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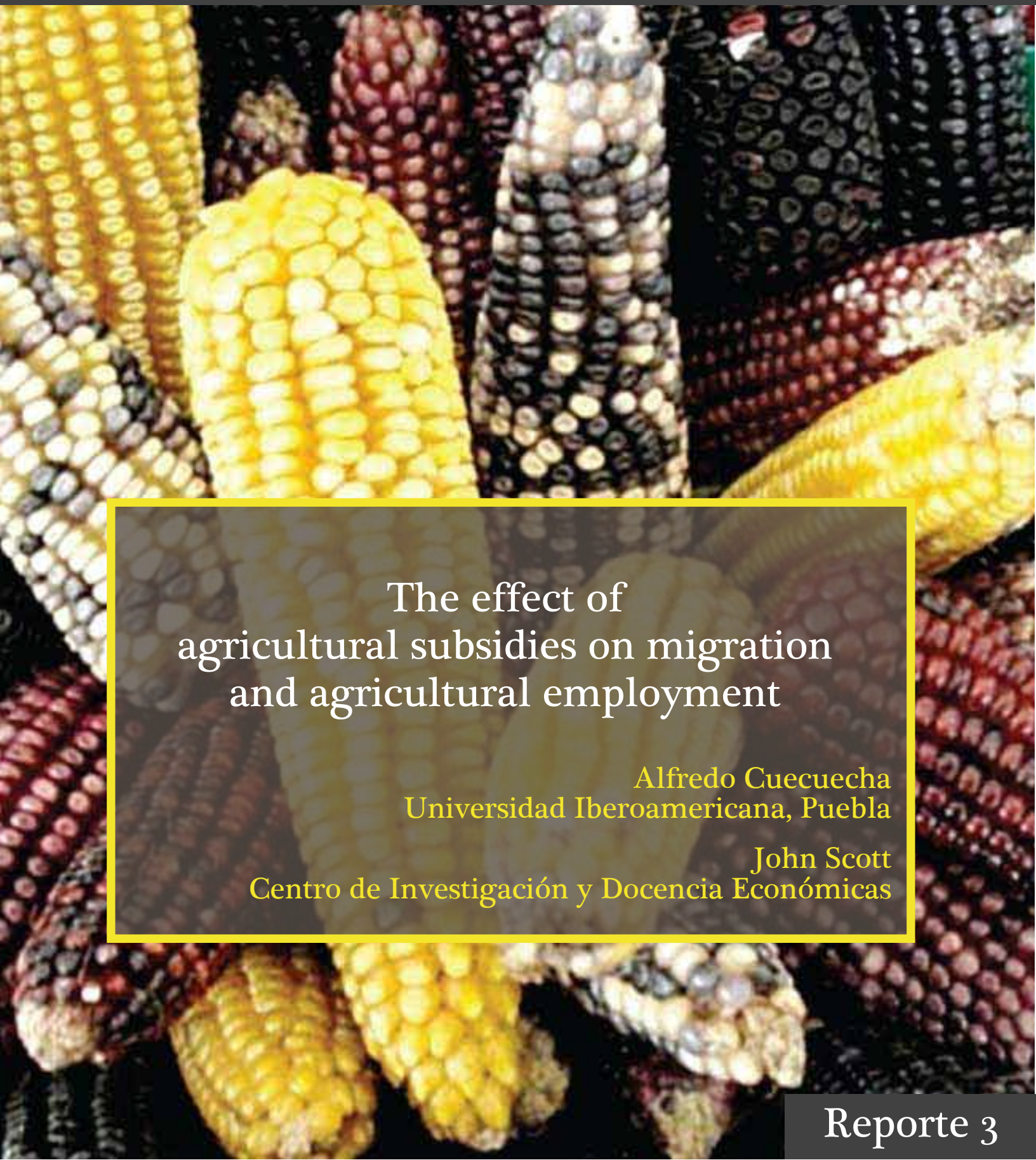

The effect of agricultural subsidies on migration and agricultural employment

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Reporte 3

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Resumen

Procampo inició en 1994 como un programa público diseñado para ayudar a la transición de actividades de baja productividad a actividades con alta productividad, entre otros objetivos. Exploramos en este artículo los efectos de Procampo sobre los flujos migratorios de México a los Estados Unidos, así como el efecto de Procampo sobre la dinámica laboral en el sector agrícola. Usando una metodología de datos panel y de variables instrumento, nuestros resultados muestran que Procampo reduce los flujos migratorios hacia los Estados Unidos, si bien se trata de un efecto pequeño. Al mismo tiempo, encontramos que Procampo no ayuda a la conservación de empleos en el sector agrícola en promedio, si bien beneficia al sector de producción de maíz y frijoles. Sin embargo, este efecto se ve más que compensado por efectos negativos sobre otros sectores agrícolas.

Abstract

Procampo was launched in 1994 to help the transition from low productivity activities to high productivity activities, among other policy objectives. We investigate the effects of Procampo on migration flows from Mexico to third countries (mainly the US), and the employment dynamics in the agricultural sector. Our results show that Procampo reduces the migration flows from Mexico to the US, while we find that does not benefit all agricultural job creation in Mexico. It benefits corn and beans job creation while it affects negatively job creation in other agricultural crops.

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Introduction

Procampo started operations in Mexico in the Fall Winter agricultural season of 1994-1995. It consisted in a subsidy delivered to producers that was aimed to replace the previous existence of subsidies that only covered producers with surplus production. By doing so, Procampo integrated to the system of subsidies many self consumption producers. The subsidy was given to producers that during the three years previous to the spring summer season of 1993 had cultivated eight types of crops: corn, beans, wheat, cotton, soy, sorghum, rice and canola (SARH, 1993). In principle, the producers could change crops, change activities or dedicate to ecological activities. It covered all Mexican states for the spring-summer seasons, while there are not registered beneficiaries in Aguascalientes, Tlaxcala and Distrito Federal for the fall-winter seasons. The number of beneficiaries has been keep virtually constant since its beginning, and the beneficiaries have only reduced as certain individuals have stop receiving payments for different reasons.

The objective of this study is to analyze the effect of Procampo subsidies on two key indicators of performance for agricultural labor markets in Mexico:

1. The migration flows observed in Mexico.

2. The employment dynamics of the agricultural sector.

These two effects are important because Procampo was designed to help out a transition in the Mexican rural sector from low productivity activities towards activities with higher productivity. From the viewpoint of the policy maker, the transition can be seen both at the municipality level, the household level and the individual level. In this analysis we will present evidence on the effects of Procampo at the municipal level and also at the household or individual level.

Migration is a key indicator of performance for the agricultural sector since remittances are such an important piece of income for the household and it is known that households use migration as a strategy to diversify household income through the remittances. In a world where migration is only determined by wage differentials and migration costs (Sjaastad, 1962), migration theory predicts that a subsidy in the agricultural sector should imply a reduction in migration, since in the margin it would change the value of being in Mexico positively. This change in the value of being in Mexico can be direct or indirect from the point of view of the household. We would say that directly affects migration if the families receive directly the subsidy and their migration decision gets affected. We would say that migration is affected indirectly by the subsidy if Procampo creates jobs in the local market and this reduces pressures for migration at the local labor market. These jobs can come from surplus producers that may increase their labor demand, as well as from the multiplier effects that the Procampo subsidies can generate in other sectors within the community and outside the community.

However, migration theory has shown that credit constraints matter in migration decisions of households and the formation of migration networks changes dynamically migration costs (Taylor, 1986 ; Massey, et al, 1993; Carrington et al, 1996; Mackenzie and Rapoport, 2007). These

two elements can change the effect of Procampo in unexpected ways. Under the assumption that households are credit constrained, there are different investments opportunities that the households do not get to carry out (Taylor, 1986). It is obvious that the subsidy loosens out the credit constraint for the household and that the household will carry out first those investments that generate the larger return for the household. Then, the size of the Procampo subsidies plays an important role since a large subsidy could make feasible the acquisition of technology in Mexico and generate the possibility of exploiting business opportunities in Mexico that could compete in the returns they offer with a migration cum remittances strategy. If the Procampo subsidies are small, it could be rational for the household to send household members abroad, generate remittances and use those remittances as the leverage to acquire or attempt new business opportunities.

The existence of migration networks also changes the incentives for families since it makes the case for productive investments to take place in Mexico more difficult at the beginning of the intervention period, but perhaps easy out the possibility of carrying out business opportunities later on in the migration process (Lindstrom, 1996; Mackenzie and Rapoport, 2007). Holding everything else constant, migrants with no social networks can value the Procampo subsidy as a way to finance migration even more, because it would be the seed capital for the start up of the migration venture for the household. That is, it would help to form the migration network for the family. On the other hand, holding everything else constant the existence of the network reduces migration costs and increases household income through the existence of remittances. Then, the Procampo subsidy can be seen as supplemental income to carry out agricultural production in Mexico and be part of the strategy of further diversifying the income sources of the household.

The employment dynamics in the agricultural sector are analyzed by looking at the probability of retention of workers and the probability of attraction of workers in the agricultural sector. The probability of retention is defined as the probability that one individual will choose to remain in the agricultural sector, while the attraction probability is defined as the probability of attracting workers into the agricultural sector. The Procampo subsidy can have an effect on these probabilities either directly or indirectly. The direct effect will occur when an individual receiving the subsidy chooses to continue working in the agricultural sector. An indirect effect occurs when the subsidies helps out to increase the demand in the local market for agricultural workers.

The study is done at different levels: first state level, then municipal level and finally at household and individual level. State level analysis is done using census data for the year 2000. The municipal level study is carried out using census data for 2000 and 1990. The individual and household level study is carried out for 2005-06 because it is the first period of time in which a representative panel data set is available for the agricultural sector in Mexico that allow the measurement of transition probabilities and the measurement of migration flows a the individual and household level, respectively. This study is the first to use the ENOE panel to analyze migration flows and its relation to Procampo.

This study is directly related to others analyzing the effects of other policy changes in Mexico and migration. Stecklov, et. al. (2005) find that Progresa conditional transfers reduced international migration but not domestic migration. Richter, Taylor and Yúnez (2007) find that the stock of migrants in the US got reduced by the introduction of NAFTA , while it got increased by the introduction of the more astringent border controls, including the beginning of the construction

of the wall between Mexico and the US in 1994 and the increase in border patrol officers, budgets and technologies.

The study is also related to others done on analyzing the effects of Procampo in other aspects of economic life. Sadoulet et al (2001) study the multiplier effects of Procampo in Mexico. Schmook and Vance (2008) find that Procampo subsidies have helped producers to increase the area that they cultivate, with a negative impact on the area under forest.

The rest of the study is organized as follows: the first section describes the different data sources used in the study, the second section presents the analysis at the municipal level, the third section presents the analysis for the migration flows from Mexico to the US, and the fourth section presents the analysis for employment dynamics in the agricultural sector.

Data Sources

In this study we gather data from different sources. The specific details on measurement for each variable are reserved for the explanation for each of the analysis that we perform. However, here we only describe the different sources that are combined in the study.

The analysis at the state level uses the migration index from CONAPO. The migration index was done by CONAPO using factor component analysis of different measures of migration that were collected at the 2000 census. They include questions about individuals that were in the US at the moment of the survey, questions about individuals that were in the US five years previous to the census and questions about the time at which individuals went to the US and the time at which they returned from the US.

The analysis on migration levels by municipalities is based on the SIMBAD data base that uses the census for the years 2000 and 1990. The SIMBAD data base aggregates the data of the census by municipalities.

The analysis of employment and migration flows is based on the National Occupation and Employment Survey (ENOE, *Encuesta Nacional de Ocupación y Empleo)*. We use the first wave through the sixth wave of the survey that cover from the first quarter of 2005 to the second quarter of 2006.

Administrative data on subsidies from the government is obtained from the Aserca data base. The specific years used are the fall-winter 1994 and spring-summer 1995 data sets, as well as the spring-summer 2004 and fall-winter 2004 data sets.

Sagarpa municipal data base on total cultivated land and population at municipal level. CONAGUA data base (ERIC) on meteorological historical information at municipal level. SCT information on the highway density at municipal level.

Migration Index at State Level and the Procampo Subsidies

As a first analysis we plotted the data from CONAPO (Migration index from the 2000 census at the state level) and the data from the Aserca data base aggregated by state for the year

2004. We normalized the Migration index to always be positive and then we divided by the national average.

Our main measure for the amount of subsidy in the municipality is the amount of Procampo resources per hectare in the municipality. We measure this variable by adding up all the Procampo resources available in one municipality and later on dividing by the total number of hectares in the municipality, which we obtained from Sagarpa. By this way, our measure attempts to control for the differences in scale that exists across municipalities. We did not attempt to measure the alternative "Procampo resources per hectare covered" because we would not have variation since this is an amount fixed by the program and that does not vary across municipalities. We decided to discard the alternatives measures "Procampo resources per total number of producers in the municipality" or "Procampo resources per producer in the program" because these variables can change not only due to variations in the resources of Procampo (in the numerator) but also by the migration of producers (in the denominator), increasing the correlation between unobserved variables correlated to migration and our exogenous variable of interest.

We measure the Procampo subsidies for the fall-winter agricultural cycles of 1994 and 2004, as well as for the spring-summer agricultural cycles of 1995 and 2004. Then, we obtain the weighted average for the 1994-1995 agricultural cycles and the 2004 cycle. Table 1 shows the average amount of subsidies per ht. In 2004 pesos, individuals received 124 pesos per hectare, approximately 12.4 dollars per ht at the 2004 exchange rate. In the 1994-95 periods, individuals received 79 pesos per ht, approximately 16 dollars per ht at the average exchange rate of the 1994-95 periods.

To perform the analysis, we obtained the simple average of the subsidies per hectare in the state and then relate this measure to the state level migration index. Figure 1 shows the relation between Procampo and the migration index. It shows that there is not a clear relation between Procampo and the migration index.

Migration at the Municipality Level and the Procampo Subsidies

A possibility for the above result is that while Procampo may not be related to the stock of migrants which may be determined by historic factors that precede Procampo, Procampo can still be related to the migration flow. We attempt to do an aggregate analysis, using data from Procampo at municipal level and a measure of the migration flow at the municipal level. Our best measure of migration at the municipal level comes from a question in the census that asks the individuals for their geographic location five years previous to the census. The question actually asks the individuals for the country of location. Most individuals that were in a different country in either of the two censuses answered "United States" as their country of location. Unfortunately, the SIMBAD data base used in our study did not specify the country of location; they simply coded all answers as individuals living in a different country from Mexico. To have a measure of the flow of migrants we obtain the difference between the total number of individuals that lived in a different country in 1995 (five years previous to the 2000 census) and the number of individuals that lived in a different country in 1985 (five years previous to the 1995 census). This is done also to eliminate fixed effects that can potentially damage our estimation. Table 1 shows that in the year 2000, 76

more individuals, on average, declared to have been in the US five years previous to the census compared to the year 1990.

Besides the Procampo subsidies per hectare, we also obtain other important information from the administrative data set for the years 1994-1995. In particular, we obtain the fraction of producers that have some land irrigated and obtain Procampo (48%) , we also obtain the fraction of recipients that belong to ejido land (20%), the fraction of recipients that cultivate corn and beans on their land (78%), the fraction of producers with land smaller than 2 ht (26%) and the fraction of producers with land between 2ht and 5 ht (46%). These variables will help us characterize certain characteristics at the municipality level that are important to control for in our study. They are important because clearly mark differences in terms of the productivity of the land, the land tenure regime, as well as on the production of traditional crops. From now on, we refer to these set of variables as the characteristics of Procampo at the municipality level.

Figure 2 presents the relation that exists between the change in migration between 2000 and 1990 and the initial distribution of the Procampo subsidies per hectare by municipality in the 1994-1995 years. We observe clearly that municipalities in the lowest quintile of the distribution of Procampo subsidies have the largest increase in migration. We also observe that starting from the second quantile there is a positive relation between migration and Procampo subsidies. Table 2 shows that when compared to the first quantile the second quintile has a change in migration that is 50% lower than the change in migration observed in the first quantile, while the third quintile has a change in migration 40% lower than the change in migration observed in the first quantile. Table 2 also shows that compared to the second quantile, the fifth quantile has a change in migration that is 80% larger, while the first quantile has a change in migration that is 100% larger. For both comparisons, these differences are the only ones that are statistically significant. However, Table 2 also shows that these differences reflect the differences in characteristics of Procampo across municipalities, since once we control for the fraction of producers that belong to ejidos, fraction of individuals that possess irrigation and the fraction of individuals that cultivate corn and beans we have that all these differences are not anymore statistically significant.

These results suggest that the effects of Procampo over migration by municipality are highly correlated with the characteristics of the municipality that determine the characteristics of the Procampo program. Consequently, they imply the need for a more detailed analysis that can control in a better way for these correlations.

The migration flows from Mexico to the United States

The migration flow is measured using questions 20 to 23 from the ENOE questionnaire. Questions 20 and 21 are used to measure the number of family members that left for the United States. In particular, question 20 asks: what is the main motive for _____to have left the household?, while question 21 asks : ¿which Mexican state or country did he go to?

Questions 22 and 23 are used to measure the number of family members that returned from the United States. Question 22 asks: what is the main motive for _____to become part of the household?, while question 23 asks: ¿which Mexican state or country did he come from?

Consequently we have a direct measure of the net change in the number of family members that departed for the US in ENOE.

The empirical model that we estimate is given by:

$M_{ij} = a_0 + a_1 X_{ij} + a_2 S_j + u_i$

M_{ij}: Net change in family members going to the US

X_{ij}: Vector of Household, Municipality and State characteristics.

S_j: Procampo subsidies in municipality.

The empirical model represents a reduced form equation that linearly relates the net change in household members in the US to the amount of Procampo subsidies present in the municipality, conditional on a set of household, municipality and state characteristics. The household characteristics are selected according to what is considered standard in migration studies: human capital of the household (a set of dummy variables marking whether the household head has primary, junior high school, high school or some university education), characteristics of the head of household (age and gender), structure of the household (number of household members below five years old, number of household member above 15). Table 3 presents the mean and standard deviations of some selected household level characteristics.

The municipality and state characteristics are selected not only on the basis of migration theory, since we are also interested in certain characteristics that are important for agricultural activities. For the later, we chose the number of agricultural producers in 1991 that we obtained from the agricultural census; the highway density of the municipality in 1998 that we obtained from SCT, and we also obtained the temperature in 1994 and the rainfall in 2005 and 1994 at the state level. We obtained these three variables from CONAGUA. For all these control variables, table 3 presents mean and standard deviations.

For the push and pull factors at the state level we selected variables related to the economic activity in the state: aggregate number of hours worked in the state, total number of employed people in the state, proportion of people employed in manufacturing in the state, the proportion of people employed in services in the state, and the aggregate number of households that receive government programs. These variables we obtained directly from ENOE and consequently, vary quarter to quarter. For Pull factors we selected certain variables that are really proxies for Pull factors and migration networks: number of individuals deported from the US in the last quarter at the state level, number of individuals that came back from the US in the previous quarter at the state level, fraction of households that receive international remittances in the state, and fraction of families that receive internal remittances in the state. We also controlled for quarterly dummies.

To sum up, our econometric objective is to find the effect of one additional peso per hectare on the migration flows at the family level.

Econometric issues:

Our data is an unbalanced panel of families, and consequently we can eliminate the unobserved fixed effects that can contaminate our data. This is important since our estimations exploit the panel data nature of the data to eliminate the potential correlation that exists between fixed unobserved elements in the process that generates migration at the family level and the variation in the Procampo subsidy at the level of the municipality. The problem that remains is that if the level of Procampo resources in the municipality are correlated with unobserved factors that change in the households over time, then we can have that our estimates would be biased. A potential solution is to use the resources of Procampo that were assigned in 1994 as an instrumental variable for the allocation of Procampo resources of 2004. This would work under the following assumptions:

a. The 2004 Procampo allocation per municipality is a function of the 1994-1995 Procampo allocation per municipality

b. Conditional on the household, municipality and state characteristics measured in 2004, the 1994-1995 Procampo allocation is not correlated with the unobserved changing factors that determine the migration decision at the household level.

Assumption a) is clearly the case since it is known that the beneficiaries of Procampo has not increased since 1994-1995, while it has decreased as certain households have drop out from the program for different reasons. Figure 3 shows the results from a regression between the subsidies per hectare in 1994-95 and the subsidies per hectare in 2004. There is clearly a positive relation between the two.

Assumption b) is more problematic because two main reasons:

i. It is a statistical assumption that must be tested in the data.

ii. Factors that determined the 1994-1995 Procampo allocation in the municipality could also be related to migration decisions at the family level in 1994-1995 that could be related to the migration decisions at the household level in the quarters analyzed (first quarter, 2005 to second quarter 2006). Specifically, if there is a correlation between unobserved factors that change during the quarters of 2005 and 2006 and determine the migration decision of the individuals and the 1994-1995 level of Procampo subsidies, then our instrument will not be valid. This is likely the case since the 1994-1995 periods were characterized by numerous political and economic shocks that most likely affected the migration decisions at the family level in 1994. Moreover, because it is known that migration works through migrants networks, it is very likely that the effects of those changes prevail up to 2005-2006. There is some hope, however, that the 1994-1995 Procampo allocation can work as instrument since condition b) establishes that the 1994-1995 Procampo allocation must work as instrument controlling for household, municipality and state characteristics prevailing in 2004. For example, suppose that the change in migration networks that the family faced after the 1994 crisis is completely controlled for by the use of the fixed effect at the household level and the information at the state level on the extent and scope of the state migration network. To analyze this possibility we will test formally for whether the 1994-95 Procampo subsidies work as instrument or not.

We also decided to look for some other variables that can potentially work as instruments. After different exploratory analysis, we found that the 1994 Procampo allocation of resources does work as an instrument.[i] Consequently, our task reduced to find an additional instrument that would over identify our model. Over identification occurs when a researcher finds more than one variable that satisfy conditions a) and b). There is however a new challenge that arises. The question is whether the additional instrument actually benefits the estimation or it actually worsens it off. The Sargan test of over identifying restrictions is performed with this end. After different exploratory work we found that the level of rain fall in 1994 together with the 1994 Procampo allocation work as instruments, although they do so only for certain specifications. Figure 4 shows the results from a regression between subsidies per hectare in 2004 and rain fall levels in 1994. They show a negative relation between rain fall in 1994 and the Procampo subsidies in 2004. This relation shows that Procampo benefits more areas with lower rainfall were irrigation and large landowners are present.

Results

Table 4 shows the results for the migration model. As explained before, we are using quarterly data for the first quarter of 2005 to the second quarter of 2006. Our endogenous variable is the change in net number of family members in the US. Our main variable of interest is the subsidies per total amount of hectares in the municipality in 2004. The table shows five different specifications of the model that were attempted. Our first specification represents a random effects model. The second specification is also a random effects model that includes controls for the characteristics of Procampo at the municipality level: proportion of beneficiaries with irrigation, proportion of beneficiaries that belong to a ejido, proportion of beneficiaries cultivating corn and beans, proportion of beneficiaries with less than 2 hectares, and proportion of beneficiaries with land holdings between 2 and 5 hectares. Our third specification uses as an instrument the Procampo subsidies per hectare in 1994, and excludes the controls explained in specification 2. The fourth specification includes the instrumental variable and also the controls for the characteristics of the Procampo subsidies in the municipality. The fifth specification includes the characteristics of Procampo, and uses two instruments: the amount of subsidies in 1994 and the rain fall in the state for the year 1994.

The table shows that the effect of the amount of subsidies per hectare in the municipality on the net number of family members in the US is negative. The effect is statistically significant only when we use instruments. Our preferred estimation for the effect of Procampo shows that a 1% increase in the amount of Procampo subsidies per hectare reduce migration .02%. According to Table 1, in 2004 Procampo assigned 124 pesos per hectare on average. Consequently, 1.23 additional pesos per hectare represent a .02% reduction in the migration flow. An alternative estimation is that obtained by analyzing the effect of one standard deviation increase in the Procampo subsidies. This represents a very important change since it implies that the mean of the distribution would increase by one standard deviation. Table 1 shows that the standard deviation of the Procampo subsidies in 2004 is 174 additional pesos per hectare. This would imply an increase in Procampo subsidies of 140% at the mean. This increase would reduce migration in 3.48%.

The employment dynamics in the agricultural sector of Mexico

Employment dynamics are studied using questions 3 and 7a in the ENOE questionnaire. Question 3 asks about the occupation of the individual at his or her main job, while question 7a asks about the occupation of the individual at his or her secondary job.

We identify individuals whose occupations are classified as agricultural (410 in the *Clasificación Mexicana de Ocupaciones)*, as well as those identified as working in corn and beans (4100), vegetables (4103) and fruits (4106).

With these questions we form four dummy variables for the events:

i. "the individual works in the agricultural sector"

ii. "the individual works in the agricultural sector, corn and beans"

iii. "the individual works in the agricultural sector, vegetables"

iv. "the individual works in the agricultural sector, fruits"

Individuals working in the agricultural sector represent 4.5% of the individuals in the labor force. That is, this number includes all individuals out of the labor force. We decided to use the individuals working in corn, beans, vegetables and fruits because they constitute together 87% of the individuals working in agricultural occupations (see Figure 5), and they constitute three types of crops that were affected by Procampo in different ways: occupations in corn and beans are influenced directly and intensively by Procampo; occupations in vegetables are influenced directly but in a lower scale than corn and beans; finally, occupations in fruits and flowers are influenced directly by Procampo only marginally. In general, occupations in corn and beans dominate all other subsectors in the agricultural occupations since 62% of individuals in agricultural occupations are in corn and beans (see Figure 5).

Our objective is to measure the effect of Procampo subsidies on the employment dynamics of Mexico. We will focus in the retention probability, which measures the probability of remaining in an occupation from one quarter to another, conditional on being employed on such occupation in the previous period. Specifically we will measure the following retention probabilities:

i. We measure the transition between an agricultural job and any other activity, conditional on be part of the agricultural sector on the previous period.

ii. We measure the transition between an agricultural job, corn and beans towards any other activity, conditional of being part of the agricultural sector, corn and beans in the previous period.

iii. We measure the transition between an agricultural job, vegetables towards any other activity, conditional of being part of the agricultural sector, vegetables in the previous period.

iv. We measure the transition between an agricultural job, fruits towards any other activity, conditional of being part of the agricultural sector, fruits in the previous period.

We decided to look at individuals working in the agricultural sector, while not necessarily working an agricultural occupation. In this case we look at all individuals whose company or business is classified in the agricultural sector. (1110 in the *Sistema de Clasificación Industrial de América del Norte*) this definition includes individuals whose occupation can be administrative or technicians, but whose jobs depend on the agricultural sector. Consequently, we measured a fifth transition:

v. We measure the transition between any occupation in the agricultural industry and any other occupation, conditional of being part of the agricultural industry in the previous period.

Table 5 shows the fraction of individuals that were retained by the agricultural occupation. The table shows that the corn and bean sector retains on average one in every two individuals. This is larger than what is observed for the vegetable sector and the fruit and flowers sector. Table 5 also shows an alternative measure: the probability that an individual will be in the x agricultural sector, conditional on being on any agricultural occupation a year before. The table shows that these probabilities are larger than the retention probability and that they are larger for individuals in the vegetable and fruit and flowers sectors, than for the corn and beans sector.

Our empirical model is then:

$T_{ij} = a_0 + a_1 X_{ij} + a_2 S_j + u_i$

T_{ij}: 1 if individual (i) stay in the agricultural activity for cases (i) through (v).

X_{ij}: Vector of Individual, Household, Municipality and State characteristics.

S_j: Procampo subsidies in municipality.

The variables used in the model are those explained in the family migration model. The intuition is that employment in the agricultural sector is related to the human capital characteristics of the household, the structure of the household, the characteristics of the head of household, the municipality and state characteristics that determine the agricultural activity, as well as on the push and pull factors that determine migration, since it is such an important option for households in rural areas that needs to be controlled for. The individual characteristics that were included in the model are the education, the age and the gender of the individual.

Measurement Issues:

Transition probabilities in the agricultural sector present certain challenges for measurement because agricultural jobs tend to follow seasonal patterns. Consequently, a quarter to quarter

transition probability may over estimate or under estimate the number of transitions out of the agricultural sector due to this seasonal variation. For example, at the beginning of the fall-winter agricultural season we may observe larger retention probabilities because the beginning of the agricultural season, while at the end of the agricultural season we may observe lower retention probabilities due to the end of the agricultural season. We can calculate transitions year to year, by comparing occupations from, say the first quarter of year t, with the occupation in the first quarter of year t+1. This, however, introduces a new problem because our data has only five observations per individual as a maximum, since ENOE is a rotating panel in which individuals exit the panel at the fifth quarter. Consequently, our panel data gets transformed into a cross section with all the limitations that an analysis based on cross section can have. We attempted some estimations based on the cross section, but the number of observations reduces and the performance of our instruments reduces, since in the cross section we cannot eliminate unobserved fixed effects or at least control for random fixed effects. We present the results but they should be taken with caution due to all the limitations mentioned.

A second problem in measuring agricultural activities is that for many individuals the agricultural activity is not their main activity, consequently even when the Procampo subsidies may be helping to preserve jobs in the agricultural sector we may not measure that, since we are focusing our estimation on the primary occupation. We will present a set of results based on both primary and secondary occupations.

Econometric Issues:

In the case of quarter to quarter transition probabilities we have the panel data structure to help us control for unobserved fixed effects that are related to the transition probability T_{ij}, and that are also correlated with the level of Procampo subsidies. It remains the same situation mentioned before: if there are unobserved factors that change over time that determine the quarter to quarter transitions and that are correlated with the Procampo subsidies at the municipality level, then we would need an instrument for the 2004 Procampo subsidies. Consequently, the same instruments explained for the case of the migration estimation will be used in the transition probabilities models.

In the case of the year to year transitions, the econometric challenge raises: now we lose the panel data structure that help us in the quarter to quarter specifications. The only option is to use instrumental variables to identify the effect of the 2004 Procampo subsidies on the year to year transition.

Results

Table 6 shows the results for the models of the retention probability. The transition is measured quarter to quarter. The model used here is a linear probability model and we attempt five different specifications, just as we did with the migration models. These models are: a) random effects, b) random effects with controls for the characteristics of Procampo in the municipality, c) instrumental variables without the controls for the characteristics of Procampo, using as instrument the amount of Procampo resources in 1994, d) the previous instrument and controls for the

characteristics of Procampo, and d) we use as instruments the 1994 allocation of resources and the rain fall in the state in 1994.

Our preferred estimation is again with one instrumental variable and Procampo characteristics. The effect of the subsidies per hectare is always significant but it has a different sign depending on the retention probability studied. In the case of jobs in agricultural occupations the effect is postive: a 1% increase in Procampo subsidies increases this retention probability in .07%. A one standard deviation increase in Procampo subsidies increases this retention probability in 8.68%%. In the case of jobs in occupations in corn and beans the effect is also positive: a 1% increase in Procampo increases the retention probability in .18%. A one standard deviation increase in Procampo subsidies increases this retention probability in 22%. In the case of vegetables the effect is negative: a one percent increase in Procampo subsidies reduces the retention probability .16%. A one standard deviation increase in Procampo subsidies reduces the retention probability 19%. In the case of fruits and flowers the effect is also negative, but very small: a 1% increase in Procampo reduces the retention probability .00002%, while a one standard deviation in Procampo subsidies reduces the retention probability in .03%. Finally, the effect on any job in the agricultural sector is positive: a 1% increase in Procampo increases .05% this probability, while a one standard deviation in Procampo subsidies increases 6.2% the retention probability.

These results suggest that Procampo changes the crop selection towards corn and beans, and that on average generates an increase in retention probability for all agricultural occupations and jobs in the agricultural sector.

Alternative Specifications in Data and Dependent Variable

Table 7 presents alternative specifications that were attempted. First, we show the results for the year to year probability of remaining in a given state. The table shows that the subsidies per hectare are significant only for vegetables, fruit and flowers and all agricultural occupations. Moreover, the effect found is negative in all cases, while the effect for corn and beans becomes statistically insignificant. These results suggest a very different picture from the one that we described using the quarter to quarter transition. Basically, they indicate a negative effect of the Procampo subsidies per hectare for some crops and on average for all agricultural occupations in the agricultural sector.

There are at least two potential explanations for the difference in results for the corn and beans sector. First, seasonal patterns are important and contaminate our quarter to quarter estimation. A second interpretation is that for the case of workers in the corn and beans sector, the Procampo subsidies can alter the retention probability only for those producers that have already decided to produce in a given agricultural cycle, perhaps changing marginally certain activities to be performed during one agricultural cycle, while year to year decisions are no longer affected by Procampo because the program has been in place for so long.

Table 7 also shows the results for the attraction probabilities. The attraction probability is defined as the probability that one individual would be attracted towards the agricultural sector. Specifically, we measure the following events:

i. We measure the transition from any other activity towards an agricultural job in any crop, conditional on not being part of the agricultural sector on the previous period.

ii. We measure the transition from any other activity towards an agricultural job, corn and beans, conditional of not being part of the agricultural sector, corn and beans in the previous period.

iii. We measure the transition from any other activity towards an agricultural job, vegetables, conditional of not being part of the agricultural sector, vegetables in the previous period.

iv. We measure the transition from any other activity towards an agricultural job, fruits, conditional of not being part of the agricultural sector, fruits in the previous period.

v. We measure the transition from any other activity towards any occupation in the agricultural sector, including technicians and administrative positions, conditional of not being part of the agricultural sector in the previous period.

Our preferred estimation is again with one instrumental variable and controls. The effect of the subsidies per hectare is always significant but it has a different sign depending on the attraction probability studied. In the case of jobs in agricultural occupations the effect is negative: a 1% increase in Procampo subsidies reduces this attraction probability in .01%. A one standard deviation increase in Procampo subsidies reduces this attraction probability in 1.24%. In the case of jobs in occupations in corn and beans the effect is positive: a 1% increase in Procampo increases the attraction probability in .01%. A one standard deviation increase in Procampo subsidies increases this attraction probability in .74%. In the case of vegetables the effect is negative: a one percent increase in Procampo subsidies reduces the attraction probability .02%. A one standard deviation increase in Procampo subsidies reduces the attraction probability 2.48%. In the case of fruits and flowers the effect is also negative: a 1% increase in Procampo reduces the attraction probability .004%, while a one standard deviation in Procampo subsidies reduces the attraction probability in .5%. Finally, the effect on any job in the agricultural sector is negative: a 1% increase in Procampo reduces .02% this probability, while a one standard deviation in Procampo subsidies reduces 2.48% the attraction probability.

Table 7 also shows the attraction probabilities measured year to year. The results are similar to those mentioned before, with the exception of the corn and beans sector which is non-significant. These results follow the same pattern that we mentioned before: Procampo subsidies seem to hurt the vegetables sector and the fruit and flower sector, while it generates no effects on the corn and beans sector. This lead us to conclude that seasonal patterns matter in the corn and beans sector and therefore the year to year estimations should be preferred over the quarter to quarter.

Finally, Table 7 shows the estimations using both the main and the secondary jobs of the individuals to identify who is working in an agricultural occupation. All our results remain similar, except for the fact that now the effect of the agricultural subsidies is statistically significant, at the 10% level, in the year to year estimations. We estimate that a one percent increase in the amount of Procampo subsidies increases the retention probability in corn and beans in .34%.

Conclusions

Our analysis finds that the Procampo subsidies have significant effects on two key indicators of the rural sector in Mexico: the net flow of migrants and the employment dynamics of the agricultural sector.

We find that 1.23 additional pesos of subsidies per hectare represent a .02% reduction in the migration flow. The same increase can actually harm the year to year retention probabilities and the attraction probabilities of some crops in the agricultural sector, especially those of the vegetables sector and the fruit and flowers sector. We also find that this increase has a small positive effect on the corn and beans sector.

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Table 1. Mean and standard deviation values for Migration at municipal level and Procampo variables used in the study.				
	Mean	**Standard Deviation**	**N**	**Level**
Change in Migration	76.488	321.284	2429	Municipality
Procampo /ht in 2004	123.582	174.216	2383	Municipality
Procampo/ht in 94-95	79.646	103.803	1463	Municipality
Proportion of Procampo producers with irrigation in 94-95	0.481	0.403	1468	Municipality
Proportion of Procampo producers in ejido in 94-95	0.201	0.358	1468	Municipality
Proportion of Procampo producers in corn and beans in 94-95	0.789	0.262	1468	Municipality
Proportion of Procampo producers with less than 2 ht in 94-95	0.467	0.213	1468	Municipality
Proportion of Procampo producers with land between 2 and 5 ht in 94-95	0.265	0.158	1468	Municipality

Source:

a. For migration: ENOE from first quarter of 2005 to second quarter of 2006.

b. For Procampo: ASERCA data base, fall-winter 1994 cycle, spring-summer 1995 cycle, 2004 cycles.
c. For hectares in the municipality: SAGARPA data base.

Table 2. Relation between Procampo by municipality and Migration

Quintil	Average Procampo/Hectare By municipality (pesos per hectare)	Change in Migration (persons)	% Difference with respect to 1st quantile (a)	% Difference with respect to 2nd quantile (a)
1	7.51	112.54	-	101.3**
2	24.63	55.91	-50.3**	-
3	47.07	67.30	-40.2*	20.4
4	85.81	79.32	-29.5	41.9
5	232.86	106.13	-5.7	89.8*

**Significant at 5 %. *Significant at 10%.

(a) None of these differences is significant after we control for the characteristics of Procampo

Table 3. Mean and Standard deviations for control variables.				
	Mean	Standard Deviation	N (a)	Units
Head with Primary	39%	49%	631289	Household
Head with Junior High	21%	41%	631289	Household
Head with High School	14%	35%	631289	Household
Head with University	14%	34%	631289	Household
Head Male	75%	43%	633091	Household
Head Age	47	15	619036	Household
Rainfall 1995	807.106	270.649	2443	Municipality
Density 1998	0.010	0.012	1265	Municipality
Temperature 1995	28.546	2.557	2443	Municipality
Rainfall 2005	1090.956	516.285	2443	Municipality
Individual with Primary	34%	47%	2550209	Individual
Individual with Junior High	20%	40%	2550209	Individual
Individual with High School	14%	35%	2550209	Individual

Individual with University	11%	31%	2550209	Individual
Male	48%	50%	2484537	Individual
Age	29	20	2484537	Individual

Source: ENOE from first quarter of 2005 to second quarter of 2006.
Notes:
(a) For households, N Refers to household times number of periods; for municipalities it refers to number of municipalities; for individuals refers to individuals times number of periods.

Table 4. Effect of Subsidies per HT on the Change in the Net Number of Family Members in the US

	Random Effects	**Random Effects**	**RE and IV**	**RE and IV**	**RE and IV**
Subsidies per hectares in municipality	-2.13e-06 (.00001)	7.60e-06 (.00002)	-.00005*** (.00002)	-.0002*** (.0001)	-.00005** (.00002)
N	26,021	26,606	26,730	26,779	25,931
Procampo characteristics in 1994	No	Yes	No	Yes	Yes
N	26,021	26,606	26,730	26,779	25,931

Notes:

a. All the regressions presented here also include the following control variables that are not included in the table to save space: rain fall in 2004, highway density, temperature, age of the individual, gender of the individual, dummies for the human capital of the individual (primary, junior high, high school, university), age of the head of household, dummies for the human capital of the head of household (primary, junior high, high school, university),

gender of the head of household, household members below 5 years old, family members above 15 years old, aggregate number of individuals in the manufacturing sector in the state, aggregate number of individuals in the service sector in the state, aggregate number of hours worked in the state, aggregate number of individuals employed in enterprises in the state, aggregate number of households that receive government programs in the state, aggregate number of households that receive international remittances in the state, aggregate number of households that receive internal remittances in the state, aggregate number of individuals that lived in the US in the state, the aggregate number of individuals that were deported from the US in the state, plus dummies for the quarter in which the survey took place.

b. All estimations that use random effects and do not use instrumental variables use the Baltagi-Chang estimators of the variance components.
c. All estimations that use random effects and instrumental variables use the Tukey-Hanning Kernel estimation with a band width of 3, to control for autocorrelation and heteroskedasticity.
d. The Anderson LR test indicates that the model is not under identified, because we reject that null hypothesis. For all the models. The Cragg-Donald test indicates that the instruments are not weak since we reject that null hypothesis. For the case in which we use two instruments, we performed the Sargan test that indicates that the model is not over identified, since we reject the null hypothesis that the model is over identified. This result suggests that the best model is the one with one instrument and controls for the characteristics of Procampo at the municipality level.

Table 5. Mean and Standard deviations for employment variables in agricultural sector.

	Mean	Standard Deviation	N (a)	Units
Individuals in Agricultural Sector All occupations	4.5%	20.8%	1897482	Individuals
Individuals in Agricultural Occupations	3.9%	19.4%	1897482	Individuals
Individuals in occupations in corn and beans sector	2.4%	15.3%	1897482	

					Individuals
Individuals in occupations in vegetables sector	0.6%	7.8%	1897482		Individuals
Individuals in occupations in fruits and flowers sector	0.4%	6.5%	1897482		Individuals
Retention Probabilities: Probability of remaining in job from period to period					
	Quarter to Quarter	N	Year to Year (B)	Year to Year (C)	N (B); N(C)
Individuals in Agricultural Sector All occupations	67%	33086	65%	78%	2693; 2476
Individuals in Agricultural Occupations	60%	28516	55%	90%	2476; 2476
Individuals in occupations in corn and beans sector	53%	16244	49%	95%	1302; 2476
Individuals in occupations in vegetables sector	38%	5376	36%	78%	509; 2476
Individuals in occupations in fruits and flowers sector	44%	3226	42%	90%	307;2476

Source: ENOE from first quarter of 2005 to second quarter of 2006.

Notes:

(a) N refers to individual times number of periods, except for year to year retention probabilities, where they refer to individuals .
(b) Year to year conditioning on being in the same agricultural occupation definition a year before
(c) Year to year conditioning on being in any agricultural occupation a year before

Table 6. Quarter to quarter probability of remaining at the occupation of previous

period					
	Occupation in the agricultural sector				
	Random Effects	**Random Effects**	**RE and IV**	**RE and IV**	**RE and IV**
Subsidies per hectares in municipality	.0003** (.0001)	.0003** (.0002)	.0003* (.0002)	.0007** (.0003)	.0007** (.0003)
N	**12370**	**11939**	**11939**	**11939**	**11939**
	Occupation in the agricultural sector, corn and beans				
Subsidies per hectares in municipality	.0017*** (.0002)	.0009*** (.0003)	.0023*** (.0004)	.0018*** (.0006)	.0018*** (.0006)
N	5386	5088	5088	5088	5088
	Occupation in the agricultural sector, vegetables				
Subsidies per hectares in municipality	-.0003 (.0002)	-.0004 (.0003)	-.0006 (.0004)	-.0016*** (.0005)	-.0016*** (.0005)
N	2808	2732	2732	2732	2732
	Occupation in the agricultural sector, fruit and flowers				
Subsidies per hectares in municipality	-.00007 (.0003)	-.0001 (.0004)	-.0009 (.0006)	-.0020* (.0011)	-.0020* (.0011)
N	2078	2059	2059	2059	2059
	Job in the agricultural sector				
Subsidies per hectares in municipality	.0001 (.0001)	.0003** (.0002)	.0002 (.0001)	.0005* (.0003)	.0005* (.0003)
N	14645	14172	14172	14172	14172
Controls for Procampo characteristics	No	Yes	No	Yes	Yes

Notes:

a. All the regressions presented here also include the following control variables that are not included in the table to save space: rain fall in 2004, highway density, temperature, age of the individual, gender of the individual, dummies for the human capital of the individual (primary, junior high, high school, university), age of the head of household, dummies for the human capital of the head of household (primary, junior high, high school, university), gender of the head of household, household members below 5 years old, family members above 15 years old, aggregate number of individuals in the manufacturing sector in the state, aggregate number of individuals in the service sector in the state, aggregate number of hours worked in the state, aggregate number of individuals employed in enterprises in the state, aggregate number of households that receive government programs in the state, aggregate number of households that receive international remittances in the state,

aggregate number of households that receive internal remittances in the state, aggregate number of individuals that lived in the US in the state, the aggregate number of individuals that were deported from the US in the state, plus dummies for the quarter in which the survey took place.

b. All estimations that use random effects and do not use instrumental variables use the Baltagi-Chang estimators of the variance components.
c. All estimations that use random effects and instrumental variables use the Tukey-Hanning Kernel estimation with a band width of 3, to control for autocorrelation and heteroskedasticity.
d. For all the regressions shown the Anderson LR test indicates that the model is not under identified, because we reject that null hypothesis. For all the models, the Cragg-Donald test indicates that the instruments are not weak since we reject that null hypothesis. For the case in which we use two instruments, we performed the Sargan test. For almost the models we cannot reject the null that the model is over-identified and consequently that the two instruments are valid. Only for the model done for jobs in the agricultural sector the two instruments are not well suited.

Table 7. Alternative data specifications. All regressions use as instrument the 1994-1995 Procampo allocation and include as controls the characteristics of Procampo at the municipality level					
	Occupation in the agricultural sector	**Occupation in the agricultural sector, corn and beans**	**Occupation in the agricultural sector, vegetables**	**Occupation in the agricultural sector, fruit and flowers**	**Job in the agricultural sector**
	Year to year transition probability of remaining in given state, cross section regressions				
Subsidies per hectares in municipality	-.003** (.0010)	.0003 (.0020)	-.0969*** (.0110)	-.0070* (.0038)	-.0009 (.0009)
N	938	353	229	180	1028
	Quarter to Quarter transition probability. Main and Secondary Job. Probability of remaining in given state, random effects regressions				
Subsidies per hectares in municipality	.0009*** (.0003)	.0024*** (.0005)	-.0016*** (.0005)	-.0021** (.0009)	
N	13559	6133	2905	2248	
	Year to Year transition probability. Main and Secondary Job. Probability of remaining in given state, cross section regressions				
Subsidies per hectares in municipality	-.0017* (.0010)	.0034* (.0019)	-.0038** (.0016)	-.0082*** (.0030)	

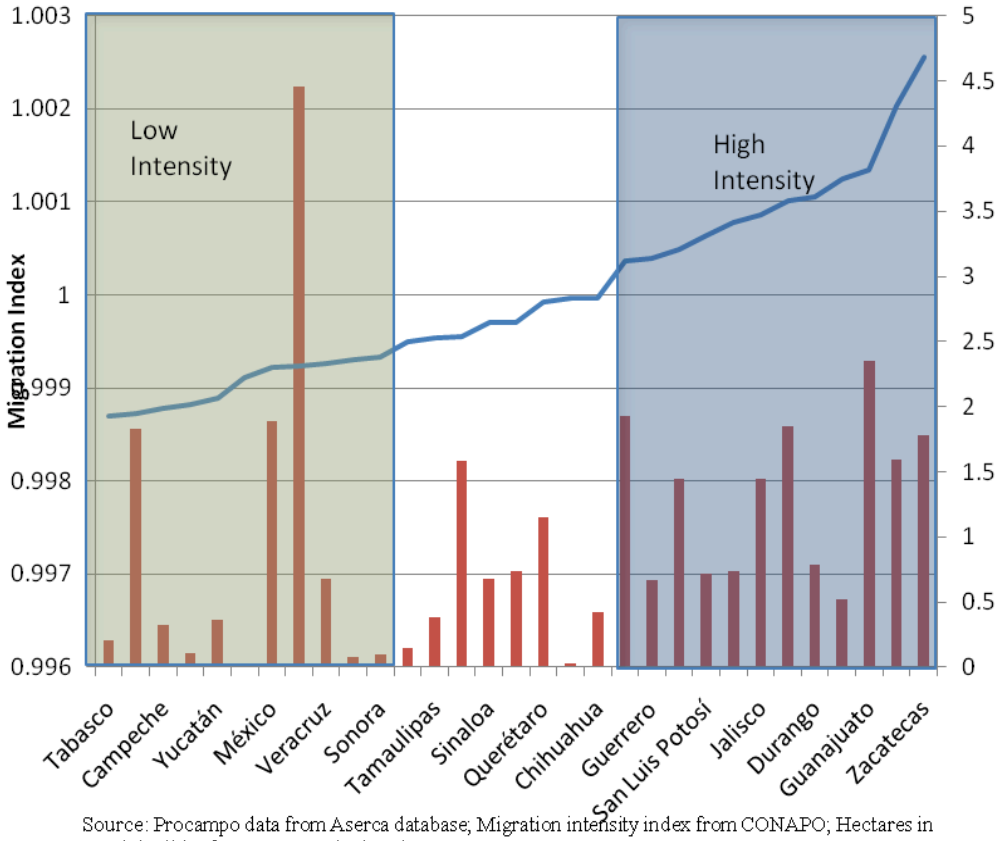
N	1093	427	258	203	
	Quarter to Quarter transition probability. Probability of attraction to the given state, random effects regressions				
Subsidies per hectares in municipality	-.0001*** (.00001)	.00006*** (.00001)	-.0002*** (9.93e-06)	-.00004*** (7.63e-06)	-.0002*** (.00002)
N	330,731	337,582	339,938	340,611	328,428
	Year to Year transition probability. Probability of attraction to the given state, cross section regressions				
Subsidies per hectares in municipality	-.0002** (.0001)	-7.64e-06 (.0001)	-.00018*** (.0001)	-.0002*** (.0001)	-.0003*** (.0001)
N	26,021	26,606	26,730	26,779	25,931

Notes:

a. All the regressions presented here also include the following control variables that are not included in the table to save space: rain fall in 2004, highway density, temperature, age of the individual, gender, dummies for the human capital of the individual (primary, junior high, high school, university), age of the head of household, dummies for the human capital of the head of household (primary, junior high, high school, university), gender of the head of household, household members below 5 years old, family members above 15 years old, aggregate number of individuals in the manufacturing sector in the state, aggregate number of individuals in the service sector in the state, aggregate number of hours worked in the state, aggregate number of individuals employed in enterprises in the state, aggregate number of households that receive government programs in the state, aggregate number of households that receive international remittances in the state, aggregate number of households that receive internal remittances in the state, aggregate number of individuals that lived in the US in the state, the aggregate number of individuals that were deported from the US in the state, plus dummies for the quarter in which the survey took place.
b. All estimations that use random effects also use instrumental variables and they use the Tukey-Hanning Kernel estimation with a band width of 3, to control for autocorrelation and heteroskedasticity.
c. All estimations that are cross section use a LIML method that is robust to heteroskedasticity.
d. The Anderson LR test indicated for all models that they were not under identified, because we reject that null hypothesis for all the models. The Cragg-Donald test indicated for all models that the instrument is not weak since we reject that null hypothesis. Only one

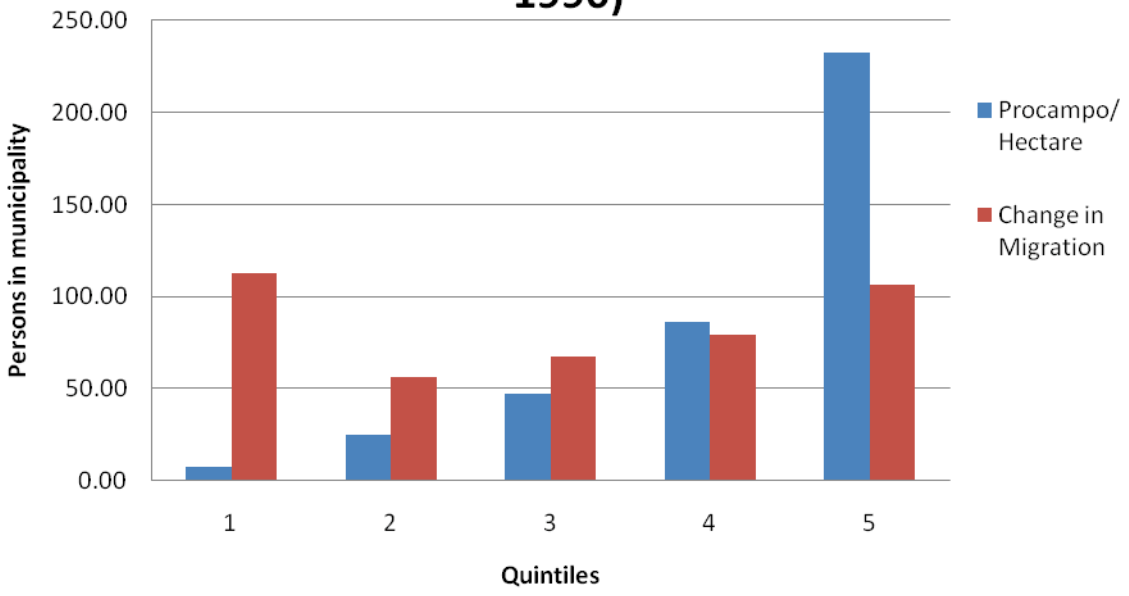
instrument is used and consequently all models that use instrumental variables are perfectly identified.

Figure 1. Procampo per ht in 2004 and Migration Intensity in 2000



Source: Procampo data from Aserca database; Migration intensity index from CONAPO; Hectares in municipalities from 1991 Agricultural census.
Notes: Procampo data is divided by the total number of hectares cultivated in 1991. The ratio Procampo over hectares is normalized by the national average in Procampo over hectares. Data is sorted progressively according to the migration index. The migration index is normalized to be positive and is presented as fraction of the national average. Low intensity: Migration Index ≤ .9933. High intensity: Migration index ≥ 1.0003.

Figure 2. Average Procampo/Hectare Subsidy 1994-1995 and Change in Migration (2000-1990)



Source: Change in Migration from 2000 and 1990 censuses. Procampo subsidies from ASERCA data base . Hectares per municipality from SAGARPA data base.

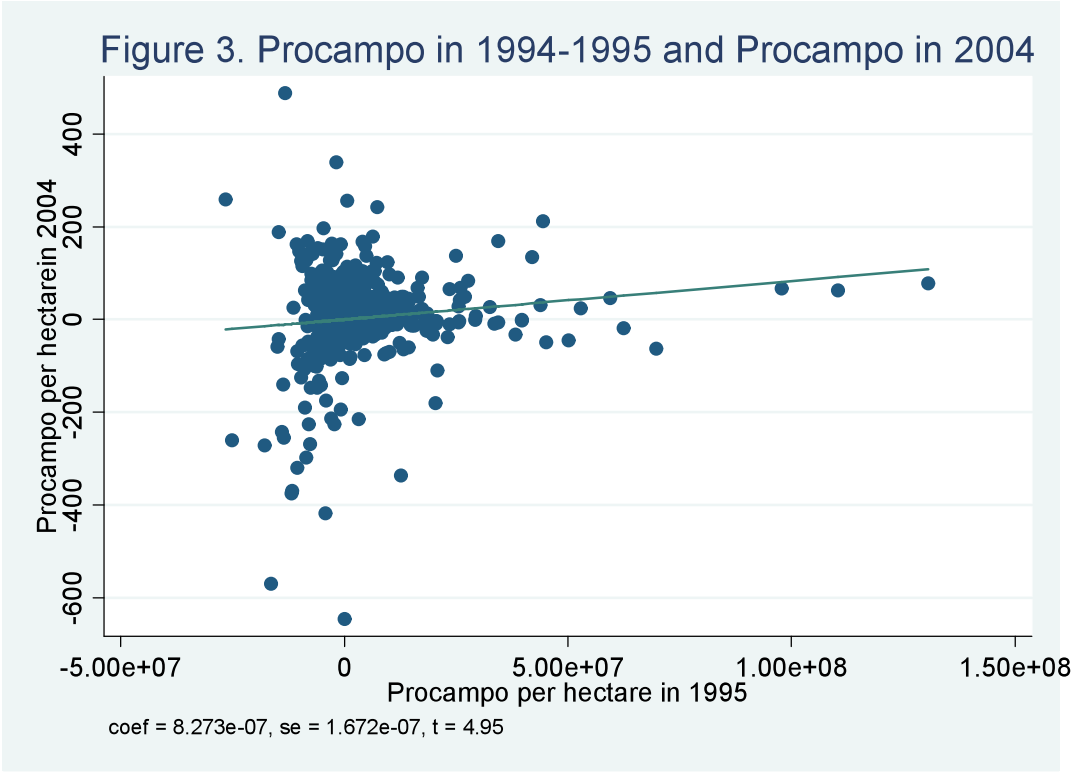


Figure 3. Procampo in 1994-1995 and Procampo in 2004
Procampo per hectarein 2004
400
200
0
-200
-400
-600
-5.00e+07
0
5.00e+07
1.00e+08
1.50e+08
Procampo per hectare in 1995
coef = 8.273e-07, se = 1.672e-07, t = 4.95

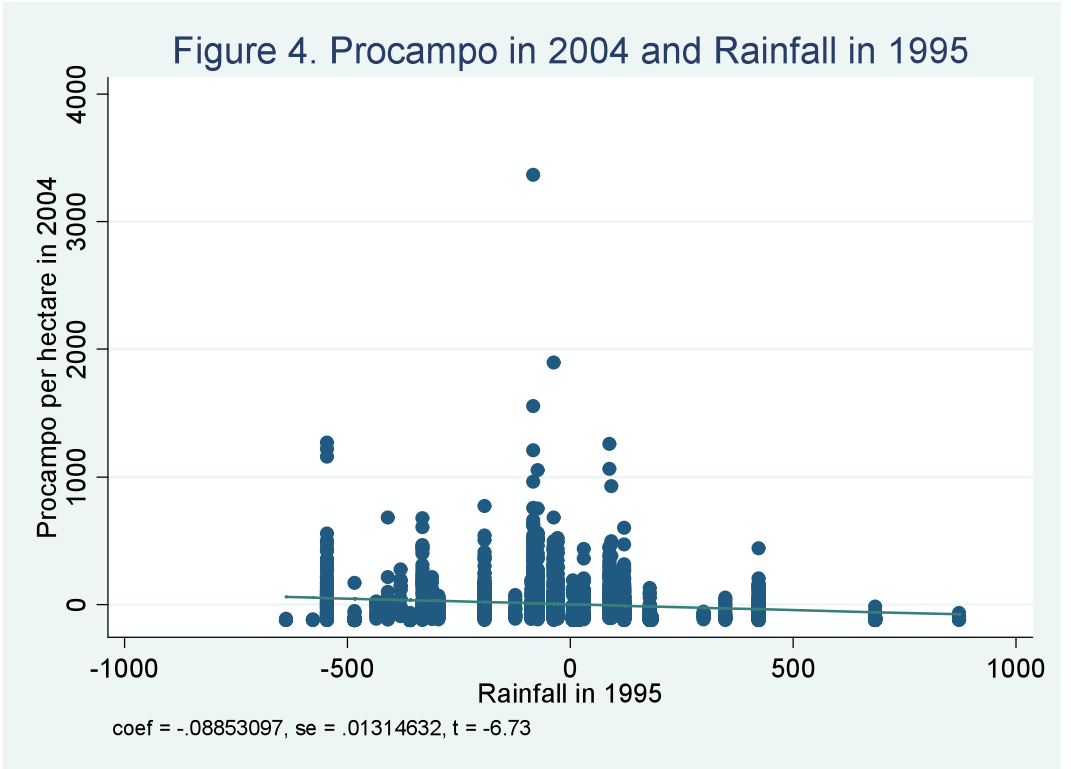
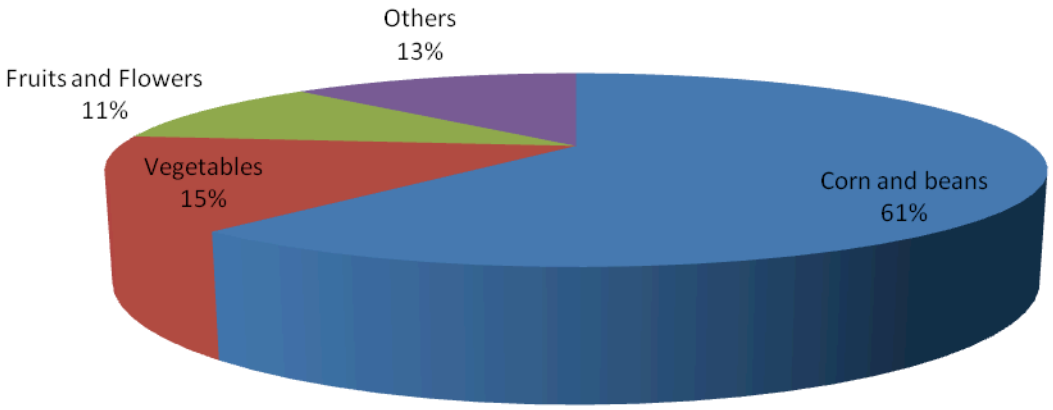


Figure 4. Procampo in 2004 and Rainfall in 1995
Procampo per hectare in 2004
4000
3000
2000
1000
0
-1000
-500
0
500
1000
Rainfall in 1995
coef = -.08853097, se = .01314632, t = -6.73

Figure 5. Distribution of Jobs in Agricultural Sector, Mexico . First Quarter of 2005 to Second Quarter of 2006



Source: ENOE 2005-2006

[i] We will present the results of the tests performed in the results section later on the paper.