Do the Effects of Free Trade Vary by Gender?

CAFTA and the Rural Dominican Republic

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Abstract

We construct a “gendered” disaggregated rural economy-wide model (DREM) for the Dominican Republic and use it to simulate the impacts of the Dominican Republic-Central American Free Trade Agreement on agricultural production, wages, incomes and welfare. By nesting agricultural household models into a general equilibrium framework, we differentiate the responses of heterogeneous actors. A phase-out of tariffs on agricultural imports hurts agricultural producer as well as some non-agricultural households, via adverse labor-market effects. Impacts vary substantially by gender. Female and male wages respond differently, and female-headed households tend to fare better in terms of welfare than comparable male-headed households.

KEYWORDS: Trade reform, gender, general equilibrium models, agricultural households, Dominican Republic, Central America and the Caribbean

1. Introduction

Who are the winners and losers of free trade? This question is particularly relevant for rural areas of less developed countries, which are home to 75% of the world's poor. The welfare effects of trade liberalization are generally believed to be positive on average but to differ across social classes, industries and regions within countries. There is reason to think that they also differ by gender. Rural areas display fundamental differences between men's and women's access to labor markets, production activities and intra-household wealth. Thus, any restructuring of rural economies around new trade regimes probably will not be gender-neutral. Despite growing awareness that the impacts of policy outcomes are likely to vary between the genders, gender has not been a focus of policy modeling or the design of trade-adjustment policies.

The present research brings gender squarely into a model aimed at understanding the impacts of agricultural trade and policy shocks in a rural economy. The key question we wish to address is whether gender shapes these impacts, and if so, how. In particular, are female workers and female-headed households affected differently than male workers and male-headed households?

1.1. Gender-aware economic thinking

Fontana and van der Meulen Rodgers (2005) identify three levels on which gender-awareness should enter into economic thinking about policy impacts. On a "macro" level, economic shifts have gender-differentiated impacts through the labor market. The distribution of males and females across occupations is notoriously unequal; women tend to participate disproportionately in service provision, while most highly-paid managerial positions are occupied by men. In order to equalize this distribution throughout the world, about 60% of working females would have to switch jobs, and this figure is usually higher in developing than in developed countries (Anker, 1998, page175). Given the gender segregation of the labor market, macroeconomic shocks affecting different employment sectors are likely to have a gender-differentiated impact on labor demand and on the male-female wage gap (for case studies, see Ghiara (1999); Kanji and Jazdowska (1993)). Bussmann (2009) found that free trade in developing countries is correlated with fewer women working in the service sector and more in agriculture and industries. On a “micro” level, females frequently control different resources than males and participate in different household production and reproduction activities. In many developing rural regions, females have control over subsistence agriculture and males over commercial agriculture. It is also widely recognized that females tend to spend their income differently than males (Dwyer, et al., 1988). Thus, changes in income are likely to have different impacts on expenditures in female-headed households. In male-headed households, if income is not perfectly pooled between spouses, an increase in a female’s income may not yield the same expenditure outcome as an equivalent increase in the male’s income. Finally, on a “meso” level, institutions create differential opportunities for males and females. Examples include public expenditures, legal structures and market institutions. These are not an explicit focus of economic models. Nevertheless, the behavioral responses represented in economic models inevitably are affected by the institutional environment in which economic agents operate.

1.2. Modeling the Impacts of Agricultural Trade and Policy Reforms

In the Dominican Republic, as in many other developing countries entering into new trade regimes, trade reforms entail the removal of import tariffs on agricultural products (Taylor, et al., 2005, Taylor, et al., 2009). Overwhelmingly, the view of researchers and policy makers alike has been that urban residents win but rural populations lose from the elimination of food tariffs. The urban gain results from lower consumption costs, while the rural loss is the consequence of increased competition with imported agricultural and livestock goods, depressing both profits and wages in a sector in which less developed countries presumably have a comparative advantage. Tangermann (2005) reports the finding from a GTAP model that full agricultural liberalization by high-income countries would enhance the nonagricultural terms of trade for developing countries, thus leading to income gains. However, Anderson and Valenzuela (2007), also using a GTAP model, find negative effects of own-country agricultural trade reforms on agricultural value-added in all the developing countries they considered. The implication of these findings would seem to be that the more narrowly one focuses on the less developed country rural economy and on own-country tariff reforms, the greater the likelihood of finding negative welfare impacts of agricultural trade liberalization.

Micro agricultural household theory suggests that the impacts of agricultural market liberalization on less developed country rural welfare are not clear cut, even if less developed country producers do not acquire greater access to high-income markets for their agricultural output. As agricultural producers or suppliers of factors (e.g., labor) to farms, rural households lose when the prices of farm goods decrease. However, rural households also are consumers, and many farmers are net buyers of protected commodities (e.g., see (Minot and Goletti, 1998)). Like urban households, they stand to benefit as consumers. Whether the negative production or positive consumption effect dominates is an empirical question, and the answer may be different for different rural household groups.

Even on the production side, a decrease in price (e.g., of food grains) may benefit households that are engaged in other crop activities (e.g., fruits and vegetables) if factor prices (e.g., wages) decrease. Even the impacts of agricultural trade reforms on factor prices are ambiguous; they depend on the relative factor intensities of the directly and indirectly affected activities.

1.3. Disaggregated Rural Economy-wide Models (DREMS)

Understanding the impacts of agricultural trade reforms on rural economies in less developed countries requires an economy-wide modeling approach that embeds within it a microeconomic focus capturing both the heterogeneity of rural households and the diversity of activities in which these households participate. GTAP and other economy-wide models are useful to explore aggregate impacts of trade policy reforms; however, their high level of aggregation precludes a rural micro focus.

New research using disaggregated rural economy-wide models (DREMS) casts doubt on the assumption that rural household welfare is inversely related to food prices. DREMS highlight the ways in which the diversity among households shapes both the aggregate and distributional outcomes of policy and market changes (Dyer, et al., 2006); (Taylor, et al., 2005). One such study concluded that lower import tariffs on food would reduce nominal incomes for nearly all rural household groups in El Salvador, Guatemala, Honduras and Nicaragua. However, they would also lower consumption costs substantially. The net effect on rural households' welfare is positive in most cases, implying that pre-CAFTA agricultural protection policies are disadvantageous for most rural household groups.

DREMS represent an important step in policy modeling, nesting heterogeneous and interacting agricultural household models within a rural economy-wide model. Their highly dissagregated nature provides an ideal structure to incorporate information on the gender of households or labor factors.

1.4. "Engendering" a CGE to Analyze the Impacts of CAFTA in the Dominican Republic

To the best of our knowledge, there have only been two published attempts at "engendering" computable general equilibrium (CGE) models, both in a 2000 special edition of *World Development* (Arndt and Tarp, 2000, Fontana and Wood, 2000). These "are gendered in the sense of distinguishing between men and women in the labor market." Fontana and Wood's (2000) framework addresses gender disparities in labor markets on a macro level. As explained previously, labor markets are only one of the avenues through which gender can shape policy impacts in rural economies.

We construct a rural economy-wide model for the Dominican Republic, disaggregating both the labor force and household accounts with respect to gender. The model distinguishes six types of households with respect to the household head's national origin (Dominican or Haitian), gender, and whether the household participates in the agricultural sector. Labor is disaggregated not only by sector and wage status but also by gender and national origin. The model is the basis for assessing the rural economy-wide and household-specific impacts of the recently initiated free-trade agreement DR-CAFTA (Dominican Republic and Central American Free-Trade Agreement). An economy-wide version of the compensating variation is used to examine the likely welfare effects of DR-CAFTA, with particular focus on households traditionally regarded as most vulnerable: migrant and female-headed households. In this model, each household group has its own set of accounts in a rural-sector Social Accounting Matrix (SAM). This endows each household group with its own income and expenditure functions, adding another "gendered" dimension to the model.

2. Model Description and Data Sources

Our "engendered" DR-CAFTA model nests a series of microeconomic models for each of six household groups. The equations of the model are available from the authors (see appendix). The originality of the model lies in the gendered disaggregation of the labor and household accounts. We distinguish among twelve labor types:

1. Dominican Hired Females employed in Agriculture
2. Dominican Hired Males employed in Agriculture
3. Dominican Hired Females employed outside of Agriculture
4. Dominican Hired Males employed outside of Agriculture
5. Haitian Hired Females employed in Agriculture
6. Haitian Hired Males employed in Agriculture
7. Haitian Hired Females employed outside of Agriculture
8. Haitian Hired Males employed outside of Agriculture
9. Female Family labor working in Agriculture
10. Male Family labor working in Agriculture
11. Female Family labor working outside of Agriculture
12. Male Family labor working outside of Agriculture

Each of these different types of labor tends to be employed in specific activities. For example, sugar-cane plantations traditionally hire Haitian males for most of their labor, while tobacco and coffee producers employ many women. In light of this, one would expect a fall in the profitability of sugar-cane production to disproportionately reduce employment opportunities for Haitian males. There would be a smaller direct effect on Dominican agricultural laborers. All labor groups would, of course, be affected indirectly through rural general equilibrium effects. However, those effects are difficult to predict intuitively without performing simulations.

Our household disaggregation is based on three criteria: activity, gender and origin. The model distinguishes six household groups:

1. Agricultural households headed by a Dominican female
2. Agricultural households headed by a Dominican male
3. Non-Agricultural households headed by a Dominican female
4. Non-Agricultural households headed by a Dominican male
5. Households headed by a Haitian female
6. Households headed by a Haitian female

They engage in distinct activity mixes and have distinct patterns of incomes and expenditures and thus are likely to experience CAFTA policy changes differently.

Differentiating between agricultural and non-agricultural households is crucial given the evolution of the rural sector. The view that rural households are agriculture-based is outdated, even in reference to developing economies long thought to be predominantly agricultural (Ellis, 2000). We define "agricultural" households as those for which at least one member receives revenues from an agricultural activity, either self-employed or as a hired laborer. Table 1 provides a breakdown of income by source for each household group. Almost sixty percent of rural Dominican households have no agricultural revenue whatsoever (third and fourth columns in Table 1). Table 2 presents descriptive statistics. Strictly non-agricultural rural households tend to be younger, wealthier, more educated, and have a higher socio-economic status. Changes in food prices affect these households through consumer expenditures, but they do not have direct income effects as for agricultural households. Indirectly, however, incomes and expenditures will both be affected via general equilibrium effects operating through rural factor, labor, commodity, and service markets.

Haitian households generally have weaker access to physical assets than natives (see Table 1). Less than 2% of their income comes from self-employed production activities, by far the smallest percentage of all ten groups. They also earn, on average, much less than the other household groups, thus representing the most income-constrained group in our model. Unfortunately, given the small number of Haitian (especially female-headed) households in the available data, it was not possible to disaggregate these groups by activity without encountering very small sample sizes.

The breakdown of households into male and female-headed is revealing. A perusal of Table 1 and Table 2 reveals that female-headed households have access to different sources of income and rely on different survival strategies (Dwyer, et al., 1988, Sen, 2001, chapter 8). Gender differences are evident not only with regard to households' participation in labor markets but also in terms of their asset ownership and access to credit, land, or capital markets. These aspects may be just as critical as the labor market in determining how trade reforms affect women; however, they are not adequately captured by models that simply distinguish male from female labor. Moreover, females and males spend their incomes differently (Table 3) and thus should not be assumed to share the same utility function. Distinguishing households by the gender of the household head makes it possible to capture part of these differences in a policy-evaluation model, assuming that female-headed households display a more "female" utility function and male-headed ones a more "male" one. In reality, both types of households are composite units. Nevertheless, this rough approximation of household gender proves to be informative.

As in standard CGE models, a Social Accounting Matrix (SAM) provides the data to parameterize the system of equations in our model. The SAM (outlined in Table 4) was constructed using various data sources. The information on incomes and expenditures of households was found in the ENCOVI survey (Encuesta Nactional de Condiciones de Vida) carried out in 2003 by the Dominican central bank. The ENCOVI surveyed more than nine thousand households, 3991 of which were rural. They are statistically representative of the approximate 930,000 Dominican rural households (3.5 million people, with an average of 3.9 people per rural household). 3759 households in the rural sample had information complete enough to be usable. Data on input and factor use in agricultural activities were collected via an original targeted survey of 220 Dominican farmers, which was carried out by the PUCMM University (Pontificia Universidad Católica Madre y Maestra). Shares of factors and inputs in specific industrial sectors, such as food processing, came from a 1991 SAM obtained from the Dominican Central Bank.

The share of each type of hired and family labor employed in agricultural production was elicited in our production-side survey of 220 farmers. The value of hired labor was determined using data on agricultural wages. Family labor was not valued at the agricultural wage, which would assume that family and hired labor are perfect substitutes. Instead, we estimated the value created by family labor inputs econometrically by regressing family value added (gross value of production minus cash outlays on inputs, including hired labor) on family labor and capital. The labor shares by gender reflect the relative proportions of male and female family labor used in each crop.

3. Simulations and Results

This section presents the results of simulations using our model of the Dominican rural economy, with a focus on the effects of price shocks likely to result from the DR-CAFTA trade agreement. The purpose of these simulations is not to predict the future or make projections, but rather to explore the possible effects of shocks related to policy reforms, to identify the households that would be most affected under alternative realistic scenarios, and to gain an understanding of how markets transmit policy shocks through the rural economy in ways that may be different for men and women.

3.1. Simulations of the CAFTA Trade Reforms

The negotiations leading to the entrance of the Dominican Republic into DR-CAFTA determined the evolution of the country's tariffs on agricultural products over the ensuing twenty years. In 2004, the Dominican Republic levied tariffs of 20% on rice, potatoes, sweet potatoes and milk and 25% on beans, onions, garlic and most meats (in our model, livestock accounts were consolidated into a single activity for lack of reliable data to estimate separate production functions). Each product follows its own tariff-reduction path over periods of varying length, and many different simulations can be run once the model is parameterized. We ran three simulations, reflecting low, medium, and complete tariff elimination. These scenarios correspond to the tariff reductions scheduled for the 6th, 12th and 20th years, respectively, of DR-CAFTA. All of the simulations assume immediate and simultaneous tariff shocks, which are translated into price-shocks of equal magnitude. They do not attempt to account for dynamic adjustments, including changes in model parameters; the possible evolution of world market prices; transition policies that might be implemented; or hypothetical increases in export demand from the United States. The simulated price changes are reported in Table 5. The prices of non-affected agricultural goods are assumed to be exogenously fixed and do not change in the simulations; thus they do not appear in Table 5.

DR-CAFTA price changes have many effects, all interlinked in our general equilibrium model. In what follows, we present the effects on prices, production, income, and wages. We also provide a measure of rural economy-wide compensating variations to assess net welfare changes for each household group. The policy experiment results are presented in Tables Table 6 through Table 10. Column (i) in each table presents the results for the "low case", which corresponds to the tariff levels reached after the 6th year of DR-CAFTA; column (ii) presents the "middle case" and column (iii) the “full case”, corresponding respectively to 12 and 20 years of tariff elimination. All affected agricultural prices decrease as a result of tariff removal, and the magnitude of the price drops increase as one goes from the low to the full case. By the 20th year, when all tariffs are eliminated (Simulation iii), the prices of all affected goods drop by 16.7% to 20% (reflecting the elimination of 20% to 25% tariffs, respectively; seeTable 5).

Production Effects

Price shocks affect the profitability of activities, prompting firms and households to alter their production decisions. Table 6 shows changes in production resulting from our tariff-reduction simulations. The production of all agricultural goods is affected, regardless of whether the goods were targeted by DR-CAFTA policies. For goods whose prices change, given the non-linearity of production functions, there is no reason for production shifts to be of the same magnitude as price shocks. In fact, because actors are facing a whole set of price decreases simultaneously, the production of a given product whose price falls may actually increase if the product becomes more profitable compared to other goods. This is the case when the output prices of other goods decrease relatively more, or less directly when shifts in demand for inputs make one good cheaper to produce relative to other goods. Rice in the medium scenario (ii) is a case in point: its price falls by 2.7 %, but its production rises by 3.5%.

Because the impacts of the price shocks are complex and many are indirect, there is little correspondence between percentage changes in output prices and production for the affected crops. In the full case, the rural sector shifts away from rice and bean production, the staples of every Dominican meal. On the other hand, export crop production increases: traditional export crops (coffee and tobacco) and sugarcane experience increases in production even in the low scenario. The output of vegetables, a more recent export crop, increases sharply (Column (iii)).

Table 6 illustrates that DR-CAFTA potentially influences the production of all crops. Due to the diversity of the agricultural sector and rural factor market linkages, non-CAFTA crops in some cases may be more affected in percentage terms than some CAFTA-crops. The last five rows in Table 6 report slight decreases in the output value of rural service activities. Rural services are affected on the cost side as factor markets adjust to the DR-CAFTA price shocks. Changes in rural household incomes also influence service demand. The simulations suggest that on balance these effects are negative.

Wage Effects

Table 7 reports the labor-market effects of the simulated price changes. The model assumes that the total size of the labor force is fixed and rural wages adjust to equilibrate supply and demand, the market wage in the case of hired labor, and for family labor, the shadow value of leisure.

Rural wages increase in most cases. In simulations (i) and (ii), only male agricultural labor loses value (whether Dominican or Haitian, hired or domestic), and female agricultural wages increase slightly, despite the general decrease in agricultural prices. In simulation (iii), the wage effects persist and become more pronounced, with wages of hired Dominican male agricultural workers losing over 25% of their value and female agricultural labor wages increasing more than 6%. While at first glance this result might seem surprising, it is consistent with the transformation of the productive landscape described above. The PUCMM survey of farms reveals that females do not represent a significant part of the hired labor force for any of the products directly impacted by the reforms. They are more likely to perform agricultural work in export crops, including coffee, tobacco, and fresh vegetables for US markets. Inasmuch as activities traditionally employing women become more profitable and increase production, employment opportunities for women in the agricultural sector expand. Male-labor-intensive activities are replaced by more female-labor-intensive ones. This is also reflected in the changes in rural wages. Non-agricultural employment, which is concentrated in rural service activities, increases in scenarios (i) and (ii) but not in scenario (iii).

Male workers are systematically more adversely affected than female workers in each sector and country-of-origin category, albeit sometimes by a small amount. The only exception is for hired Haitian non-agricultural labor in simulations (i) and (ii). It appears that, with regard to DR-CAFTA, the traditional gender division of agricultural labor in the Dominican Republic favors female laborers. This result echoes the cross-country findings of Bussmann (2009) and highlights the importance of accounting for gender when evaluating the likely labor market implications of trade reforms.

Income Effects

One would expect agricultural incomes to fall as a consequence of lower agricultural prices. The effects on incomes in non-agricultural households, on the other hand, are less obvious, because the rural service sector shifts to a "higher-wage but lower-output" equilibrium. Table 8 presents the percentage change in income for each household group. As expected, agricultural households lose in nominal terms. The sign of the effect on non-agricultural households, however, varies by gender: female-headed households gain while male-headed ones lose. The effects on non-agricultural households are of much smaller magnitude than the effects on agricultural households. Haitian households participate in both agricultural and nonagricultural activities and mostly suffer nominal income losses.

Although almost all households lose income, the percentage changes in income are of smaller magnitude than the percentage changes in agricultural prices. This reflects the diversity of the rural sector, which makes it possible for households to reallocate resources among activities and buffer themselves against the impact of price shocks. The magnitudes of nominal income effects favor female headed households. Of all the household groups, those least affected are the Non-agricultural Dominican Female-headed and the Haitian Female-headed households. They either gain slightly or lose somewhat, but their nominal income change is always less than 1%, even under the full case scenario (iii). Among female-headed households, only the agricultural households are significantly adversely impacted by CAFTA in terms of nominal income, but never to the same extent as male-headed households. Column (iii') reports the difference between the same-demographic female and male income effects under simulation (iii). In all cases, females fare better than males, by 2.67 to 3.16 percentage points. This reflects the favorable effect of CAFTA on female wages compared to male wages.

Welfare Effects

To measure the effects of DR-CAFTA tariff removal on household welfare, we calculate a general-equilibrium variant of the compensating variation (CV). The CV is the amount of cash transfer needed to maintain each household at the same level of utility as before the tariff adjustments. It was estimated in our simulations by fixing each household group's utility at the pre-DR-CAFTA level and including a slack variable in the household income equations. This "DREM-CV" represents an ex-post measure of welfare change after allowing each household group and the rural economy as a whole to adjust to the policy shock. As in the case of the classic CV from consumer theory, this does not mean that households purchase the same consumption baskets as before, but rather, the cheapest basket that can provide them with the same level of utility given the new market conditions. However, unlike the classic CV, which only allows for consumer decisions to shift in accordance with preferences, the DREM-CV permits a readjustment of entire general-equilibrium (rural) economy.

Table 9 reports the DREM-CVs in thousands of US dollars and as a percentage of pre-reform income. For agricultural households the DREM-CV is positive in all of the simulations, indicating that DR-CAFTA hurts agricultural households in terms of welfare. This corresponds to the common conception of free-trade effects on agriculture; however, it is not a predictable result because of the dual nature of agricultural households as producers and consumers. In the Dominican Republic, the negative effect of lower nominal income appears to outweigh the positive effect of lower food costs. Among non-agricultural households, the sign of the welfare effect is different for male- and female-headed households. Non-agricultural households, as pure consumers, strictly benefit from cheaper food. However, the DREM takes into account changes in the rural non-agricultural economy in response to the agricultural price shocks. For male-headed non-agricultural households, a negative income effect slightly offsets the positive food-cost effect.

The right-hand column of Table 9 presents the percentage-point differences in impacts of the agricultural price changes on male and female-headed households. Female-households, across the board, fare better than their male counterparts. Female Dominican non-agricultural households and female Haitian households experience welfare gains. This reflects the positive effect of the policy shock on female wages, differences in female-headed household's income sources, as well as the different preferences exhibited by the expenditure patterns of male- and female-headed households. These CV results illustrate general equilibrium effects that would be difficult to predict without a gendered economy-wide model.

3.2. How much does DR-CAFTA matter? Offsetting the effects of DR-CAFTA with relief strategies

The analysis in the previous section reveals that DR-CAFTA had negative effects on welfare in agricultural households and even some non-agricultural households. Indeed, the overall DREM-CV for the entire rural sector is +3.56% of total income, a non-negligible figure. In this section, we explore ways to offset this effect. We conduct three experiments which respectively increase agricultural productivity, exports, and urban labor demand. In each experiment, we ask how large of a change would be required to offset DR-CAFTA's negative effects. The design of these experiments reflects the evolution of rural economies in developing countries in general and the likely future evolution of the Dominican rural economy in particular. Productivity growth is a fundamental feature of agricultural development and a focus of agricultural policy. Sustained increases in exports are an anticipated effect of free-trade agreements such as DR-CAFTA, and a shift in labor demand from the rural to the urban sector is one of the most fundamental features of economic growth and modernization (Taylor and Martin, 2001).

Table 10 reports the results of our exercises. The negative welfare effect of DR-CAFTA can be offset by a 17.5% increase in agricultural productivity (column iv), a 35% increase in traditional exports (column v), or a 6.5% increase in labor demand from the urban sector (column vi). The increase in agricultural productivity has a particularly important welfare effect on the two agricultural household groups. It, combined with the extreme DR-CAFTA scenario, results in DREM-CV's of 0.95% and 1.29% in the female and male headed agricultural groups, respectively. Increases in traditional exports (coffee, sugarcane and tobacco) are less effective in countering the negative welfare effects of DR-CAFTA, and they strongly favor the Haitian groups, inasmuch as these sectors tend to employ migrant workers. An increase in urban demand for labor is most effective at counteracting the negative effects of the agricultural price changes. It tends to favor non-agricultural laborers. As in all of our simulations, the model captures rural economy-wide effects under each of the experiments.

These exercises suggest that there need not be unrealistically large changes in the evolution of the Dominican rural economy in order to offset the negative effects of DR-CAFTA on agricultural households. The right-hand column (vii) presents the results of an integrated experiment in which existing trends in agricultural productivity, export growth and off-farm employment are extrapolated over the course of the DR-CAFTA 20-year phase-in period. We used FAOSTAT data (available online from the Food and Agriculture Organization website) to compute yearly growth in agricultural yields and total export value, averaged over the 1984-2004 period. Average yearly growth in manufacturing employment was calculated over the 1996-2007 period using the LABORSTA dataset (available online from the International Labor Organization website). The simulation shows that the extrapolated trends in productivity, export growth and off-farm employment easily offset the negative effects of DR-CAFTA over the 20-year implementation period, and all households see substantial increases in both welfare and income. In year 20, taking these trends into account, the DREM-CV for the rural economy is -5.57% of total rural GDP. It ranges from -3.87 to -7.17 across the six household groups.

4. How Much Does Gender Matter? Comparing Identical Gendered and Non-Gendered Models

The previous section presented results from a fully gendered model with six labor and ten household accounts. We found that female-headed households benefited more from, or were less harmed by, the DR-CAFTA policy reforms than male-headed ones. These results underline the importance of integrating gender into policy evaluation models. In this section we explore the value of "engendering" policy models by asking how well our model performs compared with a non-gendered model or with a simpler "Fontana-and-Wood" (FW) type model, in which labor factors but not households are disaggregated by gender.

We repeated all of the simulations reported above using three reduced models: a non-gendered model (model A); a model gendered only for labor (model B, *a la* FW); and a model gendered only for households (model C). The fully gendered model used in the previous section is named model D. We compare the results from the four models for Simulation (iii), the complete elimination of all tariffs on agricultural goods.

Table 11 reports the simulated impacts on wages in all four models. As far as labor alone is concerned, model B is the labor-gendered version of model A, and model D is the labor-gendered version of C. Three key findings emerge from this analysis. First, the models that are not gendered for labor (A and C) give almost identical results, as do the two models that are gendered for labor (B and D). Second, the non-gendered percentage changes in wage for model A are not always in between the male and female results for model B. The same is true for models C and D. Therefore, reducing a gendered model to a non-gendered one will not simply produce a weighted average of policy effects on males and females. It will yield a different result, reflecting its assumption that male and female labor market outcomes are identical. Third, the difference between male and female wage-shocks, ranging between 0.06 and 32.08 percentage points, is far from trivial. All of these observations support the argument in favor of constructing gendered CGE models and confirm that allowing for a gendered labor market is a first, crucial step in this direction. As far as measures of wage-shocks are concerned, the FW-type model (B) performs just as well as the fully gendered model.

Such is not the case, however, for outcomes other than wages. Table 12 and Table 13 respectively present a comparison of income and DREM-CV results using the four models. As reported in the previous section, the fully-gendered model D finds differences in the income shock of up to 3.56 percentage points, and differences in CV of up to 3.21 percentage points, between male-headed and otherwise similar female-headed households. The non-gendered model A and the FW-type model B cannot pick up these impacts. The pairing of models that are not household-gendered (A and B) versus models that are (C and D) is still visible, though not as clear as in the case of wages alone. The results of models A and B on the one hand and C and D on the other are no longer nearly identical, and in some cases the impacts do not even carry the same sign. In fact, the fully gendered model D is the only one in which any household has a negative compensating variation. Model D systematically reveals greater "f-m" differences than the only partially gendered model C.

How much, then, does gender matter in these policy evaluation models? Based on Columns A and D in the above tables, a fully gendered model recognizes that wage effects for male and female laborers may be of different signs. The compensating variation two of the three female-headed groups is negative in the gendered model and positive in the non-gendered one. The least dramatic change appears for Dominican, agricultural households: the CV in the non-gendered simulation is 9.84%, and drops a little over two percentage points for the subgroup of female-headed households when we introduce gender (7.65%). These results reaffirm that engendering CGE models is a valid goal to pursue, and a fully gendered model improves upon previous attempts to engender CGEs.

5. Conclusions

This study can be seen as an experiment in "engendering" CGE modeling techniques and exploring the gender-specific effects of trade reforms. Our simulations for the Dominican Republic illustrate that the impacts of trade reforms in the rural economy are complex and vary by gender. A decrease in agricultural prices, reflecting scheduled tariff adjustments, results in most rural household groups being worse off, *including some non-agricultural households*, as shown by their positive DREM-CV measures. The disaggregated general equilibrium modeling approach makes it possible not only to net out consumer and producer-side influences of policy shocks, but also to account for market linkages that affect different household and labor groups differently. This is of particular importance when evaluating policy impacts in rural economies, in which the lines between agricultural and non-agricultural actors are not easily drawn. The conclusion that non-agricultural households may be harmed as laborers and service-providers more than they benefit as consumers is not particularly surprising, yet it contradicts conventional knowledge among those who claim that only agricultural producers suffer from trade reforms. Lower consumption costs may not be sufficient to counter the adverse effects of trade liberalization on rural household incomes.

The fact that the simulated welfare effects of DR-CAFTA are of opposite signs for some of the households in our model supports the use of disaggregated models for trade policy analysis. Lumping households together can hide substantial variation. Our simulation results suggest that failing to recognize the gender diversity of labor markets would likely yield inappropriate predictions concerning the effects of policy reforms. In terms of total welfare, aggregating our general-equilibrium model up to a single representative rural household yields an overall DREM-CV equivalent to +4.01 percent of income in the full case (iii), but this figure actually ranges from -0.31% to +10.18% using the most gender-disaggregated specification of the model.

The most positive effect of DR-CAFTA turns out to be for the groups usually considered to be the most vulnerable to policy and trade reforms: female laborers, female-headed households and migrant households. For Haitian female-headed households, the DREM-CV is actually positive, suggesting that the effect of cheaper food, for them, outweighs income losses. Higher wages for females may reshape household expenditures in ways that influence welfare, e.g., via child nutrition and education. Though not an explicit aim of DR-CAFTA, they could also contribute to the empowerment of rural females as they participate more in off-farm, cash-generating work.

A gendered DREM is a critical step towards understanding gender differences in impacts of trade policy reforms; however, it has some limitations. The most important one is that household aggregation overlooks the role of gender in shaping decision making within households. A model integrating intra-household resource allocations could shed light on the true differential welfare outcomes of trade and other policy reforms for males and females. Adding an intra-household dimension to DREM and CGE models is likely to reveal key insights and should be a priority of future research.

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Table 1: Shares of Yearly Income of Dominican Households

	Dominican				Haitian		All
	Agricultural		Non-Agricultural				
	Female	Male	Female	Male	Female	Male	
Average Yearly Per Capita Income ($US)	723	768	994	1206	379	637	**976**
Average Yearly Household Income (US$)	3348	3214	3485	4719	1098	1984	**3823**
Female Paid Labor:	7.5%	4.5%	16.6%	7.6%	31.6%	2.9%	**8.1%**
(Agricultural)	(0.4%)	(0.1%)			(3.4%)	(0.3%)	**(0.1%)**
(Non-Agricultural)	(7.0%)	(4.5%)	(16.6%)	(7.6%)	(28.2%)	(2.6%)	**(8.0%)**
Male Paid Labor	27.9%	24.1%	24.2%	44.7%	54.2%	94.9%	**37.7%**
(Agricultural)	(13.1%)	(14.4%)			(16.0%)	(43.8%)	**(6.3%)**
(Non-Agricultural)	(14.8%)	(9.7%)	(24.2%)	(44.7%)	(38.2%)	(51.1%)	**(31.4%)**
Income from Production Activities	50.0%	63.4%	25.9%	34.2%	0.0%	1.4%	**39.4%**
(Agricultural)	(33.2%)	(50.0%)			(0.0%)	(0.5%)	**(12.2%)**
(Non-Agricultural)	(16.9%)	(13.3%)	(25.9%)	(34.2%)	(0.0%)	(0.9%)	**(27.2%)**
Transfers from Other Rural Households	1.1%	0.5%	1.5%	0.4%	1.3%	0.0%	**0.6%**
Government Support	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	**0.1%**
Sales of Land and Other Forms of Capital	0.9%	0.8%	0.2%	0.4%	0.0%	0.0%	**0.5%**
Remittances from Migrants to Urban Areas	3.3%	1.7%	4.7%	1.3%	3.9%	0.1%	**2.0%**
Remittances from Migrants to Foreign Countries	5.7%	3.1%	18.0%	9.0%	2.2%	0.1%	**8.4%**
Other	3.6%	1.8%	8.8%	2.5%	6.7%	0.6%	**3.3%**
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	**100.0%**

Source: SAM constructed for this model.

Table 2: Descriptive Statistics (Sample used to construct the SAM for the Dominican Rural Sector)

	Dominican				Haitian		All
	Agricultural		Non-Agricultural				
	Female	Male	Female	Male	Female	Male	
Sample size	199	1139	731	1522	20	148	**3759**
Average Yearly Household Income (US$)	3348	3214	3485	4719	1098	1984	**3823**
Average Age of Household Head	54.0	49.6	47.8	43.7	41.3	40.8	**46.7**
Average Education of Household Head (years of schooling)	4.7	6.0	7.8	8.7	2.1	3.2	**7.3**
Percent of Household Heads who Completed Hight-School (“Bachillerato”)	9.0%	8.9%	20.9%	21.8%	5.0%	0.7%	**16.1%**
Average size of Household (# people)	4.6	4.2	3.5	3.9	2.9	3.1	**3.9**
% bi-parental household	40.7%	80.4%	17.0%	83.1%	15.0%	45.9%	**65.4%**
% HH With Running Water	14.1%	13.3%	23.8%	24.1%	5.0%	4.7%	**19.4%**
% HH With Dirt Floor	14.6%	24.4%	7.4%	7.9%	20.0%	20.9%	**13.7%**
% HH with Temporary Roof	1.0%	4.0%	1.1%	1.8%	10.0%	12.8%	**2.7%**
% HH without any form of Latrine	9.5%	13.2%	7.4%	6.4%	25.0%	41.9%	**10.3%**

Source: ENCOVI survey

Table 3: Shares of Expenditures of Dominican Households

	Dominican				Haitians		All
	Agricultural		Non-Agricultural				
	Female	**Male**	**Female**	**Male**	**Female**	**Male**	
Self-Consumed Subsistence Crops (estimated at market value)	6.1%	7.1%					**2.1%**
Out-of-Home Meals	1.1%	1.5%	2.6%	3.6%	1.1%	3.3%	**2.8%**
Purchases from Commerce	72.8%	72.6%	72.5%	71.0%	84.7%	85.0%	**72.4%**
Transportation	2.9%	3.9%	3.6%	5.1%	3.1%	1.5%	**4.3%**
Taxes	0.0%	0.1%	0.1%	0.1%	0.1%	0.0%	**0.1%**
Transfers to Other Households	0.5%	0.7%	0.6%	0.6%	0.0%	1.0%	**0.6%**
Investments in:							
Land	3.7%	3.2%	5.0%	4.1%	4.5%	1.8%	**3.9%**
Education	1.8%	1.4%	2.4%	2.0%	0.3%	0.4%	**1.8%**
Health	6.5%	5.0%	5.4%	5.4%	2.2%	1.7%	**5.2%**
Other	1.7%	1.5%	1.8%	2.2%	0.5%	0.5%	**1.9%**
Other Costs	2.9%	3.1%	5.9%	5.9%	3.4%	4.8%	**5.0%**
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	**100.0%**

Source: SAM constructed for this model.

Accounts	Ag Activities	Non-ag Activities	Commerce	Factors	Expen-ditures	Investments	Remittances	Agro-industries	Government	ROC	ROW	TOTAL
Agricultural Activities	3,374		135,180		71,221	77,936		1,250,786		286,859	106,356	1,931,712
Non-ag Activities		37,670	118,447		515,601			19,132		1,336,532		2,027,381
Commerce	288,637				3,098,283							3,386,920
Factors	1,154,976	1,434,140	517,662					485,877	163,516			3,756,172
Household Incomes				3,756,172	31,258	18,899	407,126		2,520	82,221	45,720	4,343,916
Investments	117,681	53,873	71,057		567,750			41,499				851,861
Remittances										78,018	329,108	407,126
Agro-industries			958,010					198,356		1,297,735	94,390	2,548,490
Government		667	162		3,188			381		161,638		166,036
Rest-of-Country	367,043	501,031	1,586,402		56,046	755,026		552,459				3,818,008
Rest-of-World					569					575,005	569	576,142
TOTAL	1,931,712	2,027,381	3,386,920	3,756,172	4,343,916	851,861	407,126	2,548,490	166,036	3,818,008	576,142	

Table 4: Matrix for the Dominican Rural Sector, in Reduced Form (actual matrix features 61 rows and columns). All in thousands of $US. Sources: ENCOVI dataset, PUCMM dataset, 1991 SAM (Domincan Central Bank), and own estimations.

	Percentage Change in Price		
	i Low Case (6th Year)	ii Medium Case (12th Year)	iii Full Case (20th Year)
Agricultural Goods with Exogenous Prices			
Rice	0.00	-2.70	-16.70
Beans	-8.00	-16.00	-20.00
Potatoes	-8.40	-16.70	-16.70
Sweet Potatoes	-6.70	-13.40	-16.70
Onions and Garlic	-8.00	-16.00	-20.00
Livestock	-4.70	-10.7	-19.00

Table 5: Direct Price Shocks (%) Resulting from the DR-CAFTA Tariff Reductions. The livestock price-shock is an output-weighted average of the shocks on beef, pork, chicken and milk. (Source: Model Simulations).

	Percentage Change in Production		
	i Low Case (6th Year)	ii Medium Case (12th Year)	iii Full Case (20th Year)
Rice	2.48	3.47	-4.61
Sugarcane	1.66	4.12	9.65
Traditional Exports	1.27	3.00	6.25
Beans	-12.58	-23.87	-19.36
Potatoes	-6.48	-12.80	-8.34
Sweet potatoes	-1.81	-3.74	-4.62
Cassava	0.84	1.97	4.05
Onion and Garlic	-6.25	-12.39	-12.87
Industrial Tomato	0.65	1.50	2.92
Other Fruit	0.98	2.20	4.05
Vegetables	2.24	5.90	15.56
Plantain	1.02	2.40	4.97
Livestock	-5.57	-12.70	-22.42
Construction	-0.10	-0.21	-0.39
Hotels/Restaurants	-0.56	-1.24	-2.26
Transportation	-0.40	-0.89	-1.60
Other services	-0.14	-0.31	-0.53
Commerce	-1.01	-2.50	-5.47

Table 6: Production Shifts (%) in Response to DR-CAFTA-Induced Price Drops (Source: Model Simulations).

		Percentage Change in Factor Wage		
		i	ii	iii
		Low Case (6th Year)	Medium Case (12th Year)	Full Case (20th Year)
Hired Dominican Agricultural labor	Females	0.53	1.87	6.92
	Males	-3.61	-9.73	-25.16
Hired Dominican Non-Agricultural labor	Females	0.39	0.56	-0.33
	Males	0.38	0.51	-0.41
Hired Haitian Agricultural labor	Females	1.26	2.97	6.18
	Males	-1.89	-4.16	-7.30
Hired Haitian Non-Agricultural labor	Females	0.27	0.27	-0.86
	Males	0.47	0.73	-0.01
Family Agricultural labor	Females	2.07	4.50	7.62
	Males	-1.30	-2.69	-3.95
Family Non-Agricultural labor	Females	3.30	7.10	11.66
	Males	2.22	4.66	7.20

Table 7: Percentage Changes in Wages after DR-CAFTA Price Shocks (Source: Model Simulations).

		Percentage Change in Nominal Income			
		i	ii	iii	iii'
		Low Case (6th Year)	Medium Case (12th Year)	Full Case (20th Year)	Female-to-Male Difference (Full Case)
Dominican Agricultural households	Female-headed	-1.88	-4.45	-9.17	2.79
	Male-headed	-2.58	-6.00	-11.96	
Dominican Non-Agricultural households	Female-headed	0.31	0.49	0.04	2.67
	Male-headed	-0.33	-0.96	-2.63	
Haitian households	Female-headed	0.02	-0.01	-0.20	3.16
	Male-headed	-0.83	-1.86	-3.36	

Table 8: Percentage Changes in Income after DR-CAFTA Price Shocks (Source: Model Simulations).

		Compensating Variation as a Percentage of Pre-Reform Income			
		i	ii	iii	iii'
		Low Case (6th Year)	Medium Case (12th Year)	Full Case (20th Year)	Female-to-Male Difference (Full Case)
Dominican Agricultural households	Female-headed	1.56	3.69	7.65	-2.53
	Male-headed	2.21	5.12	10.18	
Dominican Non-Agricultural households	Female-headed	-0.42	-0.79	-0.78	-2.06
	Male-headed	0.13	0.41	1.28	
Haitian households	Female-headed	-0.12	-0.25	-0.31	-3.21
	Male-headed	0.73	1.62	2.90	

Table 9: Measures of Compensating Variation (Percentage of Pre-Reform Income). ***Negative*** **Compensating Variation means household is *better* off. (Source: Model Simulations)**

			DR-CAFTA-offsetting evolutions of the rural economy			
		iii	iv	v	vi	vii
		Full Case	(iii) + Agricultural productivity	(iii) + Exports	(iii) + Urban demand	(iii) + Current Trends
Size of the offsetting effect needed to neutralize overall rural CV						
	Agricultural productivity	-	+17.5%	-	-	*
	Export demand	-	-	+35%	-	**
	Urban demand for labor	-	-	-	+6.4%	***
DREM-CV (Welfare Effects)						
Dominican Agricultural	Female-headed	7.65	0.95	1.25	4.76	-3.90
	Male-headed	10.18	1.29	1.32	7.16	-4.16
Dominican Non-Agricultural	Female-headed	-0.78	-0.34	0.27	-2.91	-3.87
	Male-headed	1.28	0.03	0.39	-3.31	-7.17
Haitian	Female-headed	-0.31	-3.43	-8.48	-1.33	-4.18
	Male-headed	2.90	-5.88	-14.41	1.98	-4.06
Income Effects						
Dominican Agricultural	Female-headed	-9.17	-1.77	-1.74	-4.21	6.27
	Male-headed	-11.96	-2.32	-1.99	-6.61	6.73
Dominican Non-Agricultural	Female-headed	0.04	0.09	-0.33	4.85	7.55
	Male-headed	-2.63	-0.28	-0.49	5.84	12.85
Haitian	Female-headed	-0.20	3.16	8.46	2.14	5.86
	Male-headed	-3.36	5.61	14.38	-1.12	5.79

Table 10: Offsetting Negative Effects of DR-CAFTA. (Source : Model Simulations). Column (vii) treatments correspond to average yearly trends in recent years. *Differs for each crop in the model (range -8.8% to +78%) Source: FAOSTAT database 1984-2004. **Equals +47% for all exports. Source: FAOSTAT database 1984-2004. ***Differs for male and female workers (males +2.8%, females +28.2%). Source: LABORSTA database 1996-2007.

		Percentage Change in Wages					
		A	B		C	D	
		Non-Gendered	Gendered Labor		Gendered Households	Fully Gendered	
		%	%	f-m	%	%	f-m
Hired Dominican Agricultural labor	Females	-24.42	6.92	(32.08)	-24.42	6.92	(32.08)
	Males		-25.16			-25.16	
Hired Dominican Non-agricultural labor	Females	-3.01	-0.25	(0.06)	-3.11	-0.33	(0.06)
	Males		-0.31			-0.41	
Hired Haitian Agricultural labor	Females	-6.22	6.18	(13.47)	-6.23	6.18	(13.48)
	Males		-7.29			-7.30	
Hired Haitian Non-agricultural labor	Females	-2.78	-0.75	(-0.82)	-2.87	-0.86	(-0.85)
	Males		0.07			-0.01	
Family Agricultural labor	Females	-6.54	7.57	(11.54)	-6.62	7.62	(11.57)
	Males		-3.97			-3.95	
Family Non-agricultural labor	Females	3.64	11.63	(4.42)	3.61	11.66	(4.46)
	Males		7.21			7.20	

Table 11: Impacts on Wage in simulation (iii) Compared for Non-Gendered and Gendered Models. [The "%" columns give the percent wage shock for each group; the "f-m" columns in parentheses show the gender differential between female and male wage-shocks in the same group.]

		Percentage Change in Incomes					
		A	B	C		D	
		Non-Gendered	Gendered Labor	Gendered Households		Fully Gendered	
		%	%	%	f-m	%	f-m
Dominican Agricultural	Female-headed	-12.01	-11.58	-9.93	(2.42)	-9.17	(2.79)
	Male-headed			-12.35		-11.96	
Dominican Agricultural	Female-headed	-3.39	-1.92	-1.55	(2.50)	0.04	(2.67)
	Male-headed			-4.05		-2.63	
Haitian	Female-headed	-3.06	-3.24	-0.85	(2.30)	-0.20	(3.56)
	Male-headed			-3.15		-3.36	

Table 12: Impacts on Income in simulation (iii) Compared for Non-Gendered and Gendered Models. [The "%" columns give the percent income shock for each group; the "f-m" columns show the gender differential between female and male income-shocks in the same group.]

		Compensating Variation as a percentage of income					
		A Non-Gendered	B Gendered Labor	C Gendered Households		D Fully Gendered	
		%	%	%	f-m	%	f-m
Dominican Agricultural	Female-headed	9.84	9.86	7.96	(-2.16)	7.65	(-2.53)
	Male-headed			10.12		10.18	
Dominican Non-agricultural	Female-headed	1.49	0.76	0.17	(-1.76)	-0.78	(-2.06)
	Male-headed			1.93		1.28	
Haitian	Female-headed	2.41	2.78	0.30	(-2.19)	-0.31	(-3.21)
	Male-headed			2.49		2.90	

Table 13: Compensating Variation in simulation (iii) Compared for Non-Gendered and Gendered Models. [The "%" columns give the CV as percentage of income for each group; the "f-m" columns show the gender differential between female and male CV in the same group.]

Appendix A – Model description for assistance to the referees

Table 14: Accounts in the SAM of the Dominican Rural Sector

Agricultural Activities

Sector	Definition	Sector	Definition	Sector	Definition
ARRO	Rice	**FRIJ**	Beans	**PLAT**	Bananas and Plantains
BATA	Sweet Potatoes	**HORT**	Vegetables	**TABA**	Tobacco and Coffee
BOVC	All Livestock	**OFRU**	Other Fruits	**TOMI**	Tomatoes (Industrial)
CANA	Sugar Cane	**PAPA**	Potatoes	**YUCA**	Cassava
CEBO	Onions and Garlic				

Migration Activities

Code	Definition
MNAC	Migration to urban sector
MEXT	Migration abroad

Non-Agricultural Activities

Sector	Definition
CONS	Construction
HOTE	Hotels and Restaurants
TRAN	Transportation
OSER	Other Services
COME	Commerce
FINA	Financial Services

Factors of Production

Factor	Definition
AHDF	Agricultural Hired Dominican Females
AHDM	Agricultural Hired Dominican Males
NHDF	Non-agricultural Hired Dominican Females
NHDM	Non-agricultural Hired Dominican Males
AHHF	Agricultural Hired Haitian Females
AHHM	Agricultural Hired Haitian Males
NHHF	Non-agricultural Hired Haitian Females
NHHM	Non-agricultural Hired Haitian Males
AFFE	Agricultural Family Female Labor
AFMA	Agricultural Family Male Labor
NFFE	Non-agricultural Family FEmale Labor
NFMA	Non-agricultural Family MAle Labor

Households

Household	Definition
ADFH	Agricultural Dominican Female-Headed household
ADMH	Agricultural Dominican Male-Headed household
NDFH	Non-agricultural Dominican Female-Headed household
NDMH	Non-agricultural Dominican Male-Headed household
HFHH	Haitian Female Headed Household
HMHH	Haitian Male Headed Household

Savings and Investment Accounts

Code	Definition
AHAN	Purchase/Sale of Animals
AHTI	Purchase/Sale of Land
AHVI	Investment in Home-Improvement
AHOT	Investments in other Physical Capital
AHED	Investments in Education
AHSA	Investments in Health

Exogenous Accounts – Out of the Rural Sector

(1) Transformation of Agricultural Products

Sector	Definition
PARR	Rice Processing
PAZU	Sugarcane Processing
PALI	Food Industry
PTAB	Tobacco Industry

(2) Other

Code	Definition
GOBI	Government
RPAI	Rest of the Country
HAIT	Haiti
RMUN	Rest of the World

Equations in the DREM for the Dominican Rural Sector

Production Technology	
Goods Produced by Household *h*, Q_i^h, *i=1,…,v*	$Q_i^h = a_i^h \left(FL_i^h\right)^{\alpha_{FL,i}^h} \left(L_i^h\right)^{\alpha_{L,i}^h} \left(T_i^h\right)^{\alpha_{T,i}^h} \left(\bar{k}_i^h\right)^{1-\alpha_{FL,i}^h-\alpha_{L,i}^h-\alpha_{T,i}^h}; \quad i=1,..,v$
Goods Not Produced by Household *h*	$Q_i^h = 0; \quad i = v+1,\dots,I$
Assumption (Y^H = Total Income, I^H = Exogenous Income)	$Y^H = \sum_i (p_i Q_i^h - wL_i^h - p_x X) + w\bar{L}^h + REM^h + I^h = \sum_i p_i c_{hi}$
Factor Demands	
Family Labor, FL_i^h	$FL_i^h = \frac{\alpha_{FL,i}^h \cdot p_i \cdot Q_i^h}{\varpi^h}$
Hired Labor, L_i^h	$L_i^h = \frac{\alpha_{L,i}^h \cdot p_i \cdot Q_i^h}{w}$
Land T_i^h and Capital k_i^h	$T_i^h = \bar{T}_i^h, \quad k_i^h = \bar{k}_i^h$
Consumption Demands, c_i^h	$c_i^h = \frac{\beta_i^h Y^h}{p_i}$
General Equilibrium Conditions for Factors	
Family Labor (Determines Shadow Wage, ϖ^h)	$\sum_i FL_i^h + MIG_{FL,NAT}^h + MIG_{FL,EXT}^h = \overline{FL}^h$
Hired Labor (Determines Wages, w)	$\sum_h \sum_i (L_i^h) = \sum_h (\overline{LS}^h - MIG_{L,NAT}^h - MIG_{L,EXT}^h)$
Land (Determines Shadow Rents, r_i^h, for Each Household)	$r_i^h = p_i \frac{\partial Q_i^h (FL_i^h, L_i^h; \bar{k}_i^h, T_i^h)}{\partial T_i^h}, \quad \bar{T}_i^h = T_i^h \quad \forall i$

Migration	
National, $MIG^h_{FL,NAT}$ $r_i^h = p_i \frac{\partial Q_i^h(FL_i^h, L_i^h; \overline{k}_i^h, T_i^h)}{\partial T_i^h}$, $\overline{T}_i^h = T_i^h \quad \forall i$ (Marginal Remittance is Equal to Wage)	$MIG^h_{FL,NAT} = \frac{\gamma^h_{FL,NAT} \cdot REM^h_{FL,NAT}}{\varpi^h}$, $MIG^h_{L,NAT} = \frac{\gamma^h_{L,NAT} \cdot REM^h_{L,NAT}}{w}$
Abroad, $MIG^h_{FL,NAT}$ (Exogenous)	$MIG^h_{FL,NAT} = \overline{MIG}^h_{FL,NAT}$, $MIG^h_{L,NAT} = \overline{MIG}^h_{L,NAT}$
Remittances, $REM^h_{FL,NAT}$ y $REM^h_{L,NAT}$	$REM^h_{FL,NAT} = \gamma_0{}^h_{FL,NAT} MIG^{h\ \gamma^h_{FL,NAT}}_{FL,NAT}$ $REM^h_{L,NAT} = \gamma_0{}^h_{L,NAT} MIG^{h\ \gamma^h_{L,NAT}}_{L,NAT}$
General Equilibrium Conditions for Goods	
Tradable Goods (MS_i^h Net Marketed Surplus, Sold at Market Price, p_i)	$Q_i^h - c_i^h = MS_i^h$
Non-Tradable Goods (Marketed Surplus = 0; Determines Shadow Price, ρ_i^h , for Subsistence Goods)	$Q_i^h - c_i^h = 0$
Model Parameters	$a_i^h, \alpha^h_{i,f}, \beta_i^h, \gamma^h_{0i}, \gamma^h_{f,NAT}, \gamma^h_{f,EXT}$