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Effects of Free Trade on Women and Immigrants: CAFTA and the Rural Dominican Republic

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Summary. — We construct a disaggregated rural economywide model with a focus on gender and immigration as well as on the allocation of time to wage work, household production activities, and housework (reproduction). We use this model to simulate the impacts of the Dominican Republic-Central American Free Trade Agreement (DR-CAFTA) on rural incomes and welfare in the Dominican Republic. We find that elimination of agricultural import tariffs hurts both agricultural and non-agricultural households, *via* adverse factor-market effects, but impacts vary substantially by workers' gender and country of origin. Females and Haitian immigrants tend to fare better than Dominican males, and there are ramifications for both market and non-market activities.

Key words — gender, immigration, general equilibrium models, Dominican Republic, Haiti, Central America and the Caribbean

1. MOTIVATION AND LITERATURE REVIEW

Who are the winners and losers from free trade? It is generally believed that trade liberalization has positive impacts for most, although its effects may differ across social classes, industries, and regions within countries. Identifying losers is particularly relevant in rural areas of less developed countries, which are home to 75% of the world's poor. The sign and size of impacts are likely to be determined by idiosyncratic factors such as preferences, income sources, and differences in employment opportunities across households and worker groups.

There are fundamental differences between men's and women's access to labor markets, production activities, and intra-household wealth in rural economies (Anker, 1998). Reliance on immigrants for low-skilled labor in agricultural production is a frequent phenomenon throughout the world (Taylor, 2010), and most international migration is toward developing countries (Massey *et al.*, 1998). In light of this, the restructuring of rural economies around new trade regimes is unlikely to be neutral with regard to gender or immigration status. Despite growing awareness that the impacts of policy outcomes vary among demographic groups, neither gender nor immigration have been the focus of much trade policy modeling.

The present research brings gender and immigration status squarely into a model aimed at understanding the impacts of agricultural trade and policy shocks in a rural economy. Our Gender and Immigration Model (GIMO) draws heavily on the Computable General Equilibrium (CGE) tradition, with the important distinction that it is constructed for a rural rather than a national or multi-nation economy. The key question we address is whether workers' gender and immigration status shape policy impacts in the rural Dominican Republic, and if so, how. We explicitly model the imperfect allocation of labor among paid and unpaid work, agricultural and non-agricultural work, housework, and leisure. Our model highlights ways in which workers may be affected differently depending on their gender and national origin as well as disparities in welfare impacts among female- and male-headed Dominican and Haitian immigrant households.

(a) *Modeling the impacts of agricultural trade and policy reforms*

For developing countries entering into new trade regimes, reforms frequently entail the elimination of import tariffs on agricultural products (Taylor, Yunez-Naude, & Jesurun-Clements, 2010). Overwhelmingly, the view of researchers and policy makers alike has been that urban residents win but rural populations lose from food tariff removal. The urban gain results from lower consumption costs, while the rural loss is a consequence of increased competition with imported agricultural and livestock goods, which depresses both profits and wages in a sector in which less developed countries presumably have a comparative advantage.

Aggregate empirical studies offer mixed findings on the welfare effects of trade reforms. Tangermann (2005), using the Global Trade Analysis Project (GTAP) platform, concludes that full agricultural liberalization by high-income countries would enhance the nonagricultural terms of trade for developing countries, thus yielding income gains. However, Anderson and

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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.

Micro agricultural household theory suggests that the impacts of agricultural market liberalization on less developed country rural welfare are ambiguous. Rural households lose as agricultural producers or suppliers of factors to farms when the prices of farm goods decrease. However, they also consume food, and many farmers are net buyers of protected commodities (Minot & Goletti, 1998; Zezza *et al.*, 2008). 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 types of rural households. Furthermore, market linkages create general equilibrium effects. For example, a decrease in the price of food grains may benefit households that grow fruits and vegetables if it leads to a drop in wages or land rents. Even the apparently simple impacts of agricultural trade reforms on factor prices are ambiguous; they depend on the relative factor intensities of the directly and indirectly affected activities.

New research using disaggregated rural economywide models (DREMs) casts doubt on the assumption that rural household welfare is inversely related to food prices. Taylor, Dyer, and Yúnez-Naude (2005) find that lower import tariffs on food reduce nominal incomes for nearly all rural household groups in El Salvador, Guatemala, Honduras, and Nicaragua. However, they also lower consumption costs substantially. The net effect on welfare is positive in most cases, implying that pre-CAFTA agricultural protection policies were disadvantageous for most rural household groups.

Trade liberalization thus unleashes a complex interweaving of influences in rural markets, and the net welfare outcomes are difficult to predict. Computable General Equilibrium (CGE) modeling is a useful tool to research this topic, and it occupies a central place in the prolific literature on trade integration. CGEs are designed to portray whole economic systems with many actors and activities interacting in multiple markets and through multiple feedback channels. They can highlight specific mechanisms underlying aggregate impacts of trade policies. CGEs all share a similar structure, with equations describing the behavior of each institution or actor in the model: production activities, factors, households, and exogenous actors such as governments or world markets, as well as the flow of goods and income between actors (i.e., activities demanding factors or households paying for commodities). They are differentiated by their scope (the boundaries of the economy being modeled); the disaggregation of production sectors, factors and households; and the choice of functional forms representing the behavior of groups of similar agents. In their most disaggregated form, they nest general equilibrium models of individual, heterogeneous actors within a general equilibrium model of a larger economy (Dyer, Boucher, & Taylor, 2006). Aggregate country CGEs also may be nested within a multinational CGE model (e.g., Robinson, Burfisher, Hinojosa-Ojeda, & Thierfelder, 1993).[1]

(b) *Disaggregation of trade policy impacts*

It is often convenient to think of trade policy impacts in terms of GDP or *per-capita* income. However, such aggregate outcomes tend to hide important variations in impacts across sectors and socioeconomic groups. Because of this, it has become standard for CGE models to distinguish among multiple productive activities, household types, and worker groups. Studies using the GTAP model, arguably the most commonly used aggregate general equilibrium modeling platform, recently emphasized the importance of disaggregating poverty impacts (Hertel, Keeney, Ivanic, & Winters, 2009).[2]

Distinct labor groups may be included in CGE models if modelers have access to disaggregated information on salaries paid to workers participating in different activities, holding different positions, or earning different wages. The number of worker categories in CGE models of trade reforms usually is limited. The criterion of choice is almost always skill level, although a rural–urban divide is not uncommon (Cloutier *et al.*, 2008). GIMO distinguishes laborers by their gender and national origin.

The number of household types in CGEs usually is limited but on occasion reaches several dozen (Devarajan & van der Mensbrugghe, 2000; Harrison, Rutherford, & Tarr, 2003) or even all households surveyed for the study (Chitiga, Cockburn, Decaluwé, Fofana, & Mabugu 2010; Cockburn, 2002; Dyer *et al.*, 2006). The level of disaggregation is a function of data availability and modeling objectives. Greater disaggregation enables modelers to explore differences in the ways in which households experience policy shocks, and in some models, the ways in which heterogeneous household responses shape aggregate outcomes.

Almost all models distinguish household types by their initial income levels relative to a poverty line or as income percentiles (Cloutier *et al.,* 2008). This is a convenient criterion clearly correlated with capital ownership, skill levels, and expenditures. It allows researchers to interpret simulation results in terms of inequality. Income patterns are also related to a household's endowment of production factors. For example, landowners can derive income from their capital by way of agricultural production, while landless households have to sell their labor for wages. That is why many models of rural economies distinguish households by land ownership (Adelman, Taylor, & Vogel, 1988; Bautista & Thomas, 2000; Taylor & Dyer, 2009). Sometimes, households are also distinguished by their primary source of income (agriculture, wage labor, transfers, *etc.*). In our model, we distinguish agricultural from rural non-agricultural households. The agricultural policies embedded in CAFTA will alter the prices of agricultural commodities and thus affect the income of agricultural households directly. Non-agricultural households may be affected *indirectly via* general equilibrium effects on rural factor and commodity markets. Differentiating between agricultural and non-agricultural rural households highlights these indirect income effects. This is particularly important in light of the non-negligible share of non-agricultural households in the rural economies of the developing countries long thought to be predominantly agricultural (Ellis, 2000).

While high levels of disaggregation are now standard in economywide models, gender and immigration status are rarely used as a basis for categorizing household types or worker groups. This masks potentially important trade reform impacts.

(c) *Disaggregating gender and immigrant status in an economywide model*

Labor market disparities along gender, social, or ethnic divisions have been studied extensively. The distribution of males and females across occupations is notoriously unequal, at all geographic levels. Worldwide, in order to equalize this distribution, about 60% of working females would have to switch jobs; this figure is usually higher in developing than in developed countries (Anker, 1998, p. 175). In the US, racial and

ethnic occupational segregations are pervasive (Queneau, 2009). In terms of wages, race and gender gaps unexplained by skills are a recurring puzzle in labor economics (Altonji & Blank, 1999). The earnings differential between Blacks and Whites in the US drew significant attention early on (Brown, 1984; Heckman, Lyons, & Todd, 2000), inspiring economic models of discrimination (Akerlof, 1976; Becker, 1971; Welch, 1967). Findings from these studies suggest that macroeconomic shocks affecting employment are likely to create differential impacts along occupational segregation lines, by gender, race, ethnicity, or immigration status. Case studies have documented this for the male–female wage gap (Artecona & Cunningham, 2002; Ghiara, 1999; Kanji & Jazdowska, 1993; Oostendorp, 2004). 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. There are also studies of the effect of macroeconomic shocks on racial or ethnic disparities (Brysk & Wise, 1997; Shari, 2000), though they tend not to focus specifically on wage gaps and labor market opportunities.

Findings such as these suggest that economywide modelers should pay careful attention to occupational segregation when choosing disaggregation criteria. In the case of the Dominican Republic, occupational segregation by gender and immigrant status in agricultural activities is striking. Haitians have become an important labor and ethnic group in rural areas.[3] Table 1 illustrates the composition of the agricultural workforce in the Dominican Republic. Dominican males represent the bulk of agricultural workers, both farmers working their own land and hired labor. Haitians do not own land and do not work as family labor, but they often are hired laborers in traditional exports (particularly sugarcane, tobacco, and coffee). Dominican females participate in select agricultural activities: they often work as family labor in coffee production (at harvest time) or as hired labor for tobacco producers. They recently also began working on modern, export-oriented vegetable farms, a growth sector in the Dominican Republic. Haitian females are seldom found working in agricultural jobs. This occupational segregation of the agricultural workforce underlines the importance of distinguishing worker groups by gender and national origin while studying the impacts of agricultural trade liberalization.

Household types in GIMO are also distinguished by national origin. Because many Haitian households rely on wage income from specific agricultural activities, they may be particularly vulnerable to changes in agricultural policy. Both male and female Haitian households depend heavily on wages and generally have weaker access to physical assets than Dominican households: less than 2% of their income comes from self-employment, by far the smallest percentage among the groups we model. They also earn, on average, much less than the other household groups, representing the most income-constrained households in our model (income sources are presented in Table 3). The effect of CAFTA policies on Haitian households will operate largely through changes in rural labor market opportunities.

We also break down households by headship, into male- and female-headed households. This captures other gendered features of the economy, which run deeper than just segregation in the labor market. Females (and by extension female-headed households) often have access to different sources of income and rely on different survival strategies than males (Dwyer & Bruce, 1988; Sen, 2001, Chapter 8), they participate in different production and reproduction activities (Fontana & van der Meulen Rodgers, 2005), and they tend to spend their income differently from males (Dwyer & Bruce, 1988), implying different utility functions.[4] Tables 3 and 4, discussed below, reveal that female-headed households in our data differ from male-headed households in terms of their asset ownership and sources of income.

(d) *Unpaid work, housework, and leisure*

One reason to distinguish between hired and unpaid family workers is that their contribution to output may be different (Eswaran & Kotwal, 1986). Another reason is that hired and unpaid labor may be drawn from different gender, immigrant, or ethnic groups. In the Dominican Republic, Haitians working in agriculture are overwhelmingly wage workers. In fact, our data sources did not uncover a single Haitian immigrant who cultivated his or her own land or worked on family plots. Many Haitians, however, were engaged in unpaid non-agricultural work as service-providers on their own account. Similarly, females often provide unpaid labor, both in agricultural and non-agricultural businesses. They have been described as the "invisible workers" of developing country agriculture, long ignored by national statistics and rural development programs (Boserup, 1970; Dixon, 1982; Safilios-Rothschild, 1985). Women's contribution to the productive economy remains chronically underestimated (Beneria, 2001; Waring, 1990).

In addition to unpaid "productive" work, the gender literature has drawn attention to the importance of "reproductive" work (housework, cooking, cleaning, child-rearing, *etc.*). The burden of this work, sometimes referred to as "care", disproportionally falls on women (Fuwa, 2004). Many explanations have been offered as to why that might be the case, drawing from a range of economic and sociological arguments (reviewed in Coltrane, 2000; Shelton & John, 1996). In the Dominican Republic in particular, a recent gender assessment report points to a "traditional view of women's roles" and a culture of "*machismo*" (Lambert,

Table 1. *Breakdown of labor hours in five selected agricultural activities*

		Rice (%)	Sugarcane (%)	Tobacco (%)	Coffee (%)	Vegetables (%)
Hired labor	Dominican females	0	0	15	0	4
	Dominican males	79	25	45	4	48
	Haitian females	0	0	3	0	0
	Haitian males	9	27	32	39	9
Unpaid labor	Dominican females	1	2	0	15	2
	Dominican males	11	46	4	41	37
	Haitian females	0	0	0	0	0
	Haitian males	0	0	0	0	0
Total		100	100	100	100	100

Source: PUCMM agricultural survey (unpublished).

Table 2. *Disaggregation in general equilibrium models with a focus on gender*

Reference	Country	# Labor groups	# HH types	Distinction by gender		Distinction by nationality/ ethnicity		Repro-ductive sector	Leisure	Unpaid productive labor	Imperfect transferability of labor	Comments, additional features
				Labor groups	HH types	Labor groups	HH types					
Fontana and Wood (2000)	Bangladesh	2	1	Yes	No	No	No	Yes	Yes	No	No	Pioneered inclusion of reproductive economy.
Arndt and Tarp (2000)	Mozambique	3	2	Yes	No	No	No	No	No	No	No	Features Risk. Simulate technological change, reduction of price margins.
Fontana (2001)	Bangladesh	8	9	Yes	Yes	No	No	Yes	Yes	No	No	
Fontana (2002)	Zambia	8	4	Yes	No	No	No	Yes	Yes	No	No	
Fofana, Cockburn, and Décaluwé (2003)	Nepal	2	7	Yes	No	No	No	Yes	Yes	No	No	Calibrate leisure econometrically.
Sinha and Sangeeta (2003)	India	6	13	Yes	No	No	No	No	No	No	No	Recursive dynamics.
Fofana *et al.* (2005)	South Africa	8	4	Yes	No	Yes	Yes	Yes	Yes	No	No	Simulate tax policy.
Siddiqui (2005)	Pakistan	2	1	Yes	No	No	No	Yes	Yes	No	No	
Arndt *et al.* (2006)	Mozambique	10	2	Yes	No	No	No	No	No	No	No	Ex-post microsimulation
Cockburn *et al.* (2009)	Ghana, Honduras, Senegal, Uganda	8, 8, 6, 6	2, 1, 1, 2	Yes	No	No	No	No	No	No	No	Dynamic modeling
Siddiqui (2009)	Pakistan	8	9	Yes	Yes	No	No	Yes	Yes	No	No	Intra-household module
Terra *et al.* (2009)	Uruguay	4	10	Yes	No	No	No	Yes	Yes	No	No	
Present model	Dominican Republic	4	6	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	CET imperfect labor allocation choices.

Table 3. *Shares of yearly income of dominican households*

	Dominican				Haitian		All households
	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: ENCOVI Dataset.

Table 4. *Descriptive statistics (Sample used to construct the SAM for the Dominican rural sector)*

	Dominican				Haitian		All households
	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 high-school	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 Dataset.

2009) as contributing to the unequal distribution of household workload. What is certain is that reproductive work creates a time constraint that disproportionally affects women. Feminist economics and social sciences have long recognized this trade-off between female formal employment and care provision (Elson, 1995; Razavi, 2007; Çagatay, 2001). Elson (1995) describes how such a situation may affect policy outcomes, in particular with respect to structural adjustment in developing countries. She argues that omitting "reproductive" work in economic models is tantamount to assuming that women can absorb an unlimited increase in their workload. GIMO distinguishes among wage-work, unpaid productive labor, and reproductive work, with imperfect transformability of time use from one activity to another. This disaggregation of time use and the way in which we model imperfect labor supply are innovative methodological contributions of GIMO.

(e) *Previous economywide models including gender or immigrant status*

The idea of using gender as a distinguishing criterion in general-equilibrium models is about 10 years old. Gendered CGE models were first published in a 2000 special edition of *World Development* (Arndt & Tarp, 2000; Fontana & Wood, 2000). Since then, several "gendered" CGE models have been published. Our literature review turned up slightly more than a dozen, some of which are compared in Table 2. Most of these models are used to simulate effects of hypothetical shocks such as increases in demands for exports, reductions of import tariffs, or tax reforms. The trade reform we model is not hypothetical but instead corresponds to a recently adopted treaty.

"Gender aware" models all distinguish between men and women in the labor market; some include no further gendered features (Arndt, Robinson, & Tarp, 2006; Arndt & Tarp,

2000; Cockburn, Decaluwé, Fofana, & Robichaud, 2009; Sinha & Sangeeta, 2003). Some gendered CGE's, like ours, distinguish household types by gender of the household head (Chitiga *et al.*, 2010; Fontana, 2002; Siddiqui, 2009). [5]

The original model of Fontana and Wood (2000) featured leisure and reproductive activities, highlighting the importance of the non-economic sector in determining policy impacts for females. Leisure and reproduction were treated as non-tradable goods, produced using labor in the same way as any activity but constrained to be consumed domestically. This is formally identical to the treatment of subsistence goods in agricultural household (De Janvry, Fafchamps, & Sadoulet, 1991) and village (Taylor & Adelman, 1996) models. Several gendered CGEs, following Fontana and Wood's lead, model non-economic sectors in a similar fashion (Siddiqui, 2005; Terra, Bucheli, & Estrades, 2009). Studies by Fofana, Cockburn, and Décaluwé (2003), Fofana, Cockburn, Decaluwé, Chitiga, and Mabugu (2005) are similar in most respects but model labor supply to production activities as an explicit function of income and leisure as the residual.

Studying the welfare of a group of recent immigrants in a general equilibrium model for a developing country has not, to our knowledge, been done before. Models that focus on immigration do not usually distinguish migrants as households or consumers, but rather as a group of unskilled workers. Some highlight the effects of an influx of unskilled labor on developed economies (Brücker & Kohlhaas, 2004; Pouliakas, Roberts, Balamou, & Psaltopoulos, 2008). Dixon, Johnson, and Rimmer (2011) use a CGE model to evaluate anti-immigration policies in the US. In the developing world, Sussangkarn (1996) models foreign workers in Thailand as a separate group of unskilled laborers. [6] GIMO contrasts with these models because it distinguishes immigrants not only as laborers but also as groups of households. In this sense, it is more similar to CGE models that distinguish among racial or ethnic groups. Examples include several models of South Africa (Devarajan & van der Mensbrugghe, 2000; Fofana, Cockburn, Decaluwé, Chitiga, & Mabugu, 2005; Mabugu & Chitiga, 2007) and one of Sri Lanka (Weerahewa, 2004).

2. MODEL DESCRIPTION AND DATA SOURCES

Our goal is to investigate the impacts of DR-CAFTA's agricultural provisions on the rural Dominican Republic, with particular focus on gender and immigration. The model we use was designed specifically for this purpose. The underlying structure is, in essence, a Computable General Equilibrium (CGE) model of a rural economy. The urban sector of the Dominican Republic is considered exogenous to the economy we model, just as the rest of the world is exogenous in a country CGE. [7] We distinguish among 13 agricultural, 5 non-agricultural, two reproduction, and two leisure activities. Each activity produces a single "commodity," which is either consumed by rural households or traded into the urban sector or the rest of the world. There are six household types, each with Cobb-Douglas preferences over the consumption of all commodities, including reproduction and leisure. They allocate a fixed share of income to savings, education, and health. Macroeconomic closure is assured by savings-driven investment (in the sense of Cloutier *et al.* (2008)). Taxes and government transfers are exogenous.

The noteworthy features of the model stem from our focus on females and immigrants. Production requires capital (agricultural or non-agricultural) and up to eight different types of labor (paid or unpaid, local or immigrant, and male or female). This labor is supplied by four categories of workers distinguished by their gender and national origin (Dominican or Haitian). Production functions are of the Cobb-Douglas form, meaning that the various groups are imperfectly substitutable factors with an elasticity of substitution equal to one. [8]

Our modeling of the "non-productive" sectors echoes previous work on gendered economywide modeling (Fontana, 2001; Fontana, 2002; Fontana & Wood, 2000; Siddiqui, 2005). Both leisure and reproduction are featured as standard activities: they employ labor and generate an output "purchased" and "consumed" by households. The value of leisure and reproduction is determined in the same way that it would be for a non-tradable good: supply meets demand within the rural economy, and this interaction determines an endogenous price. [9] In addition, we separate leisure and reproduction so that they cannot be "traded". "Dominican leisure" and "Dominican reproduction" can only be consumed by the corresponding Dominican household types; the same is true for Haitian non-productive activities and Haitian households. Unlike most other models, we also restrict the labor groups that participate in the production of "non-productive" activities: only Dominican labor can participate in the Dominican non-productive activities, and only Haitian labor can participate in the non-productive activities of Haitian households. [10]

Our household disaggregation is defined along three dimensions: immigration status, activity, and gender. The activity distinction was made only for Dominican households, for two reasons: first, Haitian households in our sample own no land and, like Non-agricultural Dominican households, they can only be impacted by CAFTA indirectly, *via* markets. Second, the sample size for Haitian households would be too small for us to confidently estimate group averages. Thus, the model distinguishes among 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 male.

We used the gender and the immigrant status of self-reported household heads to assign households to groups. Spouses in a household were almost always of the same national origin. Dominican households were defined as "Agricultural" if they had at least one member who participates in agricultural activities, either on his or her own land or for a wage. Table 3 reports sources of income for the six household groups. Non-agricultural households (third and fourth column of Table 3) live in the rural sector but do not own any agricultural capital. In our baseline they receive no income from agricultural activities whatsoever; however, in the simulations they can participate in the agricultural labor market if it becomes optimal for them to do so. This ensures that any effects we observe for non-agricultural households are exclusively driven by market linkages.

Table 4 confirms the notion that the non-agricultural side of the Dominican rural economy is sizeable: almost 60% of rural Dominican households rely exclusively on non-agricultural income sources. Descriptive statistics reveal demographic differences among household groups. Strictly non-agricultural rural households tend to be younger, wealthier, more educated, and of higher socio-economic status.

The most salient innovation of our model is its treatment of the labor market, particularly with respect to labor supply. It was designed specifically to incorporate laborers of different

genders and countries of origin, as well as unpaid labor and the non-productive sectors of the economy.

Most models divide labor into worker groups each with fixed supply and no possibility to "switch" between labor categories.[11] Depending on the categories defined in each model, this can mean for instance that male workers cannot become female (a defendable assumption), that unskilled laborers cannot become skilled (defendable in the short run), that rural workers cannot work in the urban sector, or that own-account workers cannot work for a wage (more heroic assumptions). GIMO allows for imperfect labor supply reallocation to reproduce the time-allocation choices actually faced by workers. We assume that the supply of laborers is fixed only for a given gender and nationality, but within each group it can be reallocated among six time-use categories: agricultural paid labor, non-agricultural paid labor, agricultural unpaid labor, non-agricultural unpaid labor, reproductive labor, and leisure. This allocation of labor is governed by a nested Constant Elasticity of Transformation (CET) labor supply function. We model four such CET "trees", one for each gender/origin laborer group (one of these is pictured in Figure 1). This structure captures the notion that a given type of labor can switch between some activities more easily than between others. At the top node of each CET tree, a fixed supply of labor is divided into paid and unpaid uses. Paid work, in turn, is divided into agricultural and non-agricultural, unpaid time into productive and non-productive uses. Productive work is split further into unpaid agricultural and non-agricultural work, while non-productive uses of time can be leisure or reproductive work. The elasticities in this structure portray the difficulty for unpaid workers to enter the formal (paid) labor market, or the difficulty of switching from an agricultural job to a non-agricultural one.

Once labor of a given gender and country of origin is allocated into a given time-use category, it is freely available to be used by any activity demanding such labor. This means, for instance, that the CET tree for Dominican females supplies a certain amount of paid agricultural labor, which then meets the total demand for hired Dominican female workers across the various agricultural activities we model.

The wage structure is a direct consequence of the above-described time allocation process, because wages are set by the interplay of supply and demand. Thus, the model features a specific wage (or shadow wage in the case of unpaid work) for each time-use category in each gender-origin CET tree. With 4 trees and 6 categories, this sums to 24 different market-clearing wages. Dominican females devoting their time to paid agricultural work will receive the same wage whether they work in coffee production or rice production but a different wage than their Haitian co-workers, and a different wage than they would receive working in services.

This treatment of labor contrasts with previous studies because it focuses on the supply side. The choice of a CET structure of labor supply was driven by the need to represent unpaid labor as realistically as possible: the supply of "unpaid workers" is not driven by an exogenous constraint but by endogenous allocation choices; the implicit wage for unpaid work is determined by a supply-and-demand mechanism. The supply of labor is fixed only at the level of gender/origin groups (the top node of each CET tree), which are strictly exogenous categories.[12]

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 5) was constructed using various data sources. The information on incomes and expenditures of households was found in the ENCOVI survey (*Encuesta Nacional de Condiciones de Vida*) carried out in 2003 by the Dominican central bank. The ENCOVI surveyed more than nine thousand households, 3,991 of which were rural. They are statistically representative of the approximately 930,000 Dominican rural households (3.5 million people, with an average of 3.9 people per rural household); no weighting was required. 3,759 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

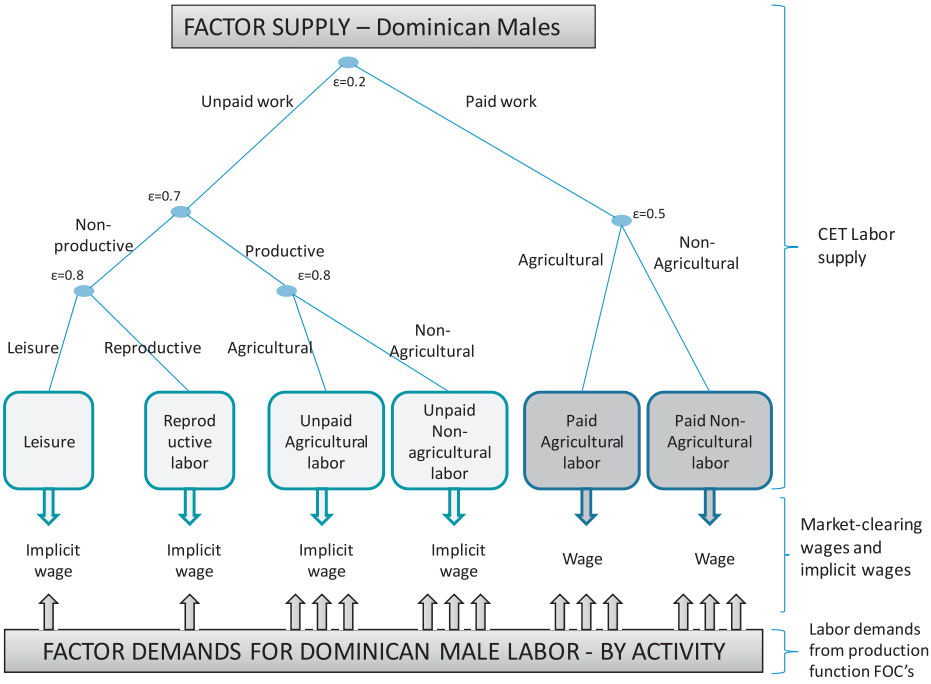

Figure 1. *Determination of labor allocation and wages for one of four laborer groups.*

Table 5. *Contracted form of the matrix for the Dominican Rural Sector (actual matrix features 61 rows and columns). Thousands of $US*

Accounts	Ag activities	Non-ag activities	Reproduction & leisure	Factors	House-holds	Investments	Agro-industries	Government	ROC	ROW	Total
Agricultural activities	3,356	131,880			117,435		1,332,112		280,081	106,056	1,970,920
Non-ag activities	285,585	40,908			3,302,236		21,141		1,540,968		5,190,838
Reproduction and leisure					2,327,429						2,327,429
Factors	1,283,675	1,447,411	2,327,429				515,967	164,238			5,738,720
Households				5,738,720	26,033	18,854	411,039	2,538	82,765	46,346	6,326,297
Investments	39,604	55,287			499,887		44,127				638,906
Agro-industries		1,022,064					218,271		1,459,592	428,771	3,128,698
Government		670			2,388		392		163,325		166,776
Rest-of-country	358,701	2,492,616			49,043	620,052	585,648				4,106,059
Rest-of-world					1,845				579,328	1,845	583,018
TOTAL	1,970,920	5,190,838	2,327,429	5,738,720	6,326,297	638,906	3,128,698	166,776	4,106,059	583,018	

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 proportion of each type of labor employed in agricultural production was elicited in our production-side survey of 220 farmers, which recorded labor inputs by gender and nationality for both hired and family labor. Values of hired labor were computed directly, using wage information. 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. With knowledge of all labor allocations to productive activities, we applied ratios of leisure-to-productive-work and reproductive-to-productive-work to estimate, for each worker group, the labor allocated to non-productive activities. Because no time-use survey is available for the Dominican Republic, we assumed time-use ratios similar to those obtained from eight other developing countries. The average ratios of leisure-to-productive-work from those studies were estimated at 0.62 ($\pm$0.30) for males and 0.59($\pm$0.38) for females, and those of reproductive-to-productive-work at 0.22($\pm$0.10) and 1.42($\pm$0.61) for males and females, respectively.[13] Labor allocation elasticities used as parameters in the CET trees had to be assumed for lack of data. Allocation is modeled to be more elastic in unpaid work than in wage work, and more elastic at the lower nodes of the CET structure. Elasticities were set to values ranging from 0.2 at the top of the CET tree (reallocation between wage work and family work) to 0.8 at the lowest levels, as shown in Figure 1[14]. We intentionally kept labor allocation elasticities equal for males and females, locals and immigrants, preferring to err on the side of caution.[15]

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 make projections, but rather to explore the possible effects of shocks related to policy reforms, to identify the actors 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 or women, locals or immigrants.

(a) *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 20 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 short and long-run simulations can be run once the model is parameterized. In this paper we report simulations of the full extent of DR-CAFTA's agricultural reforms, which will occur in 2024 once all tariffs have

been removed. The simulated price changes corresponding to DR-CAFTA's agricultural provisions appear at the top of Table 6, column (a).

Our simulations assume immediate and simultaneous tariff shocks, which are translated into price-shocks of equal magnitude. The results of our simulations point to the many potential economic pressures that may result, all else being equal, from DR-CAFTA induced price changes. In the long run, these pressures could motivate dynamic adjustments in the economy (e.g., new agricultural investments). However, we consider dynamic adjustments, like future world market price scenarios, the possible implementation of transition policies, and hypothetical increases in export demand, to be speculative and thus do not try to endogenize them in our model.

The policy experiment results are presented in Tables 6 through 9. The tables present simulated effects of DR-CAFTA on prices, production, wages, labor use and incomes, all of which are interlinked in our rural equilibrium model. We also provide a measure of equivalent variation to assess net welfare changes for each household group.

(i) *Price and production effects*

The top panel of Table 6 shows the effects on the agricultural side of the economy. The prices of Agricultural goods are determined on the world market (accounting for possible tariffs), such that only the prices of crops affected by CAFTA are subject to shocks (listed in column (a)). Price shocks affect the relative profitability of activities, prompting firms and households to alter their production decisions. Thus, the production levels of all agricultural goods are affected, regardless of whether the goods were targeted by DR-CAFTA policies or not (column (b)). Because actors face a whole set of simultaneous shocks, and because production functions are non-linear, there is no reason for production shifts to have the same magnitude as price shocks, or even the same sign. The prices of potatoes and sweet potatoes both drop by 16.7%, but production falls by 5.0% and 1.4%, respectively. The general production response of the rural sector is to shift away from rice and beans, the staples of every Dominican meal, while on the other hand export crop production increases. Traditional export crop (sugarcane, coffee, and tobacco) output rises by around 10%. The output of vegetables, a more recent export crop, increases more sharply (from a smaller base), suggesting that non-CAFTA crops may be more affected in percentage terms than some CAFTA crops.

Table 6. *Price and production shocks (%) resulting from full DR-CAFTA tariff reductions. The livestock price-shock is an output-weighted average of the shocks on beef, pork, chicken and milk*

	a % Change in price	b % Change in production
Agricultural goods (exogenous prices)		
Rice	−16.7	−6.6
Sugarcane		13.2
Other traditional exports		9.2
Beans	−20.0	−21.1
Potatoes	−16.7	−5.0
Sweet potatoes	−16.7	−1.4
Cassava		6.9
Onion and garlic	−20.0	−10.1
Industrial tomato		7.7
Other fruit		8.2
Vegetables		17.0
Plantain		9.0
Livestock	−18.7	−18.0
Rural services (endogenous prices)		
Construction	−9.2	−0.1
Hotels/Restaurants	−9.1	−0.6
Transportation	−10.5	−0.2
Other services	−12.5	0.2
Commerce	−0.4	−10.3

Source: Model simulations.

Table 6 thus serves to illustrate three points about the influence of DR-CAFTA on agriculture: (1) DR-CAFTA potentially influences the production of all crops; (2) the size of price-shocks is a poor predictor of the size of production responses; and (3) the restructuring of the rural sector in response to DR-CAFTA favors exports over staples.

The last five rows in Table 6 report indirect effects of CAFTA on non-agricultural activities in the rural sector. We model rural services as non-tradables (they cannot be exported to the cities or abroad); their prices are endogenously determined in the model. The effects of DR-CAFTA on rural services are indirect yet non-trivial. On the one hand, factor markets adjust to DR-CAFTA price shocks, altering the cost of production and thus supply of services. On the other hand, changes in rural incomes influence the demand for services. The sign of the production response is not easily predicted. A case in point is the "Other Services" sector, which shows a 12.5% decrease in price but a 0.2% increase in production. Apart from this case, our CAFTA simulations suggest that the prices of services fall and there are slight decreases in service output.

(ii) *Labor allocation and wage effects*

Table 7 reports labor-market effects of the simulated price changes. We present changes in wages and in labor allocation. As described above, the way we structured labor supply and demand in the model allows us to distinguish over twenty different wages (or shadow wages), for laborers of different genders and origins in different time-use categories. Table 7 shows that almost all wages in the economy fall sharply, which is consistent with a contraction of the economy in response to the fall in agricultural prices. The sharpest drop (−21.0%) is observed in the third column, for Dominican male agricultural workers. These workers account for the bulk of agricultural wage labor in staple foods, the most negatively affected commodities in terms of price and production. The shadow wage of unpaid females falls dramatically (−16.1%) for the same reason: much of the workforce producing staples consists of unpaid females. Haitians of both genders tend to work as street vendors and males often as day-laborers in export-oriented agriculture and construction. This explains why wages fall less for Haitian than Dominican males working in agriculture.

Two types of wages actually rise in response to DR-CAFTA: those of Dominican and Haitian females working in paid agriculture rise by 1.4% and 3.3%, respectively. The shift toward export-oriented production expands employment opportunities for females. This reflects the imperfect nature of labor supply: if females could seamlessly exit the unpaid workforce and enter the paid workforce, the positive wage effect for females employed in agriculture would disappear. [16] Dominican males suffer the largest wage shocks in both paid activities, and Haitian wages drop less than Dominican ones, suggesting a reduction in both the gender wage gap for Dominicans and the migrant wage gap.

The pattern of labor reallocation is somewhat similar to the pattern of relative wage shocks, but the matching is imperfect. The aggregate results in the lower panel of Table 7 point

Table 7. *Labor allocation and wage effects (%) resulting from DR-CAFTA Tariff Reductions*

		All workers	Dominicans		Haitians	
			Females	Males	Females	Males
Effects on Wages						
Hired workers	Paid agricultural	–	1.4	−21.0	3.3	−3.0
	Paid non-agricultural	–	−13.6	−14.5	−10.1	−10.9
	Unpaid agricultural	–	−16.1	−14.5	–	–
Family labor	Unpaid non-agricultural	–	−13.3	−13.6	−13.7	−13.7
	Dominican reproductive	–	−10.5	−10.5	–	–
	Dominican leisure	–	−11.8	−11.7	–	–
	Haitian reproductive	–	–	–	−2.8	−2.7
	Haitian leisure	–	–	–	−2.9	−2.8
Effects on Time-Use						
Aggregated results						
	Hired labor	−0.5	−0.4	−0.6	−1.2	−0.1
	Unpaid family labor	−1.7	−2.9	−1.4	−7.8	−7.9
	Non-productive labor	0.6	0.3	0.7	0.2	0.1
Disaggregated results						
Hired workers	Paid agricultural	−2.2	7.7	−3.7	5.7	0.3
	Paid non-agricultural	0.0	−0.6	0.1	−2.6	−3.8
	Unpaid agricultural	−2.1	−4.0	−1.8	–	–
Family labor	Unpaid non-agricultural	−1.1	−1.5	−1.0	−7.8	−7.9
	Dominican reproductive	−0.0	−0.0	−0.1	–	–
	Dominican leisure	1.1	1.1	1.1	–	–
	Haitian reproductive	0.1	–	–	0.2	0.1
	Haitian leisure	0.1	–	–	0.3	0.1

Source: Model simulations.

to a general trend: labor shifts away from productive activities and toward non-productive ones, consistent with the overall shrinking of the rural economy. Paid work recedes and unpaid work is less profitable due to the fall in prices, so the opportunities and incentives play against productive work. This is observed for all four gender/nationality groups, although the magnitudes of labor reallocation vary somewhat.

Disaggregating these overall effects into more precise time-use categories yields several insights. The reallocation of Dominican males follows a different pattern than that of the other groups. Dominican males turn away from agricultural employment, while Dominican females and Haitian workers all move *toward* paid agricultural work. The most dramatic percentage increases in employment are 7.7% and 5.7% for paid agricultural work by Dominican and Haitian females, respectively. This may seem counterintuitive in light of an overall contraction of the agricultural economy. However, the total loss of paid agricultural jobs (−2.2%) is born solely by Dominican males; all other groups participate increasingly in hired agricultural work. This is again reflective of the expansion of export crops, which is not sufficient to counter the loss in Dominican male jobs but provides rare employment opportunities to females and migrants of both genders.

In the aggregate, all groups reallocate their labor toward non-productive activities. This is consistent with the contraction of the productive economy, which releases labor availability for other uses. All groups allocate more time to leisure, but while leisure increases by small percentage amounts for Haitian households (0.3% and 0.1%), the jump is an order of magnitude greater for Dominican households (1.1%). In contrast, while Haitians slightly increase their allocation of time to reproductive activities, Dominicans do not. In fact, Dominican males even reduce their reproductive work somewhat (−0.1%). This outcome is the combined result of imperfect labor reallocation, unequal shares of male, and female participation in production activities, and demands for reproduction and leisure.

Our simulations show that, in the aggregate, the reallocation of labor in the rural economy is dominated by Dominican males, who represent the largest labor group. That this group fails to portray the reallocation of female and migrant labor highlights the importance of accounting for different worker groups when evaluating the labor market implications of trade reforms.

(iii) *Income and welfare effects*

Lower agricultural prices induce an expected drop in agricultural incomes. Effects on non-agricultural incomes are less predictable, as they depend on higher-order impacts: wage, output, and demand levels in the non-agricultural sector. Column (i) of Table 8 presents the percentage change in income for each household group. All households, agricultural or not, lose in nominal terms. The effects on non-agricultural households are only of slightly smaller magnitude than the effects on agricultural households. Given that non-agricultural households own no agricultural capital, this result suggests that labor market effects are substantial. Increased agricultural employment attenuates the economic shock for Haitian households, who suffer the mildest nominal income losses (around 2.5%).

The magnitudes of nominal income effects seem to favor female headed households. Each female-headed household is less impacted than its male-headed counterpart. Column (i') reports the difference between the same-demographic female and male income effects. In all cases, females fare better than males, by up to 1.9% points. This reflects the favorable effect of CAFTA on females' agricultural employment and wages.

It is commonly believed that agricultural free-trade hurts the rural sector, and our simulations show that nominal incomes indeed drop for all household groups. However, prices of purchased food and nontradables also fall in our simulation,

Table 8. *Percentage changes in income and welfare (equivalent variation as a percentage of pre-reform income) after DR-CAFTA price shocks.*

		i Nominal income %	i′ Female-to-male difference	ii Equivalent variation (% income)	ii′ Female-to-male difference
Dominican agricultural households	Female-headed	−12.0	1.0	−7.8	1.0
	Male-headed	−13.0		−8.8	
Dominican non-agricultural households	Female-headed	−8.2	1.9	−3.0	1.6
	Male-headed	−10.1		−4.6	
Haitian households	Female-headed	−2.5	0.1	−0.7	0.1
	Male-headed	−2.6		−0.8	
Overall effect on rural sector		−10.5	–	−5.5	–

Source: Model simulations.

Table 9. *Offsetting negative effects of DR-CAFTA*

			DR-CAFTA-offsetting evolutions of the rural economy			
		1 DR-CAFTA	2 (1) + Agricultural productivity	3 (1) + Traditional exports	4 (1) + Non-traditional exports	5 (1) + Current trends
Size of the offsetting effect needed to neutralize overall rural CV						
Agricultural productivity		–	+17.5%	–	–	[a]
Export demand		–	–	+35%	+53.9%	[b]
Income effects						
Dominican agricultural	Female-headed	−12.0	−0.9	−1.1	0.3	3.6
	Male-headed	−13.0	−0.9	−1.2	0.6	4.1
Dominican non-agricultural	Female-headed	−8.2	−0.8	−0.9	−0.9	1.9
	Male-headed	−10.1	−1.1	−1.4	−1.3	1.9
Haitian	Female-headed	−2.5	6.4	13.7	4.7	15.2
	Male-headed	−2.6	7.9	16.5	5.8	18.6
Welfare effects						
Dominican agricultural	Female-headed	−7.8	−0.1	−0.5	0.3	2.4
	Male-headed	−8.8	0.0	−0.4	0.7	3.1
Dominican non-agricultural	Female-headed	−3.0	−0.2	−0.4	−0.7	0.5
	Male-headed	−4.6	−0.5	−0.8	−1.1	0.4
Haitian	Female-headed	−0.7	2.4	4.9	1.5	5.0
	Male-headed	−0.8	4.2	8.4	2.9	9.1
Overall rural EV		−5.7	0.0	0.0	0.0	1.9

Source: Model simulations. Column (5) treatments correspond to average yearly trends in recent years.
[a] Differs for each crop in the model (range −8.8% to +78%).
[b] Equals +47% for all exports. (Source for yearly trends: FAOSTAT database 1984–2004).

benefiting consumers. Even agricultural households stand to gain from cheaper food, inasmuch as they are consumers as well as producers. This means that lower incomes do not necessarily translate into lower consumption levels or lower welfare. To measure the effects of DR-CAFTA on household welfare, we calculate the Equivalent Variation (EV) in our simulations (as described in Robichaud (2001)). [17]

Table 8(ii) reports the EVs as a percentage of pre-reform income. The EV is negative for all households, meaning DR-CAFTA represents a loss of welfare for all six rural household groups. In our simulations, the negative effect of lower nominal income thus outweighs the positive effect of lower food costs. While this result is not surprising for agricultural households, the fact that rural non-agricultural households are negatively affected by agricultural free-trade is an important finding. It suggests that the combination of higher-order effects (lower wages, reduced employment opportunities, reduced demand for non-agricultural goods and services) hurts those usually believed to benefit from cheap food. On the other hand, Haitian households benefit significantly as consumers: their final EV shocks, while negative, are of a magnitude smaller than 1%. In all cases, welfare changes are significantly smaller than income changes, reflecting the welfare-enhancing effect of lower consumption costs.

The right-hand column of Table 8(ii′) presents the percentage-point differences in welfare impacts on male and female-headed households. Again, we see that female-headed households, across the board, fare better than their male-headed counterparts, by up to 1.6% points. This is the result of a combination of factors: the positive effect of DR-CAFTA on certain 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.

Our results draw attention to the differential impact of DR-CAFTA in terms of country of origin and gender. Haitian households are the least negatively impacted of all rural

households, and female-headed households fare systematically better than male-headed households of the same type. These EV results illustrate general equilibrium effects that would be difficult to predict without an economywide model focused on gender and immigration status.

(b) *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 has negative effects on welfare in agricultural households and even some non-agricultural households. The overall EV for the entire rural sector, reported at the bottom of Table 6, is −5.7%, a non-negligible figure. In this section, we explore ways to offset this effect. We conduct three experiments, which respectively increase agricultural productivity, traditional exports, and non-traditional exports. In each experiment, we ask how large of a change would be required to offset DR-CAFTA's negative welfare effect, in other words, to raise the overall EV to 0%. The design of these experiments reflects the evolution of rural economies in developing countries in general and the likely future progress of the Dominican rural economy in particular. Productivity growth is a fundamental feature of agricultural development and a cornerstone of agricultural policy. Sustained increases in exports are an anticipated effect of free-trade agreements such as DR-CAFTA.

Table 9 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 2), a 35% increase in traditional exports (column 3), or a 53.9% increase in non-traditional exports (from a relatively low base; column 4). All simulations favor Haitian households most. In particular, the increase in traditional exports lifts Haitian incomes dramatically (by 13.7% and 16.5%, respectively), reflecting their role in supplying labor to large commercial farms. In both the agricultural productivity experiment (2) and the traditional exports experiment (3), Haitians are the only households with positive EV's: despite their small numbers, their welfare gains are enough to offset the welfare losses of Dominican households and bring the overall rural EV to zero. Non-traditional exports are less beneficial to Haitian households and positively impact Dominican agricultural households, by 0.3% and 0.6%, respectively. Dominican non-agricultural households own no agricultural capital and do not work in agriculture in the baseline; they benefit least from increases in productivity and exports. For them, the negative effects of DR-CAFTA persist throughout experiments (2), (3), and (4).

In all three offsetting simulations, the previously observed female advantage disappears. Female-headed households of both Dominican agricultural and Haitian households no longer fare better than their male counterparts. This reflects the fact that male-headed households own most of the capital and are, therefore, more affected by production and export shocks. Just as males suffer more when the economy shrinks, they benefit more when it grows.

There need not be unrealistically large changes in the evolution of the Dominican rural economy in order to offset DR-CAFTA's negative effects on agricultural households. The right-most column (5) presents results of an integrated experiment in which existing trends in agricultural productivity and export growth are extrapolated over the course of the DR-CAFTA 20-year phase-in period. We used FAO-STAT 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. The simulation shows that the extrapolated trends in productivity and export growth easily offset the negative effects of DR-CAFTA over the 20-year implementation period. All households see increases in both welfare and income, with EV's ranging from 0.4% to 9.1% across the six household groups. Haitian households gain most in percentage terms, and non-agricultural Dominicans gain least. In year 20, taking these trends into account, the overall EV for the rural economy is 1.9% of the total pre-CAFTA rural GDP.

4. CONCLUSIONS

Economywide methods are a *sine qua non* for modeling the impacts of trade policy shocks on rural welfare, given the complexity of general equilibrium effects in rural economies. The gender segmentation of rural labor markets and the increasing role of foreign-born workers in agricultural production make it important to incorporate gender and, in many countries, immigration into policy simulation models. The results presented in this paper suggest that DR-CAFTA will have different effects on males and females, native workers and Haitian immigrants in the rural Dominican Republic. They highlight the importance of general-equilibrium considerations in shaping the impacts of reforms on different household as well as worker groups. The finding that a CAFTA-induced decrease in agricultural prices reduces welfare for all rural household groups, *including non-agricultural households*, contradicts conventional knowledge that only agricultural producers suffer from tariff elimination. Our findings also make a clear distinction between income and welfare effects when policies affect consumption costs as well as nominal incomes. Although the removal of food import tariffs reduces nominal income for all household groups, welfare effects are uniformly small compared with income effects. Nevertheless, it appears that lower consumption costs may not be sufficient to counter the adverse effects of trade liberalization on rural household incomes. In a country where about half of the population is rural, this calls for serious consideration of transition policies, which have been a complement to trade liberalization in Mexico, the region's trailblazer in North American economic integration.

Our simulations suggest that Haitian immigrant households are least affected by the DR-CAFTA policy in terms of nominal income. Their EVs are less than 1% of their base income, suggesting that the effect of cheaper food nearly compensates them for nominal income losses. As productivity and exports increase, Haitians experience the most positive welfare shocks due to expanding opportunities in the labor market and increased wages. This is good news for Haitian immigrants and the households they support in Haiti, *via* remittances. The Haitian worker wage effects we obtain would be dampened by continued immigration. When we simulate a free-immigration scenario with a perfectly elastic supply of Haitian immigrant labor, Haitians fare somewhat worse in the Dominican Republic; however, they remain the most positively (or least negatively) affected worker and household groups.

Our finding that female-headed households fare better under DR-CAFTA than their male counterparts reflects a gender segmentation of rural labor markets that, in this particular context of trade reform, favors females. It implies that the overall contraction of the agricultural economy in

the wake of DR-CAFTA will be accompanied by a reduction in the gender wage gap. When we used the model to simulate increased exports, this wage-gap effect was pronounced for Dominican households (results not in tables). Increases in wages for women relative to men may lead to further transformations beyond the scope of our model, for example, reshaping of household expenditures in ways that influence welfare (e.g., *via* child nutrition and education) or the economic empowerment of females in rural areas. Cross-sectional econometric studies suggest that some forms of market integration may contribute to increased gender equality in terms of life expectancy and literacy (Gray, Kittilson, & Sandholtz, 2006). The mechanisms that our model highlights could contribute to this effect.

Although agricultural tariff reductions under DR-CAFTA have an overall negative impact on rural welfare, our simulation results indicate that agricultural productivity gains and the expansion of competitive exports could easily offset or reverse this impact. Interventions aimed at raising agricultural productivity and opening up new agricultural export markets thus could hold promise as elements of post-CAFTA adjustment policies. The actors suffering least from DR-CAFTA are those usually considered to be the most vulnerable to shocks: female and immigrant laborers, female-headed households, and low-skilled immigrant households. This finding should not lead to complacency but is encouraging from the point of view of designing safety nets for these vulnerable groups.

Policy shocks have ramifications for time allocation within as well as outside of households. Although not an intra-household model, GIMO makes it possible to simulate the impacts of policies on women's and men's time allocations to household reproduction as well as production activities. We believe that explicitly modeling the imperfect transformability of men's and women's time among income and non-income generating activities is an important step toward understanding the welfare impacts of policy changes. It also has implications for economic efficiency, insofar as reproduction, leisure and income activities compete for individuals' time, which often cannot readily be converted from one use to another (as any parent knows).

Although GIMO represents a step toward understanding how different socio-demographic groups experience trade policy shocks, more progress in modeling policy impacts in rural economies is needed. Above all, we believe that economywide modeling needs further improvements in its treatment of the allocation of time. Inspired by Fontana and Wood (2000), we believe that the inclusion of the unpaid economy should become standard practice in economywide modeling. GIMO's imperfect labor supplies to productive and reproductive activities are probably a more accurate representation of reality than the most commonly used assumptions of either perfectly elastic or perfectly rigid supplies of labor. Better data and rigorous econometrics could provide more reliable parameters to model time-use elasticities and help set a new standard for the economywide modeling of policy shocks.

NOTES

1. It is a common misconception that CGE models represent national economies whereas models for regions within countries are partial equilibrium models. This confuses model scope with structure. CGE models are used to explain the behavior of supply, demand and prices in a whole economy with multiple markets. The economy in question usually is a country and not the world, but this does not make a country CGE model a partial equilibrium model. In fact, an agricultural household model is a general equilibrium model for a very small economy, provided that it encompasses all of the markets with which the household is involved (including internal markets with household-specific shadow prices, in the case of subsistence goods; see Taylor & Adelman, 2003). Partial equilibrium models focus on only one or a few markets within the economy in question.

2. For an excellent review see Cloutier, Cockburn, Decaluwé, Raihan, and Khondker (2008).

3. Haiti and the Dominican Republic, despite sharing the same island, are culturally, linguistically, and racially distinct.

4. In our data set, the differences in expenditure shares between male-headed and female-headed households of the same type are not very dramatic (on the order of 1–2% points), and mostly not statistically significant. They are more pronounced between Agricultural Dominican, Non-Agricultural Dominican, and Haitian households (regardless of headship).

5. Headship is admittedly only a second-best modeling solution, which cannot capture all the gender differences existing at the intra-household level. Also, the criterion chosen to identify a household as female-headed is not without consequences, as Rogers (1995) showed for the Dominican Republic. Nevertheless, the distinction of household groups by headship in the model leads to interesting results.

6. In addition, there exist models of *emigration* and its impact on those left behind in the home country (Taylor & Dyer, 2009; Taylor, Yunez-Naude, & Dyer, 1999). This is distinct from modeling *immigrants* in the host country.

7. One referee asked whether this could be called a CGE model, inasmuch as exchange rate adjustment is missing. This again confuses scope with structure: explicit nominal exchange rate adjustment is not relevant to some country CGEs (e.g., for dollarized economies like Ecuador and El Salvador), like in state or province CGEs (Berck, Golan, & Smith, 1997). Prices for rural nontradables adjust in our model, producing rural-urban terms of trade effects that are akin to real exchange rate changes in country models.

8. Previous gendered models often assume elasticities of substitution between males and females to represent gendered social norms in the demand for labor, following Fontana and Wood (2000). We do not make such assumptions.

9. GIMO thus represents a Walrasian approach to modeling care, in the classification proposed by van Staveren (2005), who also identifies heterodox approaches that do not assume full employment or market clearing wages.

10. Most former models (Fontana, 2001, 2002; Siddiqui, 2009) feature fully mobile labor. This implies that leisure and reproduction can be "hired" from other households. One exception is Fofana *et al.* (2005). Our model does allow labor to be "traded" between different household types in the same community (Dominican or Haitian). This assumption could be relaxed with better data.

11. Exceptions include Löfgren (1999) and Yang & Huang (1997). They model explicitly a rural-urban redistribution of labor supply. Like us, Yang and Huang use a CET specification for this purpose.

12. Skill levels are often considered exogenous. We believe a CET supply structure similar the one we use could be useful in a model with endogenous skill acquisition.

13. Time-use information was culled from published articles. The eight countries include: Ecuador (Newman, 2002); Brazil (Fisher & Robinson, 2010); Bangladesh (Fontana & Wood, 2000); Zambia (Fontana, 2002); and South Africa, Benin, Madagascar and Mauritius (Charmes, 2006). Sensitivity analysis shows that our conclusions are robust to parameter changes within the standard deviation ranges.

14. We conducted sensitivity analysis on these parameters. Allowing all labor allocations to be more flexible increases the disparities we find between demographic groups; rigidifying all labor reallocations reduces them. All relative reallocation results between the different laborer groups remain identical. Reversing the order of elasticities (0.8 at the top, 0.2 at the bottom) alters simulated impacts on wages by no more than three percentage points and also preserves the relative time-allocation results between groups. None of these alterations modify our welfare conclusions.

15. We could for example rigidify the female labor supply compared to the male one, but this would run the risk of making our gender-sensitive results be driven by ad-hoc gendered parameters.

16. We verified this by repeating the simulation with extremely elastic labor transformation ($\sigma = 100$). It smoothes out the wage effects, which become equal across all time-uses for any given laborer category. (about -12% for Dominicans, about -5% for Haitians). The reallocation of labor between uses also becomes more homogenous.

17. The EV represents the money-metric income shock that would have produced the same utility-shock as our simulation. In other words, it is the income transfer (positive or negative) that would lead households to change their consumption levels in such a way that they reach the same utility level as in our simulations, only with all prices remaining at their initial levels.

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