating variations, the income needed to compensate households for a change in a tariff τ_i . These compensations can be measured with the change in exogenous income, x_0^j , that would leave the family indifferent to the pre-policy situation. Differentiating equation (1) and assuming public transfers and capital income away, the compensating variation for a change in the tariffs on good i is given by⁶

$$(7) \quad \frac{dx_0^j}{e^j} = \left(s_i^j + \sum_{k \in NT} s_k^j \frac{\partial \ln p_k}{\partial \ln p_i} - \sum_m \theta_m^j \varepsilon_{wmp_i}^j \right) \frac{\partial \ln p_i}{\partial \ln \tau_i} d \ln \tau_i,$$

where s_i^j is the budget share spent on traded good i by household j , s_k^j is the budget share spent on non-traded good k , θ_m^j is the share of the labor income of member m on total family income. The wage price-elasticities $\varepsilon_{wmp_i}^j$ capture the proportional change in the wage earned by member m caused by a change in the price of good i . Note that equation (7) shows the *negative* of the compensating variation, as a fraction of total initial household expenditure. Thus, the compensating variation is measured, as in Hicks (1939) and Mas-Colell, Whinston and Green (1995), as the revenue of a hypothetical planner that has to compensate a household for a policy change. Accordingly, a positive compensating variation means a positive revenue for the planner, a negative transfer for the household and a welfare gain.

⁶In this paper, I do not consider the impacts of trade reforms on government transfers and on non-wage income (profits, returns to specific factors). See section 3 below.

Equation (7) captures three welfare impacts: the consumption effects of traded goods, the consumption effects of non-traded goods and the labor income effects. The consumption effects of traded goods can be approximated to first order by the budget share s_i^j . The consumption effects of non-traded goods can be approximated by the product of the elasticity of the prices of non-traded goods with respect to the prices of the traded goods ($\varepsilon_{pkpi} = \partial \ln p_k / \partial \ln p_i$) and the respective budget shares (s_k^j). The labor income effects can be approximated by the weighted sum across household members of the wage price-elasticities (ε_{wmpi}^j).

The aim of this paper is to get an estimate of the compensating variation for each household. Some of the terms in (7) are data, others are estimable parameters, and others are observed policy parameters. The changes in tariffs $d \ln \tau_i$ represent the policy parameters that can be recovered from the legislation that implements Mercosur. Budget shares, s_i^j and s_k^j , are data; they can be obtained from expenditure surveys, which are readily available in many developing countries. The induced changes in the prices of traded goods, $\partial \ln p_i / \partial \ln \tau_i$, and the endogenous responses of the prices of non-traded goods, $\partial \ln p_k / \partial \ln p_i$, and wages ε_{wmpi}^j need to be estimated.

The compensating variation in (7) captures first order effects only. Extensions dealing with higher order changes require the estimation of own-price and cross-price demand elasticities, a difficult task given the available data in most developing countries. Since substitution effects are ignored, the welfare effects will be mismeasured. However, as Deaton (1989a) points out, the price elasticities will be irrelevant for the distributional effects, unless demand elasticities are a function of household expenditure. If this is not the case and all households face the same substitution terms, then the absolute welfare effect at the household level will be distorted but the measurement of the relative distributional effects will not be affected.

Another remark is that (7) is obtained under the assumption of exogenous international prices in a small country. If this were not the case, the first order effects should include additional terms involving the budget shares of other traded goods and the endogenous responses of their prices. Measuring these effects requires, as before, an estimation of the equilibrium response of prices (including both elasticities of demand and of supply) for all traded goods. For most developing countries, the small country assumption can be reasonable so that these issues will not arise.

A different concern with the approximation to the change in labor income arises when factor endowments are endogenous (with fixed factor supply, the compensating variation in (7) is properly measured). Here, there are two different problems. As in the case of the substitution terms in consumption, there can be mismeasurement in the distributional effects if the supply of labor (or the consumption of leisure) responds to product price changes.⁷ The total welfare effect will be mismeasured to an extent given by the elasticity of hours worked, but the relative impact on household well-being will not be affected if this elasticity does not vary across levels of income. A different problem is that factor prices (wages) may react to the endogenous response in hours worked, something that will not happen under the assumption that the number of traded goods is greater than the number of factors.

3 The Distributional Effects

This section describes the methods used to assess the distributional effects of trade policies in Argentina. Specifically, I investigate the welfare effects of adopting of Mercosur, a

⁷Notice that the first order distributional effect of leisure consumption is zero. To see this, write the expenditure function with \mathbf{p} , L^j (hours worked) and w^j as arguments (as in Dixit and Norman, 1980). The income-expenditure equality requires $e^j(\mathbf{p}, L^j, w^j) = w(\cdot)L^j + x_0^j$. Differentiating with respect to p_i and using the property that $\partial e^j / \partial L^j = w$ delivers the result.

regional trade agreement among Argentina, Brazil, Paraguay and Uruguay.⁸ I introduce the econometric techniques that are needed to estimate each of the different components of the compensating variations at the household level, equation (7). I describe how to recover the changes in the prices of the traded goods (section 3.1) and how to analyze the consumption effects of traded goods (section 3.2) and non-traded goods (section 3.3). Section 3.4 explains how to estimate the changes in wages and the labor income effects. The household total compensating variations including all these effects are studied in section 3.5.

3.1 Price Changes of Traded Goods

The main characteristic of this paper is the measurement of the welfare effects of trade policies in general equilibrium, a task that requires comparable consumption and labor income effects for a given family. To study the consumption effects, I need data on budget shares, which are available in the National Household Expenditure Survey (ENGH). This is a comprehensive expenditure survey in Argentina that adopts a specific classification of consumption goods which includes four traded goods and three non-traded goods. The traded goods are Food & Beverages, Clothing, House Equipment and Maintenance Goods, and Other Traded Goods. The non-traded goods are Housing, Transport and Communication, Health and Education, and Leisure related Goods.⁹ This classification of goods is adopted in this paper.

To estimate the impacts of Mercosur on prices, I look at the effects of the elimination of tariff barriers among country members and the implementation of common external tariffs on the rest of the world, the main reforms introduced by the regional trade agreement. For each traded good i , these impacts correspond to the term $(\partial \ln p_i / \partial \ln \tau_i) d \ln \tau_i$ in equation (7).

⁸The methodology could also be applied to other actual or hypothetical trade reforms, such as unilateral trade liberalization.

⁹The ENGH survey collects data on over ninety goods. The aggregation used here exploits the availability of price indices for traded and non-traded goods published by the National Institute of Statistics and Censuses in Argentina. See Appendix A1 for more details.

I assume that Argentina is a small country that faces exogenous prices of traded goods. In order to accommodate the discriminatory tariffs applied by Mercosur and the cross-hauling prevalent in trade data, I introduce regional differentiation across goods, in the tradition of the Armington (1969) model. Specifically, I follow Whalley (1985) and Shoven and Whalley (1992) and assume that products are differentiated by large trading blocks (North America, Western Europe, Eastern Europe, Asia, Latin America, and Other).

The price index for traded good i , p_i , is defined as an import-share weighted average of the price of the varieties coming from each of these regions. Let τ_{im} be the intrazone tariff on Mercosur members, and let τ_{irw} be the common external tariff on all other varieties. The change in the (logarithmic) price of good i is given by

$$(8) \quad d \ln p_i = \theta_{im} d \ln(1 + \tau_{im}) + \theta_{irw} d \ln(1 + \tau_{irw}),$$

where the weights are the fraction of imports of a good i coming from Mercosur members (θ_{im}), and the fraction of imports coming from the rest of the world (θ_{irw}). Using data on import shares, intrazone tariffs and common external tariffs, I use (8) to compute the price changes originated in Mercosur.¹⁰

The data on the tariffs levied on each of the four traded goods before and after Mercosur are listed in Table 1. In 1992 (before Mercosur), there is some fair degree of protection (column 1). The average tariff on imports of Clothing is 20.4 percent, the highest. House Equipment gets a 16.1 percent tariff and Other Goods, 12.7 percent. The lowest average rate is on Food & Beverages, 6.9 percent. The intrazone tariff (column 2) decreases to zero for

¹⁰Given the data available in Argentina, it was impossible to produce econometrically better estimates of the price changes for the goods for which there are consumption data (food and beverages, clothing, etc.). Using other sources of data, such as import and export prices for goods in the Harmonized System, Chang and Winters (2002) are able to use econometric methods. The assumptions adopted in this section are closer to the CGE literature than the rest of my study; this should be interpreted as a necessary compromise between prior restrictions and measurement.

all goods but Clothing, which gets a 3.3 percent tax. There is also some protection granted by the common external tariff (column 3). The rate on Food and Beverages is 13.7 percent, twice the pre-Mercosur rate. The tariffs on the remaining three goods are slightly lower than in 1992, 17.9 percent (on Clothing), 14.2 percent (on House Equipment) and 11.7 percent (on Other Goods).

Column (4) of Table 1 shows my estimates of the total changes in the prices of traded goods caused by Mercosur (equation 8). The price of Food & Beverages increases by 1.4 percent; instead, the prices of Clothing, House Equipment and Other Goods decline by 6.4 percent, 5.4 percent and 3.2 percent, respectively. These are the price changes for the first link of my methodology.

3.2 The Consumption Effects of Traded Goods

I investigate next the consumption effects of traded goods, which are given by the term $s_i^j (\partial \ln p_i / \partial \ln \tau_i) d \ln \tau_i$ in equation (7). To measure these terms, I need data on the budget share spent on these goods by each Argentine household. The National Household Expenditure Survey (ENGH) provides this information.¹¹

The households interviewed in the ENGH survey comprise the baseline sample used in my distributional analysis. For each of these households, I measure the *consumption effects of traded goods* by multiplying the budget share s_i^j and the price changes induced by Mercosur $(\partial \ln p_i / \partial \ln \tau_i) d \ln \tau_i$ (section 3.1). I use these household welfare effects to study the distributional effects of trade policies *across the entire distribution of income*. Since there are 21,127 households in the expenditure survey (ENGH), I need a procedure to summarize all this information in a useful way. To do this, I estimate average welfare effects at different points along the per capita expenditure spectrum. These averages are the right measures

¹¹See Appendix A1 for details on the ENGH survey.

for my distributional purpose since they reflect the marginal effect of a price change on a hypothetical social welfare function.¹²

One way to compute these conditional averages is to estimate a parametric linear regression of the welfare effects - the compensating variations cv^j defined by (7) - on the logarithm of per capita household expenditure (x^j). This would define the conditional expectation as $E[cv^j|x^j] = b_1 + b_2x^j$, where b_1 and b_2 are estimable parameters. The distributional analysis can be performed by plotting a line, $\widehat{E}[cv|x] = \widehat{b}_1 + \widehat{b}_2x$, using the OLS coefficients \widehat{b}_1 and \widehat{b}_2 to predict the regression function.

One problem with this approach is that the fit can be poor if the relationship between local changes in household welfare and per capita household expenditure is nonlinear. In these cases, the details of the statistical association between the household welfare effects and the logarithm of per capita expenditure can be more suitably explored with a non-parametric procedure. Non-parametric regressions allow the data to choose the best local shape of the regression function $m(x) = E[Y|X = x]$, thereby reducing the biases inherent in the global fit.

In what follows, I use locally weighted regressions (Fan, 1992; Fan and Gijbels, 1996; Pagan and Ullah, 1999). Conceptually, I run different linear (or polynomial) regressions of the welfare effects on the logarithm of per capita expenditure using only *local* data points. At each point in the support of the log per capita household expenditure (x), I carry out the following program (Fan, 1992)

$$(9) \quad \min_{\phi_1, \phi_2} \sum_j \omega^j (cv^j - \phi_1 - \phi_2 x^j)^2 K\left(\frac{x^j - x}{h}\right),$$

¹²The use of averages at different income levels was first introduced by Deaton (1989a, 1989b) to the study of export taxes on rice in Thailand, and has been successfully applied to the study of coffee and cocoa prices in Côte d'Ivoire (Benjamin and Deaton, 1993), food prices in Côte d'Ivoire (Budd, 1993), and the economic crisis in Indonesia (Friedman and Levinsohn, 2003).

where cv^j is the compensating variation accruing to household j , $K(\cdot)$ is a Gaussian Kernel function, and h is the bandwidth that defines the local data to be used in the non-parametric regression.¹³ In (9), I have introduced sampling weights for household j , ω^j , that are used to correct biases (due to sample design or differential response, for instance) so that the sample is representative of the population. The average compensating variation at each level of income can be estimated by $m(x) = \hat{\phi}_1 + \hat{\phi}_2 x$.

The consumption effects of traded goods caused by Mercosur are plotted in Figure 1. The solid line plots the average welfare effect conditional on the level of per capita household expenditure, computed with the Fan regressions (9). The broken lines plot the confidence bands, computed with a bootstrap procedure. In the case of the consumption effects of traded goods, the source of randomness is the sampling variability of households (and therefore of budget shares) in the expenditure survey. To get the confidence bands, I take random samples of households from the ENGH survey and I recompute the Fan regressions. The confidence bands are built using the standard error (approximated with the interquartile range) of the estimated regression functions, after repeating the procedure two hundred times. In all the following figures, I measure household per capita expenditure in monthly dollars.

Figure 1 shows the total consumption effects caused by the joint change in the price of the four traded goods. The estimated compensating variation curve is upward sloping, indicating a pro-rich bias. For middle-income and rich households, the average consumption effect is found to be positive, and significantly different from zero. In contrast, I find significant welfare losses for the poorest households in Argentina. The gains extend to 0.75 percent of initial household expenditure; the losses amount to less than 0.5 percent of expenditure. There is simple intuition for these results. The Mercosur-induced increase in the price of Food & Beverages produces negative average compensating variations that are larger for the

¹³The non-parametric regression techniques used here are explained in detail in Appendix A3.

poorest households (due to Engel Law). For the poor, in fact, these losses dominate the gains generated by the declines in the prices of the remaining traded goods, the net effect being negative as a result. For middle-income and rich households, the opposite is true.

3.3 Consumption Effects on Non-Traded Goods

The consumption effects of non-traded goods are given by the terms $\sum_k s_k^j (\partial \ln p_k / \partial \ln p_i) (\partial \ln p_i / \partial \ln \tau_i) d \ln \tau_i$ in equation (7). Their estimation requires multiplying the household budget shares in the ENGH expenditure survey (s_k^j), the change in the prices of the traded goods (section 3.1) and the endogenous responses of the prices of non-traded goods ($\partial \ln p_k / \partial \ln p_i$), which need to be estimated.

3.3.1 Price Changes of Non-Traded Goods

In section 2, I showed that the prices of the non-traded goods k , (Housing, Transport & Communication, Health & Education and Leisure Goods), are a function of the exogenously given prices of the traded goods. That is

$$(10) \quad p_k = p_k(p_{FB}, p_C, p_{EQ}, p_{OG}).$$

where p_{FB} , p_C , p_{EQ} and p_{OG} are the prices of Food & Beverages, Clothing, House Equipment and Other Goods, respectively. Equation (10) can be estimated using time series data on monthly prices from 1992 to 1999.¹⁴ To introduce some dynamics in price adjustment, I define

$$(11) \quad p_k = p_{k1}(p_{FBt}, p_{Ct}, p_{EQt}, p_{OGt}) + p_{k2}(p_{FBt-1}, p_{Ct-1}, p_{EQt-1}, p_{OGt-1}).$$

¹⁴Appendix A1 describes the price data.

To estimate a flexible function form, I approximate the functions $p_{k1}(\cdot)$ and $p_{k2}(\cdot)$ with a Taylor expansion so that the model is

$$(12) \quad \begin{aligned} \log p_{kt} = & a_{00} + \sum_{i \in T} a_{0i} \log p_{it} + \frac{1}{2} \sum_{i \in T} \sum_{i' \in T} a_{ii'} \log p_{it} \log p_{i't} + \sum_{i \in T} b_{0i} \log p_{it-1} \\ & + \frac{1}{2} \sum_{i \in T} \sum_{i' \in T} b_{ii'} \log p_{it-1} \log p_{i't-1} + \mathbf{c}'_t \boldsymbol{\gamma}_c + \mu_t. \end{aligned}$$

In (12), I regress the monthly prices of each non-traded good p_k on the monthly prices (current and lagged) of the four traded goods (plus interactions at t and $t - 1$ separately); μ_t is an error term. To account for the role of technical progress, I include year dummies and time trends in the vector of controls \mathbf{c}_t .

To avoid the problem of spurious regression, I follow the usual practice of estimating the model in first differences.¹⁵ Prior to estimation, I introduce the restrictions imposed by theory: homogeneity of degree one in prices and symmetry ($a_{ii'} = a_{i'i}$; $b_{ii'} = b_{i'i}$) require that $\sum_{i \in T} a_{0i} + \sum_{i \in T} b_{0i} = 1$, $\sum_{i \in T} a_{ik} = 0$, $\sum_{i \in T} b_{ik} = 0$, $\sum_{i' \in T} a_{ii'} = 0$, and $\sum_{i' \in T} b_{ii'} = 0$. I consistently estimate the variance of the coefficients using the Newey-West correction for autocorrelation in the residuals, using twelve lags.

Table 2 reports the estimated elasticities for two regression models per price of non-traded good, one with year dummies and a trend and another with year dummies only. There are only minor differences in these two specifications. The price of Housing, Transport & Communication is positively related to the prices of Food & Beverages, Clothing and Other Goods, and negatively related to the price of House Equipment. The price of Health & Education reacts negatively to changes in the prices of Food & Beverages and Clothing, and positively to changes in the price of House Equipment and Other Goods. Finally, there is a negative relationship between the prices of Leisure Goods and Clothing, and a positive

¹⁵I cannot reject the hypothesis that the series involved in the regressions are I(1) according to the Dickey and Fuller (1979) tests (Phillips, 1986; 1987).

association with the prices of Food and Beverages, House Equipment and Other Goods.

Since I am estimating complex, general equilibrium relationships, there are no theoretical predictions. Correlations are not transitive and thus the elasticities in Table 2 can show any sign (Dixit and Norman, 1980). Nevertheless, I argue that the coefficients pass the following intuitive test. Suppose, as it is the case, that Food & Beverages and Clothing are intensive in unskilled labor relative to House Equipment. Similarly, assume that Health & Education is intensive in skilled labor relative to Housing, Transport & Communication.¹⁶ Then, increases in the relative prices of Food & Beverages and Clothing would generate an increase in the relative wage of unskilled labor and, hence, a decrease in the price of Health & Education and an increase in the price of Housing, Transport & Communication. Similarly, increases in the price of House Equipment would generate an increase in the relative wage of skilled workers and an increase in the price of Health & Education and a decrease in the price of Housing, Transport & Communication. These are, in principle, the essence of my findings in Table 2.

The last row in Table 2 shows the total change in the index price of each of the non-traded goods that can be attributed to Mercosur. For each category of non-traded goods k , I compute $\sum_i \hat{\varepsilon}_{pkpi} d \ln p_i$, using the predicted change in the prices of traded goods (column 4 of Table 1) and the estimated relationship between the prices of traded and non-traded goods (Table 2). I estimate that Mercosur effects a decrease in the price of all three categories of goods: that of Housing, Transport & Communication, by 0.9 percent, that of Health & Education, by 4.4 percent and that of Leisure Goods, by 4 percent (the latter two being significant).

¹⁶See Table 4 below for evidence on these factor intensities.

3.3.2 The Distributional Effects

I turn next to the estimation of the average distributional effects at different levels of income using the locally weighted non-parametric regressions. In Figure 2, the continuous solid line plots the average welfare effect and the broken lines, the confidence bands. In the case of the consumption effects on non-traded goods, there are two sources of randomness: the sampling variability of budget shares and the estimation of the responses of the prices of non-traded goods. To jointly account for these sources of variability, I use bootstrap methods as follows.

In each replication of the bootstrap loop, I resample from the ENGH household expenditure survey. This step accounts for the random variation in budget shares. To deal with the variance of the estimated elasticities, I resample from their empirical asymptotic distribution. The model in (12) delivers a vector of coefficients $\hat{\beta}_1$ and a covariance matrix $\hat{\Omega}_1$, such that $\hat{\beta}_1 \rightarrow^d N(\beta_1, \Omega_1)$, where β_1 is the true vector of parameters and Ω_1 is its asymptotic variance.¹⁷ In each loop, I obtain a new set of elasticities for non-traded goods that are assigned to the resampled ENGH households. The Fan regression is run on the bootstrapped sample to deliver a new estimate of the average welfare effects. After 200 replications, I compute the standard error of the estimated regression functions to build the confidence bands.

In Figure 2, the aggregate average compensating variations are positive, and significantly different from zero, at (almost) all income levels.¹⁸ The gains are also increasing in the logarithm of per capita expenditure, suggesting a pro-rich bias. The compensations range from over 0.3 percent to over 1 percent of initial household expenditure, being therefore similar in magnitude to those found for the case of traded goods. This result highlights the

¹⁷To do the resampling in practice, I define β_1^0 as random vector of draws from $N(\mathbf{0}, \mathbf{I})$ and \mathbf{R}_1 as the Cholesky decomposition of $\hat{\Omega}_1$. I compute $\mathbf{R}_1\beta_1^0 + \hat{\beta}_1 \sim N(\hat{\beta}_1, \hat{\Omega}_1)$.

¹⁸Notice that the confidence bands are wider than those found in Figure 1 because of the additional error introduced by the estimated non-traded price elasticities.

importance of non-traded goods in the aggregate consumption effects, a topic that has never been addressed before in the related literature.

The following explanation accounts for these pro-rich consumption effects of non-traded goods. The average compensating variation for Housing, Transport & Communication is not significantly different from zero at any income level because its Engel curve (for budget shares) is relatively flat and the Mercosur-induced decline in its price is statistically insignificant. In contrast, the budget-share Engel curves for Health & Education and Leisure Goods slope strongly upwards (from nearly 0 percent at the bottom of the income distribution to nearly 10 percent at the upper end) and the Mercosur-induced changes in prices are statistically significant (table 2). These facts produce upward sloping and significant distributional effects.

3.4 Labor Income Effects

This section assesses the labor income effects of Mercosur, which are given by the term $\varepsilon_{wmpi}^j (\partial \ln p_i / \partial \ln \tau_i) d \ln \tau_i$ in equation (7). The key component of these labor income impacts is the wage price-elasticities, which are estimated next.

3.4.1 Estimation of the Wage Elasticities

In the model of section 2, wages w^j are a function of the prices of the traded goods (\mathbf{p}_T^j) and other determinants \mathbf{z}^j .¹⁹ That is,

$$(13) \quad w^j = w^j(\mathbf{p}_T^j, \mathbf{z}^j).$$

¹⁹I do not study the impact of trade on unemployment. Therefore, the analysis of this paper provides results that are *conditional* on being employed. This omission does not suggest that the issue is not relevant. Rather, it is an assumption that allows me to make progress in the estimation of the general equilibrium effects of trade policies.

In what follows, I develop an econometric method to estimate equation (13) based on the use of *household survey data*. In Argentina, these data are available in the Permanent Household Survey (Encuesta Permanente de Hogares, EPH), a labor market survey with information on wages, employment, hours worked, and individual and household characteristics.²⁰

The main problem of using survey data on wages in a regression that includes product prices of traded goods as exogenous regressors is the lack of price variability at the household level. To deal with this problem, I propose to identify the wage price-elasticities by exploiting the time variability in prices and the time variability in surveys. In this sense, my method is related to techniques used in demand analysis, such as Deaton (1997), who exploits the regional variability in unit values to estimate systems of demand parameters, and Wolak (1996), who uses the time variation in CPS surveys and prices to recover those parameters. Similarly, Goldberg and Tracy (2003) estimates wage responses to changes in exchange rates by using the time variability of CPS surveys in the United States. The procedure proposed here extends these techniques to the estimation of the wage price-elasticities needed to assess trade policies.

In order to exploit the time variability of prices, I need repeated cross sections of household surveys. In Argentina, the Encuesta Permanente de Hogares (EPH) is gathered biannually in May and October. Thus, I can use a time series of sixteen surveys from 1992 to 1999 (two per year) to identify the elasticities.²¹

The responses of factor prices to changes in product prices vary by factor due to differences in relative factor intensities across sectors. I capture heterogeneous wage responses by considering that workers supply different types of labor services depending upon their educational attainment. It is assumed that there exist three different types of labor in

²⁰The data are described in detail in Appendix A2.

²¹I use the 1992-1999 data because the period before 1992 was characterized by inflation and macroeconomic imbalances and the period after 1999 by a severe recession and financial crisis.

the economy: unskilled labor (comprising workers with only primary education), semiskilled labor (including those with completed secondary school), and skilled labor (comprising those workers with a college degree). The estimating equation is²²

$$(14) \quad \log w^j = \sum_{i \in T} \log p_i^j (\mathbf{e}^{j'} \boldsymbol{\beta}_i) + \mathbf{e}^{j'} \mathbf{d} + \mathbf{z}^{j'} \boldsymbol{\gamma} + \varepsilon^j,$$

where $\mathbf{e}^{j'}$ stands for a vector representing the j^{th} row of the matrix of dummy variables for educational attainments (primary, secondary, college), and $\boldsymbol{\beta}_i$ is the vector of coefficients that captures the differential impact of price p_i on wages. In (14), the logarithm of the wage earned by individual j is regressed on a set of exogenous variables \mathbf{z}^j (age, age squared, gender and marital status), education dummies, and the log prices of the traded goods interacted with the education dummies. The regression also includes a time trend to control for the role of technical change. The last term ε^j represents a disturbance error.

The model can be consistently estimated with ordinary least squares since prices for traded goods are exogenously set in world markets.²³ Before estimation, I impose homogeneity of degree one in prices for the different labor demands. The estimation of the standard errors has to take into account the clustering effects that may arise when aggregate variables (like prices) are used to explain a microvariable (Kloek, 1981). Clustering effects are corrected by using a robust procedure that modifies the Huber-White formulas for heteroskedasticity. I assume that the clustering is specific to the time period, region and education in which the individual is observed.

Results are listed in Table 3, which includes twelve wage price-elasticities, three responses for each of the prices of the four traded goods. The price of Food & Beverages shows

²²This is a varying coefficient model, as in Raj and Ullah (1981), Hsiao (1986) and Swamy (1971).

²³To account for the endogeneity of the trade reform, I run separate regressions using domestic prices and international prices, which are exogenous, as regressors. The coefficients estimated with these two models were statistically similar, indicating that (14) delivers consistent wage price-elasticities.

a positive association with the wages of low-education workers (with elasticities of 2.06 for unskilled workers and 0.12 for semiskilled workers) and a negative association with the wages of high-education workers (with an elasticity of -1.42). These goods appear to be produced with relative low-skill intensive techniques of production.²⁴ The elasticities are statistically significant for unskilled and skilled workers.

Changes in the price of Clothing impact negatively and significantly on the wages of high-skilled individuals (with an elasticity of -5.05) and semiskilled workers (with an elasticity of -1.8). In contrast, the response of the wage of low-skilled workers is positive (1.19) and significant. These findings support the idea that textiles are intensive in low-skilled labor.

The price of House Equipment is positively and significantly associated with the wages of skilled workers (with an elasticity of 6.04) and semiskilled workers (with an elasticity of 1.92). For unskilled workers, I find a negative and significant association between wages and prices. These findings suggest that House Equipment & Maintenance Goods is a relatively skill intensive product category.

The price of Other Goods impacts positively and significantly on the wages of semiskilled and skilled workers, and negatively but insignificantly on the wages of unskilled workers. This suggests a relative skilled labor intensity in the production of these goods.²⁵

Interestingly, my results are consistent with the correlations that are implied by the multidimensional version of the Stolper-Samuelson theorem. According to my estimates, Food & Beverages and Clothing are revealed to be relatively low-skill intensive goods, while

²⁴Evidence that supports this statement is given in Table 4. See below.

²⁵I have extensively examined the robustness of the wage price-elasticities. The benchmark regression in Table 3 includes some basic controls such as age, age squared, marital status, gender and education dummies. The results for the controls are as I might expect; a male is likely to earn a higher wage than a female (39.7 percent higher, actually) and a married person earns a 13.9 percent higher wage than a single individual. Experience, as measured by a polynomial in age, and education also have the usual positive effect on wages. I have tried a variety of variable included to control for additional determinants of wages (technical progress and factor endowments): time trends, no controls, yearly dummy variables, and dummies identifying whether observations come from May or October. The general picture that emerges from all these regressions is very similar to the picture described in Table 3. There are, of course, some minor differences in magnitudes but none in the signs. These results suggest that the findings are robust.

House Equipment (appliances, chemicals) is revealed to be relatively skill-intensive goods. Looking at employment data on the EPH (Permanent Household Survey), Table 4 reports evidence that supports this conclusion. It shows that 76.4 percent of the workforce employed in Food and Beverages is of low skills, while 4.4 percent is of high skills; for Clothing, the shares are 73.6 percent and 2.2 percent respectively. In contrast, 67.9 percent of the workforce employed in House Equipment comprises unskilled labor and 5.4 percent, skilled labor. This evidence indicates higher proportions of skilled labor over unskilled labor in House Equipment than in Food & Beverages and Clothing.

Finally, there is evidence supporting a multidimensional version of the magnification effects, according to which factor prices would react more than proportionately to price changes. These magnification effects explain why some of the wage price-elasticities are relatively large. Leamer (1996), Baldwin and Cain (1997) and Grossman and Levinsohn (1989) have found similar magnitudes.

3.4.2 Distributional Effects

The non-parametric regression that describes the average distributional effects at different levels of income is displayed in Figure 3. The estimation of the confidence bands also requires bootstrap methods. As I explained before, I want to make the consumption effects comparable to the labor income effects. This means that the households used in the distributional analysis are those interviewed in the expenditure survey (ENGH). Thus, I resample from the ENGH survey. To deal with the variance of the estimated wage price-elasticities, I take samples of these elasticities from the asymptotic distribution $\widehat{\beta}_2 \rightarrow^d N(\beta_2, \Omega_2)$, where β_2 is the vector of parameters and Ω_2 is the variance. I assign these bootstrapped elasticities to the resampled ENGH households and I rerun the Fan regressions on these samples. After 200 loops, I estimate the interquantile range of the distributional

effects (at each income level) to build the confidence bands.

In what follows, I focus on the labor income effects of the household head.²⁶ Figure 3 plots the average total welfare effects caused by the reaction of wages to the changes in the four prices of traded goods (together with the confidence bands). I find that Mercosur has a positive effect on the average labor income of the poor and a negative effect on the average labor income of the rich: the distributional curve slopes downward and the average compensating variations are significantly different from zero, and significantly different across income levels. The magnitudes are important: while the gains, for middle-income to poor households, can reach 7 percent of their initial expenditure, the losses, for rich households, can reach 5 percent of initial expenditure.

There is a simple explanation for these results, which is based on the revealed factor intensity of the traded goods. Mercosur brings about changes in tariffs on traded goods that generate an increase in the relative price of unskilled intensive goods (mainly due to the increase in the price of Food & Beverages and the larger decline in the price of House Equipment). These induced price movements impact negatively on the wages of more skilled workers and positively on the wages of less educated individuals, producing a pro-poor bias.

3.5 The Total Distributional Effects of Mercosur

The fundamental result of my investigation is reported in Figure 4, which displays the total distributional impacts of Mercosur, the sum of consumption effects (traded and non-traded) and labor income effects, across the entire distribution of income. I find that Mercosur produces welfare gains for the average Argentine household almost across the entire income

²⁶For some households in the sample, there is more than one working member. To account for their role in the welfare effects, I need information on the share of income earned by each household member, which is not available in the ENGH Survey. I therefore focus here on the household head, the major source of reported income by Argentine households. A more complete analysis, including the responses of the labor income of the head and non-head members together with capital income can be found in Porto (2002). The results remain mainly unchanged.

distribution. Whereas the gains are statistically significant for poor and middle-income households, the welfare effects are negative, but not significant, at the upper tail of the income distribution. In addition, the gains are significantly higher for the average poor household in the country, indicating that Mercosur has had pro-poor distributional effects. In fact, the average compensating variation for the poor amounts to up to 6 percent of initial expenditure, whereas for middle-income households the gains amount to around 3 percent.

Given the trends of increasing poverty and inequality observed in Argentina during the 1990s, these findings have to be put into context. They indicate that *the changes in tariffs on consumption goods adopted in Mercosur* cause the relative price of unskilled intensive goods to increase. The Stolper-Samuelson correlations then dictate an increase in the wages of unskilled workers and a decline in the wages of skilled workers. Consumption effects are also important and favor rich families, but the magnitudes are not large enough to outweigh the pro-poor labor income effects (except for the very rich families).

Naturally, Mercosur has introduced other changes that I have not considered here. The impacts on non-labor income (profits, returns to capital and specific factors, rents) and unemployment, and the effects of the new structure of protection on intermediate inputs have not been examined. The Brazilian devaluation in 1999, which significantly hurt unskilled Argentine workers, has not been addressed either. Notice also that domestic prices can change due to changes in tariffs (the effects explored here) and exogenous changes in international prices (due to shocks and policies in the rest of the world). These are indeed important determinants of the increase in inequality and poverty observed in Argentina during the 1990s, but their role is not the topic of investigation of this paper.²⁷

The impacts estimated in the paper are relatively small, with gains of, at most, 6 percent

²⁷Notice that Argentina simultaneously adopted, during this period, a large number of economic reforms, including macroeconomic stabilization, financial reforms, privatization and economic deregulation. This paper has not addresses any of these topics.

of initial expenditure. It is certainly plausible that all the other reforms introduced in the country, together with some unmeasured effects of Mercosur, outweigh the progressive impacts of the changes in tariffs on consumption goods. My conclusion is that without the tariff changes originating in the regional trade agreement, poverty in Argentina would have been still higher.

4 Concluding Comments

In this paper, I have developed a methodology to estimate the distributional effects of trade policies (and other pricing policies in general) in developing countries. The methodology is characterized by a very intensive use of household survey data, an approach seldom followed in the assessment of trade policies in the related literature. In addition, the paper has looked at the general equilibrium effects of trade reforms using econometric techniques, rather than Computable General Equilibrium modeling. This has allowed for a more important role for measurement, as opposed to assumptions, in the estimation of the distributional impacts of trade policies. Importantly, the use of household survey data has allowed me to explore the distributional analysis of trade reforms across the entire income distribution.

My general equilibrium welfare analysis builds on the estimation of the household compensating variations that would leave each Argentine family indifferent to the situation before the policy change. I have measured consumption effects, as consumers pay different prices for traded and non-traded goods, and labor income effects, as factor prices react to trade policies. The methodology has been applied to the study of the distributional impacts of the adoption of a regional trade agreement like Mercosur. The procedure can, in principle, be also applied to the experiences of other developing countries.

I have found that Mercosur has had pro-poor distributional effects. The reason is that

Argentine trade policy protected the rich over the poor, prior to the reform, and granted some protection to the poor, after the reform. As a result, the relative pre-Mercosur tariff is higher on relatively skilled intensive goods. This means that tariff removals would tend to benefit the poor over the rich. These findings indicate that trade has not been responsible for the increase in poverty and income inequality observed in Argentina during the 1990s, at least in terms of the protection granted to final goods. The role of other factors and policies, such as deregulation, privatization, social security reforms, labor market reforms, monetary stabilization and industrial policy is yet to be explored.

Appendix A1. The Household Expenditure (ENGH) Survey

The National Household Expenditure Survey (ENGH) contains data on consumption at the household level. In Argentina, the consumption classification involves nine groups of goods, with many subcategories in each group. These nine groups are Food and Beverages, Clothing, Housing, House Equipment, Entertainment, Education, Health, Transport and Communication, Other Goods and Services. The National Institute of Statistics and Censuses constructs price indices for these consumption goods.

The ENGH Survey, conducted from March 1996 to March 1997, provides information on household monthly expenditure on over ninety goods. For simplicity, I designate each of the minor categories of goods as a traded or a non-traded good and include them in one of the seven consumption aggregates in the text. Traded goods include Food & Beverages (including Tobacco), Clothing (Textiles, Apparel and Footwear), House Equipment & Maintenance Goods (Chemicals, Plastic, Appliances), and Other Traded Goods. Nontraded goods include Housing, Transport & Communication, Health & Education, and Leisure Goods. I construct the price indexes for these seven aggregates as a geometric weighted average of the index prices of all subcategories, using budget shares in 1996 as weights.

The ENGH is a comprehensive survey that covers over 21,127 households (once outliers are eliminated) across urban areas in Argentina. Some basic features of the data are as follows. The mean household per capita expenditure in Argentina during 1996/1997 was 251.2 dollars per month, with a standard error of 246 dollars. Argentine households spent, on average, 47% of their budget on Food & Beverages. Housing, Transport & Communication accounted for 20.9% of the budget while Other Traded Goods accounted for another 8.5%. 7.8% of the average budget went to Clothing, 6.3% was spent on Health & Education and 5.7% was spent on Leisure Goods. Finally, 3.7% of total household expenditure was allocated to House Equipment & Maintenance Goods.

Appendix A2. The Permanent Household Survey

In this Appendix, I describe the data used to estimate the wage price-elasticities. My method identifies these elasticities using a time series of household surveys and prices. In Argentina, the main source of labor market information is the Permanent Household Survey, Encuesta Permanente the Hogares, or EPH. These surveys are collected in May and October in each year.

The key insight of the empirical methodology is the use of the wage data in the EPHs with the price data for consumption goods. Identification comes from the time variation in prices and surveys. Specifically, I use data from 1992 to 1999, sixteen surveys in total.

Table A.1 reports the average log wages, in each time period, for each of the three educational categories. In each time period, I observe that College graduates earned higher (average) wages than Secondary school graduates who, at the same time, earned higher wages than Primary school workers. The wages of primary and secondary school graduates grew until 1994, when they started to decline. The trend in the wages of skilled individuals is similar albeit with two distinct characteristics: the initial increase in wages at the beginning of the decades continued beyond 1994 and well into 1995, and the decrease after 1995 was somewhat attenuated.

Table A.1 also reports the time series of prices of the four traded goods, from 1992 to 1999. Biannual observations, corresponding to the months of May and October (when the EPHs are collected), are shown. The price of Food & Beverages increased substantially during 1992 and 1993 and stabilized afterwards, albeit with a somewhat upward trend (except in 1999). There was a substantial decline in the price of Clothing during the 1990s. In contrast, the price of House Equipment remained relatively stable through time, whereas the price of other goods showed an upward trend.

Appendix A3. Non-Parametric Regressions

Fan (1992, 1993) regressions approximate the regression function for the welfare effects $m(\cdot)$ with a Taylor expansion in a neighborhood of a previously selected point in the support of the log per capita household expenditure (x). This gives

$$(A1) \quad m(x^j) = \alpha + \beta(x^j - x) + \sum_{a=2}^d \gamma_a(x^j - x)^a,$$

where d stands for the order of the local polynomial used in the Taylor expansion and $\gamma_a = (1/a!)((\partial^a m(\cdot))/\partial x^a)$. An estimate of α , $\hat{\alpha}$, provides a good estimate for the conditional expectation for the welfare effects, $m(x)$, at *different* points along the per capita household expenditure spectrum, x . The local coefficients at these different levels of x can be estimated with a locally weighted least squares fit. That is, the estimators, at a pre-selected point x ,

would solve

$$(A2) \quad \min_{\alpha, \beta, \gamma_2, \dots, \gamma_d} \sum_j \left(cv^j - \alpha - \beta(x^j - x) - \sum_{a=2}^d \gamma_a (x^j - x)^a \right)^2 K \left(\frac{x^j - x}{h} \right),$$

where cv^j stands for the compensating variation accruing to household j .

The bandwidth h defines the local data used in the non-parametric regression; it determines the complexity of the model; that is, the trade-off between the local details, or bias, and the variance (Fan and Gijbels, 1996). When $h \rightarrow 0$, the model becomes increasingly complex since it just interpolates the data²⁸; when $h \rightarrow \infty$, the model becomes increasingly simple for it converges to the standard, global polynomial fit. In this sense, it is said that h controls the complexity of the model. The trade-off between bias and variance suggests that the optimal h should be chosen to minimize the asymptotic mean integrated square error of the regression. In most applications, however, visual inspection (subjectively choosing among various regression functions estimated for different values of h , will work well.

The function $K(\cdot)$ in (A2) represents the kernel function that attaches weights to different observations. The idea is that, for each datum along the income distribution, observations closer to x should receive greater weight than observations farther away. Notice that the combination of local regressions with kernel smoothing allows the non-parametric regression to be locally design adaptive. This means that the regression adapts to the design of the random sample and therefore its bias does not depend on the density (or the derivative of the density function) of the pre-selected point x . Since the different available kernels do not play a decisive role in the properties of the estimators, my applications in this study use a Gaussian Kernel.

The order d of the local polynomial must also be chosen. As with h , the order of the polynomial is chosen to control the trade-off between bias and variance in the estimation of the conditional expectation $m(\cdot)$. Intuitively, a higher order local polynomial achieves a lower bias since the fit has more degrees of freedom to adapt to the data (Fan, 1992; Ruppert and Wand, 1994). In general, a higher order d for the local polynomials reduces the bias but increases the variance of the estimates (since there are more parameters to estimate). Given that the complexity of the model is driven by the bandwidth h , the literature recommends restricting the local polynomial to be of relatively low order. Furthermore, a recent finding by Ruppert and Wand (1994) and Wand and Jones (1995) shows that the local polynomial used to fit the data should always be odd. This is because, starting from an even order, increasing the order of the local polynomial by one unit does not affect the variance. In the application in the text, a local linear regression is used.

²⁸This is true unless there are multiple observations at the same x , in which case the interpolation involves the average of these observations at x .

References

- Armington, P.S. (1969). "A Theory of Demand for Products Distinguished by Place of Production", *IMF Staff Papers* 16, pp. 159-176.
- Baldwin, R.E. and G.C. Cain (1997). "Shifts in US Relative Wages: The Role of Trade, Technology, and Factor Endowments", NBER WP No 5934.
- Benjamin, D. and A. Deaton (1993). "Household Welfare and the Pricing of Cocoa and Coffee in Côte d'Ivoire: Lessons From the Living Standards Surveys", *The World Bank Economic Review*, vol. 7, No 3, pp. 293-318.
- Budd, J.W. (1993). "Changing Food Prices and Rural Welfare: a Nonparametric Examination of the Côte d'Ivoire", *Economic Development and Cultural Change*, 41, pp. 587-603.
- Chang, W. and L.A. Winters (2002). "How Regional Blocs Affect Excluded Countries: The Price Effects of Mercosur", *American Economic Review*, September, pp. 889-904.
- Deaton, A. (1981). "Optimal Taxes and the Structure of Preferences", *Econometrica*, vol. 49, No 5.
- Deaton, A. (1987). "Econometric Issues for Tax Design in Developing Countries", in Newbery, D.M. and N. Stern (1987), *The Theory of Taxation for Developing Countries*, New York, Oxford University Press, pp. 92-113.
- Deaton, A. (1989a). "Rice Prices and Income Distribution in Thailand: a Non-Parametric Analysis", *Economic Journal*, 99, pp. 1-37.
- Deaton A. (1989b). "Household Survey Data and Pricing Policies in Developing Countries", *The World Bank Economic Review*, vol. 3, No 2, pp. 183-210.
- Deaton, A. (1997). *The Analysis of Household Surveys. A Microeconomic Approach to Development Policy*, John Hopkins University Press for the World Bank.

- Dickey, D.A. and W.A. Fuller (1979). "Distribution of the Estimators for Autoregressive Time Series with a Unit Root", *Journal of the American Statistical Association*, 74, pp. 427-431.
- Dixit, A. and V. Norman (1980). *Theory of International Trade. A Dual, General Equilibrium Approach*, Cambridge Economic Handbooks.
- Edmonds, E. and N. Pavcnik (2003). "Does Globalization Increase Child Labor? Evidence From Vietnam", NBER WP No 8760.
- Fan, J. (1992). "Design-adaptive nonparametric regression", *Journal of the American Statistical Association*, vol. 87, No 420, December, pp. 998-1004.
- Fan, J. (1993). "Local Linear Regression Smoothers and Their Minimax Efficiencies", *Annals of Statistics*, 21, pp. 196-216.
- Fan, J. and I. Gijbels (1996). *Local Polynomial Modelling and Its Application*. Chapman and Hall, London and New York.
- Friedman, J. and J. A. Levinsohn (2001). "The Distributional Impacts of Indonesia's Financial Crisis on Household Welfare: A 'Rapid Response' Methodology", forthcoming, *World Bank Economic Review*.
- Gasparini, L. (1999). "Desigualdad en la Distribución del Ingreso y Bienestar. Estimaciones Para Argentina", *Económica*, La Plata.
- Goldberg, L. and J. Tracy (2003). "Exchange Rates and Wages", Federal Reserve Bank of New York, mimeo.
- Grossman, G.M. and J.A. Levinsohn (1989). "Import Competition and the Stock Market Return to Capital", *American Economic Review*, 198, pp. 1065-1087.
- Helpman, E. (1984). "The Factor Content of Trade," *Economic Journal*, volume 94, Issue 373, March, pp. 84-94.
- Hicks, J. (1939). *Value and Capital*. Oxford: Clarendon Press.

- Hsiao, C. (1986). *Analysis of Panel Data*, Econometric Society Monographs No 11, Cambridge University Press.
- Kloek, T. (1981). "OLS Estimation in a Model Where a Microvariable is Explained by Aggregates and Contemporaneous Disturbances are Equicorrelated", *Econometrica*, vol. 49, No1, pp. 205-207.
- Leamer, E.E. (1996). "In Search of Stolper-Samuelson Effects on US Wages", NBER WP5427.
- Mas-Colell, A., M.D. Whinston and J.R. Green (1995). *Microeconomic Theory*. Oxford University Press, New York and Oxford.
- Pagan, A. and A. Ullah (1999). *Nonparametric Econometrics*, Cambridge University Press.
- Phillips, P. (1986). "Understanding Spurious Regressions in Econometrics", *Journal of Econometrics*, 33, pp. 311-340.
- Phillips, P. (1987). "Time Series Regressions with a Unit Root", *Econometrica*, 56, pp. 1021-1043.
- Raj, B. and A. Ullah (1981). *Econometrics. A Varying Coefficient Approach*, London: Croom Helm.
- Ruppert, D. and M.P. Wand (1994). "Multivariate Locally Weighted Least Squares Regression", *Annals of Statistics*, 22, pp. 1346-1370.
- Shoven, J.B. and J. Whalley (1992). *Applying General Equilibrium*, New York: Cambridge University Press.
- Swamy, P.A.V.B. (1971). *Statistical Inference in Random Coefficient Regression Models*. Berlin: Springer-Verlag.
- Wand, M.P. and M.C. Jones (1995). *Kernel Smoothing*, New York, Chapman and Hall.

Whalley, J. (1985). *Trade Liberalization Among Major World Trading Areas*, Cambridge, MIT Press.

Wolak, F.A. (1996). "The Welfare Impacts of Competitive Telecommunications Supply: A Household-Level Analysis," *Brookings Papers on Economic Activity Microeconomics*, vol. 1996, pp. 269-340.

Wooland, A. D. (1982). *International Trade and Resource Allocation*, Advanced Textbooks in Economics, vol. 19, North Holland, Amsterdam.

Figure 1. Consumption Effects of Traded Goods

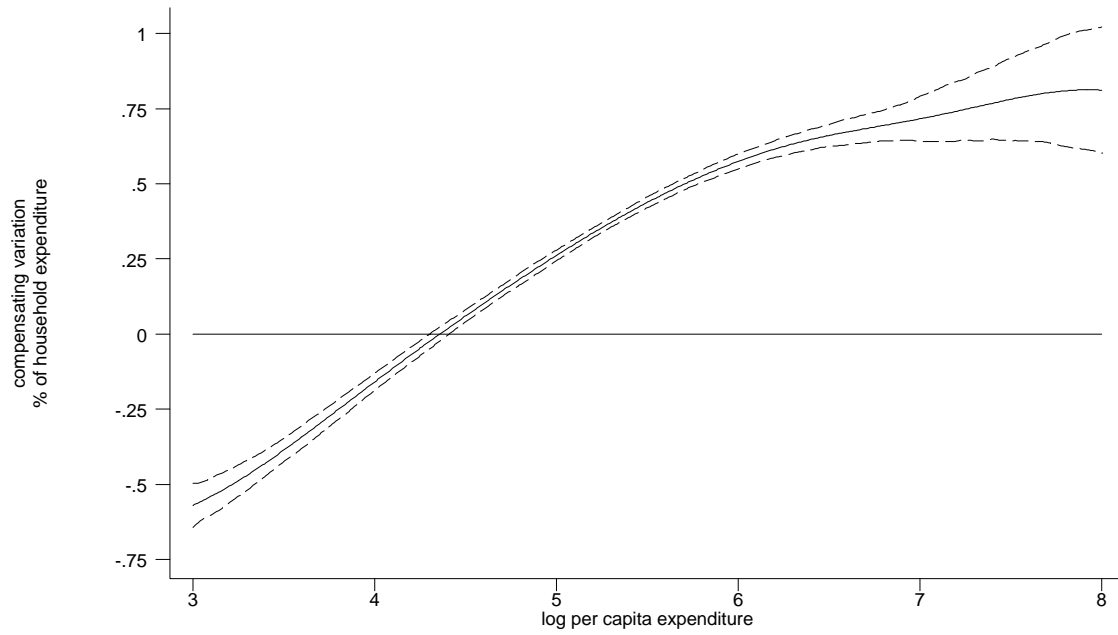


Figure 2. Consumption Effects of Non-Traded Goods

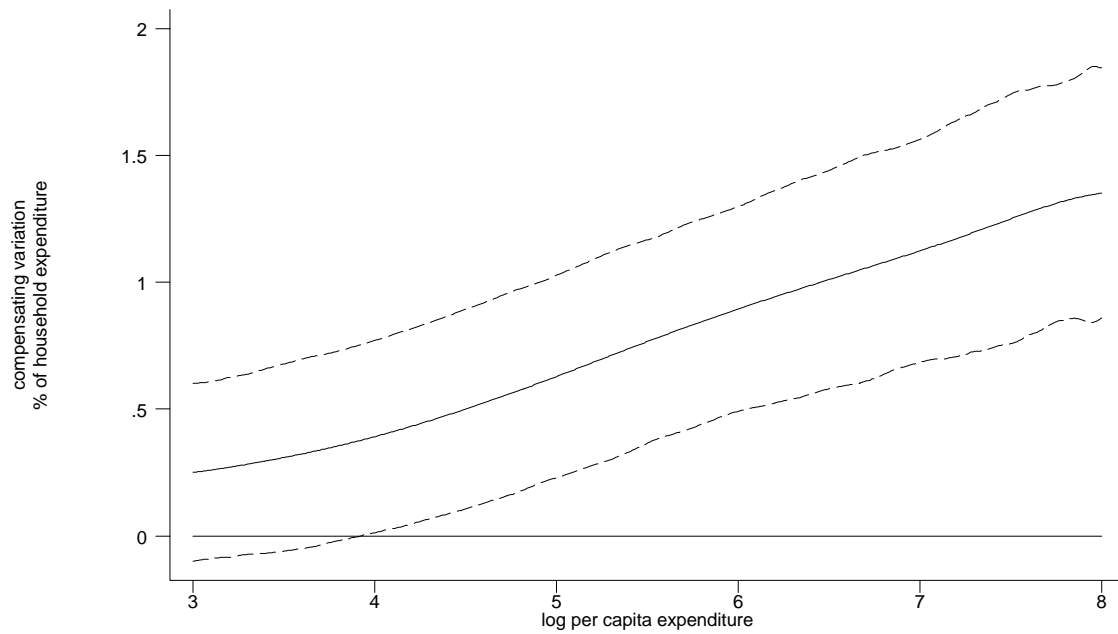


Figure 3. Labor Income Effects of Mercosur

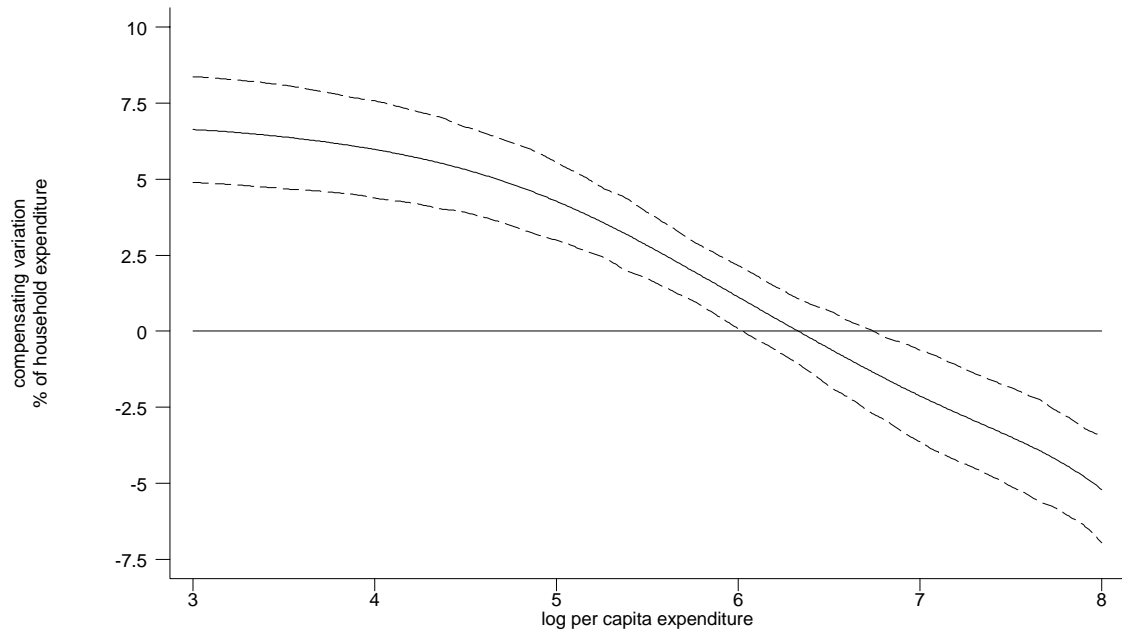


Figure 4. Total Welfare Effect

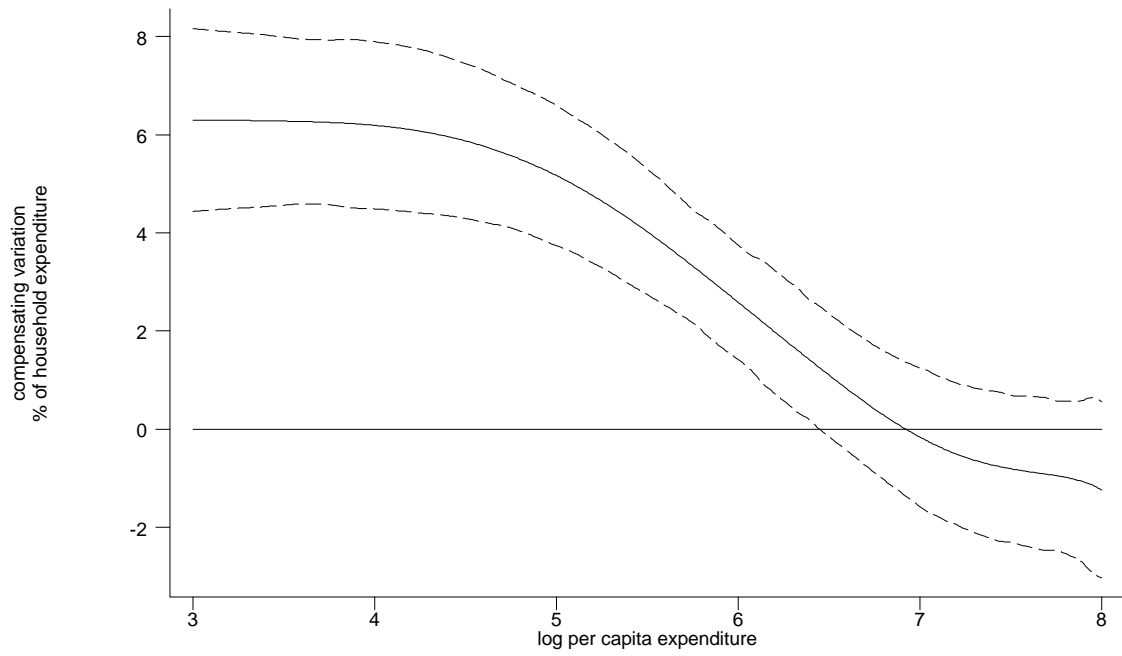


Table 1
Tariff Structure and Price Changes
Mercosur

	Tariff 1992 (1)	Intrazone Tariff 1996 (2)	Common External Tariff 1996 (3)	Price Change Mercosur (4)
Food & Beverages	6.9	0.05	13.7	1.4
Clothing	20.4	3.3	17.9	-6.4
House Equipment & Maintenance Goods	16.1	0.05	14.2	-5.4
Other Traded Goods	12.7	0.05	11.7	-3.2

Notes: computations based on tariffs rates taken from the Argentine legislation (Decreets 2657/91 and 998/95).

There is an average import tax characterizing the baseline situation in 1992 (column 1). Mercosur implemented an Intrazone Tariff (column 2) and a Common External Tariff on imports coming from the rest of the world (column 3).

The price changes in columns 4 are computed according to equation (8) in the text.

Table 2
The Responses of the Prices of Non-Traded Goods
Argentina

	Housing, Transport & Communications		Health & Education		Leisure Goods	
	(1)	(2)	(1)	(2)	(1)	(2)
Food & Beverages	0.469 <i>5.056</i>	0.484 <i>5.582</i>	-0.049 <i>-0.752</i>	-0.020 <i>-0.349</i>	0.064 <i>1.024</i>	0.129 <i>2.143</i>
Clothing	0.237 <i>1.192</i>	0.250 <i>1.088</i>	-0.225 <i>-2.021</i>	-0.201 <i>-1.809</i>	-0.270 <i>-3.934</i>	-0.216 <i>-2.501</i>
House Equipment	-0.413 <i>-1.522</i>	-0.427 <i>-1.476</i>	0.775 <i>3.722</i>	0.748 <i>3.486</i>	0.890 <i>2.865</i>	0.831 <i>2.647</i>
Other Goods	0.707 <i>2.535</i>	0.693 <i>2.408</i>	0.500 <i>2.006</i>	0.473 <i>1.988</i>	0.316 <i>0.956</i>	0.257 <i>0.785</i>
Wald Test	13.79	13.86	65.79	55.08	24.66	34.43
Price Change due to Mercosur (t-test)	-0.9 <i>-0.2</i>		-4.4 <i>-2.1</i>		-4.0 <i>-1.9</i>	

Notes: The prices of the three non-traded goods are regressed on the prices of the four traded goods using a time series of monthly prices from 1992 to 1999. A translog specification is used to estimate the elasticities shown in the Table. The regressions were run using first differenced price series to avoid spurious correlation. For each price of non-traded, column 1 includes year dummies and a trend and column 2 includes year dummies only. Coefficients in bold. t-statistics in italics.

Table 3
Wage Responses to Changes in Prices of Traded Goods
Educational Categories of Labor
Argentina

	Food & Beverages	Clothing	House Equipment	Other Goods
Primary Education (unskilled labor)	2.06 <i>7.22</i>	1.19 <i>2.08</i>	-2.02 <i>-2.99</i>	-0.22 <i>-0.98</i>
Secondary Education (semiskilled labor)	0.12 <i>0.44</i>	-1.80 <i>-3.26</i>	1.92 <i>2.91</i>	0.76 <i>3.43</i>
College Education (skilled labor)	-1.42 <i>-3.77</i>	-5.05 <i>-6.65</i>	6.04 <i>6.99</i>	1.42 <i>4.42</i>
R ² of the Regression	0.34			

Notes: for each of the three different educational attainments, the table shows the response of wages to changes in the prices of four traded goods. Using data from the Permanent Household Survey, the log of monthly wages is regressed on the log of prices interacted with educational dummies. The regression includes the following controls: age, age squared, gender and marital status, education dummies and time trends.

The cluster-corrected t-statistics are reported in italics below the coefficients.

Table 4
Factor Intensities by Skills
Argentina 1996

	Food & Beverages	Clothing	House Equipment
Primary Education (unskilled labor)	76.40	73.60	67.90
Secondary Education (semiskilled labor)	19.20	24.20	26.70
College Education (skilled labor)	4.40	2.20	5.40

Note: the numbers are the proportion of each type of labor (unskilled, semiskilled, skilled) on total labor employment in the different sectors.

Source: Permanent Household Survey (EPH).

Table A.1
Average Wages and Prices in Argentina: 1992 - 1999

	Wages			Prices				Sample Size
	Unskilled	Semiskilled	Skilled	Food and Beverages	Clothing	House Equipment	Other Goods	
May 1992	5.716	6.026	6.368	76.2	83.9	88.0	88.1	19695
Oct 1992	5.809	6.130	6.485	83.8	83.5	91.7	93.0	20830
May 1993	5.883	6.193	6.575	88.1	82.8	93.6	97.6	22934
Oct 1993	5.924	6.253	6.628	90.7	80.3	93.7	101.4	22777
May 1994	5.871	6.233	6.650	87.8	79.6	93.2	105.2	28636
Oct 1994	5.890	6.258	6.678	91.0	78.7	93.3	107.8	28645
May 1995	5.887	6.269	6.716	91.2	78.1	95.2	109.8	27377
Oct 1995	5.825	6.231	6.681	93.0	75.3	96.1	110.2	31575
May 1996	5.802	6.225	6.647	91.1	73.2	93.7	110.0	33459
Oct 1996	5.772	6.190	6.644	93.0	70.7	93.3	109.5	30304
May 1997	5.749	6.201	6.664	90.4	69.1	92.8	109.4	35134
Oct 1997	5.754	6.189	6.687	92.7	67.1	92.6	109.1	35051
May 1998	5.783	6.201	6.718	93.6	66.4	93.0	108.9	32840
Oct 1998	5.765	6.215	6.744	93.8	63.6	93.0	108.4	31027
May 1999	5.697	6.158	6.694	89.6	62.4	92.6	108.1	28070
Oct 1999	5.690	6.138	6.657	88.2	59.1	92.1	107.9	27718

Source: Wage data are from the Permanent Household Survey (EPH). Prices are reported by the National Institute of Statistic and Census (INDEC). The price data refer to the price index of the main categories of consumption goods in the National Household Expenditure Survey (ENGH) in Argentina.