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The Effects of Trade Expansion: Poverty and Inequality in Post-NAFTA Mexico

Rafael E. De Hoyos
The World Bank, Washington, DC, USA

Abstract

This paper illustrates how microeconometric techniques can be used to uncover the micro dynamics behind macro shocks. Our model's results are used to generate a scenario where the Mexican economy experienced the negative shock of the *peso crisis* in the absence of trade liberalization in the form of the North American Free Trade Agreement (NAFTA). The findings are that under such a scenario, the poverty headcount ratio would have increased more than 2 percentage points above the observed level of 1996. The relative increase in labor remuneration and participation in the expanding tradable sector helped cushion the negative income effects of the peso crisis.

Keywords: Inequality, poverty, microsimulation, NAFTA, Mexico

JEL Classification codes: C3, D1, F16, O24

The welfare effects of market-oriented reforms in developing countries remain a highly controversial topic (Winters, 2004). Although market liberalizing reforms include a wide range of economic policies, the majority of studies on the subject have concentrated on the welfare effects brought about by trade policy. This is not surprising, given the advantage of having a well-established theoretical framework linking trade policy with household welfare.[1] Moreover, most market-oriented reforms have trade liberalization at the core of their economic policy.

The most influential empirical papers linking trade and welfare have concentrated on the effect that trade liberalization had upon wage differentials (skilled vs. unskilled laborers) during the 1980s and early 1990s (Feenstra & Hanson, 1997; Harrison & Hanson, 1999; Polaski, 2004; Revenga, 1997; Wood, 1997). The main finding of those studies was that wage differentials were positively related with trade reforms, explained, possibly, by the worldwide skill-biased technological changes taking place during that time. Although wages are an important part of household welfare, the approach in the aforementioned papers fails to take other important income components into account. As shown in De Hoyos (2007), the proportion of inequality explained by wage differentials in the manufacturing sector is rather small. More importantly, the effects of a particular policy (e.g., reduction of trade tariffs) are difficult, if not impossible, to identify under the before-and-after approach used by the wage differentials literature.

The present study contributes to the ongoing trade-welfare debate by implementing a novel microeconometric technique to test NAFTA's influence on Mexican household welfare using survey data for the years 1994 to 2000. Throughout this period, Mexico undertook important market liberalizing reforms. The combination of the 1994-1995 peso crisis and the enactment of NAFTA transformed the economy into one in which the main source of growth was the export of manufacturing products. This sectoral *redistribution* favoring manufacturing exporting firms had a profound effect upon household incomes via the changes taking place in the labor market. Understanding the ex-post welfare effects of Mexico's turn towards a manufacturing-intensive economy is not only useful for future Mexican trade policy design, but it can also be the starting point for ex-ante trade policy evaluation in other Latin American countries.

We develop a model that is able to identify all household income components (variables, parameters, and unobservables).[2] In order to disentangle the influence that the policy under evaluation has upon a particular household, we estimate the underlying structural parameters determining household incomes. The model accounts for earnings and incomes from self-employment activities in Mexican urban areas. The agent's behavior is taken into account by modeling structural labor supply equations linking expected wages and participation in an explicit way. Following this approach, we can identify the household income components that changed significantly during the sectoral redistribution as well as their effect upon household and overall welfare. Moreover, the model allows us to undertake counterfactual experiments to determine *what would the distribution have looked like had the policy under evaluation been the only change taking place between time t and t'*. To answer this question, we microsimulate household incomes, imposing the counterfactual to be analyzed.

The paper contributes to the ongoing debate in two areas: (a) by creating an explicit link between expected wages and labor participation, we are able to quantify the second-order effects of changes in personal remuneration brought about by the policy under evaluation; and (b) separating markets between tradable (manufacturing) and nontradable sectors, we create hypothetical income densities capturing the *ceteris paribus* effects of changes taking place in the market for tradable produce.[3] We find that, controlling for everything else, between 1994 and 1998, returns to personal characteristics in the tradable sector increased, with highly skilled workers benefiting relatively more than their unskilled counterparts. However, by the year 2000, the positive shock upon the tradable sector had vanished, with returns to personal characteristics converging to the levels observed in the nontradable sector.

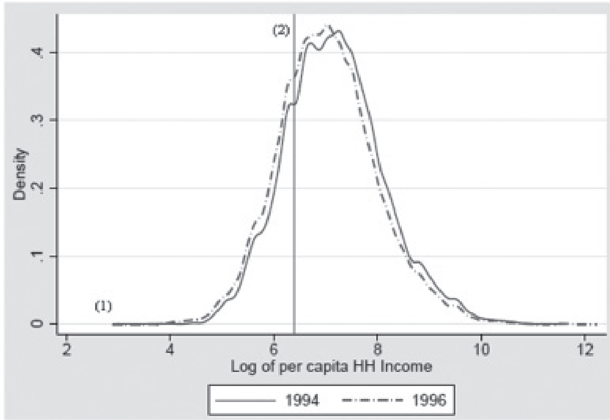
We use our model's results to simulate a scenario where the Mexican economy experienced the negative shock of the peso crisis in the absence of the trade expansion observed after 1994.[4] We find that under such a hypothetical scenario, the headcount poverty ratio would have increased more than 2 percentage points over and above the observed poverty rate in 1996. Inequality, on the other hand, would have been 4 Gini points higher under our counterfactual scenario, explaining the rather limited effect of trade expansion on poverty. We simulate the change in labor participation and occupation brought about by the sector redistribution (second-order effects). We find that in the case of men, the number of skilled laborers in the tradable sector increased, whereas in the case of women, the new entrants were relatively unskilled workers. This change in participation and occupation had an overall positive welfare effect, although it was not evenly distributed.

This paper is organized in the following way. In the next section, we develop the income-generating model used to parameterize household incomes and describe the microsimulation principles. In the following section, we show some macroeconomic trends for Mexico during the period 1994-2000, followed by the estimation results in the results section. The following section contains the microsimulation analysis used to evaluate the welfare impact of the estimated changes. Finally, the conclusions are in the last section.

Parameterizing the Density Function

A simple way of analyzing the overall changes in welfare occurring between two points in time is by plotting a density function of the log of real household incomes, as in Figure 1. Such a function will incorporate both the average income of the economy and its distribution. In turn, all income distribution functions satisfying some desired properties derive from a more general social welfare function (Jenkins, 1991). For example, a utilitarian social welfare function is the sum of all household welfare.

Assuming a decreasing marginal utility of income, we can show that social welfare can be summarized by average real income and its distribution (Sen, 1974). In Figure 1, we use the log of real monthly household per capita income for Mexico to plot a nonparametric kernel density function for the years 1994 and 1996.[5] The kernel distribution contains all the information needed to compute inequality indexes (determined by the shape of the density function) and poverty measures (a function of both the level and shape of the density). Therefore, a change in the poverty headcount ratio[6] will be the outcome of shifts in the density (growth effect), changes in its shape (distribution effect), and a residual (Datt & Ravallion, 1992).



Note. (1) Gaussian kernel density. (2) Poverty line set at 597 pesos.

Figure 1. Kernel income distributions.

Our aim is to find the underlying structural parameters determining real incomes in every household in our sample. Once we have done this, we can reproduce the shape and level of the density function using the estimated parameters, observable sociodemographic characteristics, and unobservable components. Formally, take the shape of the income density (distribution)[7] and define an inequality index, *I*, as a function of a vector of household incomes, *Y*, at time, *t*:

$$I_t = I(Y_t); Y_t = (Y_{1t},...,Y_{Ht}). \tag{1}$$

The parameters of index *I*(.) will depend on the social welfare function used; however, the underlying parameters (i.e., those determining Y_t) will depend on structural relationships determined by economic theory. Under certain assumptions, these structural parameters can be estimated empirically. Income of urban household *h*, Y_h, will be the sum of earnings, income derived from self-employment activities, and some exogenous income y^0_{ht}. Therefore, (we suppressed the time subscripts for simplicity):

$$Y_h = \sum_{i=1}^{m} (w'_{ih} L_{ih} + y_{ih} L^{se}_{ih}) + y^o_h, \tag{2}$$

where w_{ih} and y_{ih} are the hourly wage and self-employment income of member *i* in household *h*, respectively; L_{ih} and L^{se}_{ih} are labor supply functions in the earnings and self-employed sectors, respectively. The labor supply functions account for both the discrete (participation) and continuous (hours of work) dimensions of labor market decisions. Notice that Equation 2 is just an equality with no stochastic components in it.

The elements present in Equation 2 can be decomposed into different population segments (for example, wages for men vs. women and tradable vs. nontradable sector). The segmentation use should obey some prior country-specific labor market information and also the nature of the particular policy under evaluation. In our case, our objective is to perform a first approximation of the effects that trade liberalizing reforms had upon each of the elements defining Equation 2. Therefore, it seems natural to separate the economy into tradable and nontradable sectors. The former includes the manufacturing sector, whilst the latter is formed by all other formal sectors and the informal sector in urban areas.[8] To clarify, we define two earning sectors: (a) the tradable sector consisting of manufacturing earners and (b) a self-employed sector (basically an informal sector) consisting of other urban earners who are part of the nontradable sector. Furthermore, we assume separate labor market equilibria with full parameter heterogeneity between men and women.

Equation 2 accounts for all possible income sources; therefore, by parameterizing each of its elements, we can have a better understanding of the microeconomic processes behind changes in overall distribution. The remainder of this section contains a description of the methodology that we will follow to estimate each of the household income components included in Equation 2.

Wage Functions

The term $\sum_{i=1}^{m} w'_{ih} L_{ih}$ in Equation 2 measures total household earnings: w_{ih} are hourly wages and L_{ih} is a labor supply function, conditioned on member *i* being a wage earner: $L_{ih} > 0$. A separate wage function is estimated for each of the four formal labor market segments that have been defined.[9] Following standard human capital literature, the reduced form equation for wages is a function of personal characteristics in the following way:

$$w_{is} = X_{is}\beta_s + \varepsilon_{is};\ s = (tradable,\ nontradable); \tag{3}$$

where *X* is a vector of (1x*K*) dimension and β is a (*K*x1) vector $\forall s$, *K* being the different personal characteristics determining wages (including a constant) and *i* = 1,..., *N* number of workers in a particular sector. We allow the residual in Equation 3 to have an expected value different from zero: $E[\varepsilon_{is}] = G(z_i\gamma_s)$, where $G(z_i\gamma_s)$ is a generally defined function capturing an individual's *i* probability of choosing sector *s*. We will come back to this point in the subsection about labor supply.

Self-Employed Incomes

The next step is to model self-employment labor incomes, $y_{ih}L_{ih}^{se}$, where y_{ih} is also measured in hourly units. In less developed countries, the labor market for self-employed workers is very much related to the informal sector. Informal markets tend to be incomplete and, therefore, do not show desired equilibrium conditions (i.e., marginal productivity equals real wage). To estimate labor remuneration in this sector, we need separability properties and a dataset rich enough to identify the marginal productivity of all factors of production involved in the generation of y_h. Data containing information on the returns to each factor of production involved in self-employment activities is rarely available.

Suppose that the self-employed sector has a labor market close to a competitive one so that real wages can be taken as a shadow price of labor productivity in this sector. In such a scenario, returns to *X* can be said to be exclusive of all other factors of production. Furthermore, self-employment activities in the informal sector do not use capital or land in an intensive way. A formal sector that is semicompetitive and labor-intensive seems to be a reasonable assumption in the case of Mexico. The self-employment market in Mexico consists basically of independent laborers in the informal sector with little or no capital at all. Studies by Marcouiller, Ruiz, and Woodruff (1997) and Maloney (1999) showed that the informal sector in urban Mexico is as complete as the formal one, representing a desired destination rather than an inferior forced option. Therefore, it is possible to identify returns to personal characteristics using the same functional form as the one used for hourly wages:

$$y_i = X_i\beta_{se} + \upsilon_i\,. \tag{4}$$

As in Equation 3, X_i is a (1x*K*) vector and β_{se} is (*K*x1) a vector. The expected value of the residuals $E[\upsilon]$ is also equal to a function $G(z_i\gamma_{se})$ capturing participation and occupation selection. We now turn to the estimation of the labor supply components of Equation 2.

Labor Supply

Once hourly remuneration has been defined, the only elements missing from Equation 2 are the labor supply functions in the earnings and self-employment sectors L_{ih} and L_{ih}^{y}. Estimation of these elements involves modeling a discrete choice equation for participation and occupation, together with a continuous one for hours of work. However, the data for Mexico shows that, due to institutional rigidities, the distribution of hours worked is highly concentrated around one single point (i.e., 42 hours). Therefore, we focus on the discrete choice part of the labor supply function, i.e., whether to participate or not and in which sector agents decide to sell their labor endowment.[10]

Assume that participation and occupation decisions of the working-age population are the outcome of a utility maximizing process involving a set of paired comparisons between expected market wages and a subjective valuation of leisure.[11] Define the indirect utility that individual *i* gets from choosing option *j*:

$$V_{ij} = \delta \widehat{w}_{ij} + Z_i \gamma_j + \eta_{ij}, \quad (5)$$

where $\widehat{w}_{ij}$ are expected wages or self-employed income – following Equations 3 and 4, respectively; Z_i are household characteristics of individual *i*.

Expected log wages, $\widehat{w}_{ij}$, are determined by the population estimate of $X\widehat{\beta}_j$. We are implicitly assuming that workers form wage expectations based on their personal observable characteristics (X) and their respective market value (β) without accounting for the selectivity premium associated with their participation or occupation decision ($G(z_i\gamma_j)$). This is a necessary assumption to identify all the parameters of the model. An individual's *i* participation and occupation decisions will follow a utility maximizing criterion: $V_{ij} > \max_{m \neq j}\{V_{im}\}, \forall j$. If unobserved utility components, η_{ij}, follow a logistic cumulative distribution function (CDF), then the probability of observing agent *i* choosing occupation *s* is defined in the following way:

$$Pr(i = s) = \exp(\delta \widehat{w}_{ij} + Z_i \gamma_s) / \sum_{j=1}^{J} \exp(\delta \widehat{w}_{ij} + Z_i \gamma_j). \quad (6)$$

Equation 6 has two components; one of them is the expected wages which vary across outcomes and individuals and are treated as attributes of the occupations. On the other hand, Z_i varies across individuals, and it is constant across outcomes, i.e., they are characteristics attached to the individual. Vector Z_i for men includes household size, other household members' income, and its squared form. For women, Z_i includes the number of children in the household, a dummy variable taking the value of one when the head of the household is male and is actively participating in the labor market, other household members' income, and its squared form, and the variance of all other household members' income.

Agents can choose among the following choices: earner in the manufacturing (tradable) sector, earner in other formal sectors, self-employed, or inactive.[12] Equation 6 is a generalized multinomial logit model where agent *i* decides where to sell her labor endowment (or not to sell it at all) based on her expected wages in the different occupations $\widehat{w}_{ij}$ and a set of household characteristics Z_i. Defining participation and occupation decisions as a function of $\widehat{w}_{ij}$ allows us to measure the second-order effects of a policy-induced change in expected wages.

This last feature makes our model different from that developed by Bourguignon, Fournier, and Gurgand (2001). Additionally, as opposed to Bourguignon et al. (2001), our model is consistent between the way it estimates participation and occupation decisions and the way it controls for selectivity in the wage equations. Since the laborers observed in each sector are not the outcome of a random process (indeed, they are following utility maximizing criteria), we have to control for selectivity whilst estimating the wage equations' parameters (β). To be consistent between the participation/occupation estimation and the selectivity-adjusted wage functions, following Lee (1983), we correct for selectivity using the conditional probabilities of a multinomial logit.

Given the selectivity problem on the one hand and the explicit relationship between expected wages and participation/occupation decisions on the other, the model just outlined involves the simultaneous solution of Equations 3 to 6. In this paper, we estimate the model using a computationally simple two-step procedure as the one developed and discussed in De Hoyos (2011). Define z_i as a vector containing X_i and Z_i. We estimate selectivity-adjusted wages using the multinomial logit conditional probabilities $Pr(z_i\gamma_{j*}) = \exp(z_i\gamma_{j*}) / \sum_j \exp(z_i\gamma_j)$ in the following way:

$$w_{ij*} = X_i\beta_{j*} + \sigma_{j*}\rho_{j*}(\phi(J(z_i\gamma_{j*})) / Pr(z_i\gamma_{j*})) + \varepsilon_{ij*}, \quad (7)$$

where $\sigma_{j*}\rho_{j*}$ are the parameters capturing selectivity, $J(z_i\gamma_{j*})$ is a transformation of the multinomial logit index, $z_i\gamma_{j*}$, into a standard normal distribution, and ϕ is the standard normal density function. Therefore, $G(z_i\gamma_j)$, the generally defined selection adjustment component, is equal to $\sigma_{j*}\rho_{j*}(\phi(J(z_i\gamma_{j*})) / Pr(z_i\gamma_{j*}))$. The use of vector X_i in the first-stage multinomial logit proxies for expected selectivity-adjusted wages (Equation 7), and therefore, the second-step wage regressions give us the population unbiased estimators of β_j. These population unbiased estimators are used to compute the selectivity-adjusted expected wages in each sector which are used, in turn, to estimate the wage-participation elasticity (Equation 6).

Microsimulation Principles

So far we have shown how to parameterize household incomes in order to identify the elements determining the level and shape of the density function. The estimated parameters of Equations 3 to 7 can be used to perform microsimulation analysis to try to isolate the effect on welfare of the policy under evaluation.

Let us define Ω_t as a vector containing all the estimated parameters of Equations 3 to 7 for time *t*. Similarly, we define X_t^* as a vector whose elements are all the independent variables in the model at time *t*. Finally, a vector of unobservables, v_t, encloses the set of residuals of all the estimated equations in the model. Household incomes Y_t will be a function of these three elements (and the exogenous income y_h^0 which, for the moment, we exclude from the discussion); substituting the elements of Y_t into (1); any income inequality index *I* – and all other welfare measures – can be defined as follows:

$$I_t = I(\Omega_t, X_t^*, v_t). \tag{8}$$

Hence, a change in *I* can be decomposed into changes in the different elements of Equation 8. Once all the elements of Equation 8 are in place, we can create counterfactual experiments of nature asking *What would the distribution look like had the elements of, say,* Ω_t *been the only change occurring between t and t'?* For example, let us say that returns to education in the manufacturing sector, $\widehat{\beta}_{m,t}$, changed due to trade liberalization and we would like to know how this shift affected welfare-proxied by the level of household per capita income, its distribution, and the proportion of the population below a certain income level (i.e., the poverty headcount ratio). We can compute a hypothetical income inequality index[13] where the only element in Equation 8 that is changing is $\widehat{\beta}_{m,t}$:

$$I_t^t = I(\Omega_t^t, X_t^*, v_t),$$

where Ω_t^t contains the imputed value of $\widehat{\beta}_{m,t}$. I_t^t is a simulated, unobserved, hypothetical income inequality index where the income of each household in the database is allowed to change as a result of the change in $\widehat{\beta}_{m,t}$, and all other elements are kept fixed. We will call this a *first-order* effect on income. This type of counterfactual exercise is quite powerful, since it enables us to identify not only the qualitative but also the quantitative welfare effect of a change in each element defining the parameterized income in Equation 8: parameters, covariates, and residuals.[14]

Another advantage of our model is its ability to quantify the *second-order* income effects of changes in expected wages. Let us continue with our example of an exogenous increase in $\widehat{\beta}_{m,t}$. This shift will have a direct first-order effect upon household income via the increase in wages of household members working in the manufacturing sector. However, the increase in expected wages in the manufacturing sector brought about by the positive change in $\widehat{\beta}_{m,t}$ will also increase the likelihood of observing workers with particular personal and household characteristics selling their labor endowments in that sector. This second-order effect is captured by the structural labor participation/occupation function Equation 6.[15]

In order to make a clear distinction between the first- and second-order effects, let us define $\Omega_{w,t}$ as a vector containing the parameters of Equations 3 and 4 corrected for selectivity and define $\Omega_{L,t}$ as a vector whose elements are the parameters of the participation/occupation Equation 6. Therefore, $\Omega_t = (\Omega_{w,t}, \Omega_{L,t})$. Changes in $\Omega_{w,t}$ will have a second-order effect upon participation and/or occupation decisions; nevertheless, changes in $\Omega_{L,t}$ will change labor participation/occupation – and, hence, household income – without affecting market wages.[16]

We use the outlined microsimulation principles to answer the following question: What is the *ceteris paribus* welfare effect of the observed change in returns to personal characteristics taking place in the tradable sector $(\Omega_{w,t}^T)$ after the enactment of NAFTA? This simulation will capture the welfare effects – via the labor market – of trade-induced macroeconomic changes that took place between 1994 and 2000.[17]

As Winters (2000) pointed out, any macroeconomic exogenous shock (e.g., trade policy) will have an effect upon the relative prices of the economy. In our model, the single most important set of "prices" is the wages in the different segments of the labor market. Wages, in turn, are defined as an index of market prices of (returns to) personal characteristics $(\Omega_{w,t})$. Therefore, in the short run, changes in $\Omega_{w,t}$ reflect, mainly, the macro-induced shifts in labor demand. Following this argument, the difference between the observed household income density in a particular year and the simulated one capturing the changes in $\Omega_{w,t}$ is the welfare effects of macro-induced changes in labor demand. Similarly, the simulated density capturing the welfare effects of changes in prices in the tradable sector ($\Omega^T_{w,t}$) captures the *isolated* effect of shifts in labor demands in the tradable sector. In particular, the changes in prices in the tradable sector taking place in Mexico between 1994 and 2000 are attributable to the massive increase in manufacturing exports following NAFTA and the devaluation of the peso.[18] Our aim is to evaluate the effects on inequality and poverty as a result of this change.

The methodology outlined here shows a way of departing from a macro indicator (say income densities) and decomposing it into its micro components. Once this is done, via microeconometrics, we can go back and reconstruct the macro indicator, this time with the micro parameters being identified. This allows us to understand better the micro dynamics behind macro changes.

The Mexican Economy during the 1990s

In this section, we briefly outline the major changes that occurred in the Mexican economy during the second half of the 1990s, a period characterized by a huge devaluation of the Mexican peso in 1994 and the subsequent increase in exports within NAFTA.

During the early 1990s, core reforms in trade policy focused on the approval of a regional trade agreement with the United States of America and Canada where tariff reductions were scheduled. NAFTA was signed in late 1993 and enacted 1st January 1994. In the six years after the enactment, real exports grew an average rate of 17% with the manufacturing *maquiladora* sector setting the pace at a growing average annual rate of 21% during the period. Given the timing of the two events (i.e., the enactment of NAFTA and the increase in the exporting sector), it is tempting to conclude that the increase in exports was the result of trade policy. However, many other macroeconomic changes took place, especially during 1994, the year when NAFTA took effect.

Throughout 1994, Mexico experienced substantial political unrest that caused a massive outflow of portfolio investment. Capital outflow combined with a pegged exchange rate created a balance of payment crisis. The crisis prompted investors to abandon the Mexican market, and in December 1994, the peso suffered a devaluation of 83% (see Figure 2). During 1995, real gross domestic product (GDP) contracted 6%, and inflation soared to 43%. Throughout the period 1996-2000, the economy experienced an average rate of growth of 6% per year led, mainly, by exports of manufacturing products. The boost in the exporting sector can be explained partly by NAFTA and partly by the large devaluation of the Mexican peso during a period of expansion of the U.S. economy. As is clear from Figure 2, the performance of openness has been, not surprisingly, closely related with the exchange rate.

Note. Data source: World Bank and Banco de Mexico.

Figure 2. Total trade and exchange rate performance.

All these macroeconomic changes had a profound effect on welfare as is shown in Table 1 and discussed in Székely and Hilgert (1999).[19] Surprisingly, income distribution in 1996, lorenz-dominates the distribution for 1994 (i.e., for any inequality index); income was better distributed after the crisis.[20] However, the negative growth effect of the 1994-1995 crisis was so large that the poverty headcount ratio increased by more than 10 percentage points. During the recovery period 1996-2000, poverty indicators almost returned to the precrisis level, despite the increase in inequality observed during those years.

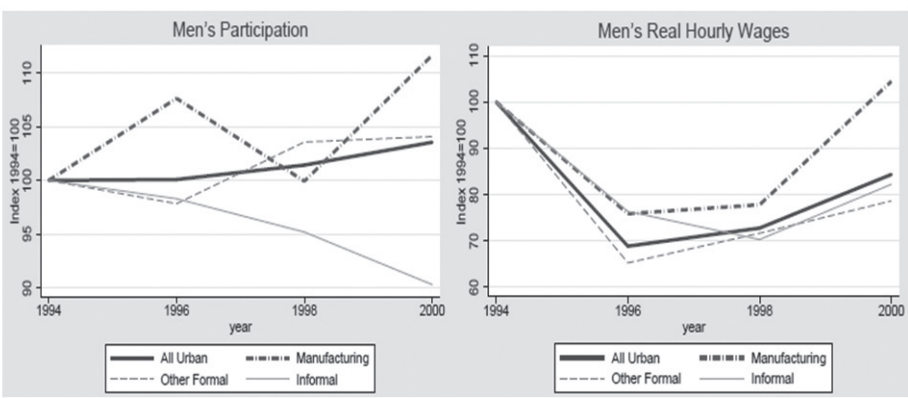
Table 1
Income Inequality and Poverty Indexes

	1994	1996	1998	2000
Inequality				
Gini	0.534	0.516	0.527	0.528
Theil	0.568	0.537	0.559	0.548
Entropy (ε = - 1)	0.751	0.697	0.796	0.782
Poverty Headcount				
Malnutrition	0.174	0.276	0.263	0.200
Capabilities	0.245	0.354	0.329	0.261
Assets	0.482	0.606	0.569	0.494

Note. Own estimations with data from ENIGH. Poverty lines defined by the Mexican Ministry of Social Development.

Labor Markets

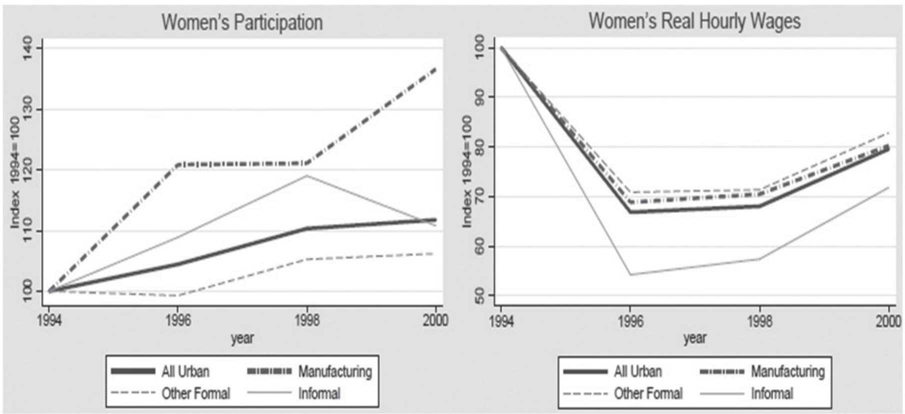
The huge increase in total trade seen in the post-NAFTA years had a strong effect upon the Mexican labor markets. To summarize its main effects, in Figures 3 and 4, we show the annual percentage change of real wages and participation in the different segments of the labor market. As predicted by the theory, the reaction of women's labor participation to exogenous changes in the economy was much stronger than for men (Deaton & Muellbauer, 1980). We can see from the upper part of Figures 3 and 4 that during the crisis years (1994-1996), male and female participation in the tradable (manufacturing) sector increased 7.5% and 20%, respectively. In the case of men, this increase contrasts with the observed reduction in participation in the nontradable sectors; for women, participation also increased in the informal but not in the formal nontradable sectors. Positive changes in participation rates in the tradable sectors are observed throughout the period with the exception of the years 1996-1998 when participation in the formal nontradable sectors recovered.



Note. Data source: ENIGH.

Figure 3. Men's participation and real hourly wages in urban areas.

In the lower part of Figures 3 and 4, we show the time trends of real 2002 hourly wages. The most important thing to notice is the different pace at which wages for men in the tradable sector recovered from the 1994-1995 negative income shock compared with the pace followed by wages in other nontradable sectors. In the case of women, hourly real wages in the tradable sector were performing as wages in the rest of the economy; however, real earnings (i.e., hourly wages multiplied by hours worked) recovered faster in the tradable sector than in the nontradable sector. The difference is explained by an increase in average weekly hours worked by women in the tradable sector. Average weekly hours worked by women in the tradable sector passed from 43.95 hours in 1994 to 45.33 hours in 1996 and 45.87 hours in 1998. This evidence suggests that while trade shocks affected real hourly wages for men, the effect upon the female labor market had more to do with changes in labor supply (participation as well as hours worked).



Note. Data source: ENIGH.

Figure 4. Women's participation and real hourly wages in urban areas.

Bearing all these macro changes in mind and being aware of the difficulty of quantifying their isolated effect, in this paper, we attempt to understand the linkages between openness – in the form of an increase in manufacturing trade volumes – and household incomes. In other words, we want to find out the isolated effect on welfare (inequality and poverty) of the documented sectoral redistribution favoring the tradable sector. Although it is important to distinguish between the effects of trade policy (NAFTA) from all other macroeconomic changes affecting the tradable sector performance (in particular the currency devaluation), the documented increase in openness and its possible impact upon income inequality and poverty represents a challenging enough task.[21] Moreover, so long as trade policy (e.g., a reduction in tariffs) is related to higher trade volumes, the qualitative relationship between trade policy and household welfare can be discerned from our results.

Estimation Results

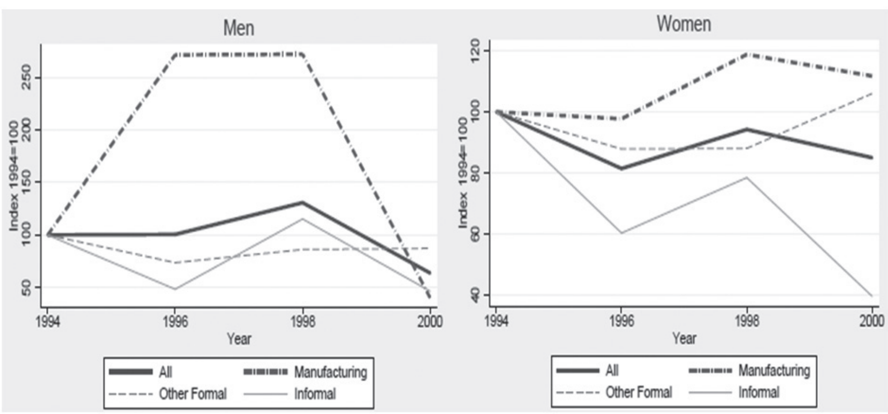
In this section, we present the estimation results of the model outlined in the section in which we discussed parameterizing the density function. The model is estimated using the National Survey of Households Income and Expenditure (Encuesta Nacional de Ingresos y Gastos de los Hogares – ENIGH) for years 1994, 1996, 1998, and 2000. ENIGH is a national survey of households representative of urban and rural areas. ENIGH includes all the usual information that can be found in household surveys: wages, transfers, and incomes from self-employment activities and all other income sources; hours worked, employment status, and industry of occupation; and personal characteristics like education, gender, and age. ENIGH follows a stratified, multistep survey designed with the household as the unit of analysis and basic geostatistical area (*área geoestadística básica*) as the primary sampling unit (PSU). All the statistical analysis undertaken in this paper takes into account ENIGH's survey design (stratification, clustering, and expansion factors).[22] Given the great volume of results, instead of describing them in a conventional way, we concentrate on the time patterns shown by our estimated wage and participation equation parameters, leaving the detailed results for an Appendix.[23]

In Figure 5, we show the annual change in the different sectors' expected log wages for men and women. Expected wages capture the selectivity-adjusted remuneration to personal characteristics in the different sectors $(X\widehat{\beta})$. Since $\widehat{w}_{ij}$ are free of selection bias, they are valid for all the population, i.e., $\widehat{w}_{ij}$ is the wage that individual *i* would earn if she decided to sell her labor endowment in sector *j* regardless of her present labor status and occupation. Notice that the discrepancy between average observed hourly log wages (Figures 3 and 4) and the average expected wages (Figure 5) is attributable to the selection component of the wage equation: $G(z_i\gamma_s)$. This component can be interpreted as the market *price* of the unobservable characteristics that make a particular worker more likely to be employed in a given sector.

In the case of the manufacturing (tradable) sector, there is a large positive difference between expected and observed wages; hence, the selection component had a negative effect on wages. This negative effect can be capturing short-term costs associated with sectoral labor reallocation. As the manufacturing sector was increasing and demanding more labor, entrepreneurs were forced to take a higher proportion of workers who were previously not employed in the manufacturing sector and who lacked certain sector-specific skills, making their "selection reward" negative.

In general, apart from the changes occurring in the informal sector, we can say that the market value of personal characteristics did not decrease (it even increased in the manufacturing sector) as much as real wages after the 1994-1995 negative shock. This evidence suggests that during a negative income shock, the better a worker is endowed with *X*, the lower the effect of the shock. In the case of post-NAFTA Mexico, this is particularly true for workers in the tradable (manufacturing) sector. The market value of male personal characteristics in the manufacturing sector was 2.5 times higher after the 1994-1995 crisis. This is a powerful result, especially if we consider that expected wages in the nontradable sectors experienced a negative shock.

The positive effect in the tradable sector is not as sharp in the female labor market; however, average $\widehat{w}_i$ still shows a performance well above the average one with expected wages in the manufacturing sector remaining constant between 1994 and 1996, whilst the change in other nontradable sectors was negative. Between 1996 and 1998, expected wages for men in the tradable sector did not change, whilst those for women showed an increase of 20%. Between 1998 and 2000, once the effect of the 1994-1995 peso devaluation was fading away, expected wages in other formal sectors rose, whereas expected wages in the tradable and informal sectors decreased, especially those of men in the tradable sector.



Note. Source: Own estimations with data from ENIGH.

Figure 5. Change in average expected log wages.

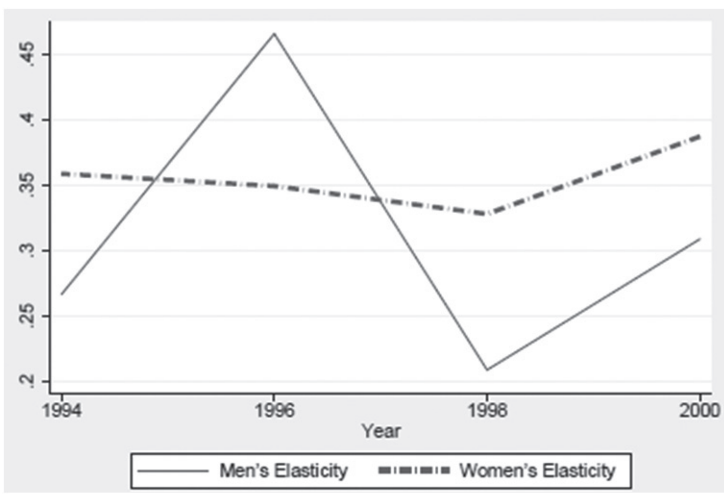
The results presented in Appendix A permit a closer inspection of the sources behind the opposing changes in average $\widehat{w}_{ij}$ between tradable and nontradable sectors. From Table A1 in Appendix A, we can see that the sharp increase in men's expected wages in the tradable sector is explained by a shift in the equation's intercept and, to a lesser extent, by an increase in the wage premium for higher education between 1994 and 1996.

On the other hand, the reduction in expected wages for men working in formal nontradable sectors is also explained by shifts in the intercepts. In both labor segments (male and female), the returns associated with formal years of schooling in the tradable sector decreased; however, the premium for higher education increased between 1994 and 1996. After 1996, changes in men's expected wages are explained by the combination of shifts in the intercept and increases in the wage premium for workers located in the north of Mexico. Because the parameters estimated in all wage equations are free of selection bias, we can interpret them as sector-specific treatment effects. Therefore, an overall positive shift in the tradable sector wage function combined with a negative change in the nontradable sector is evidence of a tradable sector-specific positive effect on wages.

Regarding women's expected wages, our results show that the main factor behind the post-1996 tradable sector $\widehat{w}_i$ outstanding performance is the increase in the wage premium associated with female workers located in the north of Mexico. Given that most of the post-NAFTA exporting manufacturing firms are located in the north of Mexico, a positive wage premium associated with workers in this region points towards a trade-induced positive effect upon real expected wages. This result, as well as those found in the male labor market, suggests a trade-specific positive effect on wages.

The changes in $\widehat{w}_{ij}$ documented in Figure 5 can have a significant effect upon labor participation (*L*) and occupation among the different sectors. Participation and occupation decisions will change as a result of changes in $\widehat{w}_{ij}$ as long as the estimated wage-participation elasticity is different from zero. In Appendix B, we show the estimation results for Equation 6.[24] The parameter capturing the wage-participation elasticity is positive and significantly different from zero in all years for both men and women. Following the marginal effect formulae for the generalized multinomial logit, the wage-participation elasticity can be easily computed based on the estimated wage-participation parameter. The results are shown in Figure 6.

We can see that apart from 1996 (a year when there was a large negative income shock), the percentage increases in female participation as a result of an increase in expected wages tended to be larger than for men. A 1% increase in expected wages would increase the female labor participation rate 0.35% on average, whereas the increase in participation for men as a result of the same change would be around 0.25% (excluding year 1996). These results help us explain the changes in labor supply documented in the previous section. Because wage-participation elasticity for women is larger than that for men, changes in the demand for female labor will have a larger impact upon employment (participation and hours worked) than on real hourly wages.[25]



Note. Source: Own estimations with data from ENIGH.

Figure 6. Wage-participation elasticity.

To summarize, we have shown that contrary to what one would expect, $\widehat{w}_i$ in the tradable sector did not decrease during the crisis years of 1994-1996 (the negative effect observed during this period is captured by the selection rewards). On the other hand, $\widehat{w}_i$ in nontradable sectors showed the expected 1994-1996 negative shock and the post-1996 recovery (for the formal nontradable sectors). The difference in $\widehat{w}_i$ between these two sectors, most likely, can be attributed to trade effects. The estimated wage-participation elasticity is positive and, apart from 1996, as predicted by theory, larger for women than for men.

Interpretation and Robustness

Based on our empirical results, we have made an argument supporting the hypothesis that most of the post-1994 sectoral redistribution was actually capturing the effects of trade. The positive and temporary treatment effect upon the tradable sector may be attributable to two main factors: trade policy (NAFTA) and the peso devaluation of 1995.[26] A sensible criticism of these results is that they are, to some extent, driven by changes in one single parameter in the wage equation, namely, the intercept. The value of this parameter could be obtained simply by capturing noise in the data or be driven by the econometric specification used. In this subsection, we will elaborate on these important points.

From Table A1 in Appendix A, we can see that, as a matter of fact, many of the intercepts of the wage equations in the manufacturing sector are not statistically different from zero. Therefore, our main result (increases in the tradable sector $\widehat{w_i}$) might be simply obtained by capturing noise rather than by a true change in labor market conditions. However, more important than their absolute value, what determines the presence of a trade-induced effect are the changes in the value of the parameters in the tradable sector relative to the changes in the nontradable sector. Between 1994 and 1996, the change in intercept in the formal nontradable sectors was negative (the difference in intercepts is statistically different from zero at the 99% level), while the change in the intercept for the manufacturing sector was positive and significant at the 90% level of confidence.[27] Hence, *ceteris paribus*, workers in the nontradable sector will experience an unconditional increase in the wage they expect to earn if they decide to move to the tradable sector regardless of their endowment *X*.

The other important variable driving our results is the change in the dummy variable measuring wage differentials between laborers in the tradable sectors located in the north of Mexico compared with nontradable sectors and other regions. The difference in these parameters, for both male and female workers between 1996 and 1998, is statistically different from zero. All these results support the hypothesis of a trade-induced positive shift in labor demand during a period of a large devaluation combined with a wider exporting window opened by NAFTA.

A temporary positive shock on returns to personal characteristics in the tradable sector is a result also found in a recent paper by Verhoogen (2007). Using firm-level data, the author developed and tested a model where south to north, the quality of products for export was higher than that of those produced for the domestic market. After an exchange rate shock, the demand for high-quality products (exports) increases; therefore, southern exporting firms increased their labor demand, particularly for skilled workers. These changes in relative demand caused an increase in the skilled-unskilled wage-ratio. After the exchange rate shock vanished, domestic market production recovered and demand for skills declined; hence, returns to personal characteristics and the wage ratio returned to its precrisis level. This pattern in returns to personal characteristics is supported by our results using household survey data.

A second point that might give rise to criticism about our results is how dependent they are on different methods to control for selectivity. To address this concern, using the conditional probabilities of participation estimated from the multinomial logit, we control for selectivity using two alternative methodologies described in Dubin and McFadden (1984) and Bourguignon, Fournier, and Gurgand (2007). Using either of these two selectivity-adjustment methods does not alter the general results discussed in this section, though the magnitude of the changes in parameters varies considerably across these methods.

Both approaches suggest that there is a manufacturing sector treatment effect shifting the wage equation parameters in favor of the tradable sector after the combination of NAFTA and the peso devaluation, particularly between years 1996 and 1998. However, the estimated parameters, especially the intercept, are very volatile under these two alternative methods. Finally, we carried out an additional experiment where selection bias was controlled à la Heckman (1979), using a probit model in the first-stage estimation measuring labor participation; the trade versus nontrade divergence in $\widehat{w_i}$ was still present, and this time, the estimated parameters showed much more stability.

A further concern about the interpretation of our results could lie in the effects captured by changes in returns to personal characteristics ($\widehat{\beta}$) in the tradable sector. Although this paper focuses on the welfare impact of increases in trade volumes, the results will not be very useful for trade *policy* implications if we are only capturing the effects of the devaluation. To make a case against this extreme interpretation, we compare the performance of trade volumes after the 1994-1995 peso crisis and NAFTA with an episode with a large currency crisis in the absence of a trade agreement. The years 1982 and 1983 represent a scenario with a large devaluation but without a trade agreement.

Between 1982 and 1983, the Mexican peso suffered a devaluation of 100%; however, at that time, the Mexican economy was a relatively closed one with average tariffs above 25% and with 90% of the tradable products subject to trade licensing. Openness (measured as the total trade flows as a percentage of GDP) increased only 2 percentage points between 1982 and 1983 (see Figure 2) as opposed to the 20% increase in openness observed after a devaluation of 80% in 1994. Therefore, we can say that the post-1994 boom in export volumes is explained by the devaluation of the Mexican peso in the presence of a trade agreement. In the remainder of the paper, we will interpret the changes in $\widehat{\beta}$ in the manufacturing sector as being the outcome of increasing trade volumes, which were triggered, mainly, by the combination of trade policy and the peso devaluation.

A final caveat must be stated. The rest of the paper tries to *quantify* the welfare effects of the changes in $\widehat{w}_{ij}$ just documented. As in any other econometric analysis, robustness in the quantitative aspect of the parameters is hardly achieved. Although we showed that the qualitative changes in $\widehat{w}_{ij}$ are robust to several selectivity-correction methods, we cannot say the same for the value of the parameters. Therefore, the results that we present in the subsequent section have to be taken as first approximations to the quantitative welfare effects of trade-induced changes in $\widehat{w}_{ij}$.[28]

Microsimulation Analysis

The changes in $\widehat{w}_{ij}$ documented so far (Figure 5) are not entirely explained by changes in parameters, Ω_w. They also capture changes in endowments and sociodemographic components, *X*, and their distribution. To be able to quantify the isolated effect on welfare of trade-induced changes in wage equation parameters, Ω_w^T, in this section, we will undertake a microsimulation analysis as described in the subsection on microsimulation principles.

To capture the micro dynamics of changes in manufacturing sector prices of personal characteristics, we undertake three separate simulations. Taking 1994 as our base year, we import the estimated tradable sector's wage equation parameters Ω_w^T for years 1996, 1998, and 2000. Each of these simulations can be interpreted as the *ceteris paribus* household welfare effect of $\Delta\Omega_w^T$ between 1994 and *t'*. Once Ω_w^T has been imported and a new set of simulated wages has been computed, we will follow the methodology outlined in the subsection on microsimulation principles to simulate a hypothetical household income for each household in our sample. This simulation is answering the question: *What would household incomes in 1994 have looked like had the returns to personal characteristics in the tradable sector been the same as those observed in t'?*[29]

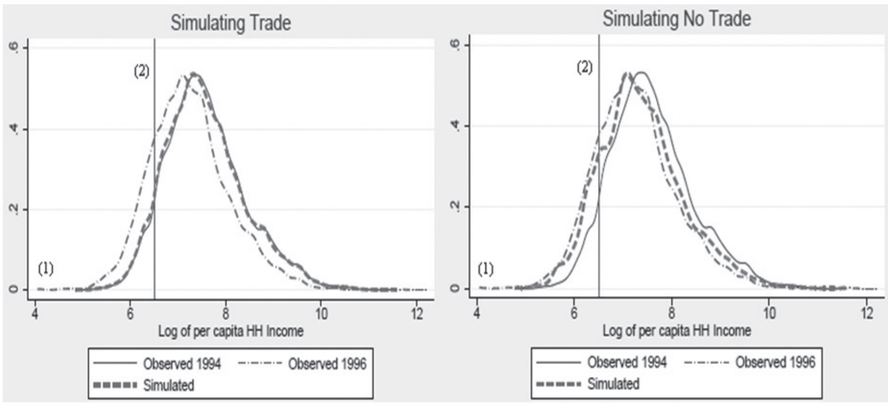
Notice that these first-order simulations do not include changes in the selectivity parameters $\sigma_{j*}\rho_{j*}$ in Equation 7. The selectivity parameters capture the remuneration to unobservable characteristics that make an individual more likely to work in a particular sector. Changes in these parameters capture the changes brought about by a reallocation of the population in the different labor segments.[30] Therefore, the changes in selectivity parameters are accounted for by the second-order welfare effects.

First-Order Welfare Effect

Given the great differences shown by expected wages, $\widehat{w}_{ij}$, between the pre- and post-crisis periods, we separate the discussion of our simulations into those covering the years 1994-1996 and those for 1996-2000. In Figure 7, we show the log of per capita household income densities of two different simulations using 1994 as the base year and importing the estimated parameters for 1996. In the simulation called "Simulating Trade" (top part of Figure 7), we import only the estimated parameters in the tradable sector for 1996, keeping nontradable parameters and all sectors' covariates and unobservables fixed. In a second simulation (lower part of Figure 7), only the estimated parameters for the nontradable sector are allowed to vary, leaving those in the tradable sector fixed. Simulating trade is creating a hypothetical scenario where we allow all the post-NAFTA and devaluation benefits of trade expansion via increases in returns to personal characteristics to happen without the costs impinged upon the nontradable sectors.

This counterfactual can be interpreted as a hypothetical economy enjoying the labor market benefits of the trade expansion without bearing the costs of the devaluation. Simulating no-trade, on the contrary, creates a hypothetical economy where the negative shock of the crisis on the returns to personal characteristics of workers in the nontradable sector occurs in the absence of the positive changes in the tradable sector's expected wages, i.e., $\widehat{\beta}$ of the nontradable sector is decreasing whilst Ω_w^T is kept constant. We can think of this second counterfactual as simulating what the income density would have been if the peso crisis had occurred in the absence of trade expansion.[31]

As we can see from the top part of Figure 7, everything else being equal, the changes in returns to personal characteristics in the tradable sector had a positive effect upon household per capita incomes regardless of their position in the distribution (positive growth effect). However, since the average worker in the manufacturing sector (the one who benefited from trade integration) tends to be located at the middle part of the density, the positive effect of trade was quite moderate in the lower income cohorts. This biased effect is reflected in the low pro-poor impact of changes in the tradable sector's wage parameters.



Note. (1) Gaussian kernel density. (2) Urban poverty line set at 673 pesos per month.

Figure 7. Simulated per capita effects on household income (1994-1996).

In Table 2, we show the observed and simulated urban poverty and inequality indexes for the years 1994 to 2000. There are no simulated values for 1994 because we always take this year as the base importing the parameters of subsequent years. We show the results of the two simulations, i.e., a scenario with and without tradable sector changes in Ω_w^T. Had the changes in returns to personal characteristics in the tradable sector been the only change in the economy between 1994 and 1996, poverty would have been reduced from an initial headcount ratio of 7.3% to a final count of 6.2%.

Conversely, if the only change allowed was the one experienced by the wage parameters in the nontradable sectors (simulating crisis without trade), then poverty would have increased from 7.3% in 1994 to 20.7% in 1996, i.e., a poverty headcount ratio 2 percentage points above the observed 1996 level. In other words, had trade not expanded the way it did after 1995, we would have observed an even larger increase in poverty after the peso crisis of 1994-1995. Regarding redistribution, changes in parameter – both in the tradable and nontradable sectors – had an adverse redistribution effect. However, the increase in inequality when simulating the effects of trade is much larger (an increase of 14 Gini points) than the one simulating the effects of no-trade (3 Gini points). This is explained by the reduction in the mass around the mean together with an increase of the upper tail in the density capturing the effects of trade (Figure 7).[32] Hence, the increase in inequality is not explained by reductions in the income of the poor but by increases in the income of upper cohorts.

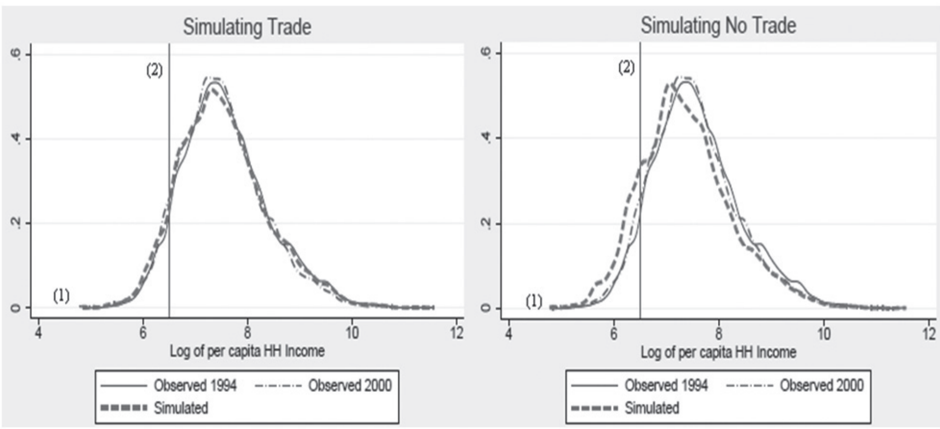
Table 2
Simulated Income Inequality and Poverty Indexes (Urban Areas)

	1994	1996	1998	2000
Observed				
Poverty	0.073	0.183	0.142	0.092
Gini	0.493	0.483	0.484	0.473
Simulating trade				
Poverty		0.062	0.060	0.100
Gini		0.635	0.621	0.501
Simulating no-trade				
Poverty		0.207	0.131	0.170
Gini		0.522	0.497	0.511

Note. Own estimations with data from ENIGH. The poverty index is the headcount ratio; using the urban poverty line defined by the Mexican Ministry of Social Development.

After 1996, the simulated poverty reduction attributable to trade expansion tended to decrease. By 2000, the simulated poverty effects of trade were similar to the observed value for that same year (see the right-hand column in Table 2). In Figure 8, we show the results for the same type of simulation as in Figure 7, this time using the wage parameters for 2000. Notice how the observed and simulating trade densities are quite similar, indicating that by 2000, even isolating the positive effect brought about by trade expansion, the welfare indicators did not show a favorable effect (see top part of Figure 8).

These results are driven by the temporary increase in the tradable sector's $\widehat{w_i}$ discussed in the previous section. Once $\widehat{w_i}$ in the tradable sector returned to its precrisis level (in 2000), the positive effects of trade tended to vanish (using the observables and unobservables of 1994). This is particularly the case for the male labor market. Nevertheless, the simulated welfare effects in the presence of trade are still preferable to those in its absence. Had trade integration not taken place (and hence the parameters of the wage equation in the tradable sector not changed), the poverty headcount ratio would have been 17% compared with an index of 10% simulated under the trade liberalization scenario (see Table 2).



Note. (1) Gaussian kernel density. (2) Urban poverty line set at 673 pesos per month.

Figure 8. Simulated effects on per capita household income (1994-2000).

In this subsection, we have shown the welfare impact of the asymmetric changes in $\widehat{w_{ij}}$, discussed in the previous section. As one would have expected, a *ceteris paribus* increase in the tradable sector's $\widehat{w_i}$ had a positive welfare effect, increasing average income and reducing poverty. Given the position of tradable sector workers in the urban income density, an increase in their remuneration had an adverse distributive effect. Our simulations also illustrated that had the peso crisis occurred in the absence of trade integration (NAFTA), the poverty headcount ratio would have been 2 percentage points above the 1996 observed level. However, the positive welfare effects occurring via changes in the tradable sector had vanished by year 2000. This last result suggests that although the negative welfare effects caused by the devaluation of the Mexican peso were ameliorated in the presence of trade reform, NAFTA, by itself, does not represent a long-term development policy.

Second-Order Welfare Effect

So far, we have discussed the changes in household income brought about by changes in returns to personal characteristics without allowing agents to reoptimize, given the new set of prices in the economy. In this subsection, we will analyze the second-order household income effects of changes in the parameters defining expected wages in the tradable sector Ω_w^T. As we saw in the previous section, the post-NAFTA and devaluation changes in $\widehat{w_{ij}}$, favored workers in the tradable (manufacturing) sector, particularly male workers during years 1996-1998. If labor markets are not perfectly segmented, we would expect labor movements out of the nontradable sector into the tradable sector as a consequence of the change in relative *expected* wages. Additionally, overall labor participation could have changed after the macro shock.

In this subsection, we simulate the *ceteris paribus* second-order effects of changes in wage equation parameters in the tradable sector. In other words, we take the hypothetical situation in which NAFTA is happening in the absence of the devaluation and let the laborers reoptimize given the new set of expected wages. The second-order effect of a scenario where the devaluation occurs without NAFTA is left out of the analysis. We believe that the mechanics and consequences for welfare of the second-order effects are captured well by a single simulation. This simplification of reality comes with a cost though.

As we have already mentioned, much of the labor participation and occupation effects of trade expansion are explained by the *combination* of NAFTA and the devaluation, i.e., an increase in the expected wages in the manufacturing sector *and* a reduction in expected wages in nonmanufacturing sectors. Hence, by focusing only on the changes in participation and occupation brought about by changes in the wage equation parameters of the tradable sector, without allowing the parameters in the nontradable sectors to change, we are indeed underestimating effects of trade expansion on participation and occupation.

To simulate the second-order effects of NAFTA in the absence of a devaluation, we conduct the following procedures: (a) use the wage-participation elasticity results presented in the previous section, (b) substitute the tradable sector's simulated expected wages ($\widehat{w_{ij}}$) into Equation 6, and, finally, (c) compute a new set of labor participation and occupation probabilities.

However, a major problem needs to be circumvented. An agent's utility maximizing decision (or the most probable outcome) could be bounded by demand-side restrictions. To take this restriction into account, we construct an *excess labor supply* by comparing the *simulated* participation/occupation with the *observed* outcomes for each sector in each point in time. For example, simulating the *ceteris paribus* change in participation/occupation as a result of the change in Ω_w^T between 1994 and 1996, we find out that, in the absence of demand-side restrictions, participation in the tradable sector would have passed from 12% to 26% of the total working age population. This simulated increase in tradable sector participation contrasts with the observed increase which passed from 12% in 1994 to 14% in 1996. If we allow all those workers willing to work in the tradable sector (26%) to do so, we will be ignoring labor demand restrictions and hence overestimating the positive second-order effects of trade.

Instead of using unrestricted labor movements, we constrain the simulated excess labor supply (i.e., whenever there is a net increase in participation) to be no larger than the observed increase. Following our example, when we simulate the second-order effects of changes in Ω_w^T between 1994 and 1996, workers are allowed to enter the tradable sector up to a point where 14% of the total population of working age is employed in that sector.

Therefore, for a change in labor status to occur, two conditions must be satisfied: (a) there must be a simulated increase in participation in the tradable sector as a consequence of a change in Ω_w^T, and (b) the actual participation in the tradable sector should have increased as well.[33] As we will show below, given these restrictions, the second-order effect of changes in Ω_w^T tends to be rather small and only positive for some years. Once the conditions for having a change in labor status have been satisfied, we need to implement a mechanism to choose who is moving in or out of the tradable sector. We select the workers that enter into, or exit from, the tradable sector based on their willingness (probability) to do so; therefore, workers with higher utility (probability) of entering the expanding sector will do so first.

In Tables 3 and 4, we show the transition matrix for men and women in 1996 and 2000, respectively, two years where changes in Ω_w^T had a net increase in simulated and observed participation in the tradable sector. The transition matrix compares the actual occupational structure with the simulated one. The right-hand column of Tables 3 and 4 shows the total number of workers observed in each sector in each point in time, whereas the last row shows the total number of workers after the simulation has taken place. Hence, the effects on participation and occupation of the changes in Ω_w^T are captured by the differences between the observed distribution of workers by sector and the simulated one, i.e., by comparing the right-hand column with the last row. The inner cells of the transition matrix contain the switching patterns between sectors.

Let us first concentrate on the second-order effects in the men's labor market (Table 3). The simulation shows that had the shifts in parameters defining expected wages in the tradable sector been the only change between 1994 and 1996, 313000 workers would have entered the manufacturing sector. This represents an increase of 13% in the number of male workers in the tradable sector. According to our simulations, the great majority of the new workers (218000 out of 313000) were previously employed in other nontradable sectors; 70000 of them left the informal sector in order to enter the tradable sector, and only 26000 of the entrants were previously inactive.

Table 3
Labor Transition Matrix for Men (1996)

	Simulated Occupation				
	Not Active	Manufacturer Earner	Other Earner	Self Employed	Total
Not Active	1 321	26	0	0	1 347
M. Earner	0	2 383	0	0	2 383
O. Earner	0	218	6 428	0	6 646
S-Employed	0	70	0	1 648	1 718
Total	1 321	2 697	6 428	1 648	12 094

Note. The figures represent total number of workers in each occupation (in thousands).

Table 4
Labor Transition Matrix for Women (2000)

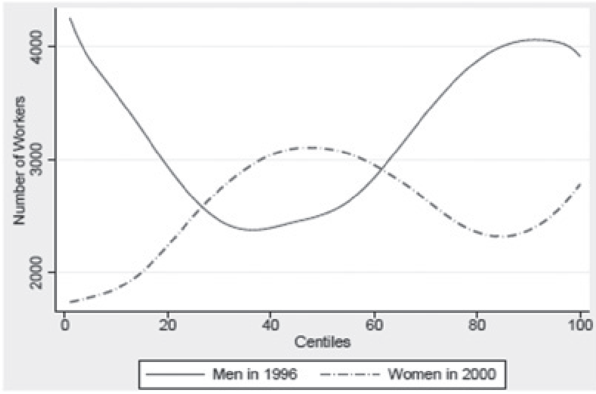
	Simulated Occupation				
	Not Active	Manufacturer Earner	Other Earner	Self Employed	Total
Not Active	8 281	171	0	0	8 452
M. Earner	0	927	0	0	927
O. Earner	0	64	3 884	0	3 948
S-Employed	0	23	0	1 128	1 151
Total	8 281	1 185	3 884	1 128	14 478

Note. The figures represent total number of workers in each occupation (in thousands).

The increase in female labor participation as a result of NAFTA was much more substantial than in the case of men; with a participation rate of 41.6% before the trade expansion and 42.8% after the trade shock. The changes in returns to personal characteristics (expected wages) of women increased the number of new entrants (participation) more than the number of switchers. According to our simulation, more than half of the total 258000 women entering the manufacturing sector were previously not active (most were probably housewives). The difference in participation effects between men and women is explained by the difference in wage-participation elasticity, where the female labor supply shows much more responsiveness to increases in expected wages than the male (see Figure 6).

Given the microeconomic nature of our methodology, we can have a closer look at the distributive impact brought about by the second-order effect. Useful information about the inequality impact caused by a sectoral redistribution can be obtained by knowing the socioeconomic characteristics of the agents working in each sector. For instance, in 1994, the majority of the workers in the tradable sector belonged to middle class households (between the 50^{th} and 60^{th} percentile). If most of the workers entering the expanding tradable sector belong to relatively better-off households, we would expect a deterioration in distribution as a consequence of labor reallocation. In Figure 9, we show nonparametric regression lines with the number of workers entering the tradable sector in each percentile according to our second-order effect simulation.[34]

The simulated change in expected wages in the tradable sector increased participation in all income cohorts (the simulation line is positive for all percentile groups) both in the case of men and women. Nevertheless, the distribution of entries by household income is very different for men and women. In the case of men, we can see a bimodal distribution with most of the new entrants belonging to either the poorest or the richest households. This distribution is precisely the opposite shown by new female entrants who basically belonged to middle class households. Therefore, the distributional effect of changes in labor participation and occupation decision as a consequence of changes in expected wages was different for men and women. For men, labor reallocation resulted in an increase in income inequality, whereas female labor reallocation (basically the increase in participation) had a favorable distributive effect.[35]



Note. Line fitted using local regressions. Data source: ENIGH.

Figure 9. Simulated entries in the tradable sector by percentiles.

In this subsection, we have shown how the micro model outlined in the section on parameterizing the density function can be used to uncover second-order household income effects of changes in prices – in our case, returns to personal characteristics. We showed that although demand-constraint second-order effects tend to be small, the effect is always positive. Our findings suggest that there are important distributional effects emanating from the changes in participation and occupation decisions. In particular, labor participation changes occurring as a consequence of changes in returns to personal characteristics in the tradable sector had an adverse distributional effect in the case of men, increasing the relative participation of workers belonging to the poorest and richest households. In the case of women, the effect was exactly the opposite, with the new entrants into the tradable sector coming from middle income households.

Conclusions

This paper is motivated by the growing concern about the microeconomic effects of market-oriented reforms. Given that policy decisions are generally taken at the macro level, we showed how the use of microeconometrics can help us discern the welfare impact of macro policies. We depart from the changes in income densities which summarize all welfare changes taking place between two points in time. With the use of economic theory and econometric techniques, we decompose the changes in income densities (and, therefore, any welfare index) into changes in parameters, covariates, and unobservables. Our model contributes to the existing literature by creating an explicit relationship between expected wages and labor participation. This last feature allows us to quantify the second-order welfare effects of policy-driven changes in expected wages.

Our methodology is used to explore the welfare impact of the expansion of Mexican exports after the peso devaluation and the enactment of NAFTA. We found robust positive changes in the returns to personal characteristics in the tradable sector between 1994 and 1998. Although expected wages in the tradable sector increased for all workers regardless of their personal characteristics (positive shift in the intercept), those workers with higher skills and those who were located in the north of Mexico experienced an even larger positive effect. The increase in higher education premium had, as a consequence, a deterioration in household income distribution. Our results are robust to several forms of selectivity-correction methods, and they are supported by the findings of recent post-NAFTA firm-level studies.

Using microsimulation techniques, we quantify the *ceteris paribus* welfare effects of increases in trade volumes. In a hypothetical economy where devaluation takes place in the absence of the trade integration brought about by NAFTA (i.e., all the costs of the devaluation upon the nontradable sector are occurring while the benefits of an expanding tradable sector are not), poverty would have increased 2 percentage points above the observed 1996 level. Nevertheless, the isolated effect of a change in the tradable sector's parameters had an adverse distributive effect of increasing the Gini by 13 points. By year 2000, the positive tradable sector treatment effect had vanished, with returns to personal characteristics converging to the levels observed in the nontradable sectors.

The paper contributes to the growing microsimulation literature by quantifying, in an explicit way, the second-order income effects brought about by changes in expected wages. We estimate a wage-participation elasticity which is then used to quantify the change in participation and occupation caused by changes in expected wages in the different sectors. After the shock of the peso devaluation and NAFTA, male workers entering the tradable sector belonged to the poorest and richest households. In the case of the female labor market, the tradable sector absorbed women who belonged to middle income households. Therefore, changes in participation and occupation decisions brought about by NAFTA had an adverse distributive effect in the case of men and a favorable effect in the case of women.

Although NAFTA cushioned the adverse effects of the peso devaluation, proving to be a useful economic policy tool at that time, as soon as the peso recovered its value (between 1998 and 2000), the growing pace of Mexican manufacturing exports and the wage premium associated with it decreased. Therefore, the isolated positive welfare effects caused by trade expansion disappeared between 1998 and 2000. Our findings suggest that NAFTA, by itself, given the present economic conditions in Mexico, does not represent a long-term development policy. The episode 1994-1998 showed the great benefits of having a trade agreement combined with a highly competitive industrial sector. At that time, competitiveness came exogenously in the form of a currency crisis; however, long-term sustainable competitiveness should come from an increase in productivity which is exactly what Mexican industrial policy should aim for.

Endnotes

1 For discussion on the subject, see Dixit and Norman (1985) and, more recently, McCulloch, Winters, and Cirera (2001).

2 Our model is an extension of the one developed by Bourguignon et al. (2001). Legovini, Bouillón, and Lustig (2004) used a model similar to that of Bourguignon et al. (2001) to quantify the distributional effect of changes in education endowments in Mexico.

3 Although the tradable sector includes agricultural produce and some services, given the focus and scope of this paper, no distinction is made between the manufacturing sector and tradable sector.

4 In the present paper, trade is measured by the increase in exports observed during the years following the enactment of the agreement.

5 We are implicitly assuming no intrahousehold economies of scale and no differences between children's and adults' cost.

6 As defined by the standard Foster-Greer-Thorbecke (FGT) indexes often found in the literature.

7 It will become apparent that finding out the household income parameters will allow us to determine also the level of the density which is simply the average household income.

8 Between 1994 and 2000, manufacturing exports accounted for 95% of total exports.

9 Manufacturer earner and other earner for men and women.

10 As stated by Heckman (1993), "Participation (or employment) decisions generally manifest greater responsiveness to wage and income variation than do hours-of-work equations for workers."

11 The utility interpretation of Equation 5 is not necessary for it to be valid. We could define V_{ij} as a latent function defining the probability of participation without any structural interpretation. Moreover, the term *utility* should be taken with caution here because, most likely, demand-side restrictions are present making the observed labor outcome the result of factors beyond an individual's utility maximizing process.

12 Notice that the agents do not have the choice of having two occupations; we impose this restriction to simplify the analysis. In Mexico, the primary source of income of all household members accounts for as much as 90% of total household income.

13 Any inequality index can be computed: the Gini coefficient, the Theil index, the Generalized Entropy, Atkinson's, etc.

14 The inequality and poverty decompositions undertaken via microsimulation analysis suffer from path dependency; i.e., the contribution attributable to the elements defining Equation 8 might vary with the order in which the remaining elements are changed. Nonetheless, we are not aiming for inequality and poverty decompositions; we are interested in the *ceteris paribus* type of experiment that is achievable via microsimulation analysis.

15 There are obvious demand-side constraints which are not taken into account by Equation 6. We will address this important issue when we measure the second-order income effects of changes in $\hat{\beta}$ in the section after the results section.

16 In a general equilibrium setting, changes in labor supply function parameters should have an effect upon market wages; however, we consider that the model outlined here is complex enough to capture first and second-order effects of parametric changes in household income sources.

17 In a recent literature review revising the trade and poverty linkages, Hertel and Reimer (2004) found that the strongest effect of trade upon poverty works via the labor market and to a lesser extend through the effects of consumption.

18 The expansion of the U.S. economy during the 1990s also helps explain the increase in trade volumes after 1994. In the results section, we will discuss to what extent we can attribute the post-1994 export expansion to Mexican trade policy (NAFTA).

19 For a detailed description of the Mexican household data used in this paper, ENIGH, and the way in which inequality and poverty indexes were constructed, see De Hoyos (2005).

20 Lopez-Acevedo and Salinas (1999) documented the possible causes behind the reduction in inequality during the 1995 economic crisis.

21 In recent papers, Porto (2003) and Nicita (2004) tried to isolate the welfare effect of trade liberalizing reforms using household data combined with price changes in certain commodities.

22 See De Hoyos (2005) for details.

23 The results of Equations 3 to 6 are shown in Appendix A; however, because of space limitations, we do not show the estimates of the multinomial logit first-stage estimations; these are available from the author upon request.

24 A detailed discussion on the participation/occupation equation results for women can be found in De Hoyos (2011).

25 Our results support the theoretical prediction developed by Deaton and Muellbauer (1980). Given that participation rates among men in developing countries are close to 100% and almost half in the case of women, increases in expected wages have a small effect on labor participation for men and relatively large effect in the case of women.

26 As we already mentioned, the expansion of the U.S. economy could have had an effect upon trade volumes during the second half of the 1990s. However, the pace followed by Mexican exports is less related to this factor than to the timing of trade policy and the currency devaluation. For example, exports to the United States of America represented 88% of total Mexican exports in 1998, a year of strong U.S. expansion. This proportion did not change during years 2001 and 2002 when the U.S. economy was in recession. Therefore, trade expansion can be seen as the combined result of trade policy (NAFTA) and the peso devaluation.

27 Given the negative change in the nontradable wage equation intercept, even a constant intercept in the tradable sector wage equation will be enough to conclude that the performance of $\widehat{w}_i$ in the tradable sector was relatively better than that in the nontradable sector.

28 As will become apparent in the following section, the microsimulation analysis is very sensitive to changes in the point estimates (values) of the parameters. The microsimulation analysis captures the welfare effects of changes in the value of the parameters (regardless of their statistical significance) although we know that the probability of $\widehat{\beta} = \beta^*$ is equal to zero. To overcome this problem, we could have undertaken a time-smoothing procedure of the parameters, taking only the value of parameters significantly different from zero. Nevertheless, the fact that we only had four points in time, limited the benefits of doing this. This is one of the major limitations of the microsimulation method.

29 Conversely, the same simulation can be interpreted as creating a counterfactual household income for year t' where everything but Ω_w^T remained constant.

30 For example, the 1994-1996 reduction in the selection parameters ($\sigma\rho$) for male workers in the manufacturing sector could be seen as an evidence that the expansion in the demand for labor that took place in this sector after 1994 was absorbing workers who were less suitable (beyond observable characteristics) for manufacturing tasks than the incumbents.

31 A note of caution is necessary at this point. Although measuring the quantitative effects of NAFTA is useful in building our understanding of the welfare impacts of trade expansion in Mexico, as we have been stressing throughout this section, the simulations are merely hypothetical economies capturing the isolated effects on household income of changes in parameters. Given the complex interrelationships between parameters, observables, and unobservables present in real life, most likely, equilibriums like those described by Figure 7 are implausible.

32 Remember that the Gini coefficient assigns a relatively large weight to changes occurring at the middle part of the income distribution function.

33 A simulated *negative* excess labor supply (i.e., whenever expected wages in the tradable sector are relatively low) is not bounded by demand restrictions, and therefore, the full effect is allowed to pass through. However, for the years we analyzed, there was always a net simulated increase in participation in the tradable sector.

34 Percentiles are formed based on household per capita income; post-simulation re-ranking is not allowed.

35 Notice that we are linking changes in labor market outcomes with household income distribution. This is somewhat different than previous studies linking labor market outcomes with personal distribution of labor income or relative (skilled vs. unskilled) wages (Feenstra & Hanson, 1997; Revenga, 1997).

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Author Note

Rafael E. De Hoyos, The World Bank, 1818 H Street NW, Washington, DC, 20433, USA.

Correspondence concerning this article should be addressed to Rafael E. De Hoyos, Email: rdehoyos@worldbank.org

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Appendix A

Selectivity-Adjusted Wages

Table A1

Wage Functions for the Tradable Sector

	1994	1996	1998	2000
Men				
Schooling	0.150***	0.111***	0.125***	0.144***
Schooling * $I(Y_s > 11)$	-0.019	0.035**	0.019**	-0.026
Experience	0.075***	0.079***	0.076***	0.077***
Experience^2	-0.001***	-0.001***	-0.001***	-0.002**
North	0.061	0.007	0.173**	0.588*
Pr (*manufacture*)†	1.129**	-0.793	-0.693	1.760
Intercept	-0.607	1.649	1.500*	-1.508
R^2	0.469	0.432	0.427	0.446
N	1 271	1 513	1 107	968
Women				
Schooling	0.138***	0.105***	0.149***	0.111***
Schooling * $I(Y_s > 11)$	-0.004	0.022	0.003	0.000
Experience	0.068***	0.042***	0.071***	0.031***
Experience^2	-0.001***	-0.001**	-0.001***	0.000
North	0.074	0.141	0.269***	0.333***
Pr (*manufacture*)†	0.275	0.142	-0.076	0.105
Intercept	0.355	0.579*	0.295	0.801**
R^2	0.271	0.248	0.28	0.237
N	491	609	511	428

Note. (i) *, **, ***, significant at the 10%, 5%, and 1% level, respectively. (ii) Bootstrapped standard errors with 200 replications. (iii) Data source: ENIGH 1994, 1996, 1998, and 2000. (iv) Pr(·)† are computed following Lee (1983).

Table A2

Wage Functions for Non-Tradable Formal Sectors

	1994	1996	1998	2000
Men				
Schooling	0.109***	0.109***	0.097***	0.088***
Schooling * $I(Y_s > 11)$	0.016**	0.021***	0.024***	0.021**
Experience	0.059***	0.065***	0.055***	0.053***
Experience^2	-0.001***	-0.001***	-0.001***	-0.001***
North	0.055	0.083*	0.180***	0.137*
Pr (*other earner*)†	-0.611*	0.090	-0.432	-0.257
Intercept	1.568***	0.663**	1.228***	1.364***
R^2	0.475	0.416	0.430	0.397
N	3 838	4 155	3 293	2 994
Women				
Schooling	0.148***	0.136***	0.143***	0.131***
Schooling * $I(Y_s > 11)$	0.020***	0.014***	0.021***	0.011*
Experience	0.077***	0.069***	0.060***	0.057***
Experience^2	-0.001***	-0.001***	-0.001***	-0.001***
North	-0.046	0.004	0.083*	0.105**
Pr (*other earner*)†	0.290***	0.245***	0.243**	0.065
Intercept	0.337*	0.210	0.059	0.637***
R^2	0.469	0.376	0.411	0.403
N	2 213	2 393	1 950	1 850

Note. (i) *, **, ***, significant at the 10%, 5%, and 1% level, respectively. (ii) Bootstrapped standard errors with 200 replications. (iii) Data source: ENIGH 1994, 1996, 1998, and 2000. (iv) Pr(·)† are computed following Lee (1983).

Table A3

Wage Functions for Non-Tradable Informal Sector

	1994	1996	1998	2000
Men				
Schooling	0.036	0.069***	0.061***	0.089***
Schooling * $I(Y_s > 11)$	0.033***	0.017	0.011	-0.011
Experience	0.046*	0.108***	0.042*	0.080***
Experience^2	-0.001*	-0.002***	-0.001**	-0.001**
North	0.068	0.063	0.082	0.006
Pr (*informal*)†	0.141	0.680*	-0.354	0.897*
Intercept	1.783**	-0.590	2.112**	-0.556
R^2	0.114	0.171	0.107	0.215
N	909	1 061	788	651
Women				
Schooling	0.081***	0.064***	0.052**	0.037
Schooling * $I(Y_s > 11)$	0.013	0.004	0.034	0.026
Experience	0.023	0.046***	0.033	0.063**
Experience^2	0.000	-0.001**	0.000	-0.001*
North	-0.124	0.034	-0.076	-0.096
Pr (*informal*)†	0.062	0.364	0.143	0.701**
Intercept	1.368**	0.272	0.902	-0.230
R^2	0.053	0.063	0.053	0.084
N	620	857	663	581

Note. (i) *, **, ***, significant at the 10%, 5%, and 1% level, respectively. (ii) Bootstrapped standard errors with 200 replications. (iii) Data source: ENIGH 1994, 1996, 1998, and 2000. (iv) Pr(·)† are computed following Lee (1983).

Appendix B

Participation and Occupation Functions

Table B1

Men's Participation and Occupation Functions

	1994	1996	1998	2000
$\hat{w}$	1.954***	1.968***	1.560***	2.147***
$\hat{h}$	-0.243***	-0.151***	-0.237***	-0.221***
Tradable Earner				
Intercept	-2.913***	-6.357***	-3.618***	-2.626***
HH Size	0.141***	0.092***	0.091***	0.201***
Y^0_m	-11.585***	-19.372***	-15.188***	-14.272***
$(Y^0_m)^2$	4.842***	3.270***	8.480**	10.310***
Non-Tradable Earner				
Intercept	-0.738***	-1.188***	0.493***	-1.736***
HH Size	0.070***	0.032	0.047*	0.132***
Y^0_m	-10.635***	-13.920***	-12.833***	-13.974***
$(Y^0_m)^2$	4.744***	2.379***	7.947**	10.323***
Informal Sector				
HH Size	0.033	0.062**	0.083***	0.117***
Y^0_m	-14.646***	-19.068***	-19.665***	-19.152***
$(Y^0_m)^2$	6.104***	3.227***	9.473***	12.823***
R^2	0.202	0.205	0.179	0.212
N	33 500	37 496	28 080	24 592

Note. *, **, ***, significant at the 10%, 5%, and 1% level, respectively (with bootstrapped standard errors).

Table B2

Women's Participation and Occupation Functions

	1994	1996	1998	2000
$\hat{w}$	1.423***	1.614***	1.311***	1.721***
$\hat{h}$	-0.168***	-0.126***	-0.127***	-0.115***
Tradable Earner				
Intercept	-1.796***	-2.688***	-2.913***	-3.819***
Children	-0.267***	-0.049	-0.002	0.135
H_s^a	-1.011***	-1.028***	-0.937***	-0.627***
H_d^a	-0.024	0.150	0.319**	0.730***
Y_m^0	-6.369***	-11.127***	-11.662***	-11.938***
$(Y_m^0)^2$	1.137***	1.727***	6.106***	7.133***
$Var\ (Y_m^0)$	0.002**	0.001	0.001**	-0.037
Non-Tradable Earner				
Intercept	-1.002***	-1.035***	-0.640***	-2.524***
Children	-0.037	-0.111***	0.008	-0.063
H_s^a	-1.017***	-1.038***	-0.894***	-0.815***
H_d^a	0.049	-0.351***	-0.021	0.047
Y_m^0	-4.545***	-6.085***	-7.973***	-6.773***
$(Y_m^0)^2$	0.807***	0.916***	5.294***	3.175*
$Var\ (Y_m^0)$	0.002***	0.001	0.001***	0.001
Informal Sector				
Intercept				
Children	-0.049	-0.028	-0.028	0.053
H_s^a	-0.495***	-0.546***	-0.500***	-0.389**
H_d^a	-1.653***	-1.221***	-1.296***	-0.755***
Y_m^0	-10.784***	-14.108***	-12.208***	-12.454***
$(Y_m^0)^2$	1.950***	2.261***	6.206***	5.063**
$Var\ (Y_m^0)$	0.002**	0.001	0.002***	0.002
R^2	0.389	0.363	0.326	0.345
N	38 932	43 392	32 836	29 320

Note. *, **, ***, significant at the 10%, 5%, and 1% level, respectively (with bootstrapped standard errors).