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Return Migration and Agricultural Productivity: Evidence from Municipalities in the Sierra Norte de Puebla

Migración de retorno y productividad agrícola: evidencia de municipios de la Sierra Norte de Puebla

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ABSTRACT

A representative survey of 281 maize and coffee producers from four municipalities in Puebla is used to estimate the effect of return migration on productivity, average costs, and profit margins. Three estimation techniques are employed: logarithmic, semi-parametric, and non-parametric. In general, the results show higher productivity on producers with returnees, as well as lower costs and profit margins for returnees. Analysis on subsamples reveals the importance of market orientation, coffee cultivation, the cultivation of small areas, and the reception of subsidies. In all these cases the results on productivity and costs are confirmed, and higher profit margins are founded. It is also shown the importance of unobserved factors particularly for average costs. The main limitation of these results is that they are only representative of the municipalities and crops studied.

Keywords: 1. agricultural productivity, 2. return migration, 3. propensity score matching, 4. Puebla, 5. Mexico.

RESUMEN

Se utiliza una encuesta representativa de 281 productores de maíz y café de cuatro municipios poblanos para estimar el efecto de la migración de retorno sobre la productividad, los costos promedio y los márgenes de ganancia. Se emplean tres técnicas de estimación: logarítmicas, semiparamétricas y no paramétricas. En general, los resultados muestran una mayor productividad en productores con retornados, así como menores costos y márgenes de ganancia para los retornados. Se exploran diferentes sub-muestras que evidencian la importancia de la venta al mercado, del cultivo de café, del cultivo de pequeñas áreas y de la recepción de subsidios. En todos estos casos se confirman los resultados en productividad y costos; además, se encuentran mayores márgenes de ganancia. También se muestra la importancia de los factores no observados, principalmente en los costos promedio. La principal limitante de los resultados es que solo son representativos de los municipios y cultivos estudiados.

Palabras clave: 1. productividad agrícola, 2. migración de retorno, 3. pareamiento por puntaje de propensión, 4. Puebla, 5. México.

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INTRODUCTION

Return migration is defined as the flow of individuals who, having migrated to another region or country, return then to their place of origin (Martínez-Caballero & Martínez de la Peña, 2019). A recent estimate of the number of returnees in Mexico provides the figure of 184 000 people (Martínez-Caballero & Martínez de la Peña, 2019). The state of Puebla (Mexico) currently has emigration levels below the national average (Consejo Nacional de Población [CONAPO], 2022), while the receipt of remittances is at the national average. In terms of return migration, Puebla is below the national average (CONAPO, 2022).

Despite the above, many studies report the importance of return migration at the local level, both through voluntary returns and deportations (Sánchez-Gavi, 2016). In fact, the survey presented in this study reports a level of returned migrants higher than that reported by the CONAPO (2022) for each of the municipalities studied in Chignahuapan, Huachinango, Xicotepec, and Zacatlán. This situation leads to the first research question: what is the effect of return migration in the four municipalities studied?

This research question is quite broad. Theoretical studies have shown that return migration is more complex than it appears at first glance. For example, the existence of return migration cannot be explained by traditional migration models (Sjaastad, 1962) without the existence of a reversal of wage differentials between countries. Early studies on return migration explained returns in the context of circular migration following agricultural cycles, where individuals returned to their place of origin during the winter season (Elkan, 1959). As for more permanent returns, early studies argued for the lack of accurate information. When information was obtained, those individuals who had miscalculated their wage differentials returned home (Herzog & Schottman, 1982). Other studies claimed that individuals migrated to accumulate savings and, once their goals were achieved, the return occurred (Borjas & Bratsberg, 1996).

Finally, a classification has been made into five categories: permanent returnees, individuals who have achieved their savings goals; temporary workers, those who return during vacations; transgenerational returnees, individuals born in the United States to Mexican migrants or who were taken to that country as children; forced returns, linked with deportation; and returns due to failure, which may occur for economic or personal reasons (Durand, 2004). Given this heterogeneity, many studies have focused on the outcomes measured after return, and attempt to measure the type of returnees based on these outcomes (Chávez, 1995; Jiménez-Díaz, 2010; Shi & Wang, 2013; Quian et al., 2016; Chávez et al., 2019; Chen et al., 2020).

This approach is followed in this article, where the first objective is to measure the effect of return migration on agricultural productivity, production costs, and profit margins in maize and coffee production in four municipalities in Sierra Norte de Puebla (the north lowlands of Puebla). Among these municipalities, one records migration above the average for the state of Puebla, while the other three record migration below the average. Determining the impact of return migration will help to understand the economic effects of such migration flows in rural areas, as well as to determine the type of return migration observed, on average, in the area studied.

There is an ongoing debate about the impact of return migration on agricultural productivity; on the one hand, different authors and international organizations argue that returning migrants bring with them savings, technology, knowledge, skills, and network connections that can increase productivity in rural areas (Organización para la Cooperación y Desarrollo Económico [OCDE], 2017; Food and Agriculture Organization of the United Nations [FAO], 2016). On the other hand, there are authors who claim that returnees do not have the opportunity to increase their productivity because their return is associated with unemployment and deportation (Mestries, 2015; Contreras, 2018). Empirical literature has found positive effects on agricultural productivity (Chávez, 1995; Jiménez-Díaz, 2010; Shi & Wang, 2013; Quian et al., 2016; OCDE, 2017; Chávez et al., 2019; Chen et al., 2020), while a few other studies have found the opposite (Carletto et al., 2010; Mestries, 2015; Contreras, 2018).

Due to the above, determining the type of return migration found in a specific region of Mexico can help inform policy makers. Of course, the fact that the results are for a specific region and products does limit the scope of this article, and so these results should not be generalized to other regions or products.

The second objective of this article is to determine the impact of return migration, controlling for municipality- and product-specific factors. Factors related to municipalities are important: they determine differentiated access to resources, including migration (Quesnel, 2010). Among these types of resources, it has been argued that migration networks are strongly related to community-specific factors (Massey et al., 1993). The importance of the type of product lies in the fact that some producers may be more market-oriented than others, and this orientation is in turn associated with higher productivity (Kamara, 2004; Tsegaye et al., 2017).

In the case of the products and municipalities studied, coffee is a product mainly for export, while maize is normally used for self-consumption (Sistema de Información Alimentaria y Pesquera [SIAP], 2023). This study makes use of a cross-section of 281 maize and coffee producers in the municipalities of Chignahuapan, Huachinango, Xicotepec, and Zacatlán. The estimates assume that municipality and product factors are constant and can be statistically controlled by means of appropriate dichotomous variables.

The third objective of the article is to present quantitative estimates of the causal effect of return migration on productivity, costs, and margins of maize and coffee producers in the state of Puebla. This is the first article to present such estimates for the region. Obtaining the causal effect is not trivial, since migration flows are associated with individual, household, and community factors (Sjaastad, 1962; Massey et al., 1993; Del Rey & Quesnel, 2005), which can be observable and unobservable; at the same time, agricultural productivity, costs, and margins are associated with production factors such as land, capital, labor, and other inputs that can be correlated with unobservable individual, household, and community characteristics (Debertin, 2012).

This implies biased estimators when using ordinary least squares (Wooldridge, 2015). Another source of bias has been suggested by Kumbhakar (2001), who argued that in less developed countries there are inefficiencies in production caused by an inadequate functioning of product and factor markets, which implies specification bias when making parametric estimates.

To address this issue, this paper presents both parametric and semiparametric estimates. Parametric estimates should be approached with caution for the reasons stated above. Semiparametric estimates use the methodology of randomized paired estimators proposed by Rosembaum and Rubin (1983), in which the probability of having return migrants is estimated and, conditioning on this probability, the productivity, costs, and margins of producers with and without returnees are compared.

The fourth objective of the paper is to present potential explanations for the results obtained. The methodology of randomized paired estimators was applied to different subsamples, so that the importance of market orientation, coffee production, receipt of remittances, use of fertilizers, land rent, extension of cultivated land, and State subsidies can be analyzed. The results found show heterogeneity among producers, that return migration does not always result in greater productivity, and that there are other factors that determine the success of producers, besides return migration.

The fifth objective of the article is to explore the role of unobserved factors, among which it can be mentioned the quality of inputs, access to new technologies, the type of input management, or the efforts of producers. Nonparametric methodologies based on DiNardo et al. (1996) were applied, which allow for comparing the nonparametric distributions of agricultural productivity, average costs, and margins between producers with and without returnees. These calculations allow for estimating how the distribution of producers without returnees would be, if the distribution of the unobservable factors of the returnees were imposed on them.

Three studies that have been carried out in Mexico to study the relationship between return migration and agricultural productivity, yet none of them have made use of quantitative methods to measure the impact. Chávez et al. (2019) found that returnees increased the investment in agricultural machinery in the State of Mexico. In the case of Veracruz and Hidalgo, Mestries (2015) and Contreras (2018) reported not having found any effects of return migration on agricultural productivity. These mixed results reveal the importance of studies in other regions, since different results could be found in different contexts.

There is available literature that has sought the effect of return migration on other economic aspects. For example, it has been found that returnees are more likely to start businesses (McCormick & Wahba, 2001; Cassarino, 2004; Durand, 2004; Cobo, 2008; Whaba & Zenou, 2012). Some authors claim that this is associated with work experience (Riddle et al., 2010; Hausman & Nedelkoska, 2018; Cuecuecha et al., 2022), education and financial capital (Krasniqui & Williams, 2018), as well as with technical and administrative knowledge (Williams, 2018), all acquired abroad.

Other literature has studied whether other migration flows are related to agricultural productivity or not. Some authors have evidenced that international emigration and the receipt of remittances increase agricultural productivity (Lucas, 1987; Tsegai, 2004; Mendola, 2008; Taylor & Wouterse, 2008; Carletto et al., 2009; Salas, 2012; Böhme, 2015; OCDE, 2017; Kapri & Ghimire, 2020). Conversely, some studies have found that international emigration can reduce productivity, but that the receipt of remittances offsets this effect (Rozelle et al., 1999; Khanal et al., 2015). Other studies claim that international emigration and remittances increase productivity, but reduce product diversification (Gonzalez-Velosa, 2011). Still other studies have found a negative impact of international emigration on agricultural productivity (Djuikom, 2013). Finally, there are studies that have shown that immigration is directed towards areas with higher agricultural productivity (OCDE, 2017; Chamberlin et al., 2020).

The rest of the article is divided as follows: the first section introduces the theoretical considerations on the impact of return migration on agricultural productivity, as well as other studies that analyze the relationship between return migration and other variables, and studies that analyze other migratory impacts and their relationship with agricultural productivity. The second section presents the techniques applied in this study. The third one presents the data, information on the municipalities studied, as well as the results obtained. The fourth section concludes the article.

THEORETICAL CONSIDERATIONS

What Explains Return Migration?

The first studies on return migration explained it as part of circular migration flows, where individuals migrate to agricultural areas and return home during the winter seasons (Elkan, 1959).

For other permanent return flows, traditional migration models based on wage differentials (Sjaastad, 1962) could not explain returns in the absence of wage differential reversals. The first explanation was based on incomplete information. Once information about the true nature of wage differentials was obtained, dissatisfied individuals returned home (Herzog & Schottman, 1982). Under this perspective, return migration implied a negative selection of returnees (Borjas & Bratsberg, 1996), and no positive effects on productivity in the country of origin were expected (Mestries, 2015; Contreras, 2018). A second explanation argues that individuals migrate to accumulate savings and, once these objectives are achieved, individuals return home (Borjas & Bratsberg, 1996). Under this perspective, returnees are positively selected and positive effects on productivity are expected upon returning to the country of origin.

Other studies have classified returnees into five categories: permanent returnees who have achieved their objectives; temporary workers who return home every winter season; transgenerational return, by children of migrants born in the United States or by those who were taken to the United States as children; forced return, associated with deportations; and return due to failure, which may be associated with economic or personal reasons (Durand, 2004).

The Relationship Between Return Migration and Agricultural Productivity

The relationship between migration flows and agricultural productivity is complex, because different migration flows have different effects on agricultural productivity (OCDE, 2017). In the traditional model of urban-rural migration (Lewis, 1954), emigration does not generate effects on productivity because there is an excess of labor in the region of origin. Schultz's work (1964) showed that even in less developed, highly populated countries, large changes in population resulted in reductions in productivity. New research argues that population reductions in the country of origin can be offset in the mid-term, because migrants can sell their land and landowners can buy said land, increase their operational scale, and substitute labor for capital (Black & Castaldo, 2009).

Other authors claim that emigration does not imply the abandonment of land, since migration is a household strategy to diversify sources of income (Lucas & Stark, 1985), so that household members who did not emigrate can continue to cultivate the land or hire labor locally (FAO, 2016; OCDE, 2017). Matter of fact, some authors claim that emigration altogether with the receipt of remittances can generate increases in agricultural productivity (Lucas, 1987; Chamberlin et al., 2020).

Regarding return migration, different authors claim that returnees can bring with them new technologies, skills, savings, and networks that can increase agricultural productivity (Black & Castaldo, 2009; OECD, 2017). Other authors argue that returnees cannot contribute to productivity because returns are associated with unemployment in the host country, and with deportations (Durand, 2004), or because returnees have limited capital and little government support (Mestries, 2015; Contreras, 2018). For other authors, the experience acquired in the United States is not relevant in Mexico (Contreras, 2018).

Evidence on the Relationship Between Return Migration and Agricultural Productivity

Empirical studies have found that returnees increased capital investment in Burkina Faso (OECD, 2017). In the case of Peru, studies argue that returnees are agents of technological change (Chávez, 1995). Studies for Spain argue that returnees introduced new technologies in Almería and Granada (Jiménez-Díaz, 2010). In the case of China, studies show that returnees increased the amount of cultivated land (Chen et al., 2020), as well as the likelihood of adopting new technologies (Shi & Wuang, 2013), and increased human and financial capital in the agricultural sector (Quian et al., 2016).

Studies in Mexico show that returnees brought agricultural machinery from the United States (Chávez et al., 2019). However, Mestries (2015) and Contreras (2018) found that returnees experienced unemployment in the U.S. and did not contribute to productivity in Veracruz and Hidalgo (both in Mexico), respectively. Contreras (2018) states that the lack of government support and small plots limit the effects of returnees in Hidalgo. Similarly, in the case of Albania, Carletto et al. (2010) report that returnees spent less on agricultural inputs.

Evidence on the Relationship Between Other Migration Factors and Agricultural Productivity

Studies have found that households with members who are migrants in other countries are more likely to hire agricultural workers and sell their products, and that households receiving remittances also invest more in agriculture (OECD, 2017). This has been interpreted as evidence that remittances compensate households for the emigration of some of their members (OECD, 2017).

Positive effects of remittances on agricultural productivity have been found in Nepal (Kapri & Ghimire, 2020), Bangladesh (Mendola, 2008), and Ghana (Tsegai, 2004). In Botswana, Malawi, and Mozambique, remittances increased agricultural productivity and investment in livestock (Lucas, 1987). In Albania (Carletto et al., 2009) and Burkina Faso (Taylor & Wouterse, 2008), remittances helped shifts in crop and livestock production. In the Philippines, remittances increased the production of high-yield varieties, but reduced crop diversification (Gonzalez-Velosa, 2011).

In the case of Mexico, remittances increased agricultural productivity but not livestock production (Böhme, 2015). Studies for the State of Mexico found that receiving remittances increased investment in agricultural capital (Chávez et al., 2019). In the case of Oaxaca, remittances were found to reduce land abandonment, and increase agricultural productivity (Salas, 2012).

In the case of China (Rozzelle et al., 1999) and Nepal (Khanal et al., 2015), emigration was found to reduce maize producers, but remittances compensated for the loss in production.

In the case of Uganda, studies have found that internal emigration generates positive effects on the productivity of small producers (Djuikom, 2013). In the case of Zambia, studies have found that immigration to rural areas has increased productivity in rural households (Chamberlin et al., 2020).

Evidence on Other Effects of Return Migration

In Burkina Faso, Costa Rica, Georgia, and the Philippines, households with returnees are more likely to start businesses (OECD, 2017). In Albania, returnees and remittances are associated with greater investment in sectors other than agriculture (Carletto et al., 2010).

Many empirical studies have found that returnees are more likely to become self-employed due to the human capital and savings acquired abroad (McCormick & Wahba, 2001; Cassarino, 2004; Durand, 2004; Cobo, 2008; Whaba & Zenou, 2012; Krasniqui & Williams, 2018). Other studies have shown that returnees bring experience working with more advanced technologies and within more complex organizations, which increases their likelihood of becoming self-employed (Riddle et al., 2010; Hausman & Nedelkoska, 2018). Similarly, it has been found among returnees that technical and administrative know-how, as well as work experience, increase the likelihood of becoming entrepreneurs (Williams, 2018; Cuecuecha et al., 2022).

EMPIRICAL MODELS

Logarithmic Models

To study the differences in productivity between producers with and without returnees, models based on Cobb-Douglas production functions were followed, using as dependent variable the logarithm of the average product per worker (Debertin, 2012):

$$1) \quad lnY/T = \beta_0 + \beta_1 lnK + \beta_2 lnT + \beta_3 lnTi + \beta_4 mig + X'\delta + e$$

Where *Y* is the product, *K* is the capital, *T* is the total labor, including family members and employees, *Ti* is the cultivated area, *mig* indicates returnees, and *X* is a vector of control variables, including whether land is rented, whether the product is for sale, as well as a dichotomous variable for coffee production, and dichotomous variables for municipalities. Here it is important to note that these variables are endogenous, and are included in order to capture the effect of return migration above and beyond the control variables.

In the case of the average cost function, logarithmic cost function models were followed (García & Randall, 1994), making some adjustments, given that the variations in input prices are not as important as the variations in inputs, since data for only four municipalities were used:

$$2) \quad \frac{lnC}{q} = \delta_0 + \delta_1 lnq + \delta_2 lnK + \delta_3 lnT + \delta_4 lnTi + \delta_5 mig + X'\pi + u$$

Where *C* is the total cost, *q* is the total production, and *K*, *T*, *Ti*, *mig*, and *X* were defined above.

In the case of the profit function, the logarithm of the income to cost ratio was used as follows:

$$3) \quad ln\frac{IT}{CT} = \gamma_0 + \gamma_1 lnp + \gamma_2 lnq + \gamma_3 lnK + \gamma_4 lnT + \gamma_5 lnTi + \gamma_6 mig + X'\rho + v$$

Equation 3 does not follow the practice of using the logarithm of profit (Sidhu & Baanante, 1981) because some of the producers operate at a loss. Similarly, the convention of using input prices (Kumbhakar, 2001) is not followed, and input demands are used for the reasons already explained.

Due to the reasons explained above, this estimate is taken as a reference point, but it is interpreted with caution because the estimates are biased.

Semiparametric Models

In this section, semiparametric estimates are presented to obtain the causal effect of return migration based on the assumption that, using the probability of having return migrants, it is possible to identify such an effect (Rosenbaum & Rubin, 1983) on productivity, costs, and profit margins.

For each of the estimated causal effects, the following model of the potential outcome is defined:

4) $Y = Y_1 t + (1 - t)Y_0$

5) $Y_0 = X'\beta_0 + e_0$

6) $Y_1 = X'\beta_1 + e_1$

Where Y_0 is the outcome variable for producers without returnees, β_0 is a vector of coefficients for such producers, Y_1 is the outcome for producers with returnees, β_1 is a vector of coefficients for these second producers, X is the vector determining productivity, and *t* assumes the value of 1 for returnees. It is assumed that the returnee set complies with the following rule of treatment participation:

7) $t = \begin{pmatrix} 1\ if\ W'\gamma + \mu > 0 \\ 0\ in\ any\ other\ case \end{pmatrix}$

Where W is the vector of variables determining participation in the returnee set. The estimation requires three assumptions: *i*. Conditional independence; which implies that, when conditioning on the control variables, the potential outcomes are not correlated with the treatment; ii. Common support; which implies that the observations have a non-zero probability of both participating in the treatment and not participating in the treatment (Rosenbaum & Rubin, 1983); iii. Random sample of the population, with observations of producers with and without returnees (Imbens & Wooldridge, 2009).

Given the three assumptions above, the randomized matched estimators were applied as follows:

8) $p(Z, t)$: $is\ the\ propensity\ to\ participate\ in\ the\ treatment$

9) $\Omega_m^p = \{j_1, j_2, ..j_m | t_{jk} = 1 - t_i, |p_i(t) - p_{jk}(t)| < |p_i(t) - p_l(t)|, t_l = 1 - t_i, l \neq j_k\}$: $is\ the\ set\ of\ neighbors\ close\ to\ observation\ i$

m *is the number of desired matches*

10) $\delta_1 = E(Y_1 - Y_0|t = 1)$: $is\ the\ average\ effect\ on\ the\ treated$

The average effect on the treated is estimated by:

11) $\delta_1 = \frac{\sum_{i=1}^{n} t_i w_i (Y_{1i} - Y_{0i})}{\sum_{i=1}^{n} t_i w_i} = \frac{\sum_{i=1}^{n} (t_i - (1-t_i) K_m(i)) Y_i}{\sum_{i=1}^{n} t_i w_i}$

Where:

12) $K_m(i) = \sum_{j=1}^{n} i \in \Omega_m^p \frac{w_j}{\sum_k k \in \Omega_m^p}$

13) w_i: $are\ the\ frequencies\ for\ the\ i\ th\ observation$

To obtain the variance, Abadie and Imbens (2016) are followed.[3]

Nonparametric Models

The previous models only obtain the average effect of return migration; however, the effect can be found throughout the entire distribution of productivity, average costs, or margins. DiNardo et al. (1996) is followed to show the nonparametric estimation of said effect. The estimation is performed using kernel density, which is defined by:

14) $\hat{f_k} = \frac{1}{qh} \sum_{i=1}^{n} w_i K\left(\frac{x - X_i}{h}\right)$

Where x are the values of the outcome variable, $q = \sum_i w_i$ y w_i are the frequencies found in the data used, h is the bandwidth obtained by means of the Parzen method (1962). The kernel function used is that of Epanechnikov:

15) $K(z) = \begin{cases} \frac{\frac{3}{4}\left(1 - \frac{1}{5} z^2\right)}{\sqrt{5}}\ if\ |z| < \sqrt{5} \\ 0\ in\ any\ other\ case \end{cases}$

Following DiNardo et al. (1996), the counterfactual distributions for producers without returnees are estimated by imposing on them the distribution of producers with returnees. This is done by multiplying each observation by the probability of having returnees, $f_i(1)$, and dividing each observation by the probability of not having returnees, $f_i(0)$, as follows:

16) $g_i = \frac{f_i(1)}{f_i(0)}$

[3] These procedures were implemented in the STATA 18.5 software.

With the above values, the counterfactual distribution is estimated as follows:

$$17)\ \widehat{f_{k,c}} = \frac{1}{qh}\sum_{i=1}^{n} w_i * g_i * K\left(\frac{x-X_i}{h}\right)$$

When comparing the probability masses obtained from the distributions of non-returnees with the counterfactual described above, the effect of having returnees on the distribution can be observed (DiNardo et al., 1996).

DATA AND RESULTS

The Four Municipalities Studied

The state of Puebla has a return migration rate of .67%, below the national average of 1.23% (CONAPO, 2022). In the case of the municipalities studied, Chignahuapan reported 1.09% of households with returnees; while Zacatlán, Huachinango, and Xicotepec have percentages of returnees below the average, at .34%, .38%, and .18%, respectively (CONAPO, 2022). The survey carried out in this article found more returned migrants than suggested by CONAPO (2022), probably because it focused on the rural area of these municipalities. These results are not shown due to lack of space, but accounting for this anomaly would not qualitatively alter the results presented in the following sections.

In 2018, the state of Puebla produced 53 700 tons of maize and cultivated 515 000 hectares, making it the ninth largest maize producer in Mexico (SIAP, 2023). In the case of coffee, the state of Puebla is the third largest producer of this product, with 135 600 tons and 69 000 hectares cultivated (SIAP, 2023). Some reports indicate that up to 30% of Puebla's production is dedicated to export (Olano, 2022). In the case of maize, small and medium-sized producers devote a large part of their production to self-consumption, and sell small surpluses in local markets (Ávila et al., 2014).

Studies have shown that maize producers have problems cultivating hybrid varieties that adapt to the climate, they use little technology, and the organization among them is weak (Ávila et al., 2014). In the case of coffee, there is a mid-level use of technology; some producers apply new varieties and cultivation techniques, while others still use traditional cultivation methods (Benítez-García et al., 2015). In some municipalities, organic coffee varieties are grown and the products are sold through cooperatives (Benítez-García et al., 2015). Given the differences mentioned between products, a dichotomous variable for coffee production was introduced in the estimation.

The sampling frame consists of 7 554 maize producers, 4 712 in Chignahuapan and 2 842 in Zacatlán. It also includes 1 824 coffee producers, 784 in Huachinango, and 1 040 in Xicotepec. All producers belong to the list of beneficiaries of the Programa de Producción para el Bienestar (PPB) (Production for Well-being Program) (Secretaría de Agricultura y Desarrollo Rural [SADER], 2019). Chignahuapan and Zacatlán cultivate 12 000 and 8 900 hectares of maize, respectively (SIAP, 2023). Huachinango and Xicotepec cultivate a total of 440 hectares and 7 100 hectares, respectively (SIAP, 2023).

The sample was stratified by municipality, and the sample size was obtained following the formula for a proportion (Lohr, 2022, p. 86), given that the proportion of households with returnees that can be obtained at the municipal level from the 2020 census was taken as a measure to estimate (CONAPO, 2022). The only selection criterion to be included in the sample was to be on the PPB beneficiary list. A sample of 281 producers was obtained, distributed as follows: 64 from Chignahuapan, 81 from Huachinango, 88 from Xicotepec, and 48 from Zacatlán. The confidence level was set at 95%, which results in a sampling error of 1.3%, according to the formula for sampling error shown in Lohr (2022, p. 97).

To generate the inflation factors for the survey, Manski and Lerman (1977) were followed, thus obtaining the ratio between the probability of being in the sampling frame, represented by p_s, and the probability of being found in the sampling carried out, represented by e_s. The p_s/e_s ratio allowed to estimate how many producers from each municipality each surveyed producer represented (Lohr, 2022, p. 87). This correction is necessary, given that the original plan was to have a sampling proportional to the participation of producers in the sampling frame, and this proportion was called for stratum s, p_s; establishing a confidence level of 95% and a sampling error of 1.6%, a sample of 271 individuals would have been needed according to formulas 3.18 in Lohr (2022, p. 96) and 3.7 (Lohr, 2022, p. 87). In practice, 281 observations were obtained, distributed as mentioned above. These proportions generate a probability of being in the sample per stratum, which was called e_s. This proportion generates a sampling error of 1.3%, according to formula 3.17 in Lohr (2022, p. 96). Because the sampling rate e_s is different from p_s, it is necessary to recover the *ex post* probabilities of participation in the sample. To achieve this, Manski & Lerman (1977) were followed, who suggested generating the p_s/e_s ratio in such a way that the sampling probabilities e_s are replaced by the probabilities of belonging to the sampling frame p_s. This makes it possible to identify the number of individuals that each observation in the sample represents (Lohr, 2022, p. 87) and, therefore, to obtain representative estimates of the sampling frame. These values were used as weights in the different estimates indicated in the following sections.

Both coffee producers and maize producers received subsidies from the Puebla state government in 2022.[4] In the case of maize producers, there is also the Programa de Precios de Garantía (Guaranteed Price Program) (Gobierno de México, 2022). A dichotomous variable for receipt of subsidies is included in the estimates.

[4] The programs that operate in Puebla, according to the field work, are the following: Apoyo Especial para el Ganado (Special Support for Livestock), Soporte Comercial para Maíces Nativos (Commercial Support for Native Maize), Insumos para la Agricultura (Inputs for Agriculture), Maquinaria y Equipo Especial para la Agricultura (Machinery and Special Equipment for Agriculture), Recuperación del Campo Poblano (Recovery of the Puebla Countryside). Eleven producers were found benefitting from the Sowing Life (Sembrando Vida) program.

In 2015, Chignahuapan had a mid-level human development index, while Huachinango, Xicotepec, and Zacatlán had high human development indices (UNDP, 2015). These different economic conditions led to the inclusion in the estimates of dichotomous variables for the municipalities.

Another factor accounted for in the estimation was whether producers dedicate their production for sale in markets, which was integrated into a dichotomous variable. Dedication to the market has been correlated with higher productivity (Kamara, 2004; Tsegaye et al., 2017).

Average Values for the Variables Used in the Model

To apply the empirical model, production is measured in tons, costs and income are measured in Mexican pesos (MXN), capital is measured by a proxy constructed with qualitative variables for the use of fertilizers, fungicides, and herbicides. The use of these inputs is correlated with greater investment in physical capital (Paul et al., 2022). The decision to use this capital proxy was due to the fact that, in exploratory work, producers refused to answer the survey if they were asked about amounts invested in Mexican pesos.

In the case of fertilizers, the qualitative variable assumes the value of zero if they only use manure, the value of one if they use compost and manure, the value of two if they add chemical fertilizer, and the value of three if they only use chemical fertilizer. For fungicides and herbicides, binary variables were used. The three variables are added linearly. The work variable includes family members and workers who work in the fields. The rest of the variables are explained by their name: male, age, years of education, receipt of agricultural subsidies, coffee production, returned migrant, years in the United States, years in agriculture, rented land, more than one crop, and the use given to production.

Table 1 shows the average values for the variables used in the analysis. 7% of the producers are returnees, which is higher than the percentage that can be inferred from the CONAPO data (2022). Production is 1.9 tons, costs are 17 000 MXN, income is 30 000 MXN, number of workers is 6, value for capital proxy is 3, cultivated area is 1.6 hectares, 73% of producers are men, age is 53 years, education is 7 years, 62% receive subsidies, 54% grow coffee, experience in the United States is .2 years, experience farming is 11 years, 85% rent land, 63% grow more than one product, 58% use production for self-consumption, 4% for self-consumption and livestock, 19% for self-consumption and sell surplus, 19% sell all their production.

Table 1. Average Values for Different Groups

	All	**Producers without returnees**	**Producers with returnees**	**Significant difference**
Production (tons)	1.9	1.9	2.6	at 5 %
	[1.6]	[1.5]	[1.9]	
Variable costs (MXN)	17 457	17 337	18 952	no
	[9 120]	[8 996]	[10 677]	
Annual income (MXN)	30 308	29 799	36 609	no
	[19 494]	[19 056]	[23 925]	
Workers	6.3	6.3	6.0	no
	[4.0]	[4.1]	[3.8]	
Proxy for capital	2.9	2.9	3.0	no
	[1.4]	[1.4]	[1.5]	
Land (hectares)	1.6	1.5	1.8	no
	[1.5]	[1.5]	[1.7]	
Workers (%)	73	71	95	at 1 %
	[45]	[46]	[22]	
Age	52.9	53.1	50.5	no
	[13.8]	[14.0]	[12.1]	
Education	7.0	6.9	8.6	at 5 %
	[3.7]	[3.6]	[4.2]	
Receipt of subsidies (%)	62	62	57	no
	[49]	[49]	[51]	
Coffee (%)	54	54	52	no
	[50]	[50]	[51]	
Return migrants (%)	7	N. A.	100	N. A.
	[26]	N. A.	N. A.	
Experience farming	11.2	11.3	10.8	no
	[2.6]	[2.6]	[2.9]	
Rented land (%)	85	85	90	no
	[36]	[36]	[30]	
More than one crop (%)	63	63	62	no
	[48]	[48]	[50]	
Production destination				
Self-consumption (%)	58	58	62	no
Self-consumption and livestock (%)	4	4	5	no
Self-consumption and the market (%)	19	20	14	no
The market (%)	19	18	19	no
Time in the United States (years)	0.2	0	3.2	N. A.
	[1.2]	N.A.	[2.9]	
Remittances (%)	11	12	4	no
	[32]	[32]	[21]	
N	281	260	21	

Source: Own calculations with data from fieldwork.

Table 1 also shows the averages for producers with and without returnees. There are no significant differences, except in three cases. Producers with returnees have higher production, are more likely to be male, and are better educated. These differences should be taken with caution, due to the endogeneity of having returnees.

Results for Logarithmic Models

Table 2 shows the estimates of equations (1), (2), and (3), weighted by the values appropriate to the survey conducted. The equation for average product shows an R^2 of 47%; it was found that a 1% increase in capital increases productivity by .33%, a 1% increase in labor reduces productivity by .69%, which shows that producers work in the second phase of production, a 1% increase in land increases productivity by .69%. Return migration increases productivity by .55%, which confirms the higher production observed in Table 1.

As for average costs, coffee producers have higher costs by 1.22%, years of education increase production by .01%, a 1% increase in production reduces costs by 1%, which shows the existence of constant returns to scale. In the case of profit margins, coffee producers have margins that are 1.21% lower, an increase in education reduces margins by .01%, while a 1% increase in production increases margins by 1%. The effect of having returnees is not significant on either costs or margins. These results should be taken with caution, for the reasons already mentioned.

Table 2. Logarithmic Models (Weighted Estimates)

	Prod. log. per worker	**Average cost log.**	**Income/cost log.**
Capital log.	0.33**	0.04	-0.03
	(0.10)	(0.02)	(0.02)
Labor log.	-0.69***	0.02	-0.03
	(0.07)	(0.02)	(0.02)
Land log.	0.66***	0.00	-0.00
	(0.08)	(0.02)	(0.02)
Experience log.	0.13	-0.00	0.00
	(0.14)	(0.03)	(0.03)
Rented land	-0.19	0.02	-0.02
	(0.15)	(0.04)	(0.04)
Coffee	0.31	1.22***	-1.21***
	(0.63)	(0.15)	(0.15)
Subsidy	0.16	0.01	-0.01
	(0.11)	(0.03)	(0.03)
Age	-0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)
Male	-0.00	0.02	-0.02
	(0.12)	(0.03)	(0.03)
Education	-0.02	0.01***	-0.01**

(continue)

(continues)

	(0.02)	(0.00)	(0.00)
Returnee	0.55**	0.06	-0.06
	(0.20)	(0.05)	(0.05)
Market sales	-0.15	0.04	-0.04
	(0.13)	(0.03)	(0.03)
Production log.		-1.00***	0.99***
		(0.02)	(0.03)
Price log.			0.99***
			(0.03)
Constant	-1.13	8.72***	-8.62***
	(0.76)	(0.18)	(0.29)
R squared	0.465	0.961	0.883
N	281	281	281

Note: Significance levels *p < 0.05, **p < 0.01, ***p < 0.001.

Source: Own calculations based on data from the survey conducted.

Results for Semiparametric Analysis

Table 3 presents the results for the Probit model estimated to obtain the propensity to have return migrants. Age increases the probability of having return migrants by .002%, education increases this probability by .02%, being male increases the aforementioned probability by .11%, the pseudo R^2 is 5%.

Table 3. Probit Model for Return Migration (Weighted Estimate)

	Coefficients	**Marginal effects**
Age	0.01***	0.002***
	[0.002]	[0.0001]
Male	0.53***	0.11***
	[0.01]	[0.001]
Education	0.007***	0.02***
	[0.001]	[0.0002]
Constant	-2.27***	
	[0.02]	
Pseudo R2	5 %	
N	281	

Note: ***Significant at 1 %.

Source: Own calculations with data from fieldwork.

Table 4 shows the results for the semiparametric model. Producers with returnees have a productivity .67% higher than producers without returnees. This effect is found per hectare (.77 %) and per worker (.98 %). The effect is greater than that shown by the logarithmic model, so it can be stated that said model had an attenuation bias. In the case of average costs, it was found that producers with returnees have 37% lower costs. In the case of the income-to-cost ratio, returnees have a ratio .09% lower.

Table 4. Average Effect on the Processed (Weighted Estimates)

	Average effect on the processed
Total production log.	0.67***
	[0.01]
Production per hectare log.	0.77***
	[0.003]
Production per worker log.	0.98***
	[0.01]
Average cost log.	-0.37***
	[0.01]
Income/cost log.	-.09***
	[0.01]

Note: ***Significant at 1 %.

Source: Own calculations with data from fieldwork.

What Do the Results Explain?

This section presents different estimates made for different subsamples. A different subsample is generated for each of the following conditions: that the product is sold to the market, that the product is for self-consumption, that they receive remittances, that they do not receive remittances, that they produce coffee, that they produce maize, that they make high use of fertilizers, and that they make low use of fertilizers.

Table 5 shows that for farmers who sell to the market, produce coffee, with and without remittances, of high and low use of fertilizers, the results are that return migration generates higher productivity per worker, lower average costs, and higher profit margins. The effects are greater for farmers who sell to the market, those who receive remittances, and those who use more fertilizers. In the case of those engaged in self-consumption, it was observed that return migration generates a reduction in productivity, average costs, and an increase in margins. This seems to indicate that they operate under a more labor-intensive production process. For maize producers, return migration causes less productivity, higher average costs, and lower profit margins.

Table 5. Average Effect on the Processed for Different Subsamples

	Sells to the market N = 53	**Self-consumption N = 228**	**Without remittances N = 248**	**With remittances N = 33**	**Coffee N = 152**	**Maize N = 129**	**Low fertilizer N = 96**	**High fertilizer N = 185**
Production per worker log.	2.3***	-0.08***	0.9***	1.6***	.9***	-0.5***	.3***	1.1***
	[0.02]	[0.01]	[0.01]	[0.02]	[0.01]	[0.03]	[0.01]	[0.02]
Average cost log.	-0.4***	-.04***	-0.6***	-2.2***	-0.8***	0.2***	-0.3***	-0.3***
	[0.02]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
Income/cost log.	.66***	.19***	.03***	1.1***	.4***	-.3***	.2***	.1***
	[.01]	[.01]	[.01]	[.004]	[.01]	[.02]	[.01]	[.01]

Note: ***Significant at 1 %.

Source: Own calculations based on data from the survey conducted.

Table 6 shows the estimates for another set of subsamples based on land rent, cultivated area, farming experience, and the receipt of subsidies. The results show that for farmers who do not rent land, for those who rent land, those who cultivate small areas, those with high experience, and those who receive subsidies, return migration causes higher productivity, lower average costs, and higher margins. The effects are greater for producers who do not rent land and those who receive subsidies. For producers with large cultivated areas, return migration causes lower productivity, higher average costs, and higher margins. This seems to indicate a use of more labor-intensive production methods. For producers with low experience, return migration causes lower productivity, higher average costs, and lower margins. Among producers without subsidies, return migration causes higher productivity and margins as well as higher average costs.

Table 6. Average Effect of Processes for Different Subsamples

	Without rented land N = 43	**Rented land N = 239**	**Small areas N = 225**	**Large areas N = 56**	**Low experience N = 60**	**High experience N = 221**	**Without subsidies N = 108**	**With subsidies N = 173**
Production per worker log.	1.3***	0.9***	.8***	-.4***	-1.1***	0.8***	0.5***	1.1***
	[0.01]	[0.01]	[0.01]	[0.02]	[0.02]	[0.01]	[0.01]	[0.01]
Average cost log.	-0.9***	-0.5***	-0.5***	.1***	.9***	-0.6***	.5***	-0.7***
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
Income/cost log.	.14***	.08***	.2***	.7***	-.4***	.3***	.05***	.01*
	[.01]	[.01]	[.01]	[.02]	[.01]	[.01]	[.01]	[.006]

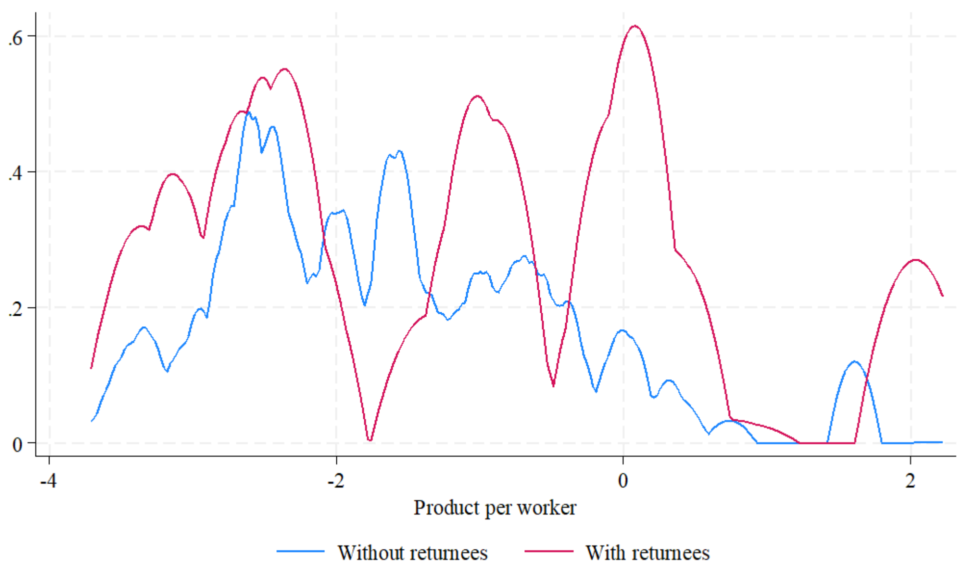
Note: ***Significant at 1 %, *Significant at 10 %.

Source: Own calculations based on data from the survey conducted.

Results for Non-parametric Analysis

Graph 1 shows the productivity distributions per worker for producers with and without returnees. The distribution of returnees is shifted to the right, as it shows more probability mass in the center and at levels above the mean. This confirms that the effect of higher productivity is observed not only on average, but throughout the entire distribution.

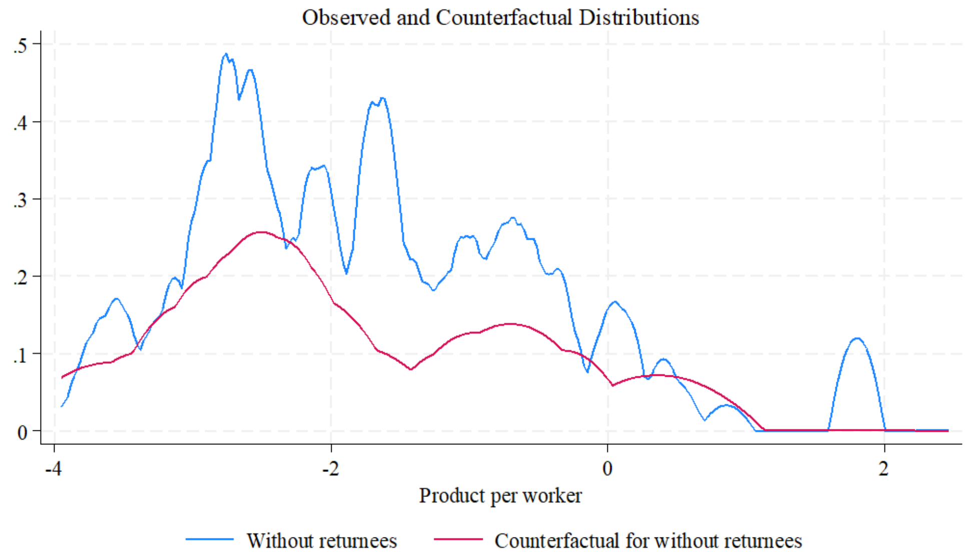
Graph 1. Productivity Differentials



Source: Own calculations with data from fieldwork.

Graph 2 shows what happens if the distribution of returnees is imposed on the distribution of non-returnees. The results show that the distribution of non-returnees reduces their mass at the base of the distribution, and increases the mass at a few points above the average. These results indicate that unobserved factors in the productivity distribution of returnees would increase the productivity of non-returnees. This may indicate that returnees employ better quality inputs, better technology, more effort, better access to credit, or better organizational practices. Some of these elements could have been acquired in the United States.

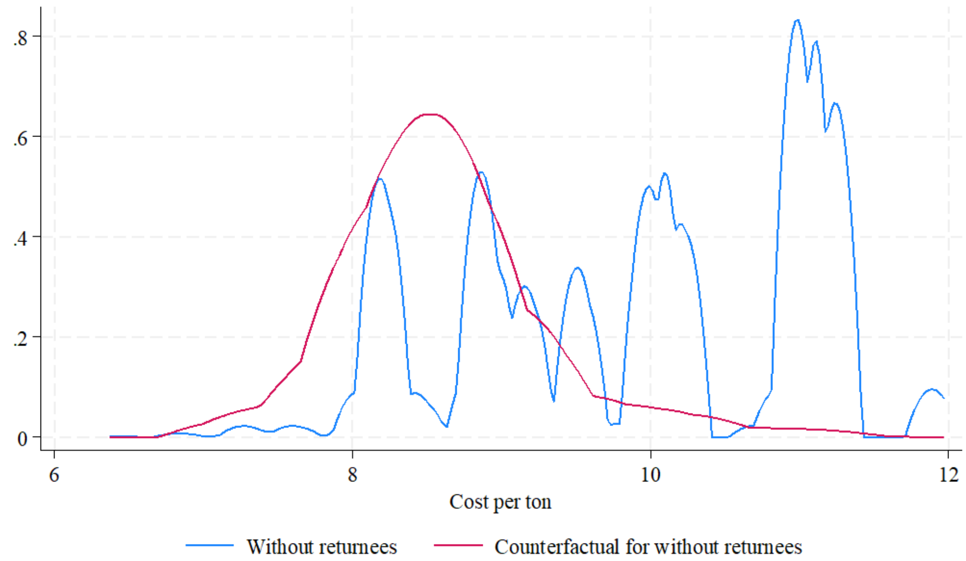
Graph 2. Productivity Differentials



Source: Own calculations with data from fieldwork.

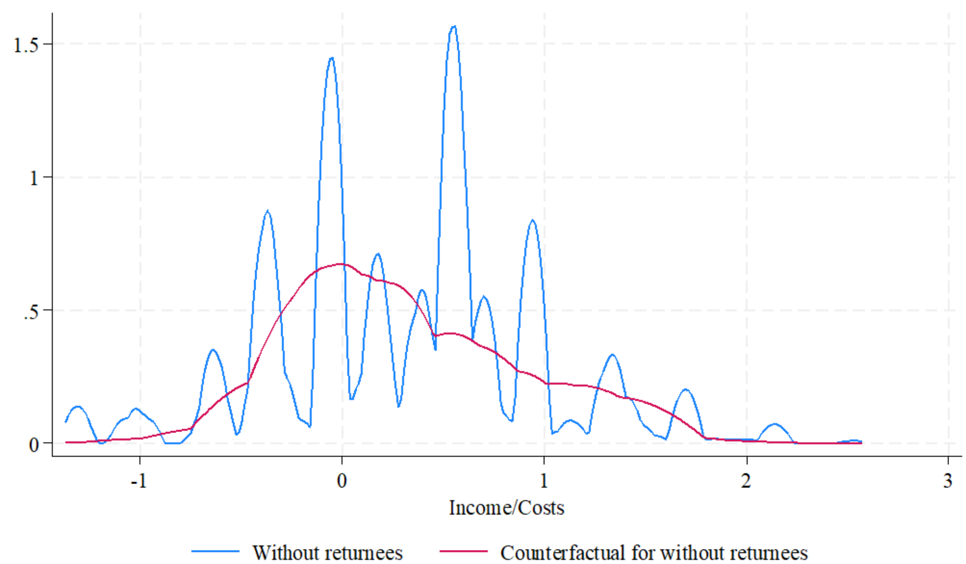
Graphs 3a and 3b analyze the same counterfactual exercises performed for average cost and profit. In the case of average cost, it can be observed that the counterfactual distribution shifts to the left. This reveals that unobserved factors in the distribution of returnees generate a reduction in costs in the distribution of non-returnees. The shift is much clearer than in the productivity distribution, which suggests that it is the management of inputs that reduces costs and not necessarily the use of better technologies, since the most important impact is observed in the reduction of costs and not in productivity per worker. More fieldwork is required to understand these practices of returnees.

Graph 3a. Differences in Average Cost



Source: Own calculations with data from fieldwork.

Graph 3b. Differences in Margins



Source: Own calculations with data from fieldwork.

In the case of the exercise with profit margins, no significant differences were observed between returnees and non-returnees, except that returnees have less mass in the lower profit margins. This indicates that perhaps returnees do not have to sell at prices as low as some non-returnees. This may suggest better access to credit. It also shows that returnees do not necessarily manage to differentiate their products from non-returnees. These results are consistent with the size of the producers surveyed, since it would be difficult to expect that any of them would have market power.

Discussion of Results

The positive results found of return migration on agricultural productivity match with the results in Burkina Faso (OCDE, 2017), China (Chen et al., 2020; Quian et al., 2016; Shi & Wang, 2013), Spain (Jiménez-Díaz, 2010), Peru (Chávez, 1995), and the Estado de México (Chávez et al., 2019). The positive results contrast with the negative results found in Albania (Carletto et al., 2010) and the Mexican states of Veracruz (Mestries, 2015) and Hidalgo (Contreras, 2018). These results evidence the importance of carrying out region-specific studies, as well as the importance of employing techniques that identify causal effects.

The positive results of return migration match with the positive results found for remittances in Botswana, Malawi, and Mozambique (Lucas, 1987), Ghana (Tsegai, 2004), Bangladesh (Mendola, 2008), Burkina Faso (Taylor & Wouterse, 2008), Albania (Carletto et al., 2009), the Philippines (González-Velosa, 2011), Nepal (Kapri & Ghimire, 2020), as well as for the Mexican state of Oaxaca (Salas, 2012) and all of Mexico (Böhme, 2015). These results point at the fact that emigration can have positive effects on productivity, both in the period in which households receive remittances and have members abroad, and in the period in which family members abroad have returned.

Finding that there are factors that help return migration be a positive, including market orientation, specialization in export sales, cultivation of small areas, experience in farming, and receiving subsidies, leads to two implications: first, it highlights the heterogeneity of the results and the fact that return migration is not a strategy that necessarily generates success, since it depends on other factors; second, it also highlights that return migration can be a source of increasing inequality in the regions of origin of migrants, since not all returnees will be successful.

CONCLUSIONS AND POLICY RECOMMENDATIONS

The first objective of this article was to find the effect of return migration on productivity, average costs, and profit margins among maize and coffee producers in the Puebla (Mexico) municipalities of Chignahuapan, Huachinango, Xicotepec, and Zacatlán. The results of logarithmic models show that returnees increase their productivity by .55%, and that there are no effects on costs and margins. The second objective was to control for the effects of municipality and product. The results do not change when controlling for these factors.

The third objective of this study was to find the causal effect of return migration. To do so, a semiparametric methodology was used that eliminates the biases found in logarithmic models. The results show that productivity increases by 1%, average costs decrease by .4%, and margins decrease by .1%.

The fourth objective was to find possible explanations for the results obtained. Different subsamples were analyzed, and it was found that the results for productivity and costs remain the same for producers who sell to the market, grow coffee, cultivate small areas, have high experience, or receive subsidies. In all these cases, the results are accompanied by the achievement of better profit margins. The results found are the same independently of the receipt of remittances, the use of fertilizers, and the use of rented land.

The fifth objective was to determine the role of unobserved factors, as well as the effect of returnees on the complete distributions of productivity, costs, and margins. The results show that returnees have a distribution slightly shifted to the right in productivity, clearly shifted to the left in costs and very similar in margins, taking as a reference the distribution of producers without returnees. These results reveal that the most important unobserved factors are those related to costs, which may be an indication of a use of better-quality inputs, a more efficient use of resources, more efficient input management techniques, or that they could be making greater effort. More research is needed to understand the reasons behind this effect.

As for the implications for public policy of the results found, the authors identified at least four: first, they highlight the need for policies that support returnees to be successful upon their return, since not all returnees succeed in their efforts; second, they point out the importance of support for all agricultural producers, since not all have returnees and this type of policy would help reduce inequalities; third, they reveal the strategic importance of attracting returnees as potential investors in rural areas of Puebla; fourth, given the different elements found to be important in explaining success, multidimensional and transdisciplinary interventions are required, since producers need not only improving their use of seeds and inputs for the field, but also learning better techniques for managing inputs and accessing markets, as well as educating themselves on the financial management of their businesses.

As for recommendations for future studies, this article points out the importance of studying other regions and other products, so as to understand the effects of return migration in other contexts. Likewise, the importance of more in-depth studies to understand the factors behind the achievement of lower average costs among producers with return migrants is evidenced.

Translation: Fernando Llanas.

REFERENCES

Abadie, A., & Imbens, G. W. (2016). Matching on the estimated propensity score. *Econometrica, 84*(2), 781-807.

Ávila, F., Castañeda, Y., Massieu, Y., Noriero, L., & González, A. (2014). Los productores de maíz en Puebla ante la liberación de maíz genéticamente modificado. *Sociológica, 29*(82), 45-81.

Benítez-García, E., Jaramillo-Villanueva, J., Escobedo-Garrido, S., & Mora-Flores, S. (2015). Caracterización de la producción y comercio del café en el municipio de Cuetzalan, Puebla. *Agricultura, Sociedad y Desarrollo, 12*(2), 181-198.

Black, R., & Castaldo, A. (2009). Return migration and entrepreneurship in Ghana and Cote D'Ivoire: The role of capital transfers. *Tijdschrift voor Economische en Sociale Geografie, 100*(1), 44-58.

Böhme, M. H. (2015). Does migration raise agricultural investment? An empirical analysis for rural Mexico. *Agricultural Economics, 46*(2), 211-225.

Borjas, G., & Bratsberg, B. (1996). Who leaves? The outmigration of the foreign born. *The Review of Economics and Statistics, 78*(1), 165-176.

Carletto, G., Davis, B., McCarthy, N., & Kilic, T. (2009). Assessing the impact of massive out-migration on Albanian agriculture. *The European Journal of Development Research, 21*(3), 448-470.

Carletto, G., Davis, B., Miluka, J., & Zezza, Z. (2010). The vanishing farms: the impact of international migration on Albanian family farming. *Journal of Development Studies, 46*(1), 140-161.

Cassarino, J. P. (2004). Theorizing return migration: The conceptual approach to return migrants revisited. *International Journal on Multicultural Societies, 6*(2), 253-279.

Chamberlin, J., Jayne, T. S., & Sitko, N. J. (2020). Rural in-migration and rural development: Evidence from Zambia. *Agricultural Economics, 51*(4), 491-504. https://doi.org/10.1111/agec.12567

Chávez, A. (1995). Migración de retorno y modernización. *Debate Agrario, 21*, 59-84.

Chávez, A. R., Herrera, F., Vizcarra, I., & Baca, N. (2019). Desarrollo territorial rural: agricultura y migración en el Estado de México. *Economía, sociedad y territorio, 19*(59).

Chen, Q., Hu, R., Sun, Y., & Zhang, C. (2020). How does rural-urban migration experience affect arable land use? Evidence from 2293 farmers in China. *Land, 9*(11), 400. https://doi.org/10.3390/land9110400

Cobo, S. (2008). ¿Cómo entender la movilidad ocupacional de los migrantes de retorno? Una propuesta de marco explicativo para el caso mexicano. *Estudios Demográficos y Urbanos, 23*(1), 159-177.

Consejo Nacional de Población. (2022). *Índices de intensidad migratoria México-Estados Unidos.* https://www.gob.mx/cms/uploads/attachment/file/789092/IIMMexEEUU2020.pdf

Contreras, R. H. (2018). Volver a la tierra: retorno migratorio y recampesinización forzada en el Valle del Mezquital, México. *Perspectiva Rurales Nueva Época, 16*(32), 45-55.

Cuecuecha, A., Cruz, M., & Tapia, E. (2022). Capital humano, ahorro e intención emprendedora de los migrantes mexicanos retornados de los Estados Unidos: el caso de tres municipios de la Mixteca poblana. *Estudios Demográficos y Urbanos, 37*(2), 553-601. https://doi.org/10.24201/edu.v37i2.2083

Debertin, D. L. (2012). *Agricultural Production Functions* (2da Ed.). University of Kentucky.

Del Rey, A., & Quesnel, A. (2005). Migración interna y migración internacional en las estrategias familiares de reproducción. El caso de las poblaciones rurales del sur del estado de Veracruz. *Papers de Demografía, 259*, 1-19. https://dialnet.unirioja.es/servlet/articulo?codigo=1282841

DiNardo, J., Fortin, N. M., & Lemieux, T. (1996). Labor market institutions and the distribution of wages, 1973-1992: A semiparametric approach. *Econometrica, 64*(5), 1001-1044.

Djuikom, M. A. (2013). *Incentives to labor migration and agricultural productivity: The Bayesian perspective* [Doctoral dissertation, unpublished]. Université Laval. https://thedocs.worldbank.org/en/doc/849501527999955391-0010022018/original/E2Migrationandagriculturalproductivity.pdf

Durand, J. (2004). Ensayo teórico sobre la migración de retorno. El principio de rendimiento decreciente. Cuadernos *Geográficos, 35*(2), 103-116.

Elkan, D. (1959). Migrant labor in Africa: An Economist's Approach. *American Economic Review,* (49), 188-197.

Food and Agriculture Organization of the United Nations. (2016). Migration, agriculture and *rural development.* https://www.fao.org/3/i6064e/i6064e.pdf

García, R. J., & Randall, A. (1994). A cost function analysis to estimate the effects of fertilizer policy on the supply of wheat and corn. *Review of Agricultural Economics, 16*(2), 215-230.

Gobierno de México. (2022). *Todo lo que debes conocer sobre el Programa de Precios de Garantía.* https://www.gob.mx/agricultura/articulos/todo-lo-que-debes-conocer-sobre-el-programa-de-precios-de-garantia

Gonzalez-Velosa, G. (2011). The effects of emigration and remittances on agriculture: Evidence from the Philippines. University of Maryland.

Hausman, R., & Nedelkoska, L. (2018). Welcome home in a crisis: Effects of return migration on the non-migrants' wages and employment. *European Economic Review, 101*(C), 101-132.

Herzog, H., & Schottman, A. M. (1982). Migration information, job search and the remigration decision. *Southern Economic Journal, 50*(1), 43-56.

Imbens, G. W., & Wooldridge, J. M. (2009). Recent developments in the econometrics of program evaluation. *Journal of Economic Literature, 47*(1), 5-86.

Jiménez-Díaz, J. F. (2010). Relatos biográficos de agricultores. Memoria de la revolución agrícola en la costa de Almería y Granada. Editorial Comares.

Kamara, A. B. (2004). The impact of market access in input use and agricultural productivity: evidence from Machakos District, Kenya. *Agrekon, 43*(2), 77-90. https://hdl.handle.net/10520/EJC18275

Kapri, K., & Ghimire, S. (2020). Migration, remittance, and agricultural productivity: Evidence from the Nepal Living Standard Survey. *World Development Perspectives, 19*, 100198. https://doi.org/10.1016/j.wdp.2020.100198

Khanal, U., Khorshed, A., Kanal, R., & Regmi, P. (2015). Implications of out-migration in rural agriculture: A case study of Manapang village, Tanahun, Nepal. *The Journal of Developing Areas, 49*(1), 331-352.

Krasniqui, B., & Williams, N. (2018). Migration and intention to return: Entrepreneurial intentions of the diaspora in post conflict economies. *Post Communist Economies, 31*(4), 464-483.

Kumbhakar, S. C. (2001). Estimation of profit functions when profit is not maximum. *American Journal of Agricultural Economics, 83*(1), 1-19. https://doi.org/10.1111/0002-9092.00133

Lewis, W. A. (1954). Economic development with unlimited supplies of labor. *The Manchester School, 22*(2), 139-191.

Lohr, S. (2022). Sampling, design and analysis. CRC Press.

Lucas, R. E. B. (1987). Emigration to South Africa's mines. *American Economic Review, 77*(3), 313-330.

Lucas, R. E. B., & Stark, O. (1985). Motivations to remit: Evidence from Botswana. *Journal of Political Economy, 93*(5), 901-18.

Martínez-Caballero, G., & Martínez-de la Peña, M. (2019). Estimaciones de la migración mexicana de retorno y la necesidad de políticas y programas para su atención. *Huellas de la Migración, 4*(8), 9-34. https://doi.org/10.36677/hmigracion.v4i08.12498

Massey, D., Arango, J., Hugo, G., Kouaouci, A., Pellegrino, A., & Taylor, J. (1993). Theories of international migration: A review and appraisal. *Population and Development Review, 19*(3), 431-466. https://doi.org/10.2307/2938462

Manski, C. F., & Lerman, S. R. (1977). The Estimation of Choice Probabilities from Choice Based Samples. *Econometrica, 45*(8), 1977-1988.

McCormick, B., & Wahba, J. (2001). Overseas work experiences, savings and entrepreneurship amongst return migrants to LDCs. *The Scottish Journal of Political Economy, 48*(2), 164-178.

Mendola, M. (2008). Migration and technological change in rural households: Complements or substitutes? *Journal of Development Economics, 85*(1-2), 150-175. https://doi.org/10.1016/j.jdeveco.2006.07.003

Mestries, F. (2015). La migración de retorno al campo veracruzano: ¿en suspenso de reemigrar? *Sociológica, 30*(84), 39-74.

Olano, M. (2022, February 1). Puebla exporta el 30 por ciento de su producción de café. *Revista La Campiña*. https://revistalacampina.mx/2022/02/01/puebla-exporta-30-por-ciento-de-su-produccion-de-cafe/#:~:text=Con%20un%20total%20de%20159,de%20200%20millones%20de%20pesos

Organización para la Cooperación y Desarrollo Económico. (2017). *Interrelations between public policies, migration, and development.* Chapter 4. http://dx.doi.org/10.1787/888933417729

Parzen, E. (1962). On estimation of a probability density function and mode. *Annals of Mathematical Statistics, 33*(3), 1065-1076.

Paul, B., Patnaik, U., Sasidharan, S., Kumar, K., & Sekar, Ch. (2022). Fertilizer use, value, and knowledge capital: A case of Indian farming. *Sustainability, 14*(19), 12491. https://doi.org/10.3390/su141912491

Programa de las Naciones Unidas para el Desarrollo. (2015). *Índice de Desarrollo Humano para las entidades federativas, México 2015.* http://www.mx.undp.org/content/mexico/es/home/library/poverty/indice-de-desarrollo-humano-para-las-entidades-federativas--mexi/

Quesnel, A. (2010). El concepto de archipiélago: una aproximación al estudio de la movilidad de la población y a la construcción de lugares y espacios de vida. In Sara M. & Lara F. (Coord.), *Migraciones de trabajo y movilidad territorial* (pp. 19-46). Miguel Ángel Porrúa.

Quian, W., Wang, D., & Zheng, L. (2016). The impact of migration on agricultural restructuring: Evidence from Jiangxi Province in China. *Journal of Rural Studies, 47*, 542-551.

Riddle, L., Hrivnak, G. A., & Nielsen, T. J. (2010). Transnational diaspora entrepreneurship in emerging markets: Bridging institutional divides. *Journal of International Management, 16*(4), 398-411.

Rosembaun, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika, 70*(1), 41-55.

Rozzelle, S., Taylor, J. E., & De Brauw, A. (1999). Migration, remittances, and agricultural productivity in China. *The American Economic Review, 89*(2), 287-292.

Salas, R. (2012). Migración internacional, actividades agrícolas y distribución del ingreso en una comunidad oaxaqueña, México. *Espacio Abierto Cuaderno Venezolano de Sociología, 21*(3), 401-422.

Sánchez-Gavi, J. L. (2016). Movilidad humana. El fenómeno migratorio en Puebla bajo la perspectiva de la Iglesia católica. *Tla-melaua, 9*(39), 108-139.

Secretaría de Agricultura y Desarrollo Rural. (2019). *Listado de beneficiarios del Programa de Producción para el Bienestar.* https://datos.gob.mx/busca/dataset/listados-de-beneficiarios-del-programa-produccion-para-el-bienestar-ciclo-agricola-primave-2019

Shi, Z. and Wang, J. (2013). Migrant labor experience and acquisition of new technologies for rural labor. *Journal of Zhongnan Univ. Econ. Law, 2*, 48-56.

Shultz, T. W. (1964). *Transforming traditional agriculture.* Yale University Press.

Sidhu, S. S., & Baanante, C. A. (1981). Estimating farm level input demand and wheat supply in the Indian Punjab using a translog profit function. *American Journal of Agricultural Economics, 63*(2), 237-246. https://doi.org/10.2307/1239559

Sistema de Información Agroalimentaria y Pesquera. (2023). *Avance de siembras y cosechas.* http://infosiap.siap.gob.mx:8080/agricola_siap_gobmx/ResumenProducto.do

Sjaastad, L. (1962). The Costs and Returns of Human Migration. *The Journal of Political Economy, 70*(5), Supplement: 80-93.

Taylor, J. E., & Wouterse, F. (2008). Migration and income diversification: Evidence from Burkina Fasso. *World Development, 36*(4), 625-640.

Tsegai, D. (2004). Effects of migration on the source communities in the Volta Basin of Ghana: Potential links of migration, remittances, farm, and non-farm self-employment activities [Working Paper. Economics and Technological Change]. University of Bonn.

Tsegaye, D., Verhees, F., & Van Trijp, H. (2017). The influence of market orientation on firm performance and members' livelihood in Ethiopian seed producer cooperatives. *Agrekon, 56*(4). https://hdl.handle.net/10520/EJC-c6b696483

Wahba, J., & Zenou, Y. (2012). Fuera de la vista, fuera de la mente: migración, emprendimiento y capital social. *Ciencia Regional y Economía Urbana, 42*(5), 890-903.

Williams, N. (2018). Mobilising diaspora to promote homeland investment: The progress of policy in post-conflict economies. *Environment and Planning C: Politics and Space, 36*(7), 156-1279.

Wooldridge, J. (2015). *Introducción a la Econometría.* Cengage Learning.