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THE IMPACT OF MIGRATION POLICIES ON RURAL HOUSEHOLD WELFARE IN MEXICO AND NICARAGUA

by

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PREFACE

The way emigration affects individuals and households in the country of origin is at the heart of the links between migration and development. For poor – although not the poorest – households, sending away a productive member of the household is often the only means available to access a steady income stream and climb out of poverty. When labour markets do not function perfectly, emigration provides the emigrant with employment. Moreover, when credit markets do not operate perfectly, the funds remitted back to the household provide it with income to invest or consume.

This paper by J. Edward Taylor and Mateusz Filipski examines how changes in migration policies in countries of destination affect rural welfare in countries of origin, namely Mexico and Nicaragua. Simulated changes in migration flows as well as to the returns to migration provide evidence that they impact the welfare of the household in both positive and negative ways. Household labour supply generally increases when a member emigrates but remittances help reduce the pressure to replace foregone labour. Moreover, the impact of South-South migration (Nicaragua to Costa Rica) on the household is smaller than in the South-North context (Nicaragua and Mexico to the United States).

This paper is part of the "Effective Partnerships for Better Migration Management and Development" project, financially supported by the John D. and Catherine T. MacArthur Foundation. The project aims at carrying out an in-depth assessment of the migration-development relationship in Central America and West Africa in two critical policy domains: the governance of international migration at the global, regional, national and local levels; and the link between migration and labour markets in developing countries.

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RÉSUMÉ

Ce document de travail tente d'évaluer l'impact des politiques d'immigration sur le bien-être des migrants et de leurs familles dans les pays de départ. Il s'appuie sur un modèle micro-économique désagrégé, conçu pour rendre compte à la fois des effets négatifs et positifs de la migration et des transferts de fonds dans les régions de départ, et des procédés complexes qui déterminent ces effets. Ce modèle permet d'étudier les effets potentiels des politiques migratoires des pays de destination sur le bien-être en zone rurale au Mexique et au Nicaragua (les politiques américaines dans le premier cas, et les politiques américaines et costaricaines dans le second). Les conclusions soulignent la sensibilité du bien-être dans les pays d'origine aux politiques d'immigration, non seulement dans les ménages de migrants qui reçoivent des transferts mais aussi dans les autres ménages qui interagissent au sein de l'économie du pays d'origine. Les impacts diffèrent selon les pays et entre ménages. Ils dépendent aussi du sexe et du niveau de qualification des migrants. Ce document discute enfin le poids des politiques des pays de destination et d'origine en matière d'impact des migrations internationales sur le bien-être en zone rurale.

Classification JEL: J08, J61, F22, O55
Mots-clés: migrations internationales, offre de travail, transferts d'argent, Mexique, Nicaragua

ABSTRACT

This working paper presents findings from an effort to evaluate the impacts of immigration policies on the welfare of migrants and their families in migrant-sending countries. It uses a disaggregated micro economy-wide modelling approach, designed to capture both the potentially positive and negative effects of migration and remittances in migrant-sending areas and the complex processes shaping these impacts. The model is used to explore the possible effects of destination-country immigration policies on rural welfare in Mexico and Nicaragua (US policies in the first case and US and Costa Rican policies in the second). The findings highlight the sensitivity of sending-country welfare to immigration policies, not only in the households that send migrants and receive remittances but other households with which they interact within the migrant-sending economy. Impacts vary between the two countries and across households, and they also depend upon the gender and skills of migrants. The paper concludes by discussing the importance of both destination and source country policies in shaping the impacts of international migration on rural welfare.

JEL-Classification: J08, J61, F22, O54
Keywords: international migration, labour supply, remittances, Mexico, Nicaragua

I. INTRODUCTION

Assessing the effects of receiving-country immigration policies on sending-country welfare is, to say the least, challenging. Economists extol the virtues of experimental approaches for policy and program evaluation, yet such an approach generally is not useful to study immigration policy impacts. Controlled experiments, in which an immigration policy change is exogenously imposed and we observe welfare before and after the policy shock, are nonexistent. The design and implementation of immigration policies are never exogenous; instead, they are shaped by a complicated process in which it is generally impossible to isolate the effects of the policy from those of other variables. One cannot randomly roll out an immigration reform like a rural development project, because immigration policies change for all people in the migrant-sending country simultaneously, yet they affect different people differently. Invariably, other variables change over time along with the policy. These considerations thwart econometric analysis of the impacts of immigration policy shocks. They call for an economy-wide modelling approach that explicitly recognises the heterogeneity of responses to immigration policy changes and their impacts.

The present study uses a Disaggregated Rural Economy-wide Modelling (DREM) framework, disaggregated by household type as well as by worker gender and skills, to explore the possible impacts of receiving-country immigration policies on household welfare in migrant-sending areas.[1] Our general modelling approach follows that of Taylor *et al*. (2005) and Taylor and Dyer (2009). It is designed to capture both the direct and indirect effects of migration and remittances in a general equilibrium framework. DREMs are calibrated using micro survey data from Nicaragua (the Household Living Standards Survey - ENMV) and Mexico (the Mexico National Rural Household Survey - ENHRUM). These models are used to simulate the possible short and long run impacts of policies influencing migration and remittances on income, production activities, and investments in human and physical capital.

Nicaragua and Mexico are ideal countries in which to study the impacts of destination-country immigration policies. Both send large and increasing numbers of migrants abroad, to the United States (in the case of Mexico) and to Costa Rica and the United States (in the case of Nicaragua). Both countries' economies depend critically on the income sent home, or remitted, by migrants abroad. Nicaraguan migrants remitted a total of USD 818 million in the year ending October 2008. To put this into perspective, migrant remittances were equivalent to more than half of the total value of Nicaragua's merchandise exports (USD 1.5 billion) in 2008. Remittances

1 Throughout the document, our measure of welfare will be the "real full income" of a household. Unlike nominal incomes, this measure accounts for price levels changing during simulations, and it values subsistence production even though it is not marketed.

to Mexico totalled USD 25.1 billion in 2008, making migrants Mexico's second largest export (after oil) in terms of the income they provided. Both countries also produce sustained flows of unauthorised emigration. In 2006 40,820 Nicaraguans were deported from Costa Rica and 3,228 from the United States. The number of unauthorised Mexican immigrants apprehended in the United States in 2006 exceeded one million.

II. IMMIGRATION POLICIES AND THEIR IMPACTS ON MIGRATION AND REMITTANCES

In order to predict the effects of an immigration policy change on welfare in the migrant-sending country, one must first ascertain how the policy affects migration and remittances. Immigration policies usually are the outcome of an intricate political process, however, and as the history of US immigration policy amply illustrates, the impacts on migration are notoriously difficult to predict and often surprising. In light of this, we begin by reviewing the most salient features of recent US and Costa Rican immigration policies and the possible direct or first-order effects of changes in these policies on migration and remittances. The rest of the paper explores the ways in which given changes in international migration and remittances create indirect or second-order effects in the migrant-sending economies of rural Nicaragua and Mexico. There is, by necessity, a certain recursiveness in our analysis of the impacts of immigration policy shocks, because as will become clear below, it is by no means certain what the first-order impacts of a given change in immigration policy on the magnitude of migration and remittance flows will be. Thus, the first and higher-order effects of immigration policy changes cannot be examined within a single simulation model.

II.1. Immigration policy in the US and Costa Rica

The United States and Costa Rica have implemented significant immigration policy reforms in the last 25 years, and both are poised to enact additional reforms in the near future.

II.1.i. US immigration laws

The US Immigration Reform and Control Act (IRCA) of 1986 had two major components. First, it imposed fines on employers who knowingly hire unauthorised immigrants while legalising 1.7 million unauthorised immigrants who had developed an equity stake in the US as part of a residency-based amnesty program. Second, responding to concerns from agricultural interests, the US Congress included the Special Agricultural Worker (SAW) program in IRCA to legalise individuals who worked 90 days or more in perishable crops between May 1984 and May 1985. An additional 1.2 million individuals were legalised under the SAW program, instantly giving US agriculture a legal work force.[2] By 1993, the SAW share of the US crop work

2 Martin *et al.* (1988) found that the 1.2 million SAW workers substantially exceeded the number of individuals who actually worked the requisite ninety days, suggesting widespread fraud. If these legalised workers left farm work quickly and farm labour shortages developed, additional workers could be admitted via the revised H-2A program or a new Replenishment Agricultural Worker (RAW)

force had fallen by two-thirds and the unauthorised share had quadrupled, to nearly 60% (US Department of Labour, 2005). The H-2A program, which admits foreign workers "temporarily to the United States to perform agricultural labour […] of a temporary or seasonal nature," requires certification from the US Department of Labour (DOL). However, only 94 000 farm jobs were filled by H-2A workers in FY08, beside an estimated undocumented farm workforce of over one million (Martin, 2009).

In the decades following IRCA, the tendency has been to strengthen restrictive immigration policies in the US. Prior to 1990, family-sponsored migration was not subject to any quota. The 1990 Immigration Act, while theoretically increasing the cap on legal migration, was effectively aimed at limiting immigration in the long-run by slowing down family reunification (Cerrutti and Massey, 2004). Later, the 1996 Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA), while not explicitly aimed at dealing with migration issues, prevented migrants (even documented) from receiving welfare benefits.

Along with the laws aimed at putting a break on legal immigration, the mid-nineties also saw efforts to control unauthorised entry. In 1996 Congress passed the Illegal Immigration Reform and Immigrant Responsibility Act (IIRIRA), which made it easier to deport or ban "unlawfully present" persons guilty of offenses. New border control initiatives also were put into place. The 1993 "Operation Blocade"[3] in El Paso, the 1994 "Operation Gatekeeper" in San Diego, the 1995 "Operation Safeguard" in Nogales and the 1997 "Operation Rio Grande" in Southeast Texas were all aimed at deterring unauthorised immigration through the Mexican border.

Despite these efforts, the question of unauthorised immigration is still a central one in the present decade. There were an estimated 9.3 million undocumented migrants residing in the United States in 2002, including 5.3 million Mexicans (Passel, 2004). Undocumented immigrants from Mexico currently comprise an estimated 73% of California's total farm work force.[4] This has prompted the US Congress and President Obama to revisit immigration policy reform.

A major part of immigration reforms under discussion focuses on agriculture. The Agricultural Job Opportunity Benefits and Security Act (AgJOBS), introduced in May 2009 by Senator Dianne Feinstein (D-CA), would switch from a certification to an attestation system, in Martin's (2009) words, "effectively shifting control of the border gate from the DOL to employers." Nicaraguan immigrants in the United States overwhelmingly work in non-farm jobs;[5] thus, AgJOBS is unlikely to have a significant effect on migration from Nicaragua. Nevertheless, it is highly relevant to migration from rural Mexico.

US immigration reforms currently under discussion would include an improved system to verify workers' legal status as a condition for employment (possibly including a tamper-proof

program. The U.S. Department of Labour concluded that there were no farm labour shortages due to SAWs leaving farm jobs; thus, the RAW program never took effect.

3 Sometimes referred to as "Operation Hold-the-Line".

4 Estimated from NAWS Public Use Data (http://www.doleta.gov/agworker/naws.cfm).

5 Less than 1%. Large employment sectors are services, trade, and construction, in an extract of the 2000 census downloaded from IPUMS (Ruggles *et al.*, 2010).

national identity card) as well as a new amnesty program. At the state level, Arizona recently passed an intensely debated law intended to "discourage and deter the unlawful entry and presence of aliens."[6] It has been contested in the courts; however, the precedent it sets could potentially have a far-reaching effect on migration from both Mexico and Nicaragua. Approximately one half of all Mexican immigrants in the United States are unauthorised.

Besides employment-based and family-sponsored migrants, approximately 312 000 Central Americans are legally in the US under the Temporary Protection Status (TPS) program for persons from countries the Secretary of the Department of Homeland Security designates as experiencing "armed conflict, environmental disaster, or certain other conditions that prevent those persons from returning to those countries."[7] About 312 000 people from Honduras, Nicaragua and El Salvador currently have TPS in the US, and they have been allowed to renew their status every 18 months for almost a decade. Leaders of these countries want the US to continue renewing TPS, saying they need the USD 10 billion a year in remittances. Only 3 000 Nicaraguans are covered by TPS, however.[8]

II.1.ii. Costa Rica immigration laws

An estimated 17% of Nicaraguans live abroad, most in the US and Costa Rica (IOM, 2001). Over the past few decades, this migration was fuelled in turn by political unrest (the Somoza dictatorship, the Sandinista revolution in 1979, the "contra" counter-revolution that followed), natural disasters (the Managua earthquake in 1972, hurricane Mitch in 1998) and economic downturns (particularly in the late eighties and early nineties). During the 1990's, the primary destination of this migration gradually shifted from the United States to Costa Rica, and today the populations of Nicaraguans in both countries are estimated to be about equal (Funkhouser, 2006). However, estimates of Nicaraguan immigrants in Costa Rica cover a wide range, largely because the Costa Rica population census does not count undocumented immigrants. The 2000 Costa Rica census put the number of Nicaragua-born residents at 226 374, or 5.9% of the country's total population. However, estimates including unauthorised immigrants range considerably higher, from 360 000 to 540 000 (Lacayo, 1999, Segnini, 1999). The previous census, in 1984, put the number of Nicaraguans in Costa Rica at just under 46 000.

Until recent years, the Costa Rican government's responses to Nicaraguan immigration have not been very forceful. In 2001, the border was described as "poorly guarded", and policies as "purely instrumental, of limited duration, and loosely articulated...a mechanism to meet Costa Rican momentary production needs" (IOM, 2001). Policies consisted essentially of successive waves of conditional amnesty programs. In 1993, Costa Rica and Nicaragua signed the Migrant

6 Among other provisions, SB1070 requires law enforcement officers to verify the immigration status of any person when "reasonable suspicion exists that the person is an alien who is unlawfully present in the United States"; http://www.azleg.gov/legtext/49leg/2r/bills/sb1070s.pdf.

7 "TPS for El Salvador extended 18 mos.; registration period ends Mar. 8." National Immigration Law Center, IMMIGRANTS' RIGHTS UPDATE, Vol. 19, No. 1, February 10, 2005, http://www.nilc.org/immlawpolicy/asylrefs/ar126.htm#tpsdef

8 Legal status extended for Central Americans, Associated Press, May 6, 2010. http://www.google.com/hostednews/ap/article/ALeqM5g5iPCZHYpxBU_Nk8s9N_ccFFnt9AD9FH1PB00

Workforce Treaty, intended to regulate seasonal migration, particularly for the coffee and sugar cane harvests. In 1997, the Nicaraguan government agreed to issue passports to enable Nicaraguan workers to apply for temporary work permits reflecting Costa Rican labour market needs. Costa Rica also issued temporary work permits to Nicaraguans working without authorisation in jobs meeting the guidelines established under the agreement, and it required them "to regularise their migratory status, in order to avoid their deportation or expulsion." This was followed by another amnesty program in 1999.

The situation changed in 2005 when Costa Rica passed an immigration reform.[9] The law's provisions included making border control more stringent (especially near agricultural production zones, thus targeting migrant workers from Nicaragua), facilitating deportation, and introducing new regulation of work permits. The law was later reformed in 2009, further tightening regulations.[10]

To the best of our knowledge, no econometric study has been published investigating the effects of Costa Rican policies on immigration flows or remittances.

II.1.iii. Laws targeting remittances

Given the size of remittance flows, the idea to tax remittances is under discussion in all countries involved, on both the sending and the receiver sides. While there are no national laws in place, Oklahoma's 2009 Drug Money Laundering and Wire Transmitter Act included a provision to tax a 1% fee, minimum of USD 5.00, on all wire transfers initiated in Oklahoma through a registered transmitter.[11] To-date, no other state has passed such a law, although a very similar text was proposed in April 2010 by the House Committee on Taxation in Kansas.[12]

II.2. Intended and unintended effects of immigration policies on migrant and remittance flows

Immigration policies have impacts both on the flow of migrants into the host country and on migrants already present. They affect migrants' livelihoods, their ability to get jobs, to start families, to buy homes, and to qualify for public assistance. They affect the flow of entering migrants, not only in terms of quantity but also via the selectivity of migration on human capital and other characteristics and individuals' reasons for migrating. They affect migrants' ability and willingness to send remittances.

These first-order impacts of policies on migration and remittances are the shocks we would like to simulate in order to predict second-order impacts: the influences of international migration on welfare in migrant-sending economies. Unfortunately, the size of those first-order impacts, and often even their sign, are not straightforward. We now review some of the empirical evidence that will guide us in choosing which simulations to perform. Unfortunately, the empirical evidence is scarce and available primarily for Mexico-to-US migration.

9 Law #8487, "Ley de Migración y Extranjería."

10 Law #8764.

11 HB 2255.

12 HB 2745.

II.2.i. Effects on authorised migration flows

The effects of immigration policies on authorised migration flows are relatively transparent because legal flows of migrants are controlled by quotas. The 1990 Immigration Act clearly defined caps on legal migration: 140 000 employment-based migrants, 55 000 "diversity migrants" (randomly selected by lottery), and 480 000 family-sponsored migrants, although this last quota was designed to be "flexible," which is why authorised immigration has consistently exceeded the cap (Cerrutti and Massey, 2004). Targeted policies such as guest-worker programs or TPS also allow some control over authorised migrant flows. Thus, the flow of legal migrants is relatively easy to assess, and the role of immigration policies in determining the size and characteristics of that flow is clear. There is evidence, however, that putting a cap on visas simply diverts migration flows towards undocumented entry without really affecting the total flow of migrants (Massey and Espinosa, 1997).

II.2.ii. Effects on unauthorised migrant entry and exit

Assessing unauthorised immigration presents many more challenges. The flow of unauthorised immigration is not easily regulated by policy; rather, it is likely to be the outcome of many complex economic and social factors in the countries involved, including employment and wages, social networks, market failures and other considerations (see Massey and Espinosa (1997) for an overview). Assessing such effects is difficult, because measuring the flows of undocumented migrants is problematic to begin with. Warren and Passel (1987) proposed a method to count the total undocumented population present in the US using the Current Population Survey. Analysis of these counts suggested that unauthorised flows into the US were not significantly affected by IRCA (Woodrow and Passel, 1990). Other studies use border apprehensions as a proxy for the size of the unauthorised immigrant flows. It was estimated that the size of the unauthorised migrant flow is about 2.2 times that of Border Patrol arrests (Espenshade, 1995).

This last result does not guarantee, however, that increasing Border Control and increasing apprehensions will reduce the migration flow. In fact, Massey *et al*. (2003, chapter 6) find no evidence that the 1993 "Operation Blocade" in El-Paso had any significant effect on unauthorised border crossings into the US. Espenshade (1994) suggests that "practically all Mexican migrants who manage to reach the US-Mexican border are able to enter the United States, if not on their first attempt, then on a second or third." Efforts to toughen border control may simply prompt border crossers to use less enforced entry routes. Over the years, the favoured border crossing sites have become increasingly remote (Orrenius, 2004), and the cost of crossing has increased (IOM, 2001). Increased border enforcement has encouraged migrants to take more dangerous routes, as evidenced by the increased probability of death during border crossings (Cornelius, 2001, IOM, 2001).

Findings from other studies suggest that strengthened border controls may have the perverse effect of increasing the stock of unauthorised immigrants, for two reasons. First, a higher cost of crossing the border, together with a greater chance of getting caught or dying while crossing, may deter return migration (Reyes, 2004). Second, in order to offset the high costs of being apprehended, deported migrants wait less time before attempting re-entry into the US (Kossoudji, 1992).

At the other end of the policy spectrum are policies designed to facilitate integration of immigrants. The effects of "softer" immigration policies, like the amnesty programs enacted in the US and Costa Rica in recent decades, are equally difficult to determine. On one hand, the undocumented population is reduced when migrants acquire documents. On the other hand, this may increase incentives for future unauthorised immigration, as individuals position themselves for future amnesty programs or simply reunite with newly documented family members. IRCA provides a well-studied example. The amnesty campaign aimed to resolve the problem of undocumented immigration by facilitating immigrants' integration into the legal labour market, while at the same time providing US agriculture with a legal workforce. Yet, according to Martin (1994), IRCA was an example of "good intentions gone awry." Previously undocumented migrants moved into more remunerative sectors, and their jobs in agriculture were filled by a new generation of undocumented immigrants. Several studies suggest that IRCA may have increased unauthorised migration in the United States (Bean *et al.*, 1990, Johnson, 1996, Woodrow and Passel, 1990).

II.2.iii. Effects on remittances

Immigration policies have an obvious impact on remittance flows simply because they affect the stock of migrants in the host country. But immigration policies can influence migrant remittances in other ways. They can influence immigrant characteristics, including legal status. Remittance behaviour is complex and has been a subject of research in its own right (De la Briere *et al.*, 2002, Lucas and Stark, 1985). There is some econometric evidence that immigrants' legal status affects their economic mobility and remittances. Taylor (1992) found that status as a legal immigrant was associated with an increase of approximately 33% in relatively high-paying, "primary" agricultural jobs, but only 5% in the less desirable "secondary" jobs in which most immigrant agricultural labourers work. Unauthorised immigrants also were found to be significantly less likely to obtain primary jobs than otherwise similar legal workers. Obtaining a higher-paying job may increase remittances, but studies suggest that once this income effect is controlled for, remittance behaviour itself seems to be negatively affected by legal status. Louis DeSipio (2002) found that immigrants with permanent resident status in the US were 27% less likely to remit than immigrants without resident status or citizenship, and legal residents remitted, on average, 5.5% less of their income. Naturalised citizens were found to be 46% less likely to remit. Amuedo-Dorantes and Pozo (2006) find that undocumented migrants from Mexico are approximately 6 percentage points more likely to remit money home, and those who remit send approximately 4 percentage points more than their legal counterparts.

Immigration policies also can affect the demographic characteristics of immigrants, which in turn can influence remittances as well as the impacts on sending countries. Acculturation, reflected in the share of an immigrant's life spent abroad, generally reduces remittances, according to DeSipio (2002). Other things being equal, he found that a 1% increase in life spent in the US by Mexican immigrants decreased the probability of remitting by 2 percentage points.

We carried out a Tobit analysis of remittances by individual US migrants in the ENHRUM. The findings reveal that remittances decrease significantly as migrants' stay in the US lengthens: conditional upon being in the US, annual remittances decrease by USD 42.86 for each additional year a migrant spends abroad, other things being equal. Expected remittances

conditional upon migration were USD 1 212 in 2007. This implies that the rate of decay of remittances is on the order of 3.5% per year, similar to the estimates from other studies reported above. Funkhouser (1995) found that remittances from Nicaraguan migrants in the US decrease on the order of USD 3/month spent in the US. These findings have an important implication for migrant-sending countries: to maintain or increase remittances, it is not sufficient to maintain a stock of migrants abroad. If the immigrant stock abroad is not infused continually with new immigrants over time, remittances will tend to erode.

Some immigration policies are sector-specific; examples in the US include the current AgJOBS legislation and the 1986 SAW program. By facilitating immigration for agricultural employment, these policies can influence the characteristics of immigrants as well as the remittances they send home differently than policies focusing on other sectors (*e.g.* the H-1 visa program for high-skilled workers) or that are sector-neutral (*e.g.* a general amnesty program). The ENHRUM data do not show that remittances are significantly different for agricultural than non-agricultural workers. Massey (1986) found that rural Mexican immigrants working in agricultural jobs remitted a higher percentage of their earnings than those working in non-agricultural jobs (39.4% vs. 20.9%). Their disposable income was lower (USD 1 360 per month, versus USD 3 266), however; thus, the amount remitted was lower for agricultural workers.

This literature review of the sometimes convoluted effects of immigration policies is the basis for designing the policy experiments we present in Part 5. In those experiments, we attempt to explore as many possible effects of changes in immigration policies as possible. The paucity of clear econometric links between policies and immigration flows makes it difficult to simulate the impacts of specific policies. However, to the extent that a policy alters immigration or remittances, we can use our model to simulate the direct and indirect effects of the change in immigration or remittances on migrant-sending economies. Where econometric studies provide estimates of changes in immigration or remittances, more definitive policy experiments can be designed and implemented.

Before presenting our policy simulation results, we discuss the potential paths by which changes in migration and remittances may influence migrant-sending economies and describe our model.

III. PATHS OF INFLUENCE OF IMMIGRATION POLICIES IN SENDING COUNTRIES

Even if one could accurately predict the first-round effects of an immigration policy change on international migration and remittances, the paths by which changes in migration and remittances influence welfare in the sending country are too complex to be uncovered by either an experimental or econometric approach. The potential impacts of changes in migration and remittances on the migrant-sending economy are multifaceted, both direct and indirect, and are not limited to the "treatment group" of households with migrants. The direct effects of changes in migration and remittances include influences on labour supplies and incomes in the households with migrants. The indirect effects include resource reallocations within the households with migrants, as well as myriad effects on other households operating through various kinds of market linkages. The structure of markets in migrant-sending areas thus plays a critical role in shaping the overall impacts of changes in migration and remittances in sending economies, including on the poor.

The direct effects of remittances on poverty and rural welfare vary both among and within countries, depending on where in the income distribution the migrant-sending (and remittance-receiving) households are found. A number of studies have been carried out in Mexico to examine the direct effects of remittances on poverty and inequality. For example, Taylor *et al.* (2008) found that remittances from international migrants had little effect on poverty in regions where the prevalence of migration was low, but a large effect where migration prevalence was high. This is consistent with a theory in which the costs and risks of international migration are too high for the poorest households to be among the "pioneer" migrant-senders but in which, as access to migrant labour markets expands, the benefits of migration begin to reach the poor. Stark *et al.* (1986) and McKenzie and Rapoport (2007) conclude that, as migrant networks expand, remittances reduce income inequalities (measured by a Gini coefficient of total income). However, Stark *et al.* (1988) find evidence that, even when access to networks is widespread and remittances reduce income inequality, international migration does not benefit the poorest households.

Studies focusing on the direct effects of remittances are likely to miss many, if not most, of migration's impacts on migrant-sending economies, because migration has indirect effects on welfare both within the households that send migrants and in nonmigrant households.

Migration produces indirect effects within migrant-sending households as these households adjust their production and consumption to the loss of the migrant's labour and the receipt of remittances. Remittances affect household demand by shifting out the budget constraint. They also may loosen constraints on household production activities, for example, by

providing a credit-constrained household with liquidity or a risk-averse household with income security. A number of studies document negative lost labour but positive remittance effects in migrant-sending households (Lucas, 1987, Rozelle *et al.*, 1999, Taylor *et al.*, 2003).

The indirect effects of migration and remittances are not limited to migrant households. The households that send migrants and receive remittances transmit the impacts of migration to others within the local economies of which they are part, via their participation in local markets. A household does not necessarily have to have a migrant in order to be affected by migration. This makes it difficult to identify the impact of migration on the welfare of migrant-sending households: one cannot simply compare welfare in households with and without migrants to ascertain this impact.[13] Migration and remittances can affect welfare in nonmigrant households through markets for factors (*e.g.* by affecting wages and land rents received or paid by these households), goods (by changing migrant households' demand for goods), or credit (by affecting local savings available to invest). The extent of these inter-household effects depends critically on the structure of local markets (Taylor and Dyer, 2009).

Econometric tests inspired by experimental methods can be useful for studying the impacts of migration on particular outcomes in migrant-sending households (*e.g.* see Yang (2008), Taylor and Lopez-Feldman (2010)). However, complex interactions between migrant and nonmigrant households highlight the limitations of a micro household-based approach. McKenzie and Rapoport (2007) offer some econometric evidence of remittance multiplier effects; however, the mechanisms producing these effects are not clear. In order to quantify and understand the indirect effects of migration on welfare, a different modelling approach is needed, one that highlights the interactions among heterogeneous households with differing connections with input and output markets.

The inter-household effects of migration have received little attention in the development economics literature. Remittance multipliers in rural economies were first explicitly documented by Adelman, Taylor and Vogel (1988), who estimated a village Social Accounting Matrix (SAM; see Stone (1986)). That study found that USD 1 of remittances from migrants in the United States raised total income in a Mexican migrant-sending village by USD 1.78. In other words, each dollar remitted produced an additional USD 0.78 in indirect income effects. The chief limitations of SAM multipliers include the assumptions of linearity and perfectly elastic supplies of goods and factors, which rule out the effects of migration and remittances on prices.

A new generation of nonlinear programming models incorporates nonlinearities and price effects as well as the heterogeneity of households in migrant-sending economies. Disaggregated rural economy-wide models have been used to explore the direct and indirect influences of trade and domestic policies in migrant-sending economies (Taylor *et al.*, 2010, Taylor *et al.*, 2005). These models nest a series of heterogeneous agricultural household models within a general-equilibrium framework. Taylor and Dyer (2009) extend the DREM approach to simulate the effects of migration and remittances in rural Mexico, in both the short and long-run. Their simulations reveal that the impacts of international migration and remittances on sending

13 If one thinks of migration as a treatment, the migrant-sending households as the treatment group, and the households without migrants as the control group, there is clearly a treatment externality, similar to that studied in an entirely different context by Miguel and Kramer (2004).

areas depend critically on the ways in which local markets transmit influences among households.

IV. THE MODEL

The disaggregated Rural Economy-Wide Model (DREM) is a series of interacting household models "nested" within a general-equilibrium model of the rural economy. Each household model within a DREM is effectively a small computable general equilibrium model, parameterised using data from a household-specific social accounting matrix. Prices may be determined inside or outside of the rural economy, and in the case of autarkic households they may be shadow prices specific to a household group. The DREM approach is described in detail in Taylor, Dyer and Yúnez-Naude (Taylor *et al.*, 2005).

Similar to Dyer, Boucher, and Taylor (2006), each agricultural household in the model is assumed to maximise utility $U(G, X, \underline{c}; \underline{\beta})$, defined by the consumption of home-produced grain (G), leisure (X), and a vector of other consumption goods (denoted by the subscript i) that may be purchased or home produced (c = *(c1, c2,…,cI)*), subject to a budget constraint (1), production technology (2), a time constraint (3), migrant remittances (4), and in the case of subsistence households, a subsistence constraint (5):

(1) $\sum_{i=1}^{I} p_i c_i = p_G(Q_G - G) - wL_G + \sum_{i=1}^{v} p_i Q_i - w\left[\sum_{i=1}^{v} L_i - F\right] + R + \bar{Y}$

(2) $Q_G = Q_G(L_G, \bar{T}_G; \bar{k}_G, \underline{\gamma}_G); \quad Q_i = Q_i(L_i, \bar{T}_i; \bar{k}_i, \underline{\gamma}_i) \quad i = 1,...,v$

(3) $X + F + M = \bar{L}$

(4) $R = R(M)$

(5) $G \le Q_G \quad (subsistence \quad households)$

U is a standard, quasi-concave utility function, β is a vector of household specific preference parameters, and γ denotes household characteristics affecting production. β and γ are not explicitly in the model, but they are implicit in the production and expenditure-function parameters, which are shaped by the criteria used to define the household groups. L_G and L_i are the amounts of labour used in the production of G and i, respectively, and $\bar{Y}$ is other (exogenous) transfer income. In the cash income constraint, goods are ordered such that the first v goods are produced by the household, Q_i is the output of the i^{th} good produced by the household, w is the local wage rate, and F is the household's total local labour supply (to own-farm as well as off-farm work). Production of each good is assumed to exhibit constant returns in labour, L_i, land, $\bar{T}_i$, and capital, $\bar{k}_i$ (land and capital are assumed fixed in the short run). The household's total time endowment, $\bar{L}$, is allocated among leisure, X, migration, M, and other work, F. R is migrant remittances, which are a quasi-concave function of household labour allocated to migration, M. The subsistence constraint (5), which is binding for subsistence but not

commercial households, restricts the consumption of home produced grain to equal grain production (Q_G).

Labour is not homogeneous. Both the activities and income generated by households' labour may vary by gender, and family members have different levels of human capital. In the simulation models, we assume a separate time endowment for men and women and for high- (≥6 years of schooling) and low- (<6 years) skill labour. This gender and human capital disaggregation is a novel feature of our models. Overwhelmingly, high-skill labour is allocated to non-farm work. Non-farm wages are fixed; they are assumed to be determined outside the rural economy. The combination of fixed non-farm wages and endogenous farm wages implies human-capital related constraints on farm workers' ability to shift to non-farm work. Migration opportunities as well as remittance behaviour differ by gender as well as education level.

The solution to this constrained optimisation problem yields a set of input and consumption demands for each household. Rural general-equilibrium constraints require the sum of labour demands across all activities and households to equal the sum of local labour supply. This constraint determines the rural wage, which is endogenous in each of the two country models. Migration may influence the rural wage by affecting the supply of labour in rural areas.

Each rural model contains three types of prices: (1) exogenous prices for tradables (non-farm wages and the prices of most goods, which are determined outside the rural economy but may be influenced by government policies, for example, import tariffs); (2) prices exogenous to households but determined within the rural economy (in the present models, these are limited to rural wages); and (3) household-specific shadow prices for grain (in subsistence households). The subsistence household's endogenous shadow price of grain is $\rho = \mu / \lambda$, where μ is the shadow value of the subsistence constraint (5) and λ is the marginal utility of income (De Janvry *et al.*, 1991) (Squire *et al.*, 1986). Although they do not participate in the output market, subsistence households nevertheless are affected by changes in the market price, both on the cost side, as factor prices adjust, and because the shadow price of the subsistence crop is indirectly a function of the market price in a rural economy-wide model (see Dyer, Boucher, and Taylor (2006)).

Households in the DREMs

An important contribution of the DREM approach is that, unlike aggregate CGE models, it explicitly takes into account the heterogeneity of rural households in terms of technologies, consumption demands, and integration with markets, as well as the diversification of these households' activities and income sources. Household heterogeneity and diversification shape both the direct and indirect, general-equilibrium impacts of migration on migrant-sending economies. For example, an increase in migration from subsistence-production households will have a different effect on production as well as on expenditure linkages than a similar increase in migration from a commercial producer or landless household.

Our models were designed explicitly to capture these features of the rural Mexican and Nicaraguan economies. Each country's rural economy model nests within it models of four different rural household groups: landless, small holder, medium holder, and large holder. Rural households without land depend primarily on salaries, both agricultural and non-agricultural,

and on remittances from internal and international migrants. Small holder households primarily produce basic grains for home consumption. In our DREMs, these households are modelled as autarkic: basic grain production is equal to demand. Compared to agricultural household models, a novelty of the DREM is its ability to represent differences in market access as well as in demands, production technologies, and activity mixes among various rural household groups.

All of the household groups participate in markets for other agricultural and non-agricultural commodities and factors, either as buyers (for example, commercial households demanding labour for crop activities) or sellers (landless households supplying labour to farm and nonfarm activities).

Household groups differ with respect to incomes, activity mixes, demand patterns, and technologies. The same rural household commonly participates in multiple activities and receives income from various sources, including production, wage labour, and migration. Policy shocks that directly affect one activity are transmitted to other activities within the household, as well as to other households in the rural economy. There is evidence of technological differences, reflected in differences in factor value-added shares, both across activities and in the same activities across households. In general, the family value-added share in a given activity is smaller for large commercial households than for subsistence producers, while market-input shares (including hired labour) are larger for commercial producers. Technological heterogeneity across households, together with differences in market access, are captured in our DREMs but generally absent from aggregate economy-wide models (Taylor *et al.*, 2005).

V. DATA AND MODEL CALIBRATION

The data to construct our DREMS comes from two multi-purpose household surveys. The Nicaragua National Household Living Standards Survey (Encuesta Nacional de Hogares sobre Medición de Niveles de Vida, ENMV) was implemented by the Nicaraguan National Institute of Statistics and Censes (INEC) in 2001 and 2005. The Mexico National Rural Household Survey (Encuesta Nacional a Hogares Rurales de México – ENHRUM) was carried out in 2003 and 2008. It was implemented jointly by UC Davis and El Colegio de México in Mexico City.[14]

To construct the rural economy-wide models, we first constructed a Social Accounting Matrix (SAM) for each rural household group. Each of these SAMs could be viewed as being generated by a single agricultural household model. The SAMs were then joined together into a rural sector-wide SAM for each country.[15] Nearly all of the information needed to calibrate the corresponding household models and the rural economy-wide models is contained within these SAMs (the framework of the SAMs is described in appendix A). Each household SAM consists of a set of production activities, factors (including labour, disaggregated by gender and education level), government, investment accounts, and "rest-of-world" accounts, including the rest of the rural sector of which the household is part, the rest of the country, and the rest of the world outside the country.

Rural households interact with the rest of the world directly through international migration. Nearly all international migration from Mexico goes to the United States; thus, the rest of the world is a single account in the Mexico model. International migration from rural Nicaragua is less concentrated; thus, the Nicaragua model has three rest-of-world accounts: the United States, Costa Rica and other countries.

This study builds upon existing DREMs for Mexico (Taylor and Dyer, 2009) and Nicaragua (Taylor *et al.*, 2010), updating and extending them for purposes of this analysis with data from both rounds of the ENMV and ENHRUM. Labour factor accounts were disaggregated by gender as well as education level. In the Nicaragua model, international migration was disaggregated by destination, as described above. For both countries, this required econometric estimation of gender and human capital specific remittance functions for each sending country and each migrant destination.

14 Data from the ENMV and the first round of ENHRUM are available online.

15 Picture the household SAMs arranged along the diagonal of a large rural-sector SAM, each interacting with shared rest-of-rural-sector, rest of country, and rest of world accounts. The rest-of-rural-sector is the key account linking the household groups with one another in each country's rural-sector SAM.

Estimation of remittance functions

Remittances by each labour type (male, female, high-education, low-education) and destination were modelled as a function of household labour allocated to migration; that is, for each destination d and labour type j,

$$R_d^j = f_d^j(M_d^j) = \gamma_{d0} \prod_j M_j^{\gamma_d^j}$$

Estimation of these remittance functions is complicated by the fact that we observe remittances from a given destination only if a household sends migrants to that destination, and households with migrants are a self-selected sample of the population.

Remittances were modelled using the well known two-step Heckman procedure. The first step is a probit estimate of the probability of remittance receipt. The estimated probit is used to construct an inverse-Mills ratio, which is used to control for sample-selectivity while estimating (log) remittances as a function of (log) migration, by labour type and destination. For Nicaragua, first-stage migration instruments include household migration capital (whether or not the household had a migrant at the given destination five years prior to the survey year). Richer migration and remittance data are available for Mexico, including a disaggregation of remittances by migrant destination.

Table 1 reports estimated remittance elasticities for Nicaragua (to the US and Costa Rica) and Mexico (to the US), respectively, by gender and education level. The elasticities for Nicaragua range from 0.19 (for male migration to Costa Rica) to 0.91 (for skilled female migration to Costa Rica). They are consistently higher for high-education migrants, with the exception of male migration to Costa Rica, for which remittance elasticities are not significantly different for high than low skilled migrants. For Mexico-to-US migration, remittance elasticities are significantly higher for men than women; for Nicaragua-to-Costa Rica migration, they are higher for women.

The form of each household-specific factor and consumption demand function depends on technology and preferences. On the technology side, we assume Cobb-Douglas production functions for each household group and good, in which the exponents are set equal to factor shares in value added as implied by profit maximisation and available from the household SAMs. Consumption demands were modelled using a linear expenditure system (LES) with no minimum required quantities (Deaton and Muellbauer, 1980), implying that preferences of individual groups are described by a Cobb-Douglas utility function. Budget shares, like factor value-added shares, were calculated from the household expenditure columns in the SAMs.

Table 1. **Estimated remittance elasticities, Nicaragua and Mexico***

Destination and migrant education	γo	Female	Male
	Nicaragua		
Nicaragua-US	7.44		
Low Ed		0.43	0.54
High Ed		0.68	0.57
Nicaragua-Costa Rica	6.97		
Low Ed		0.29	0.19
High Ed		0.91	
	Mexico		
Mexico-US	10.62		
Low Ed		0.22	0.84
High Ed		0.39	0.90

Note: *Low-education refers to primary schooling or less; high-education migrants have at least some secondary schooling.

Source: Authors' calculations.

Because land and capital are fixed factors in this model, labour plays a key role in the adjustment process. We assume that the rural hired labour market clears; that is, the total supply of hired labour (assumed to be fixed) equals the total demand, summed up across all activities and households. This determines the endogenous rural wage for each labour group (by gender and education level) in each country. Labour of each type is hired to the point where its marginal value product is equal to its rural wage.

The model includes three "rest of world" accounts: the rest of the rural economy, the rest of the country, and the world outside the country borders, with which rural households interact principally through labour migration (households do not sell goods directly to the world market). Because this is a rural economy-wide model, the rest of the national economy is treated as exogenous. Thus, the model does not capture the rural-feedback effects of endogenous adjustments to migration shocks in the *urban* economy. These, however, are likely to be small compared with the general-equilibrium effects of shocks *within* the rural economy. The model is not designed to explore the impacts of international migration shocks on the urban economy. However, in modelling the impacts on the rural economy, it offers a level of detail not available in other models.

The solution to the base model for each country determines the labour demands in each activity, production, full income and consumption demands for each rural household group, rural wages, migration, and the shadow price of grain in subsistence households. This base model is the starting point for carrying out simulations to explore the impacts of changes in international migration and other shocks on rural welfare.

VI. POLICY EXPERIMENTS

We described in Part 2 how immigration policies in migrant-receiving countries might affect migration flows into the country, migrant characteristics, and remittance sending behaviour, often in complex and hard-to-predict ways. Those first-order impacts in turn create second-order effects on welfare in migrant-sending economies. We now use the two DREMs to simulate those second-order impacts. All of our simulations consist of imposing a first-order shock onto the migrant-sending economy in terms of migration flows or remittance flows, then observing the second-order impacts according to how the model adjusts. The literature provides some econometric estimates of the first-order impacts on remittances, and we can use those as shocks in our simulations. First-order policy impacts on migration flows, however, have not been accurately estimated, and we can only simulate likely shocks.

We perform seven sets of simulations, first using a static model then incorporating recursive dynamics. Because the impacts of policies frequently are nebulous, most of our simulations can be thought to represent several different policies, as discussed below. We present results for: (1) the short-term effects of an increase in migration equivalent to the average annual increase between 1990 and 2000; (2) the effects of increases in migration equivalent to two and one half times this average annual increase; (3) the short-term effects of an increase in the returns to migration for each labour group; (4) the effect of a tax on remittances (5) the long-term effect of a one-time increase in migration equal to the recent annual average rate of increase; (6) the same long-term effect when remittance erosion is taken into account; (7) the effects of a regularisation policy. These sets of experiments were chosen to illustrate the sensitivity of the rural economies of Mexico and Nicaragua to immigration policies. They also could portray the effects of economic shocks or other variables that influence migration and remittances in similar directions. For all simulations, we report the second-order effects on agricultural production, full incomes in real terms, and investments. The modelling strategies for these simulations are summarised in Table 2 and discussed in detail below.

Table 2. **Modelling strategy for simulations (1) – (7).**

	Simulation description	Modelling		
		Change in migration flow	**Change in remittances**	**Recursive solving**
(1)	Increase in Migration at current trend, short run	X		
(2)	Increase in Migration, accelerated or decelerated vs. current trend, short run	X		
(3)	Increase in returns to migration, short run		X	
(4)	Tax on remittances, short run		X	
(5)	Increase in migration at current trend, long run	X		X
(6)	Increase in migration, accounting for remittance erosion, long run	X	X	X
(7)	Regularisation policy, short and long run	X	X	X

Source: Authors' calculations.

VI.1. Increase in migration

This experiment was designed to illustrate the possible effects on migrant-sending economies of changes in international migration due to immigration policies, expansion of migration networks, or other factors. In these simulations, we treat international migration as exogenous, and we increase it by a factor equal to the average annual increase in international migration between 1990 and 2000. According to US Census data, the Nicaragua-born population in the United States increased by 2.67% annually between 1990 and 2000, and the Mexican population rose 7.61%, more than doubling during the decade (see Table 3). Information on Nicaraguan immigration to Costa Rica, as noted earlier, is less reliable than US immigration data. We conservatively estimate an average annual increase in Nicaragua-to-Costa Rica migration between 1990 and 2000 to be on the order of 6.8%.[16] These increases in migration were applied to all labour groups in each of the three migration experiments.

16 Based on Costa Rica census data analyzed by Ottorstrom (2008), the Nicaraguan immigrant population in Costa Rica was 45 919 in 1984 and 226 374 in 2000, implying an average annual growth rate of 10%. However, this includes a surge in political immigration during the Nicaraguan civil war in the 1980s that created a refugee population of 30 000 in 1989 (Basok, 1990). The immigration rate used in our experiment nets out this refugee population. Because there is no reliable information on the number of unauthorised immigrants from Nicaragua in Costa Rica, we use the rate of change in legal immigration as a proxy for the change in all immigration from Nicaragua between the two census years. Estimates of

Table 4 reports the results of the migration experiment. The simulation findings suggest that the migration rates witnessed during the 1990s had an important effect on rural incomes in the two countries. Migration to the US results in average annual increases in full income of 0.35% in Nicaragua and 0.61% in Mexico. Migration to Costa Rica raises rural Nicaraguan income by 1.46% annually. In all of these experiments, the income gains to landless and smallholder households exceed the gains to large holder households. To the extent incomes correlate positively with land tenure status, it would appear that the overall income gains from international migration are moderately progressive in both countries. In percentage terms, the largest income effect in the table is for Nicaraguan migration to Costa Rica. This reflects both the sharp increase in Nicaragua-to-Costa Rica migration during the 1990s and the important role this migration plays in Nicaragua's rural economy.

Table 3. **Estimated immigrant populations, 1990 and 2000**

Estimated immigrant populations (thousands)	1990	2000	Average annual increase (%)
United States			
Nicaragua	169	220	2.67%
Mexico	4 300	9 200	7.61%
Costa Rica			
Nicaragua	130	226	5.55%

Source: Authors' calculations.

The income effects of rising international migration reflect remittances as well as the opportunity costs of migration and the indirect linkage effects picked up by our rural general-equilibrium models. The opportunity costs, in migrant-sending as well as other households, are reflected in the production changes presented in the table. In both countries, international migration negatively affects the production of staples, a relatively labour-intensive activity. Staple output falls by 11% as a result of increasing Nicaragua-to-US migration, 0.30% due to increasing Nicaragua-to-Costa Rica migration, and 1.17% due to increasing Mexico-to-US migration. The decreases in livestock production, which is less labour intensive than staples, are smaller: 0.08% for Nicaragua-to-US migration, 0.24% for Nicaragua-to-Costa Rica migration, and 0.11% for Mexico-to-US migration. The effects on non-agricultural production are mixed, positive for Costa Rica (0.01% and 0.06%) and large and negative for Mexico (-3.46%), suggesting that migration competes heavily with the production of nontradables in Mexico, at least in the short run. Internal migration decreases slightly in Nicaragua (on the order of 0.10%) but more in Mexico (-6.13%), reflecting a higher internal migration elasticity there.

In the long run, migration can influence rural economies by stimulating investments (Stark, 1991, Taylor and Martin, 2001). The bottom of Table 4 reports simulated changes in investments in human, physical and housing capital. These range from 0.32% for physical capital investments from Nicaragua-to-US migration to 1.48% for human capital investments from

the undocumented Nicaraguan immigrant population in Costa Rica range from 200 000 to 250 000 in 1989 (Basok, 1990) to as high as 400 000 in 2000 (Otterstrom, 2008).

Nicaragua-to-Costa Rica migration. The changes in physical capital investments are a critical input into the recursive-dynamic simulations presented in Table 8, below.

Table 4. **Simulated Percentage Effects of a One-Time Increase in International Migration in the Short Run, Based on 1990-2000 Trends**

Outcome variable	Nicaragua		Mexico to US
	to US	to Costa Rica	
Simulated change in international migration	2.67%	6.83%	7.61%
Total income	0.35	1.46	0.61
Landless	0.38	1.53	0.69
Small holder	0.33	1.41	0.53
Medium holder	0.39	1.46	0.50
Large holder	0.30	1.34	0.48
Production			
Staples	-0.11	-0.30	-1.17
Livestock	-0.08	-0.24	-0.11
Non agricultural	0.01	0.06	-3.46
Migration			
Internal	-0.10	-0.11	-6.13
Investments			
Education	0.36	1.48	0.63
Physical capital	0.32	1.28	0.61
Housing	0.34	1.43	0.61

Source: Authors' calculations.

VI.2. Acceleration or deceleration of the migration flow

We now present results very similar to those described above, only with increases in migration which are, respectively, one half and double the average annual rate calculated for 1990-2000. These simulations can represent the effect of various policies or economic conditions that slow down or accelerate the entry of migrants. For example, restrictive immigration policies, increased border controls, or a recession in the migrant-receiving country would tend to decelerate the inflow of migrants, while a guest-worker program, amnesty or economic crisis in the migrant-sending country would tend to accelerate that flow. As we saw in Part 2, such effects are very hard to estimate. By choosing to simulate migration flows one half and double the average yearly flows, we set relatively conservative bounds, since we know from Part 2 that changes of those magnitudes are relatively unlikely. The effects, reported in Table 5, are very similar to those from section 1 in terms of direction, with magnitudes reflecting the simulated migration shocks.

Table 5. **Simulated Percentage Effects of a One-Time Increase in International Migration in the Short Run, Based respectively on half and double the 1990-2000 Trends (all as % changes)**

Outcome Variable	Nicaragua				Mexico to U.S	
	to US	to US	to Costa Rica	to Costa Rica		
Simulated percentage Change in international migration	**1.34**	**5.34**	**3.42**	**13.66**	**3.80**	**15.2**
Total income	0.17	0.72	0.67	3.55	0.30	1.25
Landless	0.18	0.79	0.70	3.74	0.34	1.42
Small holder	0.16	0.67	0.65	3.42	0.20	1.10
Medium holder	0.19	0.80	0.68	3.54	0.25	1.01
Large holder	0.15	0.62	0.65	3.32	0.24	0.97
Production						
Staples	-0.06	-0.23	-0.15	-0.65	-0.58	-2.4
Livestock	-0.04	-0.17	-0.12	-0.50	-0.06	-0.23
Non agricultural	0.00	-0.02	0.03	0.16	-1.83	-5.76
Migration						
Internal	-0.05	-0.20	-0.05	-0.19	-3.07	-12.21
Investments						
Education	0.17	0.73	0.68	3.61	0.31	1.28
Physical capital	0.15	0.65	0.59	3.09	0.30	1.24
Housing	0.16	0.70	0.66	3.50	0.30	1.24

Source: Authors' calculations

VI.3. Increase in the marginal returns to migration (remittance shift parameters)

Changes in the returns to migration may result from exchange rate devaluations, economic expansion or recession at migrant destinations, or simply the erosion of remittances over time as countries' stocks of emigrants abroad become increasingly assimilated into the foreign society. How sensitive are migrant-sending areas to such changes? We explored this question by increasing the shift parameter on the remittance functions by 10% for each of the labour force groups, in turn. These experiments are akin to raising the productivity of labour in production activities: the marginal product of migration, in the form of remittances, increases. They most closely represent a simulated exchange-rate devaluation that raises the value of remittances in the local currency by 10%. An economic expansion at the migrant destination might have a similar effect on migrants' "remittance productivities." A recession or remittance erosion due to assimilation would have the opposite effect and would be simulated as a decrease in the shift parameter. To a large extent, equivalent increases and decreases in the remittance shift parameter have symmetric effects on the migrant-sending economy; thus, we only report the results of increasing the shift parameter.

The immediate effects of the positive remittance shock are twofold. First, there is a transfer effect: remittances by migrants already at the destination increase by 10%. Second, higher returns to migration stimulate additional migration by members of the affected labour group. The magnitude of the increase in migration depends on the remittance elasticity of the affected group. The entire migrant-sending economy then adjusts to the increase in remittances

and the loss of additional labour to migration. In the process, production, incomes, and migration by all labour groups are affected.

Twelve remittance experiments were conducted in total, one for each country, destination and labour factor combination. Table 6 (a)-(c) report the results of these experiments.

Overall, the results indicate that the migrant-sending economy is more sensitive to changes in the economic returns to male than female migration. The migration response is higher for men. For example, in the case of Mexico-to-US migration, a 10% increase in marginal remittances for male migrants produces a total international migration response of 5.60% - 9.02% (depending on the migrants' education level), compared with only 0.14% - 0.57% when marginal remittances for female migrants increases. The lower number for females partly reflects lower remittance elasticities for women; however, they are mostly due to the smaller female share in migration and remittances in the base model. In Nicaragua, the increase in marginal remittances has a similarly disproportionate effect on male migration to the US (1.48% - 8.36% for males, 0.30% - 0.73% for females) and low-skill migration to Costa Rica (3.72% for males, 0.86% for females). However, high skill Nicaragua-to-Costa Rica migration is more sensitive to changes in female remittances (0.39%, compared with 0.03% for men).

The impacts of migration on the sending economy depend critically on the opportunity cost of losing labour to migration. This opportunity cost is almost always higher for men, reflecting the relatively important role of male labour in household production and wage activities in these two sending countries. The increased returns to low skill male migration to the US reduce staple and livestock output by 0.55% and 0.33%, respectively, in Nicaragua and by 1.44% and 0.13%, respectively, in Mexico. By contrast, the increased returns to female migration do not reduce staple or livestock production by more than 0.1% in either country. Overall, the opportunity cost of migration appears to be higher in Mexico than in Nicaragua. In Nicaragua, it is greater for long-distance US migration than for migration across the border to Costa Rica.

The income effects of increased returns to migration vary considerably between the two sending countries and across destinations as well as labour groups. The highest impact is for male Mexico-to-US migration: the 10% increase in marginal remittances raises full income by 0.87% - 1.00%. By contrast, increased returns to female migration from Mexico to the US increase income by 0.09% - 0.28%. In Nicaragua, higher returns to low-skill female migration have a greater impact on full income than higher returns to low-skill male migration, regardless of the destination. This is despite the higher migration response to low-skill male remittances; it reflects the opportunity costs and other indirect impacts of female versus male migration. The largest income effect in Nicaragua comes from changes in the returns to low-skill female migration to Costa Rica (0.82%), and the lowest is from high-skill male migration to Costa Rica (0.01%).

Table 6. **Simulated percentage effects of a 10% increase in the returns to migration in the short run, Mexico**

(a) Mexico-to-US migration

Outcome variable	Labour Group			
	Males		Females	
	Low skill	High skill	Low skill	High skill
Total income	0.87	1.00	0.09	0.28
Landless	1.08	0.87	0.09	0.22
Small Holder	0.36	0.96	0.06	0.57
Medium Holder	0.39	1.96	0.06	0.27
Large Holder	0.90	0.92	0.11	0.22
Production				
Staples	-1.44	-0.77	-0.04	0.03
Livestock	-0.13	-0.08	-0.10	0.00
Non Agricultural	-2.34	-3.18	-0.30	-1.35
Migration				
Internal	-3.99	-8.47	-0.01	-0.15
Mexico-to-US	5.60	9.02	0.14	0.57
Investments				
Education	0.91	0.99	0.09	0.26
Physical Capital	0.89	0.99	0.09	0.27
Housing	0.82	1.03	0.08	0.30

(b) Nicaragua-to-US migration

Outcome variable	Labour Group			
	Males		Females	
	Low skill	High skill	Low skill	High skill
Total income	0.30	0.46	0.63	0.33
Landless	0.50	0.53	0.72	0.31
Small Holder	0.27	0.35	0.56	0.37
Medium Holder	0.24	0.52	0.62	0.55
Large Holder	0.17	0.51	0.61	0.14
Production				
Staples	-0.55	-0.09	-0.06	-0.02
Livestock	-0.33	-0.05	-0.04	-0.02
Non Agricultural	0.29	0.03	0.05	0.01
Migration				
Internal	-0.99	-0.11	0.03	0.01
Nicaragua-to-US	8.36	1.48	0.73	0.30
Investments				
Education	0.29	0.45	0.64	0.35
Physical Capital	0.29	0.45	0.52	0.35
Housing	0.27	0.47	0.62	0.30

(c) Nicaragua-to-Costa Rica migration

Outcome variable	Labour Group			
	Males		Females	
	Low skill	High skill	Low skill	High skill
Total income	0.30	0.01	0.82	0.41
Landless	0.25	0.02	0.87	0.39
Small holder	0.42	0.01	0.88	0.45
Medium holder	0.30	0.01	0.70	0.65
Large holder	0.10	0.01	0.69	0.17
Production				
Staples	-0.20	0.00	-0.06	-0.02
Livestock	-0.13	0.00	-0.05	-0.02
Non agricultural	0.11	0.00	0.06	-0.01
Migration				
Internal	-0.38	0.00	0.03	0.02
Nicaragua-to-Costa Rica	3.72	0.03	0.86	0.39
Investments				
Education	0.30	0.01	0.84	0.43
Physical capital	0.33	0.01	0.74	0.43
Housing	0.26	0.01	0.80	0.37

Source: Authors' calculations.

The investment effects of increasing returns to international migration for males are consistently larger than for females in Mexico, ranging from 0.82% - 1.03% for housing, 0.89% - 0.99% for physical capital, and 0.91% - 0.99% for schooling (compared with 0.08% - 0.30% across all investment categories for female Mexico-to-US migration). For Nicaragua-to-Costa Rican migration, however, the largest investment effects are for females. They range from 0.37% - 0.43% for high-skill female migration and from 0.74% - 0.84% for low skill female migration. Low-skill female Nicaragua-to-US migration also has a larger effect on investments than male Nicaragua-to-US migration.

VI.4. 10% tax on remittances

The final short-run experiment simulates a 10% tax on remittances. From the migrant-sending economy point of view, this is equivalent to a decrease in the expected returns to sending migrants abroad, which is why we model it as a 10% decrease in the returns to migration parameter. The remittance tax introduced in Oklahoma, if generalised to other states or countries, would have such an effect. If a tax on incoming remittances were introduced in Mexico or Nicaragua, the effects would be the same, unless the proceeds from taxation were injected into the rural sector. Note that we are simulating a tax in this case, but other kinds of policies or economic shocks could have similar effects. A 10% appreciation of the local currency would decrease the value of remittances. An amnesty in migrant-receiving economies could have a similar detrimental effect on remittances, as could an economic recession in the migrant-receiving countries (see Part 2).

The immediate impacts of the devaluation are, again, twofold. First the lack of remittances reduces the incomes of migrant-sending households. Second, the decrease in returns to migration leads families to allocate less labour to migration. Both migrant households and others with which they are connected in the sending economy adjust their production and consumption activities in response to the decreased remittances and extra labour staying home. The tax triggers general-equilibrium effects that transmit the shock to other households in the rural economy.

The taxation experiment results are summarised in Table 7. They illustrate the sensitivity of both international migration and its impacts to macroeconomic policies. The 10% tax reduces international migration by more than 10% in both countries. It has a negative impact on rural income, ranging from -2.01% in Mexico to -2.39% in Nicaragua. In both countries, the income effect is larger for landless than large-holder households, although in Mexico the largest effect is in the medium-holder group. As the taxation makes international migration less profitable, the production of local tradable goods expands. Staple production increases by 0.73% in Nicaragua and 2.01% in Mexico. Livestock production increases less in the short run, by 0.62% in Nicaragua and 0.20% in Mexico, while non-agricultural production contracts slightly in Nicaragua (0.15%) but increases substantially in Mexico (by 12.3%). The taxation reduces investments by factors similar to the losses in income. For example, physical capital investments rise by 2.28% in Nicaragua and 2.02% in Mexico.

Table 7. **Simulated effects of a 10% tax rate in the short run, Nicaragua and Mexico**

Outcome Variable		Nicaragua	Mexico
Simulated tax on remittances		10%	10%
Total income		-2.39	-2.01
	Landless	-2.68	-2.04
	Small holder	-2.51	-1.74
	Medium holder	-2.53	-2.41
	Large holder	-1.62	-1.93
Production			
	Staples	0.73	2.01
	Livestock	0.62	0.20
	Non agricultural	-0.15	12.30
Migration			
	Internal	0.98	12.79
	International	-16.06	-15.29
Investments			
	Education	-2.43	-2.03
	Physical capital	-2.28	-2.02
	Housing	-2.25	-2.01

Source: Authors' calculations.

VI.5. Impacts of international migration in the long run, accounting for investments

Experiments 1 - 4 illustrate the short-run impacts of changes in international migration and its determinants, showcasing income gains as well as trade-offs between migration and local income activities. Research by Stark and collaborators (1991), Massey *et al*. (2003), and others suggests that the short-run impacts of migration give an overly pessimistic picture of migration's effects, because they do not take into account the positive impact that migration and remittances can have on productive investments. In fact, increasingly researchers view migration as part of household strategies to overcome liquidity, risk and other constraints on investments, while in the process creating new (lost labour and human capital) constraints. If this perception is valid, then one would expect increases in international migration in the short run to stimulate investments and the expansion of complementary productive activities in the long run. Table 4 shows that increases in physical capital investments resulting from the average annual increase in international migration are 0.32% for Nicaragua-to-US migration, 0.61% for Mexico-to-US migration, and 1.28% for Nicaragua-to-Costa Rica migration.

To explore the dynamic effects of migration and migration policies on migrant-sending economies, we re-ran Experiment 1, simulating the one-time increase in migration as in Table 4, then allowing investments to adjust over five periods. In each period, the increases in physical capital investments are allocated to households' capital stocks in proportion to the initial shares of capital in each production activity, as proposed by Taylor and Dyer (2009). In each round of this recursive-dynamic model, higher capital stocks raise the productivity of other factors in local production activities, influencing future migration, incomes, savings and investments.

Table 8 reports the resulting changes in income, production, migration and investments at the end of the five-year period. The differences between Table 8 and Table 4 represent the dynamic investment effects of the one-time increase in migration, simulated over the 5-year period. In most cases, the dynamic investment effect reverses the negative impact of migration on production activities. For example, in the case of Nicaragua-to-US migration, staple production now increases 0.06% instead of falling 0.11%, and non-agricultural production, which was virtually unchanged in the short-run experiment, increases by 0.11%. Nicaragua-to-Costa Rica migration reduces staple production in Nicaragua by 0.30% in the short-run experiment but increases it by 0.41% in the long run simulation. In Mexico, livestock output expands as international migration increases. The effects on staple and non-agricultural production, while still negative, are smaller than in the short run.

The dynamic investment effect magnifies the impact of international migration on rural income for all household groups. The change in income is 0.44% for Nicaragua-to-US migration (compared with 0.35% in the short run experiment), 1.83% for Nicaragua-to-Costa Rica migration (compared with 1.46%), and 0.95% for Mexico-to-US migration (compared with 0.61%). The dynamic effects are not distribution neutral. For example, although landless households benefit most from Nicaragua-to-Costa Rica migration in the short run, the largest long-run gains accrue to medium and large holder households. Nevertheless, landless and small holder incomes are larger, in all cases, once the dynamic investment effects of international migration are taken into account.

Table 8. **Simulated percentage effects of a one-time increase in international migration in the long run,* based on 1990-2000 trends**

Outcome variable	Nicaragua			Mexico
	to US	to Costa Rica	To both countries	to US
Simulated change in international migration	2.67%	6.83%	2.67% 6.83%	7.61%
Total income	0.44	1.83	2.39	0.95
Landless	0.45	1.84	2.43	1.08
Small holder	0.40	1.71	2.22	0.84
Medium holder	0.49	1.89	2.25	0.75
Large holder	0.42	1.87	2.44	0.76
Production				
Staples	0.06	0.41	0.51	-0.49
Livestock	0.16	0.82	1.05	1.05
Non agricultural	0.11	0.53	0.67	-3.11
Migration				
Internal	-0.21	-0.55	-0.78	-7.39
Investments				
Education	0.44	1.84	2.41	0.97
Physical capital	0.40	1.65	2.17	0.95
Housing	0.43	1.83	2.39	0.95

Note: * Simulated over a 5-year period.

Source: Authors' calculations.

VI.6. Long-run effects of migrant assimilation and remittance erosion

Remittances tend to "erode" over time as migrants become increasingly assimilated at the destination. There are many possible explanations for this. Assuming that permanent migrants remit money to the friends and relations they left behind, the need to remit may decrease with time and distance: ties gradually weaken and family members age, move, or pass away. Families may reunite when spouses or children originally left behind also migrate, thus removing the need to remit money "home" to support family members. If migrants start a family in the host country, they may find themselves with less disposable income to remit. Migrants may remit money for investments then cease remitting once they return to their native country after retirement.[17] Amuedo-Dorantes and Pozo's (2006) findings suggest that remittances are also sent as a form of insurance should a migrant have to return home, and thus remittances decrease with the likelihood of return. All of this suggests that if receiving-country border policies curtailed the entry of new migrants, the flow of remittances gradually would cease.[18]

We used the above-described dynamic recursive model to simulate various remittance erosion scenarios (see Table 9). We first simulated the effects of erosion alone, by exogenously fixing the number of migrants at each destination then changing the returns to migration parameter. This is similar to what we did in subsection 3, only this time we simulated a *negative* shock and used the recursive model to simulate the impacts over multiple consecutive years.

Setting a value for the remittance erosion rate is not straightforward. While the determinants of remitting behaviour have been the topic of much research (Case studies in Lucas and Stark (1985); Straubhaar (1986); Glytsos (1997); Reviews in Hagen-Zanker and Siegel (2007); Stark, (2009)), the extent of remittance erosion *per se* is a little-investigated question. However, studies that include "years abroad" as a control variable in their regressions provide estimates of the erosion rate as an ancillary result. Amuedo-Dorantes and Mazzolari (2010) provide such an estimate for Latin American migrants in the US Their results suggest that controlling for legal status, relevant personal characteristics and economic conditions in both home and host countries, each additional year away from home reduces the probability of remitting by about 3.5% and the amount remitted (conditional on remitting) by about 6%. Our own estimates set the erosion rate at around 3.5 per year, and we use this value in our simulations to trace out the impacts of remittance erosion over the five-year period.[19]

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17 A working paper by Stark (2009) distinguishes no less than twelve possible reasons for remitting, and proposes methods to use the erosion of remittances or the halt in remittances to infer what the underlying reason for remitting may be in particular cases.

18 Note that while this is true in the medium and long run, it may not be the case in the first years of migration, notably if the remittances are used to repay a loan (Lucas and Stark, 1985) (Hagen-Zanker and Siegel, 2007).

19 Our model does not permit simulating both the decrease in the propensity to remit and the decrease in the amounts remitted conditional on remitting; thus, we cannot implement the Amuedo-Dorantes and Mazzolari (2010) estimates exactly. However, a 3.5% decrease is a rather conservative estimate given our estimated values and those in the literature, at least as far as Mexican migrants in the U.S. are concerned. We assume the rate to be similar for migrants from Nicaragua in Costa Rica, though we cannot provide empirical evidence of this.

Columns (a), (b), (c), and (g) of Table 9 show the effect of a 3.5% yearly remittance erosion in the absence of any other disturbances, assuming that the flow of migrants is interrupted. Results for Nicaragua are shown for each destination separately then for both destinations together, but the effects carry the same sign in all three columns. Column (a) shows that if remittances from the United States were subject to erosion, rural incomes overall would decrease by 0.35% simply due to time passing. Erosion of remittances from Costa Rica has a stronger income effect, -0.73%. Column (c) shows that if both sources of remittances are subject to erosion, incomes in the rural sector would decrease by 1.08% over five years, with small holders being more affected (-1.38%) and large holders significantly less affected (-0.40%). Production would remain virtually the same in all sectors, but investment in education, physical capital and housing would all decrease by about 1%.

Results for Mexico (Table 9) (g)) are slightly different from those for Nicaragua. Overall income decreases by 1.31%, but the medium large holders are hit hardest (-2.05% and -1.54% respectively). The effect on production is also modest in all sectors, with changes of less than 0.15% in magnitude. All investments are affected negatively by almost two percentage points.

We next repeated the earlier simulations, this time taking into account the erosion of remittances during the five years following each shock (Table 9) (d), (e), (f) and (h)). Comparison with Table 8 shows that remittance erosion seriously dampens the long-term effects of an increase in migration. Without erosion, a 2.67% increase in Nicaragua-to-US migration stimulates rural incomes by 0.44% over five years, but with erosion this five-year income shock is only 0.08%. Similarly, a 7.61% shock in Mexico-to-US migration yielded a 0.95% income increase over five years without erosion, but accounting for 3.5% yearly erosion reverses the sign and yields a -0.40% income effect over five years. For Nicaragua-to-US migration (column (d)), five years of 3.5% remittance erosion reverse the sign of the rural income effect for a single group of households: the landless.

In light of this, we used the model to find out how many years of 3.5% erosion were needed to cancel out the positive income effect of the simulated migration increases. The effects of Nicaragua-to-US migration cancel out in the seventh year. Those of Nicaragua-to-Costa-Rica migration are the longest-running: they stay positive even 25 years after the increase in migration. Conversely, positive effects of Mexico-to-US migration are extremely short-lived; they are reversed after only two years of remittance erosion. These durations can be interpreted as the time after which remittances would stop having an income-boosting effect should governments successfully prevent further migration.

The 3.5% erosion rate is rather conservative, and the simulated migration shocks are equal to recently observed yearly trends, but these results should be interpreted with caution in light of the thin empirical basis on which the simulated erosion rate is based. Despite these concerns, our results highlight the necessity for migrant-sending countries (and Mexico in particular) to continually renew their migrant outflows simply to maintain current levels of income in migrant-sending areas.

Table 9. **Long-run effects, accounting for remittance erosion (impacts after 5 years)**

Outcome variable	Nicaragua						Mexico	
	to US	to Costa Rica	to Both	to US	to Costa Rica	to Both	to US	
Column	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**
Remittance erosion (yearly 3.5%)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
US migration	Fixed	Fixed	Fixed	+2.67%	Fixed	+2.67%	Fixed	+7.61
Costa Rica migration	Fixed	Fixed	Fixed	Fixed	+6.83	+6.83%	-	-
Total income	-0.35	-0.73	-1.08	0.08	1.09	1.30	-1.31	-0.40
Landless	-0.55	-0.63	-1.18	-0.11	1.21	1.23	-1.15	-0.11
Small holder	-0.32	-1.06	-1.38	0.07	0.64	0.83	-1.16	-0.36
Medium holder	-0.39	-0.65	-1.03	0.10	1.23	1.47	-2.05	-1.37
Large holder	-0.16	-0.25	-0.40	0.27	1.62	2.03	-1.54	-0.82
Production								
Staples	-0.00	-0.03	-0.03	0.05	0.38	0.48	-0.13	-0.62
Livestock	0.00	0.00	0.00	0.16	0.83	1.06	0.00	1.06
Non agricultural	0.00	0.00	0.00	0.11	0.53	0.68	0.11	-3.04
Migration								
Internal	0.00	0.00	0.00	-0.20	-0.54	-0.77	0.10	-7.28
to US	-	-	-	2.67	-	2.67	0	7.61
to Costa Rica	-	-	-	-	6.83	6.83	-	-
Investments								
Education	-0.36	-0.75	-1.11	-0.07	1.08	1.29	-1.30	-0.37
Physical capital	-0.30	-0.78	-1.08	-0.10	0.86	1.08	-1.32	-0.41
Housing	-0.31	-0.64	-0.96	-0.11	1.17	1.42	-1.32	-0.42

Source: Authors' calculations.

VI.7. The effect of a regularisation policy

Legal status is an important aspect of immigrant assimilation. There are reasons to believe that acquiring legal status significant influences the remitting behaviour of migrants, largely through the channels described in section 4. Legalisation may precipitate assimilation: it gives access to a larger labour market, facilitates family reunification, decreases the probability of deportation, and generally stabilises the migrant's situation in the host country. Even if, other things being equal, higher wages positively affect remittances, migrants' willingness to share their wages with the sending economy, through remittances, appears to decrease following legalisation. This accelerates remittance erosion. Furthermore, if migrants use remittances primarily as a form of insurance against the misfortune of being deported, acquiring legal status may dramatically reduce the incentive to remit.

Amuedo-Dorantes and Mazzolari (2010) explore this question empirically in the case of the 1986 Immigration Reform and Control Act (IRCA), which granted amnesty to around 1.6 million undocumented migrants in the United States. They find that amnesty was accompanied by a drop in the propensity to remit of about 5%, while the average amount sent home (conditional on remitting) dropped by about 25%. Restricting the sample by country of origin, they found the amnesty effect to be significant for Mexican migrants but not immigrants from

other countries. No similar data are available on immigrants in Costa-Rica. For these reasons, the results we present for Nicaraguan migrants are primarily for purposes of comparison.

Table 10 presents results of our amnesty simulations. We model the effect of regularisation on remittances with a sudden 25% drop in the returns to migration parameter, consistent with what Amuedo-Dorantes and Mazzolari (2010) found for IRCA and Mexican migrants. Table 10 presents three columns for each of the migration flows modelled. The first column for each migration flow (columns (a), (d) and (g)) reports the results of the static amnesty effect. The second column ((b), (e) and (h)) shows the same simulation after five years of recursive updating through investments. Finally, the last column of each series ((c), (f), and (i)) incorporates erosion into the long-run simulation.

For each migration flow, all three columns display negative income effects, and the magnitude of these effects increases from each column to the next. The most acute effects are in the Mexico-to-US columns, the mildest ones in the Nicaragua-to-US. The effects of an amnesty in Costa Rica are of intermediate magnitude. The immediate effects of the amnesty in the United States are a 0.75% drop in rural income in Nicaragua and a 2.47% drop in Mexico. In the long run these negative effects increase in magnitude, to -0.85 and -3.85%, respectively, due to five years of decreases in remittance-induced investments. Once remittance erosion is accounted for, the long-run effect reaches -1.12% in Nicaragua and -4.83% in Mexico. The table also shows that, as remittances and income decline, investment suffers and internal migration out of the rural sector increases. Comparisons of production yield interesting insights: in Nicaragua, all production sectors contract, while in Mexico the rural sector shifts away from agricultural production and into non-agricultural activities. Remittance erosion (columns (c), (f) and (i)) accelerates these trends.

Table 10. **Effects of an amnesty program in the short- and in the long-run**

Outcome variable	Nicaragua to US			Nicaragua to Costa Rica			Mexico to US		
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Amnesty	yes	yes	yes	yes	yes	yes	yes	yes	yes
5-year dynamic effects	no	yes	yes	no	yes	yes	no	yes	yes
Remittance erosion (yearly 3.5%)	no	no	yes	no	no	yes	no	no	yes
Total income	-0.75	-0.85	-1.12	-1.53	-1.72	-2.26	-2.47	-3.85	-4.83
Landless	-1.16	-1.25	-1.66	-1.31	-1.45	-1.92	-2.17	-3.52	-4.38
Small holder	-0.68	-0.77	-1.01	-2.22	-2.44	-3.24	-2.18	-3.35	-4.22
Medium holder	-0.81	-0.95	-1.24	-1.36	-1.59	-2.07	-3.86	-5.52	-7.06
Large holder	-0.33	-0.47	-0.58	-0.52	-0.74	-0.92	-2.89	-4.44	-5.60
Production									
Staples	-0.01	-0.30	-0.30	-0.05	-0.64	-0.66	-0.24	-4.90	-4.99
Livestock	0.00	-0.33	-0.33	0.01	-0.64	-0.64	0.00	-5.08	-5.07
Non agricultural	0.00	-0.26	-0.26	0.00	-0.97	-0.97	0.21	7.23	7.50
Migration									
Internal	0.00	0.15	0.15	0.01	0.35	0.36	0.19	6.16	6.24
Investments									
Education	-0.76	-0.86	-1.13	-1.57	-1.76	-2.32	-2.44	-3.83	-4.81
Physical capital	-0.64	-0.75	-1.97	-1.63	-1.83	-2.41	-2.49	-3.89	-4.88
Housing	-0.66	-0.77	-1.01	-1.35	-1.55	-2.03	-2.48	-3.86	-4.85

Source: Authors' calculations

VII. CONCLUSIONS

Policies and market shocks that influence international migration and remittances potentially have far-reaching implications for migrant-sending economies. The impacts of migration and remittances are complex, shaped by the characteristics of households and individuals migrating as well as general-equilibrium effects, which transmit impacts from migrant-sending households to others in the sending economy. These considerations limit the capacity of experimental or econometric approaches to capture the full impact of international migration on sending economies or on the heterogeneous households comprising them.

This study offers an alternative approach to evaluating the impacts of migration policies on the welfare of migrants and their families, based on the disaggregated rural economywide modelling (DREM) method. DREMs are useful tools to explore the pathways though which migration and immigration policies affect welfare. Our policy simulations using DREMS for Nicaragua and Mexico highlight the costs as well as the benefits of international migration in the short and long run, as well as the heterogeneity of costs and benefits across household groups. This research is novel in extending the DREM methodology to take account of migrants' gender and human capital and to examine international migration from Nicaragua, both to the United States and to Costa Rica, which has not been the subject of rigorous economic modelling.

The outcomes of these simulations offer insights into how vulnerable rural economies might be to changes in destination-country immigration policies. Both Mexico and Nicaragua depend critically on the income sent home, or remitted, by migrants in other countries, including unauthorised migrants. Our simulations reveal that rural incomes in both countries are sensitive to changes in migration and remittances. Short-run elasticities of total rural income with respect to changes in international migration in the short run range from 0.08, in the case of Mexico-to-US migration, to 0.21, for Nicaragua-to-Costa Rica migration; that is, a 10% increase in international migration increases total rural incomes by around one to two percentage points. In the long run, once investment effects are accounted for, those elasticities increase to 0.12 (Mexico) and to 0.26 (Nicaragua-to-Costa Rica). Our simulations uncover these positive effects despite the finding that migration competes with local production activities, in most cases reducing output in the short run. In the long run, migration-induced investments reduce and, in many cases, reverse negative short-run production effects. Our results also indicate that, should destination–country immigration policies curtail the flow of new migrants, the positive impacts of international migration could quickly be erased by the erosion of remittances over time. In other words, welfare in migrant sending areas depends not only on maintaining current migration levels, but also on the continued growth of migration over time.

Immigration policies, economic conditions, and the aging of immigrant stocks in destination countries can all influence the economic returns to migration. Our model is useful for simulating the ways in which changes in the economic returns to migration affect welfare in migrant-sending areas. Findings suggest that the impacts of policies that alter the economic returns to international migration depend critically on the migrant destination as well as the affected migrants' gender and human capital. In Mexico, increases in the returns to male migration to the United States appear to have a larger opportunity cost than increases in the returns to female migration in terms of lost production in Mexico; however, they also have a larger positive effect on income. This contrasts with Nicaragua-to-Costa Rica migration, for which increases in the returns to female migration have a larger positive impact on income (as well as a lower opportunity cost in terms of lost production) than increases in the returns to male migration.

All of our experiments reveal differences in the impacts of international migration across household groups. In most cases, the combined direct and general-equilibrium effects of migration and remittances are favourable for landless and smallholder households. There is some evidence from our recursive dynamic simulations that these effects become less progressive over time. Nevertheless, dynamic investment effects appear to magnify the welfare benefits of migration for all household groups.

Policy makers in destination countries rarely consider the impacts that their immigration policy reforms might have on welfare in migrant-source countries. The findings presented here suggest that these impacts may be considerable. They also underline the importance of domestic policies to mitigate the adverse short-run impacts of international migration on the production of tradables, while facilitating positive dynamic effects, through investments. For example, micro-credit institutions that make remittance-induced savings available to households without migrants can enhance the dynamic effect of migration and remittances on investments in migrant-sending economies.

Finally, our findings highlight the usefulness of a disaggregated economy-wide modelling approach to understand the development impacts of migration and the possible ramifications of immigration policy reforms in migrant-sending economies. Remittances are critical from a development perspective, not only because of their size but also because they flow directly into households, many of which are in rural areas where poverty is most concentrated. Aggregate general equilibrium models ignore most of the heterogeneity of households in migrant-source economies. On the other hand, most micro-economic research, including remittance-use studies, considers only migrant-sending households; thus, it misses many, if not most, of migration's impacts on the migrant-sending economy. Migrant households transmit the impacts of migration to others within the local economies of which they are part. Households that send migrants and receive remittances affect nonmigrant households via their interactions in local markets. Because of this, a household does not necessarily have to have a migrant in order to be affected by migration. In fact, it is possible that most of migration's impacts on sending economies are found outside the households that send the migrants and receive the remittances. Understanding the pathways through which migration and immigration policies affect rural welfare thus is critical from both a research and policy perspective.

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