The Economics of Migration and Migration Policy in Rural Mexico *

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Abstract

Migration decisions of households in rural Mexico are both economically significant and relevant for policy. We discuss the economics of migration and migration policy, including the determinants of migration, neighborhood effects, and dynamic behavior, and survey the related literature. We then describe and review our recent empirical work analyzing the economics of migration and the effects of migration policy on migration decisions and welfare in rural Mexico. In this recent study, we find that, owing in part to neighborhood effects and dynamic behavior, a cap on total migration to the US decreases migration not only to the US but also within Mexico as well, causes migration to the US to decrease by more than what is required by the policy, and decreases average welfare per household-year. We discuss the implications of our recent study for contemporary economic policy and migration policy.

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1 Introduction

According to estimates from the World Bank (2010a), around 3 percent of the world population live in a country different from the one in which they were born. Long perceived as a land of opportunity for immigrants (Abramitzky and Boustan, 2017), the US is the country with the highest immigrant population in the world, with more than 46 million people who were foreign born (United Nations, 2013), of which about 11 million are from Mexico (World Bank, 2010b). These trends are considerably changing demographic portraits, reshaping patterns of consumption, and altering the cultures of both sending and receiving countries.

The economic importance of migration from Mexico to the US is twofold. Since the mid-1980s, migration to the US has represented an employment opportunity for Mexicans during a period of economic instability and increasing inequality in Mexico. In addition, it has represented an important source of income via remittances, especially for rural households (Esquivel and Huerta-Pineda, 2007).[1] Remittances from the US to Mexico amount to 22.8 billion dollars per year, according to estimates from the World Bank (2012). According to recent calculations, an average of 2,115 dollars in remittances is sent by each of the nearly 11 million Mexicans living in the US, which represents up to 2 percent of the Mexican GDP (D'Vera et al., 2013). Some authors estimate that 13 percent of household total income and 16 percent of per capita income in Mexico come from migrant remittances (Taylor et al., 2008).

With a border 3200 kilometers long, the largest migration flow between two countries, and a wage differential for low-skilled workers between the US and Mexico of 5 to 1 (Cornelious and Salehya, 2007), the US-Mexico migration relationship also imposes challenges to policy-makers of both countries. Beginning in 2000, Mexico moved away from its previous so-called 'no policy policy', and tried instead to pursue a more active policy to influence the US to agree to a workers program and to increase the number of visas issued for Mexicans, although

[1] Esquivel and Huerta-Pineda (2007) find that 3 percent of urban households and up to 10 percent of rural households in Mexico receive remittances.

its efforts got frustrated after the 9/11 attacks in September 2001. More recently, other domestic policies have included the programs Paisano and Tres Por Uno, which facilitate the temporary return during holidays of Mexicans legally living in the US and which match the contributions of migrant clubs for the construction of facilities with social impact in Mexican communities, respectively. On the US side, several reforms have been attempted to open a path for legalization while also increasing expenditures to discourage illegal immigration, both of which affect mostly Mexicans. The most recent, the Deferred Action for Childhood Arrivals, gives access to work permits to individuals who entered the country before they were 16 years of age. On September 5, 2017, the U.S. Department of Homeland Security initiated the phaseout of the Deferred Action for Childhood Arrivals program (U.S. Department of Homeland Security, 2017).

In this paper, we discuss the economics of migration and migration policy, including the determinants of migration, neighborhood effects, and dynamic behavior, and survey the related literature. We then describe and review our recent empirical work (Rojas Valdés, Lin Lawell and Taylor, 2019b) analyzing the economics of migration and the effects of migration policy on migration decisions and welfare in rural Mexico. In this recent study, we find that, owing in part to neighborhood effects and dynamic behavior, a cap on total migration to the US decreases migration not only to the US but also within Mexico as well, causes migration to the US to decrease by more than what is required by the policy, and decreases average welfare per household-year. We discuss the implications of our recent study for contemporary economic policy and migration policy.

2 Determinants of Migration

Given the economic significance of migration and its relevance for policy, it is important to understand the factors that cause people to migrate. The first strand of literature we survey and discuss is therefore the literature on the determinants of migration.

The new economics of labor migration posits the household as the relevant unit of analysis. Using the household as the relevant unit of analysis addresses several observed features of migration that are ignored by individualistic models, including the enormous flows of remittances and the existence of extended families which extend beyond national borders. Most applications of the new economics of labor migration assume that the preferences of the household can be represented by an aggregate utility function, and that income is pooled and specified by the household budget constraint.

For example, Stark and Bloom (1985) assume that individuals with different preferences and income not only seek to maximize their utility but also act collectively to minimize risks and loosen constraints imposed by imperfections in credit, insurance, and labor markets. This kind of model assumes that there is an informal contract among members of a family in which members work as financial intermediaries in the form of migrants. The household acts collectively to pay the cost of migration by some of its members, and in turn migrants provide credit and liquidity (in form of remittances), and insurance (when the income of migrants is not correlated with the income generating activities of the household). In this setting, altruism is not a precondition for remittances and cooperation, but it reinforces the implicit contract among household members (Taylor and Martin, 2001).

Similarly, in their analysis of how migration decisions of Mexican households respond to unemployment shocks in the US, Fajardo, Gutiérrez and Larreguy (2017) emphasize the role played by the household, as opposed to individuals, as the decision-making unit at the origin. Garlick, Leibbrandt and Levinsohn (2016) provide a framework with which to analyze the economic impact of migration when individuals migrate and households pool income.

In the new economics of labor migration, individual characteristics and human capital variables are also very important because they influence both the characteristics of the migrants and the impacts that migration has on the productive activities of the remaining household. Human capital theory à la Sjaastad (1962) suggests that migrants are younger than those who stay because younger migrants would capture the returns from migration

over a longer time horizon. The role of education depends on the characteristics of the host and the source economy. Education is positively related to rural-urban migration but has a negative effect on international migration (Taylor, 1987). The reason is that education is not equally rewarded across different host economies. For example, agricultural work in the United States requires only low-skilled labor, so education has a negative effect on the selection of migrants for this type of work.

Changes in labor demand in the United States has modified the role of migrant characteristics in determining who migrates. Migrants from rural Mexico, once mainly poorly educated men, more recently have included female, married, and better educated individuals relative to the average rural Mexican population (Taylor and Martin, 2001). Borjas (2008) finds evidence that Puerto Rico migrants to the United States have lower incomes, which is consistent with Borjas' (1987) prediction that migrants have incomes lower than the mean income in both the source and host economies when the source economy has low mean wages and high inequality. On the other hand, Feliciano (2001), Chiquiar and Hanson (2005), Orrenius and Zavodny (2005), McKenzie and Rapoport (2010), Cuecuecha (2005), and Rubalcaba et al. (2008) find that Mexican migrants come from the middle of the wage or education distribution. McKenzie and Rapoport (2007) show that migrants from regions with communities of moderate size in the United States come from the middle of the wealth distribution, while migrants from regions with bigger communities in the United States come from the bottom of the wealth distribution.

Kaestner and Malamud (2014) find that Mexican migrants tend to be young single adults from the middle of the education distribution (four to nine years of schooling) and from the first through third quantile of the earnings distribution. They do not find significant differences in terms of cognitive ability across migrants and non-migrants, and nor do they find much evidence on health-driven migration selectivity.

Chiquiar and Salcedo (2013) examine the evolution of migration flows from Mexico to the United States. They find that, in addition supply-side factors – including Mexico's peso

crisis, heightened post-9/11 U.S. immigration enforcement, and the global economic crisis – observed migration trends appear to also align with the economic performance patterns of unskilled labor-intensive sectors in the US that employ high shares of Mexican workers. They posit that the significant increases in migration from Mexico to the US during the 1990s could have been induced by the balanced economic growth across all US sectors during the economic boom of the 1990s along with the expansion of the Mexican labor pool. From 2000 to 2007, higher growth rates of capital-intensive sectors in the US may have led to a decrease in overall labor demand, which may partially explain the reduction of Mexican migration flows during these years. In recent years, the economic crisis appears to have had a disproportionate negative impact on unskilled labor-intensive sectors, particularly the construction and manufacturing sectors in which Mexican workers are most intensively concentrated, which could explain the recent decline in Mexican migration flows (Chiquiar and Salcedo, 2013).

Fajardo, Gutiérrez and Larreguy (2017) study the relationship between employment conditions in the US and migration decisions of households in Mexico in the period 2005-2010. They find that low-income Mexican households respond to negative shocks of employment in the US by sending more migrants, while wealthier households respond by bringing them back home. They interpret their results in the context of a household model. This evidence helps explaining why traditional migration destinations persist even when they may be affected by periods of bad economic performance. Bad economic times in the US cause poorer households in rural Mexico to supply more low skilled and low educated migrants since the wealth effect dominates, while medium and highly educated and skilled migrants return. Fajardo, Gutiérrez and Larreguy (2017) rationalize this behavior using a household optimization model which shows that households with lower schooling (and thus, lower income at home) respond to negative changes in wages in the US by increasing their amount of migrants in order to meet a minimum level of subsistence consumption.

The financial costs of migration can be considerable relative to the income of the poorest

households in Mexico.[2] Angelucci (2015) finds that financial constraints to international migration are binding for poor Mexicans, some of whom would like to migrate but cannot afford to. Migration costs reflect in part the efforts of the host country to impede migration, which might explain why migration flows continue over time and why we do not observe enormous flows of migrants (Hanson, 2010). Migration costs for illegal crossing from Mexico to the United States are estimated to be 2,750 to 3,000 dollars (Mexican Migration Program, 2014). Estimates reported in Hanson (2010) suggest that the cost of the "coyote" increased by 37 percent between 1996-1998 and 2002-2004, mainly due to the increase of border enforcement due to the terrorist attacks of 9/11. Nevertheless, Gathmann (2008) estimates that even when the border enforcement expenditure for the Mexico-United States border almost quadrupled between 1986 and 2004, the increase in expenditure produced an increase the cost of the coyote of only 17 percent, with almost zero effect on coyote demand.

Shenoy (2016) estimates the cost of migration and migration-related supply elasticity in Thailand using structural model of location choice. He finds that the costs of migration are 0.3 to 1.1 times as high as average annual earnings. He also finds that migration contributes 8.6 percentage points to local labor supply elasticity.

Migration decisions may also be affected by weather and climate. Jessoe, Manning and Taylor (2018) evaluate the effects of annual fluctuations in weather on employment in rural Mexico to gain insight into the potential labor market implications of climate change, and find that extreme heat increases migration domestically from rural to urban areas and internationally to the U.S. Feng, Krueger and Oppenheimer (2010) find a significant effect of climate-driven changes in crop yields on the rate of migration from Mexico to the United States. Maystadt, Mueller and Sebastian (2016) investigate the impact of weather-driven internal migration on labor markets in Nepal. Mason (2017) analyzes climate change and migration using a dynamic model, and shows that the long run carbon stock, and the en-

[2]Data from the National Council for the Evaluation of the Social Policy in Mexico (CONEVAL) show that the average income of the poorest 20 percent of rural Mexican households was only 456 dollars a year in 2012.

tire time path of production (and hence emissions), is smaller in the presence of migration. Mahajan and Yang (2017) find that hurricanes in source countries increase migration to the U.S., with the effect increasing in the size of prior migrant stocks.

3 Neighborhood Effects in Migration

We define 'neighborhood effects' (or 'strategic interactions') as arising whenever the migration decisions of other households in their village affect a household's payoffs from migration and therefore its decisions to have a member migrate. There are several reasons why a household's migration decisions may depend on the migration decisions of its neighbors .

The first source of neighborhood effects are migration networks. Migration networks may affect migration decisions because they may reduce the financial, psychological, and/or informational costs of moving out of the community. Contacts in the source economy lower financial or information costs and reduce the utility loss from living and working away from home. The role of migration networks has been studied by Du, Park and Wang (2005) on China; Bauer and Gang (1998) on Egypt; Battisti, Peri and Romiti (2016) on Germany; Neubecker, Smolka and Steinbacher (forthcoming) on Spain; Alcosta (2011) on El Salvador; Alcala et al. (2014) on Bolivia; Calero, Bedi and Sparro (2009) on Ecauado; Acosta et al. (2008) on Latin America; and several others on Mexico, including Massey and Espinosa (1997) and Massey, Goldring and Durand (1994). These papers find a positive effect of migration networks on the probability of migration. Elsner, Narciso and Thijssen (2018) find evidence that networks that are more integrated in the society of the host country lead to better outcomes after migration.

In his analysis of job networks among Mexican immigrants in the U.S. labor market, Munshi (2003) finds that the same individual is more likely to be employed and to hold a higher paying nonagricultural job when his network is exogenously higher. Orrenius and Zavodny (2005) show that the probability of migrating for young males in Mexico increases

when their father or siblings have already migrated. McKenzie and Rapoport (2010) find that the average schooling of migrants from Mexican communities with a larger presence in the United States is lower. Networks and the presence of relatives or friends in the host country are consistently found to be significant in studies such as those of Greenwood (1971) and Nelson (1976), among others.

Wahba and Zenou (2005) develop a theoretical model in which individuals are embedded within a network of social relationships. They show that, conditional on being employed, the probability of finding a job through social networks, relative to other search methods, increases and is concave with the size of the network. The effects are stronger for the uneducated. There is however a critical size of the network above which this probability decreases. They then test empirically these theoretical findings for Egypt using the 1998 Labor Market Survey. The empirical evidence supports the predictions of their theoretical model.

A second source of neighborhood effects are information externalities between households in the same village that may have a positive effect on migration decisions. When a household decides to send a migrant outside the village, other households in the village may benefit from learning information from their neighbor. This information may include information about the benefits and costs of migration, as well as information that enables a household to increase the benefits and reduce the costs of migration (Rojas Valdés, Lin Lawell and Taylor, 2019a).

A third source of neighborhood effects may be relative deprivation (Stark and Taylor, 1989; Stark and Taylor, 1991). Models of relative deprivation consider that a household's utility is a function of its relative position in the wealth distribution of all the households in the community. When migrants migrate to another country, they migrants are likely to still consider their source country as their reference group, especially when the source and the host countries are very different, and do not choose the host country as a reference group. Individuals who migrate internationally therefore remain attached to their household and

remit in order to improve the position of their household with respect the reference group.

The relative deprivation motive also helps to explain why local migration is different from international migration because when a migrant moves within the same country it is more likely that she changes her relative group since it is easier to adapt in the host economy (where maybe the same language is spoken and the cultural differences are not as dramatic as in the case of international migration). Also, the relative deprivation concept would predict that those individuals from a household that is relatively deprived might decide to engage in international migration rather than domestic migration even though the former is more costly because by migrating locally her position in the most likely new reference group would be even worse than the position she would have if she did not migrate.

Taylor (1987) and Stark and Taylor (1989) empirically test the relative deprivation hypothesis controlling for the household relative position in the village's wealth distribution in Mexico. The results show that relative deprivation increases the probability of migration to the United States, but has no effect on internal migration, which supports the idea that when it is easy to change the reference group, migration might not occur if the position within the new reference group would be worse than the position in the original distribution.

Some behavioral explanations may add to our understanding of social comparisons and reference group formation that explain, for example, the relative deprivation hypothesis. McDonald et al. (2013) use a controlled experiment in which people play a modification of a three-player ultimatum game in which one of the players is given an exogenous amount of money that the other two consider as the reference "group". They show that differences in the wealth level of the reference player matters for the bargaining process in the game because it varies the level of payoff to which players might consider to be entitled.

A fourth source of neighborhood effects is risk sharing. Chen, Szolnoki and Perc (2012) argue that migration can occur in a setting when individuals share collective risk. Each individual in a group decides her amount of contribution for a collective good. If the amount required for the transformation of the private good into the public good is not achieved,

all the contributions are lost with a certain probability. They use computer simulations on a grid with randomly seeded "players" who follow simple behavior rules for learning and moving all over the grid. They analyze the emerging patterns after several simulations and find evidence for risk-driven migration, whereby individuals move to another location when the perceived risk of not attaining the amount needed for the public good is higher. Their simulations also show that migration might also promote cooperation, creating spatially diluted groups of "cooperators" who prevent the group from being invaded by free-riders ("defectors").

In a similar fashion, Cheng et al. (2011) use simulations to study the behavior that arises when migration is positively related to wealth. They use a grid to simulate an evolutionary prisoner's dilemma which determines the mobility of players across the grid according to simple behavioral rules. They show that migration might promote cooperation in the prisoner's dilemma game. Lin et al. (2011) use a grid and an evolutionary prisioner's dilemma game in which migration is determined by aspirations, defined as a threshold payoff level of a selected neighbor. Migration occurs with a certain probability if the aspired level of payoffs is greater than the own payoff. They show that aspirations also promote cooperation in the prisoner's dilemma game. Morten (2019) develops a dynamic model to understand the joint determination of migration and endogenous temporary migration in rural India, and finds that improving access to risk sharing reduces migration.

A fifth source of neighborhood effects is a negative competition effect whereby the benefits of migrating to the US or within Mexico would be reduced if others from the same village also migrate to the US or within Mexico. This negative competition effect may be compounded if there is a limited number of employers at the destination site who do not discriminate against migrants from elsewhere (Carrington, Detragiache and Vishwanath, 1996).

A sixth source of neighborhood effects is the marriage market. Marriage and migration decisions of one's own household and those of one's neighbors are often intertwined. The possibility of marriage with someone from another household in the same village may affect

migration decisions, and vice versa. For example, a household may care about what its neighbors do in terms of migration since it may affect the marriage prospects of members of one's household. Riosmena (2009) analyzes how the association between Mexico - U.S. migration and marriage varies across socioeconomic settings in origins using Mexican Migration Project data and employing bilevel survival analysis with controls for socioeconomic, migrant network, and marriage market characteristics and family size. Results show that single people are most likely to migrate relative to those who are married in areas of recent industrialization, where the Mexican patriarchal system is weaker and where economic opportunities for both men and women make post-marital migration less attractive.

A seventh source of neighborhood effects are cultural norms that make migration a typical activity for some households and communities. Kandel and Massey (2002) find that, in some communities, migration can be seen as a normal stage of life, reflecting a transition to 'manhood' and a means of social mobility. The authors find that households with ties to US migration have their preferences shaped in a way that their investments in education is lower and their chances to eventual migrate are higher.

Owing to migration networks, information externalities, relative deprivation, risk sharing, competition effects, the marriage market, and cultural norms, households may take into account the migration decisions of neighboring households when making their migration decisions.

In Rojas Valdés, Lin Lawell and Taylor (2019a), we estimate reduced-form models to analyze neighborhood effects in migration decisions. Using instrumental variables to address the endogeneity of neighbors' decisions, we empirically examine whether neighborhood effects in migration decisions actually take place in rural Mexico, whether the neighborhood effects depend on the size of the village, and whether there are nonlinearities in the neighborhood effects (Rojas Valdés, Lin Lawell and Taylor, 2019a).

4 Dynamic Behavior in Migration

Migration decisions are dynamic because households consider the future when making these decisions, basing them not only on the current state of economic factors, but also on the prospects of economic opportunities in other areas and the potential streams of net benefits (or payoffs) from migrating. Migration decisions are also dynamic because these decisions can be viewed as forms of investment that are made under uncertainty. Migration decisions are at least partially irreversible, there is leeway over the timing of these decisions, and the payoffs from these decisions are uncertain; as a consequence, there may be an option value to waiting before making these decisions that makes these decisions dynamic rather than static (Dixit and Pindyck, 1994).

Lagakos, Mobarak and Waugh (2018) develop a dynamic model to analyze the welfare effects of encouraging rural-urban migration. In their model, heterogenous agents face seasonal income fluctuations, stochastic income shocks, and disutility of migration that depends on past migration experience. They calibrate their model to match moments in experimental data from an intervention that randomly subsidized migration costs in Bangladesh, as well as moments from a nation-wide household survey. The calibrated parameters imply that migrants are negatively selected on productivity and assets. The model also implies a large disutility of migration for new migrants, and that this disutility decays with experience. The results suggest workers with comparative advantage for the urban area are already located there. The results show that the subsidies help poorer households to afford the cost of migration when they receive a negative shock, although they are not highly productive in the urban area.

Castelhano, Lin Lawell, Sumner, and Taylor (2019) develop a dynamic model that includes decisions of household in rural Mexico on migration, remitting, and productive investments. These authors study theoretically the conditions under which migration and remittances affect the development of sending communities. They find that remittances do not increase agricultural investments in rural Mexico. They also find that better land char-

acteristics affect positively migration to the US meaning that those households can have a more diversified investment portfolio. They find a positive relationship between schooling and migration, and a negative relationship between past international migration experience and the probability of internal migration.

Djajic and Vinogradova (forthcoming) develop and calibrate a dynamic model of migration where legal and illegal migration can be chosen. Legal migration occurs under a working permit and requires return to home location after the contract ends, but migrant still has to afford migration costs. Illegal migration also requires an initial cost, and there is a risk of deportation while being abroad. The model is suitable in the context of countries with structured markets of legal migrants, for example, from Southeast Asia to the Gulf countries or East Asia. Consumption before migration is lower for illegal migrants given the risk of deportation after migration. In their model, initial assets holding affects the type of migration. They show that wealth above a certain threshold makes illegal migration more profitable. This is consistent with previous evidence from Thailand showing wealthier workers being more likely to self-finance their migration projects. They also model the decision to work at home and find that, given the parameters utilized for their migration analysis, optimal migration is higher than what is actually observed. This is consistent with models where there is a strong preference for staying at home and non-pecuniary costs of migration.

Artuc and Ozden (forthcoming) develop a multi-period model of dynamic transitory migration decisions where decisions are based on the expected utility (net of cost) that migrants derive from moving to a given location and on the opportunities for moving to a new location this decision might open. In particular, they incorporate an option value of available destinations in each location. The option value to wait arises from the underlying volatility of the economic environment. They use the estimated model to simulate the effects of different policies on migration patterns.

Lessem (2018) develops a dynamic model to study how relative wages and border enforcement affect immigration from Mexico to the United States. In particular, she develops

a discrete choice dynamic programming model where people choose from a set of locations in both the US and Mexico, while accounting for the location of one's spouse when making decisions. She estimates the model using data on individual immigration decisions from the Mexican Migration Project. Counterfactuals show that a 10% increase in Mexican wages reduces migration rates and durations, overall decreasing the number of years spent in the US by about 5%. A 50% increase in enforcement reduces migration rates and increases durations of stay in the US, and the overall effect is a 7% decrease in the number of years spent in the US.

The seminal work of Rust (1987), who develops an econometric method for estimating single-agent dynamic discrete choice models, is the cornerstone of dynamic structural econometric models. Structural econometric models of dynamic behavior have been applied to model bus engine replacement (Rust, 1987), nuclear power plant shutdown decisions (Rothwell and Rust, 1997), water management (Timmins, 2002), air conditioner purchase behavior (Rapson, 2014), wind turbine shutdowns and upgrades (Cook and Lin Lawell, 2019), agricultural disease management (Carroll et al., 2019b), supply chain externalities (Carroll et al., 2019a), agricultural productivity (Carroll et al., forthcoming), pesticide spraying decisions (Sambucci, Lin Lawell and Lybbert, 2019), and decisions regarding labor supply, job search, and occupational choices (see Keane, Todd and Wolpin, 2011).

Most of the dynamic structural econometric models in development economics model single-agent dynamic decision-making (see e.g., Todd and Wolpin, 2010; Duflo, Hanna and Ryan, 2012; Mahajan and Tarozzi, 2011). Morten (2019) develops and estimates a dynamic structural model of risk sharing with limited commitment frictions and endogenous temporary migration to understand the joint determination of migration and risk sharing in rural India. As many migrations are temporary (Dustmann and Gorlach, 2016), Kennan and Walker (2011) estimate a dynamic structural econometric model of optimal sequences of migration decisions in order to analyze the effects of expected income on individual migration decisions. They apply the model to interstate migration decisions within the United State.

The model is estimated using panel data from the National Longitudinal Survey of Youth on white males with a high-school education. Their results suggest that the link between income and migration decisions is driven both by geographic differences in mean wages and by a tendency to move in search of a better locational match when the income realization in the current location is unfavorable.

Structural econometric models of dynamic games include a model developed by Pakes, Ostrovsky and Berry (2007), which has been applied to the multi-stage investment timing game in offshore petroleum production (Lin, 2013), to ethanol investment decisions (Thome and Lin Lawell, 2018), and to the decision to wear and use glasses (Ma, Lin Lawell and Rozelle, 2018); a model developed by Bajari et al. (2015), which has been applied to ethanol investment (Yi and Lin Lawell 2019a; Yi and Lin Lawell, 2019b); and a model developed by Bajari, Benkard and Levin (2007), which has been applied to the cement industry (Ryan, 2012; Fowlie, Reguant and Ryan, 2016), the ethanol industry (Yi, Lin Lawell and Thome, 2019), the world petroleum industry (Kheiravar, Lin Lawell and Jaffe, 2018), climate change policy (Zakerinia and Lin Lawell, 2019), and the global market for solar panels (Gerarden, 2019). Structural econometric models of dynamic games have also been applied to fisheries (Huang and Smith, 2014), dynamic natural monopoly regulation (Lim and Yurukoglu, 2018), and Chinese shipbuilding (Kalouptsidi, 2018). In Rojas Valdés, Lin Lawell and Taylor (2019b), we develop and estimate a structural econometric model of the dynamic migration game.

5 The Effects of Government Policy on Migration

Migration decisions are influenced by government policy. For example, conditional cash transfers programs have several potential effects on migration (Angelucci, 2012a). First, conditional cash tranfers reduce incentives to leave the community by subsidizing schooling. Second, migration might increase if conditional cash tranfers relax credit constraints. Third,

conditional cash tranfer payments may affect the migration timing: if conditionalities require potential migrants to stay at home, conditional cash tranfers might reduce contemporaneous migration but increase future migration. Fourth, since international migration is more costly than domestic migration, conditional cash tranfers might increase contemporaneous international migration and future domestic migration as increases in schooling make individuals more suitable for work in urban or semi-urban parts of the country (Angelucci, 2012a).

Angelucci (2012a) studies the role of conditional cash transfers from the Mexican Oportunidades program on migration decisions. The author develops a two period model where the conditional cash transfer program relaxes credit constraints but also modifies the future earnings. Conditionalities require some individuals to stay in school so they will have higher wages both at home and abroad in a second period. In her model, marginal changes in income due to the conditional cash transfers change the composition of migrant destinations. For example, some might engage in local migration only due to credit constraints but the conditional cash transfer program relaxes the constraints so now international migration is affordable. Conditional cash transfers might decrease migration for those for which the conditionals apply, but increase migration in the future when they have acquired schooling and when they can afford the cost of migration to a location that gives higher wages. In her model, similar to other models, the presence of credit constraints means that migrants are drown from the medium-low part of the income distribution but not from the lowest part. Conditional cash transfers allow less wealthy households to find migration possible (Angelucci, 2012a).

Angelucci (2015) finds that the Mexican Oportunidades program increases migration from Mexico to the US. This is evidence for binding financial constraints for poor households in Mexico. Relaxing these constraints makes poor and low-skilled workers to find migration affordable. She finds that Mexican Oportunidades program increases migration to the US in the short run but does not affect domestic migration. Migration increases for households in the low part of the income distribution but not the lowest.

In addition to the Mexican Oportunidades program, other government policies in Mexico may affect migration as well. De Janvry et al. (2015) study the role of land certificates in Mexico on labor and land allocation. They exploit the rollout of Mexican certification program PROCEDE from 1993 to 2006 and find that households with secured land had a 28% higher probability of having a migrant. They also find that the overall locality population decreased by 4% due to the program. They do not find any effect on the cultivated area but do find a positive effect on consumption. They use three independent data sets matched to satellite images with details of certificated land. Their identification strategy relies in the rollout of the program, and the authors check whether this rollout is uncorrelated with migration and population patterns. The authors interpret their results as a positive effect of certification on welfare, via consolidation of land that lead to a better use of resources, including labor.

Using data from a survey that covers the final stage of the PROCEDE program, Castelhano, Lin Lawell, Sumner, and Taylor (2019) find evidence that the agricultural support program PROCAMPO and the share of land with secured property rights in the village from the Mexican certification program PROCEDE have a positive effect on internal migration.

Lagakos, Mobarak and Waugh (2018) show that an intervention that randomly subsidized migration costs in Bangladesh helps poorer households to afford the cost of migration when they receive a negative shock, although they are not highly productive in the urban area. The authors use their dynamic model to simulate an alternative policy to the subsidy: a workfare program that keeps people in the local economy. Results show this program results in lower gains in welfare because households no longer move to a location where they can be more productive. This also implies a lower migration rate (about half from that under the subsidy). To investigate the reasons behind the large disutility of moving, the authors run experiments with the same sample of people they use to calibrate the model. They find that that unemployment risk is an important deterrent to migration, while the housing conditions

appear to be in the set of amenities people consider important for migrating.

Migration decisions in rural Mexico are also affected by US migration policies. Angelucci (2012b) studies the relationship between migration from Mexico to the US and US border enforcement. She finds that border enforcement is effective in reducing migration inflows but also reduces outflows. Enforcement policies have stronger effects on states that are not traditionally migrant senders. Her evidence is also consistent with the hypothesis that enforcement contributes to the positive selection of migrants.

Djajic and Vinogradova (forthcoming) develop and calibrate a dynamic model of migration where legal and illegal migration can be chosen, and find that increasing the deportation rate by 1% affects is equivalent to an increase of 4.4% in pecuniary costs to keep the indifference between the types of migration. It is also equivalent to a decrease of wages for illegal migrants of 2.4%. They rank the set of possible policy options in order of effectiveness for the calibrated model for Thailand: 1) deportation rate, 2) wage for undocumented workers, 3) wage for illegal aliens in underground economy, 4) length of contract for legal worker, 5) cost of undocumented migration, and 6) cost of documented migration.

6 Our Research

Owing to neighborhood effects and dynamic behavior, the migration decisions of households in a village can be thought of as a dynamic game in which each household makes decisions about how to allocate its members across distinct activities, taking into account dynamic considerations about the future and strategic considerations about what neighbors in the village are doing. In Rojas Valdés, Lin Lawell and Taylor (2019b), we develop and estimate a structural econometric model of this dynamic migration game.

There are several advantages to using a dynamic structural econometric model. First, a dynamic structural model explicitly models the dynamics of migration decisions. Second, a dynamic structural model incorporates continuation values that explicitly model how ex-

pectations about future affect current decisions. Third, a structural econometric model of a dynamic game enables us to estimate structural parameters of the underlying dynamic game with direct economic interpretations. These structural parameters include parameters that measure the effects of state variables on household payoffs (utility) and the net effect of the neighborhood effects. These parameters account for the continuation value. Fourth, the parameter estimates can be used to calculate welfare. Fifth, the parameter estimates can be used to simulate the effects of counterfactual scenarios on decisions and welfare.

Our econometric estimation in Rojas Valdés, Lin Lawell and Taylor (2019b) takes place in two stages. In the first stage, we estimate the parameters of the policy function. We do so by estimating the empirical relationship between the actions and state variables in the data. Without imposing any structure, this step simply characterizes what households do mechanically as a function of the state vector. The policy functions are therefore reduced-form regressions correlating actions to states. This step also avoids the need for the econometrician to both compute the set of all possible equilibria and specify how household decide on which equilibrium will be played, as the policy functions are estimated from the equilibrium that is actually played in the data (Ryan, 2012). In this stage, we also recover the distribution of the state variables, which describes how these state variables evolve over time.

Following methods in Hotz et al. (1994) and Bajari, Benkard and Levin (2007), we use forward simulation to estimate the value functions. This procedure consists of simulating many paths of play for each individual given distinct draws of the idiosyncratic shocks, and then averaging over the paths of play to get an estimate of the expected value function. Our methodological innovation in Rojas Valdés, Lin Lawell and Taylor (2019b) is that we address the endogeneity of neighbors' decisions using a fixed point calculation.

The second stage consists of estimating the parameters of the payoff function that are consistent with the observed behavior. This is done by appealing to the assumption of Markov Perfect Nash Equilibrium, so each observed decision is each household's best response to the actions of its neighbors. Following Bajari, Benkard and Levin (2007), we estimate

the parameters by minimizing profitable deviations from the optimal strategy via using a minimum distance estimator.

We use data from the National Survey of Rural Households in Mexico (ENHRUM) in its three rounds (2002, 2007, and 2010[3]). The survey is a nationally representative sample of Mexican rural households across 80 villages and includes information on the household characteristics such as productive assets and production decisions. It also includes retrospective employment information: individuals report their job history back to 1980. With this information, we construct an annual household-level panel data set that runs from 1990[4] to 2010, and that includes household composition variables such as household size, household head age, and number of males in the household. For each individual, we have information on whether they are working in the same village, in some other state within Mexico (internal migration), or in the United States.

The survey also includes information about the plots of land owned by each household, including slope (flat, inclined, or very inclined), quality (good, regular, or bad), irrigation status, and land area.[5] We construct variables for land slope and land quality for the complete panel using the date at which each plot was acquired. Since a plot's slope and quality are unlikely to change over time (unless investments were taken to considerably change the characteristics of the plots, which we do not observe very often in the data), we interact the plot variables with a measure of precipitation at the village level (Jessoe, Manning and Taylor, 2018) so that the resulting interaction variables vary across households and over time. Rain data covers the period 1990 to 2007.

We use information from the National Statistics Institute (INEGI) to control for the urbanization and education infrastructure at the municipality level, including the number of basic schools and the number of indigenous schools. We also include the number of registered

[3]The sample of 2010 is smaller than the sample of the two previous rounds because it was impossible to access some villages during that round due to violence and budget constraints.

[4]Since retrospective data from 1980 to 1989 included only some randomly selected individuals in each village who reported their work history, we begin our panel data set in 1990.

[5]We use information on plots of land which are owned by the household because our data set does not include comparable information on plots of land that are rented or borrowed.

cars and buses. These data cover the period 1990 to 2010.

We also include aggregate variables that represent the broad state of the institutional and economic environment relevant for migration. We use data from the INEGI on the fraction of the labor force employed in each of the three productive sectors (primary, secondary, and tertiary)[6] at the state level, from 1995 to 2010. We use INEGI's National Survey of Employment and the methodology used in Campos-Vazquez, Hincapie and Rojas-Valdés (2012) to calculate the hourly wage at the national level from 1990 to 2010 in each of the three productive sectors and the average wage across all three sectors.

We use two sets of border crossing variables that measure the costs of migration. On the Mexican side, we use INEGI's data on crime to compute the homicide rate per 10,000 inhabitants at each of the 37 the Mexican border municipalities. On the United States' side, we use data from the Border Patrol that include the number of border patrol agents, apprehensions, and deaths of migrants at each of nine border sectors,[7] and match each border sector to its corresponding Mexican municipality.

We interact these border crossing variables (which are time-variant, but the same for all villages at a given point in time) with measures of distance from the villages to the border (which are time-invariant for each village, but vary for each village-border location pair).

We use a map from the International Boundary and Water Commission (2013) to obtain the location of the 26 crossing-points from Mexico to the United States. Using the Google Distance Matrix API, we obtain the shortest driving route from each of the 80 villages in the sample to each of the 26 crossing-points, and match the corresponding municipality at which these crossing-points are located. This procedure allows us to categorize the border municipalities into those less than 1,000 kilometers from the village; and those between 1,000 and 2,000 kilometers from the village.

[6]The primary sector includes agriculture, livestock, forestry, hunting, and fisheries. The secondary sector includes the extraction industry and electricity, manufacturing, and construction. The tertiary sector includes commerce, restaurants and hotels, transportation, communication and storage, professional services, financial services, corporate services, social services, and government and international organizations.

[7]A 'border sector' is the term the Border Patrol uses to delineate regions along the border for their administrative purposes.

By interacting the distances to the border crossing points with the border crossing variables, we obtain the mean of each border crossing variable at each of the three closest crossing points, and the mean of each border crossing variable within the municipalities that are in each of the two distance categories defined above. We also compute the mean of each border crossing variable among all the border municipalities.

Our structural econometric model of the dynamic migration game in Rojas Valdés, Lin Lawell and Taylor (2019b) enables us to examine how natural factors, economic factors, institutions, government policies, and neighborhood effects affect the migration decisions of households in rural Mexico. In Rojas Valdés, Lin Lawell and Taylor (2018), we use the parameters we estimate to simulate the effects of counterfactual scenarios regarding climate and the environment on migration decisions and welfare. In Rojas Valdés, Lin Lawell and Taylor (2019b), we use the estimated parameters to simulate the effects of counterfactual policy scenarios, including those regarding wages, government policy, schooling, crime rates at the border, and precipitation, on migration decisions and welfare.

7 Policy Implications

According to our results in Rojas Valdés, Lin Lawell and Taylor (2019b), increases in the wage in Mexico not only increase migration within Mexico, but also increase migration to the US, likely because higher wages make migration to the US becomes more affordable to poor and credit-constrained households. Our result that increases in wages in Mexico will increase migration to the US contradicts a common belief that, in order to keep Mexicans in Mexico, one simply needs to improve economic opportunities for Mexicans in their home country. Thus, since it is usually assumed that labor moves to the United States mainly because of a lack of opportunities in Mexico (in other words, implying some substitution across activities), our results finding evidence to the contrary have important implications for the discussion and design of policy (Rojas Valdés, Lin Lawell and Taylor, 2019b).

In terms of counterfactual government migration policy, a minimum threshold household average schooling needed for migration to US decreases migration not only to the US but also within Mexico, and also decreases average welfare per household-year. Owing in part to neighborhood effects and dynamic behavior, a cap on total migration to the US decreases migration not only to the US but also within Mexico as well, causes migration to the US to decrease by more than what is required by the policy, and decreases average welfare per household-year (Rojas Valdés, Lin Lawell and Taylor, 2019b).

According to our results in Rojas Valdés, Lin Lawell and Taylor (2019b), strategic interactions explain why policies that decrease migration to the US also decrease migration within Mexico. Owing to the significant positive other-migration strategic interaction in the policy functions, decreases in migration to US by neighbors are associated with a decrease in a household's probability of migrating within Mexico (Rojas Valdés, Lin Lawell and Taylor, 2019b).

Also according to our results in Rojas Valdés, Lin Lawell and Taylor (2019b), dynamic behavior explains why a cap on total migration to the US causes migration to the US to decrease by more than what is required by the policy. Owing to the significant positive effect of lagged migration to the US on the probability of migration to the US in the policy functions, there is persistence in the decision to engage in migration to the US. Thus, policies that restrict migration to the US are amplified over time (Rojas Valdés, Lin Lawell and Taylor, 2019b).

Dynamic behavior may also explain why policies that decrease migration to the US also decrease migration within Mexico (Rojas Valdés, Lin Lawell and Taylor, 2019b). Migration within Mexico may be a form of transitory migration whereby households may decide to engage in migration to a given location only as a means to eventually engage in migration to another location (Artuc and Ozden, 2018). In particular, migration within Mexico may have an option value of facilitating subsequent migration to the US. Thus, policies that decrease migration to the US may also decrease the option value a household may receive

from engaging in migration within Mexico, and may therefore decrease migration within Mexico as well (Rojas Valdés, Lin Lawell and Taylor, 2019b).

In their analysis of how the scale and composition of low-skilled immigration in the United States have evolved over time, Hanson, Liu and McIntosh (2017) find that, because major source countries for U.S. immigration are now seeing and will continue to see weak growth of the labor supply relative to the United States, future immigration rates of young, low-skilled workers appear unlikely to rebound, whether or not U.S. immigration policies tighten further. Our results in Rojas Valdés, Lin Lawell and Taylor (2019b) show that migration policies that cap total migration from Mexico to the US decrease migration not only to the US but also within Mexico as well, and cause migration to the US to decrease by more than what is required by the policy.

In response to concerns that foreign workers were taking jobs from Americans, Congress cut the annual quota on new H-1B visas, which allow skilled foreign-born individuals to work in the United States, from 195,000 to 65,000, beginning with fiscal year 2004. Using data for the fiscal years 2002-2009, Mayda et al. (2018) find that the reduced cap did not increase the hiring of U.S. workers.

In their review of the literature on historical and contemporary immigration to the United States, Abramitzky and Boustan (2017) find that although immigrants appear to reduce the wages of some natives, the evidence does not support the view that, on net, immigrants have negative effects on the US economy. Instead, new arrivals created winners and losers in the native population and among existing immigrant workers, reducing the wages of low-skilled natives to some degree, encouraging some native born to move away from immigrant gateway cities, and either spurring or delaying capital investment. In the past, these investments took the form of new factories geared toward mass production, whereas today immigrant-receiving areas have slower rates of skilled-biased investments such as computerization (Abramitzky and Boustan, 2017).

Similarly, in their analysis of undocumented immigrants in the US from Mexico, Lessem

and Nakajimae (2019) find, while the flexibility of immigrant wages may increase the volatility of low-skilled native employment, it may also reduce the volatility of high-skilled native employment over the business cycles.

In their analysis of the relationship between migration flows and the dynamics of the export baskets of host countries, Bahar and Rapoport (2018) find that migrants serve as drivers of productive knowledge. Their results suggest international migration is an important driver of knowledge diffusion and, thus, of inequality reduction.

Clemens, Lewis and Postel (2018) evaluate an immigration barrier that was intended to improve domestic terms of employment by shrinking the workforce – a policy change that excluded almost half a million Mexican bracero seasonal agricultural workers from the United States – and fail to reject the hypothesis that exclusion did not affect U.S. agricultural wages or employment. Chassamboulli and Peri (2018) find that all types of immigrants to the US generate higher surplus for US firms relative to natives, hence restricting their entry has a depressing effect on job creation and, in turn, on native labor markets. Our results in Rojas Valdés, Lin Lawell and Taylor (2019b) show that such barriers to migration decrease the average welfare of households in rural Mexico.

The current policy discussion on border enforcement at the US border targets Mexican illegal migration as a priority. Our results suggest that such a policy aimed to reduce migration to the US would also reduce migration within Mexico. This means that shutting down the channel of migration to the US radically modifies the nature of the problem households face. We could think of some possible stories for this to happen, but having in mind an agricultural household with credit constraints being relaxed by migration could be a good starting point. In part owing to increases in income via remittances, migration allows home production to be run at a more efficient level than when there are restrictions to mobility. Furthermore, migration can be diversified into international and local migration. When one of these two channels is shut down, credit constraints again are binding and the operation of the farm moves to a more inefficient one. For example, without credit constraints, households

might be able to hire labor to substitute for the household labor allocated in the US or other states within Mexico. But when a policy restricts migration to the US, credit constraints bind again and households can no longer afford to hire labor, so household labor allocated somewhere else is called back. Our model suggests further indirect consequences of policies that restrict migration to US: we find that these policies reduce welfare (Rojas Valdés, Lin Lawell and Taylor, 2019b).

8 Conclusion

Migration decisions of households in rural Mexico are both economically significant and relevant for policy. In this paper, we discuss the economics of migration and migration migration, including the determinants of migration, neighborhood effects, and dynamic behavior, and survey the related literature.

We then describe and review our recent empirical work in Rojas Valdés, Lin Lawell and Taylor (2019b) analyzing the economics of migration and the effects of migration policy on migration decisions and welfare in rural Mexico. In this recent study, we find that, owing in part to neighborhood effects and dynamic behavior, a cap on total migration to the US decreases migration not only to the US but also within Mexico as well, causes migration to the US to decrease by more than what is required by the policy, and decreases average welfare per household-year (Rojas Valdés, Lin Lawell and Taylor, 2019b). Thus, not only do barriers to migration from Mexico to the U.S. have no positive effect on U.S. agricultural wages or employment (Clemens, Lewis and Postel, 2018), and may actually have a negative effect on job creation instead (Chassamboulli and Peri, 2018), but our results show that such barriers to migration decrease the average welfare of households in rural Mexico.

Our study in Rojas Valdés, Lin Lawell and Taylor (2019b) has important implications for contemporary economic policy and migration policy. Our structural econometric model of the dynamic migration game enables a better understanding of the factors that affect

migration decisions, and can be used to design policies that better improve the welfare of households in rural Mexico and other parts of the developing world.

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