Conversion from Staple to Cash Crop Production in Mexico After NAFTA: Effects of PROCAMPO and Credit Constraints

Joanne Henderson
Department of Agricultural and Consumer Economics
University of Illinois at Urbana-Champaign
henders6@illinois.edu

Kathy Baylis
Department of Agricultural and Consumer Economics
University of Illinois at Urbana-Champaign
baylis@illinois.edu

Jason Barton
Land and Food Systems
University of British Columbia
jasonjbarton@mac.com

Selected Paper prepared for presentation at the Agricultural & Applied Economics Association 2010 AAEA, CAES, & WAEA Joint Annual Meeting, Denver, Colorado, July 25-27, 2010

ABSTRACT

In this paper, we ask whether PROCAMPO helped Mexican agricultural producers benefit from NAFTA. Specifically, we explore the effect of these decoupled income payments (PROCAMPO) on producers' ability to switch to cash crop production, and whether these payments help alleviate credit constraints for poorer producers. Given that WTO negotiations are currently stalled in part because of the trade concerns of developing nations, exploring the constraints that small producers face and whether decoupled subsidies can assist those producers in benefiting from new markets is important.

Unlike previous studies, who concentrated on specific regions and *ejidal* lands, we use nation-wide county-level data, which allows for us to see the regional distribution of change across Mexico. We use these data to estimate the change in staple crop production as a function of county-level characteristics. We find some evidence to support the hypothesis that an increase in PROCAMPO payments leads to a decrease in the area planted in staples. Second, the implementation of NAFTA is associated with greater cash crop production and we can see that the creation of new markets is, in general, leading to a reduction in land planted in staples. Third, we find that the effect of PROCAMPO is even larger for ejido producers, implying that their benefits are not constrained to larger producers. Last, we find evidence that areas closest to the United States border have seen a greater movement to cash crop production after NAFTA.

The authors would like to thank Rafael Garduño-Rivera, Pablo Alvarez, and Marybel de Soto for their extensive assistance in collecting the data used for this study.

Keywords: NAFTA, PROCAMPO, Credit Constraint, Mexico, staple production, crop choice

1. INTRODUCTION

The effect of the North American Free Trade Agreement (NAFTA) on Mexican agriculture has been debated extensively over the past fifteen years. While trade advocates note that Mexican farmers have dramatically increased the value of their agricultural exports to the United States and Canada, anti-globalization activists argue that NAFTA has harmed small-scale and subsistence producers in Mexico, forcing them to compete against subsidized imports. In this paper, we examine which farmers in Mexico have benefited from NAFTA by being able to switch from traditional staples to the production of higher-value cash crops. Specifically, we ask whether the decoupled income payments under PROCAMPO have helped producers move to cash crops by alleviating credit constraints. Due to World Trade Organization (WTO) regulations, many developing countries have and may continue to move to agricultural support systems similar to PROCAMPO. Therefore understanding whether this decoupled income payment program can help agricultural producers overcome credit constraints and make the transition to cash crops may have important implications for policy development in developing countries worldwide.

In 1995, the WTO's Uruguay Round Agreement on Agriculture[1] went into effect. As part of this agreement, the type of support that each country provided to the agricultural sector was placed into one of three "boxes." Policies that cause high trade distortion, such as commodity specific price supports, fall into the "amber box" while those that are minimally trade distorting belong in the "green box." Member countries of the WTO, such as Mexico, were therefore encouraged to reform their agricultural policy to allow their method of support to be categorized in the "green box." Decoupled income payments are approved under "green box" requirements as they reduce trade distortion by delinking the payment from the production and prices of specific agricultural commodities.

The first efforts to move towards decoupling of agricultural support were made by the United States and the European Union in the 1985 Farm Bill and the Common Agricultural Policy (CAP) Reform of 1992, respectively. The United States and European Union's agricultural markets are much more highly developed than that of Mexico so when Mexico implemented a decoupled income payment system, PROCAMPO, in 1993 it was significant. Mexico's program is an example of how moving to decoupled income payments in agriculture can affect farmers in a less developed country. In particular, by examining this program we can see how the poorest agricultural regions in

[1] This round of agreements took place under the General Agreement on Tariffs and Trade (GATT) organization. As an outcome of the Uruguay Round of agreements, the GATT organization became the WTO in 1995.

a developing country are affected by this form of decoupled payment. This examination may provide details that assist other less developed countries in establishing similar programs, as international trade agreements further compel them in the coming years.

There have been many studies that analyze the effects of instituting a decoupled income payment system. The majority of these focus on the agricultural markets of the United States and the European Union. One study found that these payments can effect production depending on a producer's degree of credit constraint (Girante 2008). However, an additional study shows that at an aggregate level decoupled income payments have not led to an increase in on-farm investment (Burfisher 2003). In developed countries, such as the United States and European Union, these payments also tend to be capitalized into land values and rents, which means that producers income actually increases very little (Ciaian 2008). We find fewer studies that look directly at the effect of the transition to decoupled income payment on less developed countries.

In addition, studies have specifically analyzed the effects of trade liberalization on exports, prices, and producer income in Mexico. However, fewer studies examine the effects of NAFTA in relation to the PROCAMPO program. The majority of these studies use data from the late 1990s, so NAFTA and the PROCAMPO program would only have been in effect for a few years. They also tend to concentrate on small regions and *ejidal* lands[2]. Studies that examine the effects of the PROCAMPO program on producers in *ejidos* found that PROCAMPO has a positive multiplier effect on income and reduces household poverty (Sadoulet 2001 and Cord 2001). However neither study specifically discusses the use of these funds as transitional support to move towards the production of cash crops.

By contrast, we use a unique county-level dataset in Mexico that includes the pre-NAFTA agricultural census and post-NAFTA county-level cropping information and government payments. Combining these data with population and economic censuses, we obtain information on population, education, infrastructure, and off-farm wages. We have also constructed measures of road distance to the United States to control for those counties with a greater change in market access due to NAFTA. This complete dataset then provides us with the ability to generate a broader view of crop changes across the entire country. Generating an econometric model using this data we are able to see the effects that trade liberalization and the movement from commodity specific price supports to decoupled income payments has had on agricultural at a regional level in Mexico.

[2] *Ejido's* are areas of land that the government had granted to a community of producers to farm, under the land distribution policy of the 1920's.

We develop several hypotheses in regards to the effects of trade liberalization and decoupled income payments on agricultural production in Mexico. First, we hypothesize that the shift from commodity specific prices supports to decoupled income payments will be associated with a conversion to cash crops. Secondly, the implementation of NAFTA will also lead producers to transition to cash crop production particularly in those regions closest to the United States border. Last, we believe that direct payments such as PROCAMPO will aid credit constrained producers to make the often substantial investments needed to switch to cash crop production.

We feel this paper makes several contributions. First, to our knowledge, it is one of the few papers to consider the effect of PROCAMPO or other direct payments in developing countries on crop choice. Specifically, we are able to see whether the effects of PROCAMPO were restricted to wealthy regions, or whether they also afforded poorer producers agricultural opportunities. Second, we use a unique county-level data set to explore the regional effects of NAFTA on Mexican agricultural production choices. Last, we consider the effect of PROCAMPO on credit.

First, a background of Mexico's agricultural policy will be described. This will include programs and policies that were in place prior to the signing of NAFTA and those that were created to garner the benefits from trade liberalization. Then an evaluation of studies that have been conducted on these policies will be provided. Next, we present our conceptual model, which is based on agricultural household theory. This section will include a discussion detailing how our variables fit into the agricultural household construct. Then our data and empirical model will be described and results will be provided. Finally, conclusions, future extensions and applications will be discussed.

2. BACKGROUND

The Mexican government implemented several policy changes affecting agriculture prior to signing NAFTA in 1994 and several more throughout the implementation phase of the trade agreement. The hope was that these policy changes would help agricultural producers assimilate to the increased competition from the United States and Canada and allow them to benefit from the new markets made available by NAFTA. A timeline of trade liberalization events and agricultural policies discussed can be found in Table A-1 of the Appendix.

To benefit from trade, producers need access to credit to make changes in crop choice in response to changes in relative prices. The expectation was that if agricultural producers could produce higher value crops for the export market, their incomes would increase. We have seen

evidence of this effect as Mexico's trade in agricultural products with the United States and Canada has steadily grown in the past fifteen years. According to the U.S. Department of Agriculture (USDA), Mexico's average total exports to the United States in the period between 1991 and 1993 were $2.5 billion U.S. dollars. By 2006-08 the average amount of exports to the United States was $10.2 billion U.S. dollars, which is a 299% increase from the period before NAFTA was implemented (Zahniser 2009, 47). The full effect of these changes on individual agricultural producers, specifically the rural poor, is more difficult to determine.

The question remains as to whom in Mexico benefited from this trade. The World Bank reported that in 2002, 20.3% of the Mexican population was living below the national poverty line. Poverty is even greater in rural areas where 34.8% percent of the population live below the national poverty line (World Bank 2008, 17). Also the Gini Coefficient, as measured over the past fifteen years, shows that income disparity in Mexico has decreased very little since NAFTA (World Bank 2009). The Gini Coefficient measures income distribution and shows that the income disparity between rich and poor has diminished slightly but still remains relatively high as compared to the other OECD countries. Not all regions within Mexico have benefited equally, as evidence shows that the northern and central states have received the majority of the benefits from trade. For example between 1999 and 2003 Mexico's southern states only received one percent of the FDI that came into the country (Randall 2006, 111). In addition, studies have shown that trade has primarily increased wages in the north Mexico (Robertson 2000 and Chiquiar 2008) and that the south has seen very little benefit from trade (Esquivel, 2005).

Prior to the early 1990s, Mexico's agricultural sector was heavily supported by the government. CONASUPO (the National Company of Popular Subsistence) was the governmental agency that provided price supports, bought and distributed commodities, and provided inputs and credit from the mid-1960s through the mid-1990s. Credit was provided to small scale agricultural producers through *Banrural*. *Banrural* waived collateral requirements and had low penalties for default, so even producers that owned small areas of land or who were part of an *ejido*, had access to credit.

In the early to mid-1990s several changes to the agricultural structure of Mexico were implemented. First, Article 27 was enacted in 1992 which granted the right for *ejido* lands to be titled, bought and sold. Prior to this law *ejidatarios* did not own the land and therefore were unable to use it for collateral to obtain loans from privately owned banks. As noted above, the Mexican government did however provide price supports, technical assistance, and credit through *Banrural* which did

compensate somewhat for the lack of credit from private sources. With Article 27, land rights were granted so that that land could now be used for loan collateral or be sold.

Second, state owned banks were privatized in the early 1990s which was of critical importance to agricultural producers. The belief was that when privatization occurred, the private banks would provide the necessary loans to the agricultural producers, both small and large. This surge in private lending did not occur as currently agriculture accounts for a very small part of bank lending (only 4.5 percent in 2001), and practically no commercial bank lending goes to small farmers (Income 2005, 235). *Banrural* was eventually dissolved in 2003 and replaced by the *Financiera Rural*, whose main purpose is to make loans to agricultural producers. As of 2009, *Financiera Rural* has granted over five hundred thousand rural loans, totaling over seven billion U.S. dollars (Financiera Rural 2009). It is not known whether these loans have included the poorest producers. However, it is known that access to credit is an important factor in lifting rural agricultural producers out of poverty, especially after the removal of price supports, technical assistance, and government provided fertilizers and pesticides. Without access to credit the majority of the poor, subsistence agricultural producers will be unable to purchase these inputs that can help them modernize and increase their yields per hectare. They will also be unable to make the capital investment necessary to transition to cash crop production and fully realize the benefits from trade.

The Mexican government established several programs to address the issues that agriculture producers would face with increased competition from the United States and Canada. These programs tend to concentrate on providing agricultural producers transitional assistance so that they can benefit from trade. Among these programs were the Target Income/Market Support Programs, *Alianza por el Campo* (the Alliance for the Countryside) and PROCAMPO (the Program of Direct Support for the Countryside). The Target Income/Market Support Program's purpose is to strengthen agricultural trade by building markets between producers and buyers. The program's objectives include distributing marketing information to agricultural producers in order to increase exports. The majority of this support is specifically for medium to large producers who are exporting grains and oilseeds. There has also been disparity in where the support has gone as four states in northern and central Mexico received over 80% of these funds (Income 2005, 252). Therefore we find little evidence that this program helped small-scale farmers.

Alianza por el Campo (*Alianza*) is a governmental program that was designed to assist in increasing agricultural and rural infrastructure. Specifically rural Mexican agricultural producers tend to have low yields and low rates of technological adoption. The main objectives of *Alianza* are to

increase rural agricultural producers' incomes, to create food security, and improve the balance of trade. *Alianza* has four main programs: agricultural improvement, livestock improvement, rural development, and sanitation (Suvedi 2000, 4-5). By providing funds for these infrastructure improvements farmers should more easily make the transition to cash crops production and increase exports. However, one evaluation of *Alianza* showed that *ejidatario* participation in *Alianza* had "no significant impact on the household's poverty" (Cord 2001, 2). This may imply that only the middle and large producers reap the benefits of this program.

The Program of Direct Support for the Countryside (PROCAMPO) was specifically created to address the effects that NAFTA would have on Mexican agricultural producers. Among these concerns were that foreign competition as well as structural changes in Mexican agricultural policy would lead to an increase in poverty in rural farming communities, from the loss of import subsidies, price supports, and import protection. The PROCAMPO program represented a shift from price-based supports to direct income subsidies to producers. Initiating a cash transfer program allows the government to assist the producers without distorting the market price for the various crops. It also tends to have lower administrative costs.

Producers of any of nine crops would receive payments based on the number of hectares seeded for the three crop-cycle years preceding the August 1993 reforms. These crops included barley, beans, maize, cotton, rice, sorghum, soy, sunflower and wheat. The payments are made per hectare farmed each crop season and are not tied to production after 1993. This allows for farmers to change which crops they produce, such as a movement towards fruits and vegetables, while continuing to receive the payments. They also are allowed to transfer land use to farm livestock, forestry, or any ecological project and still continue to receive payments.

It is also important to note that only farmers who could prove that they had farmed one of the nine crops prior to 1993 will receive transfers, therefore new producers cannot benefit from this program. To give a better idea of the size of this program, in 2003 approximately 2.8 million farmers received PROCAMPO payments for 13.7 million hectares of land. Since acreage enrolled in this program was fixed in 1993, these numbers have changed very little over the last decade. Producers must apply for payments each agricultural year and are asked to provide proof of planting, however there is very little monitoring to see if the land actually is under cultivation. Applications and payments are obtained from the Center for the Assistance of Rural Development (CADER) offices and payments are received after planting.

The way in which PROCAMPO payments have been distributed has been altered over the life of the program in response to producer's needs as well as administrative costs. Under the "traditional PROCAMPO" program, all producers that farm over five hectares must send applications to the CADER offices after sowing as was mentioned above. The "anticipated PROCAMPO" program was instituted in 2001. This program allows for producers who plant less than five hectares to receive payment prior to planting. According to OECD studies, over one third of the land and three quarters of the producers now receive their payments through this program (OECD 2007, 104). Receiving these payments before the start of the agricultural season provides producers the funds to purchase inputs prior to planting, which is especially important to small producers who may not have access to traditional credit. Lastly, there is "capitalized PROCAMPO" which was introduced in 2002. This method of payment allows producers to use all future PROCAMPO payments (through the life of the program) as collateral. However, this is a more technical process as producers must submit their proposed project for capital improvement to both the CADER offices and credit institutions. As of 2006 approximately twenty percent of PROCAMPO beneficiaries were participating in the "capitalized PROCAMPO" program (Winters 2007, 620-621).

One criticism of PROCAMPO was that the payments may primarily benefit large producers, who would have been able to transition to cash crops without the extra financial help. Approximately ninety percent of producers receiving PROCAMPO payments cultivated less than five hectares, yet they only receive about half of the amount of the total payments (Cord 2001, 4). However, an interesting element of this program is that small producers may benefit relatively more from the program since the payment is made per hectare farmed and is not based on actual yield and therefore they can be technically inefficient and still receive the same payment as someone who has improved seed, fertilizers, pesticides, and equipment. One additional note regarding PROCAMPO is that under this system more subsistence farmers receive financial benefits. Under the previous system of price supports, CONASUPO, most of the rural poor did not benefit from the price supports as they did not produce enough to sell. The PROCAMPO program is then seen as having a positive effect on raising agricultural producers' incomes and reducing rural poverty.

One purpose of PROCAMPO, as a government sponsored cash transfer program, is to provide supplemental income to the producers. These cash transfers can also have indirect effects if the payments are invested into productivity improving resources. Since PROCAMPO payments are made regardless of yield, farmers can depend on them and therefore may be willing to use payments

to invest in improvements. For example, a farmer who wants to purchase a piece of farm equipment may be more likely to do so because he can depend on the incoming PROCAMPO payments to help him to pay off the loan on the equipment. Therefore the poor are more likely to make riskier decisions based on knowledge of incoming funds (Cord 2001, 10). They may also be more willing to make the capital investment necessary to transition from producing only staple crops, to the production of cash crops.

PROCAMPO was initially set-up to span the 15-year transitional period established by NAFTA and would therefore be discontinued in December 2008. The funding was scheduled to slowly decline over this 15-year period. This period was to give Mexican farmers time to modify land use and adopt new technologies. In 2007, President Calderon announced that he would extend the PROCAMPO program for an additional four years. Therefore it is currently set to be dismantled in 2012. Due to heavy dependence on these subsidies by the rural poor it would be difficult to completely eliminate the program, and a new type of agricultural assistance program may be necessary.

3. CONCEPTUAL MODEL

To consider the forces that affect crop choice, we use the agricultural household model. The agricultural household model has been used extensively in the past twenty years for examining the effects of policy changes on agricultural households in developing countries. The original model developed by Singh, Squire, and Strauss (1986) brought to light the main difficulty in studying agricultural households; these households are both consumers and producers. Therefore consumer and producer theory must be combined to create a model that truly reflects decision making in a dynamic agricultural household.

Several studies use the agricultural household model to examine policies that affect rural households in Mexico. Key, Sadoulet, and de Janvry (2000) use an agricultural-household model to determine the effect of transaction costs on production choices made by rural households in Mexico. For example, the assumption of perfect markets can alter results significantly as many agricultural producers in Mexico face imperfect markets where transaction costs are often extremely high. Taylor, Dyer, and Yunez-Naude (2005) create a disaggregated rural economy-wide model using data from west-central Mexico, to show that lower maize prices have negative income effects on both large and small scale producers.

In the basic agricultural household model, households chose the level of land (l) and capital (k) to invest in the production of staples (q_s) and cash crops (q_c). We assume these choices are made to maximize utility from consumption of staple crops and all other goods purchased in the market, c_s and c_o, respectively. We use c_o as our numeraire good, with price p_o=1. The model is based on the period of one agricultural year, with the agricultural year starting just prior to planting. Therefore the utility function for our household model is:

$$Maximize\ U(c_s, c_o)$$

$$subject\ to:$$

$$[(p_s - r)q_s^m + (p_c - r)q_c] + w_{t-1} + g - k_s - k_c - c_o\ = w_t$$

$$q_s = f(l_s, k_s)$$

$$q_c = j(l_c, k_c)$$

$$l_s + l_c \leq l$$

$$q_s^m + c_s \leq q_s$$

If credit constrained the following must also be true:

$$g + w_{t-1} - k_s - k_c \geq 0$$

Income from agricultural production consists of the price they receive for their agricultural goods sold minus the transaction costs (r) to get the product to market times the quantity sold in the marketplace. Second, any wealth endowment (w_{t-1}), which we will define as cash carried over from the previous agricultural cycle, and government payments (g), including PROCAMPO, PROGRESA, and other market support programs, are added to this amount. Lastly, the cost of capital and the price of consumption goods times the quantity of goods consumed are subtracted from the household's income. We assume that not all incoming money is spent but that some is saved to be used in the next agricultural cycle (w_t).

We assume each farm produces only two goods, staple crops and cash crops. Production of each good is a function of land (l) and capital (k), where it is assumed that the capital and input requirements for the production of cash crops is greater than that for staples[3]. In addition, we include two inequality constraints. First, the land planted in staples plus the land planted in cash

[3] Since we do not have access to data on farm labor it is not included in our production function. We assume all labor is on-farm labor which also negates the need for a labor time constraint.

crops must be less than or equal to the total available agricultural land. Second, the quantity of staples sent to the market and the quantity of staples consumed by the household must be less than or equal to the total production of staples. Capital investment for producing cash crops is higher than that for producing staples and cash crops are being produced primarily for the market and therefore are not being consumed by the household. If we assume that the producers are credit constrained, then the last constraint must be true, which states that current government payments plus wealth minus the investment in capital for staple and cash crops must be greater than or equal to zero.

As discussed above, several factors might affect the crop choices made by agricultural producers in Mexico after NAFTA went into effect and price supports were eliminated. We believe that the following variables help to explain why the choice was made to move from staple crop production to cash crop production. However, we are constrained by the data available from the Mexican government which will be discussed further in the data section.

Our main dependent variable is the percent of agricultural land planted in staples.[4] We chose this as our dependent variable as one of the purposes of PROCAMPO payments is to assist producers in moving out of staple crop production towards the production of crops with a higher market value. We define staples as the nine crops that were eligible to receive PROCAMPO payments. We propose that the agricultural household model will show that the change in the percent of land in cash crops as a percent of the change in government payments will be greater than zero ($\partial \frac{l_{ci}}{l_i} / \partial g_i > 0$). This supports our hypothesis that PROCAMPO payments will assist people in moving from staple crop production to cash crop production.

Our independent variables include those that represent local market demand, transportation costs, transition costs, and the effects of governmental policies. Our market demand variables are total population in thousands and wages per worker.[5] The wages per worker variable only includes wages from manufacturing, wholesale/retail, and services sectors. It does not contain information on agricultural wages which allows us to refer to it as off-farm wages. This measure of income provides us with an idea of the market demand for cash crops, as Bennet's Law states that as incomes increase the per capita consumption of starchy staple crops will fall. Therefore an increase

[4] This variable was created by dividing the area planted in staples by the total area planted of all crops.
[5] The log of both these variables has been taken because of their initial skewed distribution.

in demand for cash crops should cause the price of cash crops (p_c) to increase, which will provide additional incentives for producers to switch to cash crop production.

The distance to the United States border along with local infrastructure may affect the transaction costs associated with participating in the market opportunities created by NAFTA. The distance variable is the road distance, in thousands of kilometers, from each county seat to the closest United States border crossing point.[6] We would expect that as distance from the border increases transaction costs (r) also increase. Therefore those producers further from the border will be more likely to stay in staple crop production, as the transportation costs to send cash crops to the market are too high. Conversely, this would mean that those areas closest to the border would have lower transaction costs and would therefore produce fewer staples after NAFTA.

The infrastructure variable is an index of two infrastructure variables: percent of households with drainage and percent of households with sanitation.[7] This variable provides us with a proxy for households that are linked to sewage systems. Since sewage is much more common in developed urban areas this allows us to pull out details on how remoteness from markets may affect crop choice. We would expect that an increase in infrastructure would be associated with lower transaction costs (r) as the producers may be close to a market.

The variable that we use to capture transition costs from staple to cash crops is the percent of individuals in a county that have a high school education. We believe that those who are literate and have at least a high school education are better able to make the transition to cash crops. Producers with higher levels of education tend to have greater access to market information and may be more likely to fill out applications for credit and funding from various government programs. Since these are often complicated documents, without literacy and education it would be very difficult to receive benefits from these institutions. The high school education variable shows the percent of people in a county that have received a high school degree. Based on this discussion we would expect that as education levels increase the transition costs related to switching to cash crop production (k_c) will decrease.

There are three variables that capture government policies, including PROCAMPO, PROGRESA[8], and other government payments. We ask whether or not these programs are alleviating the credit constraint of producers, which then enables them to make the transition from

[6] This variable was created by Rafael Garduño-Rivera. Please reference Garduño-Rivera (2009) page 18 for more details.
[7] These variables were created by Rafael Garduño-Rivera. Please reference Garduño-Rivera (2009) pages 18-19 for more details.
[8] Program for Education, Health and Nutrition

staple to cash crop production. The PROCAMPO payment per producer variable was created by dividing the total amount paid to a county by the number of producers that received the payments. This gives us a proxy for the liquidity constraint of producers. PROGRESA is a social welfare program that provides conditional cash transfers for education, nutrition and health. This program is targeted specifically at poor rural communities and many households that receive PROCAMPO payments may also receive PROGRESA payments. The PROGRESA payment per person variable was generated by dividing the total amount of payments to a county by the population of the county.[9] Our total other government payments variable is total government payments made to agriculture divided by the number of farms in 1991. Total government payments include both federal and state funds distributed to programs for the improvement of the agricultural sector and rural communities. These programs include irrigation, infrastructure development, technical improvements, research and transfer, livestock development, health and food safety, and marketing support.[10] Our expectation is that all these payments would increase producer's incomes through g, which would in turn reduce their credit constraint and allow them to transition to cash crop production. Therefore we would expect these programs to allow for producers to move out of staple crop production.

We also created a dummy variable to represent NAFTA, where years prior to the implementation of NAFTA are zero and those years after NAFTA are one. Additionally interaction term between NAFTA and distance to the border, total population in thousands, and wages per worker were created. Creating these interaction terms allows me to isolate the effects of certain variables after NAFTA. For, example we expect the distance to the United States border to have a greater effect on staple crop production after NAFTA than before NAFTA. Those who are closer to the United States border should face lower transportation and transaction costs related to sending their crops to the United States and Canada, and therefore should be better able to transition out of staple crop production.

[9] The PROGRESA data does not contain total number of beneficiaries of payments per county and that is why total population was used.

[10] Since we did not have information on how many producers received these payments we normalized the data using the number of farms in each county in 1991. We also divided the total government payments by the number of producers who received PROPCAMPO payments. However, we feel that normalizing by the total number of farms in 1991 gives a better estimation, as not all agricultural producers receive PROCAMPO payments and we do not have access to data on the total number of farms in 2001 or 2003.Using the PROCAMPO producers as the divisor would therefore cause an overstatement of benefits to PROCAMPO producers.

4. DATA AND ECONOMETRIC MODELS

4.1. Data

The majority of the data used in this study was obtained from Mexico's National Institute of Statistics, Geography and Information (INGEGI). The infrastructure and economic data were obtained from *Sistema Municipal de Base de Datos* (SIMBAD) and come from the economic censuses of 1989, 1999, and 2004 and the general population censuses of 1990, 2000, and 2005.[11] The agricultural data comes from the 1991 agricultural census and the annual agricultural yearbooks for the following agricultural years, 2000/2001 and 2002/2003. The PROCAMPO data and information on credit and other government payments was also obtained from the annual agricultural yearbooks for agricultural years 2000/2001 and 2002/2003. The PROGRESA/ *Oportunidades* data is the only data not provided by INEGI. It is available directly through the *Oportunidades* website for 2002 and 2003. Our final dataset contains information related to wealth, general agricultural production, producer characteristics, and program participation for a year prior to NAFTA and for two years after NAFTA was implemented.[12] All our variables are further described in Table A-2.[13]

The crop and PROCAMPO data from the annual agricultural yearbooks was very disjointed as each state did not report the exact same variable. Because of this issue our dataset includes only those variables for which data was reported for the majority of states. In addition, agricultural data for several states is only reported at the district level, which is a group of counties.[14] Since the size (in square kilometers) for counties and districts varies widely, we weight the results by the agricultural area in each county and district.[15] Additionally, the information on credit and other government payments to agriculture is only reported at the state level. The information for other government payments is distributed to the county and district level based on agricultural hectares in each county or district. The information on credit will only be evaluated at the state level and all other variables will be summed up to the state level for our credit model.

---

[11] This cleaned data file was obtained from Rafael Garduño-Rivera, for further details please reference, Baylis, Garduño-Rivera, Piras (2009), pp. 16.

[12] Please note that all payment data reported in pesos has been discounted by the 2003 Consumer Price Index.

[13] To formulate three complete years we had to move years of data slightly; however we do not believe this change significantly alters any results. For example, the PROCAMPO, government payment and credit data for agricultural year 2000/2001 was mapped to 2001, and 2002/2003 was mapped to 2003.

[14] Therefore eleven states, Baja California Norte, Coahuila, Distrito Federal, Guanajuato, Guerrero, Edo Mexico, Nuevo Leon, Oaxaca, Sinaloa, Sonora, and Tlaxcala will have all results reported at the district level.

[15] Our agricultural base variable is used as the weight and was generated from the 1991 total agricultural hectares and the 2001 and 2003 agricultural area in hectares that received PROCAMPO payments. The greatest agricultural area was then drawn from each county to form the agricultural base variable.

To better visualize the spatial distribution of our data across the whole country, we generated maps of all of the key variables. Please reference Figures 1-6. These were created by joining our data to a spatial file of all the counties in ESRI's ArcGIS. For the majority of our variables we created side by side maps, in which the data for 1991, is on the left-hand side and the data for 2003 will be on the right-hand side. There are a few figures that are worth discussing in some detail. Figure 1 is our dependent variable, the percent of agricultural land planted in staples. Simply based on this projection of raw data one can see that there are several regions in northern Mexico that produce less staples as a percentage of all crops than they did in 1991. Thus, some areas have reduced the amount of staple crops they produce since NAFTA. Figure 4 shows the percent of people within a county that have a high school education. We can see that education levels have risen over time and the counties that now have the highest percentage of high school educated people tend to be in the north-east and along the north-western coast.

Our PROCAMPO variable and PROGRESA variable can be seen in Figure 5. Since these programs were instituted after NAFTA, we only have data for 2001 and 2003. We have projected the data for 2003 for both variables. Since we know that each hectare receives the same payment, the PROCAMPO payment per producer shows the farm size distribution across the country. We can see that many of the larger producers are in northern and central Mexico. We also map the PROGRESA payments per person. Since this program was targeted specifically at the rural poor, this map depicts the actual spatial distribution of the rural poor, who tend to be concentrated in central and southern Mexico. For additional details please also reference Table A-3 for summary statistics of our main variables.

Since our data is at the county level, we assume that agricultural households within a county are relatively homogenous. To support our assumption we use individual census data from 1990 that comprises 10% of the population of Mexico. From this data we obtain the means and standard deviations both within and between counties. Please refer to Table A-4 in the Appendix for the results. We examine wages and education for those working in agriculture and who own agricultural land. The average of the variation of wages within a county is 1,095,499, whereas the national variance of county averages is 2,124,893. Like the latter number, our data is comprised of county-level means, which appear to have greater variation than within county data. The education variable supports the same conclusion, as the average variance within a county is 0.6909 while the variance of county averages is larger at 0.7444.

Additionally, we have access to geographic information such as elevation and climate. Since we know that elevations and climates affect crop choice it follows that those producers within a county will face similar physical constraints. This provides further evidence that municipalities are fairly homogenous. Agriculture in mountainous or arid areas is constrained by certain factors. Therefore, if the elevation and climate is similar for all producers within a county they will tend to produce a set of similar crops. Producers within a county will also face similar water resources which will directly affect which crops they are able to grow.

4.2. Model 1: Percent of Agricultural Land in Staple Production

Our first proposal is to examine the percent change in agricultural land used for the production of staple crops as a function of local market demand, transportation cost, transition cost, and government policies.

$$\%\ land\ in\ staples = f(local\ market\ demand, transportation\ cost, transition\ cost, policies)$$

1) $local\ market\ demand = local\ population, local\ wages$
2) $transportation\ cost = distance\ to\ U.S.\ border$
3) $transition\ cost = education$
4) $policies = Procampo\ payments, Progresa\ payments, other\ government\ payments$

4.2.1. Initial Regression Results

Initially we ran five econometric models using the basic equation described above. These include 1) ordinary least squares (OLS), 2) fixed effects (FE), 3) fixed effects weighted by total agricultural land (weighted FE), 4) random effects (RE) and 5) random effects weighted by total agricultural land (weighted RE).[16] The results are detailed in Table 1. As a brief overview of the results; population, government payments, and distance to the border are positive in all models and wages, high school and the infrastructure index are negative in all models. The only two variables that change signs across models are PROCAMPO and PROGRESA; reasons for this will be discussed in detail later in this analysis.

We know that an OLS model will not be the most appropriate since our data is panel data, a cross-sectional dataset of information on the same counties over time. However it is beneficial to look at the results generated from the OLS model. Population, PROCAMPO, government payments, and distance to the US border are all positive, however government payments is not significant at the 5% level. The population variable is significant and shows that for a 1% change in

[16] We conducted the Breusch-Pagan / Cook-Weisberg test for heteroskedasticity. With the result being chi2(1) = 33.23 and Prob > chi2 =0.0000. Since heteroskedasticity is present we will use robust standard errors for all models.

the population there is 7% increase in staple crop production. The wages per worker and high school education variables are both negative, as we would expect them to be. For a 1% increase in wages per worker there is a 4% decrease in staple crop production. Our two variables that we are using to proxy for market demand, population and wages, are in effect offsetting each other as one is positive and one is negative.

The fixed effects (FE) model allows for the intercepts to vary across individuals, therefore an individual intercept for each county will be calculated. In doing this it strips out the entire cross sectional effects and leaves us only with variance over time. In our FE model, population, PROGRESA payments, government payments, and distance to the border[17] are all positive. This model has population playing a greater role than the OLS model, in that a 1% increase in the population leads to a 32% increase in staple production. Wages per worker, high school education, and PROCAMPO payments are all negative. It is interesting that in the OLS model PROCAMPO had a positive sign but in the FE model the sign switches to negative. Therefore for a 1% increase in PROCAMPO payments there is a 7.5% decrease in the area planted in staples. A negative sign is what we hoped to see on the PROCAMPO variable as it was a program that was targeted at reducing credit constraint and assisting producers in moving out of staple crop production.

The random effects (RE) model also allows for different intercepts but instead of calculating them separately like the FE model does, it estimates a variance of the intercepts. The RE model allows cross-sectional variation to influence the estimates of the coefficients. Therefore the RE model enables us to see effects both over time and between counties. We also use this model as we believe that there are differences across counties that have some influence on crop choice. Just like in the OLS and FE models, population and distance to the border are positive, and wages and high school education are negative. PROCAMPO is negative in this model, so for a 1% increase in PROCAMPO payments there is a 2.7% reduction in area planted in staples. PROGRESA payments and government payments are not statistically significant in this model.

Results from two other models, weighted FE and weighted RE are also reported. We know that we need to weight the regression by total agricultural surface area as the counties and districts are of varying size. For example, the largest district has 3.7 million hectares of agricultural land (district in Coahuila) and the smallest county has only 1 hectare (district in Distrito Federal, which is Mexico City.) By creating a weighted version of both the FE and RE models, counties and district

[17] Our distance to the US border variable is time-invariant. Therefore it is dropped by the fixed effects regression and absorbed by the intercept. The Fixed Effects Vector Decomposition (FEVD) model created by Plümper and Troeger was used to obtain the coefficient distance to the US border. (Plümper 2007)

that are larger in land area will count more in the regression, a feature necessary for obtaining accurate results. We will discuss the weighted models in more detail in the next section.

4.2.2. Main Model Results

Next, we take the model constructed above but add in a NAFTA variable, which is our dummy variable where years after 1994 equal 1. We also constructed three interactions with NAFTA. Specifically, we interact NAFTA with our population, wages per worker, and distance to the border variables. This will allow us to determine if the effects of these variables on staple crop production changes after NAFTA. We then ran both weighted FE and weighted RE models. These results can be seen in Table 2.[18]

We will examine the weighted FE in comparison to the weighted RE model with our dependent variable being the percent of agricultural land in staples. These two regressions are what we refer to as our main model in later discussions. For the FE model all our variables are statistically significant at the 5% level except for the NAFTA dummy and the NAFTA×population interaction term. We are not concerned with the NAFTA dummy being insignificant as some of the significance of this variable is going to the NAFTA interaction terms. For the RE model all of our variables are statistically significant at the 5% level.

First, we will discuss our main variable of interest, PROCAMPO payments. The PROCAMPO variable tells an interesting story in that in the FE model it is negative and in the RE model it is positive. In the FE model a 1% change in PROCAMPO payments leads to a 5.3% decrease in land planted in staple crops. This result makes intuitive sense as the FE is only taking in the time effects, and the purpose of PROCAMPO is to provide assistance to switch from staple crop production to cash crop production for export. In the RE model, since the counties are also being compared to one another, a 1% higher PROCAMPO payment in one county means that the county also has 3% more land planted in staples. Since PROCAMPO was a program that only goes to producers who were planting staples in 1993/1994, it makes sense that those municipalities which receive PROCAMPO payments would have a higher percentage of crops in staples. Thus, we believe that the RE model is largely picking up the placement of the PROCAMPO program.

[18] Throughout this analysis we examine both fixed effects and random effects models. The results of the Hausman test and an additional test of the averages concludes that the RE model is not capturing everything and therefore the FE model is the more precise model.

The PROGRESA payments per person and other government payments per farm coefficients are positive in both models. Our initial speculation was that these payments would increase the amount of cash crops by decreasing the credit constraints faced by producers. However, in the FE model, one percent increase in PROGRESA payment increases the percentage of land in staple crops by 52% and the RE model reports an increase of 23%. The positive effect of PROGRESA may be due to the fact that it is a program that is specifically targeted at the poorest rural communities in Mexico. Therefore it is going to areas that traditionally would have a higher proportion of subsistence farmers and would be more likely to have a greater percentage of land planted in staple crops to start with. Receiving PROGRESA is also contingent on children attending school. This may reduce farm labor, which will decrease the amount of other crops produced. Also this program started with only a few communities receiving benefits but since 1997, it has expanded to cover a much greater portion of the population. Since the amount of payments is increasing each year the FE model may just be capturing the increase in the number of poor people participating in the program in each county.

The other government payments variable is also positive in both models with an effect of a 3.4-3.8% increase in staples for a 1% increase in other government payments. This positive effect may be due in part to the fact that price supports for some staple crops were not immediately removed in 1994, but were slowly phased out during the 15-year transition period. Two important staple crops, corn and beans, were both part of this slow phase out. These additional payments to producers of some staple crops may have induced them not to switch to cash crop production. These other payments are in some ways counteracting the effect that PROCAMPO is having, as they actually compel producers to continue producing certain staple crops.

Our variables that proxy for market demands are population and wages per worker. The population variable is positive in both models; however the magnitude is much different between the two models. In the FE model for a 1% change in population the area planted in staple crops increases by 26%, whereas in the RE model the increase is only 6%. Wages per worker is negative in both models and the magnitudes of their effect on staple crop production are also very similar. The FE model reports a 5% reduction in staple crop production and the RE model reports a 4% decrease given a 1% increase in wages. Thus, in both models it appears as if a larger population is associated with a greater demand for staples, while higher income indicates a market for cash crops.

Next we examine our variables that represent transition costs, education levels and infrastructure. Both the FE and RE models show that for a 1% increase in high school education

staple crop production decrease by 1.9%. Since education is often needed for producers to fill out credit forms and apply for government payments we would expect that an increase in education would lead to a decrease in staple crop production. Our infrastructure variable shows the percent of households within a county that have access to a sewage system. This variable is negative in both the FE and RE models. These variables taken together appear to imply that as education and infrastructure increase, then staple crop production decreases. Therefore education and infrastructure may decrease transaction costs which allows for producers to more easily transition to cash crop production.

We also added in a NAFTA dummy variable and various interactions terms. We interacted the NAFTA dummy with our population, wages, and distance variable to see if their effect changes after NAFTA. Table 2.1 details the affects of these variables before and after NAFTA. The total calculated effect of NAFTA in our FE model at the average of population, wages and distance is that after NAFTA staple crops increase by 1%, however this is not significant. The difference between the effect of population before and after NAFTA is less than 1%, so population has minimal affect on production decisions. The effect of wages after NAFTA becomes positive, but it is not statistically significant. Distance to the border has a much greater effect after NAFTA. Prior to NAFTA a 1% increase in distance led to a 1.3% increase in staple crop production. After NAFTA a 1% increase in distance leads to a 7.3% increase in staple crop production. Distance from the United States border does likely increase transaction and transportation costs which make producers in southern Mexico less likely to switch to cash crop production.

In our RE model the overall effect after NAFTA is significant. After NAFTA, at the average of our interaction variables, staple crop production decreases by 7.7%. Similar to the results of our FE model, population does not appear to have that much greater of an effect after NAFTA. Additionally wages, appear to have less of an effect after NAFTA. Taken together this once again supports the idea that producers are switching to cash crops not based on local market demand, but based on the new markets in the US and Canada. The effect of distance is actually negative before NAFTA, we believe this may be in part due to the fact that there are areas in the southern-most part of Mexico that have traditionally produced items that would be consider cash crops, such as coffee and citrus. They already produced these prior to NAFTA due to having the right climate and land quality. Other than this region, most of Mexico was producing staple crops. This explanation may help account for why areas further from the border were producing less staple crops prior to NAFTA. After NAFTA the distance coefficient does become positive and for a 1% increase in

distance from the US border there is a 4.6% increase in staple crop production. This effect is similar to that reported by the FE model.

4.2.3. Robustness Tests

To determine the robustness of our main results we ran several different versions of our model.[19] First, we ran the exact same model above except with revenue per hectare as our dependent variable. Secondly, we reduced the number of counties in our model to only include those that contain either a high percentage of *ejidal* lands or receive a high amount of PROGRESA payments. Details of these robustness tests follow.

For comparison purposes we ran weighted FE and weighted RE models with the dependent variable now being total agricultural revenue and all the independent variables remaining the same as our main model. Since the price of staples should be lower than the price of cash crops, we would expect higher revenue per hectare to be associated with less staple crops. This means that the signs on our coefficients should be opposite of what they were in the previous model. Please reference Table 3 for the results of this regression. In the FE model all variables are statistically insignificant at the 5% level except for population and high school education. Therefore analyzing this model does not yield much information. It is worth noting that the high school education variable now has a positive sign, and for a 1% increase in education there is a 167 peso increase in revenue per hectare.

The RE model provides us with more tangible results in that all variables are significant at the 5% level. The majority of the coefficients on the variables also have signs opposite to the main model. The education and infrastructure variables that were consistently negative in our main model are now positive. For a 1% increase in education there is a 103 peso increase in revenue per hectare. This shows that areas with higher revenue per hectare are associated with higher education and infrastructure.

PROCAMPO and PROGRESA payments are now negative but the coefficient on other government payments is positive. The coefficient on PROCAMPO was positive in our main FE model, as it was comparing counties, and counties that were producing more staples will tend to have higher total PROCAMPO payments. We now see that for a 1% increase in PROCAMPO payments there is a 609 peso decrease in revenue. For PROGRESA we see something similar in that

[19] We also have data on two other variables, literacy, and cities, which is a dummy variable that is equal to one if a county has a city with over 100,000 people. Neither of these variables provided much additional information therefore they are not included in the main model. The results of the models that contain these variables can be seen in Table A-5 of the Appendix. Since our dependent variable is a percentage constrained to be between 0 and 1, we also ran a Tobit model to see if there was anything that our FE and RE models were not capturing. The results changed very little but are reported in Table A-6 of the Appendix.

for a 1% increase in PROGRESA payments there is a 4,821 peso decrease in revenue per hectare. This result supports the idea that revenue per hectare is lower in places that traditionally planted staples and are defined as areas with a high concentration of rural poor. Other government payments continue to be positive and for a 1% increase in government payments there is a 399 peso increase in revenue. Since some of this government revenue is from programs such as *Alianza*, which provides technical assistance in order to increase yields and exports, or irrigation projects, it makes sense that it would have a positive effect on revenue per hectare.

Those areas that receive PROCAMPO and PROGRESA payments are not random, but specifically targeted based on certain characteristics. PROCAMPO is only received by those who were producing staple crops just prior to 1993. PROGRESA is specifically directed to the poorest rural communities in Mexico based on census data and interviews. Therefore we feel that it is important to create these two models that will test the robustness of our main model. In addition, there has been concern that PROCAMPO benefits the large producers, but not necessarily the small subsistence farmers. By examining areas that have a high percentage of *ejidal* lands or a high amount of PROGRESA payments we hope to see if the PROCAMPO program has a similar or different effect from the main model.

First, we calculate the percent of agricultural land within a county that is categorized as *ejidal* land. We then keep only the half of the data that has the percentage of *ejidal* lands as greater than the mean. We then run our main model on this smaller set of counties. Please see Figure 7 for a distribution of these select counties in Mexico. The results of our regression are reported in Table 4. We focus on the variables that see a marked difference from the main model. In general, the results of this model do not differ as greatly from the main model as we had originally expected. The effect of PROCAMPO payments is larger in this model. In the FE model, for a 1% increase in PROCAMPO payments, there is a 6.2% reduction in staple crop production, whereas in our main model it was only a 5.3% reduction. PROGRESA payments have a smaller effect in both the FE and RE models using this truncated dataset. In the FE model the effect goes from a 52% increase in staples in our original model to only a 45% increase using just counties with a high percentage of *ejidal* lands. Interestingly, education appears to have a greater affect in this model.

If we examine our NAFTA interaction terms in the FE model, we can see that the effect of distance to the border increased after NAFTA. After NAFTA, a 1% increase in distance to the border leads to an 8.7% increase in staples. This shows that the after-NAFTA effect is greater where the percent of *ejidal* lands is higher, as our main model with all counties included reports a 7.3%

increase in staple production after NAFTA given a 1% increase in distance to the border. The effects of our interaction terms before and after NAFTA can be seen in Table 4.1. The RE model also reports similar results in regards to the distance to the border variable.

Next, since PROGRESA is targeted at the poorest communities in Mexico, we form a dataset that only includes those counties that have PROGRESA payments per person that are greater than the mean.[20] Please see Figure 4 for a distribution of these select counties in Mexico. we then run our main model using only these counties. If we look at our education variable in the FE model, a 1% increase in education coincides with a staple crop production decrease of 0.83%. This is a much smaller effect than in the main model, in which it causes a 1.9% reduction in staples. This reflects that education levels are lower in counties that have received greater PROGRESA payments, which is consistent with the nature of the program. Also the mean of high school education in this sample is 4.3% whereas the mean in the complete dataset is 6%. In the RE model this reduction is much greater as a 1% increase in education only causes a 0.69% decrease in staples.

The PROCAMPO and PROGRESA variables are not significant in the FE model. However, the coefficients on these variables in the RE model are quite different from our original model. For example, PROCAMPO has a greater effect on staple crop production than in the main model. For a 1% increase in PROCAMPO payments we see a 7.4% increase in staple crop production, whereas it was a 3.2% decrease in the main model. This positive coefficient in the RE model may be due to this smaller dataset containing a large proportion of subsistence farms who traditionally producer staple crops, and by comparing counties to each other this effect is being picked up. The PROGRESA variables effect is much smaller now, as we would expect. Since this dataset now only includes those counties that receive a high amount of PROGRESA payments, the variation between county is going to be much smaller. In the original model, it had a positive effect of 22% and now it only has a positive effect of 3.9%.

If we examine distance from the US border, we see that before NAFTA if distance increases by 1% it causes a 13% reduction in staple crop production. Possible reasons for this were discussed previously. After NAFTA it has a positive effect yet it is very small as there is only a 2% increase in staple crops. Please refer to Table 4.2 for the before and after NAFTA coefficients for our interaction terms. We believe that we see a much smaller coefficient after NAFTA when we just look at areas that receive larger PROGRESA payments, as many of the area closest to the border are no longer included in the model. When comparing relatively poorer counties to other poor counties,

[20] This is based on 2003 payments and population.

distance to the US border becomes less important as a determining factor in regards to staple crop production.

If we compare the overall effect of NAFTA on *ejidal* lands and the areas with greater PROGRESA payments, we see an interesting result. The *ejidal* model shows the area in staple crop production decreasing after NAFTA, whereas the PROGRESA model shows staple production increasing after NAFTA. The coefficients are insignificant for both the FE models. The RE model for *ejidal* lands shows that after NAFTA, land in staple crop production decreases by 10.8%. The RE model for PROGRESA shows a 10% increase in staple crop production after NAFTA. This is an interesting result, and shows that *ejidos* may be responding differently to the new markets created by NAFTA than those who are just poor, as measured by PROGRESA.

4.3. Model 2: Total Credit

As has been stated we are interested in seeing if producers are credit constrained and if PROCAMPO payments as well as other government payments provide them with liquidity. The data that we have on credit is only provided at the state level. Please reference Table A-7 for state-level summary statistics. Figure 8 shows the distribution of our credit variable by state. A few states did not report credit data. Nonetheless, the distribution of credit supports the idea that credit tends to go to larger producers, as the states that have larger farms also have greater amounts of credit. This effect can be seen by comparing the map of our PROCAMPO payments (Figure 1) to this credit map. We will run our model at the state level with similar variables to our main model except that total credit received in thousands of pesos is our dependent variable. Our credit equation is:

$$credit = f(government\ payments, county\ characteristics)$$

1) $government\ policies = PROCAMPO, PROGRESA, and\ other\ government\ payments$
2) $county\ characteristics = wages\ per\ worker,\ high\ school\ education, infrastructure\ index$

We generate both fixed effects and random effects models using this data. Both models are weighted by total agricultural land in a county. This model will only compare two years, 2001 and 2003, as we do not have credit data for years prior to NAFTA. In our fixed effects model very little is significant at the 5% level, which is understandable given that we only have two years of credit data. However, the coefficient on our main program of interest, PROCAMPO, is significant at the 5% level. For a 1% increase in PROCAMPO payments there is a 23.6% increase in credit. This means that over time, PROCAMPO payments do have a positive effect on the credit situation for producers within counties. The effect of both PROGRESA and other government payments on

credit is negative. Both PROGRESA and other government payments are insignificant and show relatively small changes.

In our weighted random effects model the coefficients on all our variables are significant at the 5% level. Once again, we will first look at the effect of our PROCAMPO variable on credit. For a 1% increase in PROCAMPO payments there is a 0.53% increase in credit. Now that we are not just looking at the time effect, but also comparing counties, the effect of PROCAMPO is much smaller. It does have a positive effect on credit which means both our models support the idea that PROCAMPO may help alleviate credit constraint. Once again, we see negative coefficients for our PROGRESA and other government payments variables. For a 1% increase in PROGRESA there is a 0.88% decrease in credit and for a 1% increase in other government payments there is a 0.16% decrease in credit. This effect of the government payments may be so small because many of the programs in this variable may be going directly to creating infrastructure, irrigation, roads, technology, and not actually be funds that go to producers. These are not necessarily direct cash payments.

Wages per worker and percent of the population with a high school education are both positive as we would expect. An increase in both wages and education should positively affect credit. For a 1% increase in wages we see a 0.61% increase in credit and for a 1% increase in education we see an 11% increase in credit. This finding is encouraging to see as both traditionally both wages and education are important factors in credit applications. For example, banks may be more willing to loan to someone with a high school education than someone with only primary school education. Those with a greater level of education also tend to be better equipped to seek credit.

There are a few limitations of our study. First, we do not observe farm level data. We are able to provide evidence that supports our assumption of county homogeneity; however this still does not allow for us to truly observe the decision making in individual agricultural households. In addition, based on the results of our Hausman test we can only control for placement of the programs using fixed effects, which limits our cross-sectional variation. Lastly, since our credit data is only available at the state level we can not explicitly consider PROCAMPO's affect on an agricultural households' access to credit.

5. CONCLUSIONS

In conclusion, our data and econometric models provide some evidence that PROCAMPO assisted producers in moving away from the production of staple crops and towards the production

of higher-value, cash crops. Specifically, we observe a correlation between increased PROCAMPO payments and a decrease in the area planted in staples when controlling for county-level fixed effects. When we examine our model that only contains the counties with a high percent of *ejidal* lands, the negative effect of PROCAMPO on staple crop production is even stronger. This result provides an indication that these decoupled income payments have assisted those who are credit constrained to make crop choice changes. However, there is also some evidence that other government payments to agriculture has slowed this conversion to cash crops. This effect may be due to the lingering price supports and quotas which provided incentives for producers to continue planting certain staple crops throughout the NAFTA conversion period.

We hypothesized that the implementation of NAFTA would be associated with greater cash crop production. We can see that the creation of new markets through NAFTA is, in general, leading to a reduction in land planted in staples. We also see evidence that producers in both *ejidal* lands and poor regions are responding to new market incentives. Additionally, we hypothesized that areas closest to the United States border would see a greater movement to cash crop production after NAFTA than those further away from the border. We find evidence in our model that supports this hypothesis. Counties that have decreased staple crop production tend to be closer to the border. This may be related to transaction costs, measured in distance to the United States border, being higher for those in southern Mexico.

Since decoupled income payments are a part of the WTO agenda, these results may have a broader world-wide application. Given that the rural poor tend not to benefit under a system of price supports, a decoupled income payment system such as PROCAMPO can assist the poorest producers in a country. In addition, decoupled income payments can reduce agricultural producers' credit constraints. Therefore decoupled income payments may allows for producers to make the investments necessary to produce higher-value cash crops, which leads to an increase in income and a reduction in rural poverty.

The results of this study may also provide information that would assist other less-developed countries in establishing similar programs. For example, government payments, such as price supports, are actually compelling producers to stay in staple crop production. Therefore if a government is going to implement a decoupled income program, they should consider minimizing the length of time that both the new program and the old price support system co-exist. Moving to these subsidies allows for the entire agricultural market support system to be truly decoupled from the prices and production of specific crops as well as facilitating the transition to international trade.

REFERENCES

Baylis, Kathy, Rafael Garduño-Rivera, and Gianfranco Piras. 2009. "The Distributional Effects of NAFTA in Mexico: evidence from a panel of municipalities." Working paper, Champaign-Urbana: University of Illinois.

Burfisher, Mary E. and Jeffrey Hopkins, eds. 2003. "Decoupled Payments: Household Income Transfers in Contemporary U.S. Agriculture." USDA-ERS Agricultural Economic Report No. 822.

Chiquiar, Daniel. 2008. "Globalization, regional wage differentials and the stolpersamuelson theorem: Evidence from Mexico." *Journal of International Economics*. Vol. 74, No. 1:70-93.

Ciaian, Pavel, d'Artis Kancs and Johan F.M. Swinnen. 2008. "Static and Dynamic Distributional Effects of Decoupled Payments: Single Farm Payments in the European Union." LICOS Discussion Papers 20708, LICOS - Centre for Institutions and Economic Performance, K.U.Leuven.

Cord, Louise and Quentin Wodon. 2001. "Do Agricultural Programs in Mexico Alleviate Poverty? Evidence from the Ejido Sector." *Cuadernos de Economía* (Latin American Journal of Economics). Vol. 38, No. 114: 239-256.

Esquivel, Gerardo, Daniel Lederman, Miguel Messmacher, and Renata Villoro. 2002. "Why NAFTA Did Not Reach the South." World Bank Report, Washington, DC.

Financiera Rural. April 2009. [http://www.financierarural.gob.mx/fr/Paginas/English.aspx]

Garduño-Rivera, Rafael. 2009. "The Effect of Trade on Regional Distribution in Mexico." Working paper, Champaign-Urbana: University of Illinois.

Girante, Maria J., Barry K. Goodwin, and Allen Featherstone. 2008. "Farmer's Crop Acreage Decisions in the Presence of Credit Constraints: Do Decoupled Income Payments Matter?" Selected Paper for the American Agricultural Economics Association Annual Meeting, Orlando, FL.

"Income Generation and Social Protection for the Poor". 2005. The International Bank for Reconstruction and Development. The World Bank. [http://www.wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/0/27/000012009_20060727152557/Rendered/PDF/368530ENGLISH01d0328670rev01PBLIC1.pdf]

Key, Nigel, Elisabeth Sadoulet, and Alain de Janvry. 2000. "Transaction Costs and Agricultural Household Supply Response." *American Journal of Agricultural Economics*. Vol. 82, No. 2: 245 259.

Plümper, Thomas and Vera E. Troeger. 2007. "Efficient Estimation of Time-Invariant and Rarely Changing Variables in Finite Sample Panel Analyses with Unit Fixed Effects." *Political Analysis*. Vol. 15: 124-139.

Organisation for Economic Co-operation and Development (OECD). 2007. "The Implementation Costs of Agricultural Policies. OECD Publishing. 99-111.

Randall, Laura, Ed. 2006. *Changing Structure of Mexico: Political, Social, and Economic Prospects*. 2nd ed. Armonk: M.E. Sharpe.

Robertson, Raymond. 2000. "Wage Shocks and North American Labor-Market Integration." *American Economic Review*. Vol. 90, No. 4: 742-764.

Sadoulet, Elisabeth, et.al. 2001. "Cash Transfer Programs with Income Multipliers: PROCAMPO in Mexico." *World Development*. Vol. 29, No. 6: 1043-1056.

Singh, Inderjit, Lyn Squire and John Strauss. 1986. "A Survey of Agricultural Household Models: Recent Findings and Policy Implications," *World Bank Economic Review*. Vol. 1, No.1: 149-179.

Suvedi, Murari. 2000. "Evaluation of the Alliance for the Countryside (Alianza Para el Campo)". Food and Agricultural Organization.

Taylor, J. Edward, George A. Dyer, and Antonio Yunez-Naude. 2005. "Disaggregated Rural Economywide Models for Policy Analysis." *World Development*. Vol. 33, No. 10: 1671-1688.

Winters, Paul and Benjamin Davis. 2009. "Designing a Programme to Support Smallholder Agriculture in Mexico: Lessons from PROCAMPO and Oportunidades." *Development Policy Review*. Vol. 27, No. 5: 617-642.

World Bank. 2008. "2008 World Development Indicators: Poverty data." The International Bank for Reconstruction and Development/The World Bank.

World Bank. 2009. The Gini Coefficients. [http://iresearch.worldbank.org/PovcalNet/povcalSvy.html]

Zahniser, Steven and Zachary Crago. 2009. "NAFTA at 15: Building on Free Trade." Washington, DC, USDA Economic Research Service.

TABLES AND FIGURES

Table 1: Initial Results

Percent of Agricultural Land in Staples					
	Model 1	Model 2	Model 3	Model 4	Model 5
	Ordinary Least Squares	Fixed Effects	Weighted Fixed Effects	Random Effects	Weighted Random Effects
log(population in thousands)	0.0707***	0.316***	0.395***	0.0658***	0.0791***
	(0.00547)	(0.0477)	(0.112)	(0.00715)	(0.0000353)
log(wages per worker)	-0.0394***	-0.00178	-0.0400*	-0.0197***	-0.0319***
	(0.00697)	(0.0101)	(0.0238)	(0.00752)	(0.0000584)
% of population with a high school education	-1.764***	-1.559***	-1.653***	-1.624***	-1.707***
	(0.152)	(0.133)	(0.356)	(0.123)	(0.00079)
infrastructure index (drainage and sanitation)	-0.0261**	-0.0101	-0.0854**	-0.00912	-0.0256***
	(0.0103)	(0.0148)	(0.0368)	(0.0109)	(0.0000791)
log(PROCAMPO payment per producer)	0.0421***	-0.0751***	-0.0533***	-0.0265***	-0.00608***
	(0.00812)	(0.00737)	(0.0106)	(0.00707)	(0.0000388)
log(PROGRESA payment per person)	-0.164***	0.140***	0.573***	0.0258	0.250***
	(0.0312)	(0.0467)	(0.0862)	(0.0355)	(0.000212)
log(other government payments per farm)	0.00864	0.0169**	0.0459***	0.0115	0.0396***
	(0.00872)	(0.00789)	(0.0114)	(0.00783)	(0.0000395)
log(distance to the US border in thousands of kilometers)	0.0341***	0.0550***	0.0552***	0.0205**	0.00531***
	(0.00687)	(0.000308)	(0.000308)	(0.00902)	(0.0000387)
constant	0.605***	-0.166	-0.892*	0.593***	0.462***
	(0.0207)	(0.139)	(0.487)	(0.0251)	(0.000182)
Observations	4105	4105	4098	4105	4098
Counties		1385	1378	1385	1378
R-squared	0.093	0.153	0.182		

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 2: Main Model

	Percent of Agricultural Land in Staples	
	Model 1	Model 2
	Weighted Fixed Effects	Weighted Random Effects
log(population in thousands)	0.263**	0.0600***
	(0.129)	(0.0000455)
log(wages per worker)	-0.0479**	-0.0399***
	(0.0238)	(0.0000708)
% of population with a high school education	-1.915***	-1.784***
	(0.33)	(0.000824)
infrastructure index (drainage and sanitation)	-0.0791**	-0.0330***
	(0.0346)	(0.0000875)
log(PROCAMPO payment per producer)	-0.0529*	0.0320***
	(0.0309)	(0.0000757)
log(PROGRESA payment per person)	0.518***	0.227***
	(0.111)	(0.000325)
log(other government payments per farm)	0.0384***	0.0340***
	(0.0113)	(0.0000391)
log(distance to the US border in thousands of kilometers)	0.0126***	-0.0457***
	(0.00032)	(0.0000464)
NAFTA dummy (=1 if year is after 1994)	-0.167	-0.212***
	(0.103)	(0.000344)
NAFTA×log(population in thousands)	0.00737	0.0240***
	(0.0151)	(0.000044)
NAFTA×log(wages per worker)	0.0737**	0.0340***
	(0.0308)	(0.0000875)
NAFTA×log(distance to the US border in thousands of kilometers)	0.0605***	0.0913***
	(0.0197)	(0.0000486)
constant	-0.294	0.545***
	(0.552)	(0.000223)
Observations	4098	4098
Counties	1378	1378
R-squared	0.219	

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 2.1: Main Model: Effects Before and After NAFTA

Percent of Agricultural Land in Staples				
	Weighted Fixed Effects		Weighted Random Effects	
	Before NAFTA	After NAFTA	Before NAFTA	After NAFTA
log(population in thousands)	0.263**	0.2703**	0.0600***	0.08395***
	(0.129)	(0.1213883)	(0.0000455)	(0.0000377)
log(wages per worker)	-0.0479**	0.0258	-0.0399***	-0.00587***
	(0.0238)	(0.030779)	(0.0000708)	(0.0000744)
log(distance to the US border in thousands of kilometers)	0.0126***	0.0731***	-0.0457***	0.04558***
	(0.00032)	(0.0196776)	(0.0000464)	(0.000045)

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Robustness Model (Agricultural Revenue per Hectare)

	Total Revenue Per Hectare	
	Model 3	Model 4
	Weighted Fixed Effects	Weighted Random Effects
log(population in thousands)	5.393**	0.681***
	(2.677)	(0.00118)
log(wages per worker)	-0.377	-0.645***
	(0.343)	(0.00191)
% of population with a high school education	16.77**	10.30***
	(7.588)	(0.0225)
infrastructure index (drainage and sanitation)	-0.264	2.124***
	(0.716)	(0.00228)
log(PROCAMPO payment per producer)	-0.653	-0.609***
	(0.659)	(0.00194)
log(PROGRESA payment per person)	-0.227	-4.821***
	(2.174)	(0.00861)
log(other government payments per farm)	0.015	0.399***
	(0.313)	(0.00107)
log(distance to the US border in thousands of kilometers)	0.398	-0.0802***
	(14.06)	(0.00119)
NAFTA dummy (=1 if year is after 1994)	1.409	0.364***
	(2.272)	(0.0094)
NAFTA×log(population in thousands)	-1.104***	-0.858***
	(0.284)	(0.00125)
NAFTA×log(wages per worker)	0.989**	0.900***
	(0.479)	(0.00242)
NAFTA×log(distance to the US border in thousands of kilometers)	0.286	0.295***
	(0.518)	(0.00135)
constant	-14.39	7.690***
	(11.87)	(0.00581)
Observations	4098	4098
Counties	1378	1378
R-squared	0.03	

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 4: Robustness Model (*Ejidal* Lands and PROGRESA Payments)

Percent of Agricultural Land in Staples				
	Ejidal Lands		PROGRESA Payments	
	Model 1	Model 2	Model 3	Model 4
	Weighted Fixed Effects	Weighted Random Effects	Weighted Fixed Effects	Weighted Random Effects
log(population in thousands)	0.243*	0.0289***	-0.0883	0.0136***
	(0.144)	(0.0000543)	(0.188)	(0.0000799)
log(wages per worker)	-0.0313	-0.00568***	0.0295	0.00838***
	(0.028)	(0.0000898)	(0.0313)	(0.0000982)
% of population with a high school education	-2.144***	-1.944***	-0.825*	-0.691***
	(0.33)	(0.00106)	(0.485)	(0.00155)
infrastructure index (drainage and sanitation)	-0.0846**	-0.0209***	-0.0934**	-0.130***
	(0.0401)	(0.000104)	(0.0436)	(0.000135)
log(PROCAMPO payment per producer)	-0.0621*	0.0259***	0.0043	0.0740***
	(0.0323)	(0.000106)	(0.0526)	(0.000135)
log(PROGRESA payment per person)	0.454***	0.143***	0.117	0.0386***
	(0.128)	(0.000405)	(0.278)	(0.000763)
log(other government payments per farm)	0.0536***	0.0336***	0.00934	0.0209***
	(0.0183)	(0.0000564)	(0.0146)	(0.0000639)
log(distance to the US border in thousands of kilometers)	-0.0368***	-0.0720***	-0.0540***	-0.130***
	(0.000708)	(0.0000834)	(0.000615)	(0.000186)
NAFTA dummy (=1 if year is after 1994)	-0.164*	-0.232***	-0.0689	-0.0811***
	(0.0991)	(0.000448)	(0.166)	(0.000618)
NAFTA×log(population in thousands)	0.0325**	0.0512***	0.0585**	0.0640***
	(0.0154)	(0.0000528)	(0.0238)	(0.0000768)
NAFTA×log(wages per worker)	0.0209	-0.0141***	0.00393	-0.0239***
	(0.0298)	(0.000111)	(0.03)	(0.000121)
NAFTA×log(distance to the US border in thousands of kilometers)	0.0559	0.0884***	0.138**	0.154***
	(0.0464)	(0.0000846)	(0.0568)	(0.000179)
constant	-0.233	0.694***	0.76	0.391***
	(0.663)	(0.000291)	(0.707)	(0.000336)
Observations	2049	2049	2062	2062
Counties	685	685	690	690
R-squared	0.29		0.17	

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 4.1: *Ejidal* Lands: Effects Before and After NAFTA

Percent of Agricultural Land in Staples				
	Weighted Fixed Effects		Weighted Random Effects	
	Before NAFTA	After NAFTA	Before NAFTA	After NAFTA
log(population in thousands)	0.0325**	0.2759*	0.0512***	0.0801***
	(0.0154)	(0.14099)	(0.0000528)	0.000046
log(wages per worker)	0.0209	-0.01044	-0.0141***	-0.0198***
	(0.0298)	(0.0369)	(0.000111)	0.000096
log(distance to the US border in thousands of kilometers)	0.0559	0.08657*	0.0884***	0.0164***
	(0.0464)	(0.04638)	(0.0000846)	0.000078

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 4.2: PROGRESA Payments: Effects Before and After NAFTA

Percent of Agricultural Land in Staples				
	Weighted Fixed Effects		Weighted Random Effects	
	Before NAFTA	After NAFTA	Before NAFTA	After NAFTA
log(population in thousands)	-0.0883	-0.0299	0.0136***	0.0776***
	(0.188)	(0.18266)	(0.00008)	(0.00007)
log(wages per worker)	0.0295	0.0335	0.0084***	-0.0156***
	(0.0313)	(0.03221)	(0.0001)	(0.0001)
log(distance to the US border in thousands of kilometers)	-0.0540***	0.2764***	-0.130***	0.0237***
	(0.00062)	(0.0568)	(0.00019)	(0.00017)

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 5: Credit Model

log(credit payment total)		
	FEW	**REW**
log(PROCAMPO payment total)	23.61**	0.531***
	(10.42)	(0.00097)
log(PROGRESA payment total)	-2.959	-0.883***
	(7.167)	(0.00106)
log(other government payments total)	-0.265	-0.163***
	(0.204)	(0.00013)
log(wages per worker)	-0.0246	0.607***
	(3.818)	(0.000805)
% of population with a high school education	-106.9	11.02***
	(76.01)	(0.0386)
infrastructure index (drainage and sanitation)	-16.63**	-3.966***
	(6.358)	(0.00223)
year dummy (0=2001 and 1=2003)	25.17**	3.559***
	(9.223)	(0.00306)
constant	-251.2	11.47***
	(156)	(0.017)
Observations	64	64
States	32	32
R-squared	0.505	

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Figure 1: Percent of Agricultural Land Planted in Staples

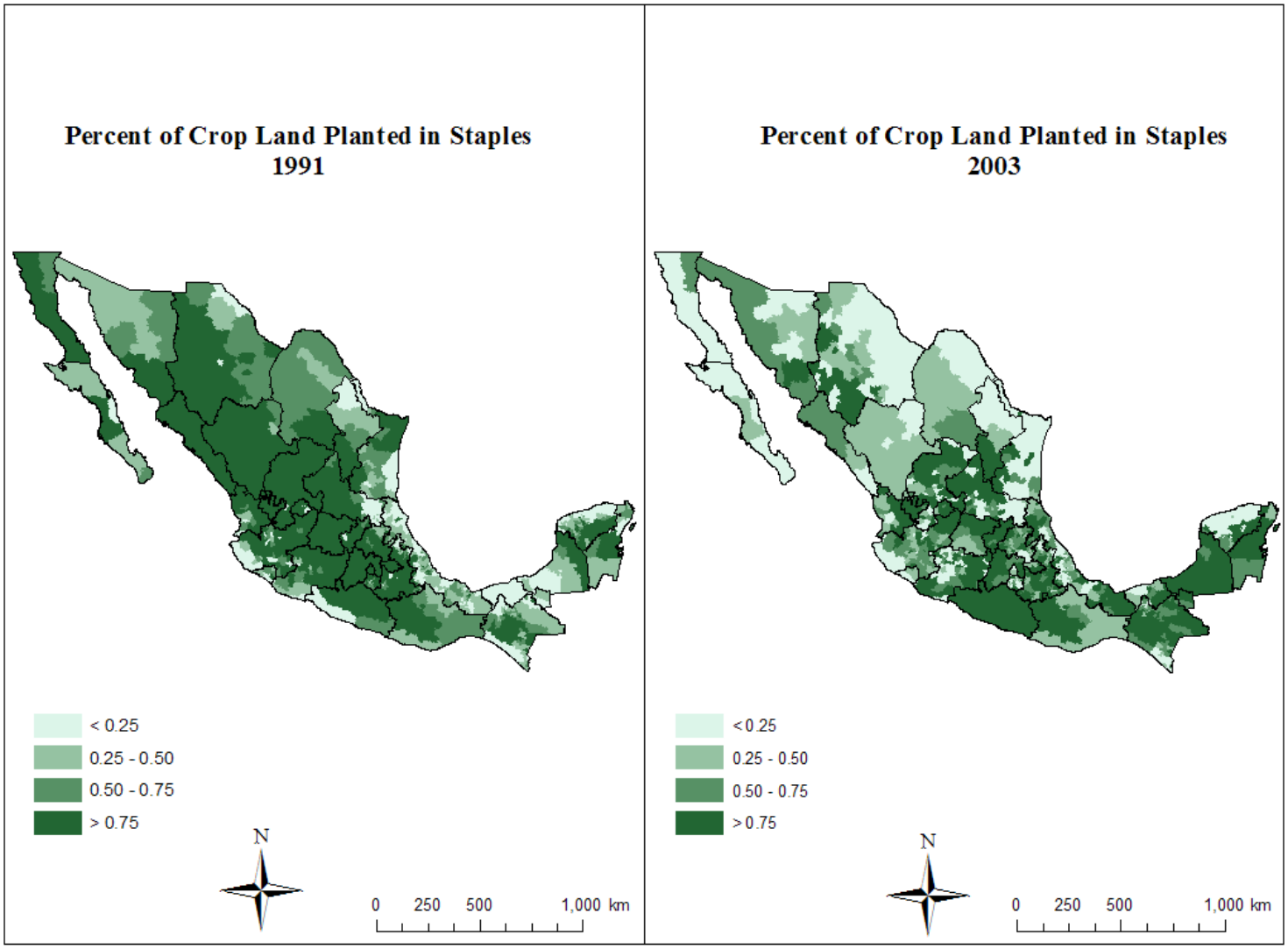


Figure 2: Revenue Per Hectare

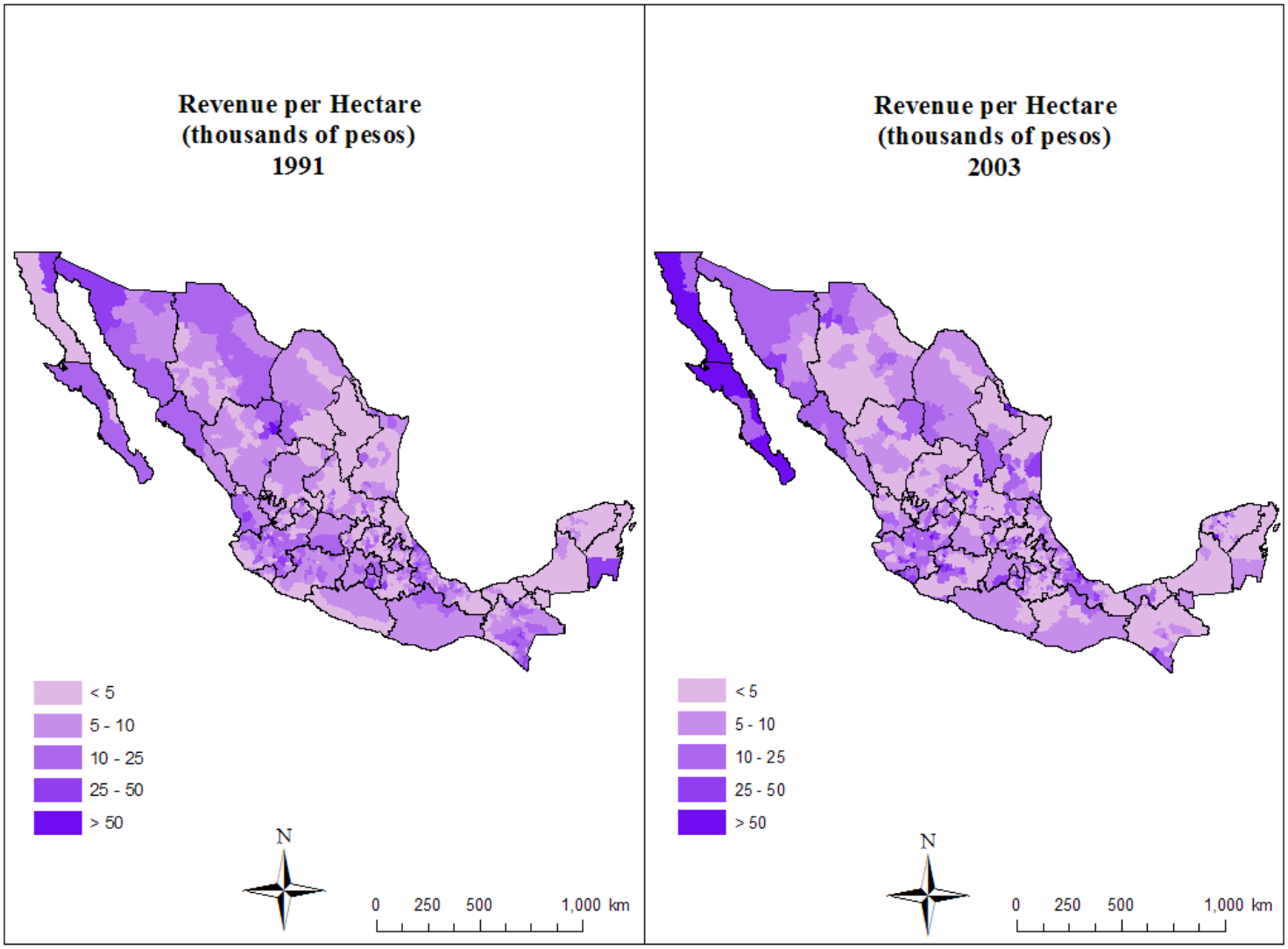


Figure 3: Wages per Worker

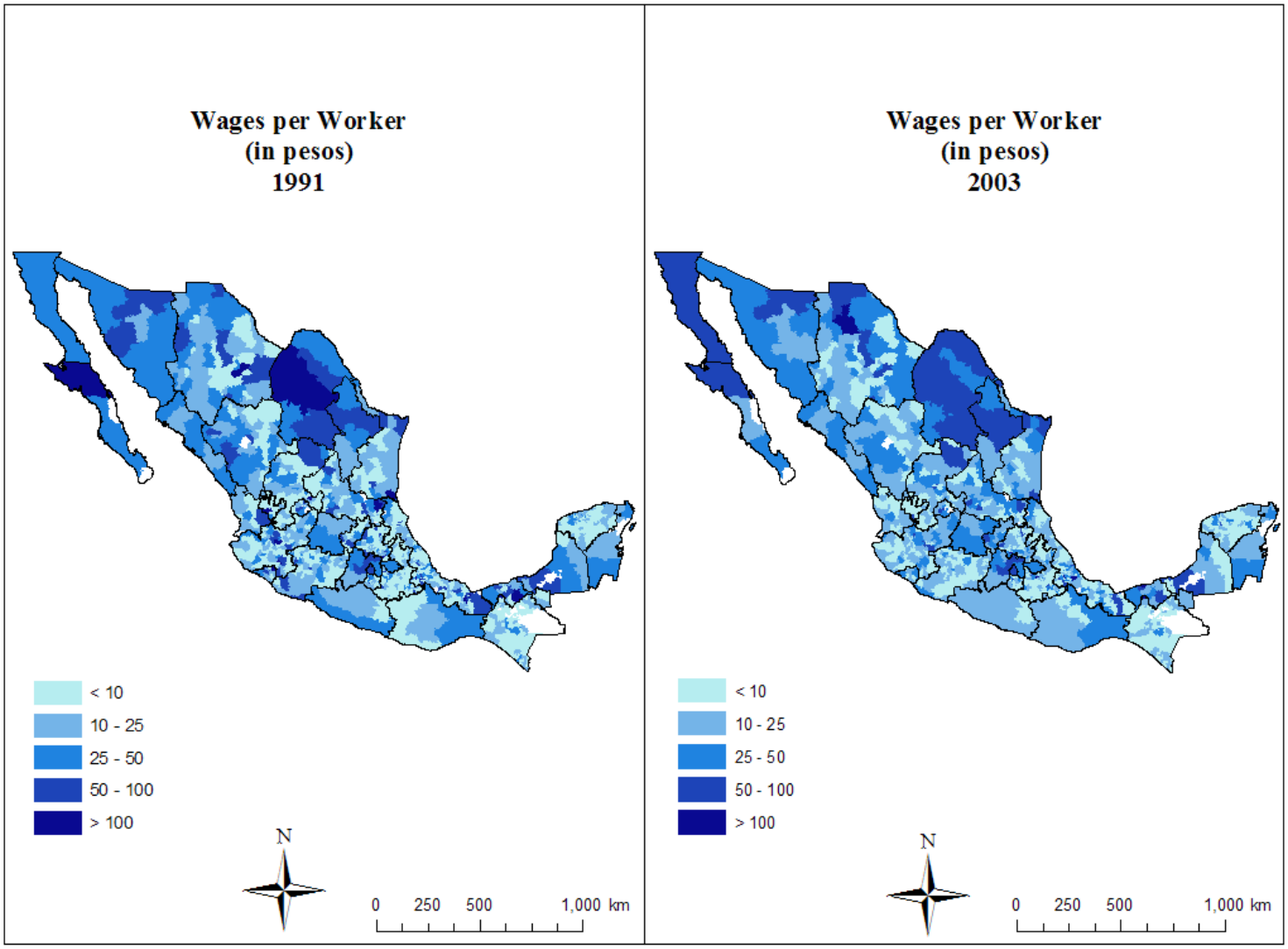


Figure 4: Percent of the Population with a High School Education

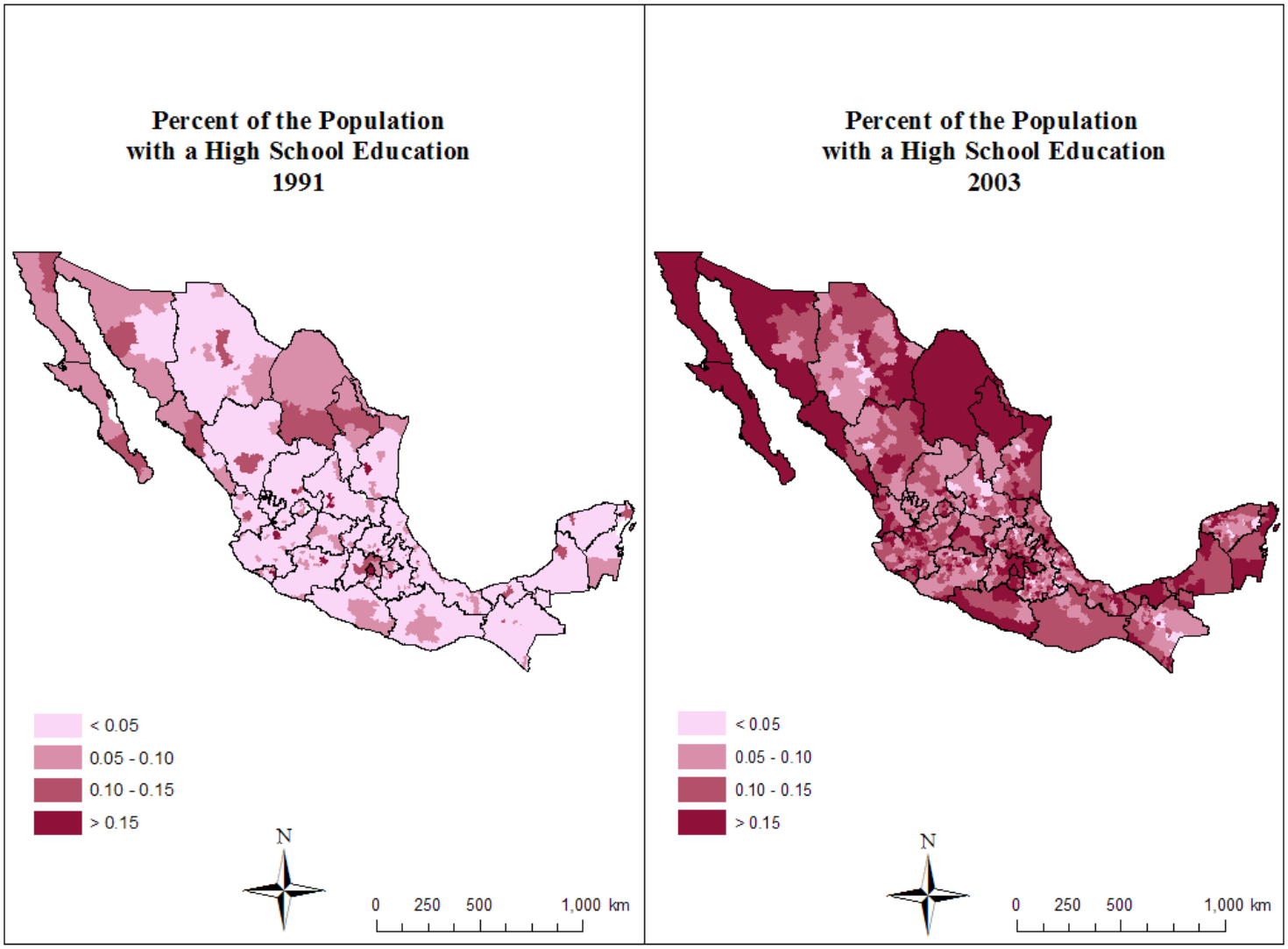


Figure 5: PROCAMPO Payments and PROGRESA Payments

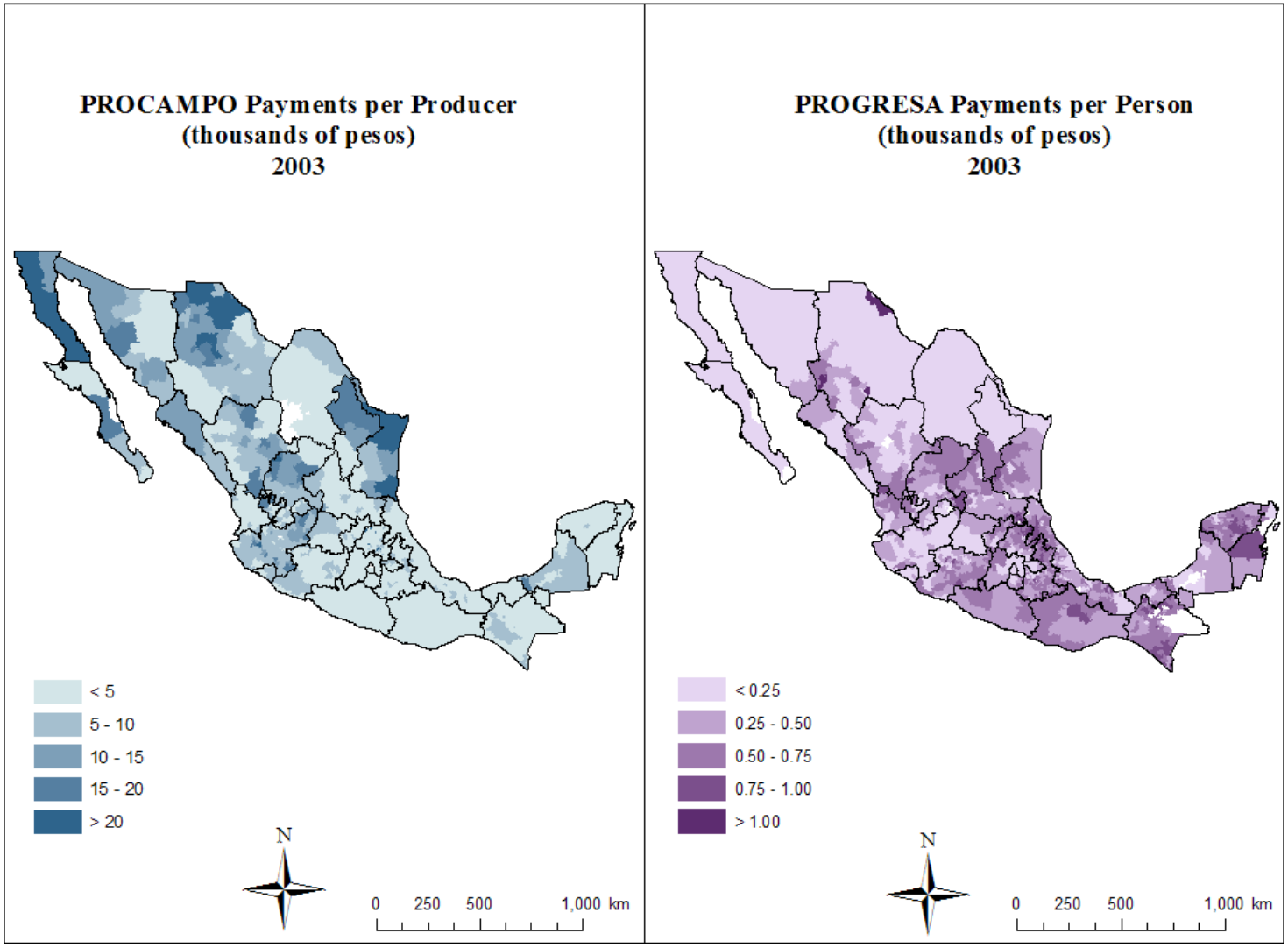


Figure 6: Government Payments and Distance to the US Border

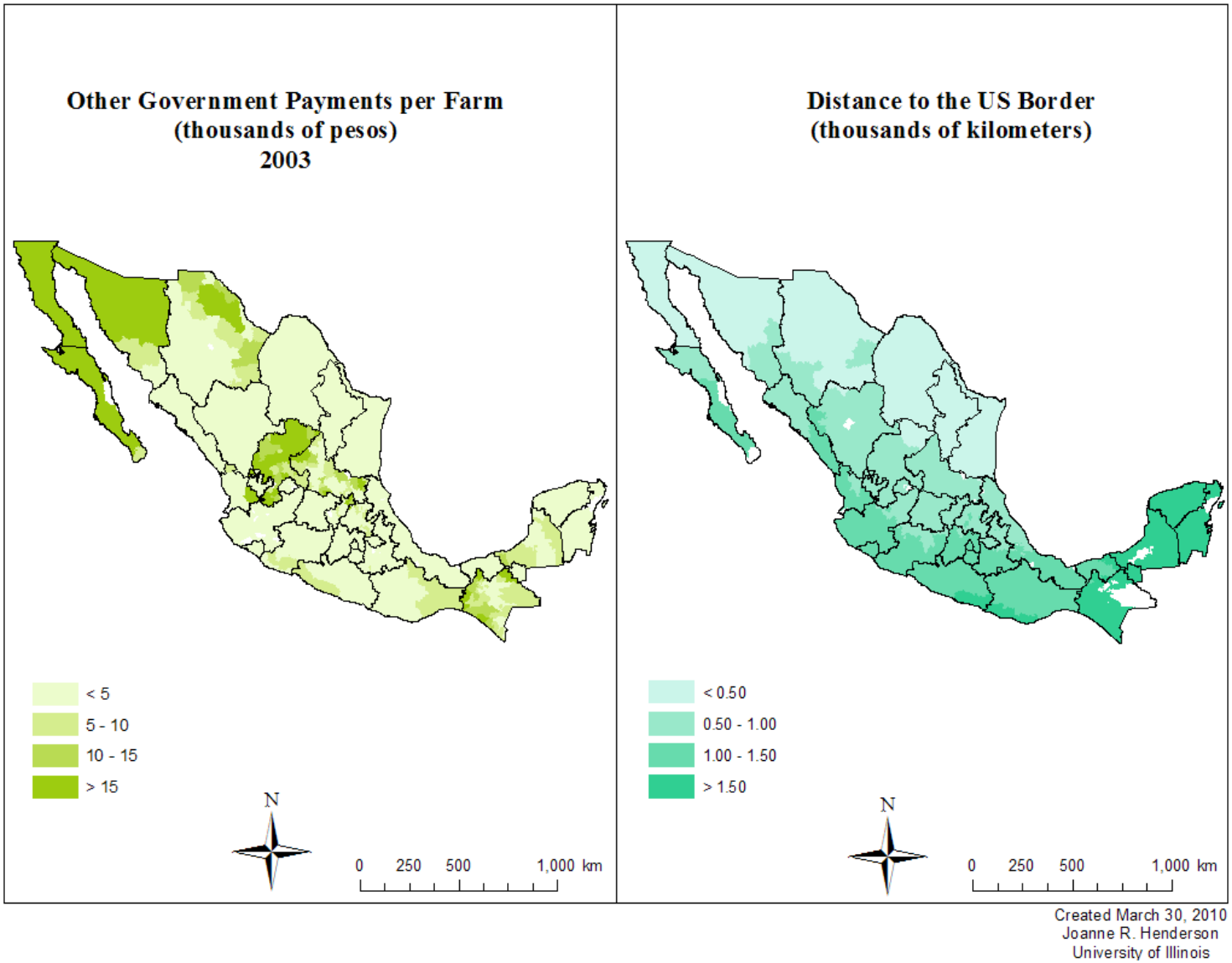


Figure 7: *Ejidal* Lands and PROGRESA Distribution

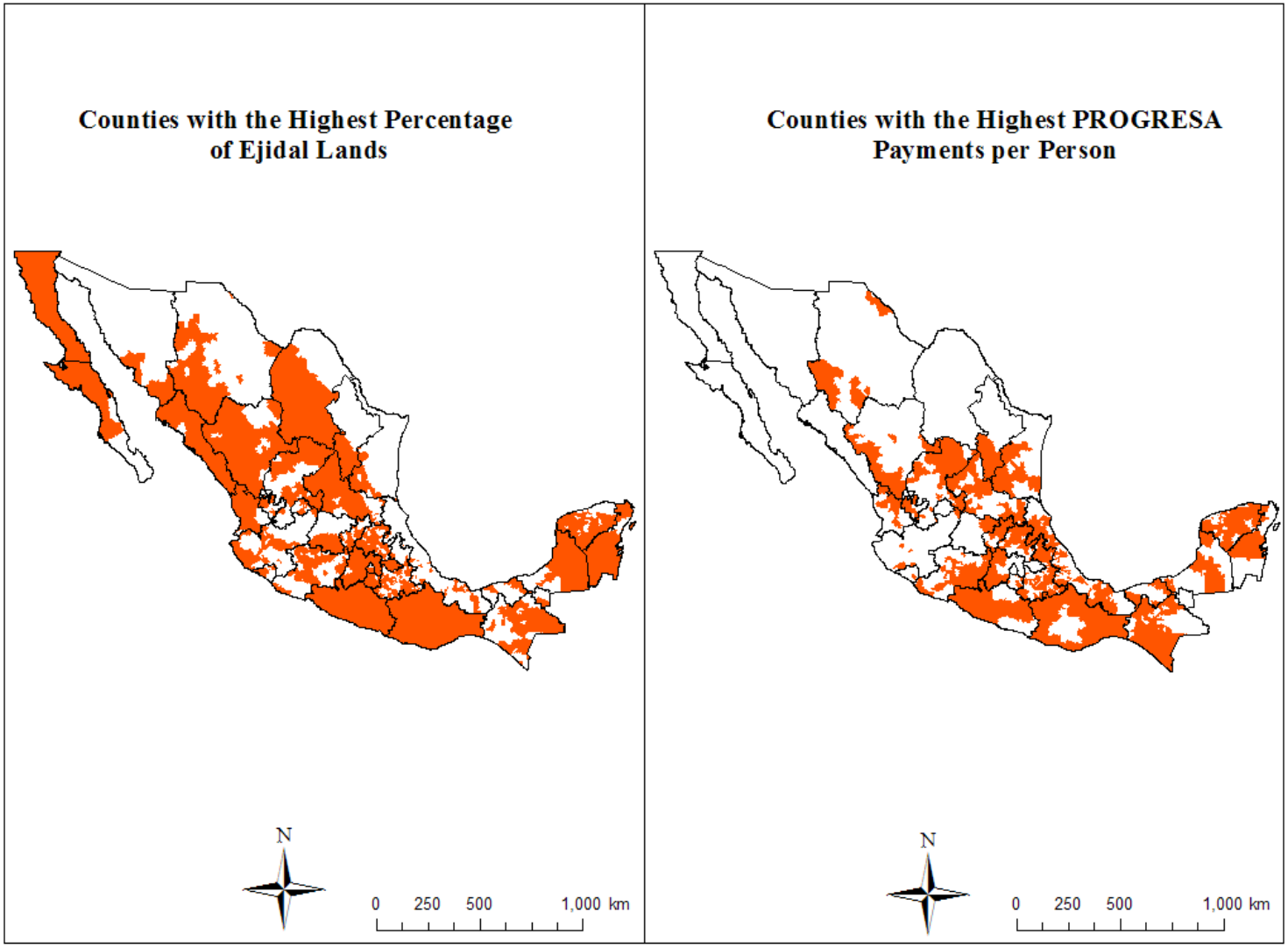
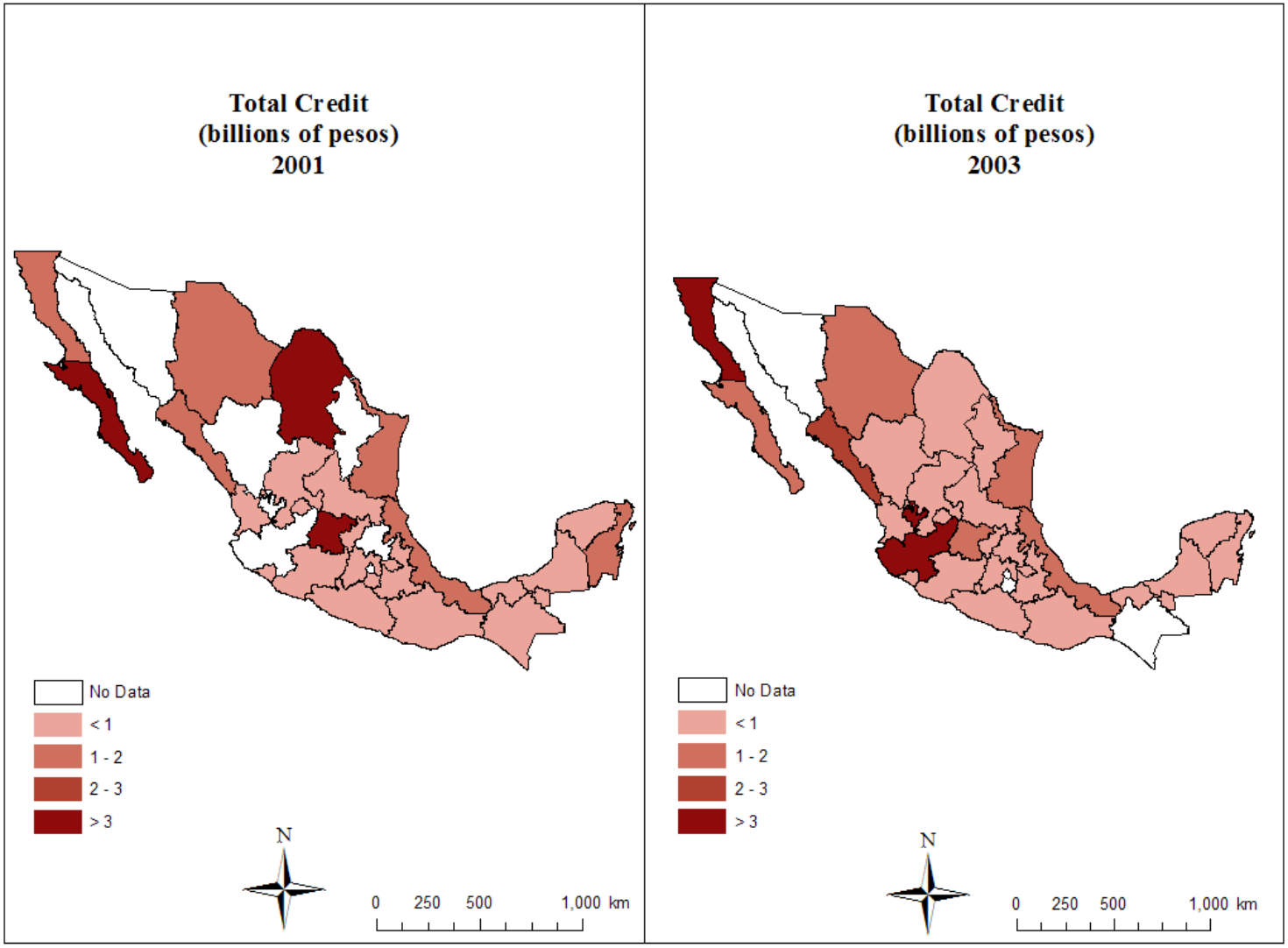


Figure 8: Total Credit by State



Created March 30, 2010
Joanne R. Henderson
University of Illinois

APPENDIX

Table A-1: Agricultural and Agricultural Trade Related Policies and Institutions (1965-2010)

Policy	Year	Description
CONASUPO (the National Company of Popular Subsistence) established	1965	Governmental agency that set agricultural policies. Involved in creating price supports, buying and distributing commodities, and providing credit.
Banrural established	1975	State owned bank that provided credit to small scale agricultural producers.
Joined the GATT (General Agreement on Tariffs and Trade)	1985	Removed some trade barriers, increased exports and saw an increase in foreign direct investment (FDI).
ASERCA (Support and Services for Agricultural Marketing) established	1991	Goal was to strengthen agricultural trade by building markets between producers and buyers, and distributing marketing information to producers in order to increase exports.
Article 27: *Ejido* Land Reform enacted	1992	Granted the right for *ejidal* lands to be titled, bought, and sold.
Joined NAFTA (North American Free Trade Agreement)	1994	Preferential trade agreement with the United States and Canada. Established rules in regards to market access, subsidies, tariffs, and phytosanitary standards.
PROCAMPO (Program of Direct Support for the Countryside) established	1994	Provides per hectare decoupled income payments to agricultural producers who produced any of nine crops during the 1993/1994 agricultural season.
Alianza para el Campo (Alliance of the Countryside) established	1996	Provide technical assistance for four main program areas: agricultural improvement, livestock improvement, rural development, and sanitation.
CONASUPO dismantled	1999	Process started in 1991 with the guaranteed prices for many crops being eliminated. Completed in 1999 when support prices for beans and corn were eliminated.
PROGRESA (Program for Education, Health, and Nutrition) established	1997	Provides conditional cash payment transfers to poor rural female household heads for nutrition, health services and education. The name of the program was later changed to *Oportunidades*.
Banrural dissolved, *Financeria Rural* established	2003	Privatization of state owned banks started in the early 1990s, *Banrural* was finally dissolved in 2003. *Financeria Rural* was established to make loans to agricultural producers.
Implementation phase of NAFTA completed	2008	Final tariff and quota barriers on culturally sensitive crops such as corn and beans were lifted.
PROCAMPO program extended until 2012	2008	President Calderon announced that he would extend the PROCAMPO program until 2012.

Table A-2: Description of Variables

Variable	Type	Description	Units
% of crop land planted in staples	dependent	area planted in staple crops divided by area planted of all crops (hectares)	%
revenue per hectare for all crops	dependent	value of all crops (1,000s of pesos) divided by total crop area planted (hectares)	1,000s of pesos
population in thousands	independent	population of each county (thousands)	1,000s
wages per worker	independent	wages per county (1,000s of pesos) divided by the number of workers in the county	1,000s of pesos
% of population with a high school education	independent	number of people in the county that have a high school education divided by the total population of each county	%
infrastructure index (drainage and sanitation)	independent	index that contains percent of the population in each county that has drainage and sanitation	%
PROCAMPO payment per producer	independent	total PROCAMPO payments (1,000s of pesos) divided by the number of producers that received payments	1,000s of pesos
PROGRESA payment per person	independent	total PROGRESA payments (1,000s of pesos) divide by the municipal population	1,000s of pesos
other government payments per farm	independent	total other government payments (1,000s of pesos) divided by the total number of farms in 1991	1,000s of pesos
distance to the US border in thousands of kilometers	independent	distance to the US border from the municipal seat reported in thousands of kilometers	1,000s of kilometers
NAFTA dummy (before 1994=0, after 1994=1)	independent	dummy variable for NAFTA, where (before 1994=0, after 1994=1)	0 or 1
% of population over 15 years old that is literate	independent	number of people in the county over 15 years old that are literate divided by the population over 15 years	%
city dummy (=1 if county has a city over 100,000)	independent	dummy variable for cities, where (=1 if county has a city over 100,000)	0 or 1

Table A-3: Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
% of crop land planted in staples	4293	0.6181	0.3765	0	1
revenue per hectare for all crops	4293	7.6361	10.2223	0	172.7737
log(population in thousands)	4284	2.8756	1.3307	0	8.7408
log(wages per worker)	4154	2.2228	1.0680	0	7.3631
% of population with a high school education	4267	0.0605	0.0543	0	0.2753
infrastructure index (drainage and sanitation)	4268	0.0000	0.8469	-2.3461	1.2910
log(PROCAMPO payment per producer)	4252	1.0479	0.8947	0	4.0635
log(PROGRESA payment per person)	4201	0.2152	0.2161	0	1.6258
log(other government payments per farm)	4209	0.4002	0.7173	0	4.8309
log(distance to the US border in thousands of kilometers)	4155	-0.1109	0.8544	-6.9078	0.8699
NAFTA dummy (=1 if year is after 1994)	4293	0.6667	0.4715	0	1
NAFTA×log(population in thousands)	4284	1.9371	1.7587	0	8.7315
NAFTA×log(wages per worker)	4154	1.5100	1.3393	0	7.3631
NAFTA×log(distance to the US border in thousands of kilometers)	4155	-0.0740	0.6996	-6.9078	0.8699
% of population over 15 years old that is literate	4226	0.8134	0.1153	0.1389	0.9794
city dummy (=1 if county has a city over 100,000)	4293	0.0468	0.2113	0	1

Table A-4: Tests for County Homogeneity

Counties with Agricultural Land Owners		
	Avg. St. Dev	Std. Dev. Of Avg.
Wage	1,095,499	2,124,893
Education	0.6909	0.7444

(Micro-Sample of the 1991 Population Census, INEGI)

Table A-5: Robustness Model (Literacy and City Dummy)

Percent of Agricultural Land in Staples				
	With Literacy Variable		With City Variable	
	Model 1	Model 2	Model 3	Model 4
	Weighted Fixed Effects	Weighted Random Effects	Weighted Fixed Effects	Weighted Random Effects
log(population in thousands)	0.225	0.0657***		
	(0.138)	(0.0000452)		
log(wages per worker)	-0.0502**	-0.0598***	-0.0523**	-0.0202***
	(0.024)	(0.0000718)	(0.0234)	(0.0000636)
% of population with a high school education	-1.921***	-1.770***	-1.838***	-1.682***
	(0.331)	(0.000815)	(0.34)	(0.000831)
infrastructure index (drainage and sanitation)	-0.0956***	-0.0900***	-0.0991***	-0.0574***
	(0.0351)	(0.0000971)	(0.0344)	(0.0000884)
log(PROCAMPO payment per producer)	-0.046	0.0180***	-0.0677**	0.0117***
	(0.0314)	(0.0000751)	(0.0304)	(0.0000755)
log(PROGRESA payment per person)	0.481***	0.281***	0.518***	0.248***
	(0.12)	(0.000323)	(0.115)	(0.00033)
log(other government payments per farm)	0.0389***	0.0376***	0.0414***	0.0373***
	(0.0113)	(0.0000389)	(0.0118)	(0.0000393)
log(distance to the US border in thousands of kilometers)	0.0307***	-0.0279***	-0.0161***	-0.0373***
	(0.000318)	(0.000048)	(0.000341)	(0.0000479)
NAFTA dummy (=1 if year is after 1994)	-0.187*	-0.189***	-0.129	-0.162***
	(0.105)	(0.000341)	(0.109)	(0.000337)
NAFTA×log(population in thousands)	0.00567	0.0184***		
	(0.0151)	(0.0000439)		
NAFTA×log(wages per worker)	0.0779**	0.0392***	0.0955***	0.0713***
	(0.0313)	(0.0000868)	(0.0248)	(0.0000748)
NAFTA×log(distance to the US border in thousands of kilometers)	0.0603***	0.0818***	0.0582***	0.0907***
	(0.0196)	(0.0000485)	(0.0195)	(0.0000487)
% of population over 15 years old that is literate	0.736	0.888***		
	(0.579)	(0.000686)		
city dummy (=1 if county has a city over 100,000)			0.176***	0.205***
			(0.00112)	(0.000133)
constant	-0.738	-0.168***	0.834***	0.693***
	(0.582)	(0.000594)	(0.0771)	(0.000211)
Observations	4098	4098	4098	4098
Counties	1378	1378	1378	1378
R-squared	0.22		0.209	

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table A-6: Robustness Model (Tobit Regression)

Percent of Agricultural Land in Staples	
	Model 1
	Tobit Weighted Random Effects
log(population in thousands)	0.0632***
	(0.0000503)
log(wages per worker)	-0.0382***
	(0.0000786)
% of population with a high school education	-2.053***
	(0.000925)
infrastructure index (drainage and sanitation)	-0.0359***
	(0.0000978)
log(PROCAMPO payment per producer)	0.0444***
	(0.0000851)
log(PROGRESA payment per person)	0.231***
	(0.000365)
log(other government payments per farm)	0.0280***
	(0.0000438)
log(distance to the US border in thousands of kilometers)	-0.0478***
	(0.0000513)
NAFTA dummy (=1 if year is after 1994)	-0.218***
	(0.000387)
NAFTA×log(population in thousands)	0.0356***
	(0.0000492)
NAFTA×log(wages per worker)	0.0217***
	(0.0000981)
NAFTA×log(distance to the US border in thousands of kilometers)	0.102***
	(0.0000549)
constant	0.536***
	(0.000248)
Observations	4098
Counties	1378
R-squared	

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table A-7: State-Level Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
log(credit payment in thousands of pesos)	64	10.9285	5.1449	0	19.8488
log(PROCAMPO payment in thousands of pesos)	64	12.4633	1.2738	8.4772	14.2754
log(PROGRESA payment in thousands of pesos)	64	12.3701	2.5335	0	14.7118
log(other government payment in thousands of pesos)	64	8.7230	5.4513	0	14.6040
log(wages per worker)	64	5.9553	1.0467	4.4030	8.0004
% of population with a high school education	64	0.1428	0.0498	0.0583	0.2606
infrastructure index (drainage and sanitation)	64	0.41066	0.60383	-1.42815	1.31946
year dummy (=0 if year is 2001, =1 if year is 2003)	64	0.5000	0.5040	0	1